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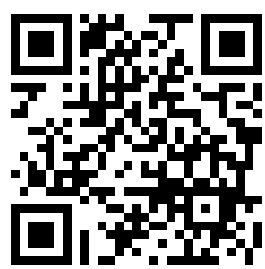

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TM 11-801

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

AMPLIFIER GROUP AN/FRA-2

DEPARTMENT OF THE ARMY • NOVEMBER 1950

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TM 11-801

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AMPLIFIER GROUP AN/FRA-2

DEPARTMENT OF THE ARMY *NOVEMBER 1950*

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DEPARTMENT OF THE ARMY

WASHINGTON 25, D. C., *17 November 1950*

TM 11–801 is published for the information and guidance of all concerned.
[AG 300.7 (24 Oct 49)]

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CONTENTS

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RESCUE.

In case of electric shock, shut off the high voltage at once and ground the circuits. If the high voltage cannot be turned off without delay, free the victim from contact with the live conductor as promptly as possible. Avoid direct contact with either the live conductor or the victim's body. Use a dry board, dry clothing, or other nonconductor to free the victim. An ax may be used to cut the high-voltage wire. Use extreme caution to avoid the resulting electric flash.

SYMPTOMS.

a. Breathing stops abruptly in electric shock if the current passes through the breathing center at the base of the brain. If the shock has not been too severe, the breath center recovers after a while and normal breathing is resumed, provided that a sufficient supply of air has been furnished meanwhile by artificial respiration.

b. The victim is usually very white or blue. The pulse is very weak or entirely absent and unconsciousness is complete. Burns are usually present. The victim's body may become rigid or stiff in a very few minutes. This condition is due to the action of electricity and is not to be considered rigor mortis. Artificial respiration must still be given, as several such cases are reported to have recovered. The ordinary and general tests for death should never be accepted.

TREATMENT.

a. Start artificial respiration immediately. At the same time send for a medical officer, if assistance is available. Do not leave the victim unattended. Perform artificial respiration at the scene of the accident, unless the victim's or operator's life is endangered from such action. *In this case only*, remove the victim to another location, but no farther than is necessary for safety. If the new location is more than a few feet away, artificial respiration should be given while the victim is being moved. If the method of transportation prohibits the use of the Shaeffer prone pressure method, other methods of resuscitation may be used. Pressure may be exerted on the front of the victim's diaphragm, or the direct mouth-to-mouth method may be used. Artificial respiration, once started, must be continued, without loss of rhythm.

b. Lay the victim in a prone position, one arm extended directly overhead, and the other arm bent at the elbow so that the back of the hand supports the head. The face should be turned away from the bent elbow so that the nose and mouth are free for breathing.

c. Open the victim's mouth and remove any foreign bodies, such as false teeth, chewing gum, or tobacco. The mouth should remain open, with the tongue extended. Do not permit the victim to draw his tongue back into his mouth or throat.

d. If an assistant is available during resuscitation, he should loosen any tight clothing to permit free circulation of blood and to prevent restriction of breathing. He should see that the victim is kept warm, by applying blankets or other covering, or by applying hot rocks or bricks wrapped in cloth or paper to prevent injury to the victim. The assistant should also be ever watchful to see that the victim does not swallow his tongue. He should continually wipe from the victim's mouth any frothy mucus or saliva that may collect and interfere with respiration.

e. The resuscitating operator should straddle the victim's thighs, or one leg, in such manner that:

(*1*) the operator's arms and thighs will be vertical while applying pressure on the small of the victim's back;

(*2*) the operator's fingers are in a natural position on the victim's back with the little finger lying on the last rib;

(*3*) the heels of the hands rest on either side of the spine as far apart as convenient without allowing the hands to slip off the victim;

(*4*) the operator's elbows are straight and locked.

f. The resuscitation procedure is as follows:

(*1*) Exert downward pressure, not exceeding 60 pounds, for 1 second.

(*2*) Swing back, suddenly releasing pressure, and sit on the heels.

(*3*) After 2 seconds rest, swing forward again, positioning the hands exactly as before, and apply pressure for another second.

g. The forward swing, positioning of the hands, and the downward pressure should be accomplished in one continuous motion, which requires 1 second. The release and backward swing require 1 second. The addition of the 2-second rest makes a total of 4

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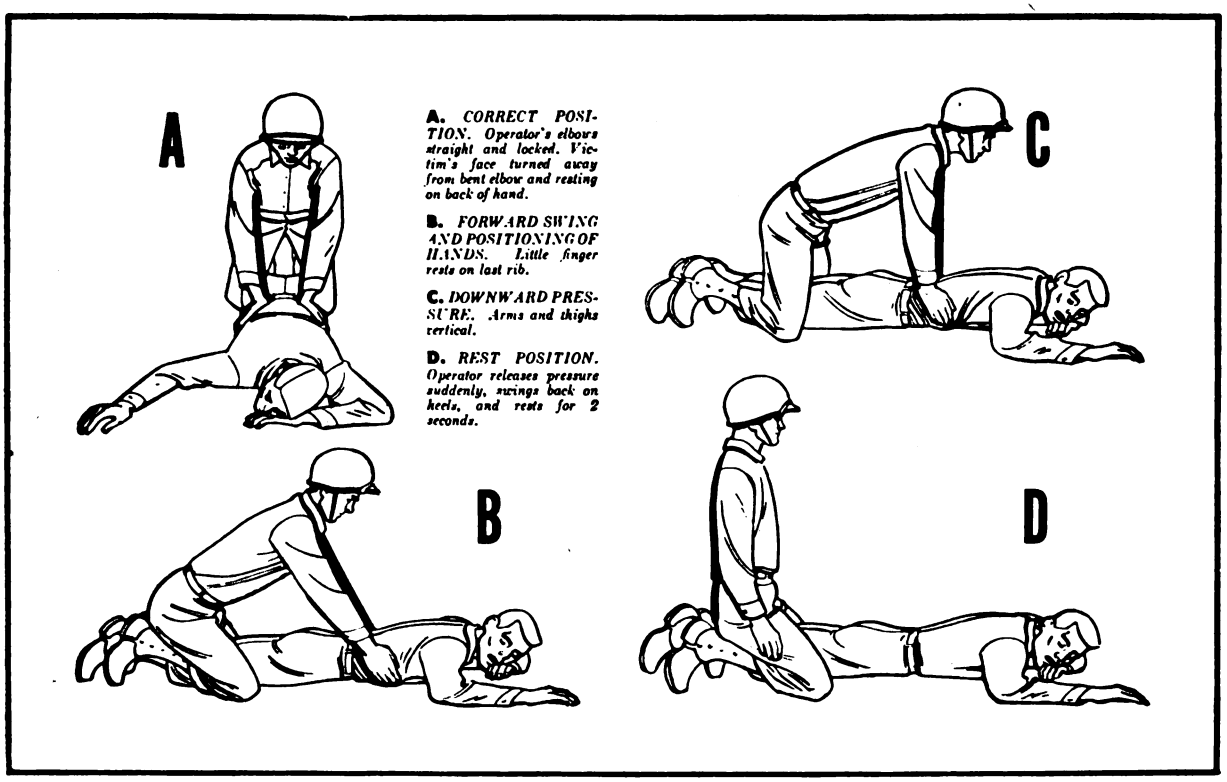

seconds for a complete cycle. Until the operator is thoroughly familiar with the correct cadence of the cycle, he should count the seconds aloud, speaking distinctly and counting evenly in thousands. Example: one thousand and one, one thousand and two, etc.

h. Artificial respiration should be continued until the victim regains normal breathing or is pronounced dead by a medical officer. Since it may be necessary to continue resuscitation for several hours, relief operators should be used if available.

RELIEVING OPERATOR.

The relief operator kneels beside the operator and follows him through several complete cycles. When the relief operator is sure he has the correct rhythm, he places his hands on the operator's hands without applying pressure. This indicates that he is ready to take over. On the backward swing, the operator moves and the relief operator takes his position. The relieved operator follows through several complete cycles to be sure that the new operator has the correct rhythm. He remains alert to take over instantly if the new operator falters or hesitates on the cycle.

STIMULANTS.

a. If an inhalant stimulant is used, such as aromatic spirits of ammonia, the individual administering the stimulant should first test it himself to see how close he can hold the inhalant to his own nostril for comfortable breathing. Be sure that the inhalant is not held any closer to the victim's nostrils, and then for only 1 or 2 seconds every minute.

b. After the victim has regained consciousness, he may be given hot coffee, hot tea, or a glass of water containing ½ teaspoon of aromatic spirits of ammonia. ***Do not give any liquids to an unconscious victim.***

CAUTIONS.

a. After the victim revives, keep him LYING QUIETLY. Any injury a person may have received may cause a condition of shock. Shock is present if the victim is pale and has a cold sweat, his pulse is weak and rapid, and his breathing is short and gasping.

b. Keep the victim lying flat on his back, with his head lower than the rest of his body and his hips elevated. Be sure that there is no tight clothing to restrict the free circulation of blood or hinder natural breathing. Keep him warm and quiet.

c. A resuscitated victim must be watched carefully as he may suddenly stop breathing. ***Never leave a resuscitated person alone until it is CERTAIN that he is fully conscious and breathing normally.***

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WARNING

HIGH VOLTAGE

is used in the operation of this equipment.

DEATH ON CONTACT

may result if operating personnel fail to observe all safety precautions.

Voltages as high as 8,000 volts are used in the operation of this equipment. These voltages are dangerous to life.

Do not change tubes or make adjustments inside this set with the high-voltage supply on.

All hinged panels which can be opened by handles to give access to the inside of the equipment are provided with interlocks to shut off the equipment when the panels are opened. Panels screwed or bolted on *do not* have these interlocks. A few service checks must be made inside the set with the high voltage on. When making these checks, always have present another person capable of rendering first aid. Keep one hand in your pocket while making high-voltage measurements. This precaution will prevent your touching the electrical circuit with more than one part of the body at one time.

Radio-frequency voltage as high as 4,500 volts may develop on the antenna of this equipment group. *Do not touch the antenna while the set is turned on.*

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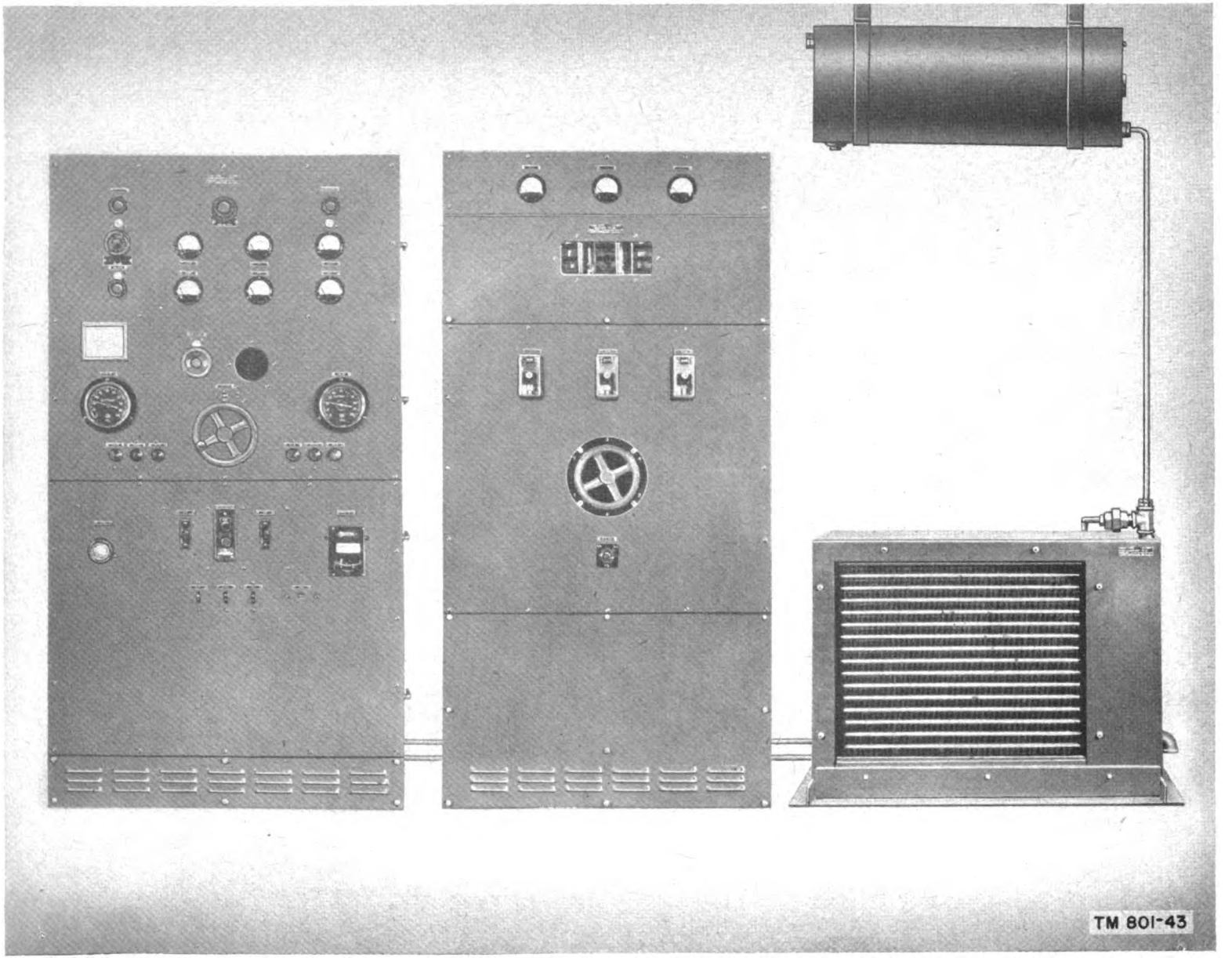

Figure 1. Amplifier Group AN/FRA-2.

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CHAPTER 1

INTRODUCTION

Section I. GENERAL

1. Scope

a. This manual contains instructions for the installation, operation, maintenance, and repair of Amplifier Group AN/FRA-2. In addition to these instructions there are two appendixes covering a list of references and an identification table of parts.

b. Official nomenclature followed by (*) is used to indicate all models of the item of equipment included in this manual. Thus Power Amplifier BC-340-(*) represents Power Amplifiers BC-340, BC-340-A, -B, and -D through -I; Rectifier RA-22-(*) represents Rectifiers RA-22, RA-22-A, and -C through -H; Water Cooling Unit RU-2-(*) represents Water Cooling Units RU-2, RU-2-A, -B, and -C.

2. Forms and Records

The following standard forms will be used for reporting unsatisfactory conditions of matériel and equipment, or improper preservation, packaging, packing, marking, loading, stowage, or handling thereof:

a. DD Form 6, Report of Damaged or Improper Shipment (Reports Control Symbols CS GLD-66 (Army), S and A-70-6 (Navy), and AF-MC-U2 (Air Force), will be filled out and forwarded as prescribed in SR 745-45-5 (Army), NAV DEPT SERIAL 85POO (Navy), and AFR 71-4 (Air Force).

b. DA AGO Form 468, Unsatisfactory Equipment Report (Reports Control Symbol CS GLD-247), will be filled out and forwarded to the Office of the Chief Signal Officer, as prescribed in SR 700-45-5.

c. AF Form 54, Unsatisfactory Report, will be filled out and forwarded to Commanding General, Air Matériel Command, Wright-Patterson Air Force Base, Dayton, Ohio, as prescribed in SR 700-45-5/AFR 65-26.

d. Use other forms and records as authorized.

Section II. DESCRIPTION AND DATA

3. Purpose and Use

a. Amplifier Group AN/FRA-2 (fig. 1) is a 10-kw (kilowatt) r-f (radio-frequency) amplifier, used to amplify a c-w (continuous-wave) or frequency shift radioteletype signal over a continuous frequency range of 4 mc (megacycles) through 26.5 mc.

b. The equipment consists of the following major components:

(1) Push-pull Power Amplifier BC-340-(*) (fig. 2).
(2) Rectifier RA-22-(*) (fig. 3), which supplies the high d-c (direct-current) voltage to the amplifier tube plates.
(3) Water Cooling Unit RU-2-(*) (fig. 4), which is a closed circuit type water circulating system.
(4) An installation kit (par. 11) to permit installation and interconnection of the units.

c. This equipment is intended for use as a fixed field station.

4. Application of Equipment

a. Amplifier Group AN/FRA-2 is designed for use in connection with c-w 1-kw Radio Transmitter BC-339-(*)[1] as an exciter. The output of Power Amplifier BC-340-(*) is the same as the output of the Radio Transmitter BC-339-(*) exciter, except that it is at a much higher power level.

b. A simplified block diagram of the over-all system showing the relations between the various com-

[1]Radio Transmitter BC-339-(*) refers to the following models: BC-339, BC-339-A, -B, -C, -E, -F, -G, -H, -J, -K, -L, -M, -N, and -O.

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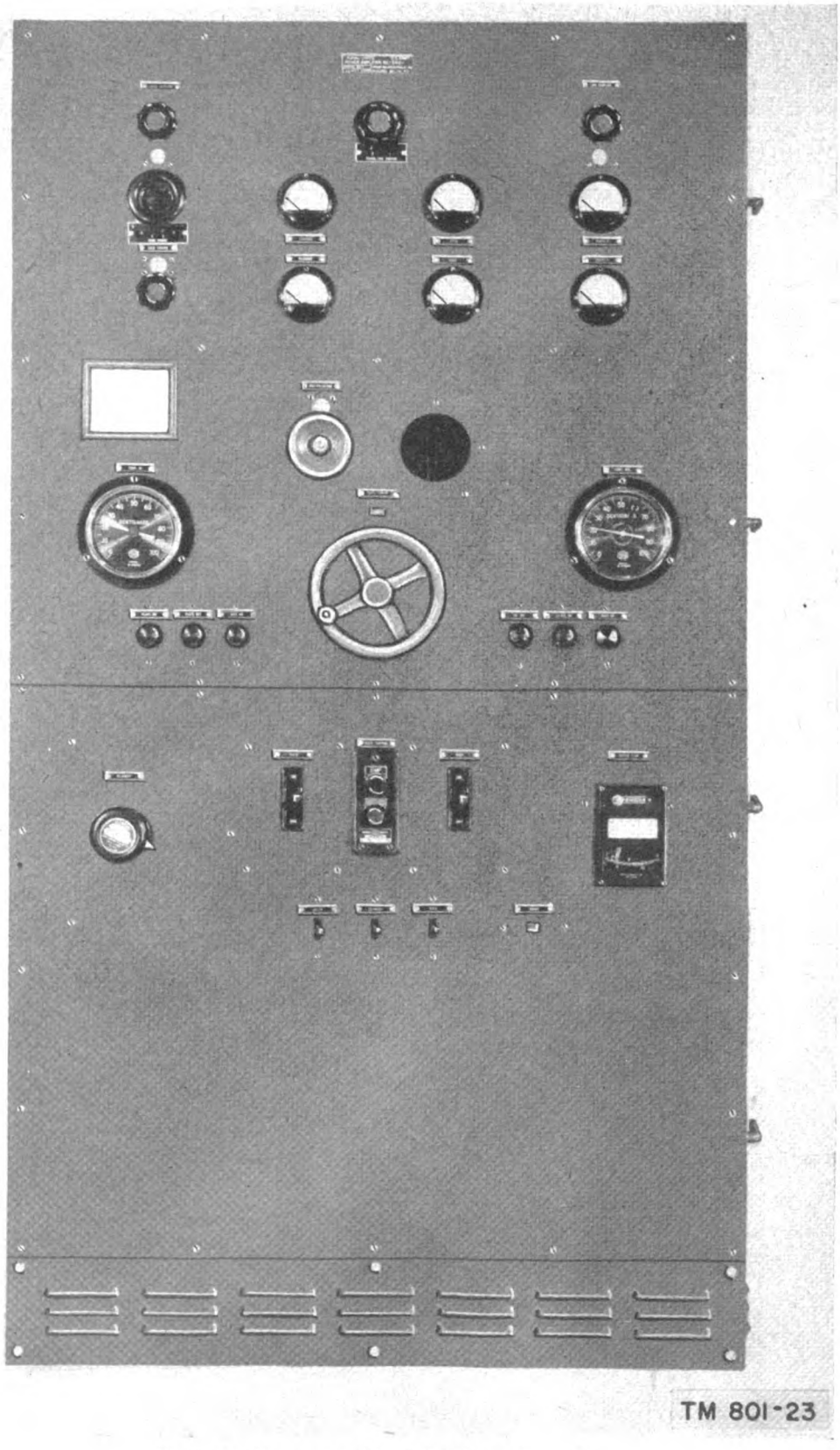

Figure 2. Power Amplifier BC-340-(*), front view.

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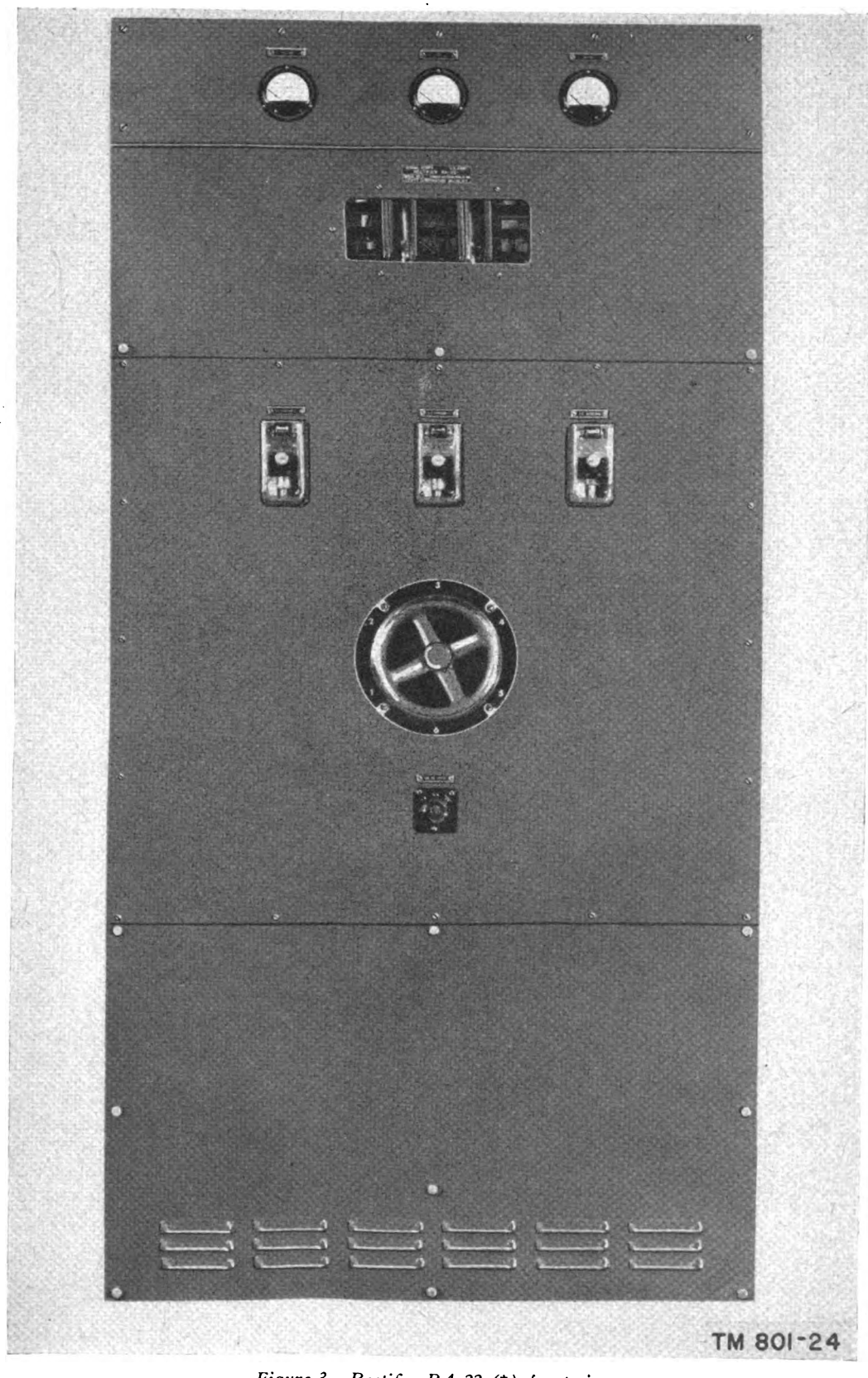

Figure 3. Rectifier RA–22–(*), front view.

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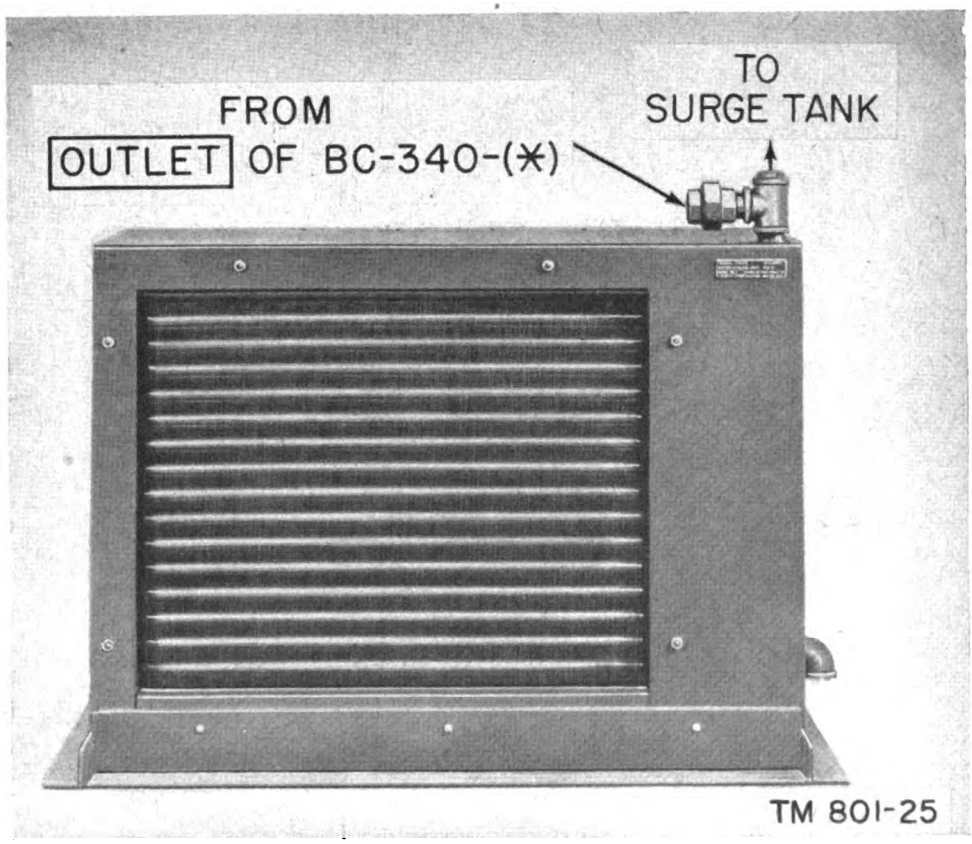

Figure 4. Water Cooling Unit RU-2-(*), front view.

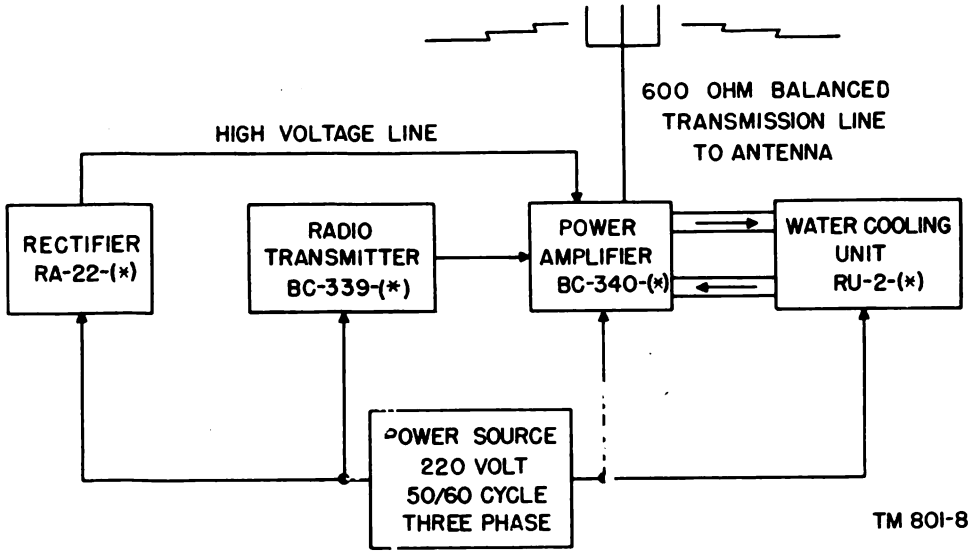

Figure 5. Amplifier Group AN/FRA-2, simplified block diagram.

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ponents and their interconnections is given in figure 5. Note that the radio signal originates in Radio Transmitter BC–339–(*) and is fed to Power Amplifier BC–340–(*) and then through a 600-ohm balanced transmission line to the antenna. It is shown that the power amplifier is supplied with high voltage by Rectifier RA–22–(*) and is cooled by Water Cooling Unit RU–2–(*). As shown in the block diagram (fig. 5), the supply line for Radio Transmitter BC–339–(*), Power Amplifier BC–340–(*), Rectifier RA–22–(*), and Water Cooling Unit RU–2–(*) is a 220-volt, 60-cycle, 3-phase supply. However, Power Amplifiers BC–340–D and –F through –I, Rectifiers RA–22–C and –E through –H, and Water Cooling Units RU–2–A and –C are also designed to operate from a 50-cycle, 3-phase, 220-volt supply.

5. Technical Characteristics

a. Power Amplifier BC–340–(*).

Frequency range:
4 mc through 26.5 mc.

Exciter requirements:
R-f output of a radio transmitter producing from 400 watts up to 1 kw at any frequency within the operating range of 4 mc through 26.5 mc.

Power output:
Delivers up to 10 kw to a transmission line with a surge impedance of 600 ohms in keyed telegraph service.

Signals:
Output is a c-w signal keyed at a rate of 300 words per minute, 5 characters per word, International Morse code. Frequency shift radioteletype having a frequency shift of 425 cycles either side of the mean carrier frequency.

Transmission line:
600 ohms balanced line ±200 ohms.

Tube complement:
Power Amplifier BC–340, four tubes 846, r-f power amplifiers. Power Amplifiers BC–340–A, –B, and –C through –I, two Tubes JAN–129B, r-f power amplifiers. Two tubes JAN–872A, mercury-vapor grid bias rectifiers.

Supply line requirements:
200-volt, 60-cycle, 3-phase, 95 percent power factor. Power Amplifiers BC–340–D and –F through –I are also capable of operating from a 50-cycle source.

Line current distribution:

	With key up	With key down
Voltage	230 volts	226 volts
Current phase 1...	28.2 amperes	71.0 amperes
Current phase 2...	23.0 amperes	72.0 amperes
Current phase 3...	17.0 amperes	61.0 amperes

b. Rectifier RA–22–(*).

Supply line requirements:
220-volt, 60-cycle, 3-phase; fed through Power Amplifier BC–340–(*).
Rectifiers RA–22–C and –E through –H are also capable of operating from a 50-cycle source.

Basic circuit:
Three-phase, full-wave rectifier.

Operating characteristics:
Output voltage: from 3,750 to 8,250 volts dc.
Operating current: up to 3.45 amperes dc.
Voltage regulation: 7.5 percent between full load and no load.
Efficiency: 90 percent.

Tube complement:
Six Tubes JAN–872A, mercury-vapor, half-wave rectifiers.

c. Water Cooling Unit RU–2–(*).

Supply line requirements:
Water Cooling Units RU–2 and –B, 220-volt, 60-cycle, 3-phase.
Water Cooling Units RU–2–A and –C, 220-volt, 50/60-cycle, 3-phase.

Coolant:
Approximately 35 gallons of distilled water.

Maximum operating temperature:
45° C.

d. Surge Tank.

Dimensions:
14.5-inch diameter, 30 inches long.

Capacity:
20 gallons.

Water level indicator:
Water Cooling Units RU–2, –A, and –C, float type dial.
Water Cooling Unit RU–2–B, glass tube direct reading.

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6. Table of Components

Component	Req No.	Dimensions				
		Height (in.)	Width (in.)	Depth (in.)	Volume (cu ft)	Weight (lb)
Power Amplifier BC-340-(*) (fig. 2)	1	83	42	60	122.5	2,370
Rectifier RA-22-(*) (fig. 3)	1	79	54	39	95	3,105
Water Cooling Units RU-2, -A, and -B	1	47	52	43	61	950
or						
Water Cooling Unit RU-2-C	1	38	46	54	54	850
Surge tank (fig. 6)	1	14.5" OD by 30" lg			3.4	80
Installation kit	1	(See component listing in par. 11.)				
Instruction book	2	11	8.5			1

Note. This list is for general information only. See appropriate supply publications for information pertaining to requisition of spare parts.

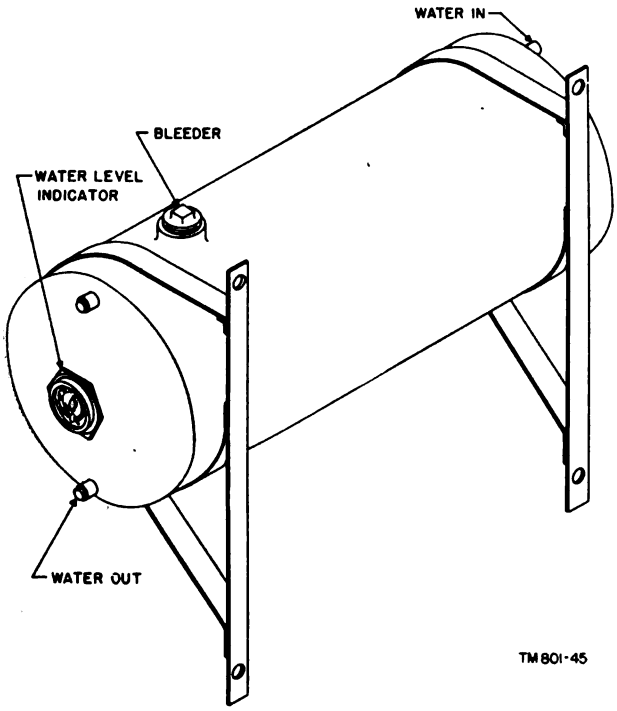

Figure 6. Surge tank.

7. Packaging Data

a. When packaged for export shipment, the components of Amplifier Group AN/FRA-2 are placed in moistureproof, vaporproof containers and packed in 19 wooden export crates. A breakdown view of a typical component packed for export is shown in figure 17.

Note. Items may be packaged in a manner different from that shown, depending on supply channel.

The size, weight, and volume of each crate are given in the following chart.

Number of crates	Height (in.)	Width (in.)	Depth (in.)	Volume (cu ft)	Weight (lb)
1	96	54	62	186.0	1,200
1	35	50	25	35.32	242
1	37	24	35	17.91	154
1	34	16	16	5.0	120
2	15½	12	14	1.5	100
1	26¾	12⅛	9⅝	1.83	62
1	50	59	38	67.43	1,230
1	96	51	62	175.67	1,100
1	21¾	20	15½	3.94	80
1	17⅝	13⅞	18⅞	2.65	45
1	56	30	36	35.0	1,000
1	30	21½	24¼	9.0	105
2	40	45	45	47.0	1,500
4 or 6	25	14	14	2.82	120
Total weight (lb)					7,058

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b. The following list indicates contents of each case. See packing list attached to each case for exact contents.

Case dimensions (in.)	Contents	Notes
96 x 54 x 62	1—Power Amplifier BC–340–(*).	Less fragile and excessively heavy components.
	2—Lead water pipe assembly.	Packed inside power amplifier cabinet.
35 x 50 x 25	2—Water coil (D–7).	See figure 23.
37 x 24 x 35	2—Plate tuning coil (L–2–1 and L–2–2).	See figures 8 and 25.
	4—Porcelain piping.	
	2—Power amplifier operating Tube JAN–872A.	
34 x 16 x 16	1—Plate tuning capacitor assembly (C–5, C–3, C–4, C–8, B–49).	See figure 22. B–49 is shown in figure 23.
15½ x 12 x 14	Air blower assembly.	Two cases.
26¾ x 12⅝ x 9⅝ ...	Transformers T–1, T–3, and T–4.	See figure 10.
50 x 59 x 38	Water Cooling Unit RU–2–(*) and surge tank.	See figures 6, 14, and 15.
96 x 51 x 62	Rectifier RA–22–(*), cabinet assembly.	Less fragile and excessively heavy components.
21¾ x 20 x 15½	Controller (SW–1).	
17⅝ x 13⅞ x 18⅞ ..	Rectifier components and CH–1, T–2, and C–1.	
56 x 30 x 36	Plate transformer (T–1).	
30 x 21½ x 24¼	Grid input assembly, antenna coupling capacitor, spare Tubes JAN–872A and fuse links.	
40 x 45 x 45	Installation kit.	Two cases.
25 x 14 x 14	Operating and spare Tubes JAN–129B or 846.	Four cases or six cases.

8. Description of Power Amplifier

Power Amplifier BC–340–(*) is a push-pull class C power amplifier designed for c-w transmission within a range of 4 mc through 26.5 mc.

a. The front panel (fig. 2) contains the meters and controls required for operation of the unit. The right and left sides of the equipment and the bottom of the front panel are louvered to permit proper air circulation for cooling purposes.

b. The right side of the unit has two doors, each of which can be opened by two handles located near the front of the unit. These doors swing open, giving access to the inside of the power amplifier (fig. 7 or 8). An interlock safety switch is controlled by each of these doors.

c. The left side of the unit is closed by two panels that are screwed down. Removal of the lower panel *when the power is off* on Power Amplifier BC–340–D and –F through –I reveals the 50/60-cycle switch (SW–12) of the voltage regulator (VR–1) (fig. 10).

d. The rear of the unit consists of two panels; the top panel has several large air holes covered with loose wire mesh. The bottom panel (fig. 11) contains the water INLET, water OUTLET, and DRAIN valves and two terminal strips. The large contact strip contains contacts 1 to 6, and the small contact strip contains terminals 7 through 24. Internal connections from terminals 7 through 24 are made through a large lead grommet. In addition, the lower panel contains a bushing for the h-v (high-voltage) cable and a ground stud.

e. On the top of the unit are two sets of large stand-off output terminals and one set of smaller input terminals.

9. Description of Rectifier

Rectifier RA–22–(*) is a h-v, three-phase, full-wave rectifier designed to supply plate voltage to Power Amplifier BC–340–(*).

a. The front panel of this unit (fig. 3) consists of four sections and contains the meters and controls required in the operation of the unit. One of the sections is a hinged door that swings upward and locks in position when fully opened, to facilitate replacement of tubes. The door controls a h-v interlock switch. The front and sides of the rectifier are louvered for ventilation.

b. The sides of the unit are removable panels that give access to the inside of the unit (fig. 12 or 13).

10. Description of Water Cooling Unit

Water Cooling Unit RU–2–(*) (figs. 4 and 14 or 15) is a water cooler used to circulate water and

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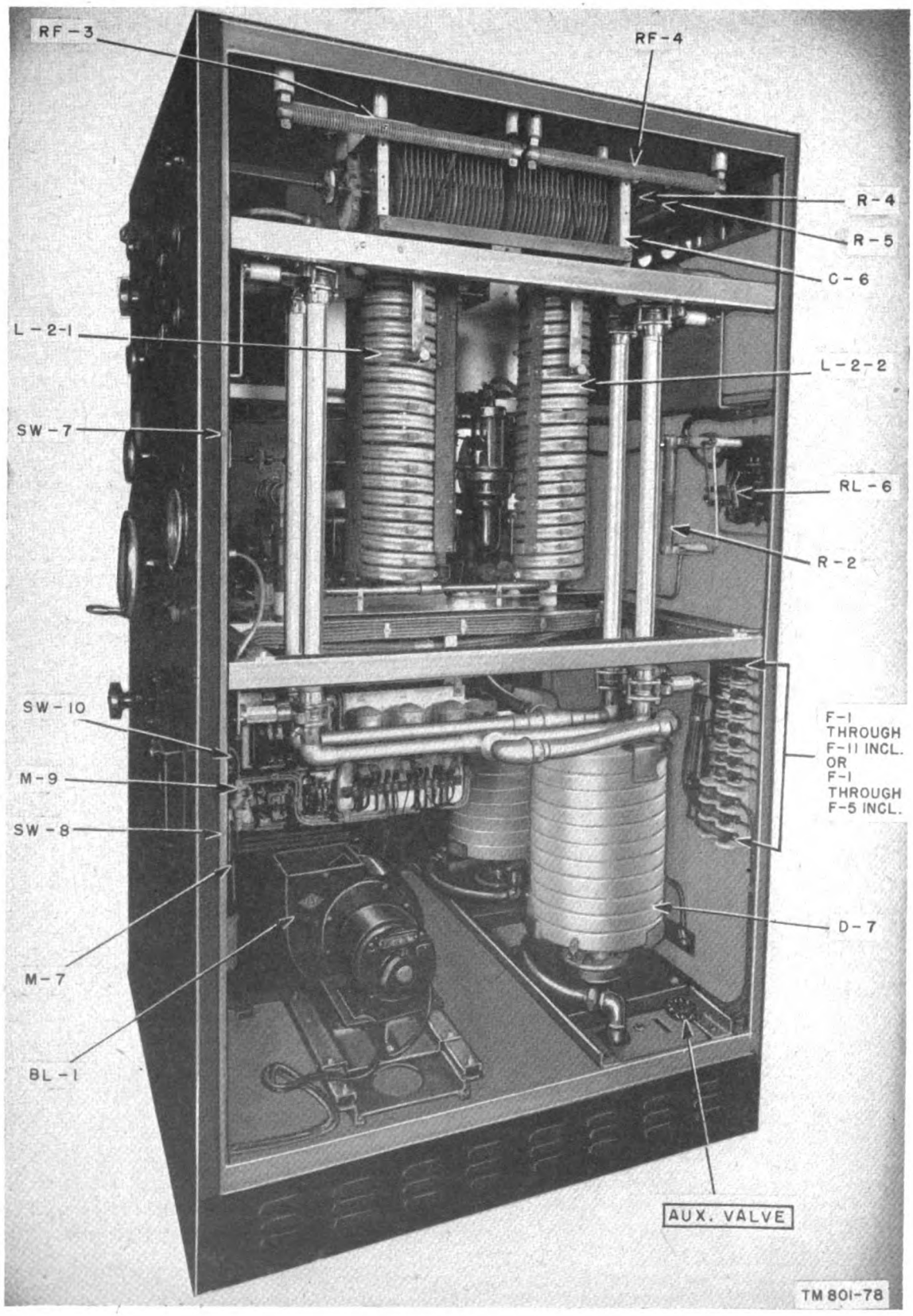

Figure 7.—Power Amplifiers BC-340-A, -B, and -D through -H, inside right side.

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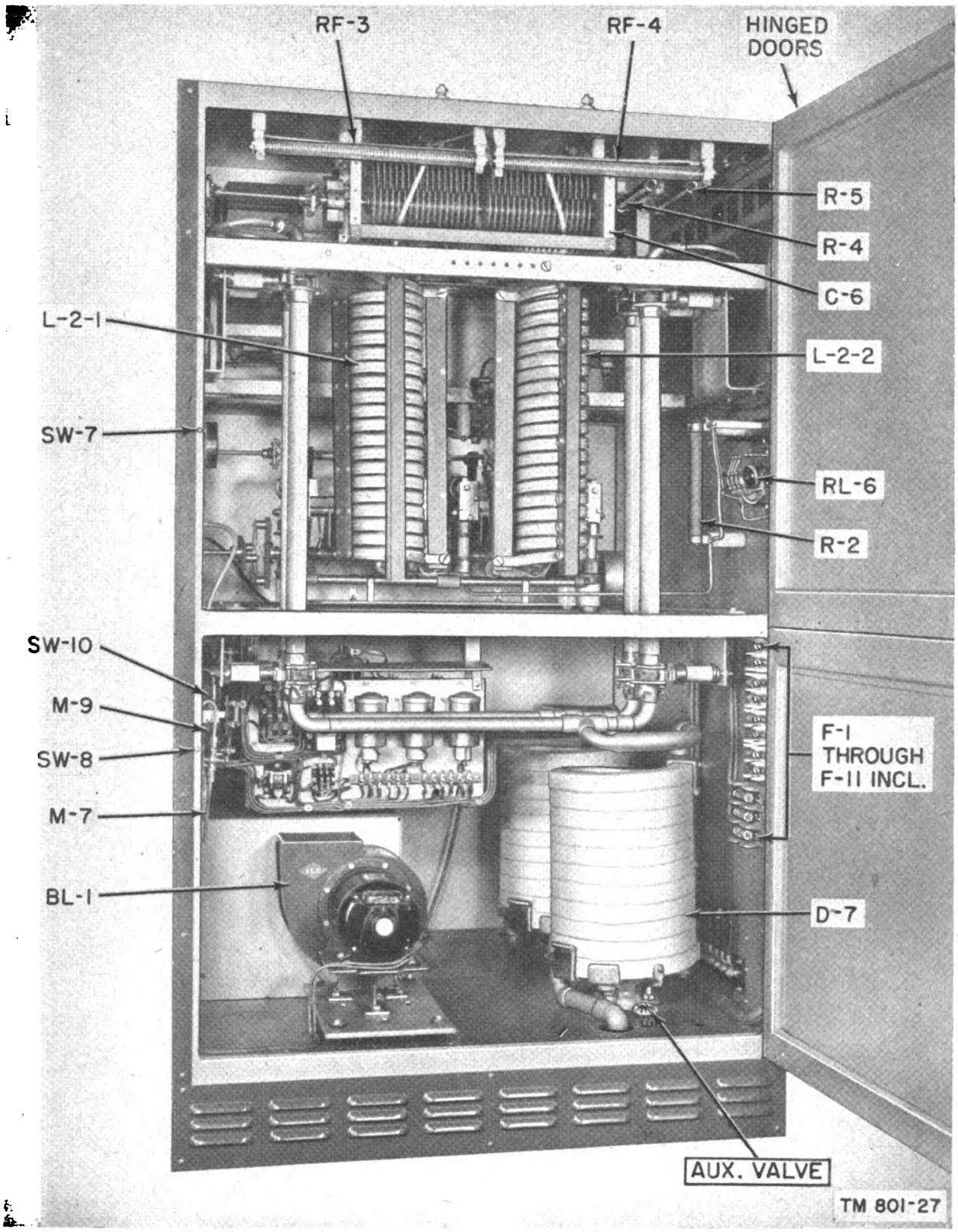

Figure 8. Power Amplifier BC-340-I, inside right side.

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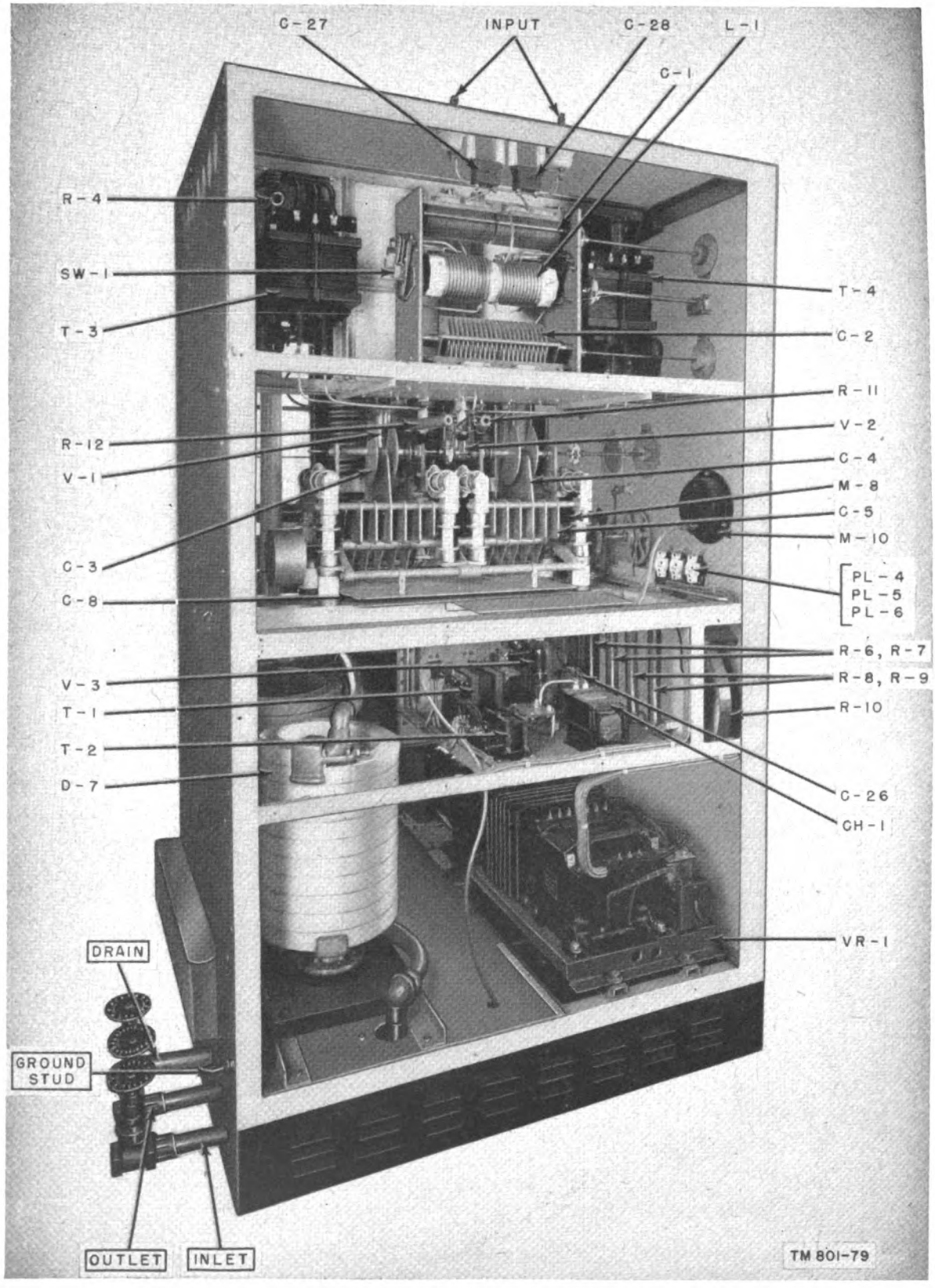

Figure 9. Power Amplifiers BC-340-A, -B, and -D through ***-H, inside left side.***

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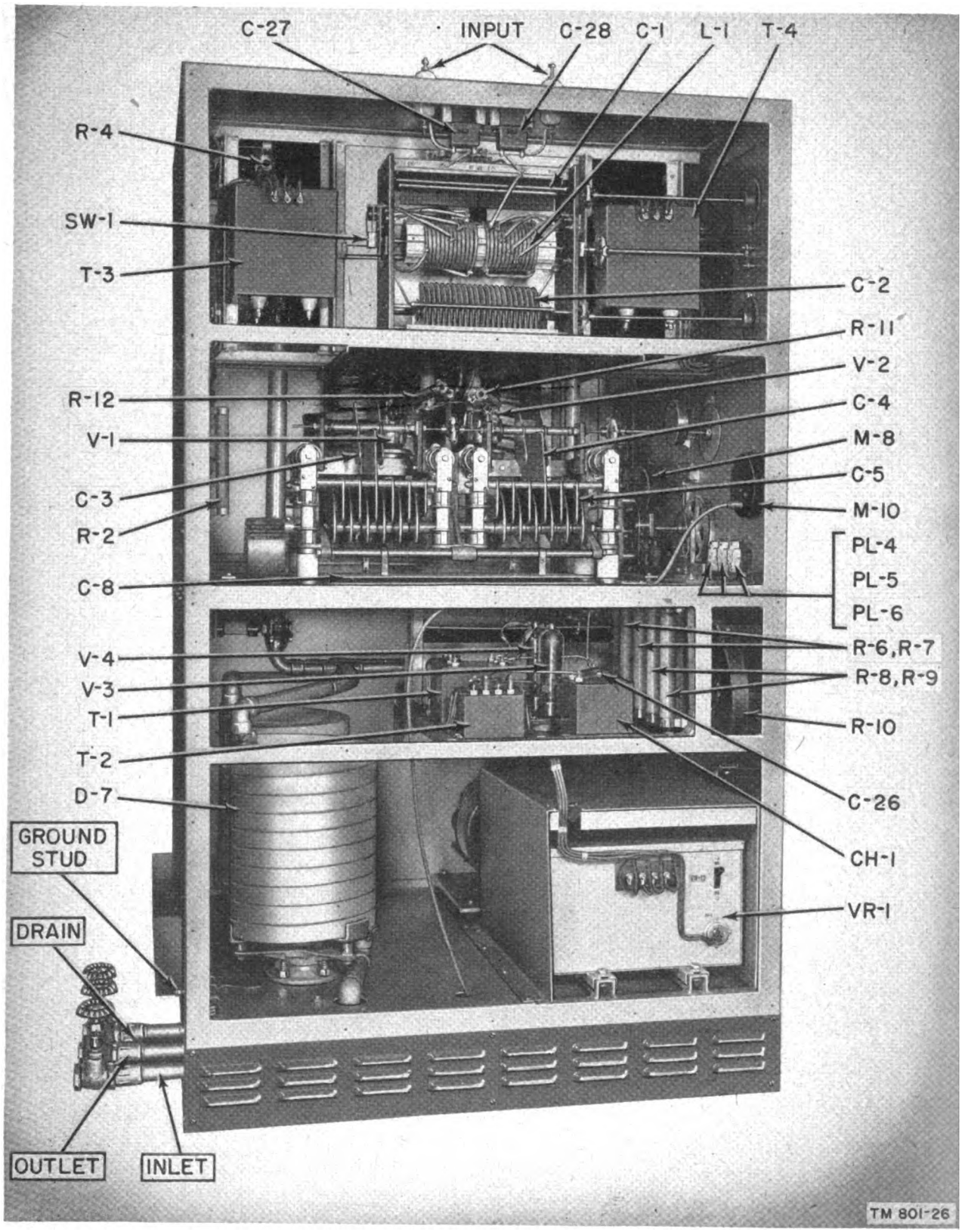

Figure 10. Power Amplifier BC-340-I, inside left side.

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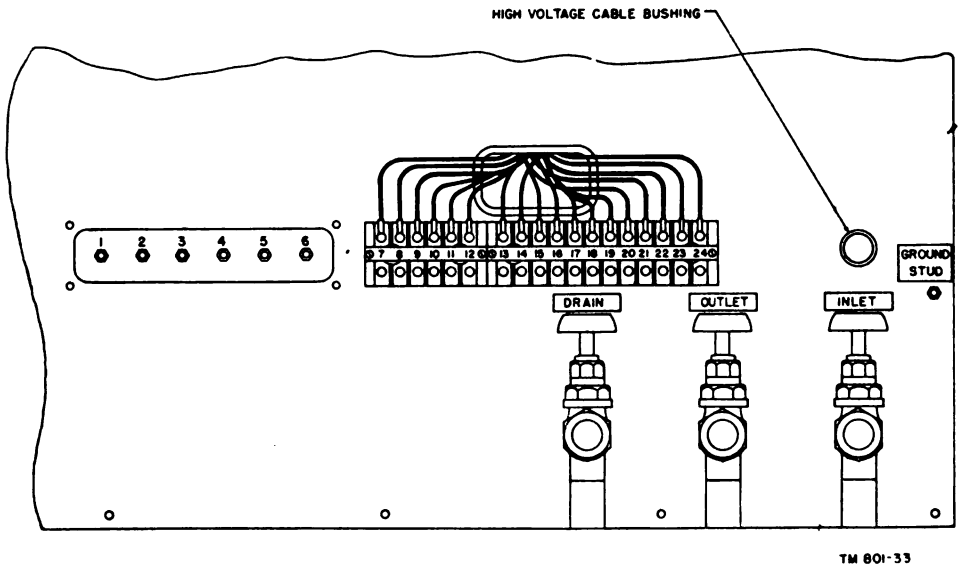

Figure 11. Power Amplifier BC-340-(*), lower rear view.

to dissipate the heat absorbed by the water during its circulation within the vacuum tube water jackets and the plate tuning coils. It consists of a motor, pump, fan, and radiator.

11. Installation Kit Items for Amplifier Group AN/FRA-2

The installation kit is composed of the following items:

Item No.	Name and description	Quantity
1	Lead covered cable, No. 14, solid	300 ft
2	Lead covered cable, No. 10, solid	400 ft
3	Lead covered cable, No. 8, stranded	50 ft
4	Lead covered cable, No. 0, stranded	200 ft
5	Lead covered cable, No. 7, stranded	30 ft
6	Switch, safety, TPST, 100 amp	1
7	Terminal TM-115	18
8	Terminal TM-136	6
9	Terminal lug, soldering, size 3/16"	36
10	Terminal lug, soldering, 50 amp, size 3/16"	24
11	Ground Rod GP-26	6
12	Pipe dope, 1-lb can	1 can
13	Soldering paste, 2-oz container	2 cans
14	Solder M-31	5 lb
15	Friction tape, cotton, black, 1/2-lb roll	1 roll
16	Rubber tape, black, 1/2-lb roll	1 roll
17	Pipe fitting, plug, brass, 1/2" IPS	3
18	Reducing bushing, rough finish, brass, male and female thread, 1 1/4" IPS to 1" IPS.	2
19	Pipe adapter fitting, 1" nominal solder fitting for 1" type K or L copper tubing to 1" IPS male thread.	5
20	Pipe adapter fitting, wrought copper 1/2" nominal solder fitting for 1/2" type K or L copper tubing to 1/2" IPS male thread.	3
21	Pipe fitting all wrought copper, 1" nominal solder fitting for 1" type K or L copper tubing.	3
22	Tubing, general purpose, annealed copper, 1/2" ID.	50 ft
23	Tubing, general purpose, annealed copper, 1" ID.	100 ft

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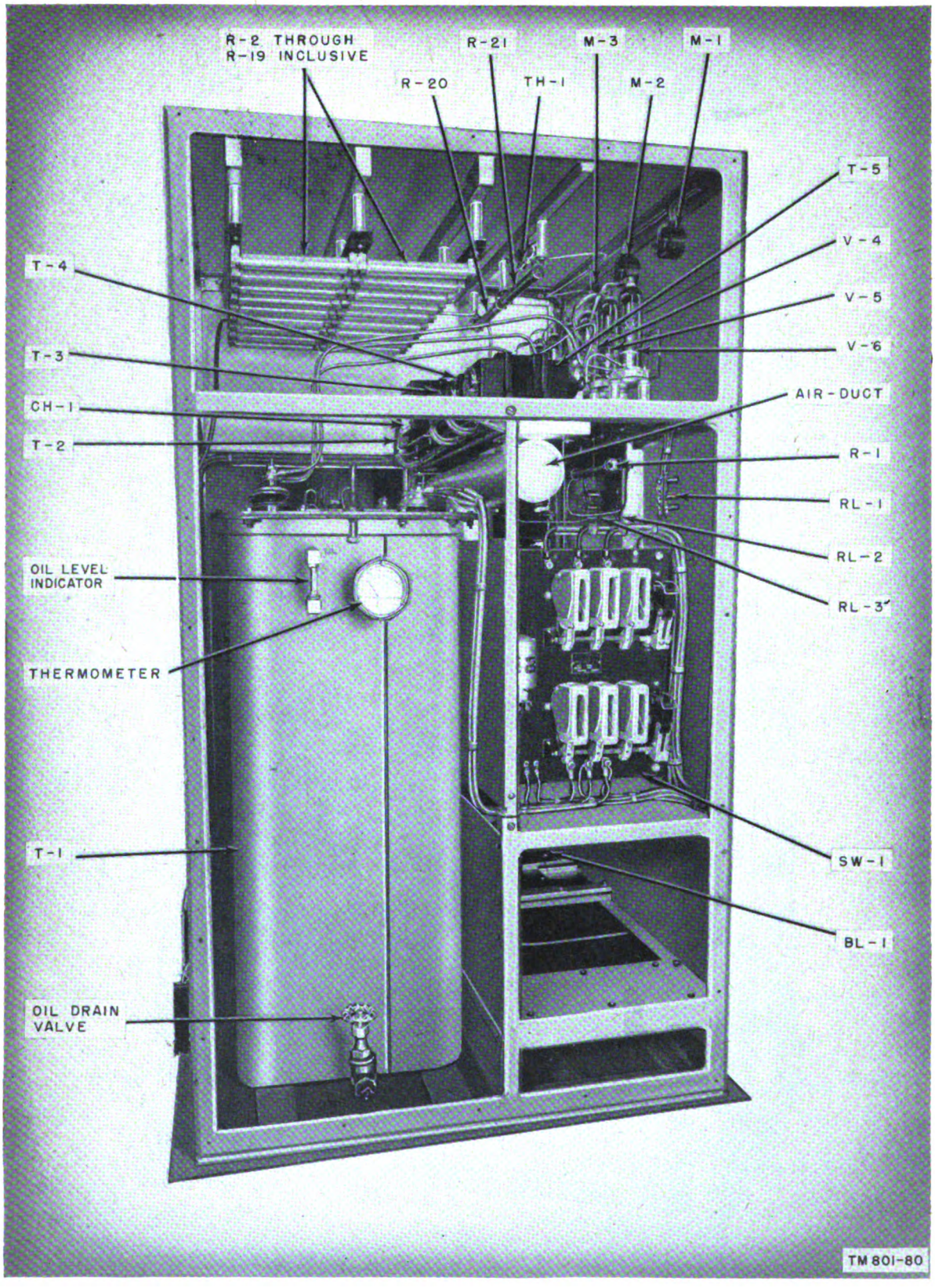

Figure 12. Rectifiers RA-22-A and -C through -G, inside left side.

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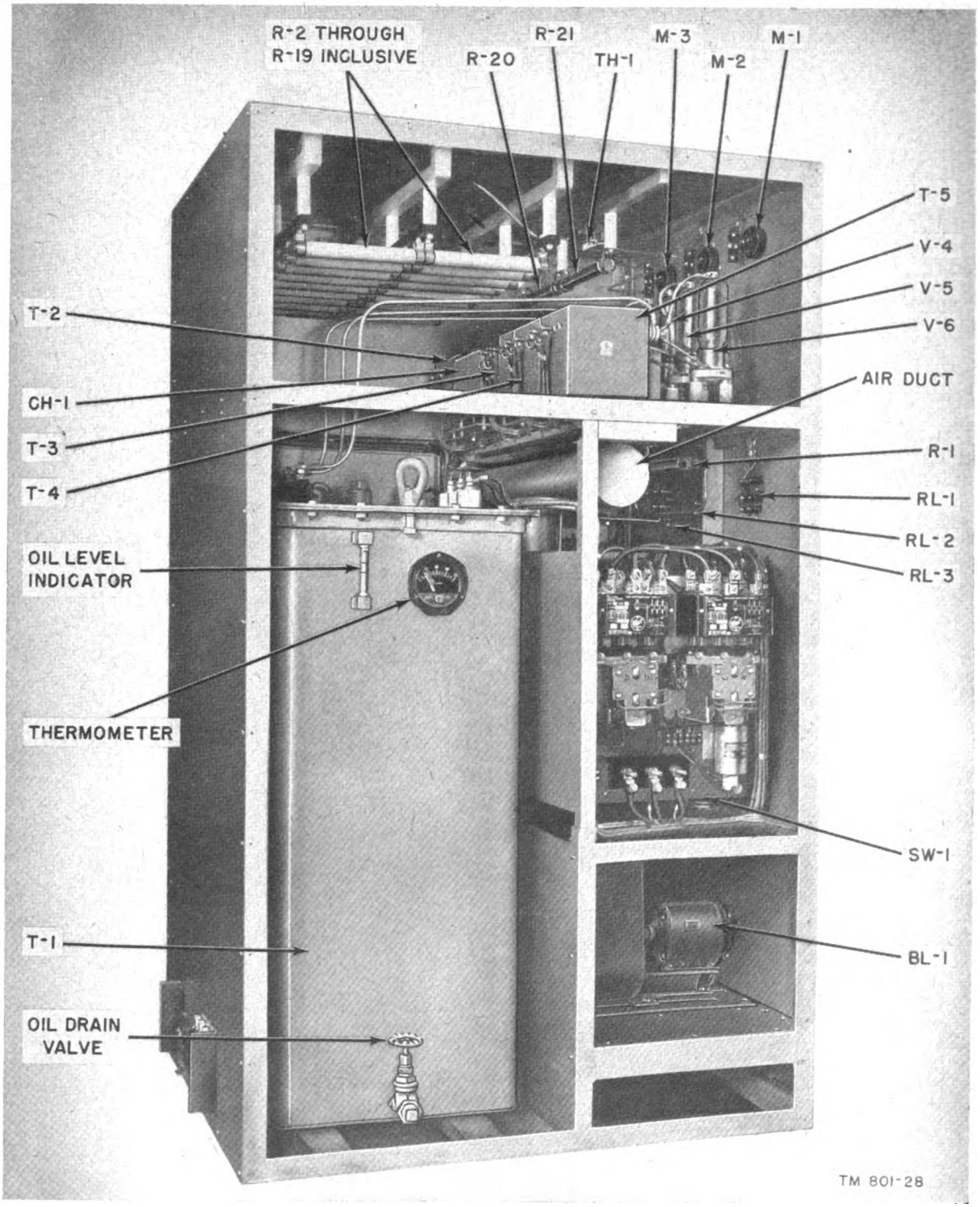

Figure 13. Rectifier RA-22-H, inside left side.

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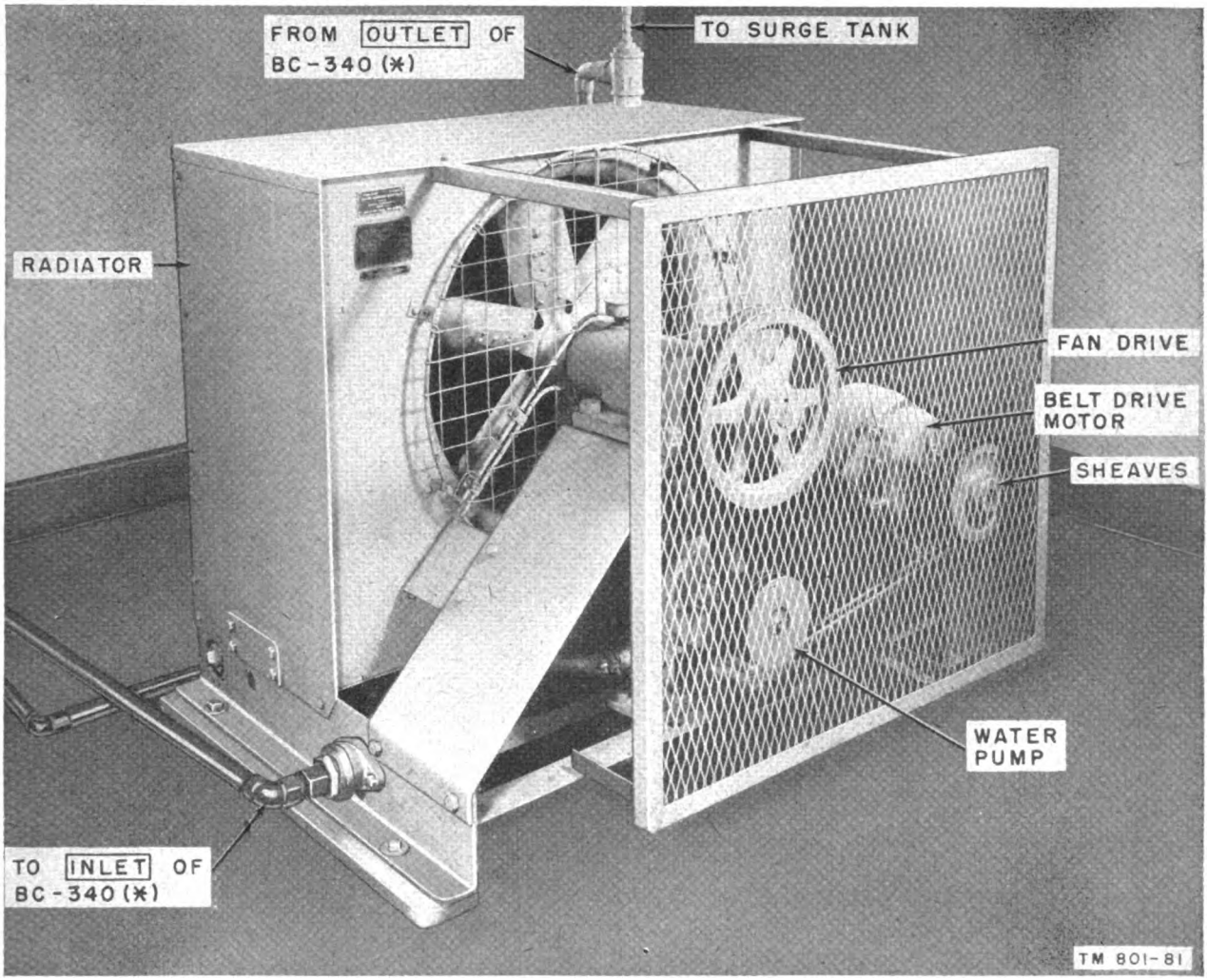

Figure 14. Water Cooling Units, RU-2-A and -B, rear view.

12. Running Spares

The following running spares are supplied:

Item	Quantity
Power Amplifier BC-340-(*):	
Tubes JAN-129B or 846	2
Tubes JAN-872A	2
Pilot light lamps, 10 w, clear	6
Fuse cartridges	55
Fuse links	110
Rectifier RA-22-(*): Tubes JAN-872A	6

13. Additional Equipment Required

The following equipment is not supplied as part of Amplifier Group AN/FRA-2, but is required for its installation and operation:

Radio Transmitter BC-339-(*).
Antenna and antenna transmission lines.
Mounting hardware.

14. Differences in Models of Components

a. Power Amplifier Unit.

(1) All the models except Power Amplifier BC-340 have identical circuits, with minor variations in the values of some of the circuit components. Power Amplifier BC-340 differs from the other models in that it uses four 846 tubes instead of two Tubes JAN 129B for amplifiers, two voltage regulators (VR-1) instead of one, no parasitic suppressors, and no additional relay (RL-8) in the filament circuit. In addition, many of the parts have different values and reference symbols.

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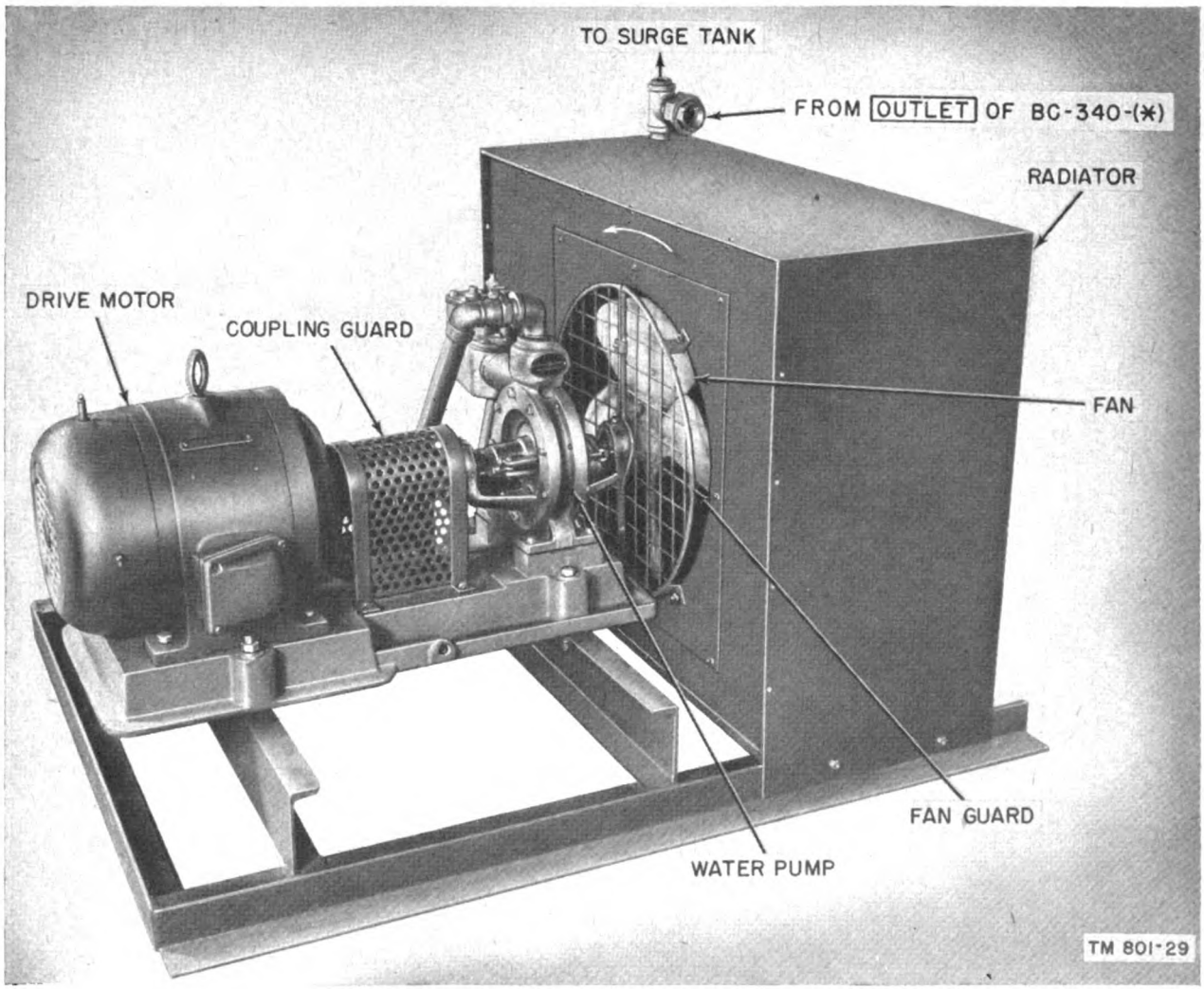

Figure 15. Water Cooling Unit RU-2-C, left side view.

(2) All the models except Power Amplifier BC-340-I have shorting bars and clamps for the tuning of the plate tank coils. They also use the restriction method of varying the rate of water flow through the amplifier. Power Amplifier BC-340-I uses tuning screws for tuning the plate tank coils and uses the bypass method for varying the rate of water flow through the amplifier.

(3) Power Amplifiers BC-340-A, -B, and -E are designed for operation from a 60-cycle source only. The other models are designed to operate from a 50- or 60-cycle source and their voltage regulators have a 50/60-cycle switch.

(4) Power Amplifiers BC-340-G and -I have the same fuses as the other models but the fuses have different reference symbols.

b. Rectifier Unit. All the models have identical circuits, except for minor variations in circuit component values. However, because of this variation of circuit values, some components in Rectifier RA-22 have different reference symbols than functionally similar components in the other models. Rectifiers RA-22, -A, and -D are designed for operation from a 60-cycle source. The other models are designed for operation from either 50- or 60-cycle source.

c. Water Cooling Unit. Only Water Cooling Unit RU-2-B has the surge tank mounted on the cooling unit. Water Cooling Units RU-2 and RU-2-B are designed for operation from a 60-cycle source only. The other models are designed for operation from either a 50- or 60-cycle source.

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CHAPTER 2

OPERATING INSTRUCTIONS

Section I. INSTALLATION OF AMPLIFIER GROUP AN/FRA-2

15. Siting

a. EXTERNAL REQUIREMENTS. Signals from this equipment have a greater range if the antenna is high and clear of hills, buildings, cliffs, densely wooded areas, and other obstructions. Depressions, valleys, and other low places are poor locations for radio reception and transmission, because the surrounding high terrain absorbs r-f energy. Weak or otherwise undesirable signals may be expected if the set is operated close to steel bridges, power lines, or power units. Choose, if possible, a location on a hilltop or another suitable elevation. Flat ground is desirable. Normally, transmission over water is better than over land. See that drainage is adequate, to prevent flooding the interior of the shelter. If the equipment is part of a communication center but is not installed within the center, locate the equipment nearby. In locating the antenna, avoid obstructions which are 2° or 3° above the horizontal plane of the antenna, in the direction of the desired transmission. This is approximately 200 to 300 feet at a distance of 1 mile from the antenna.

b. INTERIOR REQUIREMENTS. The shelter for the equipment must meet the following requirements:

(1) The floor must be capable of sustaining the weight of the equipment in a level position without vibration.

(2) Sufficient space must be available for possible repair work and for door swing, as explained in subparagraph (4) below.

(3) There must be a ceiling height of at least 9 feet to allow for r-f transmission line installation.

(4) Sufficient space must be allowed around the transmitter so that the doors may be opened, and sufficient space must also be provided on one side of the equipment so that it is possible to walk to the rear of the transmitter. Allow space (when possible) on the sides of the transmitter to permit removal of side panels when repair and maintenance work is required. Except for these limitations, the transmitter may be located anywhere convenient to the transmission lines and external power connections.

(5) Adequate lighting for day and night operation must be provided. Position the transmitter so that the panel designations may be easily read by the operating personnel. Artificial lighting should be accomplished with light bulbs placed so that the light falls directly upon the panel. A portable drop lamp and extension cord are convenient assets for operating and maintenance personnel.

16. Uncrating, Unpacking, and Checking

a. GENERAL. Equipment may be shipped in oversea packing cases or in domestic packing cases. When new equipment is received, select a location where the equipment may be unpacked without exposure to the elements and which is convenient to the permanent or semipermanent installation of the equipment.

Note. Be careful in uncrating, unpacking, and handling the equipment; it is easily damaged. If it becomes damaged or exposed, a complete overhaul might be required or the equipment might be rendered useless.

b. UNCRATING AND UNPACKING POWER AMPLIFIER AIR BLOWER ASSEMBLY, RECTIFIER AIR BLOWER ASSEMBLY, CONTROLLER (RECTIFIER), AND PLATE TUNING CAPACITOR ASSEMBLY.

(1) Remove the nails from the crate with a nail puller.

(2) Remove the top and one side of the wooden box. *Do not* attempt to pry off the sides and the top; the equipment may be damaged.

(3) Remove the waterproof and moistureproof barriers, gaskets, and all wadding.

(4) Remove the desiccant that is taped to the assembly.

(5) Remove all blocking, bracing, and felt.

(6) Loosen and remove the bolts that secure the assembly to its mounting base.

(7) Carefully lift or slide the assembly from its base.

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Caution: Be careful not to mar finish on capacitor plates, not to crack insulators, and not to bend the bottom plate.

c. Uncrating and Unpacking Grid Input Assembly, Antenna Coupling Capacitor, and Amplifier Electrical Spares (Including Tube JAN–872A and Fuse Links).

(1) Remove the nails with a nail puller.
(2) Remove the top and one side of the case.
(3) Remove all wadding and fiberboard filler cells.
(4) Remove from the crate the cartons containing the following items:
  (*a*) Grid input assembly.
  (*b*) Antenna coupling capacitor.
  (*c*) Spare Tubes JAN–872A of the power amplifier.
  (*d*) Electrical spares.
(5) Carefully open the fiberboard carton containing the grid input assembly.
(6) Remove the excelsior and the inner carton.
(7) Remove the waterproof barrier material.
(8) Remove the moistureproof barrier and desiccant material.
(9) Open the close-fitting fiberboard box.
(10) Carefully remove all cushioning from around the assembly.
(11) Repeat steps (5) through (10) above for the carton containing the antenna coupling capacitor.
(12) Carefully open the cartons containing the spare Tubes JAN–872A of the power amplifier.
(13) Remove all wadding.
(14) Carefully remove the tubes from the individual cardboard cartons.
(15) Carefully unwrap the electrical spares.

d. Uncrating and Unpacking Power Amplifier Transformers T–1 (Bias Rectifier Plate Transformer), T–3, and T–4 (Tube JAN–129B or 846 Filament Transformer). Repeat steps (1) through (8) of *b* above, omitting (4) and (6).

e. Uncrating and Unpacking Power Amplifier BC–340–(*) Cabinet, Water Pipe Assembly, Grid Chokes, and Resistors.

(1) Place the packing crate as near the operating position as convenient.
(2) Cut and fold back the flat metal strapping.
(3) Remove the nails with a nail puller.
(4) Remove the top and then the sides of the crate.
(5) Loosen the fastenings and open the cabinet panels.
(6) Remove all felt and/or sponge cushioning.
(7) Remove waterproof barrier material and moistureproof barrier material.
(8) Remove all wadding, blocking, and bracing.
(9) Remove the following cartons from Power Amplifier BC–340–(*) cabinet compartments:
  (*a*) The carton containing the water pipe assembly.
  (*b*) The carton containing the grid chokes, plate chokes, and resistors.
(10) Open each of the above cartons.
(11) Carefully unwrap the contents of each of the above cartons.
(12) Unwrap all wires, cables, and cords within the cabinet.
(13) Loosen and remove the six mounting bolts.
(14) Tilt the unit and then skid it forward slightly, and carefully slide the cabinet off the skid. ***Avoid bouncing the unit.***
(15) Strip off all protective wadding and taping.

f. Uncrating and Unpacking Water Coils.

(1) Open the nailed wooden crate.
(2) Remove the waterproof barrier material.
(3) Open the fiberboard box.
(4) Carefully lift out each of the two coils and remove all gummed tape.

g. Uncrating and Unpacking Plate Tuning Coils, Porcelain Tubing, Operating Tubes JAN–872A (Amplifier), Lamps, and Instruction Literature.

(1) Remove the nails from the wooden crate with a nail puller.
(2) Remove the top and one side of the box.
(3) Remove all filler material and take out the cartons containing the following items:
  (*a*) Plate tuning coils.
  (*b*) Porcelain tubing.
  (*c*) Operating Tubes JAN–872A (amplifier).
  (*d*) Lamps (operating and spares).
  (*e*) The waterproof bag containing the instruction literature.
(4) Open the carton containing the plate tuning coils.
(5) Remove all filler paper and lift out each of the two set-up boxes.

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(6) Open each of the two boxes and remove the plate tuning coils.
(7) Remove all cushioning and gummed tape.
(8) Open the carton containing the porcelain tubing.
(9) Remove all filler paper.
(10) Take out each of four set-up boxes.
(11) Open the boxes and remove the tubing.
(12) Remove all cushioning and gummed tape.
(13) Open the carton containing Tubes JAN–872A.
(14) Remove each of the two individual tube cartons.
(15) Open the individual tube cartons and remove the tubes.
(16) Carefully strip off the wadding.
(17) Open the carton containing the lamps.
(18) Remove and carefully unwrap each of the 12 lamps.
(19) Open the waterproof bag containing the instruction literature.
(20) Remove the instruction literature.

h. Uncrating and Unpacking Operating Spare Tubes JAN–129B or 846.

(1) Unscrew the single screw indicated by the black arrow (fig. 16) of the *bird cage* type tube crate.
(2) Remove the front panel by lifting it slightly.
(3) With a pair of diagonal cutters, carefully clip the iron wire which holds the tubes.
(4) Grasp tube with one hand.
(5) Disengage the lower portion of the tube from the spring-supported ring.
(6) Move the tube downward and slide it out of upper ring.

i. Uncrating and Unpacking Oil Filled Plate Transformer (Rectifier).

(1) Cut and fold back the flat metal strapping.
(2) Remove the nails with a nail puller and remove the top and all sides.
(3) Slide the transformer near its position of use.
(4) Cut away all metal strapping.
(5) Remove all the felt stripping.
(6) Slide or hoist the transformer into place in the rectifier (par. 20*d*).

j. Uncrating and Unpacking Rectifier RA–22–(*) Cabinet.

(1) Repeat steps (1) through (8) of *e* above.
(2) Repeat steps (12) through (15) of *e* above.

k. Uncrating and Unpacking Water Cooling Unit RU–2–(*) with Surge Tank and Wall Mounting Brackets.

(1) Place the packing crate as near the operating position as convenient.
(2) Cut and fold back the flat metal strapping.
(3) Remove all filler material.
(4) Remove the top and one side of the crate.
(5) Remove all filler material.
(6) Remove the carton containing the surge tank and wall mounting brackets.
(7) Open this carton and remove all filler material.
(8) Lift out the two wall mounting brackets and carefully unwrap them.
(9) Lift the tank out and carefully unwrap it.
(10) Remove the remaining sides of the wooden crate.
(11) Loosen and remove the four carriage bolts.
(12) Tilt the skid slightly and carefully slide the unit off the skid. Avoid bouncing the unit.

l. Uncrating and Unpacking Installation Kit.

(1) Repeat *k* (2) through (4) above.
(2) Open the waterproof bag to gain access to the fiberboard boxes within the crates.
(3) Remove all filler material.

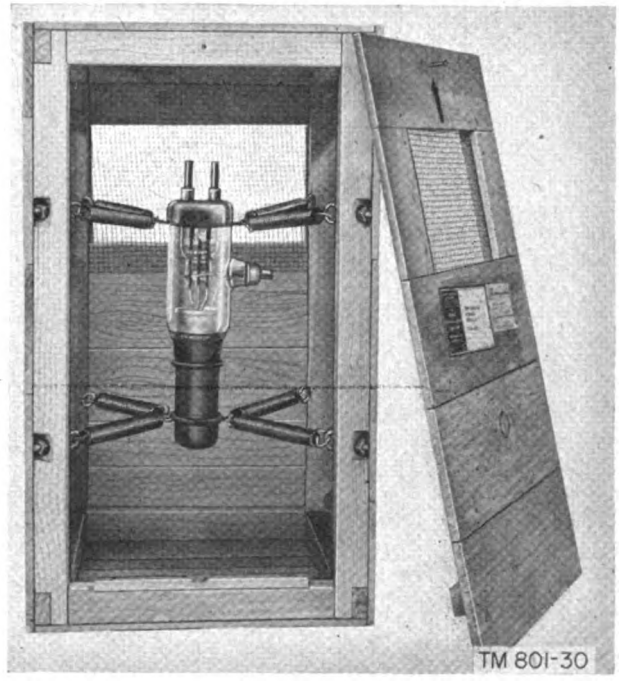

Figure 16. Amplifier Tube JAN–129B in shipping container.

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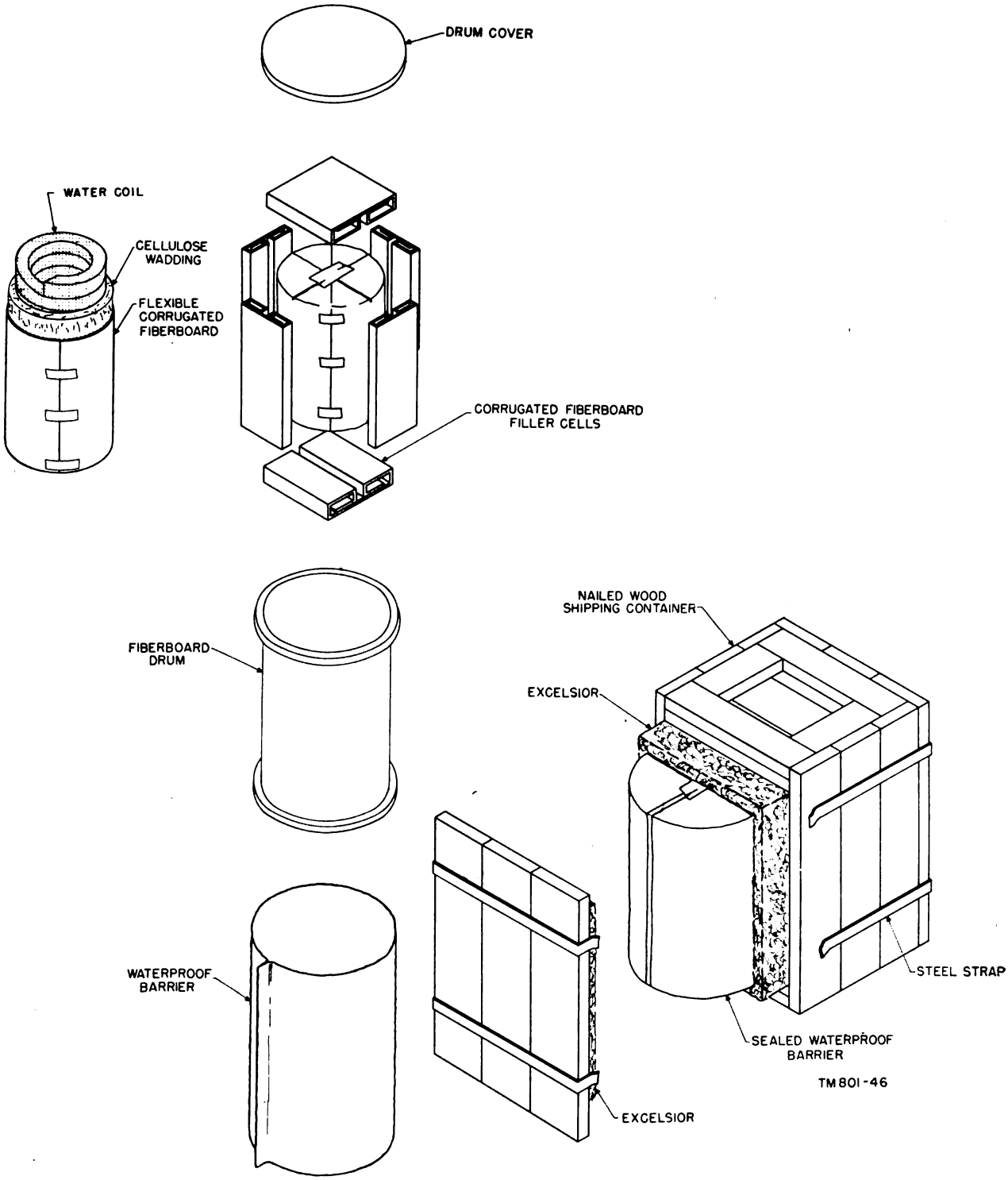

Figure 17. Typical component packed for export shipment.

(4) Remove and open each carton in turn.
(5) Remove from the cartons each of the 23 different items comprising the kit (par. 11).
(6) Carefully unwrap each item.

Note. Save the original packing cases and containers. They can be used again when the equipment is repacked for storage or shipment to field maintenance repair shops.

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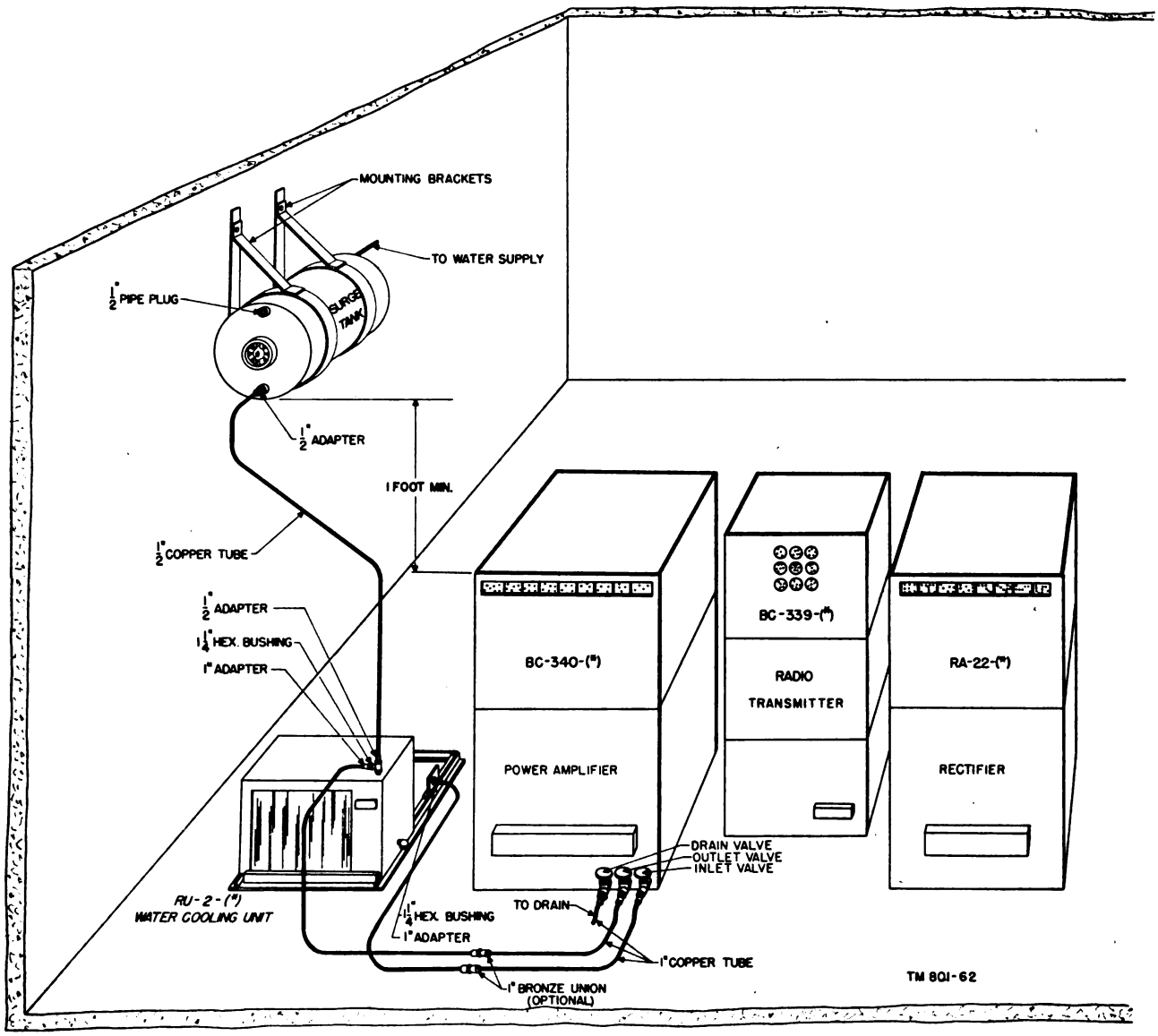

Figure 18. Plumbing installation diagram, all units in line.

17. Installation of Equipment

The material for plumbing and for the interconnecting wiring of the basic equipment is supplied as an installation kit and a component of Amplifier Group AN/FRA–2. The component parts of this installation kit (Signal Corps stock No. 2C2940–1) are listed in paragraph 11.

a. Positioning Equipment. Wherever possible, the equipment should be arranged as indicated on the plumbing installation diagram (fig. 18). Some alternate arrangements are illustrated in figures 19 and 20. It is recommended that both wiring and plumbing be laid in ducts below floor level; but in cases where this is not feasible, every precaution must be taken to prevent damage to plumbing or wiring.

(1) It is not necessary to bolt the power amplifier and the rectifier units to the floor. If possible, fasten the water cooling unit to the floor, using the four holes provided in the base for mounting the unit to the shipping skid. Expansion bolts 1/2 inch by 2 inches, for fastening to a concrete floor, or lag screws, for a wooden floor, are not supplied.

(2) Mount the surge tank so that the bottom is at least 2 feet higher than any part of the water circulating system. This will be at

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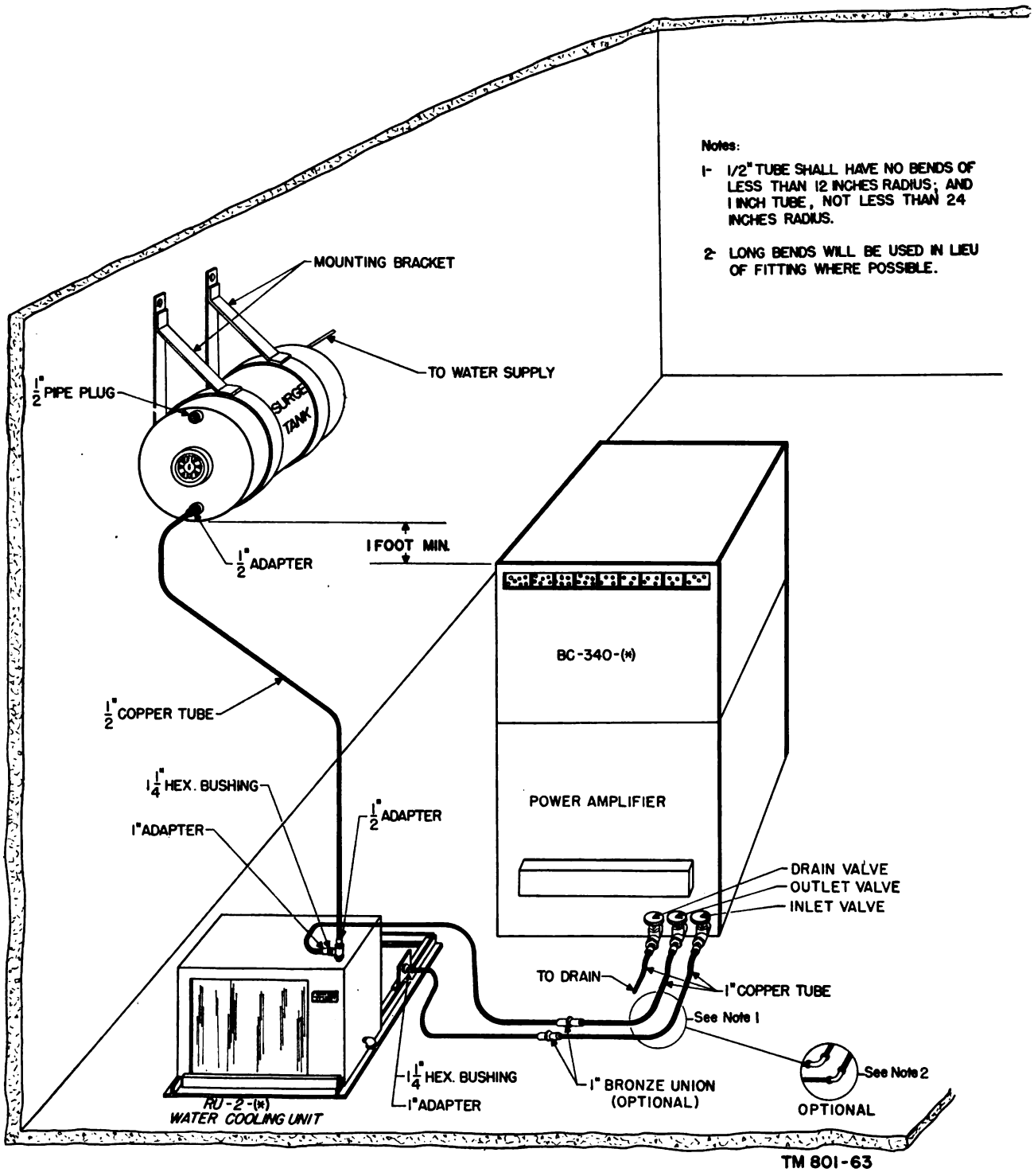

Figure 19. Plumbing installation diagram, all units on same floor.

least 1 foot higher than the top of the amplifier cabinet. Two wall mounting brackets for the surge tank are supplied with Water Cooling Units RU–2, –A, and –C. However, the $\frac{9}{16}$-inch by 2-inch wall bolts for mounting these brackets are not supplied. The surge tank supplied with Water Cooling Unit RU–2–B is designed for mounting

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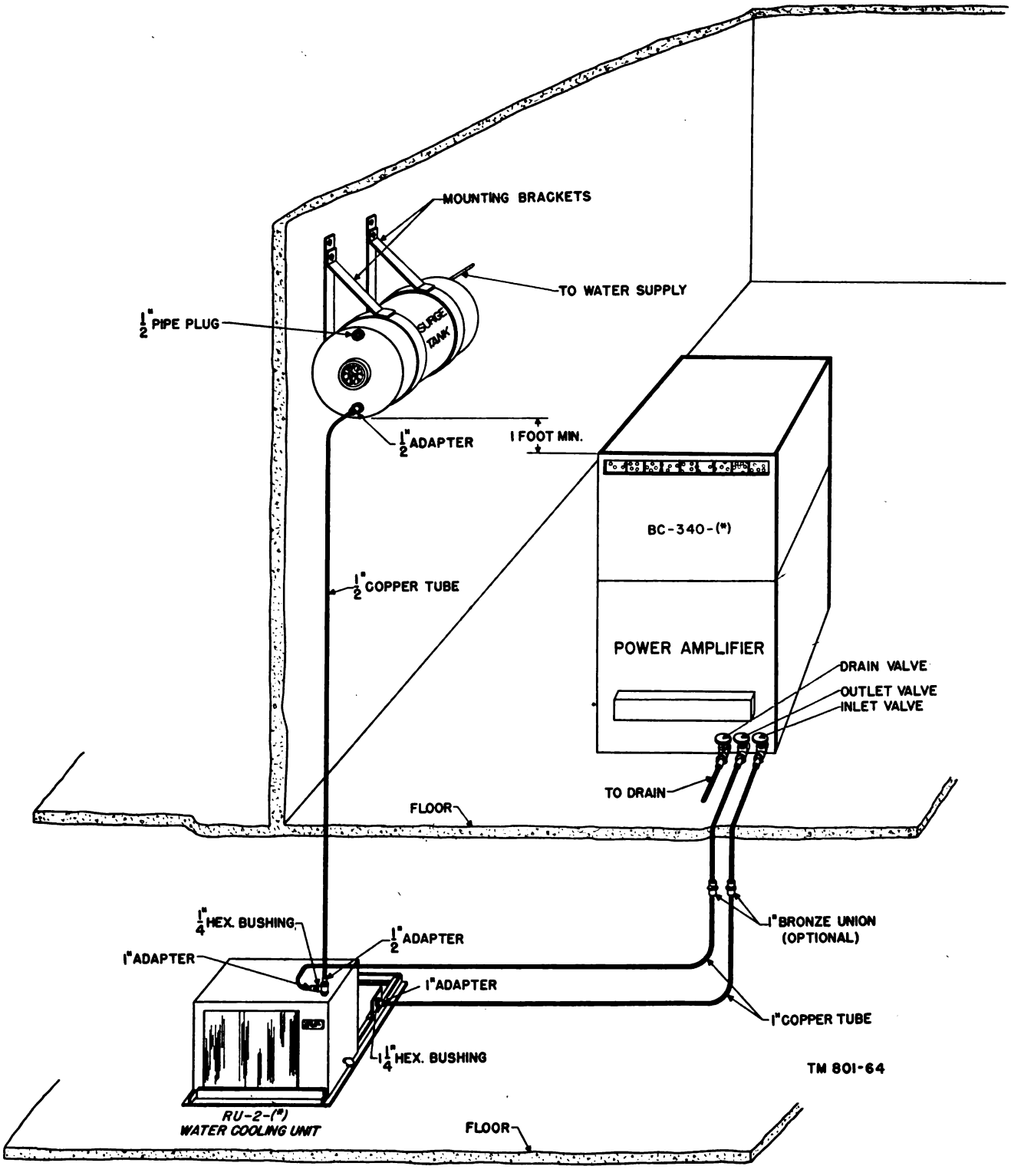

Figure 20. Plumbing installation diagram, units on different floor levels.

on Water Cooling Unit RU–2–B. If this cooling unit is to be used on the same level as the amplifier, the mounting on the cooling unit will be found unsatisfactory unless the mounting bars are extended to place the tank at a higher level (fig. 21). As the ma-

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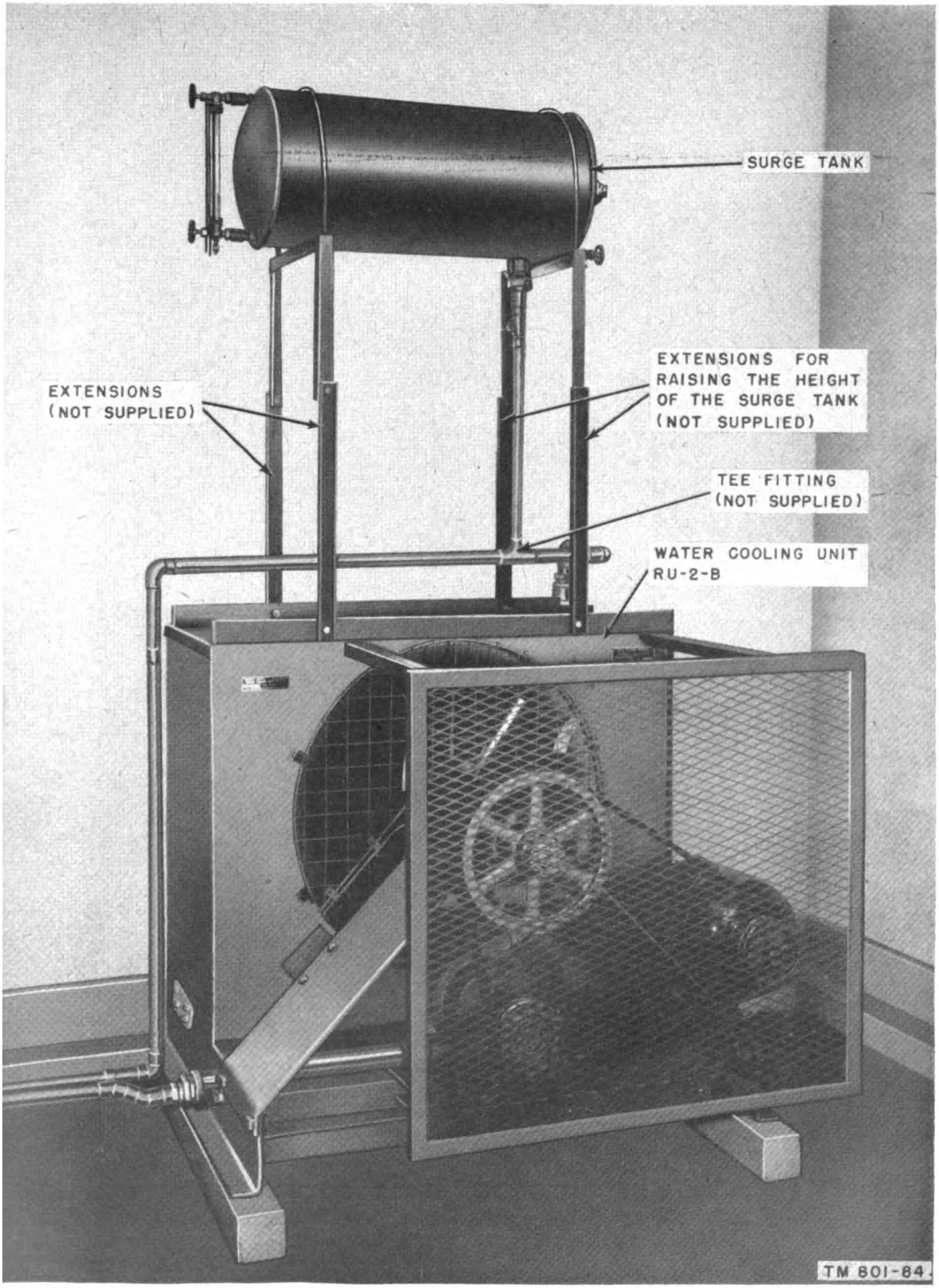

Figure 21. Water Cooling Unit RU-2-B, with single tank mounted on adapted mounting.

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terials for this change are not supplied, it may be necessary to arrange some type of wall mounting for the surge tank. Before mounting this tank, refer to paragraph 18.

b. PLUMBING.

Caution: Tubing supplied for piping water is soft thin-wall copper and is easily dented or crushed. Crushed tubing cannot be used.

(1) Both parts of a solder fitting are to be prepared by burnishing them with steel wool until they are thoroughly clean and then fluxing with solder paste. A blow torch is required to heat the fitting after the tube is inserted. The blow torch is available in Tool Equipment TE–87–A, which is supplied to major fixed-station installations. Preheat the entire joint, so that solder will flow freely when applied to the junction of the fitting and the tube. Use the torch to insure that solder has thoroughly filled the space between the fitting and the tube and is visible around the junction.

(2) Female pipe threads of all fittings used should be lightly coated with pipe dope. Appropriate fittings will be inserted and fully tightened before they are soldered. Wrenches must not be applied where the fitting will be crushed. Tubing may be cut and formed next. A bending form, either a grooved pulley of suitable size or the equivalent, should be used in forming, to prevent kinking or crushing the tube. Elbows are supplied for the 1-inch tube, but are to be used only when longer sweeping curves are impractical. Longer curves are desirable, but should not be less than 12 and 24 inches in radius for ½- and 1-inch tubes, respectively. Pipe unions may be inserted in the INLET and OUTLET lines. After the tubing is cut and formed, solder it in accordance with subparagraph (1) above.

(3) Piping must line up naturally. Do not force it into desired position with flange bolts.

(4) Piping at the water cooling unit must be supported independently of the pump, so there will be no strain on the pump casing. Such strain can also be produced by expansion and contraction due to temperature variations, if the piping is not properly arranged.

(5) For unusually long discharge lines secured at each end, an expansion loop should be provided to compensate for elongation of the pipe caused by pressure. This loop should be put into the straight run in the form of a "U." The length of the loop should be made approximately 20 times the diameter of the tubing, and the width approximately 2 times the diameter of the tubing. An alternate method is to provide a packed slip joint instead of a soldered joint at one end of the line.

(6) Permanent type antifreeze of any type must not be used in this equipment, because of the resultant high leakage current and electrolysis. Where temperatures are liable to drop below freezing, the entire cooling system must be installed in a heated building or drained when not in actual use. If this is impossible, use only pure grain (ethyl) alcohol as an antifreeze.

(7) The pipe or tubing used in the plumbing of the water circulating system must be installed so that all air can be removed from the overhead pipes by opening the air cocks and so that all water can be drained from lower pipes, to prevent freezing in cold weather.

18. Installation of Water Cooling System

The procedure outlined below is for Water Cooling Units RU–2, –A, and –C and their respective surge tanks. For Water Cooling Unit RU–2–B and its associated surge tank, the procedure below has to be modified because of the different type of water level indicator and because the installation kit was designed for the other models. How the procedure below is modified will be determined by the material available to the personnel installing the system. See figure 21 for one method of installing this type of surge tank. Refer to paragraph 17*b* before starting this procedure.

a. Screw one of two ½-inch adapters, item 20 of paragraph 11, into the surge tank in the appropriate opening below the water level indicator (fig. 6), and screw the other adapter into the appropriate opening on top of the radiator of Water Cooling Unit RU–2–(*) (fig. 14).

b. Cut and form a section of the ½-inch copper tubing supplied in the installation kit; this is to be placed between the surge tank and the water cooling unit (fig. 18). Make sure that the pipe extends suf-

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ficiently into the adapters to enable making good soldered connections.

c. Insert one end of the cut and formed pipe into one of the adapters. The other adapter will then have to be removed and slipped on the free end of the pipe. Now replace the adapter in position. Tighten fully both adapters and solder them. The adapters cannot be further tightened after soldering.

d. Screw one of two 1¼-inch reducing bushings into the appropriate opening on top of the radiator of the water cooling unit (fig. 14). Screw the other bushing into the opening of the pipe coming from the water pump (fig. 14 or 15). Tighten the bushings securely.

e. Screw one 1-inch adapter into each of the two reducing bushings.

f. Cut and form two sections of the 1-inch copper pipe supplied in the installation kit; this is to be placed between the water cooling unit and the power amplifier, as shown in figure 18, 19, or 20. The total length of pipe used between the water cooling unit and the power amplifier should be as short as possible. One hundred feet of 1-inch inside diameter tubing is supplied. In the event that more than 100 feet is required at any installation, a large size of pipe and fittings must be used throughout.

g. Place the two sections of pipe into position and solder as explained in subparagraph *c* above.

h. The installation of the portion of the water cooling system inside the power amplifier is explained and done with the installation of the power amplifier components.

19. Installation of Power Amplifier Components

Note. The order in which the various components are listed is the order in which the components will be assembled into the unit. As the components are installed in the unit, all that require electrical wiring will be wired in accordance with the power amplifier wiring diagram (fig. 88). The necessary preformed wiring and electrical connections will be found inside the unit.

a. TRANSFORMERS T–1, T–2, T–3, AND T–4 AND CHOKE CH–1 (fig. 9 or 10).

(1) Mount transformers T–3 and T–4 with the insulators facing down. T–3 is mounted on two vertical supports between the grid shelf (fourth or uppermost shelf) and the top of the unit toward the rear and left side of the unit. T–4 is mounted on two vertical supports between the grid circuit shelf and the top of the unit, toward the front and left side of the unit. Four mounting holes are provided for each transformer, with the mounting hardware already inserted in the holes.

(2) Mount transformers T–1 and T–2 and choke CH–1 with their terminals facing upward. These units are mounted on horizontal supports of the second shelf of the unit. (See fig. 9 or 10 for the exact positions.) Mounting holes are provided with the hardware inserted in the holes.

b. INPUT CIRCUIT ASSEMBLY (C–1, C–2, L–1, AND SW–1) AND CHOKES RF–1 AND RF–2 (fig. 9 or 10).

(1) Insert the two r-f grid chokes (RF–1 and RF–2) into their respective fuse clips. These clips are mounted in back of L–1 (see fig. 9 or 10 for position of L–1) on the vertical sheet metal plate that shields the input circuit from the output circuit. The clips are mounted so that the chokes are accepted in a vertical position. Both coils are identical. The two ends of the same coil are different and must be properly installed. Place each coil in its holder, so that the greater spaced turns are at the upper ends.

(2) Mount the input circuit assembly onto the top shelf. Position the assembly so that the switch contacts (SW–1) face the rear of the unit and the protruding shafts face the front panel. The assembly is fastened onto the grid shelf with two angle iron mounting brackets, one at each micalex strip. The component should be carefully alined, so that mechanical connections can be made between the shafts of C–1, C–2, and SW–1 and the drive shafts that extend to the dials on the front of the unit. Mechanical connection is made by inserting the shafts into their respective insulator connector assemblies and tightening the setscrews. Mechanically connect C–1 and C–2 when in full mesh and with the dial at 0. Mechanically connect SW–1 when coil L–1 has maximum inductance (greatest number of turns) and the switch is in position 1.

c. PLATE TUNING CAPACITOR (C–5), NEUTRALIZING CAPACITORS (C–3 AND C–4), AND R-F BYPASS CAPACITOR (C–8). These units comprise one assembly (fig. 22). The upper plate of the r-f bypass capacitor, C–8, is the base plate of the over-all capacitor assembly, and the other plate of this capacitor is

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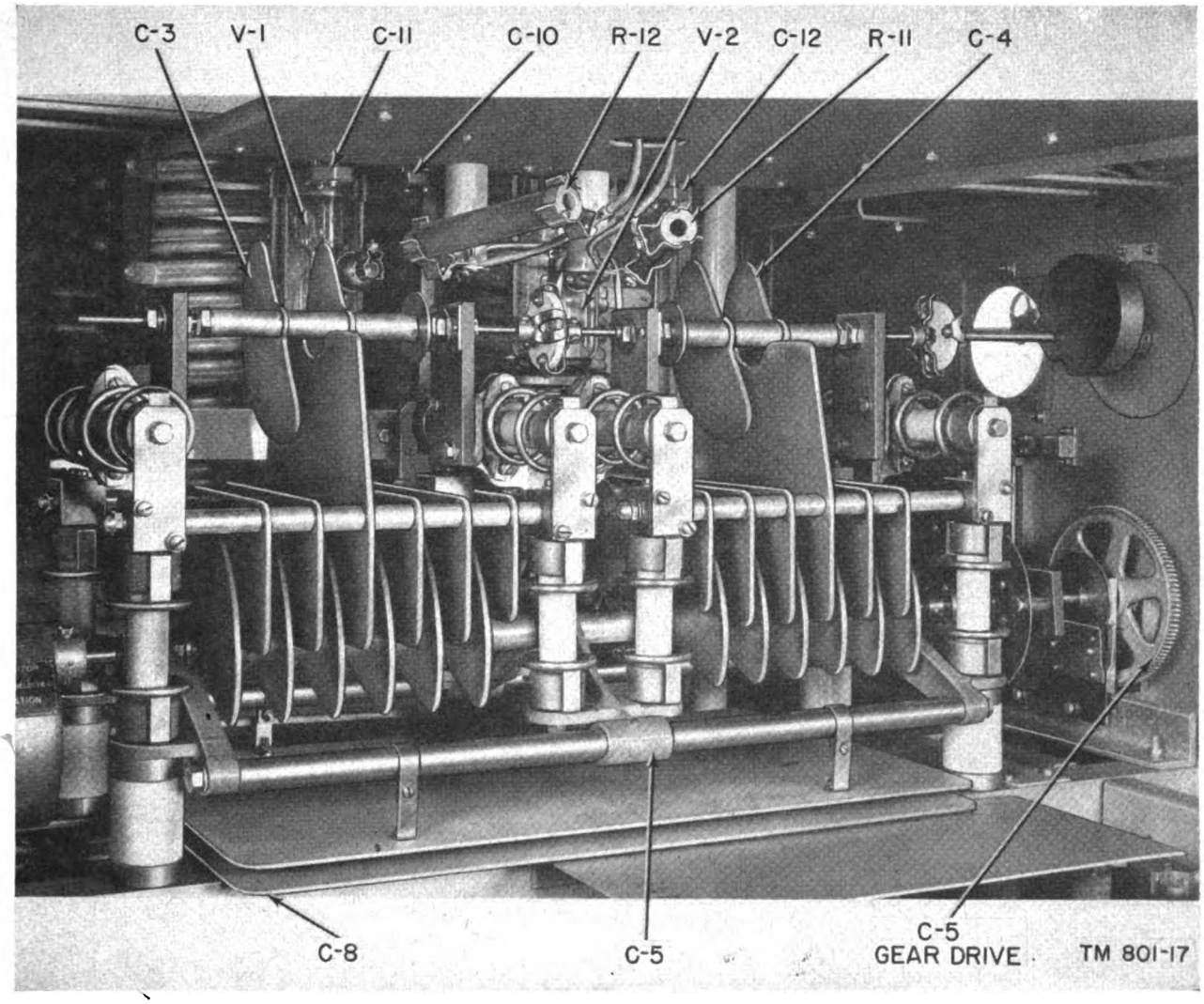

Figure 22. Plate tuning capacitor (C–5) assembly, including C–3, C–4, and C–8.

mounted with four screws, directly on the angle irons that comprise the third shelf of the amplifier cabinet. Mount the assembly in place (fig. 9 or 10). Make sure that the drive shafts for the plate tank capacitor (C–5) and the neutralizing capacitors (C–3 and C–4) are alined with their respective dial drive shafts, that the two plates of the bypass capacitor (C–8) are parallel, and that the four spacing bars holding the upper plate are not bent. There should be an air gap spacing of one-half inch between the plates. Make the mechanical connections between the capacitor shafts and their respective dial drive shafts in the same way as for the input circuit assembly.

d. Antenna Coupling Capacitor (C–6) (fig. 7 or 8). This unit is mounted to the under side of the top deck of the amplifier cabinet by means of three stand-off insulators (fig. 7 or 8). The end of the capacitor (C-6) facing the front panel of the amplifier cabinet is supported by two stand-off insulators, and the end toward the back of the cabinet is supported by one stand-off insulator. The counterweight is mounted on the shaft at the front of the capacitor. Be careful to properly aline and connect the drive shaft with the capacitor shaft. The hardware for mounting this unit is found inserted in the three mounting holes in the top panel.

e. Porcelain Water Coils (D–7).

(1) Although the two porcelain water coils are referred to as the *right* and *left* coils, both units are identical and interchangeable (fig. 23).

(2) Position each of the coils so that the lead pipe fittings at the bottom can be easily attached to the water coil fittings. The exact

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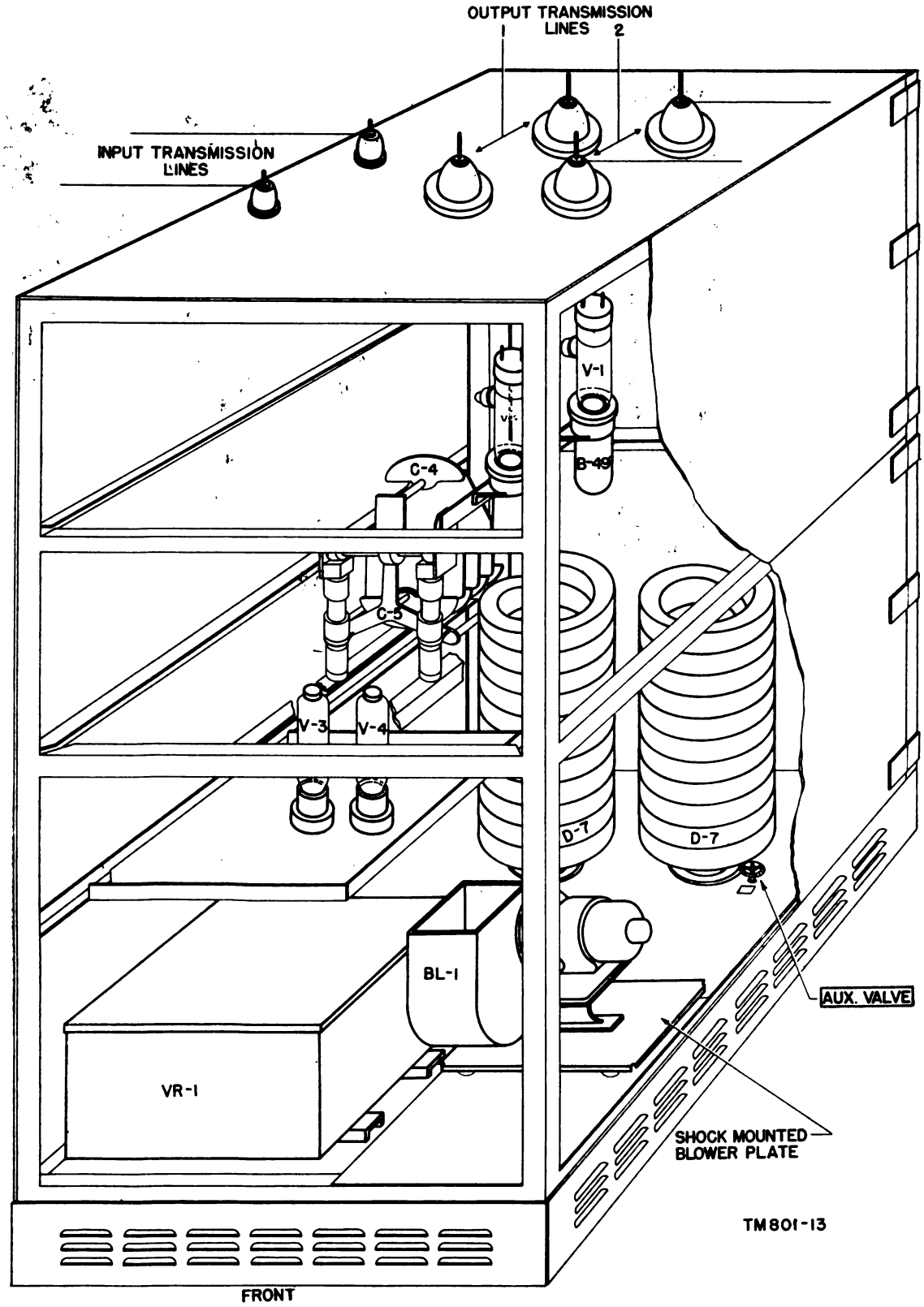

Figure 23. Power Amplifier BC–340–(*), component location.

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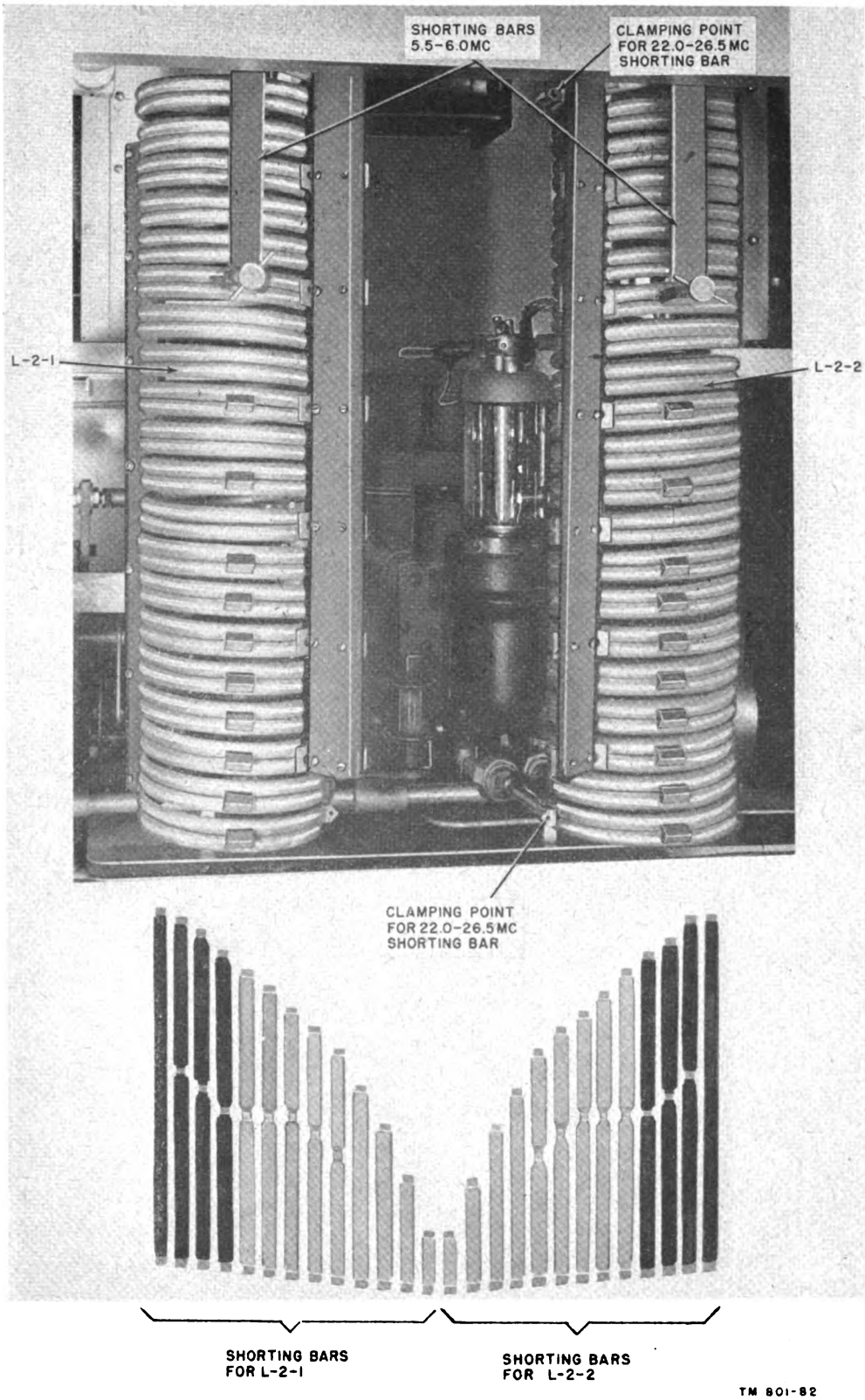

Figure 24. Power Amplifiers BC-340, -A, -B, and -D through -H, plate tuning coils L-2-1 and L-2-2.

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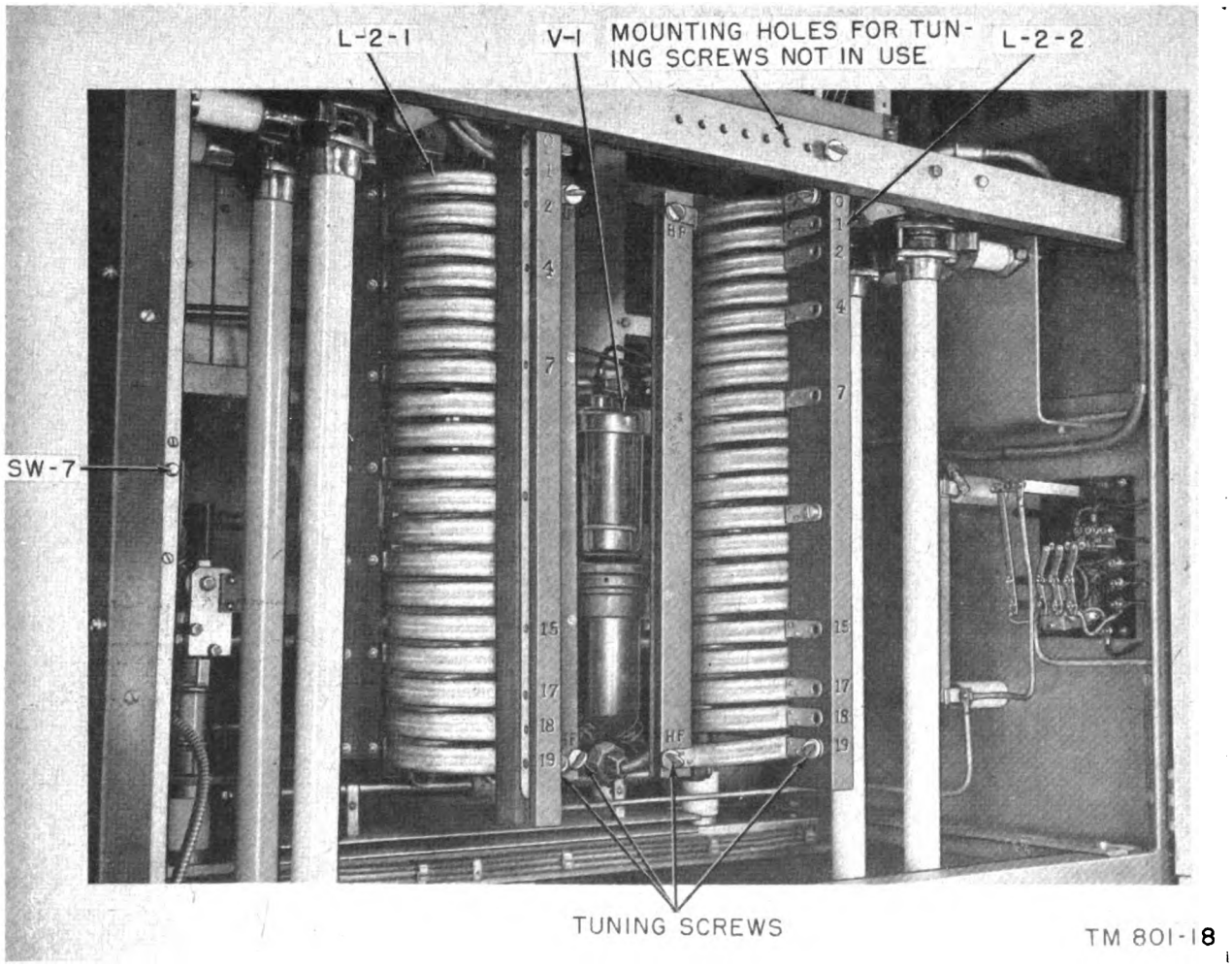

Figure 25. Power Amplifier BC–340–I, plate tuning coils L–2–1 and L–2–2 with tuning screws

positioning of the coils is determined by the four bolt holes provided for each coil pedestal. Do not fasten down the coils firmly until the bottom and top water fittings are attached to the water coils. This will prevent undue strain on the coils and the clamping devices. The hardware for mounting the coils is found in position in the coil mounting base.

(3) Notice that each coil is fitted at the bottom with a leakage current terminal, but only the terminal on the left coil is used.

f. Plate Tuning Coils (L–2–1 and L–2–2) (fig. 24 or 25).

(1) Before these coils can be mounted into the unit, it must be determined which end of each coil is the upper end, which coil is mounted toward the rear, and which coil is toward the front of the amplifier cabinet. Each coil terminates at one end in a large sweeping loop. This is the top end of the coil and is solder-connected to the porcelain tubing (not yet installed). The lower end of each coil bears a screw fitting, and the turns are so shaped that it is impossible to interchange the rear coil with the coil mounted toward the front of the unit. As a final check, the correct assembly is such that the coil (L–2–2) with the right-hand (clockwise) winding is mounted toward the rear of the cabinet, and the coil (L–2–1) with the left-hand (counterclockwise) winding is mounted toward the front of the cabinet.

Caution: Be careful when handling these coils, since they may be easily deformed. When tightening the connections, avoid a direct strain on the coils.

(2) Place coil L–2–1 in position and connect

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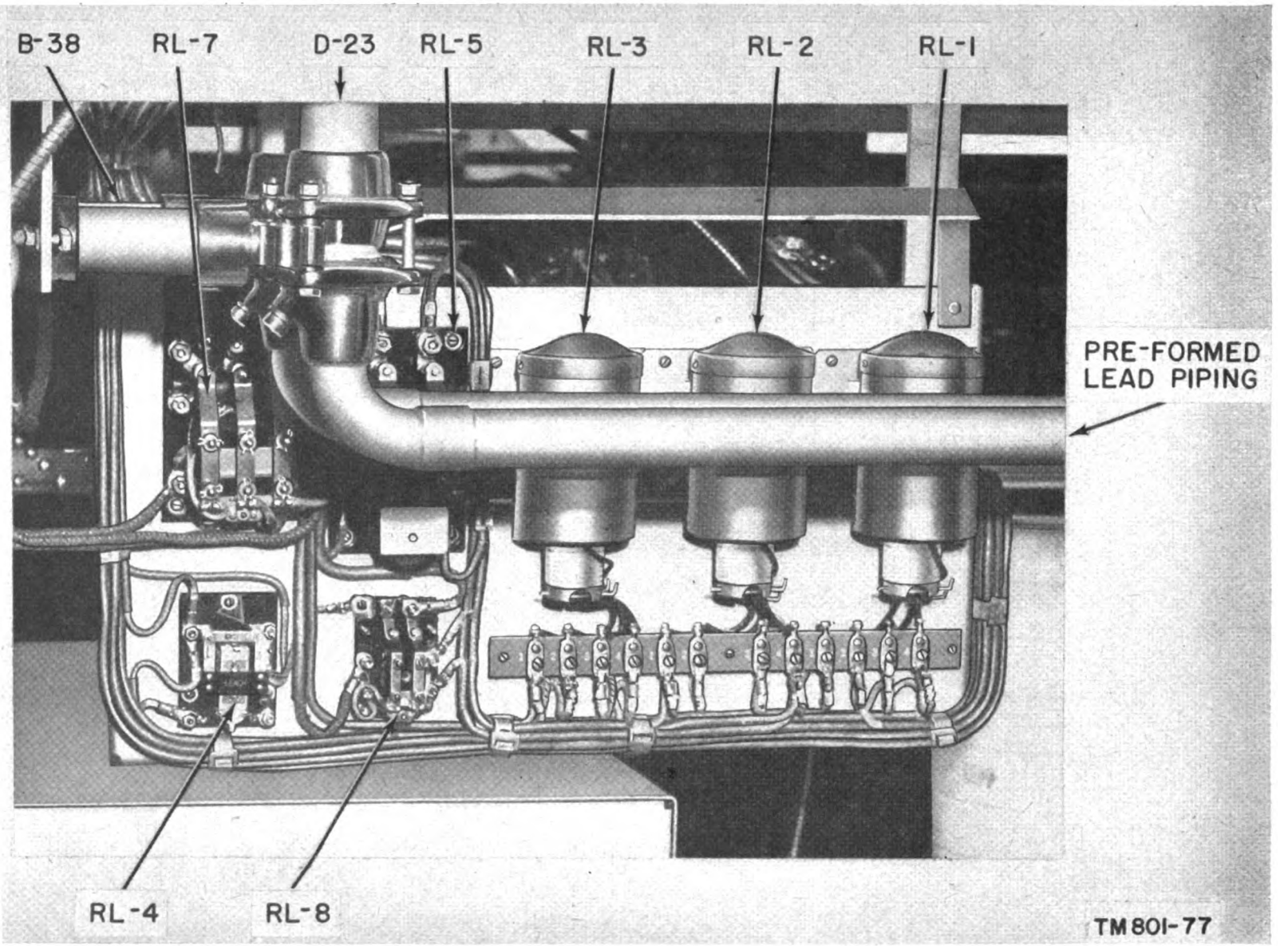

Figure 26. Water circulating system, junction of preformed lead piping and porcelain tubes.

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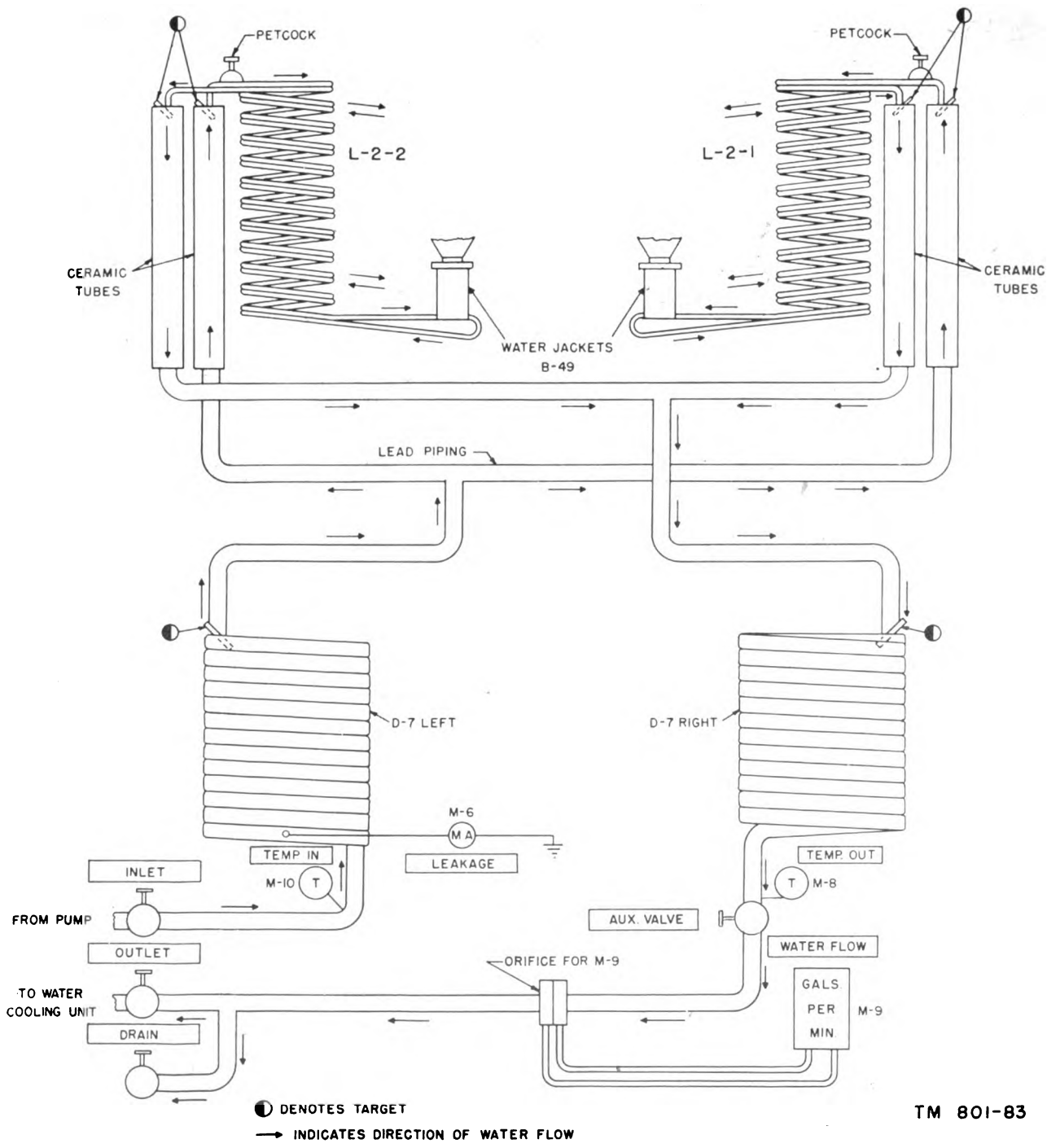

Figure 27. Power Amplifiers BC-340, -A, -B, and -D through -H, water circuit diagram.

the screw fittings at the bottom of the coil to their respective openings in the water jackets (B–49). Bolt the top of the coil to the stand-off which is located on the upper frame crossbar. Install coil L–2–2 in the same manner as coil L–2–1.

g. Preformed Lead Water Piping and Porcelain Tubes.

(1) The lead piping is provided assembled into the correct form for placement in the unit. However, lead piping has some degree of flexibility, and slight adjustments and re-

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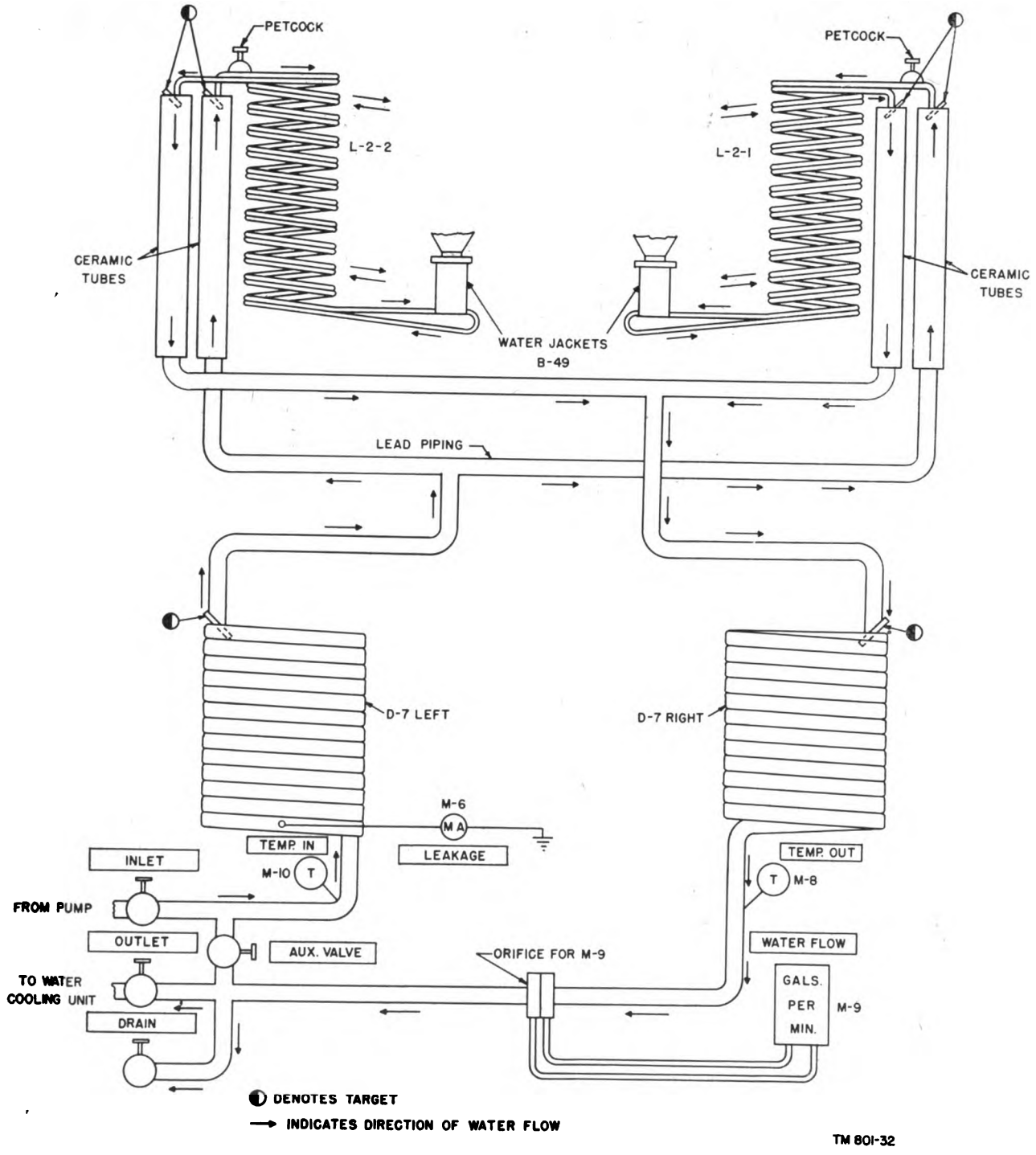

Figure 28. Power Amplifier BC–340–I, water circuit diagram.

forming can be accomplished if necessary.

Note. The lead piping must be held in place until all connections to it have been made.

(2) Place two gaskets in each of the water openings of the porcelain water coils. Now place the lead water piping in position with the correct pipes inserted into the water coils. Screw down the clamping screw that clamps the lead pipe into place. In the same manner, clamp the lead pipes coming out of the bottom of the unit to their respective openings at the bottom of the water coils.

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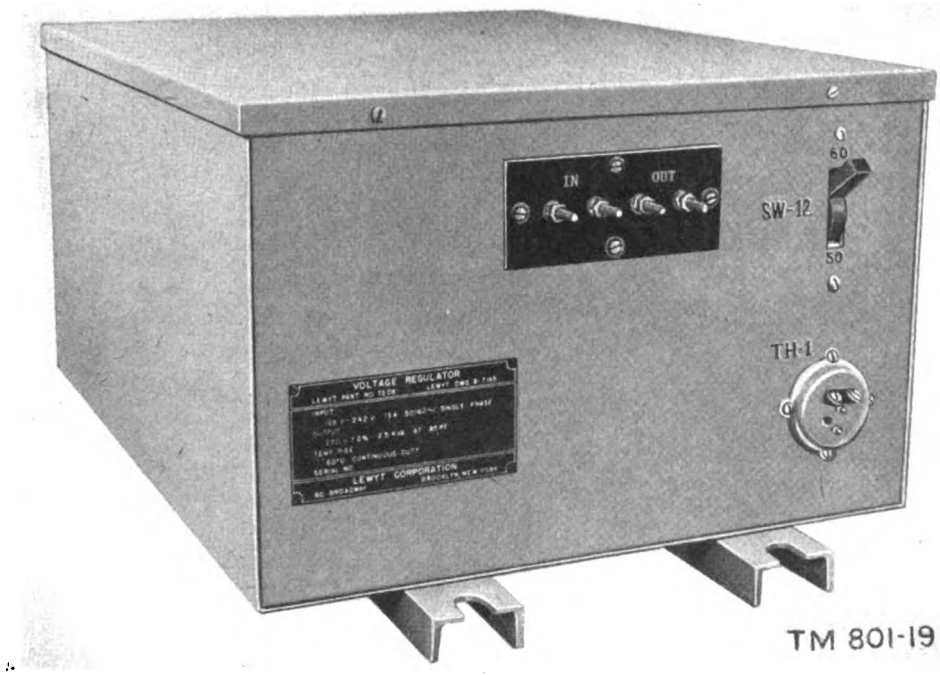

Figure 29. Power Amplifier BC–340–I, voltage regulator unit VR–1.

(3) Four identical porcelain tubes are supplied as connecting links between the lead piping and the plate tuning coils. Each one is held in position by clamping screws that go through the spring clips on premounted porcelain stand-offs. There are two such stand-offs for each porcelain tube.

(4) Place one of the porcelain tubes fitted with gaskets in position; that is, between two of the stand-offs, so that the lower end is over one of the openings in the preformed lead piping and the upper end is by the related opening at the top of the plate tuning coil. Now, using the three clamping screws provided, clamp the lower end of the porcelain tube to the lead pipe (fig. 26). Make sure that two of the clamping screws go through the spring clip on the porcelain stand-off. Take one of the adapters provided for connecting the porcelain pipe to the piping of the plate tuning coil and clamp it to the porcelain pipe. Insert the open end of the plate tuning coil and make a good solder connection. Repeat the above procedure for the other three porcelain pipes.

h. AIR BLOWER (BL–1) (fig. 7 or 8). The back of the voltage regulator housing is provided with an opening. Place the intake manifold of the air blower into this opening until it is slightly under flush, and bolt down the assembly into the three mounting holes provided in the shock-mounted base plate (fig. 23). The hardware for this mounting is found inserted in proper position in the base plate.

i. CHOKES RF–3 AND RF–4. Insert chokes RF–3 and RF–4 in their respective clips. For Power Amplifiers BC–340–A, –B, and –D through –I, see figures 7 and 8 for the location of these components. For Power Amplifier BC–340, the location of these chokes is also at the top right-hand side of the unit, but in the center and parallel to each other.

j. RESISTORS. Resistors in Power Amplifier BC–340 have different reference symbols than those in the other models. However, the location of these parts in Power Amplifier BC-340 can be determined from the location of comparable parts in the other models. Therefore the procedure below will be presented for all the models by putting the reference symbols of the part for Power Amplifier BC-340 in parenthesis next to the comparable part for the other models.

(1) Insert resistors R–2 (R–5), R–4 (R–3a), and R–5 (R–3b) in their respective clips (fig. 7 or 8).

(2) Insert resistors R–6 through R–9 (R–6a through R–6e), R–11 and R–12 (none) in their respective clips (fig. 9 or 10).

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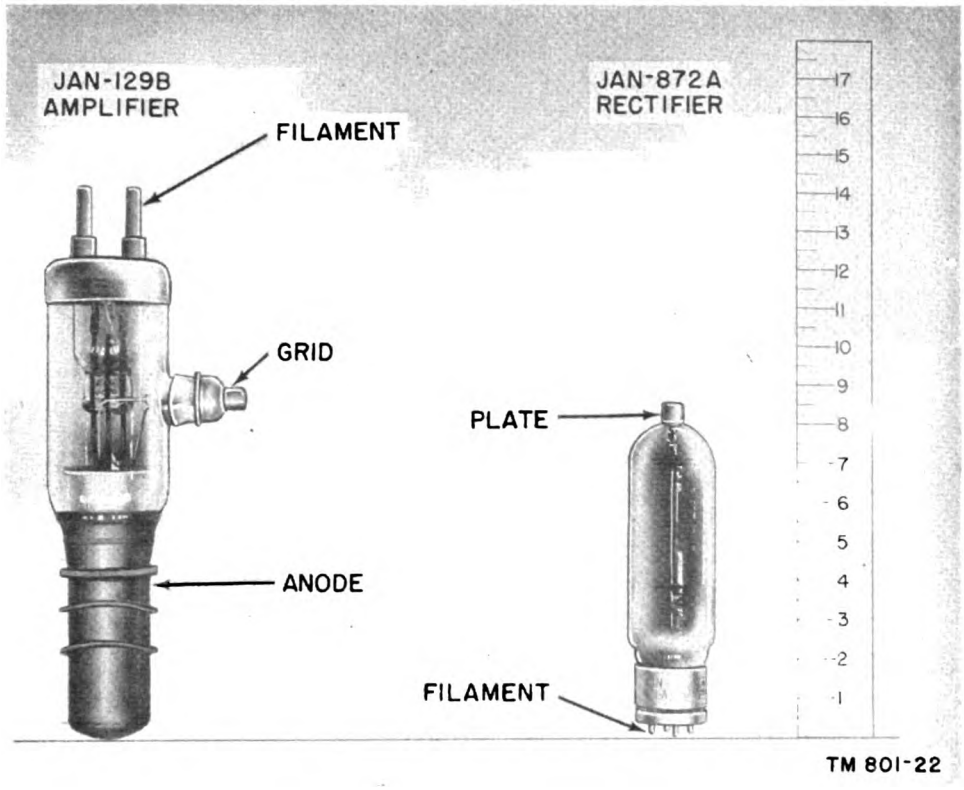

Figure 30. Tubes JAN–129B and JAN-872A.

k. FUSES. The location of the fuses is the same for all models (fig. 7 or 8). However, the reference symbols assigned to the fuses for Power Amplifiers BC–340–G and –I are different from those assigned to the other models.

(1) For Power Amplifiers BC–340–G and –I, insert the 11 fuses, F–1 through F–11, in the bank of fuse clips (fig. 7 or 8). Insert them in numerical order, starting at the top with fuse F-1.

(2) For the other models, start at the top of the bank of fuse clips and insert the fuses in the following order: two 20-ampere fuses (F–1), two 3-ampere fuses (F–2), two 6-ampere fuses (F–3), two 6-ampere fuses (F–5), and three 40-ampere fuses (F–4).

l. POWER AMPLIFIER TUBES.

(1) The four 846 tubes, V–1, V–2, V–3, and V–4, for Power Amplifier BC–340 or the two Tubes JAN–129B, V–1 and V–2, for the other models are installed in the same way. Each tube is supplied with two thin gaskets over the anode, both of which are used in the assembly. Unscrew the flange of the water jacket until the split rings are easily moved back to allow the tube to be placed in the socket. Carefully slip the tube behind the plate tank coils and place into the water jacket. Gently turn the tube while pressing it down until assured that it is properly seated. Make certain that the tube is in the proper position to accept the electrical connections. Move the split rings into place over the anode ring and turn the water jacket flange clockwise until it holds the tube firmly. Excessive tightening will result in distortion of the flange, or it may damage the tube. For the proper position of Tubes JAN–129B, see figure 23. With the tubes firmly clamped in their jackets, the filament and grid connections are made. The leads from these connections should be adjusted so they do not result in any undue strain on the tubes.

(2) Insert and rotate the two rectifier Tubes JAN–872A in their respective sockets. Make the necessary electrical connections by attaching the clip leads to the plate terminals.

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20. Installation of Rectifier Components

Note. The order in which the various components are listed is the order in which the components will be assembled into the unit. As the components are installed in the unit, they are to be electrically wired in accordance with the rectifier wiring diagram (fig. 88). The necessary wiring and preformed electrical connections will be found inside the unit.

a. CHOKE CH–1 AND TRANSFORMERS T–2, T–3, T–4, AND T–5 (fig. 12 or 13). These five units are mounted on two cross members which make up the top shelf. The members run parallel along the width of the rectifier cabinet, and the components are mounted side by side on them (fig. 31). Transformer T–2 mounts at the extreme right, followed by filter choke CH–1 mounted on a base plate equipped with an opening for air flow. The third component from the right is transformer T–3 and then T–4, with T–5 at the extreme left. The hardware for mounting these pieces is found in the component mounting holes.

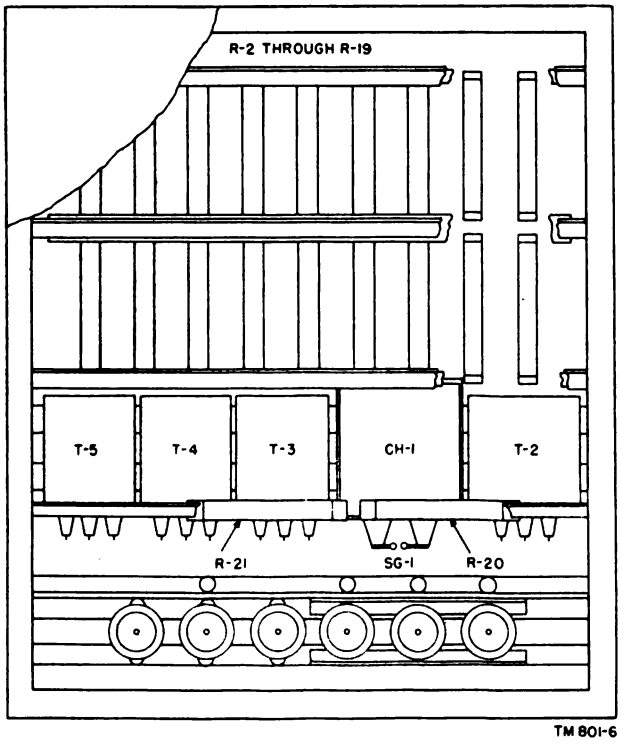

Figure 31. Rectifier RA–22–(*)(except unlettered model), top, cutaway view.

b. CURRENT TRANSFORMERS T–6 AND T–7 (fig. 32). The frame at the right side of the rectifier cabinet contains two sets of crossbars, two crossbars per set. Each bar is equipped with two countersunk mounting holes approximately 4½ inches center to center. Current transformer T–7 mounts on the upper set of bars, and T–6 mounts on the lower set. Mount these components so that the heavy copper secondary terminals are on the under side of the transformers. Mounting hardware is provided in the mounting holes.

c. FILTER CAPACITOR (C–1) (fig. 32). On the shelf situated immediately below current transformers T–6 and T–7 is mounted filter capacitor C–1. This component is fastened in place by two mounting brackets. Each mounting bracket is fastened down at both sides of the capacitor, with one screw through each of the bracket mounting feet. The mounting hardware is provided in the four capacitor mounting holes.

d. PLATE TRANSFORMER T–1 (fig. 33). Using a wrench, turn the transformer detent to the extreme counterclockwise position. This will aline the transformer wheel dial numbers (position 1 extreme counterclockwise) with the detent positions. Before

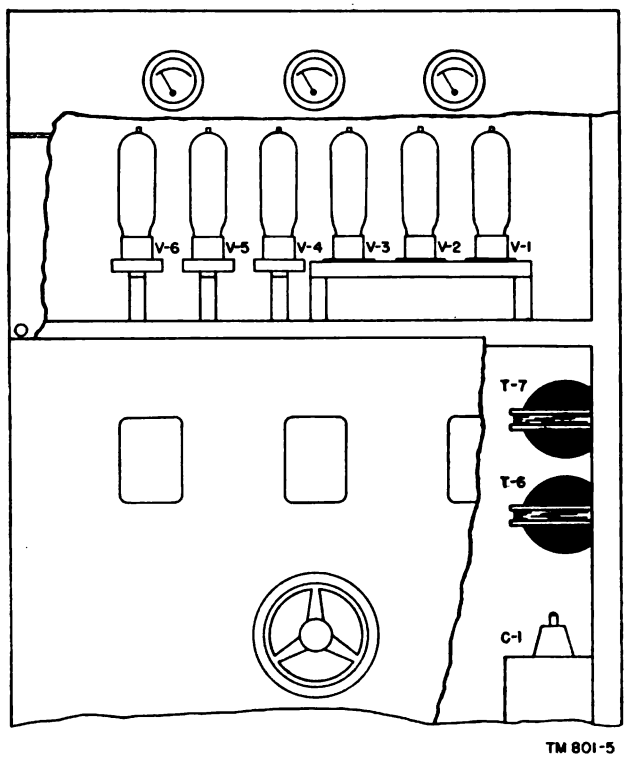

Figure 32. Rectifier RA–22–(*), front, cutaway view.

the oil-filled transformer can be placed in the back of the cabinet, remove the vertical frame member at the center of the left side of the cabinet frame (fig. 12 or 13) along with the sheet metal panel attached to it by taking out the two screws that hold the frame section in place. In addition, loosen the front panel screws

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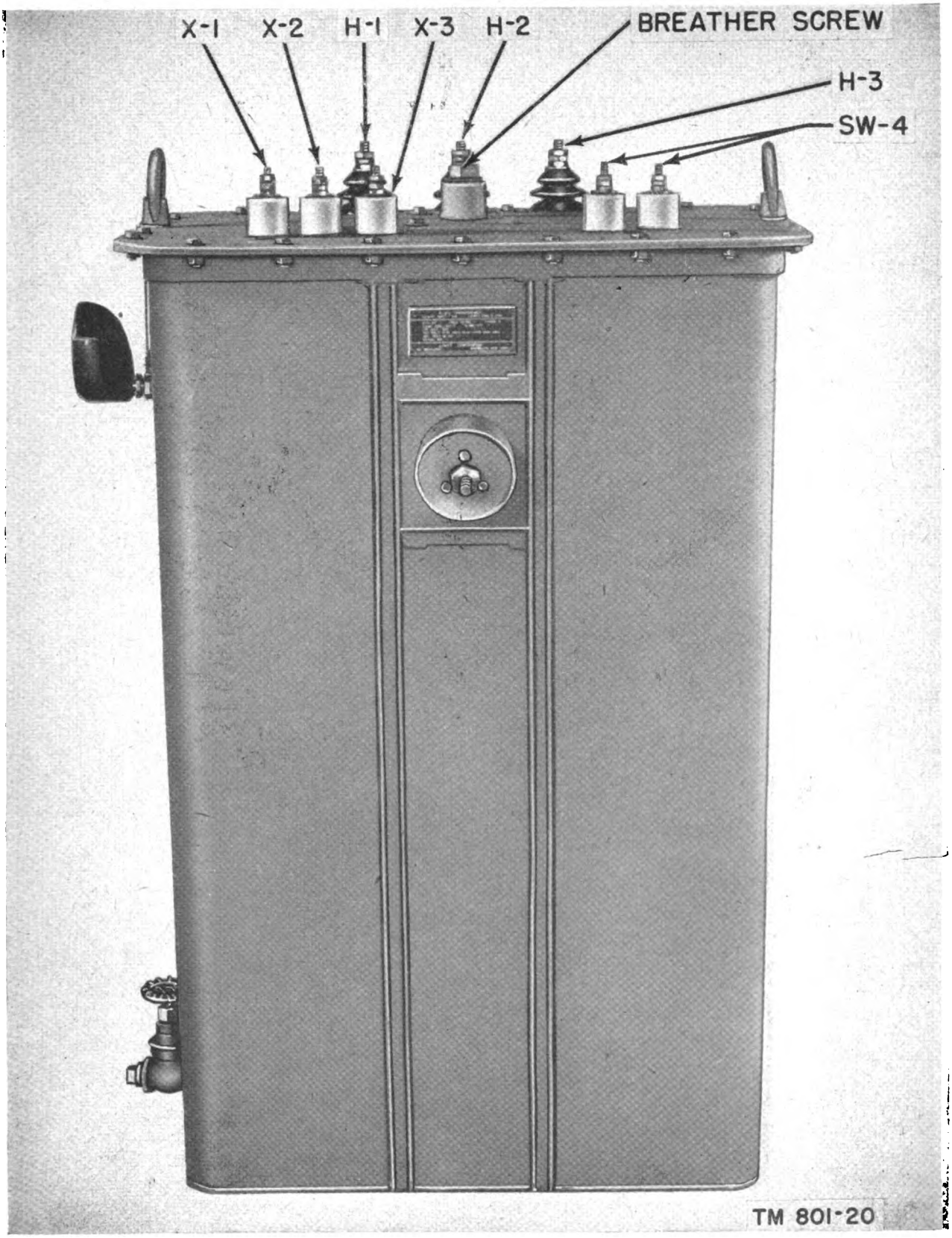

Figure 33. Plate transformer T-1.

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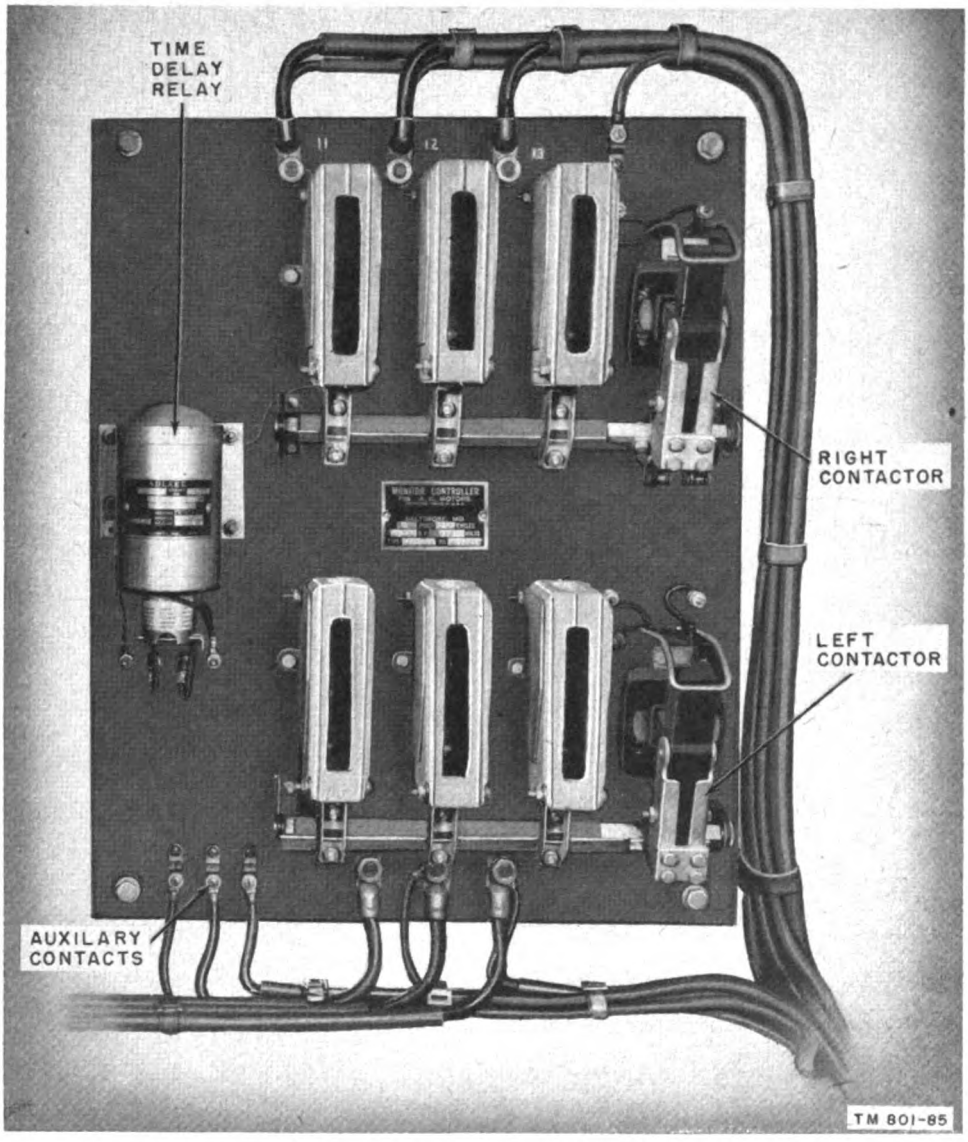

Figure 34. Rectifiers RA-22, -A, and -C through -G, controller assembly SW-1.

and slightly tilt the panel away from the frame. This is to allow room for alining and coupling the transformer detent shaft to the drive shaft of the transformer detent wheel. Slide the plate transformer in its compartment and aline the detent shaft with the drive shaft of the transformer wheel. Tighten the front panel screws, making sure that the drive shaft still engages the detent shaft.

e. CONTROLLER ASSEMBLY SW-1 (fig. 34 or 35). Remount the vertical frame member and associated sheet metal plate to the left side of the controller assembly by means of the two mounting feet on the left side of the assembly. Place the entire assembly into position (fig. 12 or 13), fitting the lower right slotted mounting foot over the protruding stud on the frame of the unit and bolting the upper right foot to the frame.

f. AIR BLOWER BL-1. The air blower is placed into the lower right-hand compartment (fig. 13) with the air exhaust opening placed directly under the T-shaped air duct. With the hardware provided, secure the blower mounting base to the shock-mounted base plate.

21. Connections

a. R-F INTERCONNECTIONS.

(1) The transmission line from the Radio Transmitter BC-339-(*) exciter unit to Power Amplifier BC-340-(*) consists of

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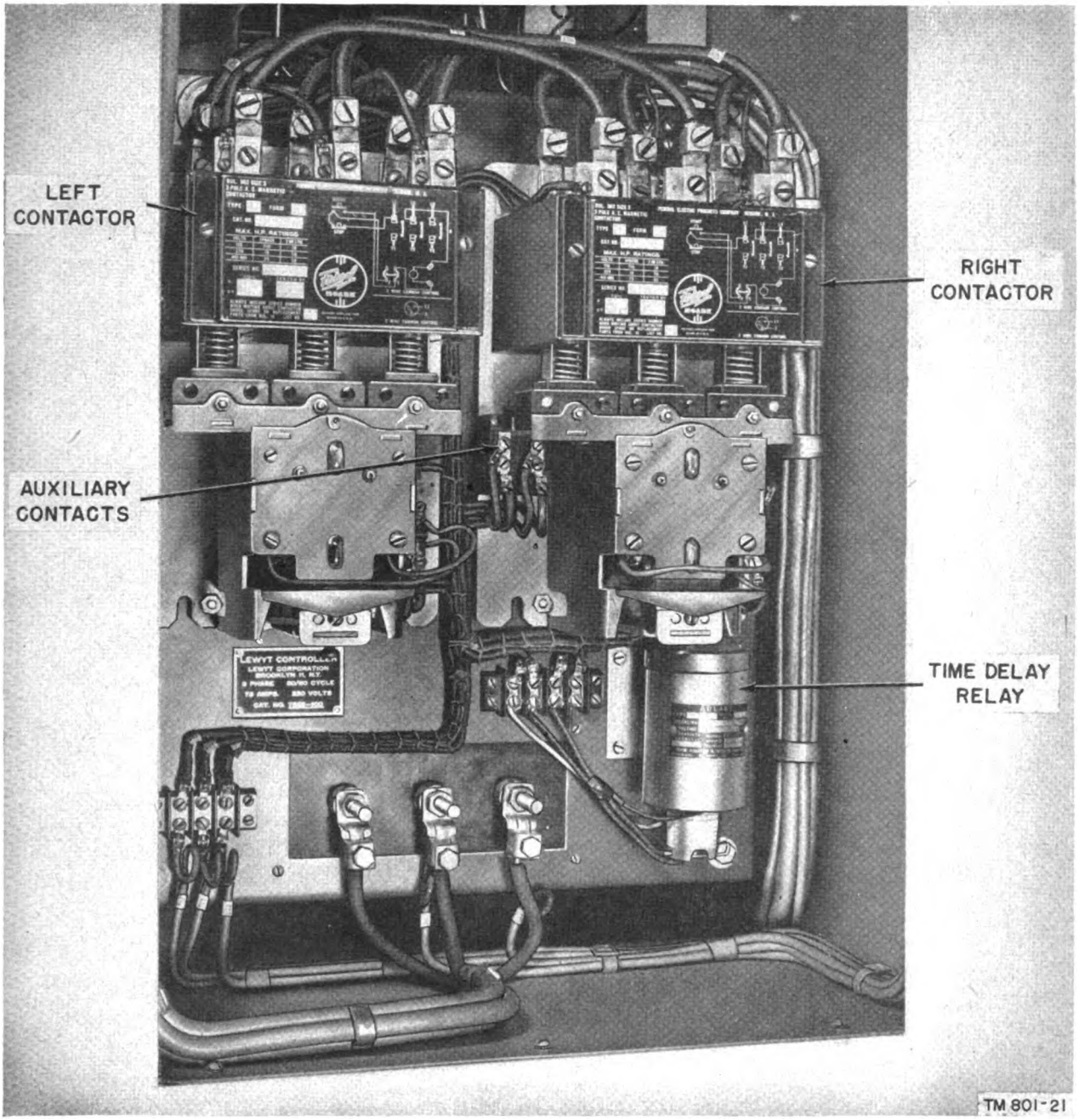

Figure 35. Rectifier RA–22–H, controller assembly SW–1.

two parallel lines of ¼-inch copper tubing spaced to give an input impedance of 600 ohms. However, since the r-f input line is comparatively short, this spacing is not at all critical. Cut the ¼-inch copper tubing to the correct length, and solder a lug on each end. Connect the lines as shown on figure 36.

(2) The output of the power amplifier can be switched (by SW–3) to either of two transmission lines connected (as shown in fig. 36) to the two sets of large stand-off insulators located the same distance to the right of the input terminals at the top of the power amplifier. The spacing of these terminals is fixed at 1 foot, which necessitates the use of No. 6 AWG solid copper wire for the transmission line. If copper wire is not available, either of the following can be

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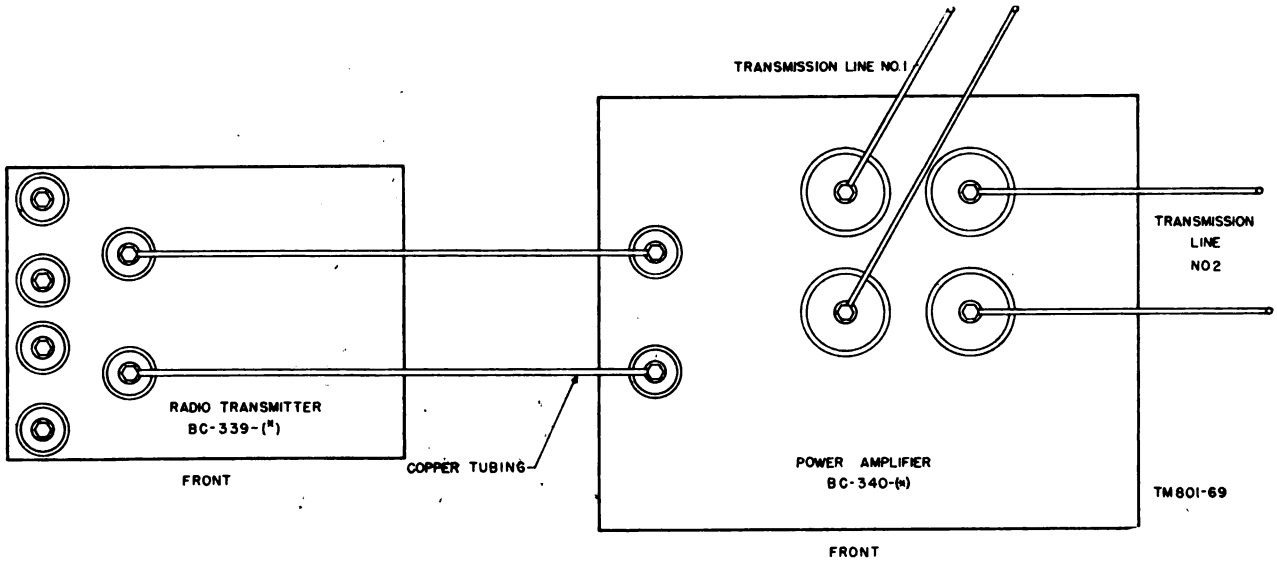

Figure 36. Amplifier Group AN/FRA-2, r-f interconnection diagram.

used: (0.162-inch diameter) copper tubing or copper wire of the nearest size spaced so that the distance between wire centers is equal to 73 times the diameter of the wire used. The length of this transmission line will depend on the type of antenna used and the best possible standing wave ratio.

(3) If No. 6 AWG copper wire is not available, it becomes necessary to change the spacing between the lines. This is accomplished by placing an insulating spacer as close as possible to the power amplifier output terminals (fig. 37).

b. Power Line and Control Circuit Interconnections.

(1) Make the connections between Power Amplifier BC–340–(*) and Rectifier RA–22–(*) by using wire of the size indicated in table I to connect the corresponding terminal numbers of the terminal strips at the back of the units (fig. 38).

(2) Make all interconnection wiring in accordance with the power line and control circuit interconnection diagram (fig. 38). In addition, utilize a safety switch and grounding system as herein described. The safety switch supplied is a triple-pole single-throw unit rated at 100 amperes at 230 volts, with provision for a fuse in each phase. Mount it on a convenient wall or post to provide a junction for the power source and

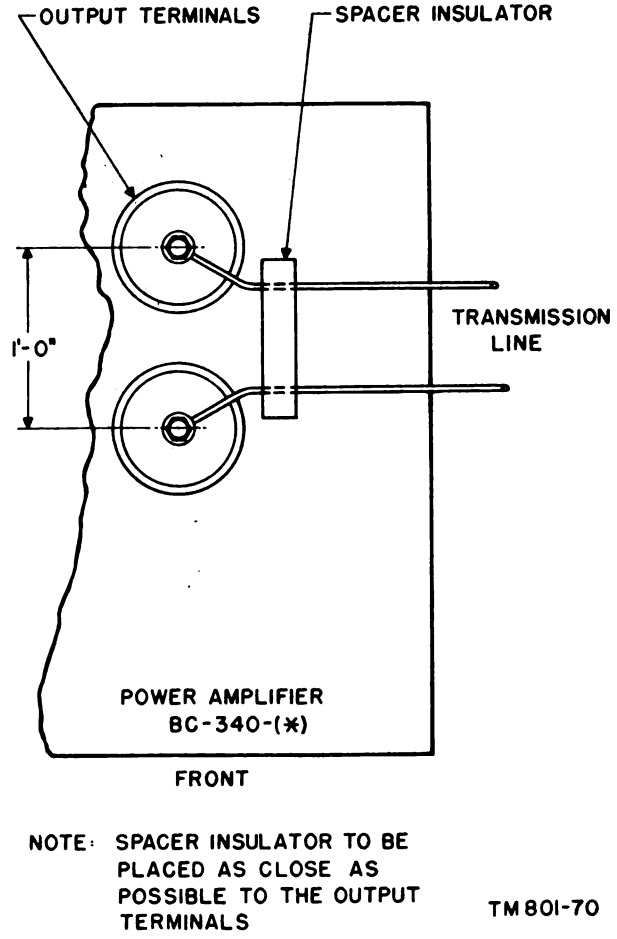

Figure 37. Amplifier Group AN/FRA-2, method of changing transmission line spacing.

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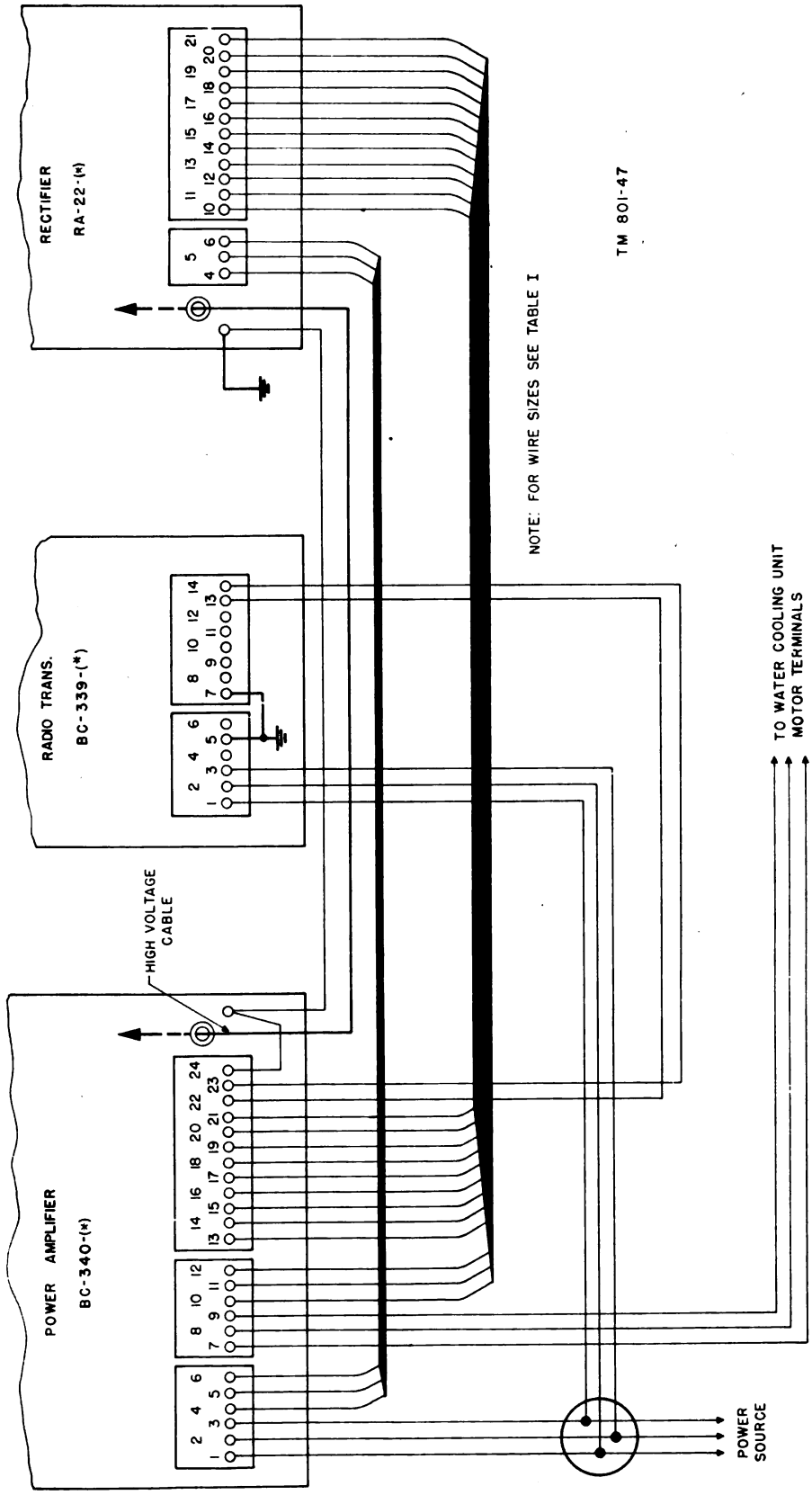

Figure 38. Transmitting equipment, power line and control circuit interconnections.

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Table I. Minimum Wire Size for each Connection

American wire gage	Signal Corps cable	Wire diam. (in.)	Connects	
			From terminal	To terminal
No. 0	WC–631	0.325	1, 2, 3, power amplifier.	1, 2, 3, power line.
No. 0	WC–631	.325	4, 5, 6, power amplifier.	4, 5, 6, rectifier.
No. 10 ...	WC–623	.102	7, 8, 9, power amplifier.	Motor input, water cooling unit.
No. 14 ...	WC–621	.064	10 through 19, power amplifier.	10 through 19, rectifier.
No. 10 ...	WC–623	.102	20, 21, power amplifier.	20, 21, rectifier.
No. 14 ...	WC–621	.064	22, 23, power amplifier.	13, 14, Radio Transmitter BC–339–(*).
No. *7 ...	.....	.144	H–v cable bushing, power amplifier...	H–v cable bushing, rectifier.
No. 10 ...	WC–623	.102	24, power amplifier.	Grounding stud, power amplifier.
No. 10 ...	WC–623	.102	Grounding stud, power amplifier. ...	Grounding stud, rectifier.
No. 10 ...	WC–623	.102	Grounding stud, rectifier.	Frame, water cooling unit.
No. 10 ...	WC–623	.102	Frame, water cooling unit.	Ground rods 1 through 6, in turn.
No. 10 ...	WC–623	.102	6th ground rod.	Grounding stud, power amplifier.

*This line is fed through the bushing provided at the rear of both the power amplifier and rectifier units, as shown in figures 11 and 38.

the power lines to the power amplifier. Drive six Ground Rods GP–26 to their full depth in damp earth, and space them not less than 3 feet apart. Using Cable WC–623, connect a grounding cable to the ground terminal on each cabinet, to the frame of Water Cooling Unit RU–2–(*), and, in turn, to all ground rods. Appropriate sizes of solder terminals are supplied; after soldering them in place, tape exposed portions with rubber Tape TL–94 and then with friction Tape TL–83.

22. Service upon Receipt of Used or Reconditioned Equipment

a. Follow the detailed instructions given in paragraph 16.

b. Check the used or reconditioned equipment for tags or other indications pertaining to changes in the wiring of the equipment. If any changes in wiring have been made, note the change on the schematic and wiring diagrams in this manual.

c. In general, give equipment a close visual inspection. Check used equipment for—

(1) Loose connections.
(2) Broken wires.
(3) Dirty contact surfaces on switches and relays.
(4) Burned, dirty, or marred variable capacitor plates.
(5) Condition of the chokes.
(6) Improper operation of the time delay relays.
(7) Condition of the motors.
(8) Condition of the piping.

d. Check reconditioned equipment as listed in *c* above. Check component parts against the schematics at the back of this manual to determine whether:

(1) Any parts are missing.
(2) Replaced parts (if any) are improperly rated.

e. Check the operating controls for ease of rotation. If lubrication is required, refer to the lubrication instructions in section III, chapter 3.

f. Perform the installation and connection procedures given in paragraphs 17 through 21.

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Section II. CONTROLS AND INSTRUMENTS

23. Controls and Instruments of Power Amplifier BC–340–(*)

a. The following table lists the controls and instruments of the Power Amplifier BC–340–(*) front panel and indicates their application:

Control or instrument	Function
BIAS ON-OFF switch (SW–4) (fig. 41).	Controls the grid bias circuit. In the ON position, a-c (alternating-current) voltage is applied to T–1, the bias circuit plate transformer.
BIAS kilovoltmeter (M–3) (fig. 39).	Measures grid bias voltage.
BIAS ON pilot light (PL–4) (fig. 40).	Red jewel signal light indicates when bias circuit is energized.
FILAMENT ON-OFF switch (SW–5) (fig. 41).	Controls the filament circuit. In the ON position a-c voltage is applied to filament transformers T–2, T–3, and T–4.
FILAMENT voltmeter (M–5) (fig. 39).	Measures primary voltage of filament transformers T–3 and T–5.
FILAMENT control (R–10) (fig. 41).	Rheostat in filament circuit to control filament voltage.
FIL. ON light (PL–3) (fig. 40).	Green jewel signal light indicates when power is supplied to filament circuit.
GRID RANGE switch (SW–1) (fig. 39).	Rotary contact switch selects any one of six grid operating ranges by tapping off turns from the grid tank inductance, L–1.
GRID milliammeter (M–2) (fig. 39).	Measures power amplifier grid current.
GRID TUNING capacitor (C–2) (fig. 39).	For tuning the grid tank circuit to the proper operating frequency.
HOURS meter (M–7) (fig. 41).	Records hours of operation of equipment. Meter is in the filament circuit; therefore, it actually records the filament operating time. For 50-cycle operation multiply the reading by 6/5.
INPUT COUPLING control (C–1) (fig. 39).	Matches the impedance of the input transmission line to the grid tank circuit.
LEAKAGE milliammeter (M–6) (fig. 39).	Measures current leakage through water system by connecting to electrical leakage terminal on left water coil.
LINE COUPLING control (C–6) (fig. 39).	Matches the impedance of the plate tank circuit to the output transmission line.
MAIN ON-OFF switch (SW–10) (fig. 41).	Controls connection to 3-phase, 50/60-cycle power source.
MAIN ON pilot light (PL–1) (fig. 40).	Amber jewel signal light indicates when the power mains are connected.
NEUTRALIZATION control (C–3 and C–4) (fig. 40).	Prevents oscillation in the amplifier.
PLATE ON-OFF switch (SW–11) (fig. 41).	Controls interconnecting lines 4, 5, and 6 to Rectifier RA–22–(*) and, therefore, application of a-c power to rectifier unit.
PLATE CONTROL START-STOP switch (SW–6) (fig. 41).	This switch is a momentary contact push-button switch, which applies a-c voltage to the primary of plate transformer T–1.
PLATE 1 ammeter (M–1) (fig. 39).	Measures total emission current of tube V–1.
PLATE 2 ammeter (M–4) (fig. 39).	Measures total emission current of tube V–2.
PLATE ON pilot light (PL–6) (fig. 40).	Red jewel signal light indicates when plate circuit is energized.
PLATE OFF pilot light (PL–5) (fig. 40).	Green jewel signal light indicates when plate circuit is de-energized.
PLATE TUNING capacitor (C–5) (fig. 40).	For tuning the plate tank circuit to the proper operating frequency.
TEMP. IN meter (M–10) (fig. 40).	Measures temperature in degrees centigrade of incoming water.

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Control or instrument	Function
TEMP. OUT meter (M–8) (fig. 40).	Measures temperature in degrees centigrade of outgoing water. Also acts as a water flow control.
TRANS. LINE SWITCH (SW–3) (fig. 39).	Connects output to either of two pairs of transmission line terminals on the top deck of the power amplifier cabinet.
WATER ON-OFF switch (SW–9) (fig. 41).	Controls water cooling system.
WATER FLOW meter (M–9) (fig. 41).	Indicates rate of water flow. Meter also acts as a water flow control.
WATER ON pilot light (PL–2) (fig. 40).	Green jewel signal light indicates when the water cooling system is in operation.

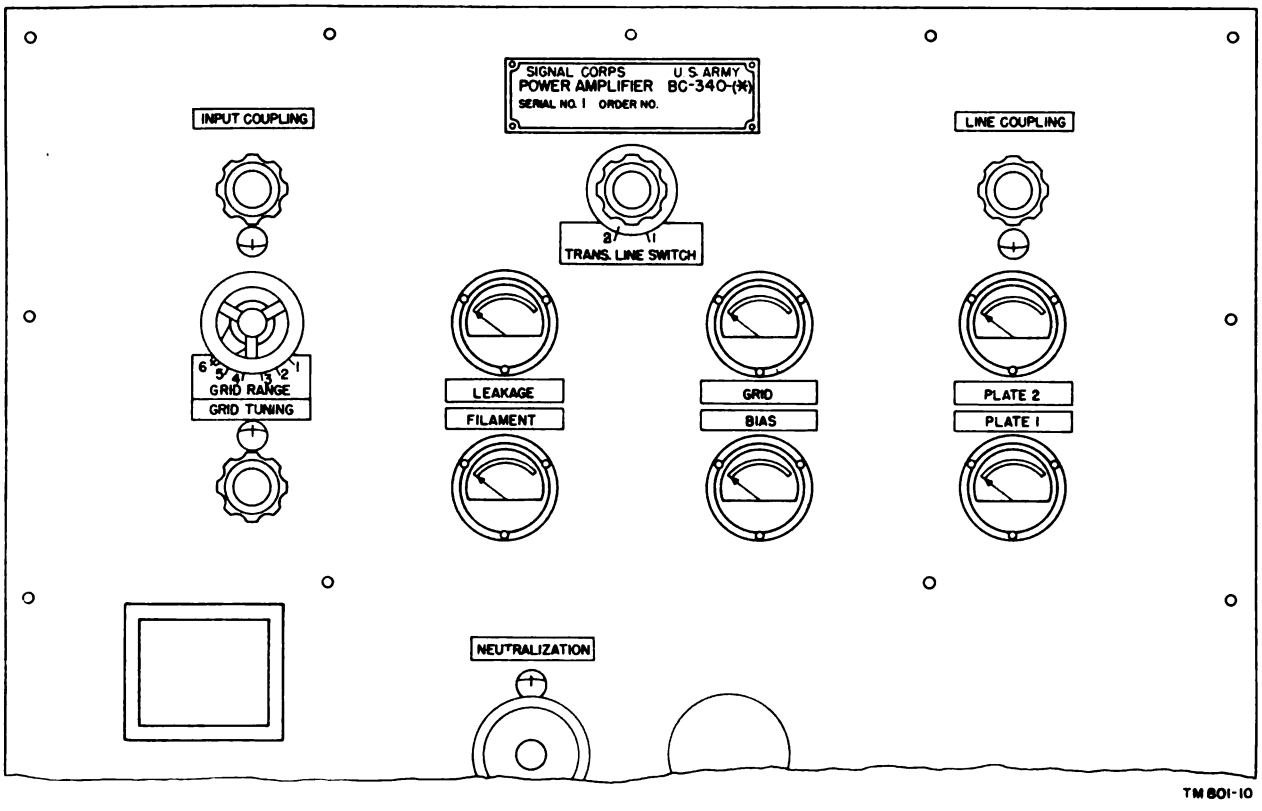

Figure 39. Power Amplifier BC–340–(*), front panel, top section.

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b. The following table lists the controls of Power Amplifier BC–340–(*) which are not located on the front panel and indicates their application:

Control	Location	Function
Line frequency switch 50–60 (SW–12) (fig. 29).	Mounted on voltage regulator (VR–1) at lower left side of Power Amplifier BC–340–D, –F through –I.	Places the equipment in 50-cycle or 60-cycle operation, depending upon the supply line frequency.
Coarse tuning (fig. 24).	Tuning bars and clamps on plate coils L–2–1 and L–2–2 for Power Amplifier BC–340, –A, –B, –D through –H.	Varies the operating frequency range by shorting out turns on the plate tuning coils.
Coarse tuning (fig. 25).	Tuning screws in plate coils L–2–1 and L–2–2, for Power Amplifier BC–340–I.	Varies the operating frequency range by shorting out turns on the plate tuning coils.
INLET water valve (fig. 11).	At lower rear of Power Amplifier BC–340–(*) cabinet.	Controls flow of water into the unit. Refer to water flow circuit diagram (fig. 27 or 28).
OUTLET water valve (fig. 11)	At lower rear of Power Amplifier BC–340–(*) cabinet.	Controls flow of water out of the unit. Refer to water flow circuit diagram (fig. 27 or 28).
DRAIN water valve (fig. 11).	At lower rear of Power Amplifier BC–340–(*) cabinet.	In same line as OUTLET valve. Refer to water flow circuit diagram (fig. 27 or 28).
AUX. VALVE (fig. 7 or 8)	At right rear of lowest shelf of Power Amplifier BC–340–(*) cabinet.	Controls rate of water flow in entire water circulating system. Refer to water flow circuit diagram (fig. 27 or 28).

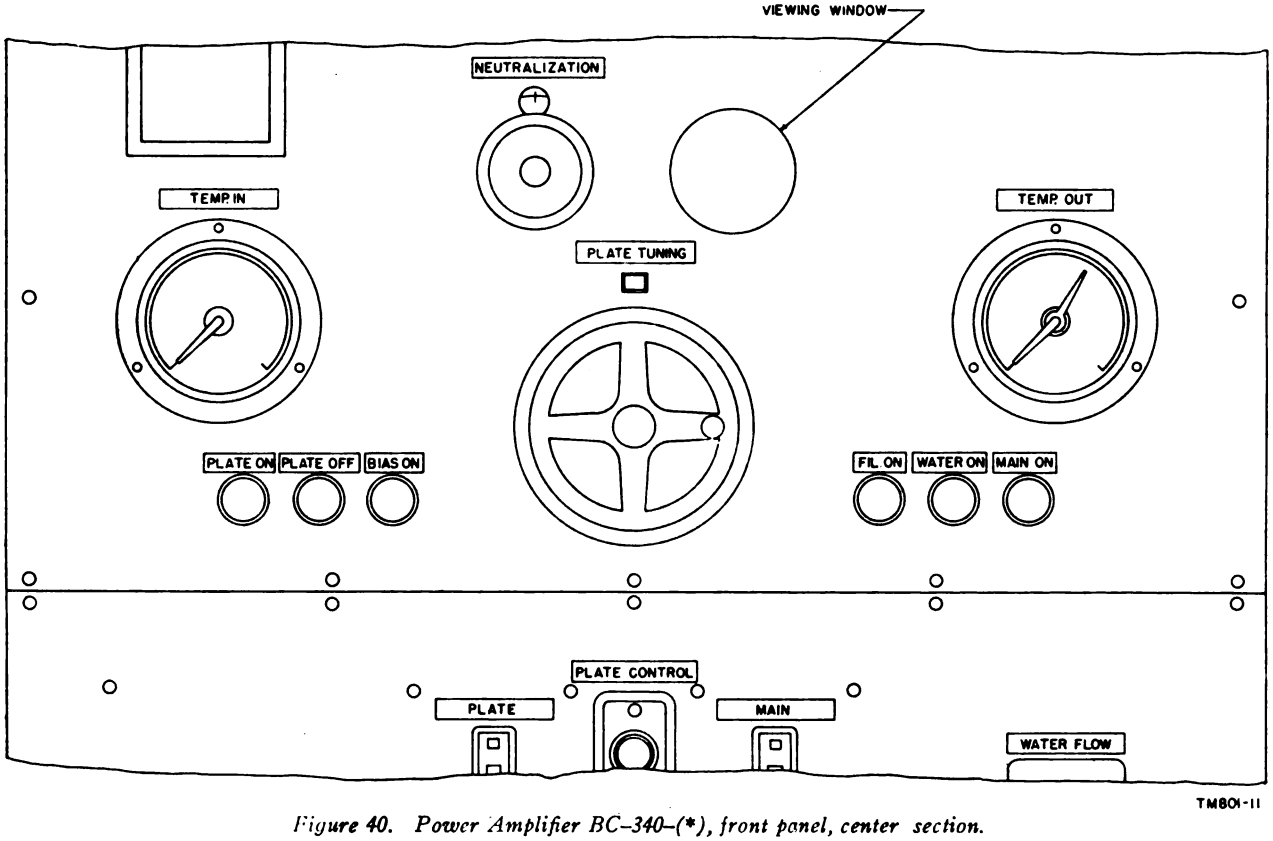

Figure 40. Power Amplifier BC–340–(*), front panel, center section.

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24. Controls and Instruments of Rectifier RA–22–(*)

a. The following table lists the controls and instruments of the Rectifier RA–22–(*) front panel and indicates their application:

Control of instrument	Function
A.C. OVERLOAD ϕ 1 relay (RL–1) (fig. 43).	Breaks the a-c input circuit when phase 1 is overloaded.
A.C. OVERLOAD ϕ 2 relay (RL–2) (fig. 43).	Breaks the a-c input circuit when phase 2 is overloaded.
D.C. OVERLOAD relay (RL–3) (fig. 43).	Breaks the a-c input circuit when the d-c output circuit is overloaded.
FIL. PRI. voltmeter (M–1) (fig. 42).	Measures primary voltage of filament transformers (T–2, T–3, T–4, and T–5).
LINE voltmeter (M–2) (fig. 42).	Measures the line voltage.
LINE VM. SWITCH (SW–3) (fig. 43).	Switches voltmeter M–2 across any one of the three phases.
OUTPUT kilovoltmeter (M–3) (fig. 42).	Measures rectifier output voltage.
PRIMARY VOLT CONTROL handwheel (SW–5) (fig. 43).	Operates detent on primary of T–1 for changing the output voltage of rectifier RA–22–(*). As a result of ganging arrangement, operates SW–4.

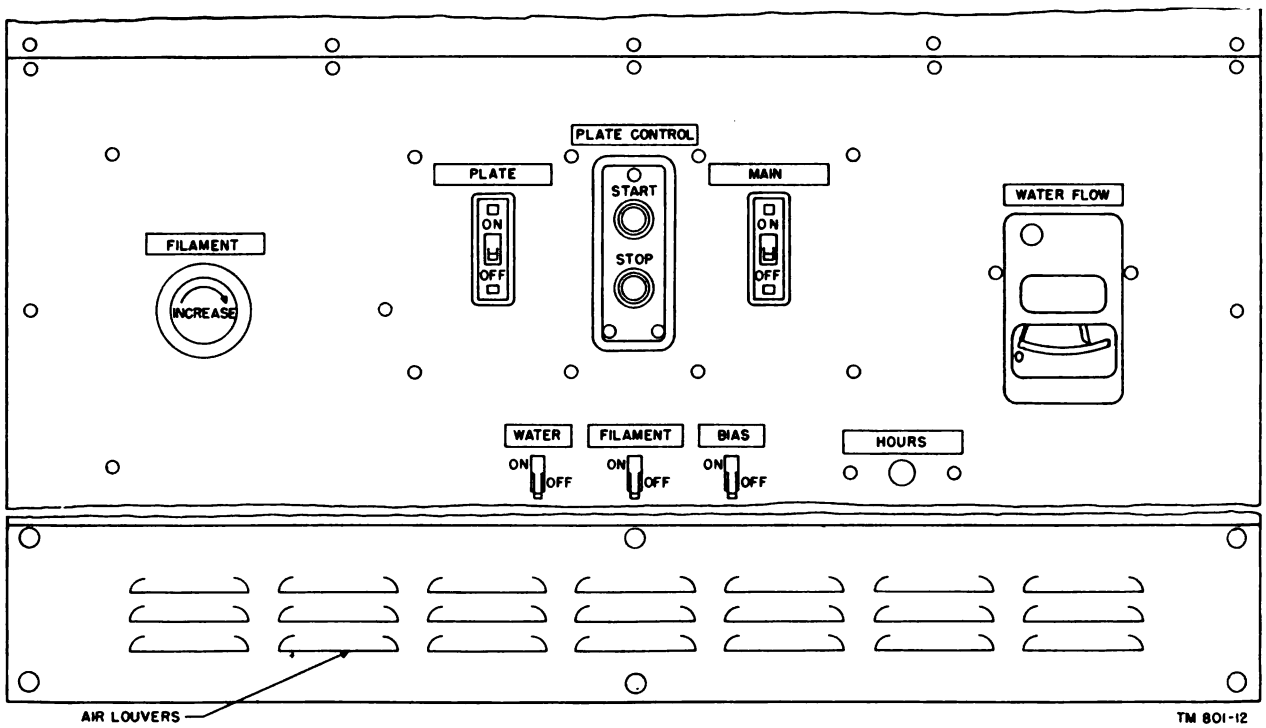

Figure 41. Power Amplifier BC–340–(*), front panel, bottom section.

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b. The following table lists the controls of Rectifier RA–22–(*) which are not located on the front panel and indicates their application:

Instrument or control	Location (fig. 12 or 13)	Function
Oil gage	On plate transformer T–1. Left side rear of rectifier cabinet.	Indicates amount of oil in plate transformer T–1. Normal level can be seen in figure 13.
Thermometer	On plate transformer T–1. Left side rear of rectifier cabinet.	Indicates operating temperature of plate transformer T–1.
Valve	On plate transformer T–1. Left side rear of rectifier cabinet.	For draining oil from plate transformer T–1.

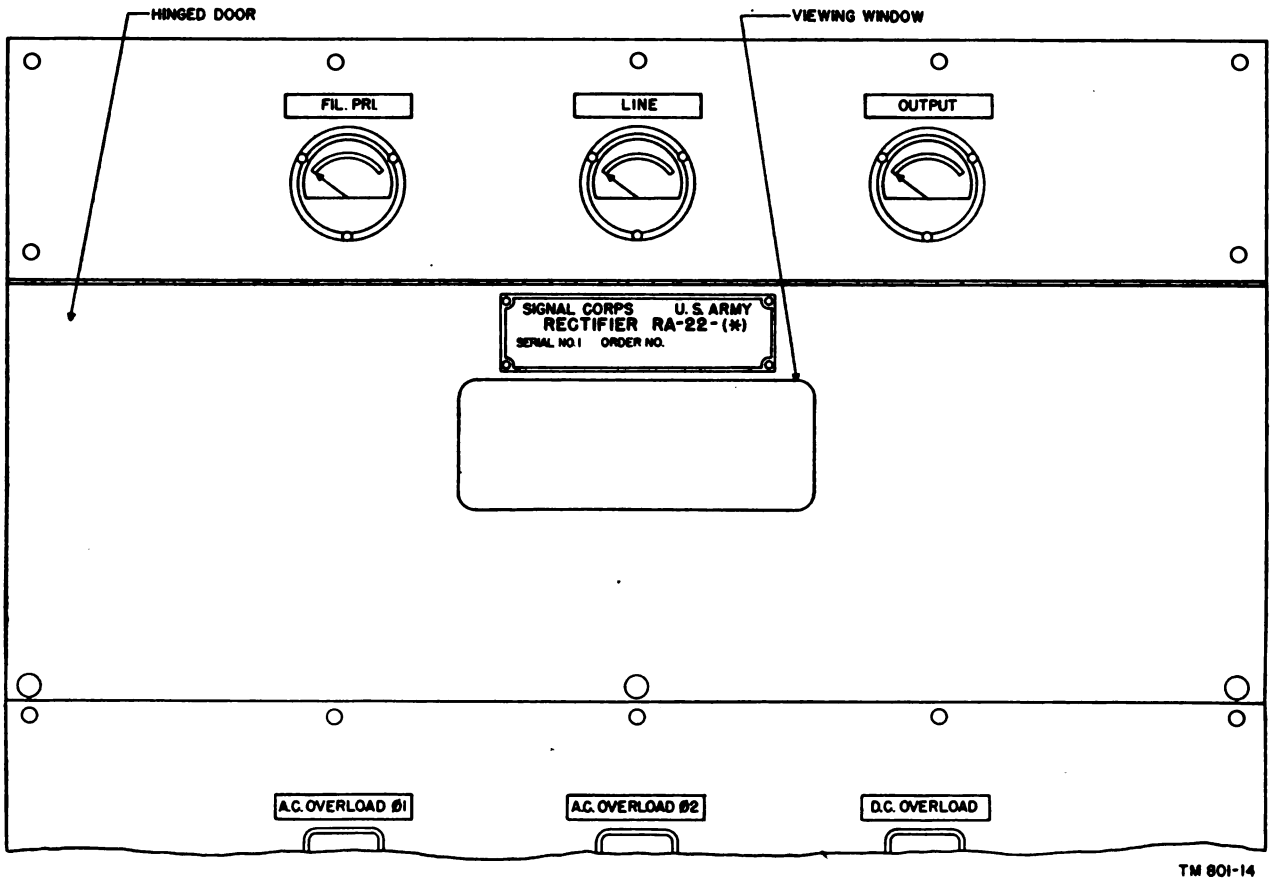

Figure 42. Rectifier RA-22-(*), front panel, upper section.

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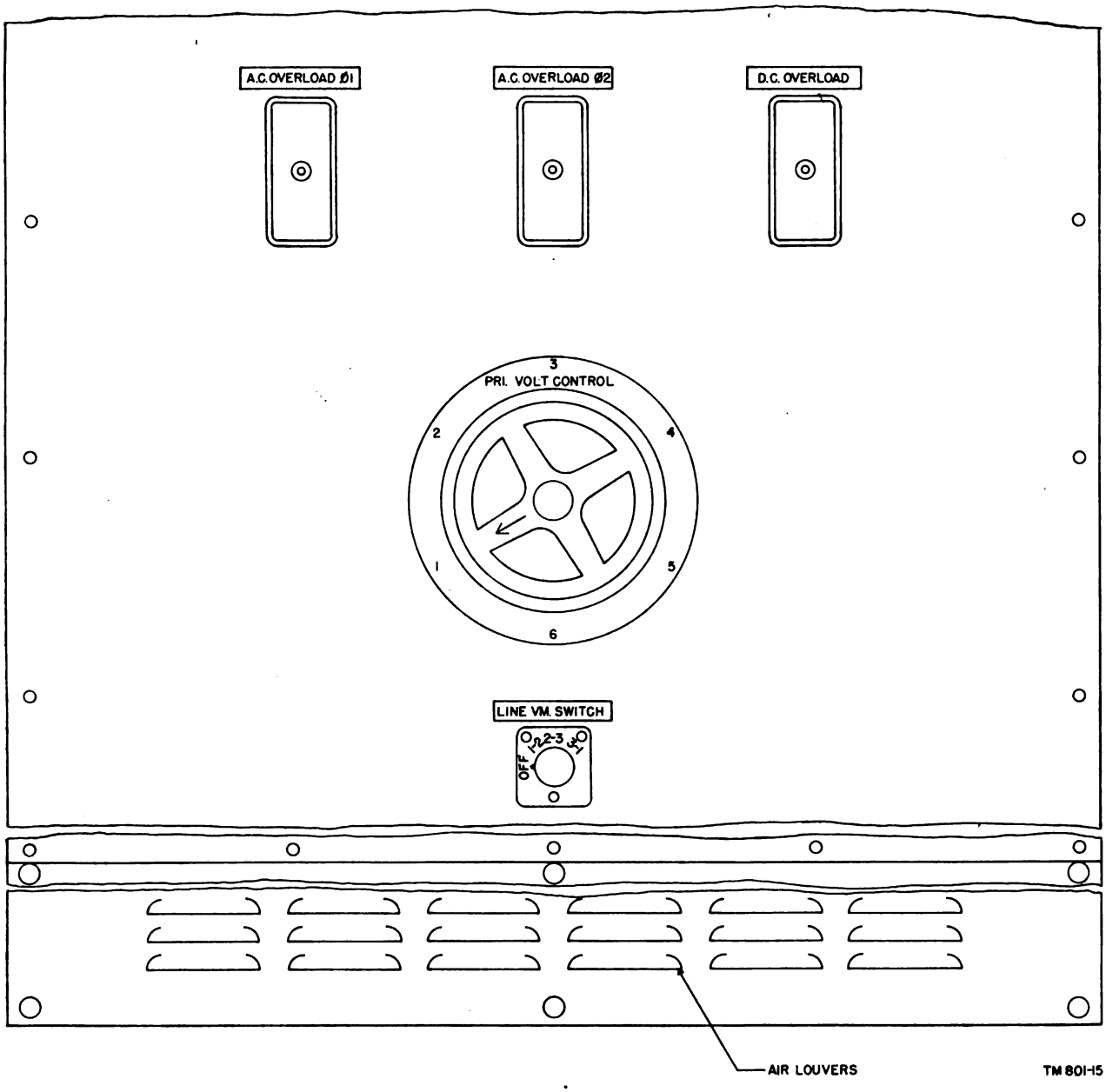

Figure 43. Rectifier RA-22-(*), front panel, lower section.

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Section III. OPERATION UNDER USUAL CONDITIONS

25. Preliminary Starting Procedure

Perform the preliminary starting procedure given below before using the starting procedure described in paragraph 26.

a. Check paragraphs 32 and 33 for initial adjustments.

b. Set GRID TUNING capacitor C–2 and GRID RANGE switch SW–1 in accordance with the calibration curves of figures 60 and 61.

Note. In some cases it will be possible to use either of two taps on switch SW–1. Use the tap that will give the lowest reading for capacitor C–2.

c. Set INPUT COUPLING capacitor C–1 in accordance with the calibration curves of figures 62 and 63.

d. Set NEUTRALIZATION capacitors C–3 and C–4, PLATE TUNING capacitor C–5, and LINE COUPLING capacitor C-6 in accordance with their respective calibration curves.

Table II. Coarse Tuning Shorting Bars for Plate Tuning Coils

Band	Frequency coverage (mc)	Shorting bars (mc)	Active turns
1	4.0 to 4.5	None	20
2	4.5 to 5.5	4.5 to 5.5	17
3	5.5 to 6.0	5.6 to 6.0	14
4	6.0 to 7.0	6.0 to 7.0	11
5	7.0 to 8.0	7.0 to 8.0	9
6	8.0 to 9.0	8.0 to 9.0	7
7	9.0 to 10.0	9.0 to 10.0	6
8	10.0 to 11.0	10.0 to 11.0	5
9	11.0 to 12.0	11.0 to 12.0	4
10	12.0 to 14.0	12.0 to 14.0	3
11	14.0 to 16.0	14.0 to 16.0	2
12	16.0 to 19.0	16.0 to 19.0	1
13	19.0 to 22.0	19.0 to 26.5	0
14	22.0 to 26.5	22.0 to *26.5 and 19.0 to 26.5.	0

*For this band, the two shorting bars are used. See figure 24 for the fastening points for the 22.0- to 26.5-mc shorting bar.

(1) For Power Amplifiers BC–340–A, –B, and –D through –H, see figures 64 through 72.

(2) For Power Amplifier BC–340–I, see figures 73 through 81.

e. Make the necessary adjustments to plate tuning coils L–2–1 and L–2–2, for operation at the desired frequency.

(1) For Power Amplifiers BC–340–A, –B, and –D through –H, set the shorting bars and clamps in accordance with figure 24 and table II. Table II shows the frequency range divided into 14 bands and the shorting bars necessary for each band. Determine in which band the desired frequency of operation falls. Note the shorting bars indicated for that band and then fasten the proper shorting bars on plate tuning coils L–2–1 and L–2–2. When fastening these shorting bars in place, note that the clamping wedges on the plate coils have a slant or pitch corresponding to the pitch of the coils, and that the corresponding inverted wedges on the shorting bars are also arranged to fit the coil pitch. This means that each plate tuning coil has its own set of shorting bars. The clamping yokes together with pins complete the clamping assembly. Tighten the clamping assembly with the fingers only. The pins should be pushed into the wedge before tightening the clamps, to avoid bending or deforming the pins.

(2) For Power Amplifier BC–340–I, set the tuning screws into plate tuning coils L–2–1 and L–2–2 in accordance with figures 25 and 82. Figure 82 shows the frequency range divided into 11 bands and the positions of the tuning screws for each band. Determine in which band the desired frequency of operation falls. Note which turn numbers are indicated by the positions of the screw-head symbols in figure 82. Place a tuning screw into each of the taps (fig. 25) corresponding to the turn numbers noted. For band 11, note that tuning screws must also be placed into the two taps marked HF.

f. Set TRANS. LINE SWITCH SW–3 for selection of the desired transmission line.

g. Connect a suitable antenna to the amplifier transmission lines.

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26. Starting Procedure

Note. If during the starting procedure an abnormal result is obtained, see paragraph 45. Be sure that paragraph 25 has been complied with before using this starting procedure.

a. Set the MAIN ON-OF switch (SW–10) at ON. The amber MAIN ON light (PL–1) should light.

b. Set the WATER ON-OFF switch (SW–9) at ON. The green WATER ON light (PL–2) should light. Check the water system for leaks (par. 32).

c. Set the FILAMENT ON-OF switch (SW–5) at ON. The green FIL. ON light (PL–3) should light.

d. Adjust the FILAMENT control (R–10) for a reading of 200 volts on the FILAMENT meter (M–5).

e. Set the BIAS ON-OFF switch (SW–4) at ON. The red BIAS on light (PL–4) should light.

f. Excite the power amplifier with one-half the normal output from the exciter, Radio Transmitter BC–339–(*).

g. Adjust, in order, GRID TUNING capacitor C–2 and INPUT COUPLING capacitor C–1 for maximum reading on GRID meter M–2.

h. Check final tuning of Radio Transmitter BC–339–(*).

i. Apply normal output from the exciter to the power amplifier.

j. Readjust GRID TUNING capacitor C–2.

k. Note the reading of the GRID meter (M–2) and then vary the PLATE TUNING control C–5. If no dip is observed in the GRID meter reading, the circuit is properly neutralized. Set the PLATE TUNING control back to its original position. If a dip in the GRID meter reading is observed, vary the NEUTRALIZATION control in small steps. As the point of neutralization is approached, the dip in grid current will become smaller until, at the point of neutralization, no dip is observed when the PLATE TUNING control is varied. Further change in the NEUTRALIZATION control will cause de-neutralization of the circuit. The correct setting is exactly halfway between the point where the dip disappears and the point where the dip returns.

l. Set the PRIMARY VOLT CONTROL (SW–5) on the rectifier unit to position 1.

m. Set PLATE ON-OFF switch (SW–11) at ON. The green PLATE OFF light (PL–5) should light.

n. Press the START button of the PLATE CONTROL switch (SW–6). The right contactor of the controller (SW–1) of the rectifier unit closes with an audible clap. The red PLATE ON signal light (PL–6) should light. After 3 seconds a second clap is heard, indicating that the second contactor has closed.

Caution: Never *key* the exciter while pressing this START button.

o. Depending upon the operating frequency, follow the procedure described in either (1) or (2) below.

(1) When operating below 20 mc, adjust the PLATE TUNING control (C–5) for *minimum* readings on the PLATE 1 and PLATE 2 meters. This should occur simultaneously with a *maximum* reading of the GRID meter.

(2) When operating above 20 mc, adjust the PLATE TUNING control (C–5) for *maximum* reading on the GRID meter M–2. This should occur simultaneously with *minimum* readings of the plate meters.

p. Check the neutralization adjustment by varying slightly the PLATE TUNING control, C–5, and noting the variations in the grid and plate current meters. If the peak (maximum) grid current occurs concurrent with a dip (minimum) plate current, the amplifier is properly neutralized. If this does not occur, reneutralize.

q. Adjust LINE COUPLING capacitor C–6 for a reading of 0.5 ampere or maximum on the plate meters and then readjust the PLATE TUNING control, C–5, in accordance with *o* above.

r. Increase the setting of the PRIMARY VOLT CONTROL from 1 to 2.

s. Readjust PLATE TUNING control C–5 for minimum plate current. Adjust LINE COUPLING control C–6 for a reading of 0.75 ampere or maximum on the plate meters. Check GRID TUNING capacitor C–2 for maximum indication on GRID meter M–2. Readjust PLATE TUNING control C–5 for minimum plate current.

t. Increase the setting of the PRIMARY VOLT CONTROL from 2 to 5. However, repeat *s* above with each increased setting of the PRIMARY VOLT CONTROL, while the LINE COUPLING, C–6, is adjusted for the following readings on the plate meters:

Primary volt control setting.....	2	3	4	5
Plate meter reading.....	0.75	1.0	1.3	1.6

u. Check all meter readings against table III.

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Table III. Typical Operating Data

Rectifier RA-22-(*)

Line (volts)	Fil pri (volts)	Output (kv)
220	233	7.5
217	231	7.45
218	232	7.45

Power Amplifier BC-340-I

Freq (mc)	Fil (volts)	Bias (volts)	Grid (ma)	Plate 1 (amp)	Plate 2 (amp)
20	205	560	220	1.59	1.61
12	200	550	270	1.54	1.55
4	200	550	210	1.50	1.60

Power Amplifiers BC-340-A, -B, and -D through -H

Freq (mc)	Fil (volts)	Bias (volts)	Grid (ma)	Plate 1 (ma)	Plate 2 (ma)
22	200	620	350	1.5	1.44

27. Stopping Procedure

a. Press the STOP button of the PLATE CONTROL switch (SW-6).

b. Set the PLATE ON-OFF switch (SW-11) to OFF.

c. Set the BIAS ON-OFF switch (SW-4) to OFF.

d. Set the FILAMENT ON-OFF switch (SW-5) to OFF.

e. Set the WATER ON-OFF switch (SW-9) to OFF.

Caution: Do not perform *f* below until time delay relay RL-3 shuts off the water supply. RL-3 has a time delay of 1 minute.

f. Set the MAIN ON-OFF switch (SW-10) to OFF.

Section IV. OPERATION UNDER UNUSUAL CONDITIONS

28. General

The operation of Amplifier Group AN/FRA-2 may be difficult in regions where extreme cold, heat, humidity and moisture, sand conditions, etc., prevail. In the following paragraphs instructions are given on procedures for minimizing the effect of these unusual operating conditions.

29. Operation in Arctic Climates

Subzero temperatures and climatic conditions associated with cold weather affect the efficient operation of the equipment. Instructions and precautions for operation under such adverse conditions follow:

a. Keep the equipment warm and dry. If the equipment is not in a heated inclosure, fabricate the structure as shown in figure 44. Figure 44 illustrates one method of recirculating the heated air from the cooling system to supplement the heating system of the building and to control the temperature of the water. Materials for this type of structure are not supplied but may be salvaged from packing cases. The hinged panels, shown in solid lines, control the air flow and may be used to obtain the desired input temperature of the water as indicated by the TEMP. IN meter of Power Amplifier BC-340-(*).

b. Mercury-vapor tubes require more time to warm up than vacuum tubes. Before turning on the plate voltage, let the tube filaments heat for 10 to 15 minutes, depending on the temperature of the surrounding air. If the tube is not warm when the plate voltage is turned on, the surge of high voltage may ruin the tube. When operating in extreme cold, it may be found that Tubes JAN-872A will not ignite. If this condition is encountered, replace Tubes JAN-872A with Tubes JAN-4B32. No further changes are required.

c. Locate the equipment inside a heated inclosure where there is no danger of a cold draft striking the glass tubes when a door is opened. A sudden draft of cold air is often sufficient to shatter the glass envelope of a heated tube. If the inclosure is so constructed that this precaution is impossible, place a blanket or some barrier between the source of the draft and the equipment.

d. In general, allow the maximum possible warm-up time prior to equipment operation.

e. For further information on low-temperature operation, refer to TB SIG 66.

30. Operation in Tropical Climates

When operated in tropical climates, the equipment may be installed in swampy areas, making moisture conditions more acute than normal in the tropics. Ventilation is usually very poor, and the high relative humidity causes condensation of moisture on the equipment whenever the temperature of the equip-

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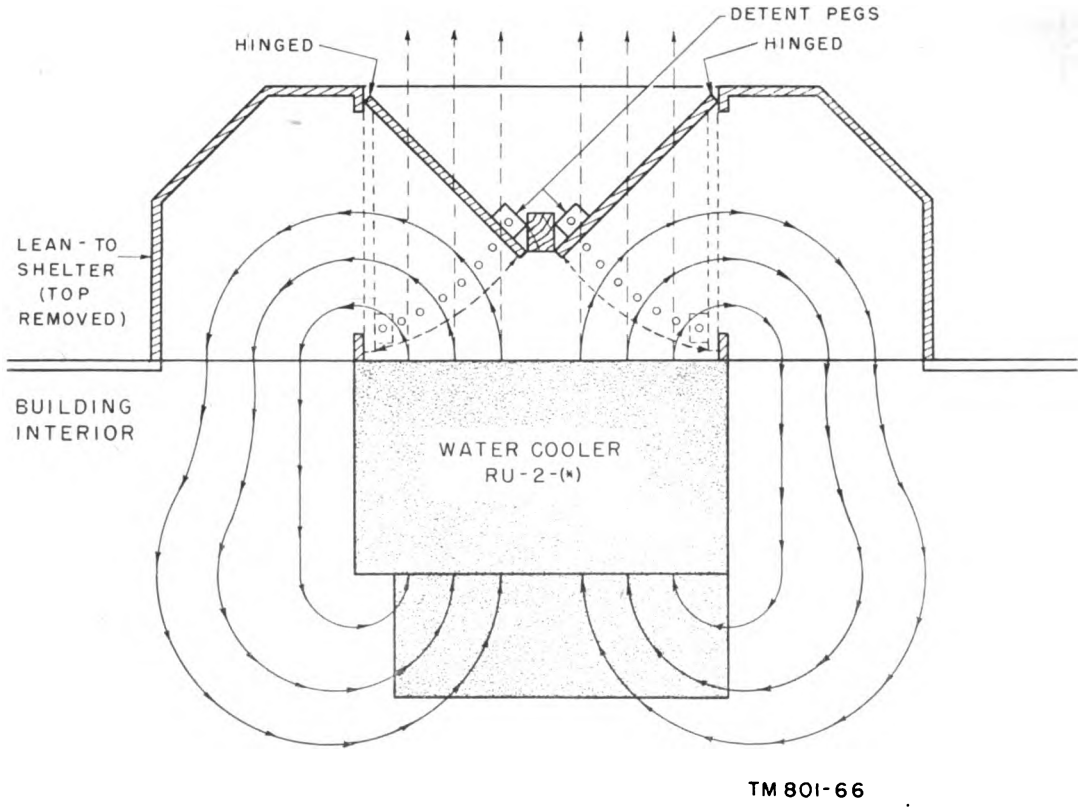

Figure 44. Water Cooling Unit RU–2–(*), method for recirculating heated air.

ment becomes lower than the ambient air. To minimize this action, place any means of heating near or inside the equipment, such as large electric light bulbs.

31. Operation in Desert Climates

a. Conditions similar to those encountered in tropical climates often prevail in desert areas. Use the same measures to insure proper operation of the equipment.

b. The main problem which arises with equipment operation in desert areas is the large amount of sand or dust and dirt which enters the motors and pump. The ideal preventive precaution is to house the equipment in a dustproof shelter. Since, however, such a building is seldom available and would require air conditioning, the next best precaution is to make the building in which the equipment is located as dustproof as possible with available materials. Hang wet sacking over the windows and doors and cover the inside walls with heavy paper.

c. If the ambient temperature is greater than 65° C. (140° F.), operate the unit at lower power; that is, turn the handwheel of the PRIMARY VOLT CONTROL to tap 4 or lower, depending on the ambient temperature.

d. Never tie power cords, signal cords, or other wiring connections to flimsy supports. Desert areas are subject to sudden wind squalls which may jerk the connections loose or break the lines.

e. Take care to keep the equipment as free from dust as possible. Make frequent preventive maintenance checks (pars. 36 and 37). Pay particular attention to the condition of lubrication of the equipment. Excessive amounts of dust, sand, or dirt that come into contact with oil and grease result in grit, which will damage the equipment.

f. For further information on precautions to prevent equipment failure due to dust or dirt infiltration, refer to TB SIG 75.

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Section V. INITIAL ADJUSTMENTS OF EQUIPMENT

32. Initial Adjustments of Water Cooling System

a. Water Cooling Unit RU–2–A is provided with a variable sheave on the motor drive. For operation from a 50-cycle power source, set this variable sheave to give a pitch diameter of approximately 6.6 inches to the motor pulley. For operation from a 60-cycle power source, set this variable sheave to give a pitch diameter of approximately 5.4 inches to the motor pulley. However, the variable sheave has been set at the factory for 60-cycle operation and it will be necessary to change it only when 50-cycle operation is desired. This change is made by loosening the belt tension (par 64*b*), loosening the setscrews in each side of the variable sheave, and rotating the outside halves of the double sheave clockwise to increase the pitch diameter (counterclockwise moves the plates apart and decreases the pitch diameter). After the sheave is adjusted to the correct diameter, tighten the setscrews and readjust the belt tension (par. 64*b*). Water Cooling Units RU–2 and RU–2–B can not be adjusted to operate from a 50-cycle power source. Water Cooling Unit RU–2–C can operate from either a 50- or 60-cycle power source without any changes being made to the unit.

b. Fill the surge tank with distilled water or water known to be free of harmful ingredients. The LEAKAGE meter reading *must not* exceed 15 ma. Approximately 35 gallons of water are necessary for filling the system, and the surge tank must be kept at least three-quarters full.

c. For Water Cooling Unit RU–2–C, prime the water pump (fill it with water). Make certain that the casing and suction pipe are completely filled with water. Unless this is done, the unit will pump air instead of water.

d. Check paragraph 38 on lubrication of drive motor of Water Cooling Unit RU–2–(*) before starting the water cooling system.

e. Set the water cooling system into operation by performing the following:

(1) Turn the MAIN ON-OFF switch to ON.
(2) Turn the WATER ON-OFF switch to ON.

f. If in Water Cooling Units RU–2, –A, and –B the water does not circulate properly, open the petcock at the top of the pump casing while the pump is running. This will allow the air that is trapped in the pump to escape. Allow sufficient time for all the air in the system to escape and then shut the petcock.

g. Check the entire water system for leaks. Leaks in the water system should not be repaired by further tightening of the screws but by replacing the gaskets. The lead piping is further sealed, if necessary, with the pipe dope provided in the installation kit.

h. Remove the air from the water system by opening slightly the petcocks on either side of the back of the WATER FLOW meter, M–9. A piece of small rubber tubing can be used to prevent water from running inside the equipment. Open the valves, very carefully, one at a time. Do not open or close them suddenly or the sudden surge of water, when the air is removed, will damage the delicate movement of the WATER FLOW meter. Make sure that all the air has been removed, by opening the petcocks several times while the water is circulating and noting whether the water is free of air bubbles. The above procedure should also be followed after extended stand-by periods of the equipment.

i. Set the AUX. VALVE control (fig. 23) so that the WATER FLOW meter reads between 7 and 8 gallons per minute.

j. Shut down the water cooling system as follows:

(1) Turn the WATER ON-OFF switch to OFF.
(2) Wait 1 minute, then turn the MAIN ON-OFF switch to OFF.

33. Initial Adjustments of Electrical System

a. For Power Amplifiers BC–340–D and –F through –I, set the 50/60-cycle switch (SW–12) on the voltage regulator to the power line frequency of either 50 or 60 cycles.

b. Remove the glass front of the TEMP. OUT meter (M–8) and adjust the indicator for the 70° C point. This will cause the electrical contacts of M–8 to close when the temperature of the outgoing water exceeds 70° C.

c. Adjust the knurled knob on the front of the WATER FLOW meter, M–9, so that the indicator reads between 7 and 8. This will cause the electrical contacts of M–9 to close when the water flow falls below the indicator reading.

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d. Set the overload relays on the rectifier front panel as follows:

(1) Remove the glass covers and adjust the knurled thumbscrews at the bottom of each relay.

(2) Set the two A.C. OVERLOAD relays to a reading of 2.0 on the calibrated scale. The scale of each relay is located adjacent to the relay plunger and below the relay coil.

(3) Set the D. C. OVERLOAD relay to a scale reading of 1.8.

e. Remove the small breather screw (fig. 33) from the top of the oil-filled plate transformer (T–1). The transformer is filled with 89 gallons of Esso Transformer Oil, Universal No. 35, or equivalent.

f. Set spark gap distance on CH–1 in the rectifier unit to 0.02 inch.

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CHAPTER 3

ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

Section I. ORGANIZATIONAL TOOLS AND EQUIPMENT

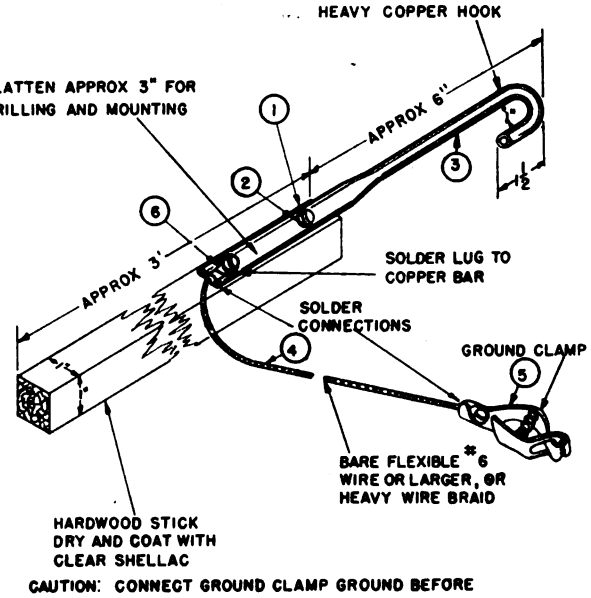
34. Tools and Sets Supplied with Amplifier Group AN/FRA–2

No tools are supplied with Amplifier Group AN/FRA–2. The necessary tools for the installation of the equipment are supplied in Tool Equipment TE–87–A, which is supplied as standard tool equipment for all fixed stations.

35. Special Tools Issued for Amplifier Group AN/FRA–2

No special tools are supplied for the installation, repair, or maintenance of this equipment. However, in order to safeguard personnel working on this equipment, it is necessary to utilize some shorting device to short to ground all points normally carrying high potential. The equipment design incorporates shorting devices, but the procedure of shorting out all h-v circuits should become a habit to be performed before trouble shooting or servicing the equipment. The shorting stick shown in figure 45 is of simple construction and will serve the purpose very well. In using this stick, first inspect it to make sure that it is in good condition, attach the grounding clamp to a reliable ground connection, and then touch the hook to all positive connections of capacitors and to all h-v circuits. The hook on the end of the stick will enable the user to hook the device to h-v point as protection, in case the power should be accidentally turned on. If this should ever happen, the h-v would be grounded.

Remember: *Do not* rely on bleeder resistors or the automatic shorting device to discharge filter capacitors. Short out the filter capacitors with a shorting stick as a habitual precautionary measure.



LEGEND

ITEM	NOMENCLATURE	SIG C STOCK NO.	QUANTITY
1	BOLT W/NUTS	6L 803-2R	2 EA
2	WASHERS	6L 50103-8	4 EA
3	COPPER TUBE	6E 3320-3.5	1 FT
4	COPPER BRAID	1F6C1-6	5 FT
5	CLAMP	3E1087-8.2	1 EA
6	TERMINAL LUG	3E12050-5.26	1 EA

TM801-16

Figure 45. Construction of grounding stick.

Section II. PREVENTIVE MAINTENANCE SERVICES

36. General

Preventive maintenance is work performed on equipment (usually when the equipment is not in use) to keep it in such good working order that breakdowns and needless interruptions in service will be kept to a minimum. Preventive maintenance differs from trouble shooting and repair since its object is to prevent certain troubles from occurring.

Note. Operations described in this section are organizational maintenance (see TM 38–650).

a. Use No. 0000 sandpaper to remove corrosion.

b. Use a clean, dry, lint-free cloth or a dry brush for cleaning.

(1) If necessary, except for electrical contacts, moisten the cloth or brush with Solvent,

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drycleaning (SD); then wipe the parts dry with a cloth.

(2) Clean electrical contacts with a cloth moistened with carbon tetrachloride; then wipe them dry with a dry cloth.

c. To remove dust from inaccessible places, dry compressed air may be used at a line pressure not exceeding 60 pounds per square inch. Be careful, however, or mechanical damage from the air blast may result.

37. Performing Preventive Maintenance

The preventive maintenance operations which follow should be performed by organizational personnel at the intervals indicated, unless these intervals are reduced by the local commander.

Caution: Screws, bolts, and nuts should not be tightened carelessly. Fittings tightened beyond the pressure for which they are designed will be damaged or broken.

a. DAILY.

(1) Clean exterior of cabinet.
(2) Check operation of panel lamps.
(3) Check meter readings (par. 26).
(4) Check water system for leaks.
(5) Check dials for improper settings.
(6) Check the oil level and temperature of the plate transformer.

b. WEEKLY.

Caution: Disconnect all power before performing the operations which follow. Upon completion, reconnect power and check the equipment for satisfactory operation.

(1) Clean interior of cabinet and all parts accessible without removal from cabinet.
(2) Inspect filter capacitors for leakage of dielectric, for bulging, and for heating.
(3) Inspect transformers for excessive heating.
(4) Inspect fuses and fuse holders for corrosion, cracks, and lack of tension sufficient to insure good contact.
(5) Check vacuum tubes; replace if necessary.
(6) Check meters for zero adjustment.
(7) Check mounting clips for dirt and lack of tension.
(8) Check relays for misalined contacts and improper timing.
(9) Check motors for binding and dirt.
(10) Check dial shafts for loose coupling.
(11) Check the surge tank level for low water supply.
(12) Check the spark gap on CH–1 in the rectifier unit for incorrect spacing.
(13) Check air filters for dirt (par. 56).
(14) Inspect variable capacitors for dirt, bent plates, corrosion, and signs of arcing.

c. MONTHLY. Make visual inspection of the items which follow; correct and/or clean if necessary.

(1) Tube sockets and pins, for loose contacts, dirt, and corrosion.
(2) Filter capacitor terminals, for corrosion.
(3) Resistors, for blistering, discoloration, and other evidence of overheating.
(4) Switches, for dirt, corrosion, loose contacts, and unsatisfactory mechanical action.
(5) Wires, cords, and cables, for cracked, cut, and frayed insulation.
(6) Cable lugs and connectors, for looseness, dirt, and corrosion.
(7) Tube water jackets B–49, for scale formation.
(8) Targets, for insufficient length (par. 64*a*).
(9) Motor drive belts, for slack (par. 64*b*).

Section III. LUBRICATION

38. Lubrication Instructions

a. GENERAL.

(1) The type of lubricant to be used, the interval, and the specific instructions for lubrication of the air blowers, water cooling unit, and miscellaneous items are given in the subparagraphs that follow.
(2) Gasoline will not be used as a cleaning fluid for any purpose. When the unit is overhauled or repairs are made, parts should be cleaned with solvent (SD).
(3) Carbon tetrachloride will be used as a cleaning fluid only in the following cases: on electrical equipment where inflammable solvents cannot be used because of fire hazard, for electrical contacts, including relay contacts and switches, and for items specifically indicated.

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b. Air Blowers BL–1. The air blower of both the power amplifier (fig. 7 or 8) and the rectifier should have their sleeve type bearings lubricated after about 1,000 hours of operation. One oil cup is provided in each air blower motor for oiling the bearings, and about 60 drops of Oil, engine (OE–10) should be added.

c. Miscellaneous Items.

(1) Capacitor bearings and shaft bearings have been properly lubricated by the equipment manufacturer. Relubricate these points each month by applying a film of Oil, lubricating, preservative, special (PL–Special).

(2) The detent cams have been lubricated by the equipment manufacturer. Relubricate these points each month by applying a film of Grease, lubricating, special (GL).

(3) To prevent binding of the water valves and petcocks, each month apply a few drops of oil (PL–Special).

d. Drive Motor of Water Cooling Unit RU–2–(*). Before placing the motor into operation for the first time, and each month thereafter, add Grease, general purpose No. 2 (WB), or equivalent, and oil (OE–10), as follows:

(1) Wipe clean the pressure-gun fitting and the region around the fitting and relief plug or the drive and bearing.

(2) Remove the relief plug.

(3) Free the relief hole of any hardened grease.

(4) With the motor running, add grease (GL) until it is expelled through the relief hole. Adding grease until new grease is expelled tends to purge the housing of used grease.

(5) Run the motor about 20 minutes with the relief hole left open, to allow excess grease to be expelled.

(6) Clean and replace the relief plug.

Caution: Keeping dirt from the bearing housing and the lubricant is very important. Never use grease that was used before.

(7) At the fan end, the housing is provided with a removable pressure relief (excess grease) pipe, extending horizontally to the outside of the fan casing. Remove, clean, and replace this pipe before greasing.

(8) Add grease; removing, cleaning, and replacing the relief pipe one or more times during the greasing process.

(9) Add no more grease after grease is observed in this pipe.

(10) Clean and replace the pipe, which then will act as a sump to catch excess grease when expansion due to heating takes place.

(11) Be sure drain plugs of sleeve bearing housings are tight. Fill each reservoir through the oil-filler gage to within one-eighth inch of the gage overflow level, using a good grade of oil (OE–10).

e. Water Pump of Water Cooling Unit RU–2–(*).

(1) Fill the two grease cups (point 6 of fig. 56) with grease (WB), or equivalent.

(2) Apply the grease to the bearings every 24 hours of operation, by turning the grease cups down by one turn.

Caution: Heating of bearings indicates an excess of grease instead of a deficiency.

39. Lubrication under Unusual Conditions

a. Arctic Regions.

(1) *General.* Lubricants which are satisfactory at moderate temperatures stiffen and solidify at subzero temperatures, thus causing moving parts to bind or become inoperative. Use the correct grade of lubricant for operating the equipment in arctic regions. When preparing the equipment for low-temperature operation, see that lubricants used for moderate temperatures are thoroughly removed. Even small amounts of such lubricants, if allowed to remain, may impair the operation of moving parts. Be sure to use the lubricant specified for low-temperature operation.

(2) *Preparing motors and pump.* At low temperatures it is impossible to replace the grease on the bearings by forcing in the grease prescribed for low temperatures. Attemps to do so result in overloading the bearings with an unsuitable lubricant, which solidifies at temperatures below 32° F. (0° C.). Wash the bearings in solvent (SD) to remove all traces of the old lubricant, dry them thoroughly, and lubricate with grease (GL), as directed in paragraph 38.

b. Tropical Regions. High temperatures and moisture due to rain, condensation, etc., may cause lubricants which normally are satisfactory to flow from moving parts and other surfaces. These bearing surfaces will wear excessively, and hinges, shaft bear-

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ings, and other parts will be damaged or destroyed by rust and corrosion. Inspect the equipment daily and lubricate it as required to insure efficient operation, using lubricants suitable for high temperatures.

c. DESERT REGIONS. Dust and sand infiltration into the equipment causes grit in the lubricants and will seriously impair and damage the moving parts of the equipment. Hot dry temperatures cause the lubricants to flow from moving parts, and conditions result similar to those described in *b* above. Use lubricants suitable for high temperatures. Inspect and clean the equipment daily.

Section IV. WEATHERPROOFING

40. Weatherproofing

a. GENERAL. Signal Corps equipment, when operated under severe climatic conditions such as prevail in tropical, Arctic, and desert regions, requires special treatment and maintenance. Fungus growth, insects, dust, corrosion, salt spray, excessive moisture, and extreme temperatures are harmful to most materials.

b. TROPICAL MAINTENANCE. A special moisture-proofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable degree of protection. This treatment is explained in TB SIG 13 and TB SIG 72.

c. WINTER MAINTENANCE. Special precautions necessary to prevent poor performance or total operational failure of equipment in extremely low temperatures are explained in TB SIG 66.

d. DESERT MAINTENANCE. Special precautions necessary to prevent equipment failure in areas subject to extremely high temperatures, low humidity, and excessive sand and dust are explained in TB SIG 75.

e. LUBRICATION. The effects of extreme cold and heat on materials and lubricants are explained in TB SIG 69. Observe all precautions outlined in TB SIG 69 when operating equipment under conditions of extreme cold or heat. Refer to section III of this chapter for detailed instructions.

41. Rustproofing and Repainting

a. When the finish on the case has been badly scarred or damaged, rust and corrosion can be prevented by touching up bared surfaces. Use No. 00 or No. 000 sandpaper to clean the surface down to the bare metal; obtain a bright smooth finish.

Caution: Do not use steel wool. Minute particles frequently enter the case and cause harmful internal shorting or grounding of circuits.

b. When a touch-up job is necessary, apply paint with a small brush. When numerous scars and scratches warrant complete repainting, remove all components, leaving only the frames, and spray paint over the entire case. Remove rust from the case by cleaning corroded metal with solvent (SD) to soften the rust and sandpaper to complete the preparation for painting. Paint used will be authorized and consistent with existing regulations.

Section V. TROUBLE SHOOTING AT ORGANIZATIONAL MAINTENANCE LEVEL

42. Scope

a. The trouble shooting and repair work that can be performed at the organizational maintenance level (operators and repairmen) is necessarily limited in scope by the tools, test equipment, and replaceable parts issued and by the existing tactical situation. Accordingly, trouble shooting is based on the performance of the equipment and the use of the senses in determining such troubles as burned-out tubes, cracked insulators, etc.

b. The paragraphs which follow in this section help in determining which of the components, such as the rectifier or amplifier, is at fault and in localizing the fault in that component to the defective stage or item, such as a tube or fuse.

43. Visual Inspection

a. Failure of this equipment to operate properly usually is caused by one or more of the following faults:

(1) Relay contacts burned because of overloads.
(2) Defective tubes.
(3) Burned-out fuses.
(4) Poor or broken switch contacts.
(5) Broken or loose connections.
(6) Water leakage.
(7) Door interlocks opened.
(8) Cracked or broken insulators.

b. When failure is encountered and the cause is not immediately apparent, check as many of the above items as is practicable before starting a detailed ex-

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amination of the component parts of the system. If possible, obtain information from the operator of the equipment regarding performance at the time trouble occurred.

c. Visually inspect the transmission line and antenna system for obvious abnormalities.

44. Trouble shooting by using Equipment Performance Checklist

a. GENERAL. The equipment performance checklist (par. 45) will help the operator to determine whether the amplifier and the rectifier units are functioning properly. The list gives the item to be checked, the conditions under which the item is checked, the normal indications and tolerances of correct operation, and the corrective measures the operator can take. *To use this list, follow the items in numerical sequence.*

b. ACTION OR CONDITION. For some items, the information given in the *action or condition* column consists of the setting of various switches and controls under which the item is to be checked. For other items it represents an action that must be taken to check the normal indication given in the *normal indications* column.

c. NORMAL INDICATIONS. The normal indications listed include the visible and audible signs that the operator should perceive when he checks the items. If the indications are not normal, the operator should apply the recommended corrective measures.

d. CORRECTIVE MEASURES. The corrective measures listed are those the operator can make without turning in the equipment for repairs. When reference is made in the table to chapter 5, it indicates that the trouble cannot be corrected during operation and that trouble shooting by an experienced repairman is called for. If the set is completely inoperative and the recommended corrective measures do not yield results, trouble shooting is necessary. However, if the tactical situation requires that communication be maintained and if the set is not completely inoperative, the operator must maintain the set in operation as long as it is possible to do so.

e. PREPARATORY AND START ITEMS. These items should be checked each time the equipment is put into operation.

f. STOP ITEMS. These items should be checked whenever the station is taken out of operation. Any abnormal indications at this time are probably caused by trouble in the set and should be corrected before the next expected period of operation.

45. Equipment Performance Checklist

	Item No.	Item	Action or condition	Normal indications	Corrective measures
PREPARATORY	1	INPUT COUPLING control. NEUTRALIZATION control. PLATE TUNING control. LINE COUPLING control.	Check the positions as determined by frequency of operation and figures 62 through 81.		
	2	GRID TUNING control. GRID RANGE switch.	Check the positions as determined by frequency of operation and figures 60 and 61.		
	3	TRANS. LINE SWITCH.	Set for selection of the desired transmission line.		
	4	Plate tuning coils	Check the settings of the tuning screws or starting bars as determined by frequency of operation and the coarse tuning chart (fig. 82 or table II).		
	5	All other switches.	Set in off positions.		

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	Item No.	Item	Action or condition	Normal indications	Corrective measures
START	6	MAIN ON-OFF switch.	Turn to ON position	Amber MAIN ON light lights.	Reset ripped MAIN switch. Check power source.
	7	WATER ON-OFF switch.	Turn to ON position	Green WATER ON light lights.	Vary AUX. VALVE to correct water temperature. Check TH–1. Check relays RL–7 and RL–5.
				Motor of Water Cooling Unit RU–2–(*) is heard operating.	Check fuses F–1 and F–2.
					Check fuses F–9, F–10, and F–11 in models –G and –I and F–4 in the other models.
				Amplifier air blower BL–1 is heard operating.	Check fuses F–5 and F–6 in models –G and –I, and F–3 in the other models.
				When a temperature of 60° F. is reached in the rectifier unit, the rectifier air blower is heard operating.	Check fuses F–7 and F–8 in models –G and –I and F–5 in the other models. Check TH–1 in the rectifier unit.
EQUIPMENT PERFORMANCE	8	FILAMENT ON-OFF switch.	Turn to ON position	Green FIL. ON light lights.	Refer to chapter 5.
				FILAMENT METER M–5 reads 200 volts	Adjust FILAMENT control.
	9	BIAS ON-OFF switch.	Turn to ON position	Red BIAS ON light lights.	Check door interlocks. Check relay RL–6 and time delay relay RL–1.
					Check fuses F–3 and F–4 in models –G and –I and F–2 in the other models.
				BIAS meter M–3 reads approximately 550 volts.	Check bias supply. Check tubes V–3 and V–4 in power amplifier unit.
				Reading on GRID meter M–2.	Check tubes V–1 and V–2.
	10	PLATE ON-OFF switch.	Turn to ON position	Green PLATE OFF light lights. LINE meter in rectifier unit reads approximately 220 volts.	Check relay RL–4 and right contactor of SW–1.
	11	PRIMARY VOLT CONTROL.	Turn to position 1	Reading on OUTPUT meter.	Check h–v rectifier.
	12	PLATE CONTROL START-STOP push button.	Press the START button	Right contactor of SW–1 clicks into position.	Check A.C. OVERLOAD 1, A.C. OVERLOAD 2, and D.C. OVERLOAD relays in the rectifier unit.

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	Item No.	Item	Action or condition	Normal indications	Corrective measures
					Check SW–4 in the rectifier unit.
EQUIPMENT PERFORMANCE				Green PLATE OFF light goes off and red PLATE ON light lights.	
				Left contactor of SW–1 clicks into position.	Check time delay relay on SW–1.
				Reading on PLATE 1 and PLATE 2.	Check tubes V–1 and V–2 in power amplifier.
	13	PRIMARY VOLT CONTROL.	Set to position 5	BIAS meter reads 550 volts. GRID meter reads 100 to 270 ma (milliamperes).	Check tuning and neutralization.
				PLATE 1 and PLATE 2 meters read 1.54 to 1.61 amperes.	See chapter 5.
STOP	14	PLATE CONTROL START-STOP push button.	Press the STOP button	Contactors of SW–1 will release with an audible click.	
				Red PLATE ON light goes off and green PLATE OFF light lights.	
	15	PLATE ON-OFF switch.	Turn to OFF position	Green PLATE OFF light goes off.	
	16	BIAS ON-OFF switch.	Turn to OFF position	Red BIAS ON light goes off.	
	17	FILAMENT ON-OFF switch.	Turn to OFF position	Green FIL. ON light goes off.	
	18	WATER ON-OFF switch.	Turn to OFF position	Green WATER ON light goes off, if time delay relay RL–3 has had 1 minute in which to open.	
				Motor of water cooling unit stops operating.	
				Air blowers in amplifier and rectifier units stop operating.	
	19	MAIN ON-OFF switch.	Turn to OFF position only after relay RL–3 has shut off the water.	Amber MAIN ON light goes off.	

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CHAPTER 4

THEORY OF EQUIPMENT

46. Block Diagram
(fig. 46)

a. Amplifier Group AN/FRA–2 is composed of three units, Power Amplifier BC–340–(*), Rectifier RA–22–(*), and Water Cooling Unit RU–2–(*). The power amplifier is driven by an external exciter. The rectifier unit supplies the high voltage for the power amplifier. The water cooling unit is a motor-driven water pump and cooling radiator which circulates water through the power amplifier unit for cooling the p-a (power-amplifier) tubes.

b. The power amplifier is a push-pull, class C, r-f amplifier. The output of the exciter is fed to the balanced grid circuit of the amplifier. Grid bias is fed to the grid circuit from the grid bias rectifier. A typical cross-neutralization circuit for push-pull amplifiers is used. Rectifier RA–22–(*) supplies the high voltage through the plate circuit to the plates of the p-a tubes. The balanced r-f plate circuit is similar to the r-f grid circuit and feeds the antenna output circuit. Power is supplied to the filaments of the p-a tubes from a voltage regulator.

47. Grid (Input) Circuit
(fig. 47)

a. The output of the exciter is fed through capacitors C–27 and C–28, which block the bias voltage from the input transmission lines, to the grid circuit. The grid circuit is composed of two pi networks in push-pull. Each pi network is composed of L–1, one-half of C–1, and one-half of C–2 (B, fig. 47). The purpose of such a network is for a nonresonant line characteristic impedance match. It is used to transform the resistive load of the input transmission line to the grid input impedance. C–1, L–1, and C–2 are made variable to enable maintaining the proper impedance relationship at different operating frequencies.

b. Chokes RF–1 and RF–2 prevent rf from entering the bias supply. A 1,000-ohm, 20-watt resistor, with a length of wire across it, is placed in each of the grid circuits. At high frequencies the wires that appear to be shorting out these resistors (R–11 and R–12) act as inductances. Therefore the combination of resistance and inductance is used as a parasitic

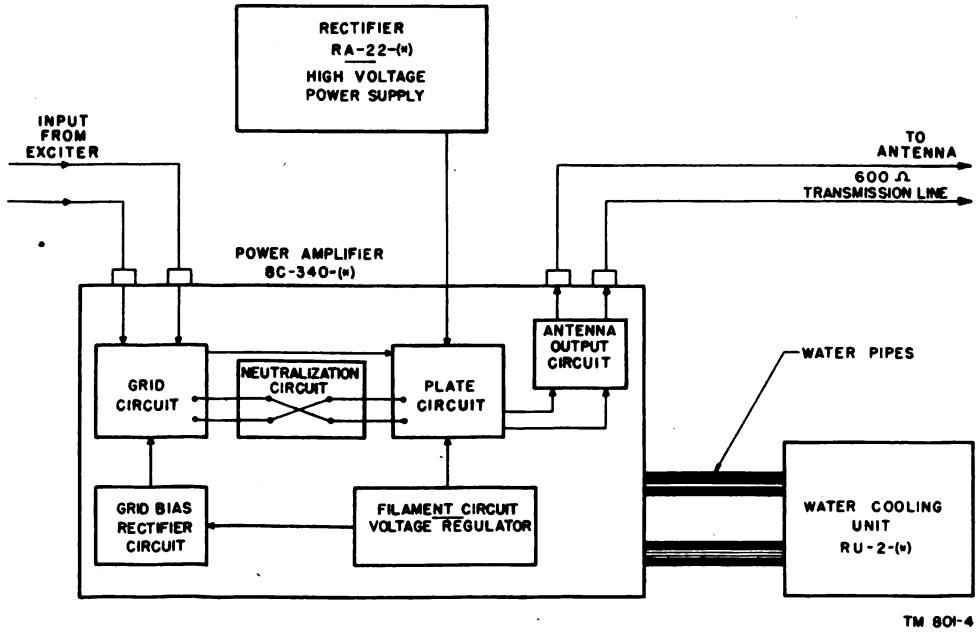

Figure 46. Amplifier Group AN/FRA–2, block diagram.

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suppressor. That is, it suppresses the r-f grid current that would be produced by unwanted h-f (high-frequency) oscillations. Resistor R–1 is a bias resistor, used primarily as a protection for the p-a tubes in case the bias supply should fail and relay RL–4 (fig. 86) fails to operate. Capacitor C–7 bypasses rf to ground.

c. In class C, r-f power amplifier operation with the key down and without modulation, the rated d-c grid current for the tubes (triode Tubes JAN–129B, fig. 30) is 250 ma each, and the d-c grid voltage can be as high as 1,500 volts. However, the grids in this application are biased at about 550 volts and each grid draws 110 ma. The grid current is measured on d-c milliammeter M–2 (fig. 86).

48. Grid Bias Rectifier
(fig. 48)

This unit is a single-phase, full-wave rectifier which uses two half-wave rectifier Tubes JAN–872A. The rectifier filament current is supplied by transformer T–2. Transformer T–2 is a single-phase unit and is supplied with 220 volts at 50/60 cps (cycles per second). The secondary supplies 5 volts at 15.0 amperes to the filaments of the rectifier tubes, and regulation is adequate for quick starting of the tubes. Each half of the secondary operates at 655 volts below ground. The plates of the rectifier tubes are supplied by transformer T–1. Transformer T–1 is also a single-phase unit and supplies 655 volts ac. The bias voltage rectifier output is fed to a single-section choke input filter. The choke of the filter (CH–1) has an inductance of 4 henrys at 600 ma, and the filter capacitor (C–26) is a 10-uf (microfarad) oil-impregnated and oil-filled paper unit. The filter output in turn appears across a bleeder bank of four 240-ohm resistors in series (R–6, R–7, R–8, and R–9), which are used to improve regulation. A grid bias interlock relay (RL–4) is provided so that if the bias rectifier output drops or fails the relay will open and remove amplifier plate voltage by causing relay RL–6 to open. The coil of this relay (RL–4) is connected between the negative end of the bias bleeder resistance (R–6, R–7, R–8, and R–9) and ground. The grid bias is measured with O- to 1-kv (kilovolt) voltmeter M-3 (fig. 86), in conjunction with the 1-megohm external multiplier, R–3.

49. Neutralization
(fig. 47)

One side of the grid circuit of tube V–1 is connected to the plate of tube V–2 through the variable air dielectric neutralizing capacitor (C–4). The same arrangement exists between the grid of tube V–2 and the plate of tube V–1, involving neutralizing capacitor C–3. This is a typical neutralization arrangement used

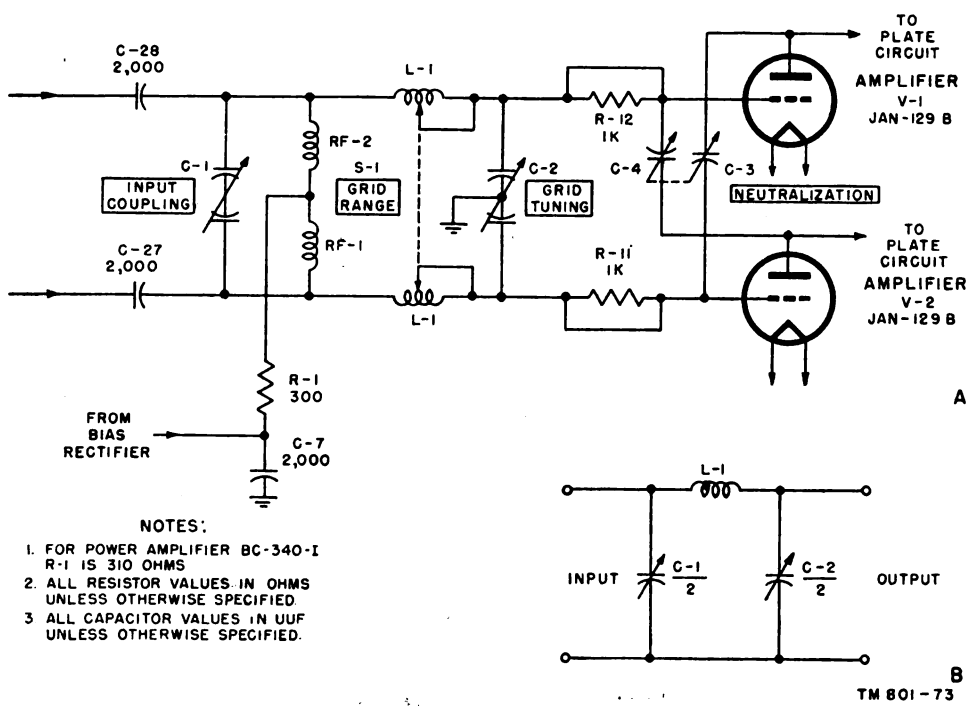

Figure 47. Power Amplifier BC-340-(*) (except model BC-340), functional diagram of grid (input) neutralization circuits.

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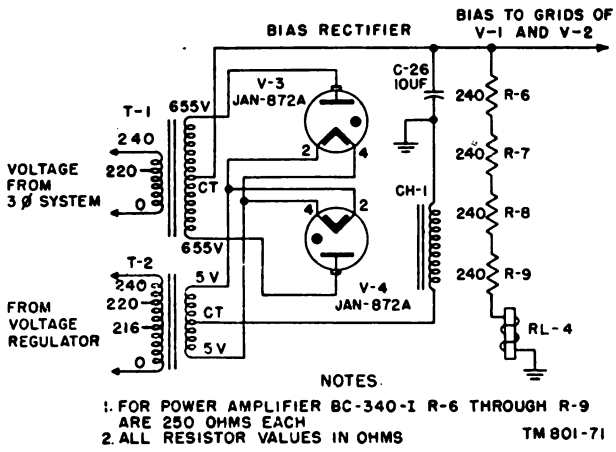

Figure 48. Power Amplifier BC-340-(*) (except model BC-340), functional diagram of grid bias rectifier.

in push-pull power amplifiers on radio transmitters. Neutralization is necessary to prevent oscillations that would otherwise occur as a result of the energy fed back from the output circuit to the input circuit of the triode tubes through the comparatively high interelectrode plate-to-grid capacity. If permitted to occur, such oscillations can produce currents large enough to damage the tubes. With the grids and plates cross-connected through C–3 and C–4, the energy fed to the grid of V–1 through capacitor C–4 will oppose the energy fed to this same grid through the interelectrode capacitance. Capacitor C–4 must be variable so that the amount of energy fed through it can be controlled. The same arrangement holds for the grid of V–2 and neutralizing capacitor C–3. This method of neutralization balances the circuit and makes for better circuit stability.

50. Power Amplifier Plate and Output Circuit (fig. 49)

a. The arrangement of the plate tank circuit is similar to that of the grid circuit and consists of plate tuning coils L–2–1 and L–2–2 and the two-section variable air capacitors, C–5 and C–6. C–5 is the main tuning capacitor that tunes the plate circuit over the frequency range as set by the plate coils (L–2–1 and L–2–2). Tuning the amplifier to different operating ranges is accomplished by varying the inductance of the tank circuit. This entails shorting out sections of the plate tuning coils L–2–1 and L–2–2. For the lowest operating range, 4.0 mc to 4.5 mc, all the active turns are required; thus none are shorted out. At the highest operating frequency, 22.0 mc to 26.5 mc, no active turns are required; thus all the turns are shorted out. The plate tuning capacitor (C–5) has its rotor connected through capacitor C–8 to ground. C–8 serves as an r-f bypass, has a capacity of 265 uuf (micromicrofarads), and is physically nothing more than two parallel metal plates mounted directly beneath main tuning capacitor C–5 (fig. 22). LINE COUPLING capacitor C–6 is a split stator variable air capacitor. Because of the balanced circuit, the point between the two sections of C–6 is a virtual ground for rf. High r-f potential is impressed across C–6, and there is the danger of arc-over if the capacitor is not set correctly.

b. B+ voltage is fed to the plates of tubes V–1 and V–2 from Rectifier RA–22–H, through r-f chokes RF–3 and RF–4, respectively, and then through coils L–2–1 and L–2–2, respectively, thereby placing the tuning coils, chokes, and water jackets (B–49) at a very high d-c potential. Capacitor C–18 and chokes RF–3 and RF–4 prevent rf from entering Rectifier RA–22–(*). Resistor R–2 is a current-limiting resistor when the B+ is grounded out through the contacts of relay RL–6. Capacitors C–16 and C–17 block dc from the rectifier to the transmission lines.

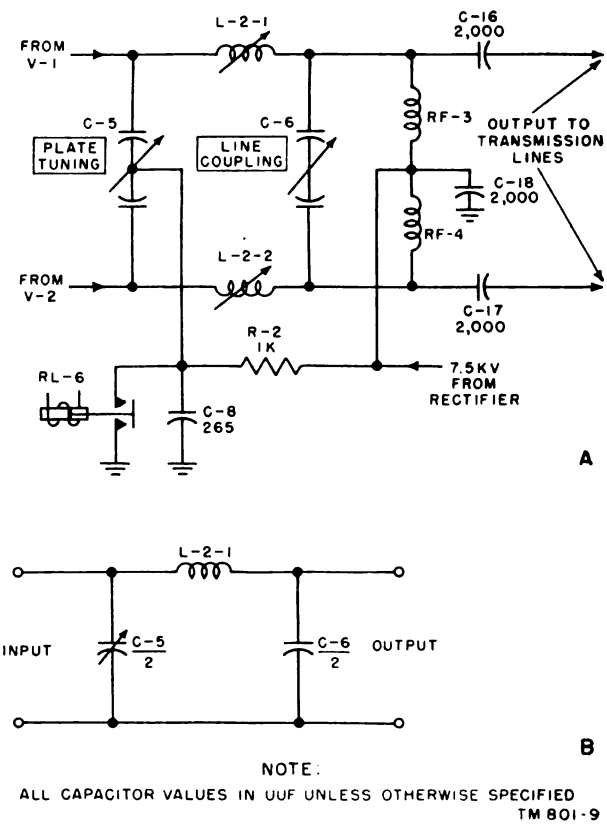

Figure 49. Power Amplifier BC-340-(*) (except model BC-340), functional diagram of plate and output circuit.

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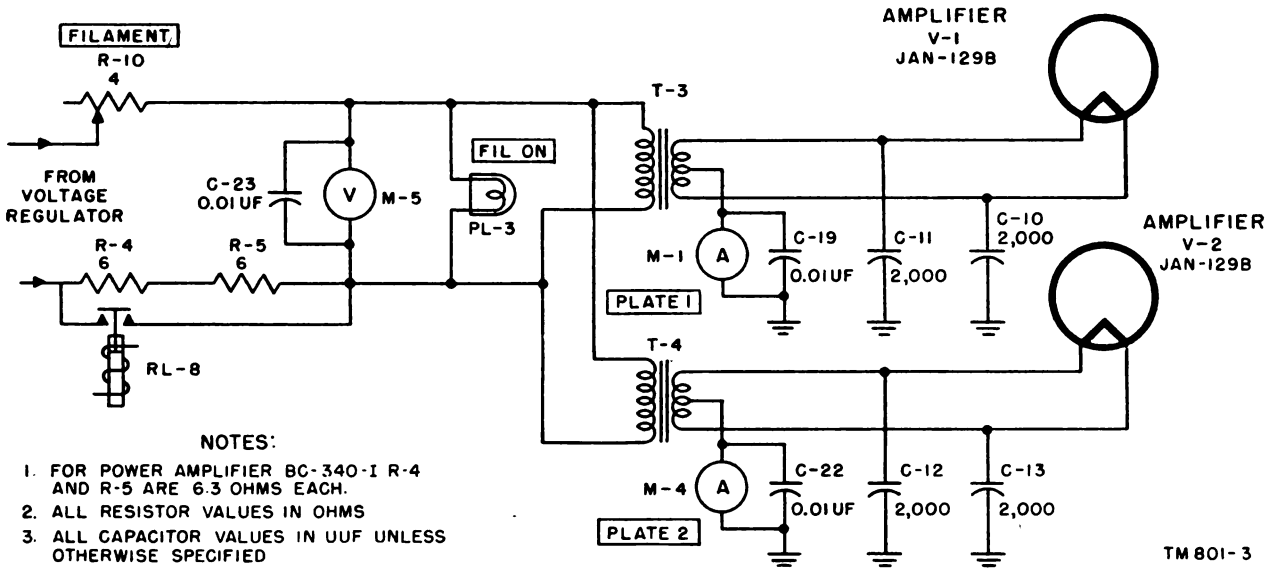

Figure 50. Power Amplifier BC-340-(*) (except model BC-340), functional diagram of filament circuit.

The water circulating system supplies a d-c leakage path, because the water jackets are at a high d-c potential. This leakage current is measured by LEAKAGE meter M–6 (fig. 86) and should be kept below 15 ma.

c. The output circuit is two balanced pi networks in push-pull. Each pi network is composed of one-half of C–5 and L–2–1, and one-half of C–6 (B, fig. 49). The purpose and theory of the output circuit are similar to those of the grid circuit (par. 47), in that the network matches the impedance of the output circuit to that of the antenna transmission lines.

51. Filament Circuit and Voltage Regulator

(figs. 50 and 51)

a. The filaments of each of the amplifier Tubes JAN–129B (V–1 and V–2) are supplied by separate transformers, T–3 and T–4. Transformers T–3 and T–4 are single-phase, and the windings are insulated to withstand 3,530 volts peak value. The primaries are supplied by 220 volts at 50/60 cps. The secondaries are center-tapped and deliver 18.2 volts at 58 amperes of load current. The center tap carries a maximum current of 2 amperes. Rheostat R–10, controlled from the front panel, controls the voltage supplied to the primary of the filament transformers. Resistors R–4 and R–5 are voltage-dropping resistors, which prevent full filament voltage from being applied to cold tubes. Between 15 to 30 seconds after the FILAMENT ON-OFF switch (SW–5) is thrown, these dropping resistors are shorted out by relay RL–8, permitting full voltage to be applied to the primary. The rated 18.2-volt potential is thus applied to Tube JAN–129B filaments without the danger of burning them out. FILAMENT meter M–5 measures the voltage applied to the primaries of the filament transformers. Rf is bypassed around the meter unit by capacitor C–23. The four capacitors, C–10, C–11, C–12, and C–13, bypass r-f currents around the transformers. D-c ammeters M–1 and M–4 are marked PLATE 1 and PLATE 2, but are connected into the filament return line. Thus these meters actually read the total cathode current. True plate current would be obtained by subtracting half the grid current (as indicated on d-c milliammeter M–2) from each of the plate meter readings.

b. All filament transformer primary voltages are controlled by the automatic voltage regulator (VR–1) (fig. 51). This unit is the saturating iron type and regulates the filament voltage to within 3.5 percent of the nominal tube voltage. If the regulator were omitted from the circuit, a change in input voltage would cause a change in filament voltage. However, with the regulator included, a large increase of input voltage causes only a slight increase in magnetic flux, due to the core of the regulator reactor being at magnetic saturation. This in turn produces only a slight increase in secondary voltage, thus maintaining the secondary voltage of this transformer fairly constant. The capacitor placed across the primary of this transformer produces a phase shift, and the value of this capacitor is determined by the frequency at which regulation is desired.

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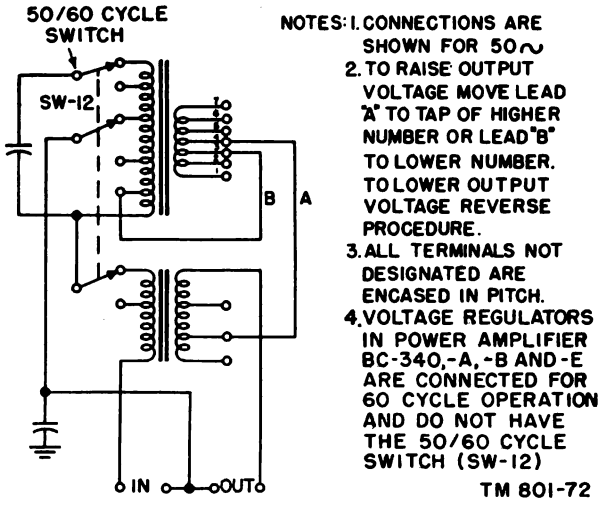

Figure 51. Voltage regulator, schematic diagram.

52. Rectifier Circuit

(fig. 52)

a. The high voltage for the plates of Tubes JAN–129B is supplied by a 6-tube, 3-phase, full-wave rectifier circuit operating from a 220-volt, 3-phase, 50/60-cycle power source. The six tubes are Tubes JAN–872A mercury-vapor half-wave rectifiers. H-v ac is supplied to the rectifier tubes by the large oil-filled transformer (T–1). The input to the transformer delta primary is 220 volts, 3-phase, 50/60 cycles, and the output voltage per leg at the wye secondary can be varied to give 2,810, 3,920, 4,470, 5,030, 5,600, and 6,140 volts. This variation is accomplished manually with the PRIMARY VOLT CONTROL handwheel on the front panel. The control is marked by numbers 1 through 6, number 1 yielding the 2,810 volts, number 2 yielding the 3,920 volts, and so on.

b. The polyphase rectifier circuit is essentially six half-wave rectifiers. The tubes are arranged so that full-wave rectification is obtained through each leg of the secondary winding. The ripple in the output wave therefore is small and has a fundamental frequency six times that of the power supply. The rectifier output is filtered with reactor CH–1 and capacitor C–1. No elaborate filter is required, since the circuit output waveshape is a six-phase (360-cycle) ripple. The choke has a pair of ½-inch sphere arc gaps mounted on the wiring terminals and are referred to as SG–1. The gaps are a protective device and are set so that they will draw an arc when a voltage sufficiently high to cause damage exists across the coil. Thus the excess energy developed in circuit surges will be dissipated in the arc and will not destroy the coil. The

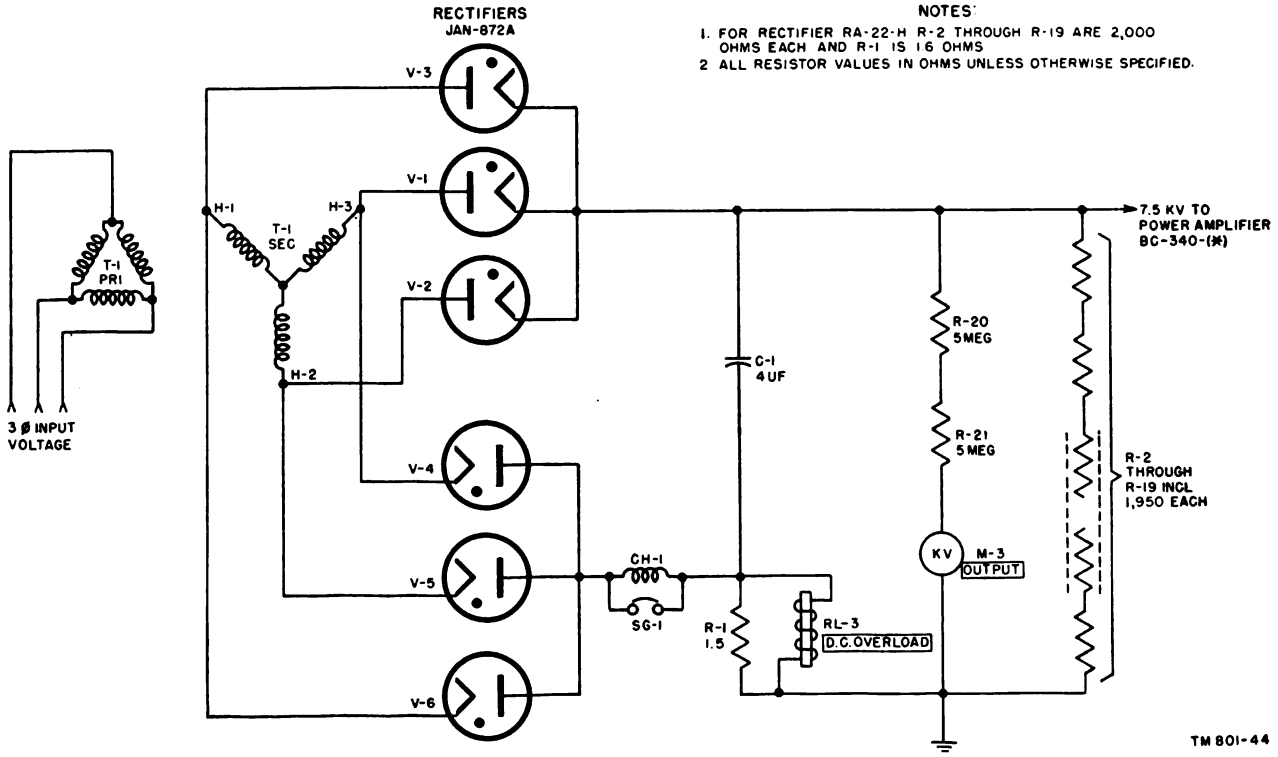

Figure 52. Rectifier RA-22-(*) (except model RA-22), functional diagram of rectifier.

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voltage that must exist across the terminals to produce an arc is dependent on the distance between the spheres. The greater the distance, the greater the voltage required for break-down. These gaps are set a distance of 0.020 inch apart, which requires a break-down potential of 15,000 volts peak. The single-section filter produces practically pure d-c voltage which appears across an approximately 36,000-ohm bleeder, to maintain good regulation in operation. The bleeder consists of eighteen 116-watt resistors (R–2 through R–19) in series, and its current is included in the 3.45-ampere output. Normally, the rectifier output voltage can be adjusted to 3,750, 5,250, 6,000, 6,750, 7,500, and 8,250 volts dc, each at the rated output current of 3.45 amperes. The output voltage is measured by OUTPUT meter M–3. Resistors R–20 and R–21 are multipliers for the OUTPUT meter.

c. The filaments of three of these tubes (V–1, V–2, and V–3) are fed by a single transformer, T–2 (fig. 85), rated at 216, 220, and 224 volts, 50/60 cycles for the primary and rated at 5.0 volts, 20.25 amperes, and center-tapped for the secondary. The other three tubes, V–4, V–5, and V–6, are supplied by individual transformers, T–3, T–4, and T–5, respectively (fig. 85). These three transformers have a primary rating of 216, 220, and 224 volts at 50/60 cycles and a secondary rating of 5.0 volts, 7.5 amperes, each. All the primaries are regulated by the automatic voltage regulator (VR–1). The output of this voltage regulator (VR–1) is measured by voltmeter M–1, which is mounted on the panel of Rectifier RA–22–(*). This rectifier circuit is highly efficient and yields an output voltage far above the step-up effect of the transformer (T–1). Because of the delta primary and wye secondary, the secondary voltages are 1.73 greater than they would be with both connected in the same manner. Since the rectifier circuit is 3-phase and full-wave bridge, the average d-c voltage is 0.954 of the a-c value, as compared to 0.636 for a similar single-phase rectifier or 50 percent more efficient. Because of this greater efficiency in the rectifier, the filter choke and capacitor are much smaller.

53. Cooling System

a. Water Cooling Unit RU–2–C. This unit (fig. 15) consists of a centrifugal type pump driven by a 3-hp (horsepower), 3-phase, 50/60-cycle motor, a 20″ 4-blade fan also driven by this motor, and a four-row radiator. The system contains a cylindrical surge tank (fig. 6) with a capacity of 20 gallons; the diameter is approximately 14 inches and the length is approximately 30 inches. Under normal conditions the tank is partially filled. The remaining volume serves as a reserve to handle the thermal expansion of water. The water level in the tank is shown either by a float type dial indicator mounted on the face of the tank or by a glass tube direct reading radiator. For the dial type, as the water level varies, the internal float moves accordingly and controls the dial needle. The dial is a small circular type unit and is calibrated from *empty* to *full*. The tank is mounted on wall brackets that are placed at least 1 foot higher than the top of the amplifier unit. This condition assures that the system is replenishable without interrupting service. The system operates by forcing water into the power amplifier where it absorbs heat; the water is then fed to the four rows of the radiator cooling coils where the heat is lost by radiation. The rate of water flow is adjusted to between 7 and 8 gallons per minute.

b. Power Amplifier Blower BL–1. The power amplifier blower is driven by a single-phase, 220-volt, 50/60-cycle motor. The air fed to the blower is drawn up through the air filter located beneath the voltage regulator (VR–1) unit. This insures a draft around the regulator, which, because of its location, is not cooled appreciably by the air coming from the blower. This air is not channeled through ducts but is directed upward over the relays (RL–4, RL–8, RL–7, RL–5, RL–3, RL–2, and RL–1), Tubes JAN–129B, and the plate coils (L–2–1 and L–2–2), and, in general, produces a cooling air draft in the top section of the amplifier.

c. Rectifier Blower BL–1. The rectifier air blower, BL–1, is a duplicate of the one in the power amplifier. The blower motor is connected across the supply line through terminals 10 and 11 (fig. 85) of the rectifier. Thermostat TH–1 is in series with the line feeding the blower and will not close until the ambient temperature is greater than 60° F. (15.5° C.). Since this control (TH–1) is mounted above the rectifier tubes, the blower will not operate unless required. When operating, the blower draws in air through the louvered panel at the bottom of the rectifier unit and up through the air filter. The blower forces air into the vertical T-shaped air duct equipped with five air holes at the top. The air then flows around transformers T–2, T–3, T–4, T–5, choke CH–1, and the rectifier tubes, and produces a cooling air draft in the entire top section of the rectifier unit (fig. 12 or 13).

d. Dust Filters. The filters are the permanent,

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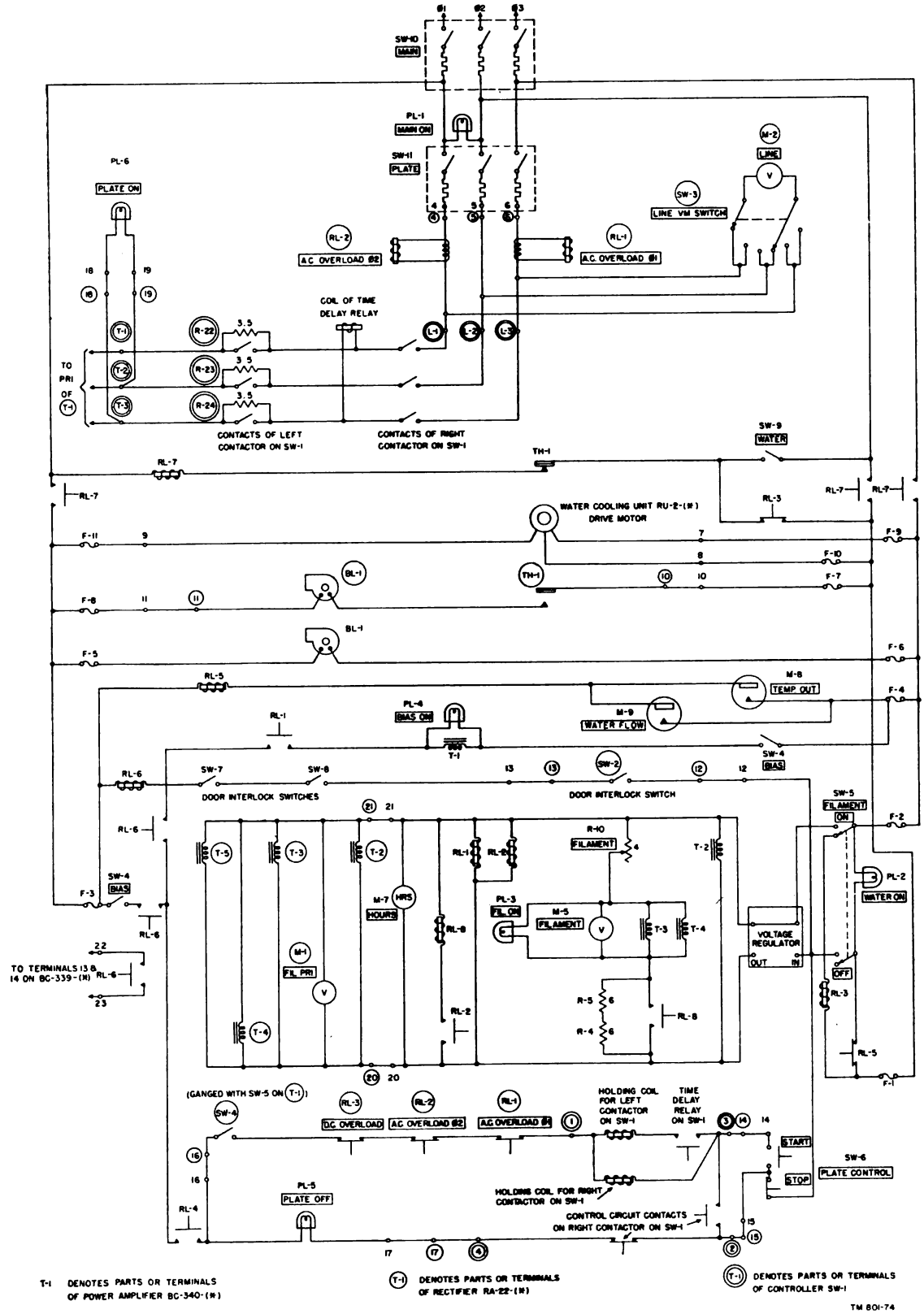

Figure 53. Amplifier Group AN/FRA-2, control circuits.

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baffle-impingement type and are made of crimped galvanized screen wire mesh. These filters strain the dust from the air before the air reaches the blowers. To clean them, follow the instructions in paragraph 57.

54. Control Circuits

In order to ascertain the order of operation of the various controls and relays, refer to the equipment functional diagram (fig. 53). Start at the top and read downward. For the location of all the controls, see chapter 2.

a. STARTING. Since this equipment is designed to operate at both 50 and 60 cycles, the voltage regulator switch (SW–12) is the first control to be set (fig. 29). When all doors are closed, the panel interlocks (single-pole, single-throw switches SW–7 and SW–8) close. These switches control power to the rectifier, the rectifier interlock system, and the amplifier grid bias rectifier circuit.

(1) The first step in the starting procedure proper is to close the MAIN ON-OFF switch (SW–10). This breaker is a three-pole unit containing a thermal overload heater element and a magnetic tripping device, which will open the circuit when a 200 percent overload or greater is applied for several seconds. However, the trips are not sensitive enough to open the circuit as a result of the instantaneous starting current surge. A tripped breaker is indicated when the switch handle has moved to the mid-position, halfway between ON and OFF. To reset, wait 1 minute to permit the thermal element to cool, and throw the handle to the OFF position to recock the control; then throw it back to ON. Thus, the amber pilot light (PL–1) is turned on, and the lines are energized down to the contacts of normally open relay RL–7.

(2) The closing of SW–9, the WATER ON-OFF switch, does not energize the coil of relay RL–7 unless amplifier thermostat TH–1 is closed. Under normal conditions the thermostat is closed, since it is rated as being closed below 140° F. (60° C.) and will not open until 160° F. (71.1° C.) is reached. The coil of relay RL–7 is energized and the closing of the contacts supplies power to the water cooling unit motor, rectifier air blower, and power amplifier air blower. Note that the rectifier air blower line is controlled by rectifier thermostat TH–1. The contacts of the thermostat close with rising temperature and are normally set to close at 60° F. (15.5° C.) but can be adjusted up to 350° F. (176.5° C.). The water interlock relay (RL–5) normally is closed and is controlled by the normally open electrical contacts on both the temperature meter (M–8) for the outgoing water and the water flow meter (M–9). The former will close when the temperature reaches 158° F. (70° C.), thus shorting out the electrical contacts of M–9 and energizing the water interlock relay (RL–5) coil which opens its contacts. The green WATER-ON pilot light (PL–2) will thus be open-circuited and will not turn on. A similar condition will exist if the contacts of the water flow meter (M–9) close, as a result of the water flow dropping below the 7-gallon-per-minute setting, except that the temperature meter (M–8) electrical contacts will be the shorted instrument. Since phase 2 of the line has a return path through the coil of relay RL–3, all portions of the equipment already operating will continue to operate, and the only indication thus far that something is amiss will be the failure of the green WATER-ON pilot light (PL–2) to light. True protection, however, is afforded, since under such conditions it will be impossible to continue with the next starting operation explained below. Under normal conditions, relay RL–5 is not energized and the green WATER-ON pilot light (PL–2) will glow.

(3) Energizing the filament circuit by throwing the filament switch (SW–5) to the ON position puts the filament circuit across the phase 1 to phase 2 line, across which pilot light (PL–2) already appears. If this bulb is not glowing because the relay contacts of RL–5 are open, no voltage will be applied to the filament circuit. This, therefore, is the true protection afforded by the operation of the water interlock relay (RL–5).

(4) In the event that step (3) above is carried out before step (2) above (that is, the filament switch (SW–5) is thrown before the water switch (SW–9)), the contact of relay RL–7 would still be open and no power

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would be available to the filament circuit. In this case it is not harmful to leave the FILAMENT ON-OFF switch (SW–5) ON and then to throw the WATER ON-OFF switch. Thus the filaments would be normally energized.

(5) Under normal conditions, closing the FILAMENT ON-OFF switch (SW–5) applies full power to the voltage regulator (VR–1) and thus to the primary of amplifier bias filament transformer T–2, rectifier filament transformer T–2 supplying the three rectifier Tubes JAN–872A, V–1, V–2, and V–3, rectifier filament transformer T–3 supplying tube V–4, rectifier filament transformer T–4 supplying Tube V–5, and rectifier filament transformer T–5 supplying tube V–6. The voltage applied to the primaries of filament transformers T–3 and T–4 (supplying Tubes JAN–129B, V–1, and V–2, respectively) is equal to the line voltage less the voltage drop across a portion of the 4-ohm filament voltage control rheostat (R–10), less the voltage drop across the two 6-ohm resistors (R–4 and R–5) connected in series. This voltage is indicated on the 0- to 250-volt a-c voltmeter, M–5. However, after a time delay of 15 to 30 seconds, the normally open time delay relay RL–2 trips, energizing the coil of relay RL–8. The contacts of RL–8 close and short out the 12 ohms (R–4 and R–5) of filament dropping resistance. The full-line voltage is thus placed across the primary, and the rated 18 volts appear across the secondary.

(6) The green FIL. ON pilot light (PL–3) is connected directly across the primaries of filament transformers T–3 and T–4 and therefore lights as soon as the FILAMENT ON-OFF switch (SW–5) is thrown. The functional diagram also shows rectifier meter M–1 is a 0- to 250-volt a-c voltmeter that meters the rectifier filament transformer primaries. Also controlled by the FILAMENT ON-OFF switch (SW–5) is the amplifier hour meter (M–7), which indicates the number of hours of filament operation.

(7) Closing the FILAMENT ON-OFF switch (SW–5) also energizes the bias plate time delay relay (RL–1). The normally open contacts of this relay close after 30 seconds and permit the grid BIAS ON-OFF switch (SW–4) to control the primary of the bias rectifier plate transformer (T–1). If the BIAS ON-OFF switch (SW–4) is closed before the time delay relay (RL–1) is energized, that is, before the FILAMENT ON-OFF switch (SW–5) is closed, the plate of the bias rectifier will receive no power, since the contacts of the relay RL–1 will still be open.

(8) Closing the BIAS ON-OFF switch (SW–4) provides power to the plates of tubes V–3 and V–4 of the power amplifier grid bias circuit. Note, however, that the contacts of the normally open grounding contactor relay (RL–6) are in series with the BIAS ON-OFF switch (SW–4) and will therefore prevent this power from being applied unless the relay (RL–6) coil is energized. This relay (RL–6) coil is in series with, and thus controlled by, the normally open power amplifier door interlock switches (SW–7 and SW–8) and the rectifier door interlock switch (SW–2).

(9) Under operating conditions the doors are closed, causing the contacts of the grounding contactor relay (RL–6) to close. This permits bias rectifier plate power to be supplied when the BIAS ON-OFF switch (SW–4) is closed and causes the red BIAS ON pilot light (PL–4) to light. The amplifier schematic diagram (fig. 86) shows that included in the bias rectifier bleeder circuit is the coil of the d-c grid bias interlock current relay (RL–4). When the base circuit is energized, this relay (RL–4) coil is energized, causing its normally open contacts to close. This in turn causes the green PLATE OFF pilot light (PL–5) to operate, indicating that all controls thus far have been closed in proper sequence and that the next step in the starting procedure can be carried out.

(10) Application of plate power is controlled by the controller unit (SW–1), which in turn is controlled by the PLATE ON-OFF switch (SW–11). Closing this switch (SW–11) connects the supply line to the rectifier and gives plate voltage control to the controller (SW–1). The right contactor of the starter (SW–1) is energized by pressing down the START button of the

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PLATE CONTROL switch (SW–6), if the a-c overload current relays (RL–1 and RL–2) and d-c overload current relay (RL–3) on the rectifier remain closed. Voltage is thus applied between rectifier terminals 14 and 16 which, as shown on the functional diagram (fig. 53), are tied to points 14 and 16, respectively, on the power amplifier terminal strip. Note that the diagram shows switch SW–4 in series with the overload relays of the rectifier (RL–1, RL–2, and RL–3). This switch (SW–4) is ganged with the primary voltage control on the plate transformer (T–1) of the rectifier and opens only when the voltage control is being changed from one tap to another. Thus, the right-hand contactor of the controller (SW–1) is energized when the PLATE CONTROL switch (SW–6) is pressed to the START position. When this contactor is energized, line voltage less the voltage drop across the series starting resistors (R–22, R–23, and R–24) is applied to the primary of the h-v rectifier plate transformer (T–1), lighting the red PLATE ON pilot light (PL–6). The controller unit is equipped with a mercury type time delay relay which, after 3 seconds, energizes the left contactor, closes it, and shorts out the series starting resistors (R–22, R–23, and R–24). This action causes full voltage to be applied to the primary of the plate transformer (T–1). When the START button of the momentary contact switch (SW–6) is released, the holding circuit is still energized as a result of the action of the auxiliary contact on the first contactor. The last operation is the automatic opening of the normally closed relay contact shown in the functional diagram, to extinguish the green PLATE OFF pilot light (PL–5). If, during the starting procedure, an abnormally large current is drawn by the power amplifier, one or more of the overload relays of the rectifier (RL–1, RL–2, and RL–3) will trip. The tripped relay will be indicated by the appearance of the aluminum flag within the glass inclosure. The relay resets itself instantaneously after tripping, but the indicators do not. To rest the indicators, pull the pin protruding from the glass envelope at the center of the knurled nut.

b. STOPPING. The stopping procedure is the reverse of the starting sequence outlined above, and it involves the operation of all the controls, relays, and indicating devices mentioned above. When the filament switch (SW–5) is open, the coil of the normally closed water shut-down time delay relay (RL–3) is energized. The water switch (SW–9) is opened and after 1 minute the time delay relay (RL–3) opens and shuts off the water supply. Then, ***and not before,*** MAIN LINE switch (SW–10) can be opened. This switch (SW–10) controls all power to the system and, if opened before the relay (RL–3) trips, will shut down circulation too soon and will prevent the proper cooling of the tubes.

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CHAPTER 5

FIELD MAINTENANCE INSTRUCTIONS

Note. This chapter contains information for field maintenance. The amount of repair that can be performed by units having field maintenance responsibility is limited only by the tools and test equipment available, and by the skill of the repairman.

Section I. PREREPAIR PROCEDURES

55. Tools, Materials, and Test Equipment

The tools, materials, and test equipment needed for performing the prerepair procedures in this section are listed below.

Tool Equipment TE–113 (Signal Corps stock No. 6R38113).
Solvent (SD) (Fed spec No. P–S–661a).
Test Set I–176: Test meter; 0 to 1,000 volts ac; 0 to 5,000 volts dc; 0 to 10 amperes ac; 0 to 5 amperes dc; 0 to 10 megohms.

56. Stripping

Most of the component parts of this equipment are readily accessible and the method of removal is obvious. However, the few special stripping techniques necessary are listed below.

a. Removal of Water Cooled Tubes (Power Amplifier). To prevent spilling water within the unit when the tubes are removed, perform the following steps:

(1) Close the INLET and OUTLET valves at the rear of the amplifier unit.
(2) Open the petcocks at the top of the two vertical porcelain water pipes farthest from the upper door at the right of the unit.
(3) Open the DRAIN valve at the rear of the amplifier unit.
(4) Allow the water to drain out for 3 minutes.
(5) Loosen the rim of the water jackets from around the tube gaskets.
(6) Disconnect all leads and remove the tubes.

Caution: Be certain to close the petcocks and DRAIN valve before starting water circulation again.

b. Removal of Rectifier Tubes JAN–872A (Power Amplifier and Rectifier). To remove rectifier Tubes JAN–872A, proceed as follows:

(1) Remove plate caps.
(2) Turn tube counterclockwise in socket.
(3) Pull tube out.

c. Removal of Air Filters.

(1) *Power amplifier.* To remove the horizontally mounted air filter panel located beneath the voltage regulator, take the following steps:
  (*a*) Remove the thumbscrews from the louvered panel at the front of the amplifier.
  (*b*) Remove the panel.
  (*c*) Remove the thumbscrews immediately above the panel; do not let the air filter fall.
  (*d*) Lower the air filter out of the amplifier unit.
(2) *Rectifier.* The air filter used in the rectifier is exactly the same as the one in the amplifier. The unit is also horizontally mounted several inches from the floor. To remove the filter, proceed as follows:
  (*a*) Remove the thumbscrews from the louvered panel at the front of the rectifier.
  (*b*) Remove the two thumbscrews which hold the filter.
  (*c*) Slide the filter forward and remove it from the rectifier unit.

d. Removal of Fuses. Insert a screw driver in the fuse holder and twist. The fuse then can be readily removed from its holder.

e. Removal of Pilot Light Lamps. Unscrew the jewel guard of the pilot lights on the front panel and remove the screw base lamp by turning counterclockwise.

57. Cleaning, Inspecting, and Testing

a. Cleaning.

(1) To clean air filters, flush them with a solution of grease solvent and hot water. Dry thoroughly and dip in Oil, engine, preservative (SAE 30–50). Drain off all excess oil before replacing the air filter in service.

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(2) Remove any scale formation on the tube anode or water jacket with a hard brush or by dipping in a 10 percent solution of hydrochloric acid. Do not brush the copper area near the seal between the anode and glass envelope. When using acid, take care to keep this area free of acid. Clean out the jacket with a hard brush. Perform this operation when the water is to be drained from the system. The loosened scale will then be flushed out. Then cover the portion of the water jacket subject to friction or binding with a thin film of oil to prevent corrosion.

b. INSPECTING. The source of trouble may be determined by a visual inspection of the units. Inspect the units according to the procedures outlined in paragraph 37.

c. TESTING.

(1) Test all the tubes by substitution. However, when changing to new Tubes JAN–872A, allow filaments to run for one-half hour before applying plate voltage. To do this, open both hinged doors on the amplifier and start up in the normal manner. When changing to new Tubes JAN–129B, allow filaments to burn for 10 minutes before applying plate and grid voltage. Then apply low plate voltage and normal grid voltage for 15 minutes. Then apply normal plate voltage. If flash-overs occur, repeat the procedure for longer periods of time.

(2) Test the plate transformer oil as follows:

(*a*) Use a large-mounted glass bottle as the sample container. Clean all bottles with gasoline and dry them before using them. Use a cork stopper.

(*b*) The sample for dielectric tests should be at least 16 ounces, and if other tests are to be made, 1 quart (32 ounces). Take the test samples only after the oil has settled for some time, varying from 8 hours for a barrel to several days for a large transformer. Cold oil is much slower in settling and may not settle at all. Oil samples from the transformer should be taken from the bottom of the drum. Use a brass or glass *thief* for this purpose. Use the same method for cleaning the *thief* as for cleaning the container.

(*c*) When samples of oil are drawn from the bottom of the transformer or large tank, sufficient oil must be drawn off to make sure that the sample will be composed of oil from the bottom of the container and not from the oil stored in the sampling pipe. A glass receptacle is desirable so that if water is present, it may be readily observed. If water is found, an investigation of the cause should be made and a remedy applied. If water is not present in sufficient quantity to settle out, the oil may still contain considerable moisture in a suspended state. It therefore should be tested for dielectric strength.

(*d*) For testing oil for dielectric strength, use some standard device for oil testing. The standard oil testing spark gap has disk terminals 1 inch in diameter and spaced 0.1 inch apart. Clean the testing cup thoroughly, remove any particles of cotton fiber, and rinse out with a portion of the oil to be tested.

(*e*) Fill the spark gap receptacle with oil; both the oil and the spark gap should be at room temperature or approximately 25° C. After filling the receptacle, allow 1/2 to 1 minute for air bubbles to escape before applying voltage.

(*f*) The rate of increase in voltage should be about 3,000 volts per second. Make five breakdowns on each filling; then empty the receptacle and refill it with fresh oil from the original sample. The average voltage of 15 tests (5 tests on each of the 3 fillings) is usually taken as the dielectric strength of the oil. Continue the test until the mean of the averages of at least three fillings is consistent.

(*g*) The dielectric strength of oil when shipped is at least 22 kv, tested in the standard gap. If the dielectric strength of the oil in a transformer tests at less than 17,500 volts, the oil should be filtered. New oil of less than the standard dielectric strength should not be put in a transformer.

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Warning: When servicing the radio transmitter, be extremely careful because of the high voltages exposed. Always ground the h-v line before doing any testing. With the high voltage off, potentials as great as 240 volts are still present in the transmitter. Keep one hand in pocket when measuring socket voltages with the probe. Before touching any part after the voltage is shut off, short the part to ground by using the shorting stick shown in figure 45.

58. Trouble-Shooting Procedures

The first step in servicing defective equipment is to sectionalize the fault. Sectionalization means tracing the fault to the *major component or circuit* responsible for the abnormal operation of the set. The second step is to localize the fault. Localization means tracing the fault to the defective *part* responsible for the abnormal conditions. Some faults such as burned-out resistors, r-f arcing, and shorted transformers often can be located by sight, smell, and hearing. The majority of faults, however, must be localized by *checking voltage and resistance.*

a. SECTIONALIZATION. Careful observation of the performance of the transmitter on the various bands and while operating the various controls may sectionalize the fault to a particular stage or circuit. Paragraph 45 shows normal operating indications. The meter or signal light involved may indicate whether or not the various stages are functioning. Check the meter readings with table III.

b. COMPONENT SECTIONALIZATION AND LOCALIZATION. The methods listed below aid in isolating the source of trouble. To be effective, the procedure should be followed in the order given. Remember that servicing should cause no further damage to the equipment. First the trouble should be localized to a single stage or circuit. Then the trouble may be isolated within that stage or circuit by appropriate voltage, resistance, and continuity measurements. The service procedure is summarized as follows:

(1) *Visual inspection.* Through this inspection alone (par. 43), the repairman may frequently discover the trouble or determine the stage in which the trouble exists. This inspection is valuable in avoiding additional damage to the units.

(2) *Trouble-shooting chart.* The symptoms listed in this chart (par. 62) will aid greatly in localizing trouble.

(3) *Resistance and voltage measurements.* These measurements checked against the values listed in paragraph 63 will help locate the faulty component.

59. Trouble-Shooting Data

Take advantage of the material supplied in this manual. It will help in the rapid location of faults. Consult the following trouble-shooting data:

Fig. and table No.	Description
86	Power Amplifier BC–340–(*) (except model BC–340), schematic diagram.
85	Rectifier RA–22–(*) (except model RA–22), schematic diagram.
88	Power Amplifier BC–340–(*) (except model BC–340), wiring diagram.
87	Rectifier RA–22–(*) (except model RA–22), wiring diagram.
47	Power Amplifier BC–340–(*), functional diagram of grid (input) and neutralization circuits.
49	Power Amplifier BC–340–(*), functional diagram of plate and output circuits.
28	Power Amplifier BC–340–I, water flow circuit diagram.
50	Power Amplifier BC–340–(*), functional diagram of filament circuit.
38	Transmitting equipment power line and control circuit interconnections.
36	Amplifier Group AN/FRA–2, r–f interconnection diagram.
48	Power Amplifier BC–340–(*), functional diagram of grid bias rectifier.
53	Amplifier Group AN/FRA–2, control circuit.
Table IV	Power Amplifier BC–340–(*), resistance measurements.
Table V	Power Amplifier BC–340–(*), voltage measurements.
58	R–f output, waveshapes.
Table VI	Rectifier RA–22–(*), resistance measurements.

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60. Test Equipment Required for Trouble Shooting

The test equipment required for trouble shooting Amplifier Group AN/FRA–2 is listed below. The technical manuals associated with the test equipment also are listed.

Test equipment	Technical manual
Test Unit I-176 or equal.....	TM 11–2626
Electronic Multimeter TS–520/U or equal	TM 11–2654
Voltohmmeter TS–294C/U or equal.....	TM 11–2624

61. General Precautions

Whenever a transmitter is to be serviced, observe very carefully the precautions listed below. Careless replacement of parts often makes new faults inevitable. Note the following points:

a. Before a part is unsoldered, note the position of the leads. If the part, such as a transformer, has a number of connections, tag each of the leads to it.

b. Be careful not to damage other leads by pulling or pushing them out of the way.

c. Do not allow drops of solder to fall into the set, since they may cause short circuits.

d. A carelessly soldered connection may create a new fault. It is very important to make well-soldered joints, since a poorly soldered joint is one of the most difficult faults to find.

e. When a part is replaced in the r-f circuit, it must be placed exactly as the original one was. A part which has the same electrical value but different physical size may cause trouble in h-f circuits. Give particular attention to proper grounding when replacing a part. Use the same ground point as in the original wiring. Failure to observe these precautions may result in decreased gain or possibly in oscillation of the circuit. These precautions are especially true in the grid circuits. The grid leads, to which resistors R–11 and R–12 are attached, must be mounted in the proper position without bending.

62. Trouble-Shooting Chart

The following chart is supplied as an aid in locating trouble in Amplifier Group AN/FRA–2. This chart lists the symptoms which the operator may see or hear while making a few simple tests. The chart also indicates how to localize trouble quickly to the various stages of the equipment. Once the trouble has been located to a stage or circuit, a tube check and voltage and resistance measurements of the stage or circuit found defective should ordinarily be sufficient to isolate the defective part. Normal voltage and resistance measurements are given in paragraph 63.

a. Power Amplifier BC–340–(*).

Symptom	Probable trouble	Correction
1. Failure of amber MAIN ON signal light (PL–1) to light when MAIN ON-OFF switch (SW–10) is thrown to ON.	1a. Bulb defective	1a. Replace bulb.
	b. Tripping of MAIN ON-OF switch (SW–10).	b. Reset switch
	c. No voltage across the lines.....	c. Check with voltmeter.
2. Failure of green WATER-ON signal light (PL–2) to light when WATER ON-OFF switch (SW–9) is thrown ON.	2a. Bulb defective	2a. Replace bulb.
	b. Thermostat (TH–1) mounted on voltage regulator (VR–1) case, tripped because of excessive temperature.	b. Check operating and ambient temperatures.
3. Failure of green WATER-ON signal light (PL–2) to remain lit when FILAMENT ON-OFF switch (SW–5) is thrown to ON.	3a. Bulb defective	3a. Replace bulb.
	b. Water interlock relay (RL–5) is not closed.	b. Increase water flow or decrease water temperature.
	c. Fuse (F–1 or F–2) is blown.....	c. Find reason for fuse blow-out and replace fuse.
4. Failure of green FIL. ON signal light (PL–3) to light. No deflection on FILAMENT voltmeter (M–5) after FILAMENT ON-OFF switch (SW–5) is thrown to ON.	4a. Bulb defective	4a. Replace bulb.
	b. No output from voltage regulator (VR–1).	b. Check connections to voltage regulator (VR–1) terminal board. Check continuity of voltage regulator (VR–1).
	c. Short circuit in filament circuit..	c. Find short and repair.

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Symptom	Probable trouble	Correction
5. Failure of red BIAS ON signal light (PL–4) to light after BIAS ON-OFF switch (SW–4) is thrown to ON.	5a. Bulb defective	5a. Replace bulb.
	b. Blown fuse (F–3 or F–4 in models –G and –I, F–2 in the other models).	b. Find cause of fuse blow-out and replace fuse.
	c. Grounding contactor (RL–6) has not operated.	c. Make certain that doors on power amplifier and rectifier are closed. If they are, shut down equipment and check door interlock switches SW–7 and SW–8 on power amplifier and SW–2 on rectifier.
6. Failure of green PLATE OFF signal light (PL–5) to light after BIAS ON-OFF switch (SW–4) is thrown to ON. Green FIL. ON signal light (PL–3) is on.	6a. Bulb defective	6a. Replace bulb.
	b. Grounding contactor (RL–6) has not operated.	b. Same as item 5c above.
	c. D-C grid bias interlock current relay (RL–4) has not operated because of no bias voltage from the bias rectifier circuit of the power amplifier.	c. Check rectifier Tubes JAN–872A of this circuit. With the aid of the bias rectifier schematic diagram (fig. 48), check each of the components of this circuit.
7. Failure of PLATE ON signal light (PL-6) to light after the PLATE ON-OFF switch (SW–11) is thrown to ON and the START button of the PLATE CONTROL switch (SW–6) is pressed.	7a. Bulb defective	7a. Replace.
	b. Improper operation of controller (SW–1) contactor in the rectifier unit.	b. Check interconnecting wiring. Check cable connections to controller (SW–4). Check connections to terminals of controller (SW–1).
	c. PRIMARY VOLT CONTROL detent microswitch (SW–4) of oil-filled plate transformer (T–1) in rectifier unit.	c. PRIMARY VOLT CONTROL switch (SW–5) not locked into switch contacts. Try hand-wheel to make sure that contact is being made. If this fails to rectify the trouble, it is necessary to readjust SW–4, located within transformer T–1.
8. Failure of filaments of all four tubes in power amplifier to light.	8. No voltage output from voltage regulator (VR–1). Verify by checking FILAMENT VOLTMETER (M–5).	8. Check voltage regulator and continuity between VR–1 and filament transformers T–2, T–3, and T–4.
9. Failure of any *one* tube filament to light.	9a. Open circuit within tube.....	9a. Check tube for continuity.
	b. Poor contact to filament terminals or to filament transformers.	b. Clean contacts and tighten connections.
	c. Defective filament transformer.....	c. Check transformer for continuity.
10. Excessively high currents indicated on GRID milliammeter (M–2).	10a. Self-oscillation due to improper neutralization.	10a. Readjust NEUTRALIZATION capacitors C–3 and C–4.
	b. Excessive excitation	b. Reduce exciter power.
11. Excessively high currents on PLATE 1 ammeter (M–1) or PLATE 2 ammeter (M–4).	11. Plate circuit adjusted out of resonance.	11. Readjust PLATE TUNING capacitor C–5 and LINE COUPLING capacitor C–6.
12. Abnormally low output.....	12a. Low r-f excitation.....	12a. Adjust INPUT COUPLING capacitor (C–1).
	b. Low plate voltage.....	b. Check rectifier R–22 (*).
	c. Low filament voltage.....	c. Increase filament voltage by varying FILAMENT rheostat (R–10).
13. Arc-over in PLATE TUNING capacitor (C–5).	13a. Dirt and dust on capacitor plates..	13a. Clean plates thoroughly.
	b. Insufficient loading of plate tank circuit.	b. Readjust LINE COUPLING capacitor (C–6).
	c. Excessive r-f excitation.....	c. Readjust output coupling circuit of exciter unit. Readjust INPUT COUPLING capacitor (C–1).

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Symptom	Probable trouble	Correction
14. Arc-over in LINE COUPLING capacitor (C–6).	14a. Uusually occurs at the higher operating frequencies as a result of variation in transmission line and antenna impedance from 600 ohms.	14a. Slight variation in distance between transmission line might suffice or reduce transmission line impedance.
	b. Dirt and dust on capacitor plates...	b. Clean plates thoroughly.
	c. Distortion of the plates.....	c. Check *all* the plates for mechanical distortion. Straighten plates.
	d. Undercoupling to transmission lines.	d. Readjust LINE COUPLING capacitor C–6.
15. Persistent blue haze throughout amplifier tubes.	15. Gassy tube	15. Replace tube.
16. BIAS voltmeter (M–3) indicates low grid bias voltages.	16a. Tube JAN–872A failure in grid bias rectifier circuit.	16a. Check connections to tube socket. Check tube. Replace if necessary.
	b. Bad filter capacitor (C–26).....	b. Replace capacitor.
17. FILAMENT voltmeter M–5 indicates low filament voltage.	17a. Filament time delay relay RL–2 remained open.	17a. Check relay coil and coil connections.
	b. Defective voltage regulator VR–1..	b. Same as item 4b above.
18. Chattering or hum noise coming from relays.	18. Relay noise due to:	
	a. Low voltage across relay armature	a. Check line voltage. Check circuit of which relay is a part.
	b. Contacts or armature not properly seated.	b. Check relay for cracks or distortion. Repair or replace if necessary.
	c. Poor contact surfaces.....	c. Clean contacts.

b. RECTIFIER RA–22–(*)

Symptom	Probable trouble	Correction
1. Controller SW–1 contactor opens when the exciter is keyed.	1. Grid bias interlock relay RL–4 in power amplifier opens at keying current surge.	1. Readjust the relay RL–4 to hold at the lower bias voltage produced by the current surge. Reset overload relay.
2. Chatter or hum heard coming from equipment.	2. Controller SW–1 contactors chatter or hum.	2. Check line voltage; may be too low.
3. Opening of second controller SW–1 contactor immediately upon closing.	3. Tripping of an overload relay.....	3. Check indicator flags to determine which relay tripped. Determine cause of overload. Reset flag.
4. Failure of second contactor on controller SW–1 to close after first contactor has closed.	4a. Faulty time delay relay on controller unit SW–1.	4a. Check continuity of time delay relay coil. Check contacts for corrosion. Make certain that mercury cartridge is in place at bottom of relay.
	b. Open circuit at contactor coil.....	b. Check continuity of second contactor coil. Find break and repair.
5. D.C. OVERLOAD relay RL–3 opens.	5a. Resistor R–1 burned out.....	5a. Find cause and replace resistor.
	b. Plate circuit off resonance.....	b. Retune.
6. Odd color glow within tubes.....	6. Gassy tube	6. Replace tube in question.
7. Failure of filaments of all six tubes to light.	7. No voltage output from voltage regulator VR–1 unit in power amplifier. Verify by checking FIL. PRI. voltmeter M–1.	7. Same as item 4b of power amplifier section (*a* above).
8. Failure of any one tube filament to light.	8. Filament transformers T–2, T–3, T–4, and T–5.	8. Check transformers.
9. FIL. PRI. voltmeter M–1 indicates low filament voltage.	9. Same as item 17a and b of power amplifier section (*a* above).	9. Same as item 17a and b of power amplifier section (*a* above).
10. Failure of air blower BL–1 to operate after ambient temperature exceeds 60°F (15.5°C).	10 Blown fuses F–7 and F–8 in Power Amplifiers BC–340, –G, and –I or fuse F–5 in the other models.	10. Determine cause of fuse failure and replace fuses.

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Symptom	Probable trouble	Correction
11. OUTPUT kilovoltmeter M–3 indicates low output voltage.	11a. Excessive current drain from rectifier unit.	11a. Readjust power amplifier controls so that tube cathode currents fall within proper operating values.
	b. Defective tube	b. Replace tube.
	c. Bad filter capacitor C–1	c. Replace capacitor.
12. PRIMARY VOLT CONTROL SW–5 rotates past position 6 clockwise, or past position 1 counterclockwise, or both.	12. The stop within the transformer is broken.	12. Remove the top of the transformer and replace the bakelite stud on each of the three switch wafers.

c. WATER COOLING UNIT RU–2–(*).

Symptom	Probable trouble	Correction
	Water pump	
1. WATER FLOW meter M–9 on power amplifier front panel indicates no water flow or insufficient water flow.	1a. Pump speed too low	1a. Check motor speed (see item 2 in this table).
	b. Discharge head too high	b. Lower discharge head.
	c. Impeller is clogged	c. Clean water pump.
	d. Impeller is rotating in wrong direction.	d. Check drive motor direction of rotation. If wrong, interchange two of the input lines.
	e. Wearing rings are worn	e. For Water Cooling Unit RU–2–C, these are indicated as COVER, items 15 and 22, on the pump cross-sectional drawing (fig. 56). When these covers are worn out, replace them. Follow the disassembly and reassembly instructions given in paragraph 65.
	f. Impeller is damaged	f. Impurities will damage the impeller. It must be replaced. For Water Cooling Unit RU–2–C, follow the disassembly and reassembly instructions given in paragraph 65.
	g. Air in pump	g. Open air cock on pump or prime (par. 32*c*).
2. Motor speed too low	2a. Improper voltage to motor	2a. Check voltage.
	b. Binding of rotating elements	b. Clean motor and pump assemblies.
	c. Slack in drive belts	c. Take up slack (par. 65).
	d. Variable sheaves improperly set	d. Reset sheaves (par. 32*a*).

63. Checking Resistance and Voltage Measurements

The tables below will aid in determining the part or circuit at fault.

Table IV. Power Amplifier BC–340–(*), Resistance Measurements

Measure	Test set scale	Resistance	Possible component at fault
Plate V–1 to ground	150K	1,040 ohms	L–2–1, RF–3, C–18, R–2, C–8, RL–6 contact.
Plate V–2 to ground	150K	1,040 ohms	L–2–2, RF–4.
Grid V–1 to ground	150K	1,430 ohms	L–1, RF–2, RL–1, R–6, R–7, R–8, R–9, RL–4 coil.
Grid V–2 to ground	150K	1,430 ohms	L–1, RF–1.
Filament V–1 to ground	500 ohms	0	Secondary T–3, M–1.
Filament V–2 to ground	500 ohms	0	Secondary T–4, M–4.

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Table IV—Continued

Measure	Test set scale	Resistance	Possible component at fault
Plate V-3 or V-4 to ground	150K	1,000 ohms	Secondary T-1, C-26.
Filament V-3 or V-4 to ground.	500 ohms	32	Secondary T-2, CH-1.
Coil RL-1		1,100 ohms	
Coil RL-2		1,100 ohms	
Coil RL-3		1,100 ohms	
Coil RL-4		4 ohms	
Coil RL-5		4,107 ohms impedance	
Coil RL-6		160 ohms	
Coil RL-7		4,107 ohms impedance	
Coil RL-8		9,700 ohms impedance	

Table V. Power Amplifier BC-340-(*), Voltage Measurements

Measure across	Test set scale	Voltage
Coil RL-1	250 v ac	222 v ac.
Coil RL-2	250 v ac	222 v ac.
Coil RL-3	250 v ac	205 v ac.
Coil RL-4	10 v dc	2.2 v dc.
Coil RL-5	250 v ac	205 v ac.
Coil RL-6	250 v ac	205 v ac.
Coil RL-7	250 v ac	205 v ac.
Coil RL-8	250 v ac	222 v ac.
R-4 and R-5 with RL-8 open	250 v ac	90 v ac.
R-4 and R-5 with RL-8 closed	250 v ac	0.
T-2 secondary	10 v ac	5 v ac.
Plate V-3 or V-4 to secondary T-1	1,000 v ac	650 v ac.
Plate V-3 or V-4 to ground	1,000 v dc	540 v dc.
CH-1	50 v dc	13 v dc.
C-26	1,000 v dc	510 v dc.
R-10 maximum	50 v ac	7.25 v ac.

Table VI. Rectifier RA-22-(*), Resistance Measurements

Measure		Test set scale	Resistance (ohms)	Possible component at fault
From	To			
Term. 20	Term. 21	500	0.15	T-2, T-3, T-4, T-5, M-1.
T-2 CT	Ground	150M	37,000	Bleeder resistors, C-1, M-3, R-20, R-21.
Plate V-4, V-5, or V-6	Ground	500	1.9	CH-1 or R-1.
Plate V-1	Plate V-2	500	16	T-1 Secondary.
Plate V-2	Plate V-3			
Plate V-3	Plate V-1			
Across				
Coil RL-1		500	0.15	
Coil RL-2			0.15	
Coil RL-3			2.7	
Coil time delay relay		150M	1,100	
Left contactor coil		500	20	
Right contactor coil		500	20	

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64. Replacement of Parts

The major components of this equipment are readily accessible and are easily replaced if faulty. Complete information on mounting of components is given in the installation section, paragraph 17.

a. Replacement of Targets in Water Fittings. Targets are located in each fitting in the water system, representing a junction between the positive end of the porcelain and the metal piping. They are included in the positive fittings of the ceramic tubes and the porcelain water coils. These targets consist of a small plug into the end of which has been soldered a length of copper wire. The size of this wire is unimportant, except that the larger sized wire will last somewhat longer. The size wire installed with the equipment will give an indication as to the approximate size most desirable. The purpose of these targets is to concentrate the electrolytic action between water and metal upon the wire instead of the metal parts of the fitting, and, therefore, the wire will ultimately be dissolved by electro-chemical action into the water stream. The wire must extend into the water stream beyond the metal fitting by an appreciable amount, so that the electrical leakage current will leave from the wire rather than from the metal fitting, as the wire represents a shorter electrical path to the target at the other end of the insulated water column. A periodic inspection will indicate how frequently the targets must be replaced. Use copper wire when replacing the targets, and make the wire long enough to extend at least 1 inch beyond the lowest portion of the metal fitting which comes in contact with the water.

b. Replacement of V Belts for Water Cooling Units RU–2, –A, and –B.

(1) Unlock the motor base and move the motor toward the fan drive until it meets the stops. Lock the motor in this position and remove the old belts.

(2) Put on the new set of V belts. Do not roll the belts on or use a tool, as these methods will damage the belts. Always replace both belts at the same time.

(3) Pull all the slack toward the motor sheave. Unlock the motor base and move the motor away from the fan drive until the belts are seated in the sheaves.

(4) Start the motor and adjust the motor base to obtain sufficient tension on the belts to eliminate *belt squeal* caused by the slipping of the belt. DO NOT USE ANY TYPE OF BELT DRESSING.

(5) During the first 36 hours of operation, slight additional tension must be applied to take up the initial stretch and wearing-in or seating of the belts in the grooves. After the initial running-in period, reset the belt tension to just beyond the point where the *belt squeal* is eliminated.

(6) DO NOT TIGHTEN THE BELTS MORE THAN NECESSARY. Excessive tension reduces belt life and causes the bearings to overheat.

c. Parts List for Water Pump on Water Cooling Units RU–2, –A, and –B (figs. 54 and 55).

Cat. No.	Description	No. req 405–64€ incl	No. req 702–721 incl	No. req 805–815 incl
1	Body	1	1	1
2	Cover—opposite motor end	1	1	1
3	Cover—motor end	0	1	1
4	Cover gasket	1	2	2
5	Cap screws, body cover	7	24	40
6	Flange—suction side	0	1	1
7	Gasket, suction flange	0	1	1
8	Bolts, nuts for suction flange	0	4	8
9	Flange—discharge side	0	1	1
10	Gasket for discharge flange	0	1	1
11	Discharge flange, bolts, nuts	0	4	8
13	Grease cups	2	2	2
14	Pipe plug for suction	1	1	1
15	Pipe plug for discharge	1	1	1
15A	Discharge pipe plug (top)	0	------	1
16	Pipe plug, knockout open	2	4	4
17	Pipe plug for drain	1	0	0
18	Pipe plug for packing lubricant	0	------	2
19	Air cock	1	1	1
20	Nameplate	1	1	1
21	Screws for nameplate	2	2	2
35	Liner—inner	1	1	1
36	Liner—outer	1	1	1
40	Impeller assembly	1	1	1
41	Impeller only	1	1	1
42	Shaft only	1	1	1
43	Locknuts for shaft	2	2	2
45	Lockwashers for shaft	2	2	2

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Cat. No.	Description	No. req 405-646 incl	No. req 702-721 incl	No. req 805-815 incl
49	Keys for shaft	2	2	2
50	Water slingers	2	2	2
51	Sleeve for shaft	1	0	0
55	Packing	[1]2	[1]2	[1]2
56	Packing gland	2	2	2
57	Eyebolt assembly (includes next 5 items)	4	4	4
58	Eyebolts only	4	4	4
59	Nuts for eyebolts	4	4	4
60	Washers for eyebolts	4	4	4
61	Pins for eyebolts	4	4	4
62	Cotter pins for eyebolts	4	4	4
65	Ball bearings	2	2	2
66	Inner adjusting nut, bearing	1	1	1
67	Outer adjusting nut, bearing	1	1	1
68	Lockscrews for adjusting nut	2	2	2
69	Inner cap for bearing	1	1	1
70	Outer cap for bearing	1	1	1
71	Bearing cap retaining screw	0	2	2
90	Flex. coupling—complete (includes next 6 items)	1	1	1
91	Flex. coupling, pump half	1	1	1
92	Flex. coupling, motor half	1	1	1
93	Discs for flexible coupling	3	3	4
94	Setscrew, flexible coupling	2	2	2
95	Coupling setscrew wrench	1	1	1
100	Base (not illustrated)	1	1	1

[1]Sets.

65. Disassembly and Reassembly Instructions for Water Pump of Water Cooling Unit RU-2-C

a. DISASSEMBLY OF WATER PUMP. Follow instructions below for disassembling the water pump. Refer to the cross-sectional drawing (fig. 56) for part numbers and to table VII for description. Read instructions through entirely before starting to disassemble.

(1) Remove cover plate cap screws No. 19A.
(2) Loosen adjusting nut setscrews No. 29.
(3) Remove adjusting nut No. 25.
(4) Remove jam nut No. 24; use a socket type wrench.
(5) Loosen packing gland eyebolts No. 18A and swing clear of gland No. 17A.
(6) Remove cover plate No. 22. If it should stick tap lightly around flanged edge to loosen, or drive flat-edge tool (screw driver or chisel) between flanges of cover plate, and pump shell at several points around shell. (Be careful not to break flanges.)
(7) Loosen ball bearing lock collar setscrew No. 42.
(8) Hold lock collar No. 39 with pipe wrench and turn pump shaft with coupling until lock collar loosens.
(9) Loosen coupling setscrew No. 4.
(10) Pull out shaft and impeller together, just enough to remove pump half coupling No. 2 and Woodruff key No. 3.
(11) Now pull shaft and impeller clear of pump.
(12) Loosen setscrews No. 21.
(13) Remove impeller from shaft.
(14) Remove cap screws No. 19.
(15) Remove cover plate No. 15.
(16) Ball bearings can be removed from bearing arms by pushing them outward from stuffing box side of cover plates after adjusting nuts have been removed.

b. REASSEMBLY OF WATER PUMP. Follow procedure below for reassembling the water pump. Perform *c* below first if necessary.

(1) Follow in reverse order the procedure given for disassembly.

Table VII. Description of Water Pump Components

No.	Description	No.	Description	No.	Description
1	Coupling motor half	11	Packing	21	Setscrew.
2	Coupling pump half	12	Coupling insert	22	Cover, right.
3	Coupling key	13	Shaft	23	Ball bearing.
4	Setscrew	14	Ball bearing	24	Jam nut.
5	Adjusting nut	15	Cover, left	25	Adjusting nut.
6	Grease cup	16	Water slinger	26	Clevis pin.
7	Adjusting nut	17	Gland	27	Cotter pin.
8	Shell	18	Eyebolt, nut, and washer	39	Lock collar.
9	Impeller	19	Cap screw	29	Setscrew.
10	Impeller key	20	Gasket	42	Lock collar setscrew.

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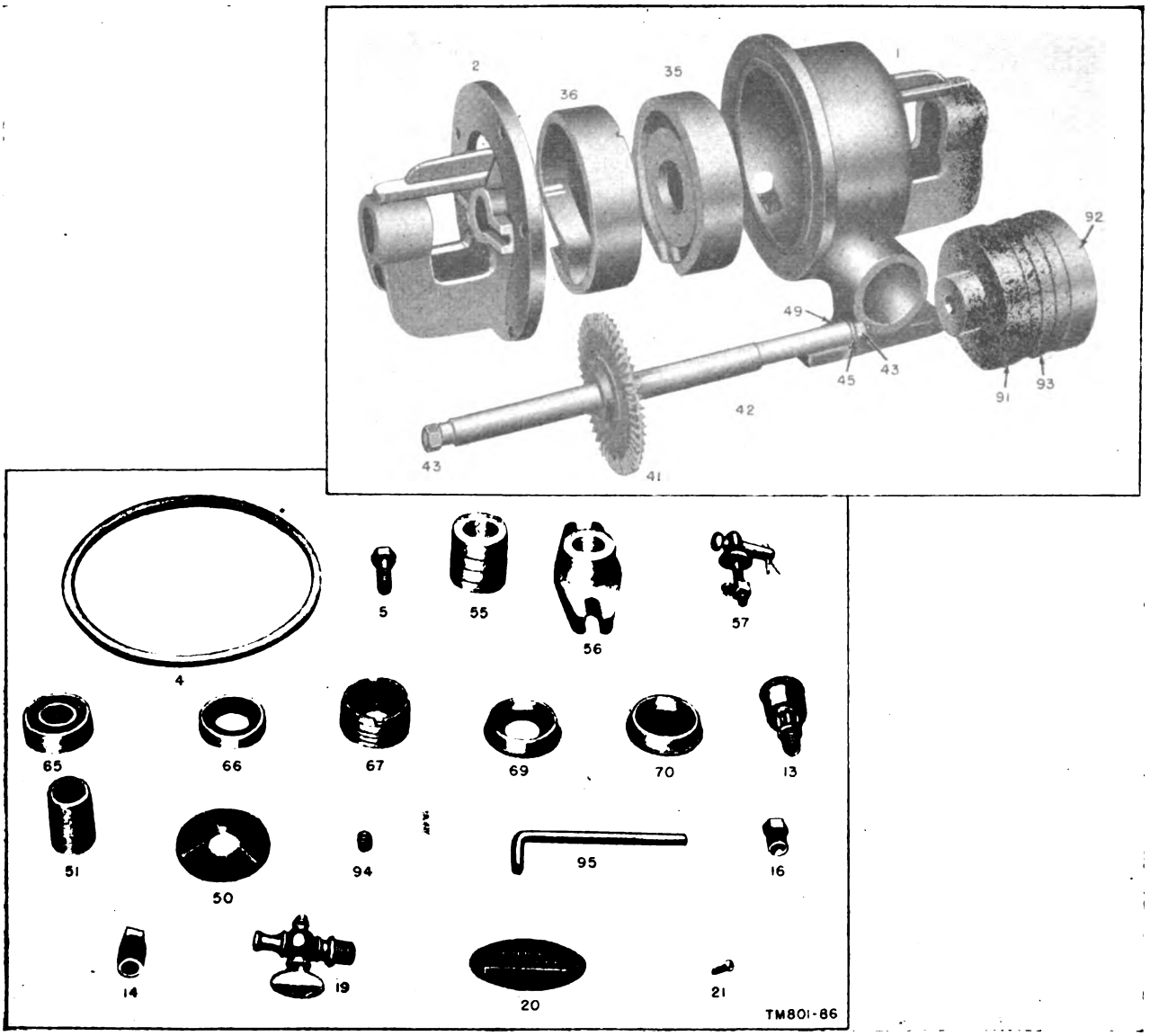

Figure 54. Water Cooling Unit RU–2, –A, and –B, water pump parts for series BR405 through BR646.

(2) Be extremely careful to make sure that all inner surfaces of pump shell No. 8 are absolutely free from scale, dirt, and burrs.

(3) This also applies to cover plate surfaces and to all other surfaces; otherwise the parts will not fit properly and trouble will be encountered in the assembly.

(4) Wash all parts carefully in solvent (SD).

(5) Make sure liquid slingers No. 16 are placed on shaft when reassembling. These slingers prevent the possibility of any liquid which may leak from the stuffing boxes from entering the ball bearing and washing out the grease.

(6) Readjust impeller clearance (par. 68).

c. Repacking Instructions for Water Pump. At the start of the reassembly process, check the packing in the stuffing box. It may have become dried out and hard. If so, renew it as follows:

(1) Use a good grade of braided, graphited, and lubricated asbestos packing.

(2) Remove the glands.

(3) Make sure the packing is cut to proper length.

(4) Make sure the packing is compressed just enough to slide readily without being smashed while placing.

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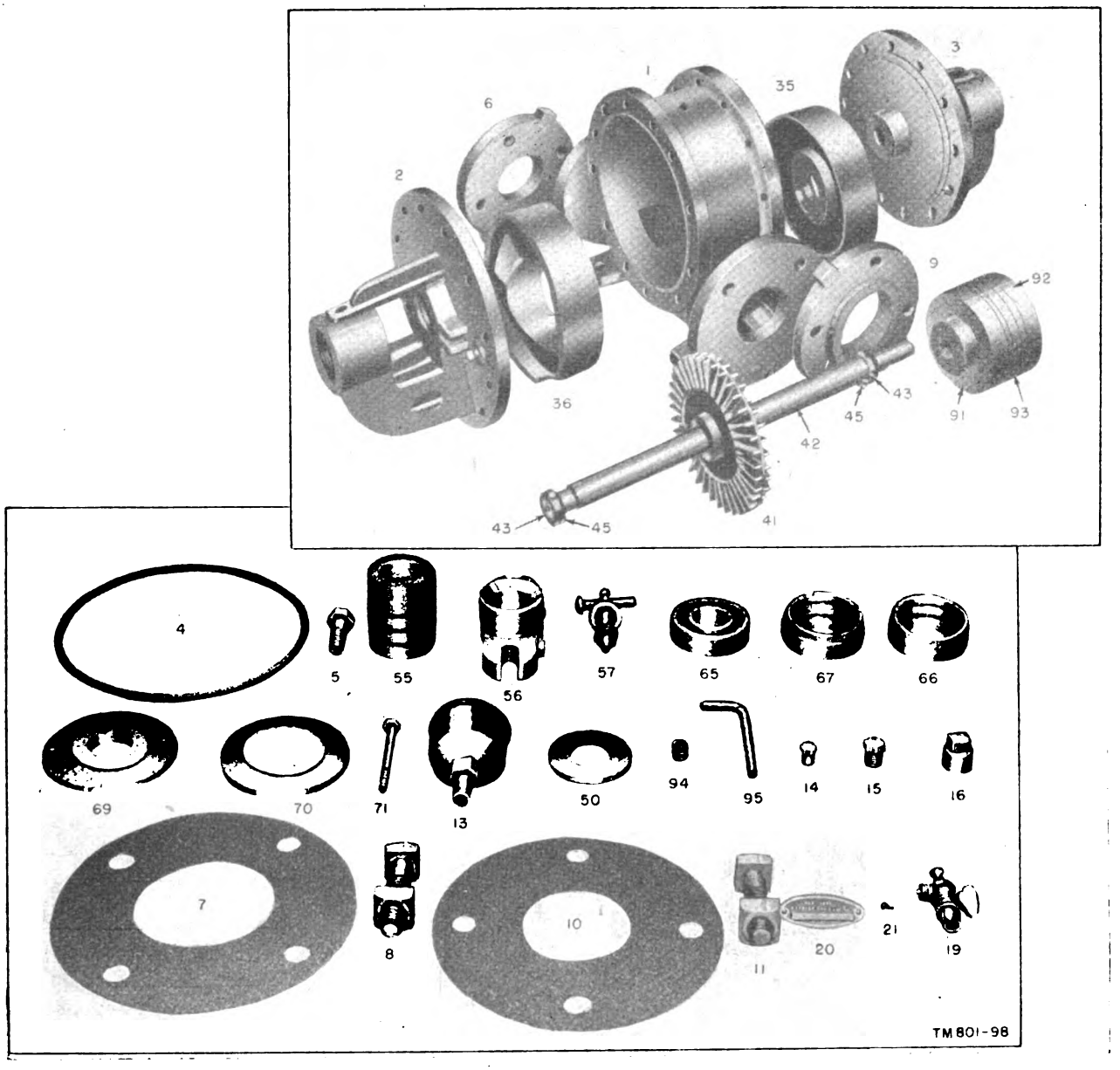

Figure 55. Water Cooling Unit RU–2, –A, and –B, water pump parts for series BR700 and BR800.

(5) Pressure with the hand and fingers should be sufficient for pushing the rows of packing into place. If it is not, either the packing is too large or some obstruction exists.

(6) Place glands into position and insert into stuffing box.

(7) Let the pump run in.

(8) Always tighten packing glands when the pump is running.

(9) Tighten just enough to prevent excess leakage.

(10) Permit a few drops of liquid to drip per minute; this keeps packing from drying out and prevents scoring of pump shaft.

d. Water Pump Alinement. Another adjustment sometimes required is the realinement of the pump of Water Cooling Unit RU–2–C. All pumps are properly alined at the factory by leveling the base and bringing the pump and driving motor into exact alinement with shims. Experience has proved, however, that all bases, no matter how rugged, will spring and twist during shipment; therefore, it cannot be assured that the original alinement will be maintained. Consequently, it is sometimes necessary

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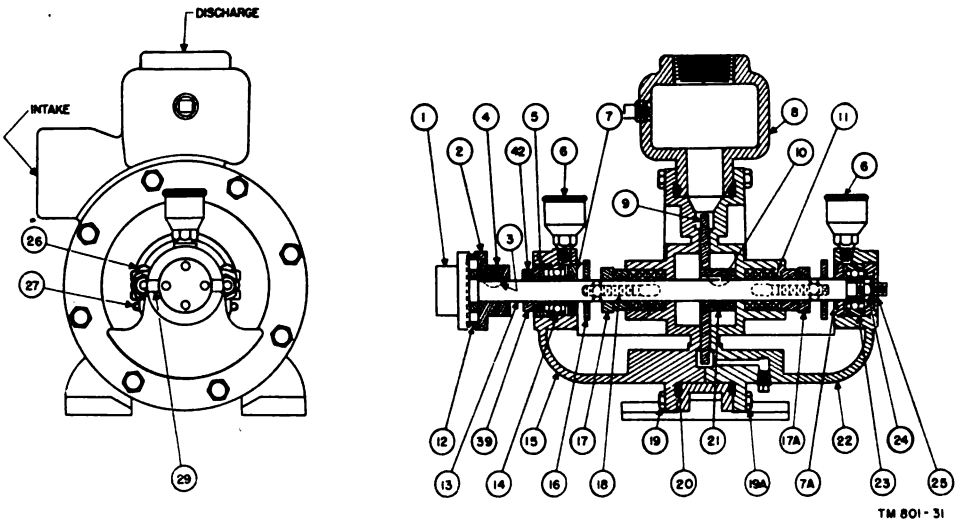

Figure 56. Water Cooling Unit RU-2-C, water pump cross-section.

that the factory alinement be reproduced after shipment or after disassembly and reassembly.

(1) Place pump unit on its foundation, allowing approximately 1 inch between top of foundation and bottom of base; use wedges to obtain proper spacing.

(2) Check top of base for level, using the same wedges for adjustment.

(3) Tighten foundation bolts evenly and firmly so that the base rests solidly on the wedges.

(4) Check the alinement at the coupling by placing a straight edge across the coupling flanges. This should be done at four points, 90° apart, on the coupling. The distance between the faces of the coupling halves should also be checked at four points with a thickness gage. See coupling drawing (fig. 57).

(5) The unit should be alined under the operating thermal conditions, in order that contraction and expansion due to these changes in temperature may be taken into account.

(6) The coupling halves are to be brought into perfect alinement by adjusting the wedges under the base, which must at the same time be level.

(7) Check the alinement after the piping has been completed, using the straightedge and

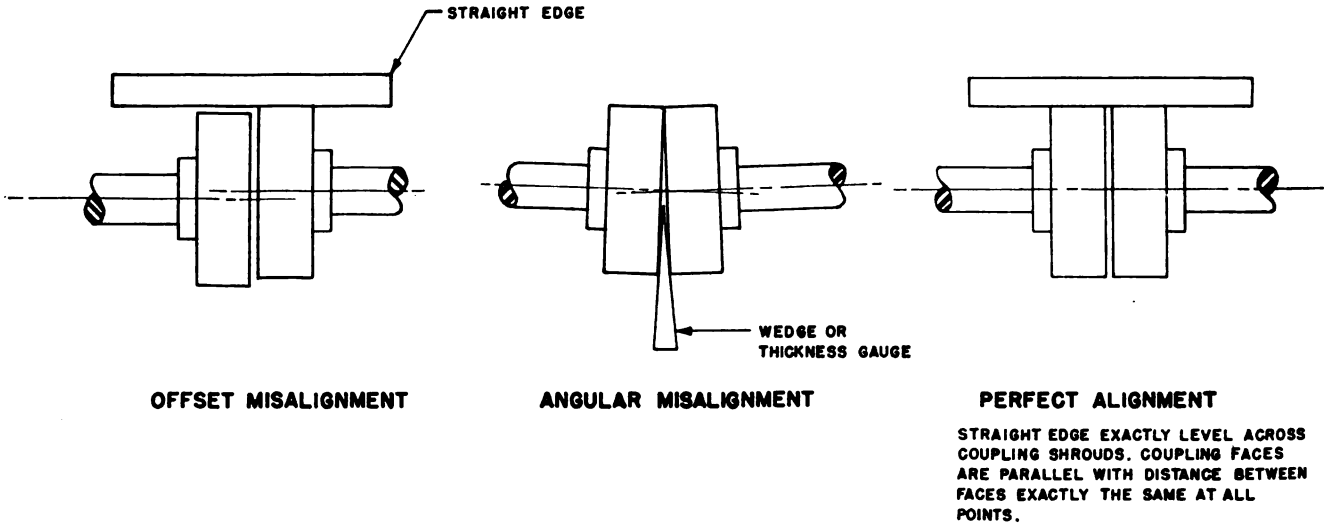

Figure 57. Water Cooling Unit RU-2-C, water pump alinement.

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thickness gage method. Since the unit was alined before the piping was completed, piping strains may be the cause of any misalinement found and changes should be made accordingly. If the stuffing boxes are properly adjusted and the pump and drives properly alined, the unit can be turned over easily by hand.

66. Refinishing

See paragraph 41 on rustproofing and repainting.

67. Repair of Water Leaks

The entire water cooling system should be tested with the amplifier in operation. Any leaks in the exterior plumbing require draining the water from the system. If the leak is at a pipe thread, the joint must be melted loose, the fitting removed and doped again, and then the joint reassembled and soldered. If the leak occurs at a solder joint, melt the joint loose, clean, and resolder. After the equipment has been used for a time, vibration and electrolysis may cause leaks at the solder joints, which will require cleaning and resoldering of both parts.

68. Apparatus Adjustment

a. A complete list of adjustments required for the operation of the unit is given in paragraphs 32 and 33.

b. After performing the complete lubrication procedure for the water pump of Water Cooling Unit RU–2–C, it will be necessary to readjust the impeller clearance. Refer to the pump cross-sectional diagram (fig. 56) and perform the following steps:

(1) Partially screw in adjusting nut No. 25. Make sure both adjusting nuts No. 25 and 7A are loose before starting the adjustment. Leave adjusting nuts No. 5 and 7 slightly loose.

(2) Tighten adjusting nut No. 25 sufficiently so that the shaft will not turn. (Take hold of coupling and try to rotate.) The impeller is now rubbing against the cover plate on the coupling side of the pump.

(3) Loosen adjusting nut No. 25 just a fraction of a turn or until the shaft can be rotated freely. Now tighten adjusting nut No. 7A and try to rotate the shaft again. If the pump turns freely with no indication of impeller rubbing, the pump is properly adjusted. If rubbing still occurs, work the two adjusting nuts back and forth until the pump does rotate freely. Do not tighten adjusting nuts too much; bring up firmly by very light tap of a hammer. After proper adjustment has been obtained, lock adjusting nuts by tightening up the adjusting nut setscrews No. 29, located in the bearing arms.

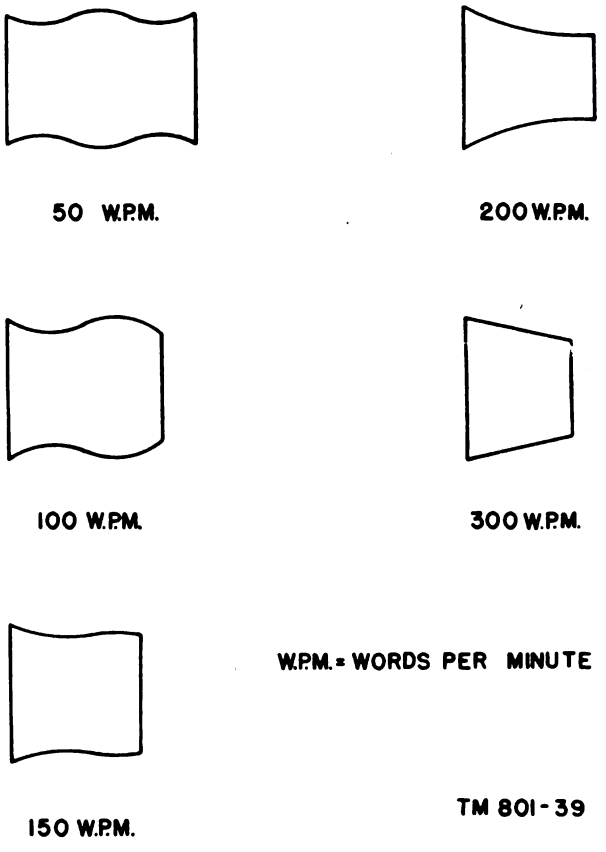

Figure 58. R–f output, waveshapes.

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CHAPTER 6

SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

Section I. SHIPMENT AND LIMITED STORAGE

69. Disassembly

If disassembly of Amplifier Group AN/FRA–2 is necessary, follow in reverse order the installation procedure described in paragraphs 17 through 21. Disassemble the equipment and prepare it for packing in units similar to those in the original packing cases.

70. Repacking for Shipment or Limited Storage

a. The exact procedure in repacking for shipment or limited storage depends on the material available and the conditions under which the equipment is to be shipped or stored. Refer to paragraph 16 of this manual on uncrating, unpacking, and checking; and follow in reverse order the instructions given.

b. Whenever practicable, place a dehydrating agent such as silica gel inside the crates. Protect the crates with a waterproof paper barrier. Seal the seams of the paper barrier with waterproof sealing compound or tape. Provide at least 3 inches of excelsior padding or some similar material between the paper barrier and the packing case.

Section II. DEMOLITION OF MATÉRIEL TO PREVENT ENEMY USE

71. General

The demolition procedures outlined in paragraph 72 will be used to prevent the enemy from using or salvaging this equipment. Demolition of this equipment will be accomplished *only* upon order of the commander.

72. Methods of Destruction

a. Smash. Smash the meters, controls, tubes, switches, insulators, resistors, coils, piping, motors, and capacitors, using sledges, axes, handaxes, pickaxes, hammers, crowbars, or heavy tools.

b. Cut. Cut cords and cables, using axes, handaxes, or machetes.

c. Burn. Burn technical literature, tuning chart, resistors, coils, and capacitors, using gasoline, kerosene, oil, flame throwers, or incendiary grenades.

d. Bend. Bend panels, lead cabling, and chassis.

e. Explosives. Blow up the transformers, motors, and cooling unit, using firearms, grenades, or TNT.

f. Disposal. Bury the destroyed parts in slit trenches, fox holes, or other holes, or throw them into streams.

g. DESTROY EVERYTHING.

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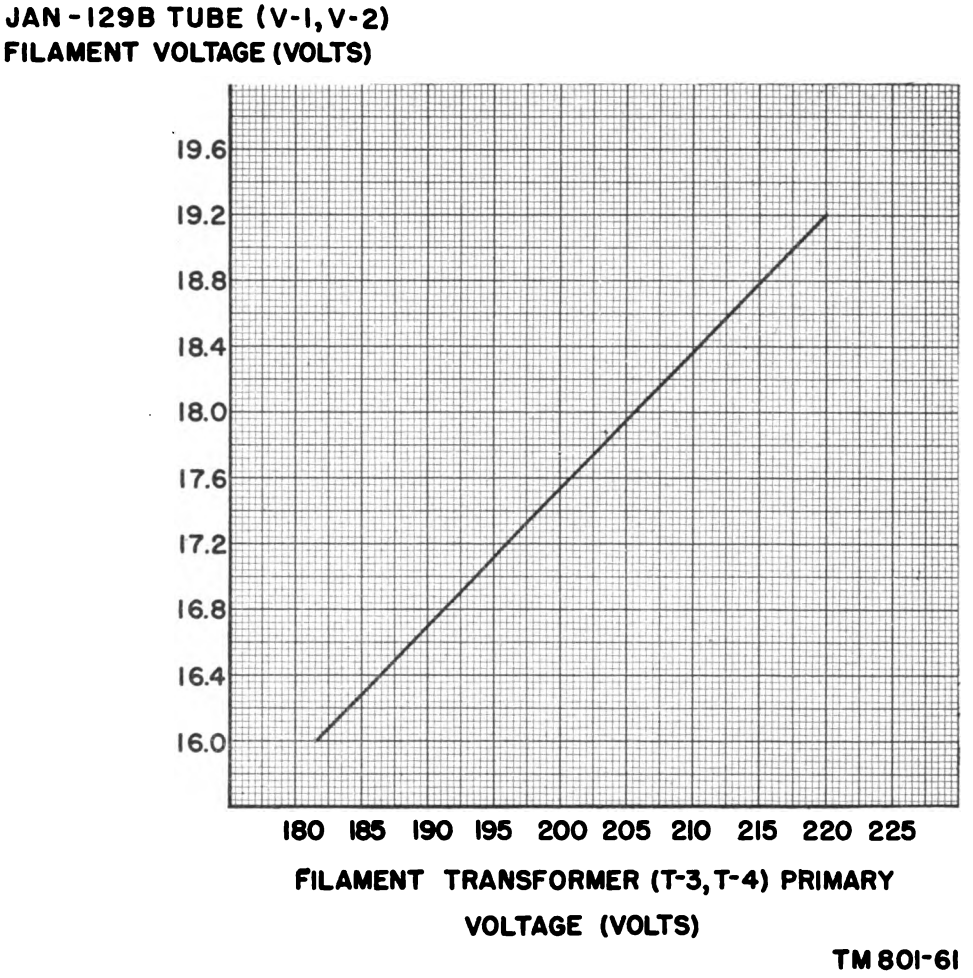

Figure 59. Amplifier Tube JAN–129B, filament voltage curve.

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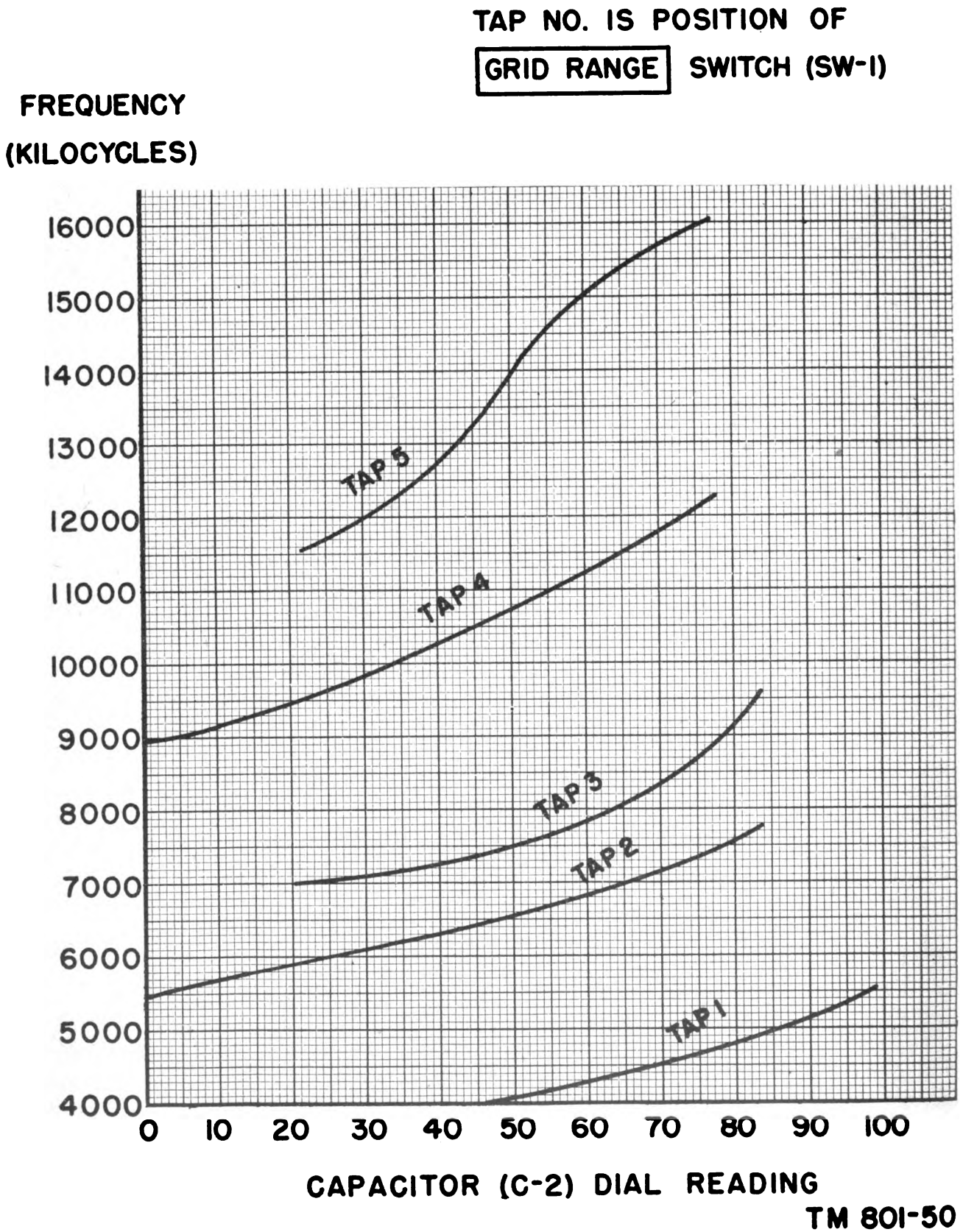

Figure 60. Grid tuning capacitor C-2, calibration curve (4,000 to 16,000 kc).

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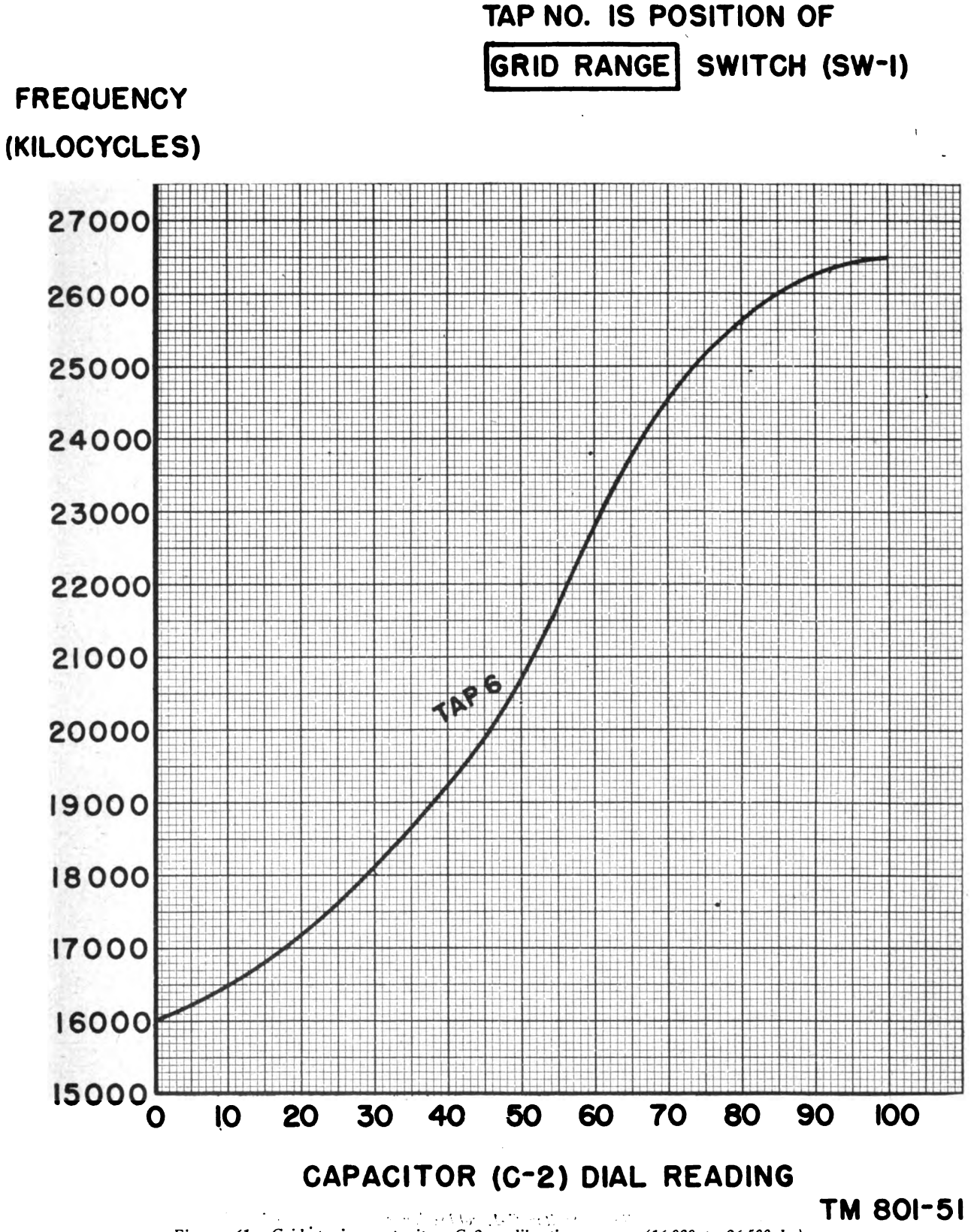

Figure 61. Grid tuning capacitor C-2, calibration curve (16,000 to 26,500 kc).

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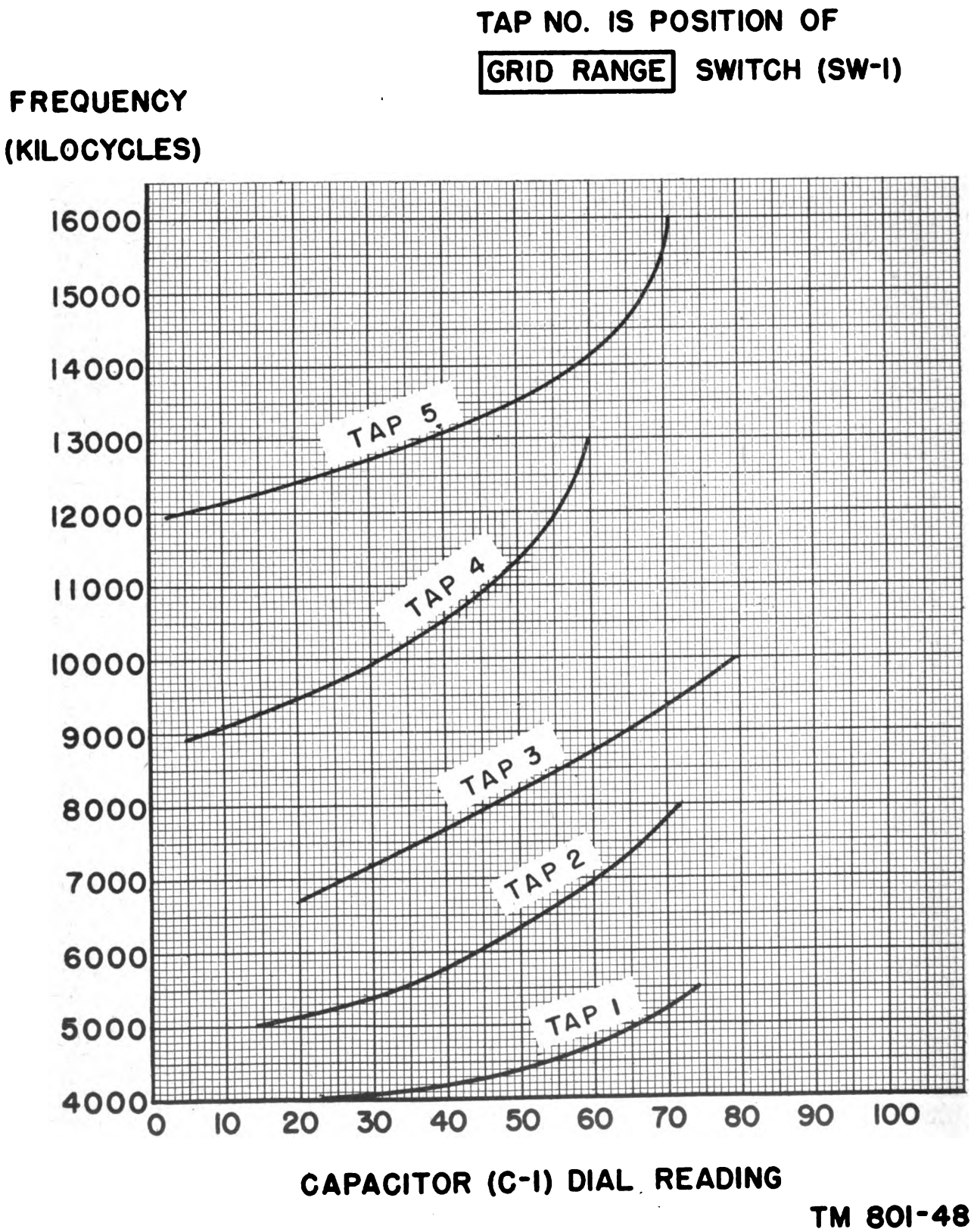

Figure 62. Input coupling capacitor C-1, calibration curve (4,000 to 16,000 kc).

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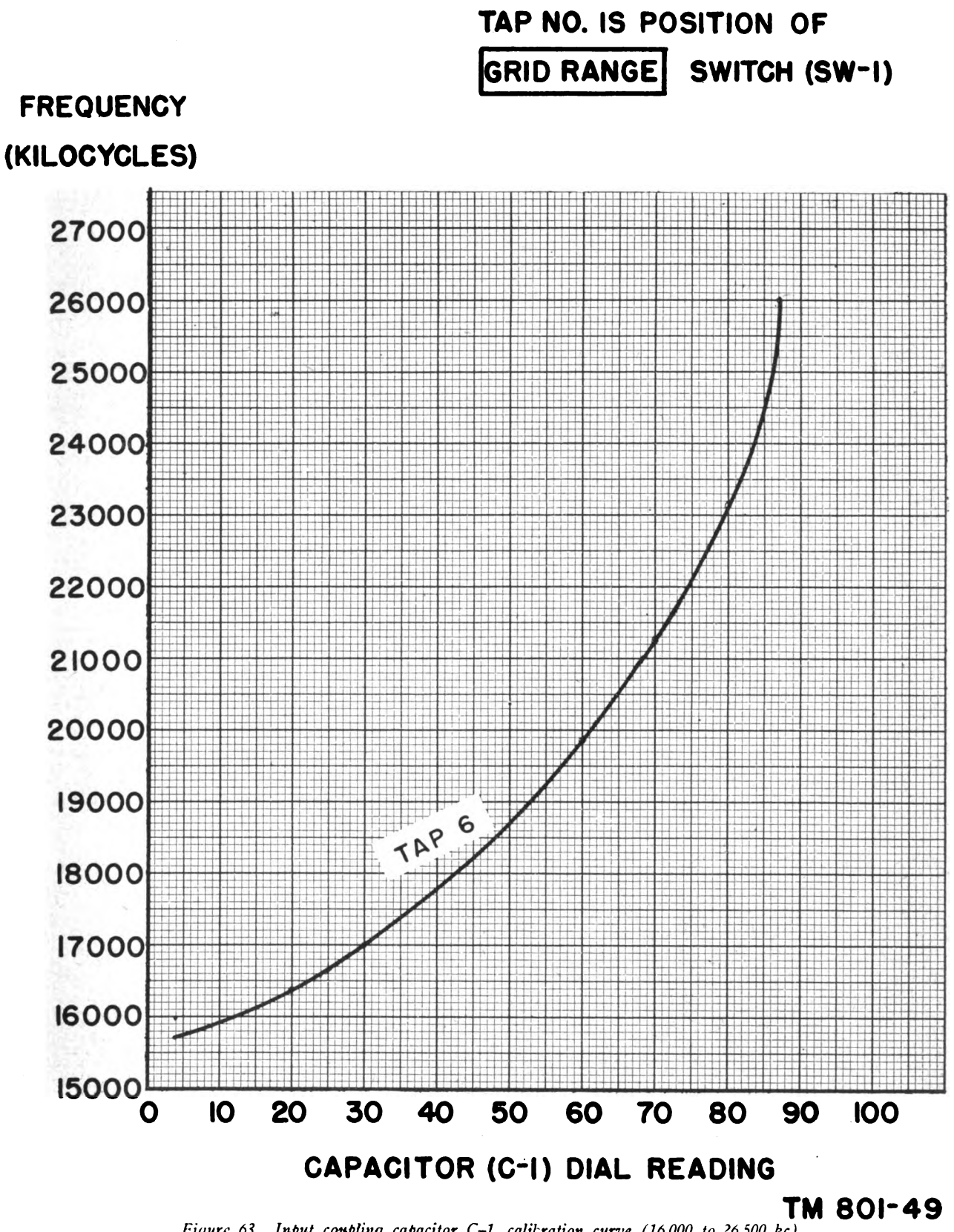

Figure 63. Input coupling capacitor C-1, calibration curve (16,000 to 26,500 kc).

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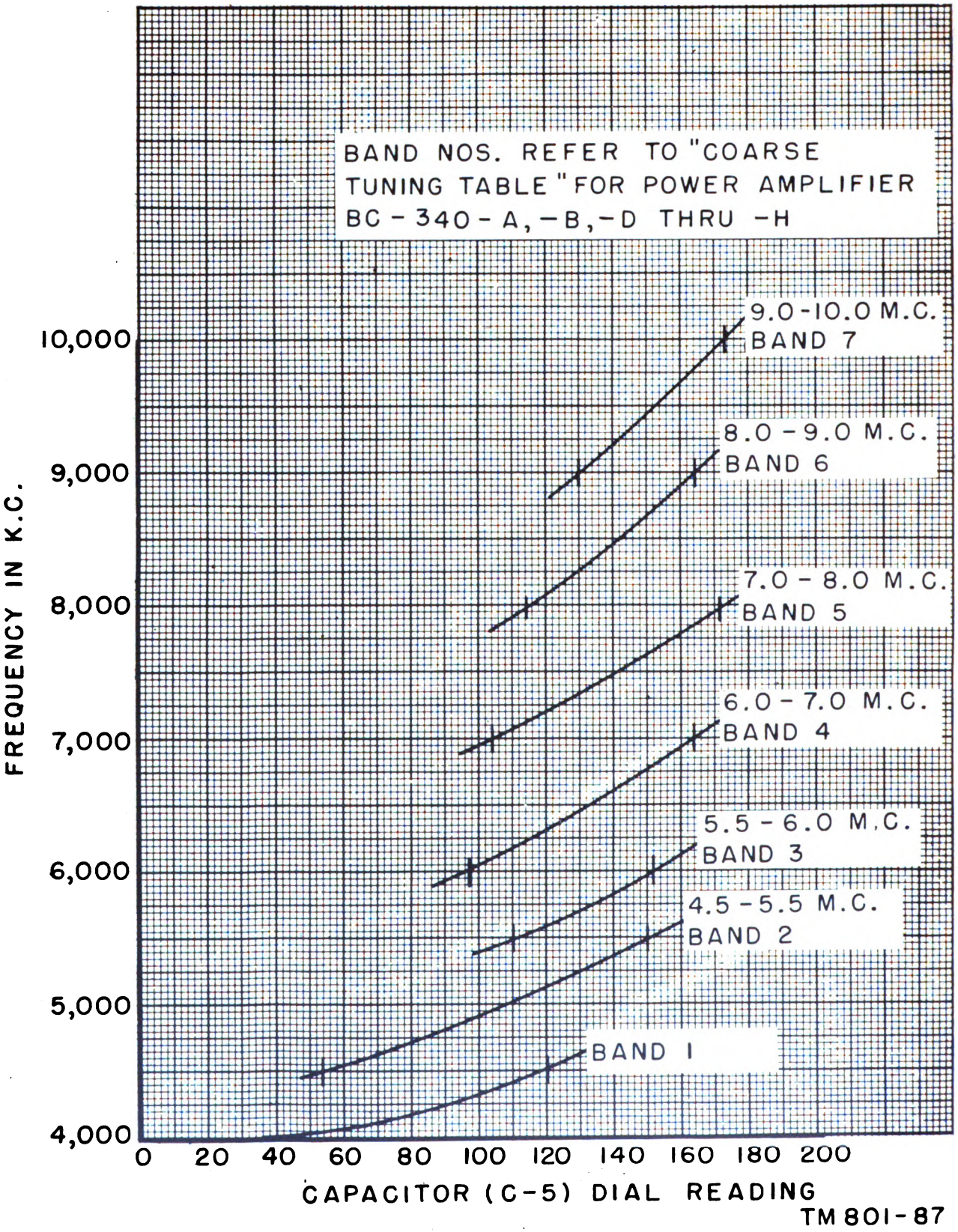

Figure 64. Power Amplifiers BC-340-A, -B, and -D through -H, plate tuning capacitor C-5, calibration curves (4,000 to 10,000 kc).

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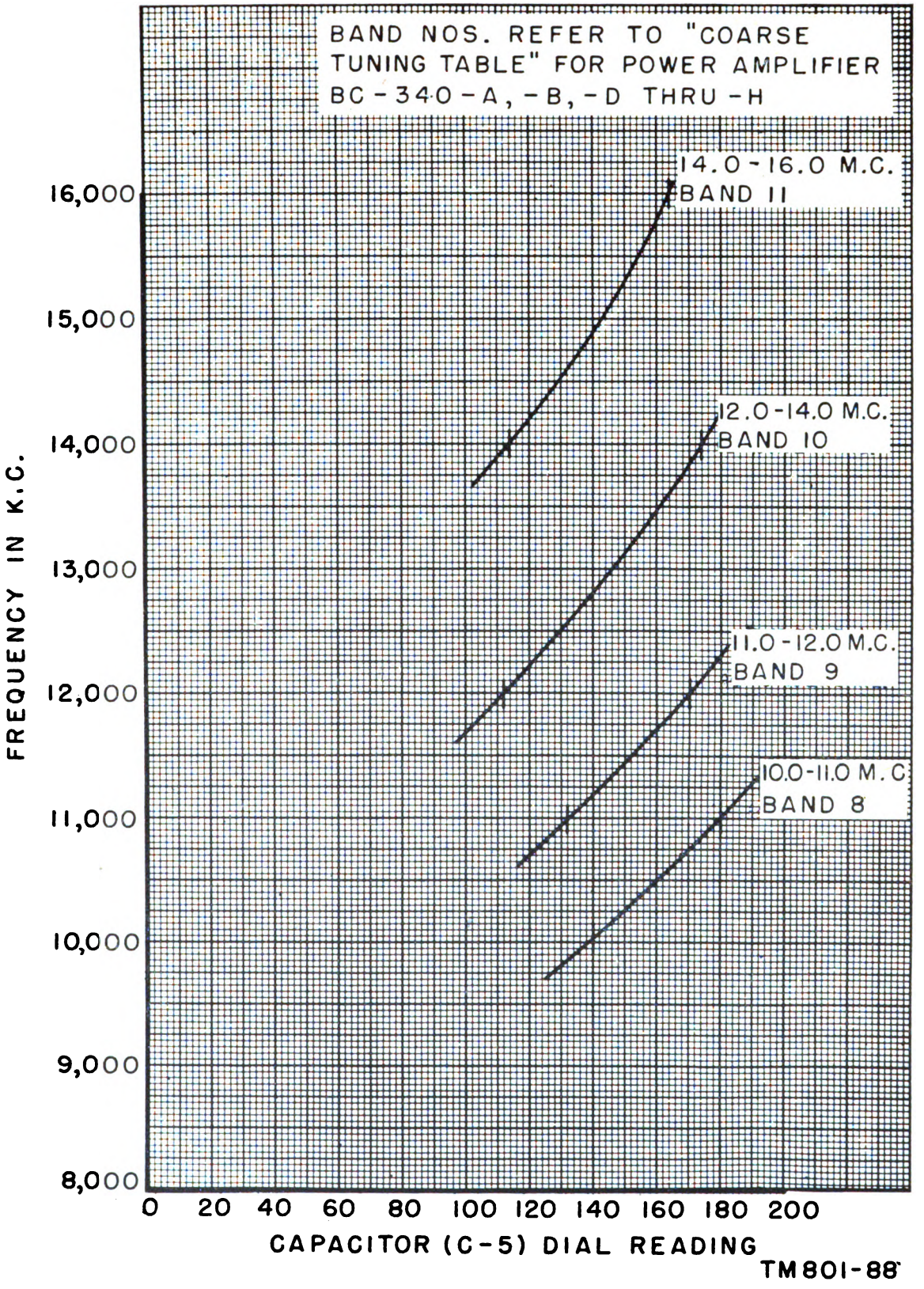

Figure 65. Power Amplifiers BC-340-A, -B and -D through -H, plate tuning capacitor C-5, calibration curves (10,000 to 16,000 kc).

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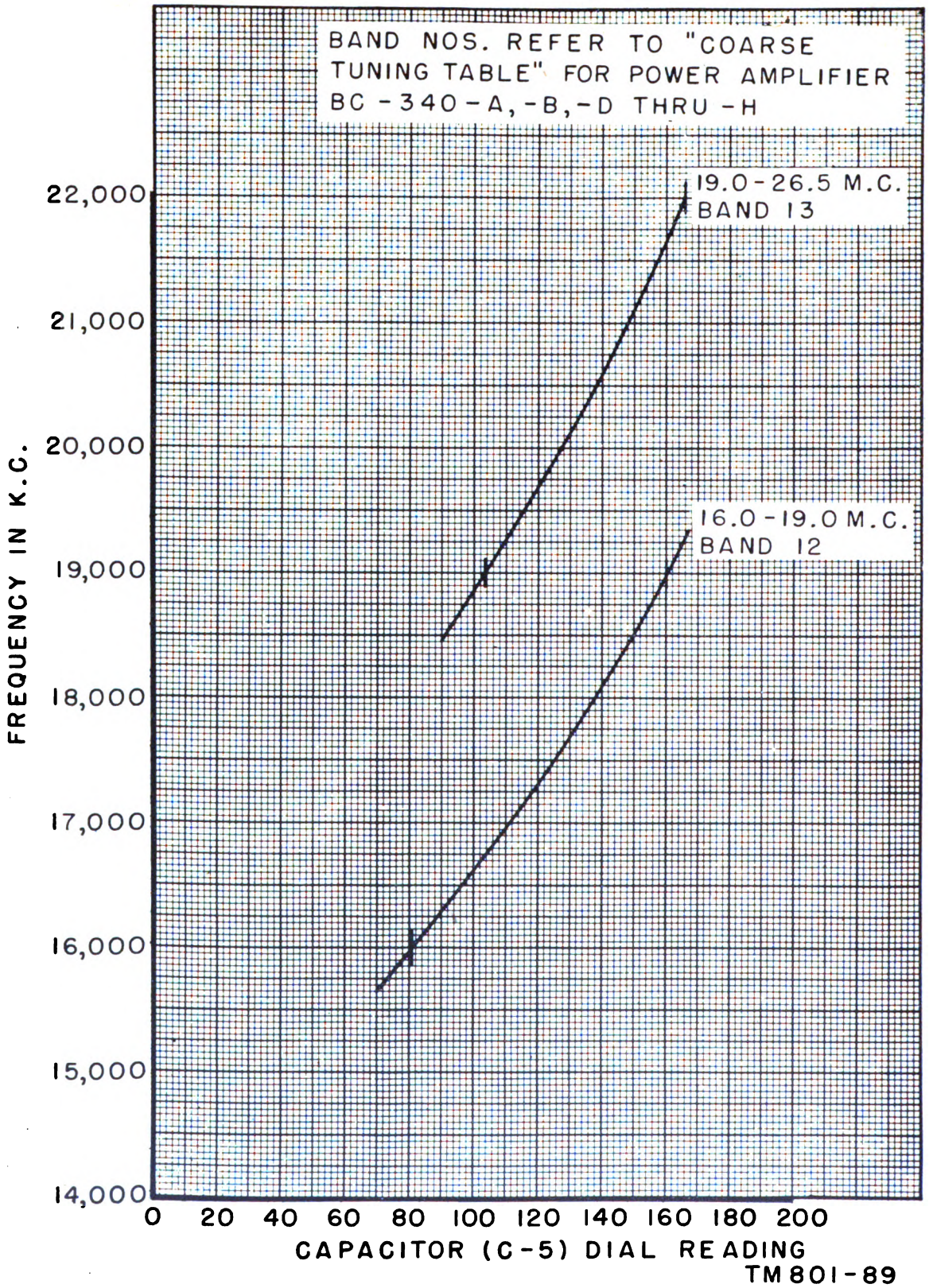

Figure 66. Power Amplifiers MC-340-A, -B, and -D through -H, plate tuning capacitor C-5, calibration curves (16,000 to 20,000 kc).

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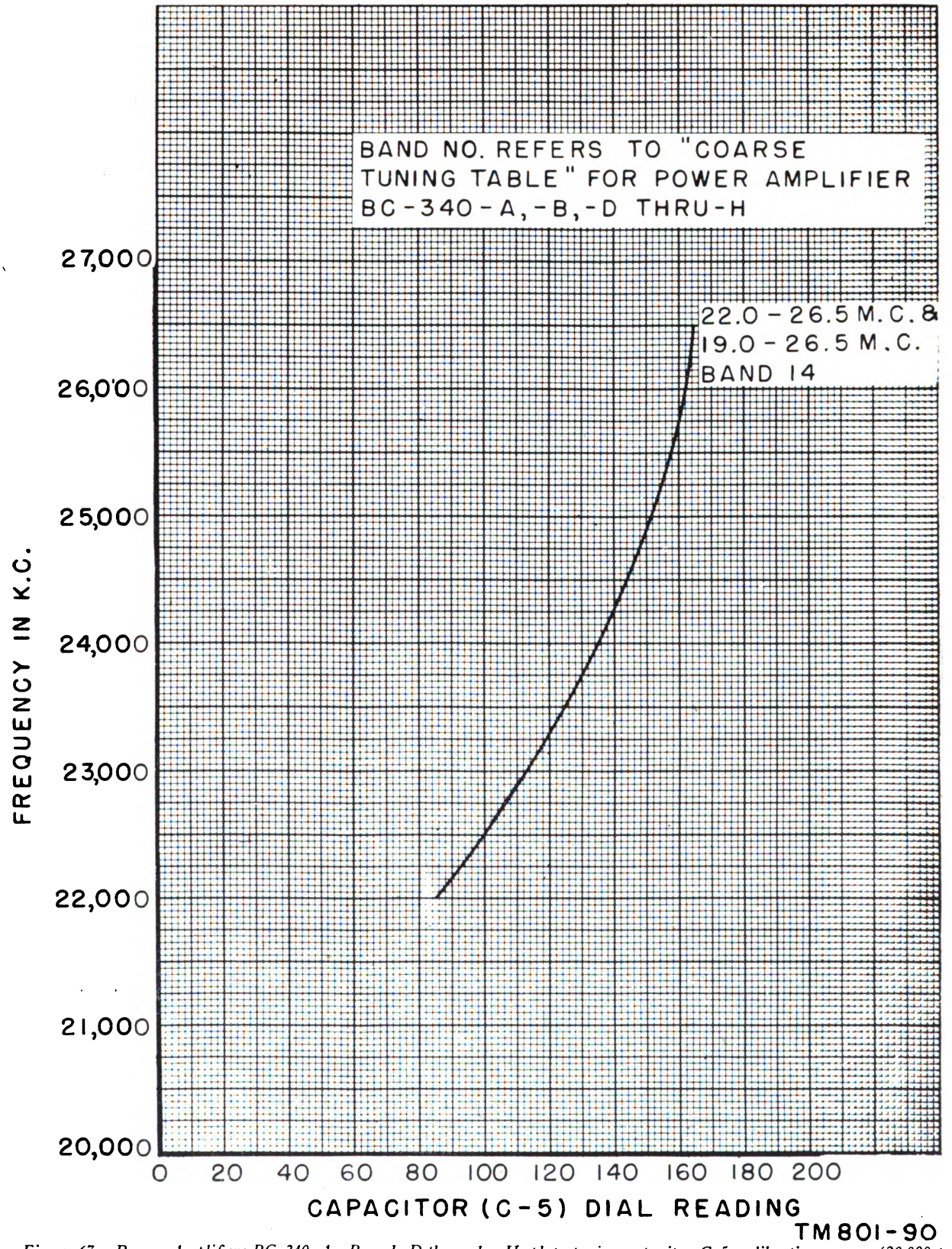

Figure 67. Power Amplifiers BC-340-A, -B, and -D through -H, plate tuning capacitor C-5, calibration curves (20,000 to 26,500 kc).

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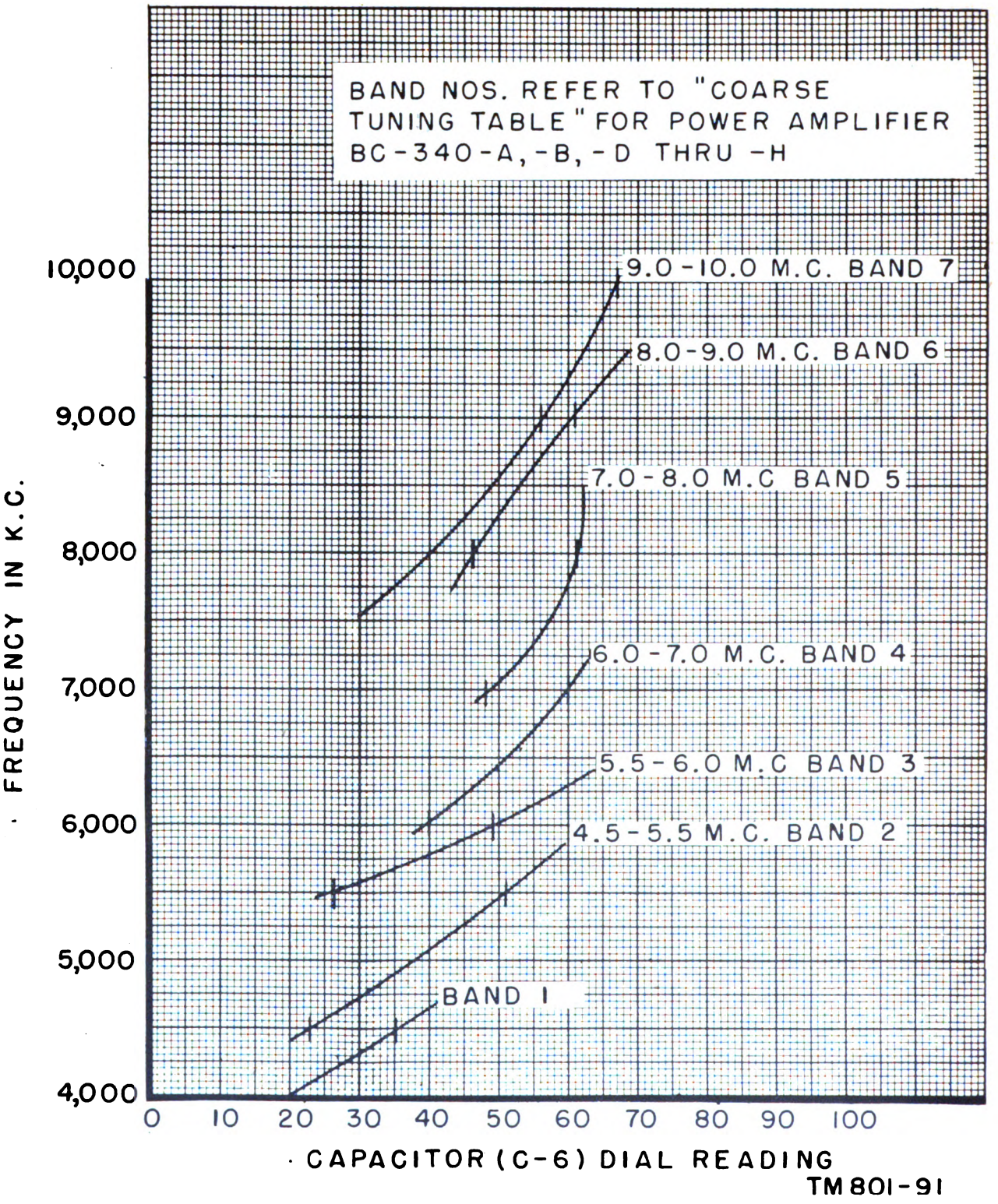

Figure 68. Power Amplifiers BC-340-A, -B, and -D through -H, antenna coupling capacitor C-6, calibration curves (4,000 to 10,000 kc).

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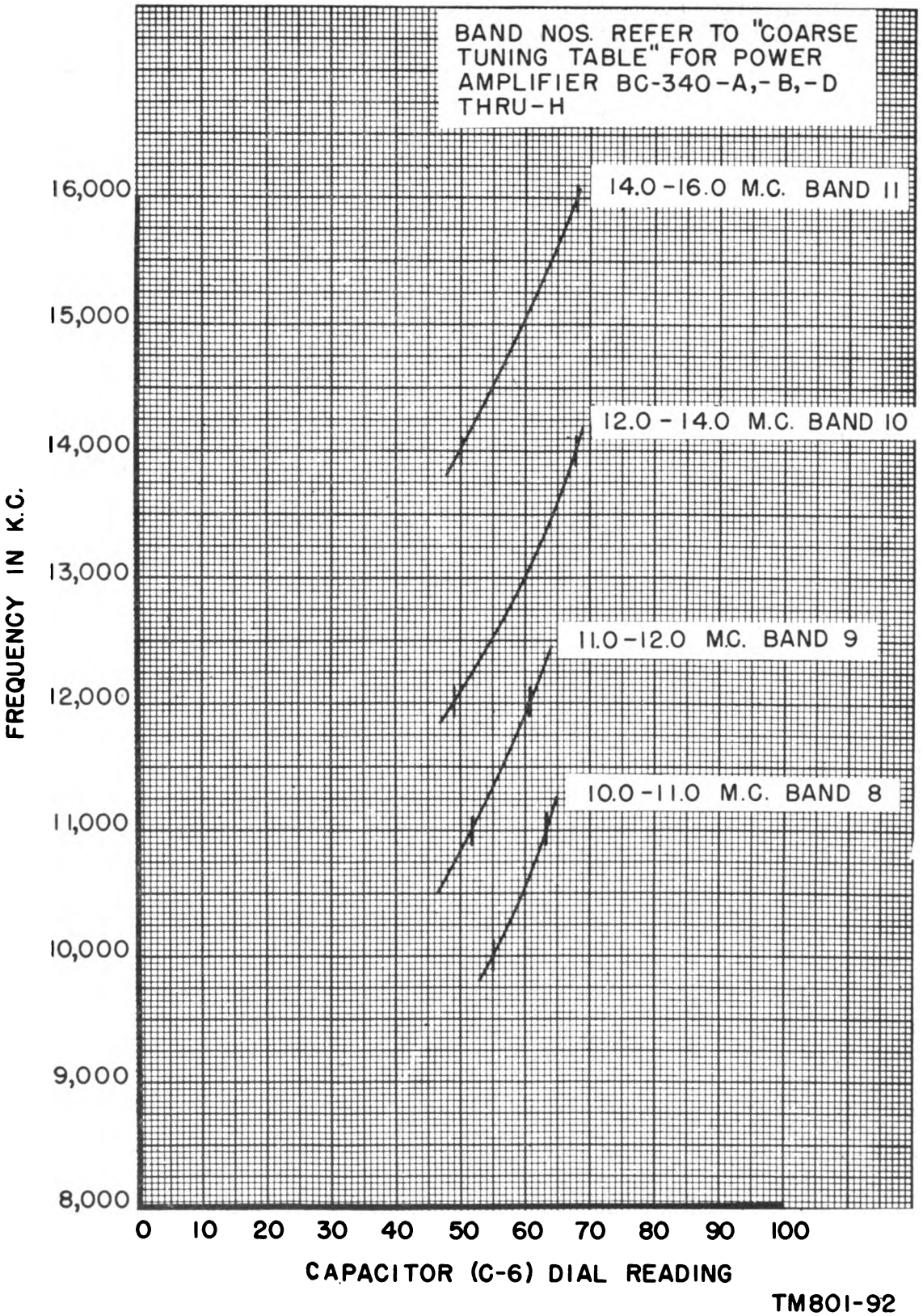

Figure 69. Power Amplifiers BC-340-A, -B, and -D through -H, antenna coupling capacitor C-6, calibration curves (10,000 to 16,000 kc).

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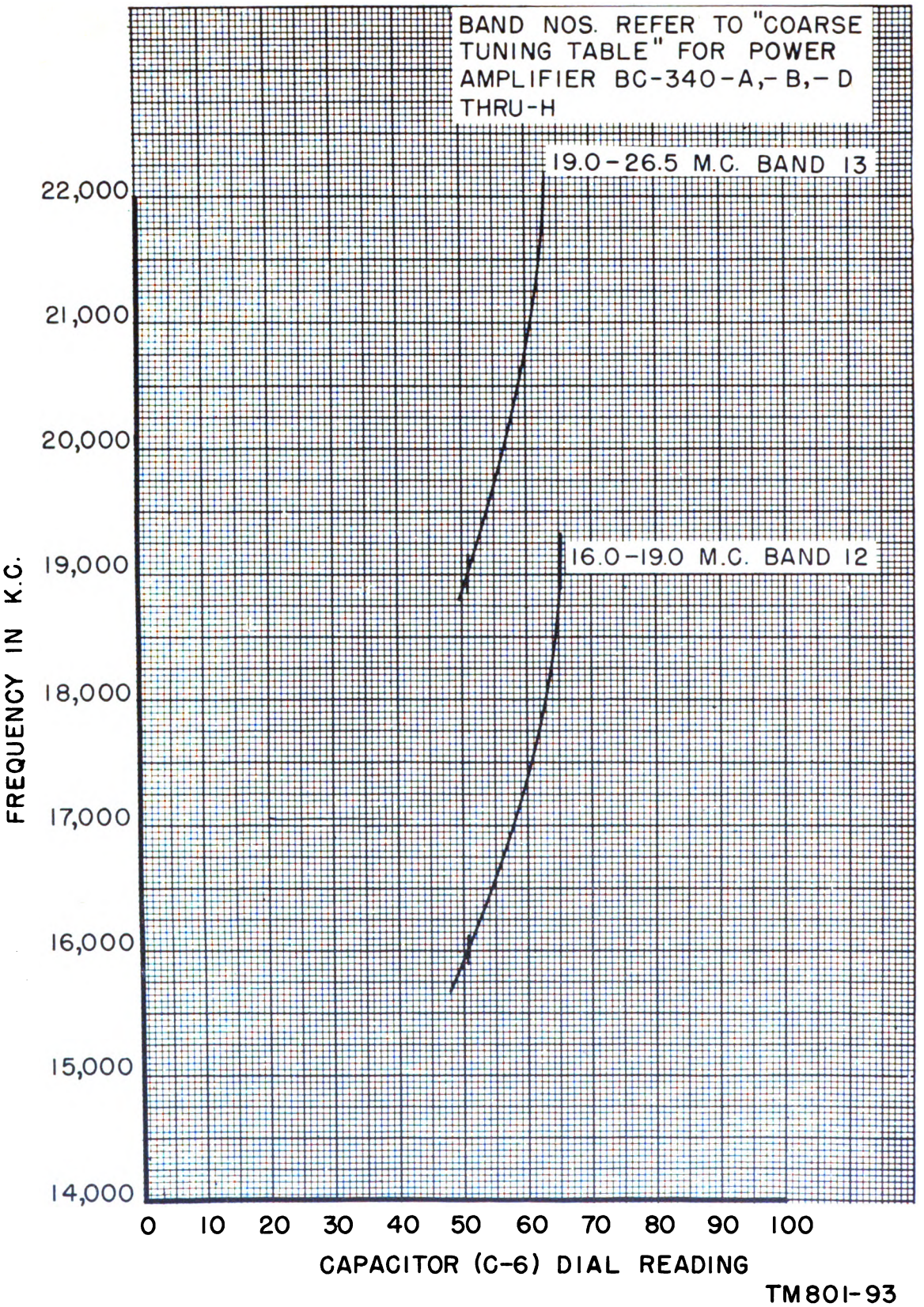

Figure 70. Power Amplifiers BC-340-A, -B, and -D through -H, antenna coupling capacitor C-6, calibration curves (16,000 to 22,000 kc).

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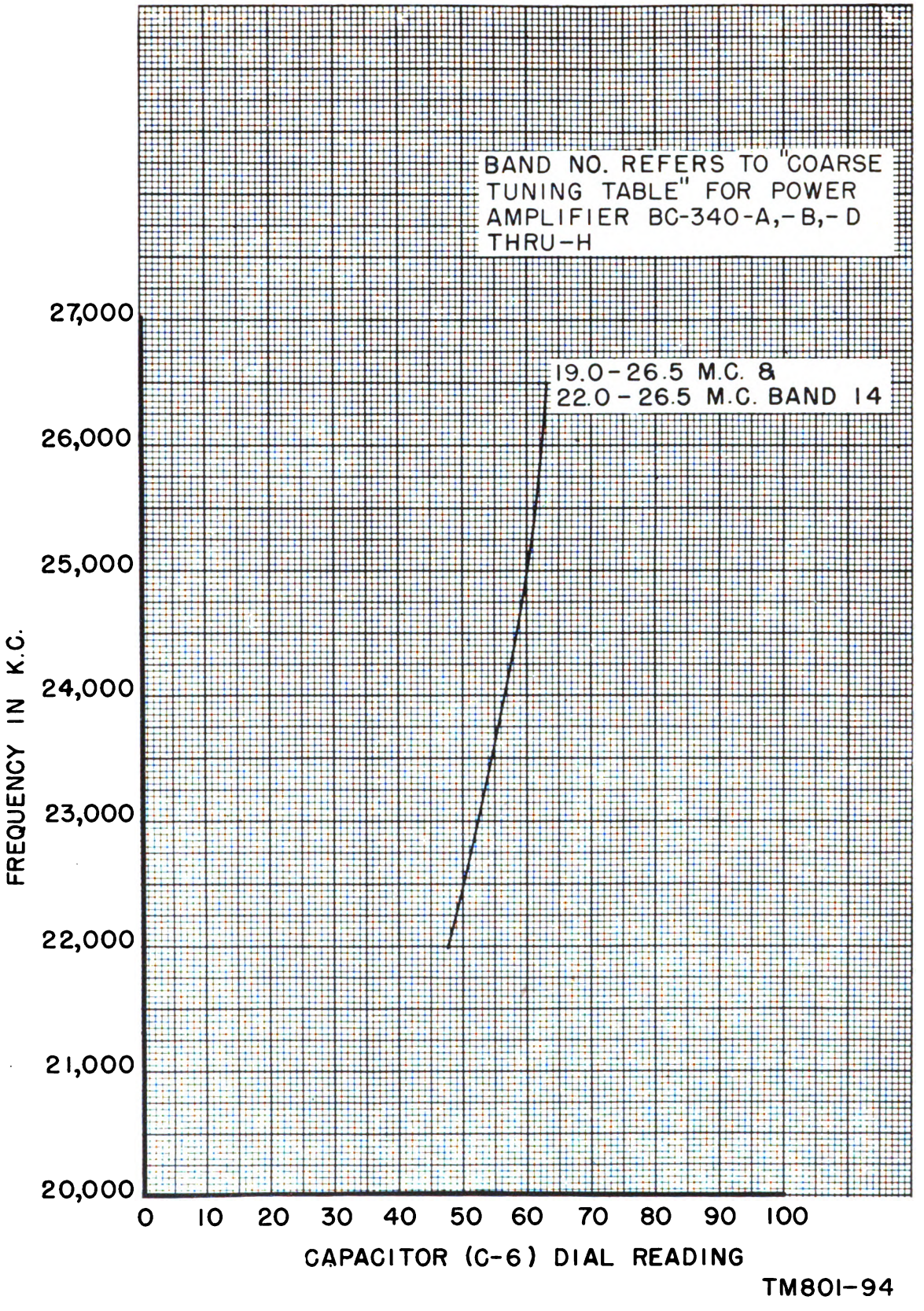

Figure 71. Power Amplifiers BC-340-A, -B, and -D through -H, antenna coupling capacitor C-6, calibration curves (22,000 to 26,500 kc).

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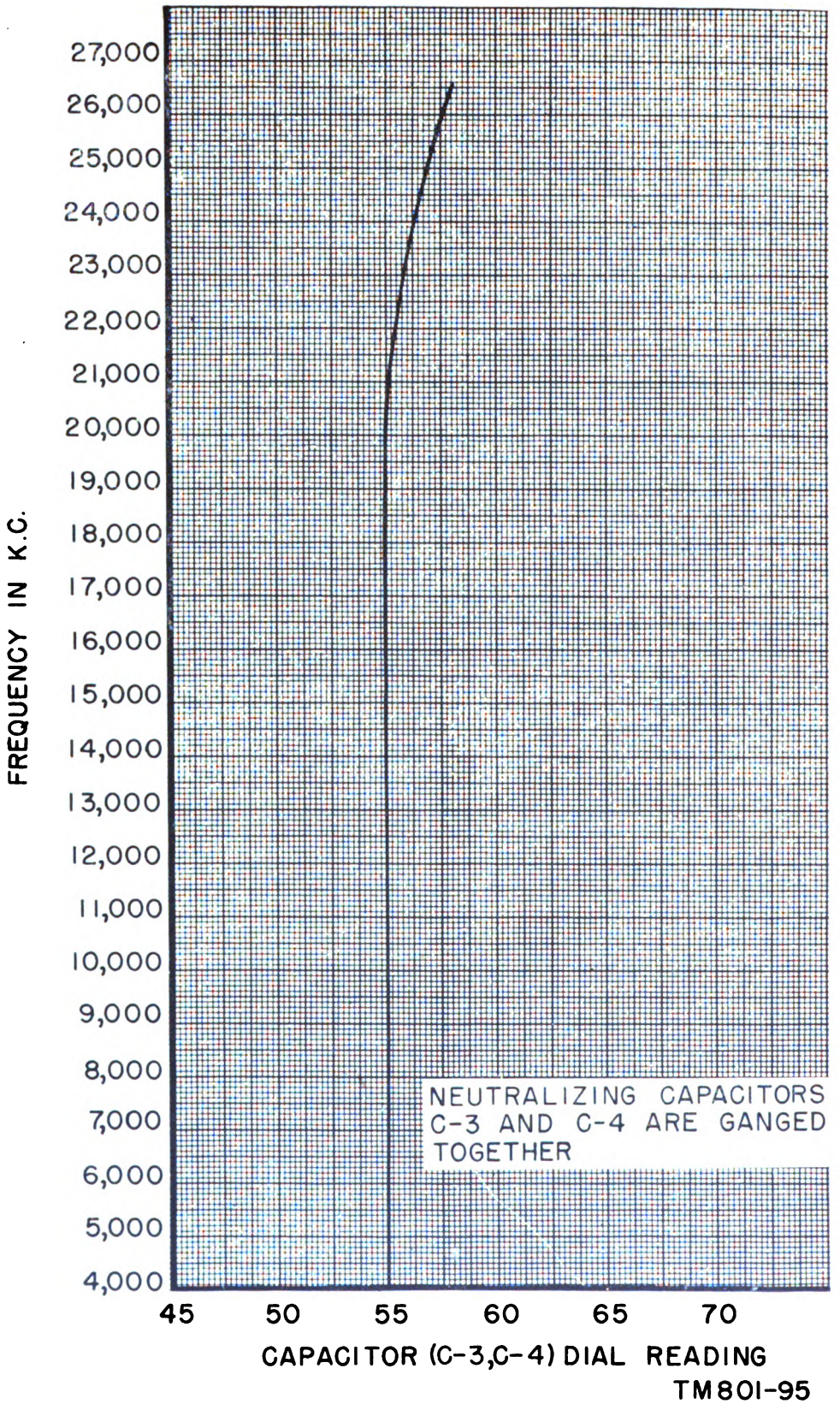

Figure 72. Power Amplifiers BC-340-A, -B, and -D through -II, neutralizing capacitors C-3 and C-4, calibration curve.

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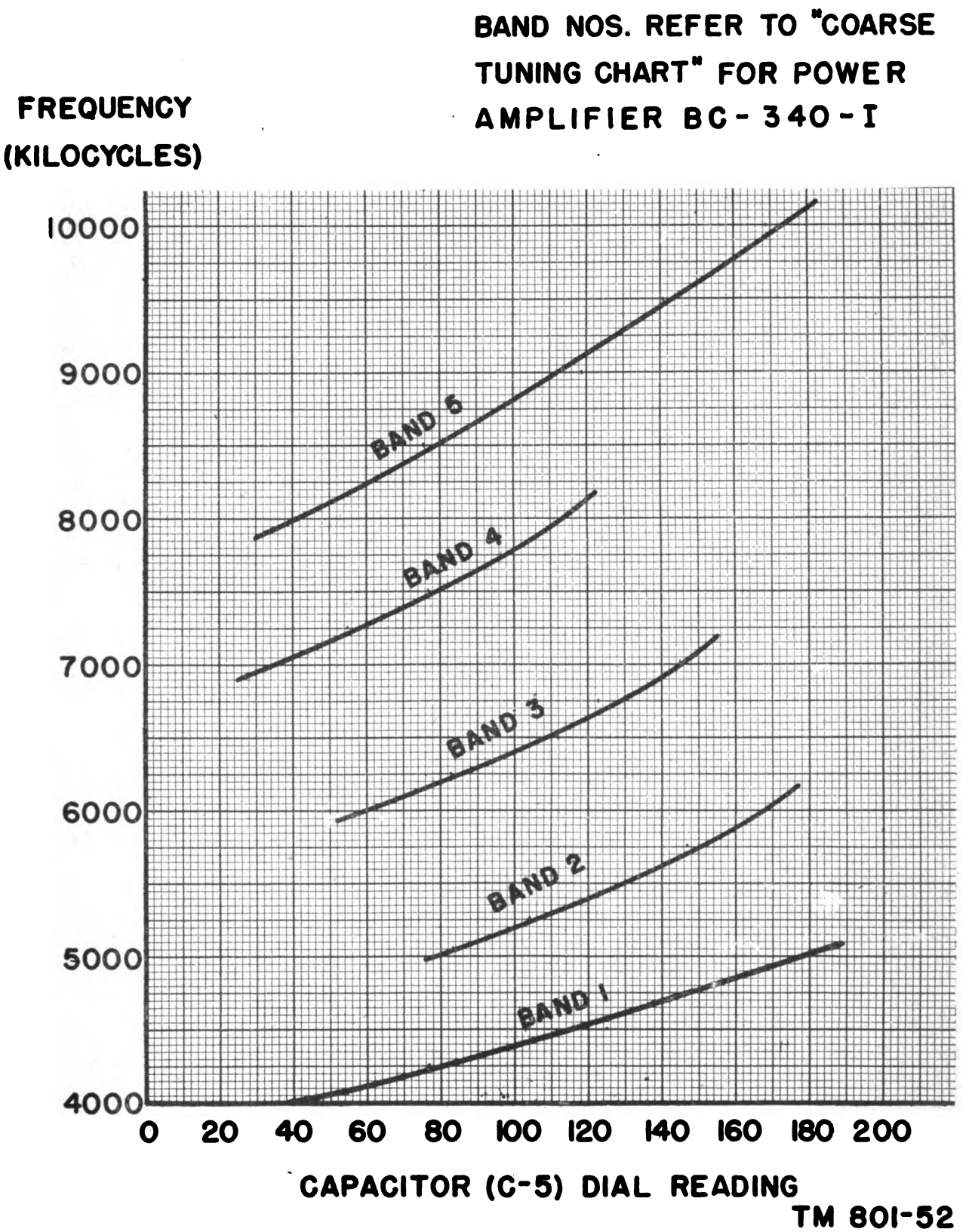

Figure 73. Power Amplifier BC-340-I, plate tuning capacitor C-5, calibration curve (4,000 to 10,000 kc).

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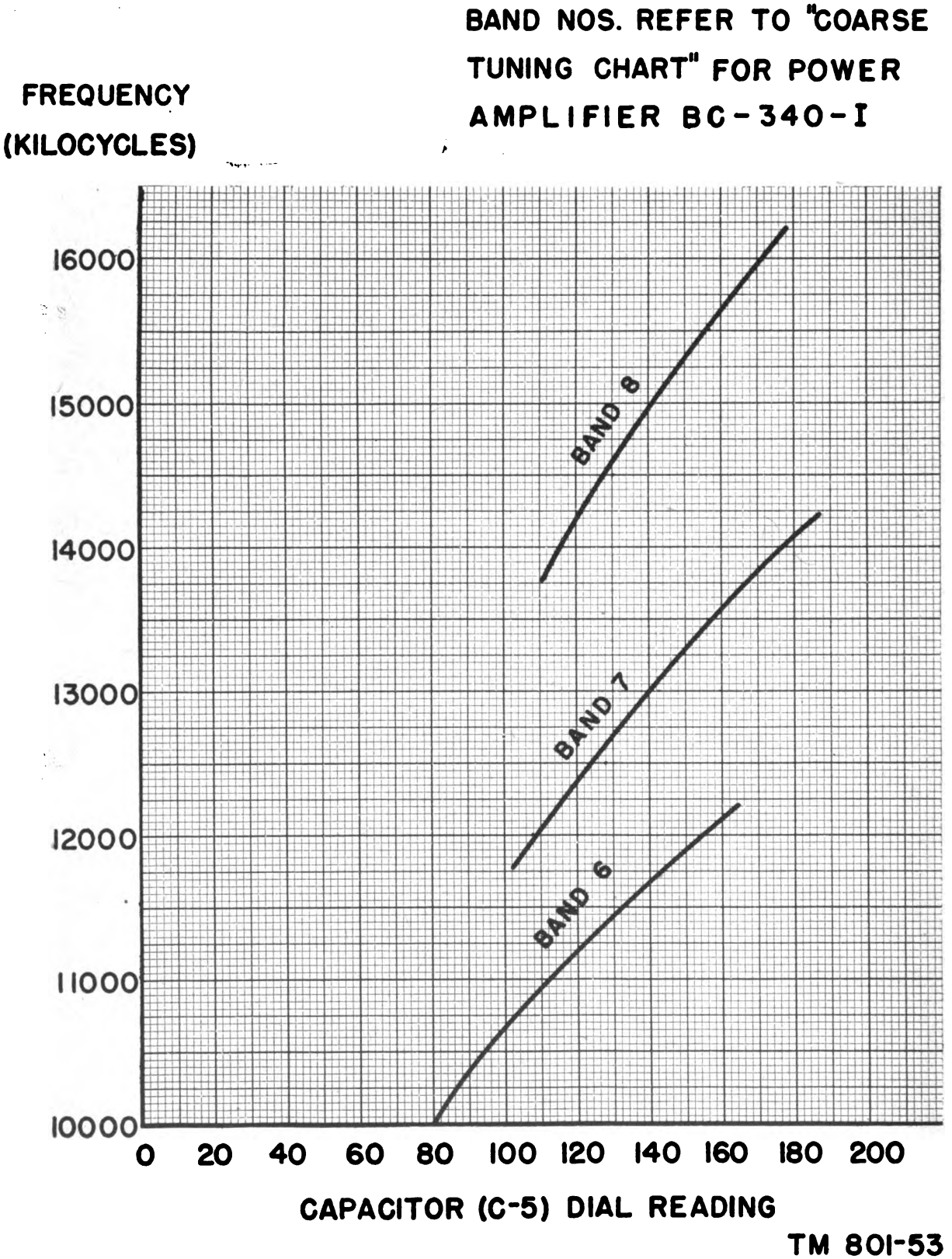

Figure 74. Power Amplifier BC–340–I, plate tuning capacitor C–5, calibration curve (10,000 to 16,000 kc).

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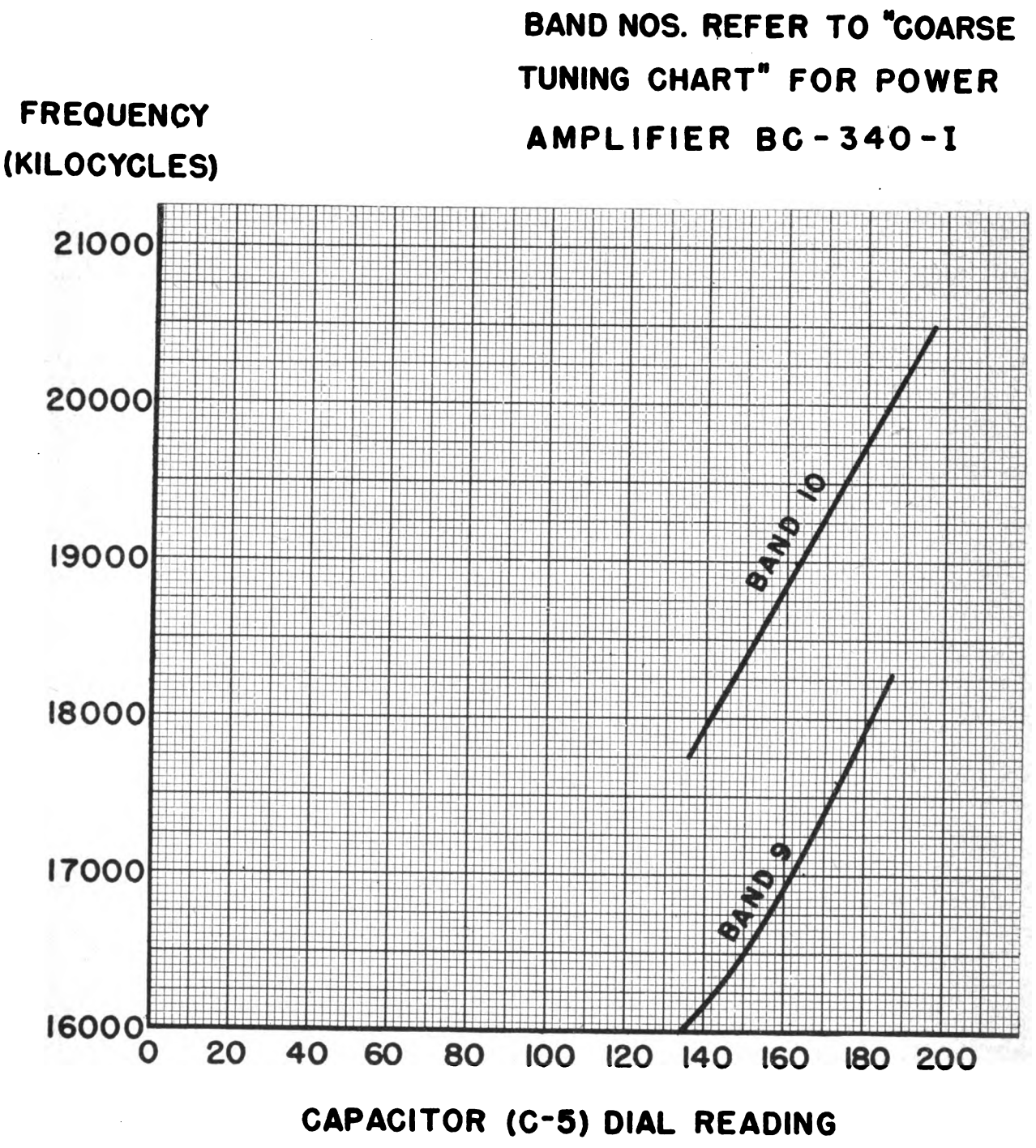

Figure 75. Power Amplifier BC-340-I, plate tuning capacitor C-5, calibration curve (16,000 to 20,000 kc).

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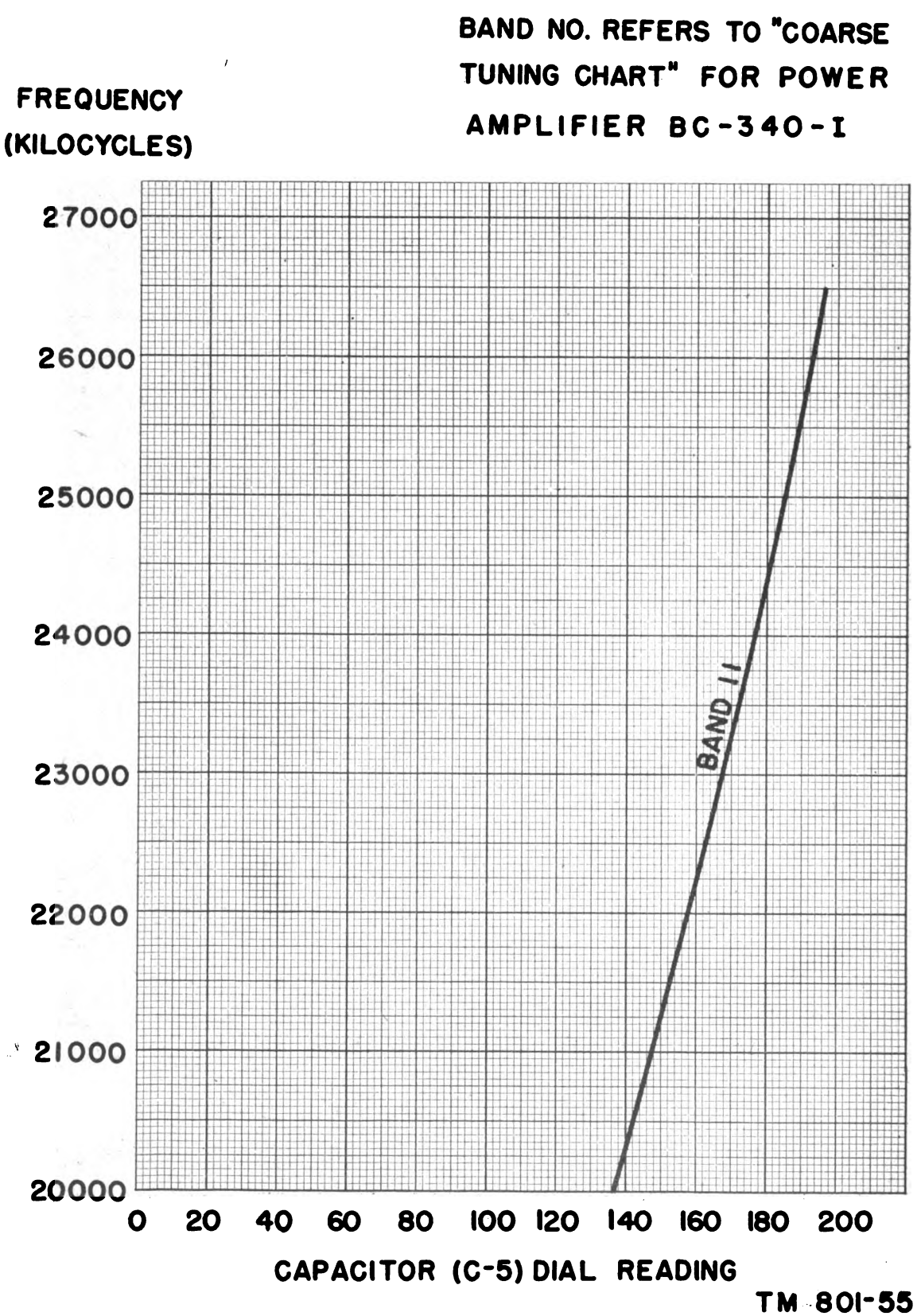

Figure 76. Power Amplifier BC-340-I, plate tuning capacitor C-5, calibration curve (20,000 to 26,500 kc).

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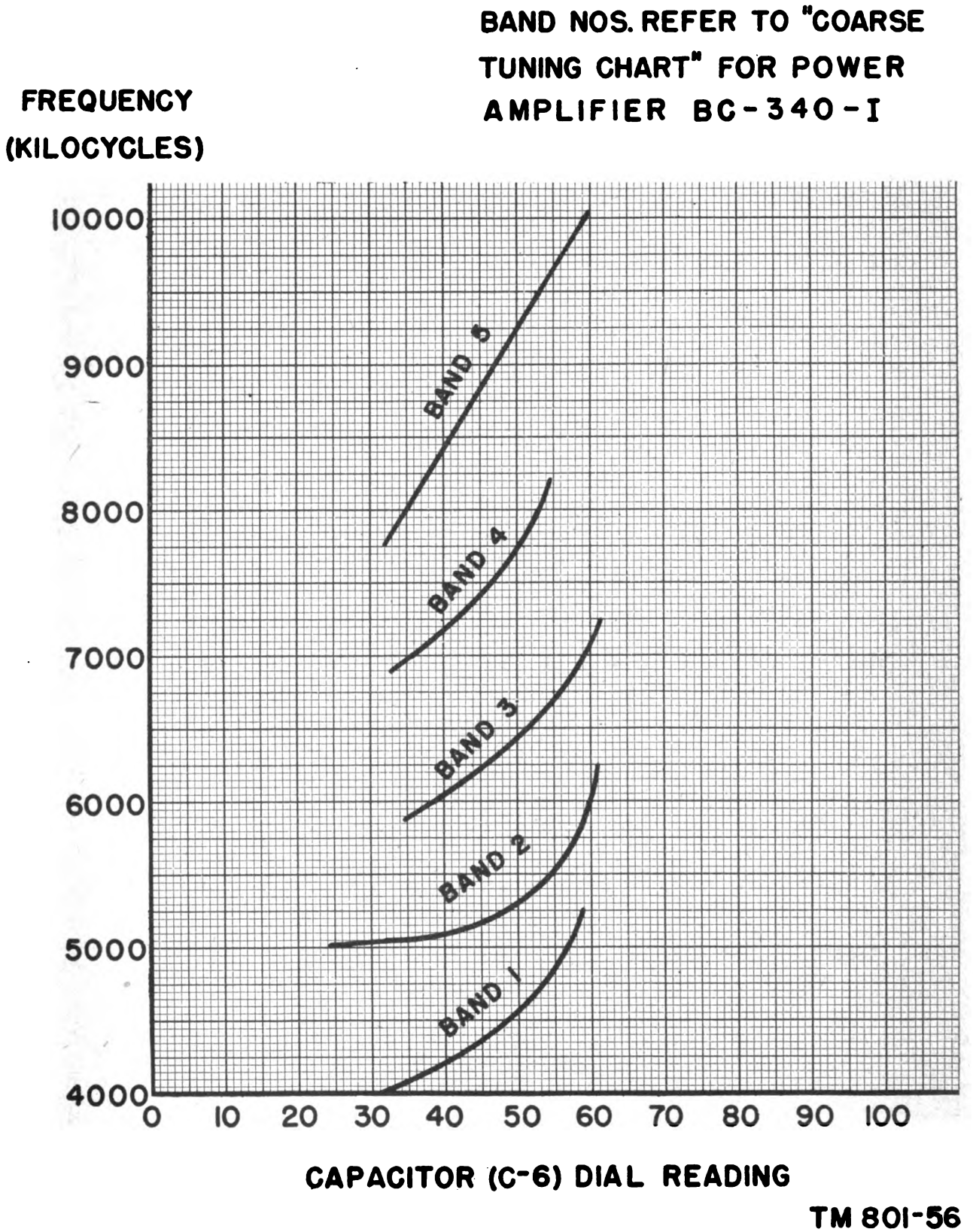

Figure 77. Power Amplifier BC-340-I, antenna coupling capacitor C-6, calibration curve (4,000 to 10,000 kc).

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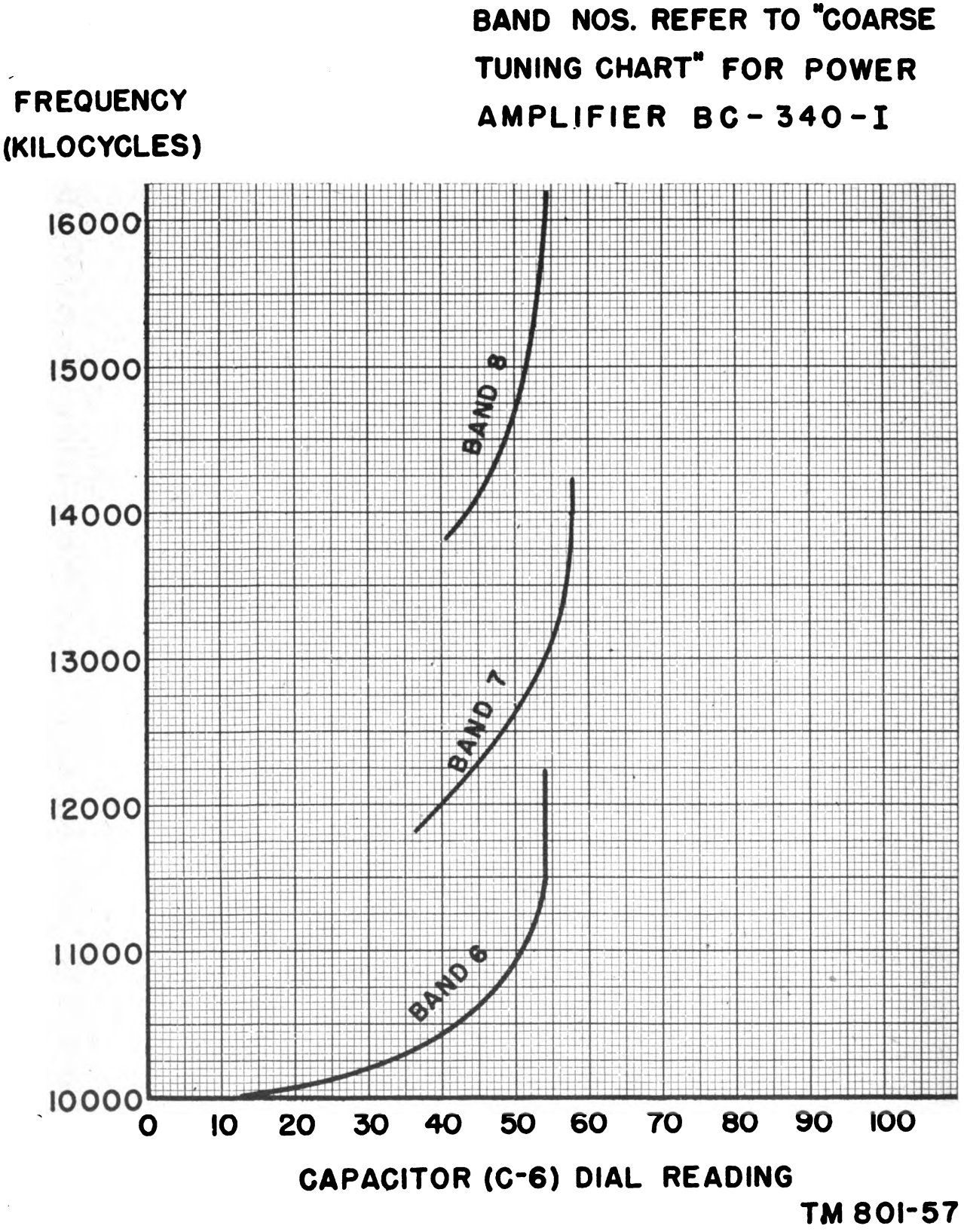

Figure 78. Power Amplifier BC-340-I, antenna coupling capacitor C-6, calibration curve (10,000 to 16,000 kc).

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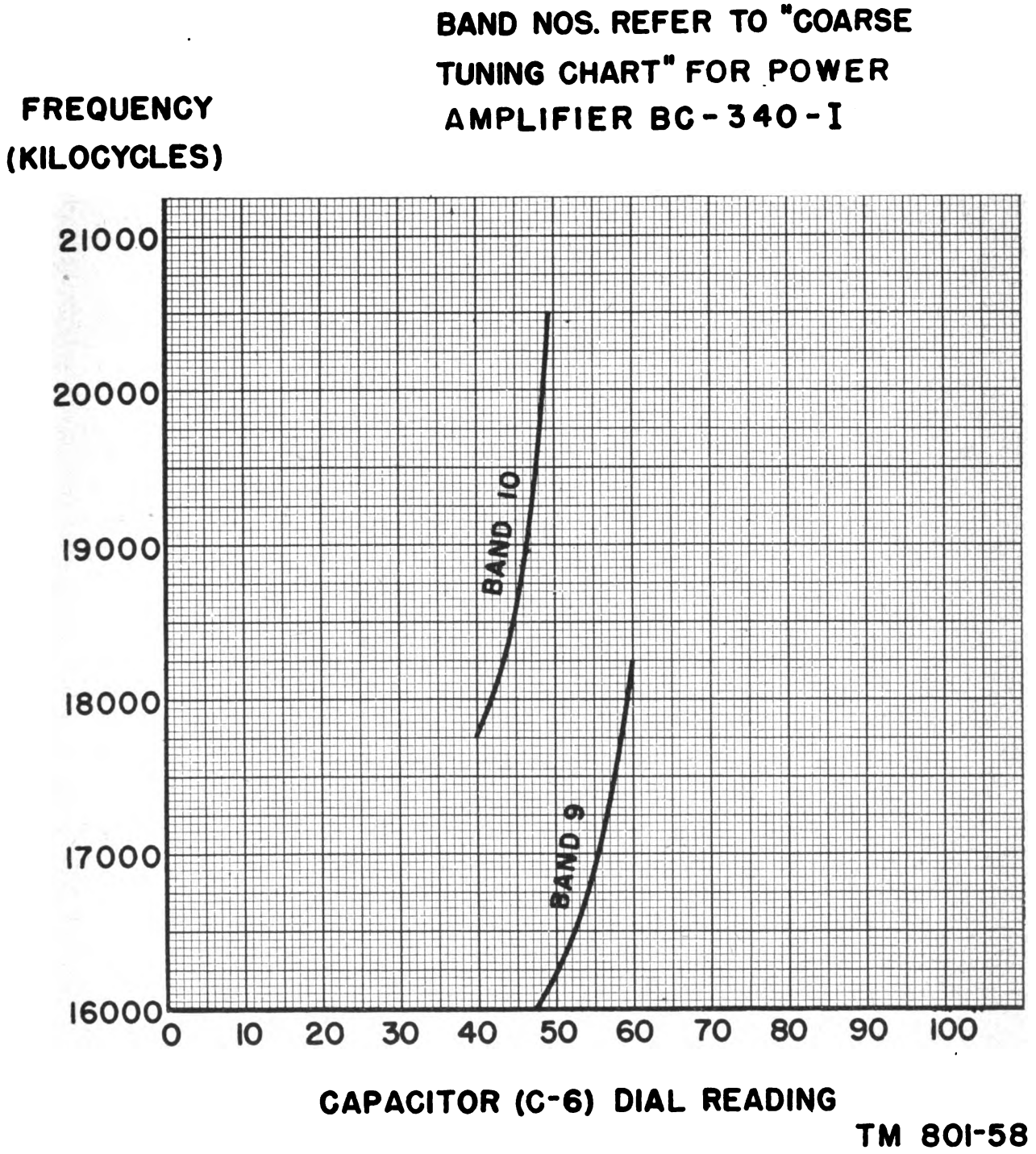

Figure 79. Power Amplifier BC-340-I, antenna coupling capacitor C-6, calibration curve (16,000 to 20,000 kc).

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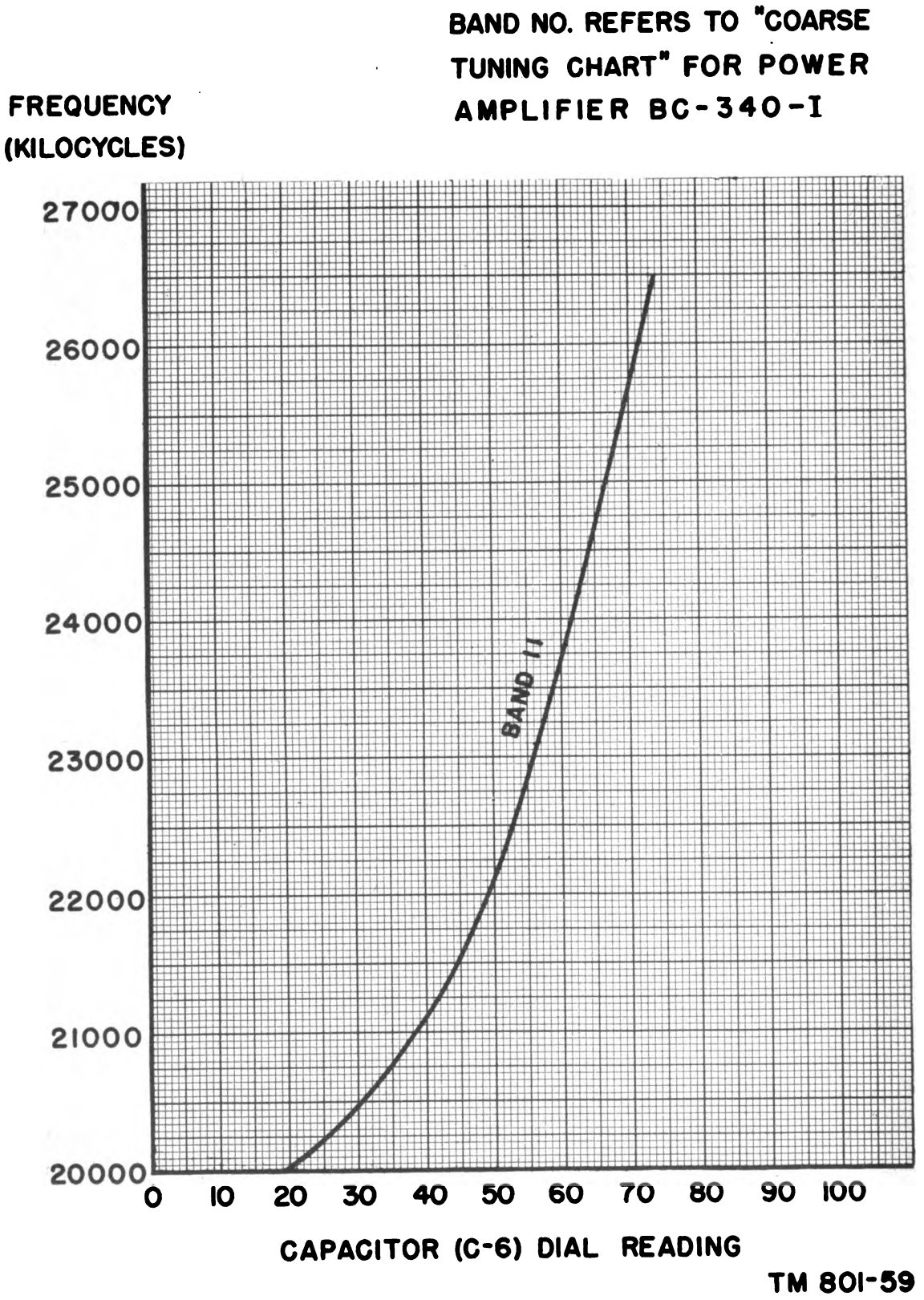

Figure 80. Power Amplifier BC-340-I, antenna coupling capacitor C-6, calibration curve (20,000 to 26,500 kc).

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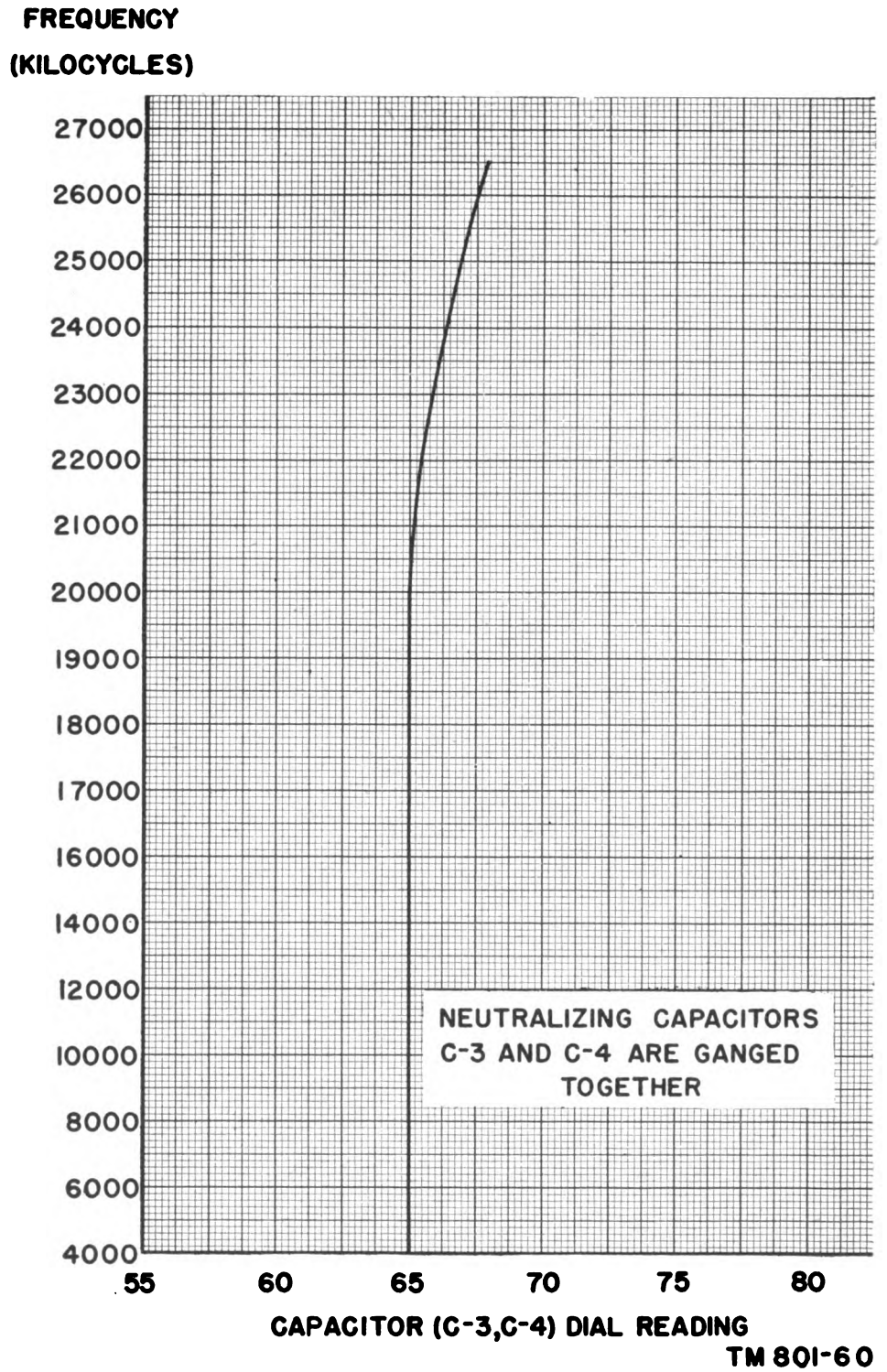

Figure 81. Power Amplifier BC–340–I, neutralizing capacitors C–3 and C–4, calibration curve.

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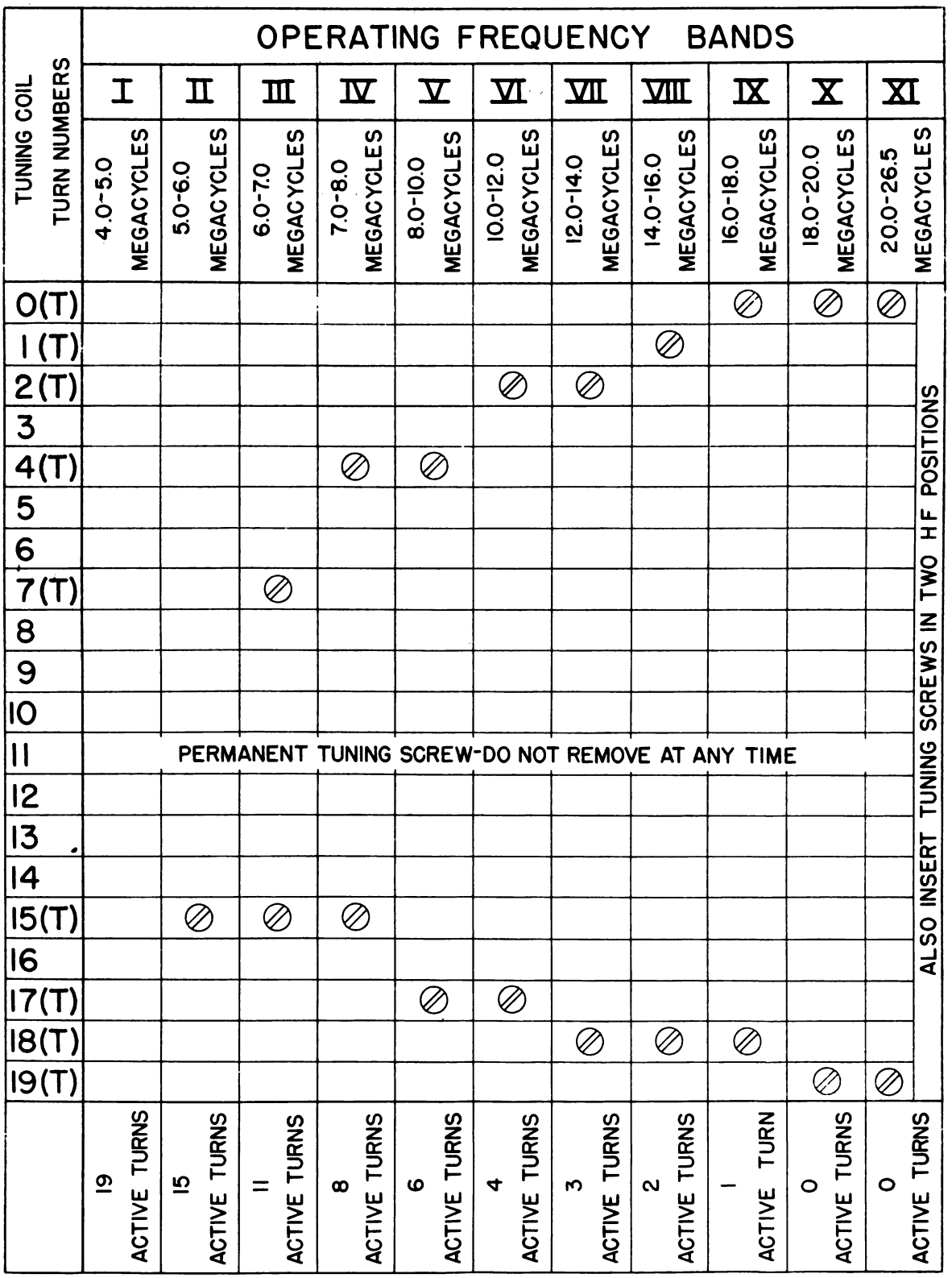

Figure 82. Power Amplifier BC-340-I, plate tuning coil coarse tuning chart.

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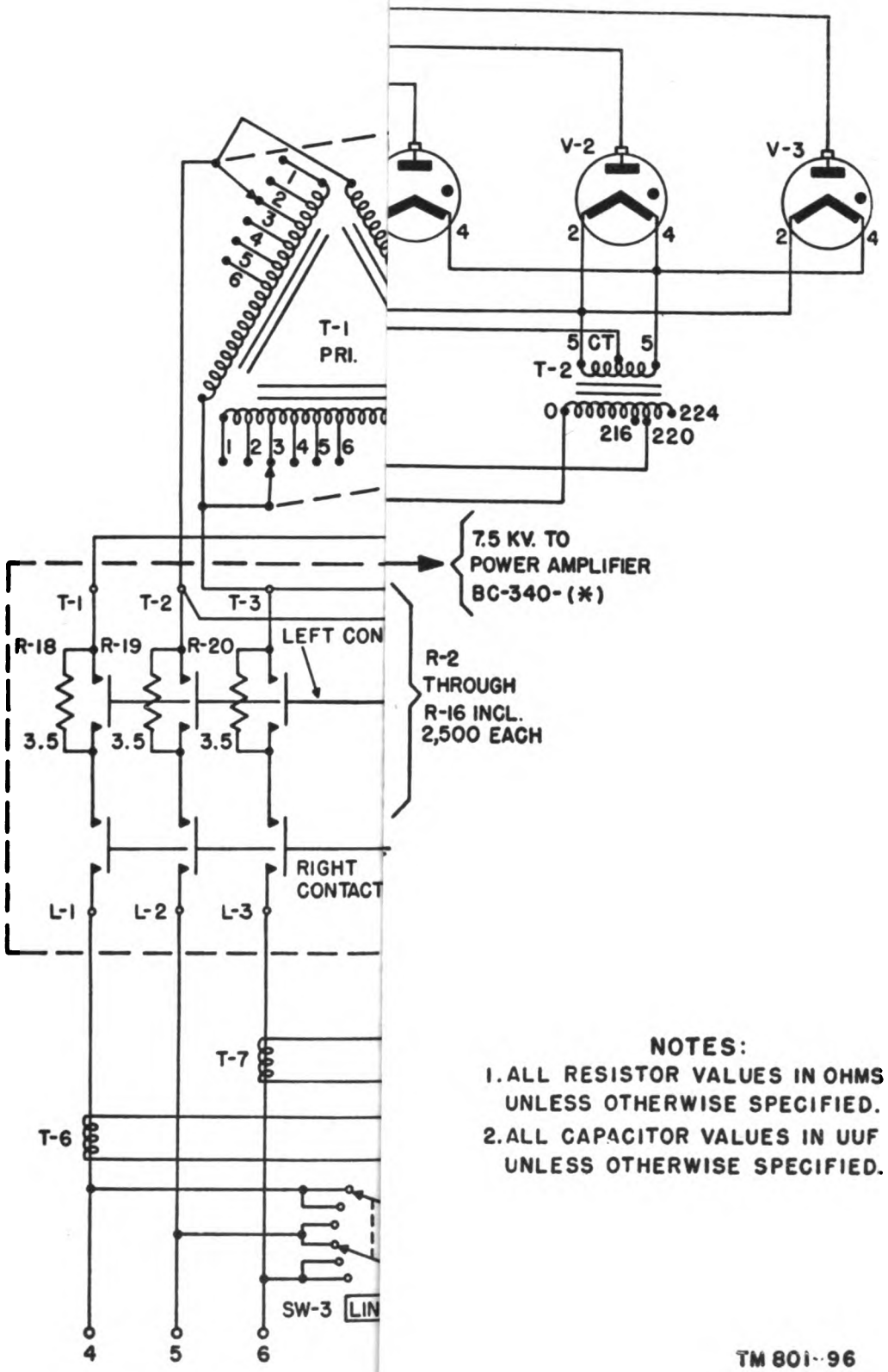

NOTES:

1. ALL RESISTOR VALUES IN OHMS UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITOR VALUES IN UUF UNLESS OTHERWISE SPECIFIED.

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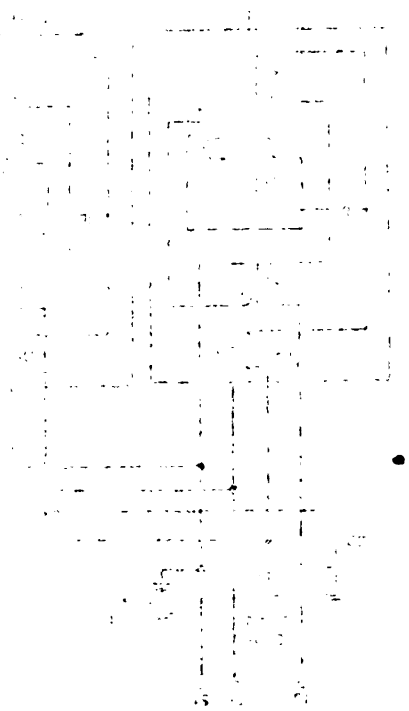

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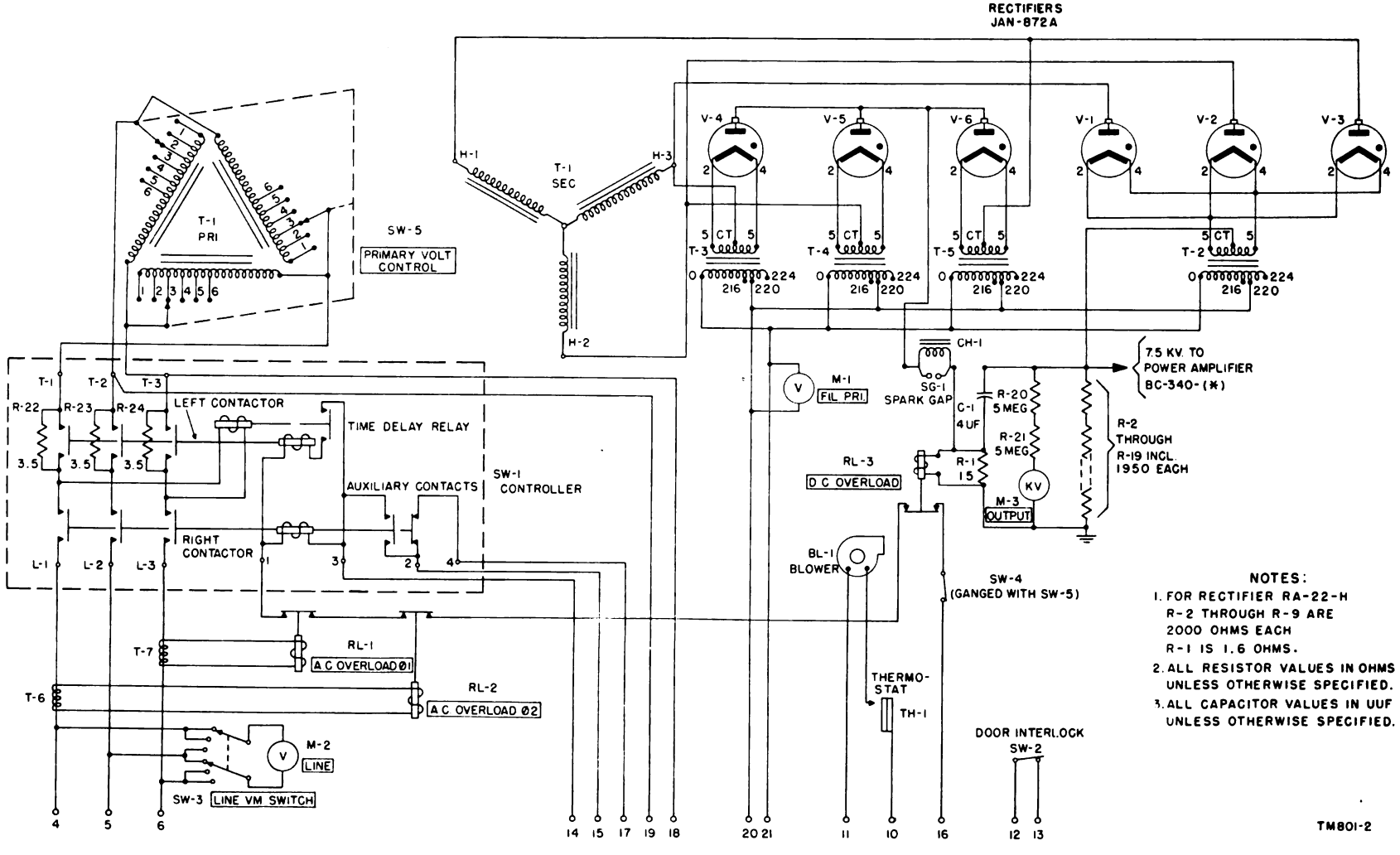

Figure 85. Rectifier RA-22-(*) (except model RA-22), schematic diagram.

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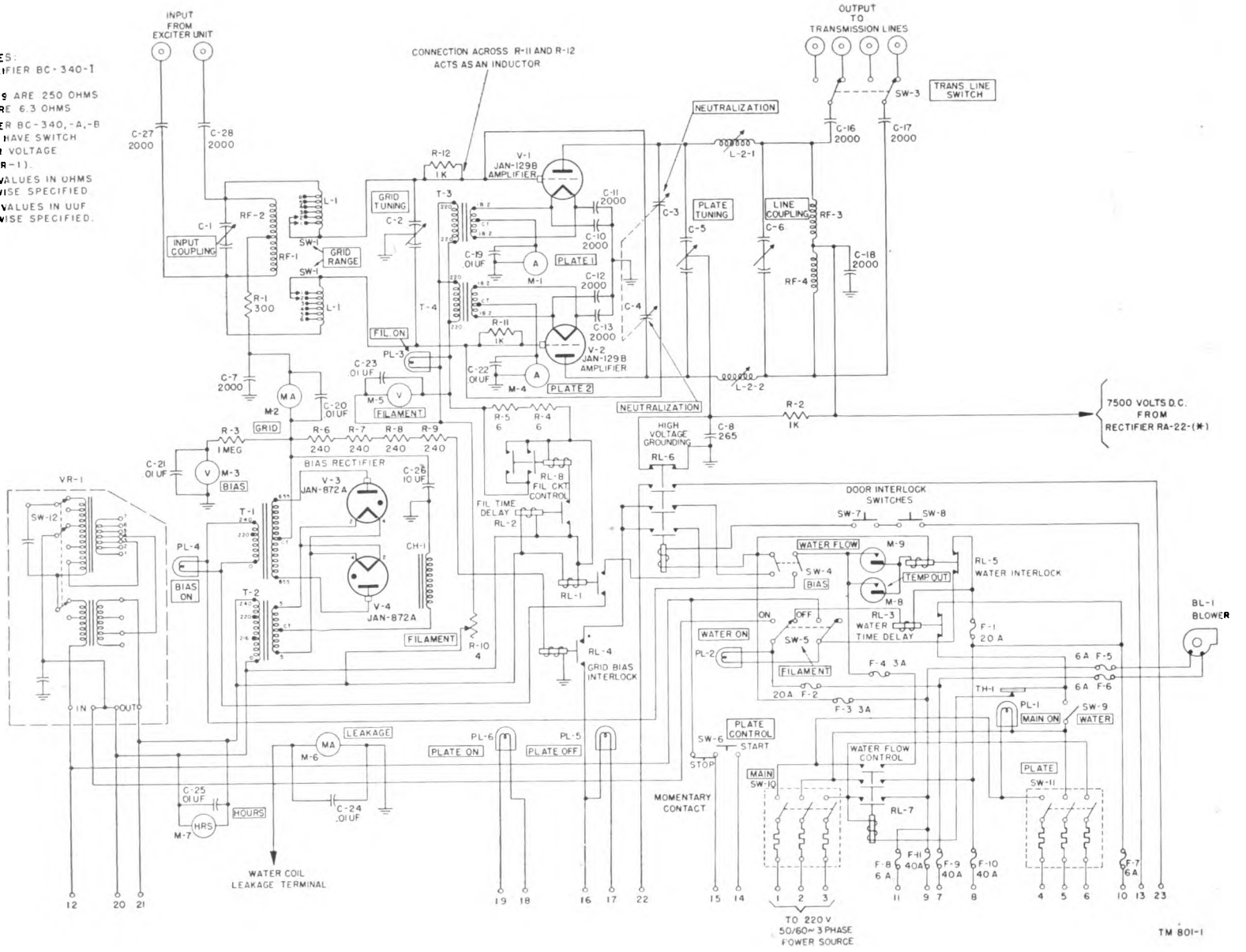

Figure 86. Power Amplifier BC–340–(*) (except model BC–340), schematic diagram.

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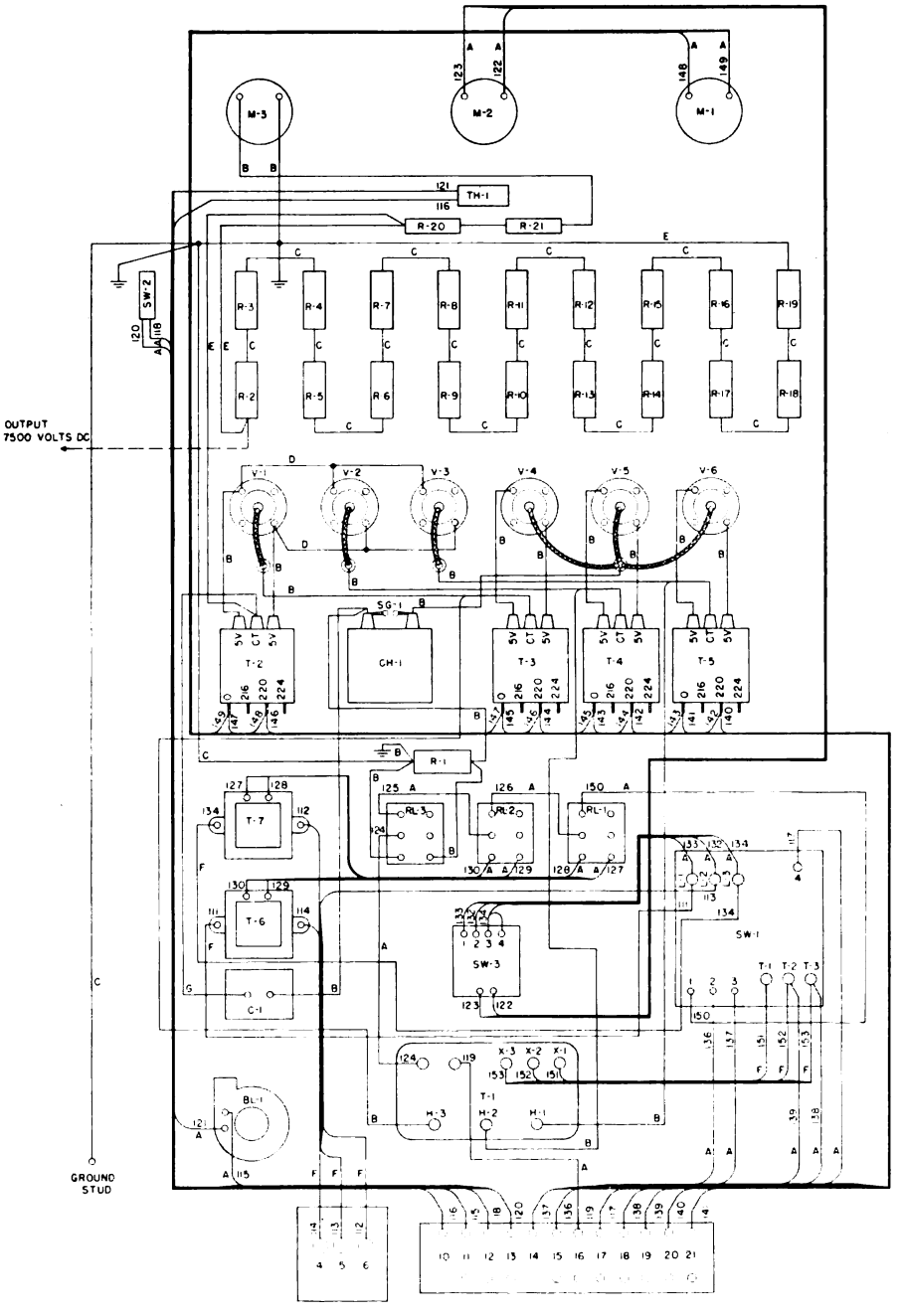

WIRE DESIGNATION	
LETTER	TYPE
A	NO 14 VARNISHED CAMBRIC, LEAD COVERED
B	1/4 O D X 3/16 I D COPPER TUBING
C	1/16 X 1/2 COPPER BUS
D	3/16 X 3/4 COPPER BUS
E	3/8 O D X 5/16 I D COPPER TUBING
F	NO 6 VARNISHED CAMBRIC, LEAD COVERED
G	NO 7 VARNISHED CAMBRIC, LEAD COVERED

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Figure 87. Rectifier RA-22-(*) (except model RA-22), wiring diagram.

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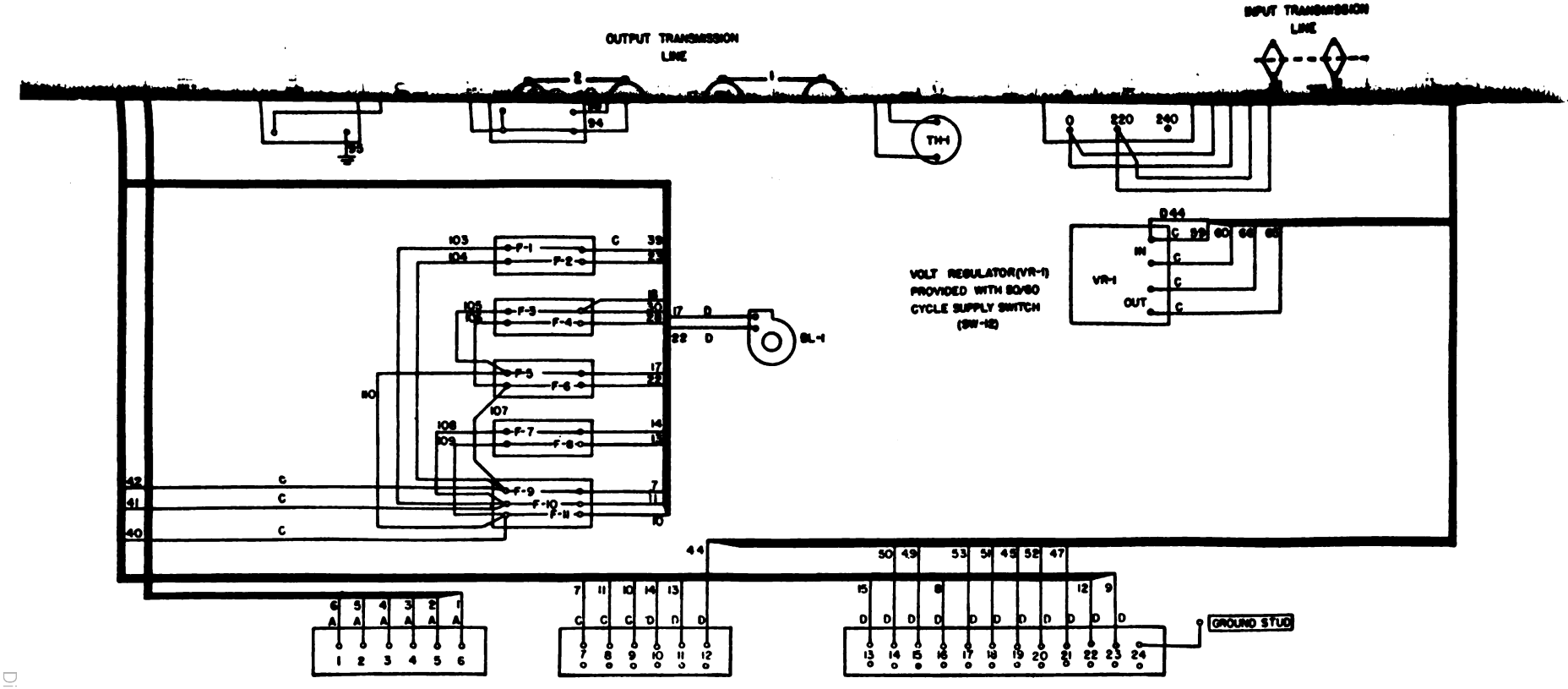

WIRE DESIGNATION	
LETTER	TYPE
A	NO.6 VARNISHED CAMBRIC, LEAD COVERED
B	NO.7 VARNISHED CAMBRIC, LEAD COVERED
C	NO.10 VARNISHED CAMBRIC, LEAD COVERED
D	NO.14 VARNISHED CAMBRIC, LEAD COVERED
E	1/4" O.D. X 3/16" I.D. COPPER TUBING
F	3/8" O.D. X 5/16" I.D. COPPER TUBING
G	1/16" X 1/2" COPPER BUS

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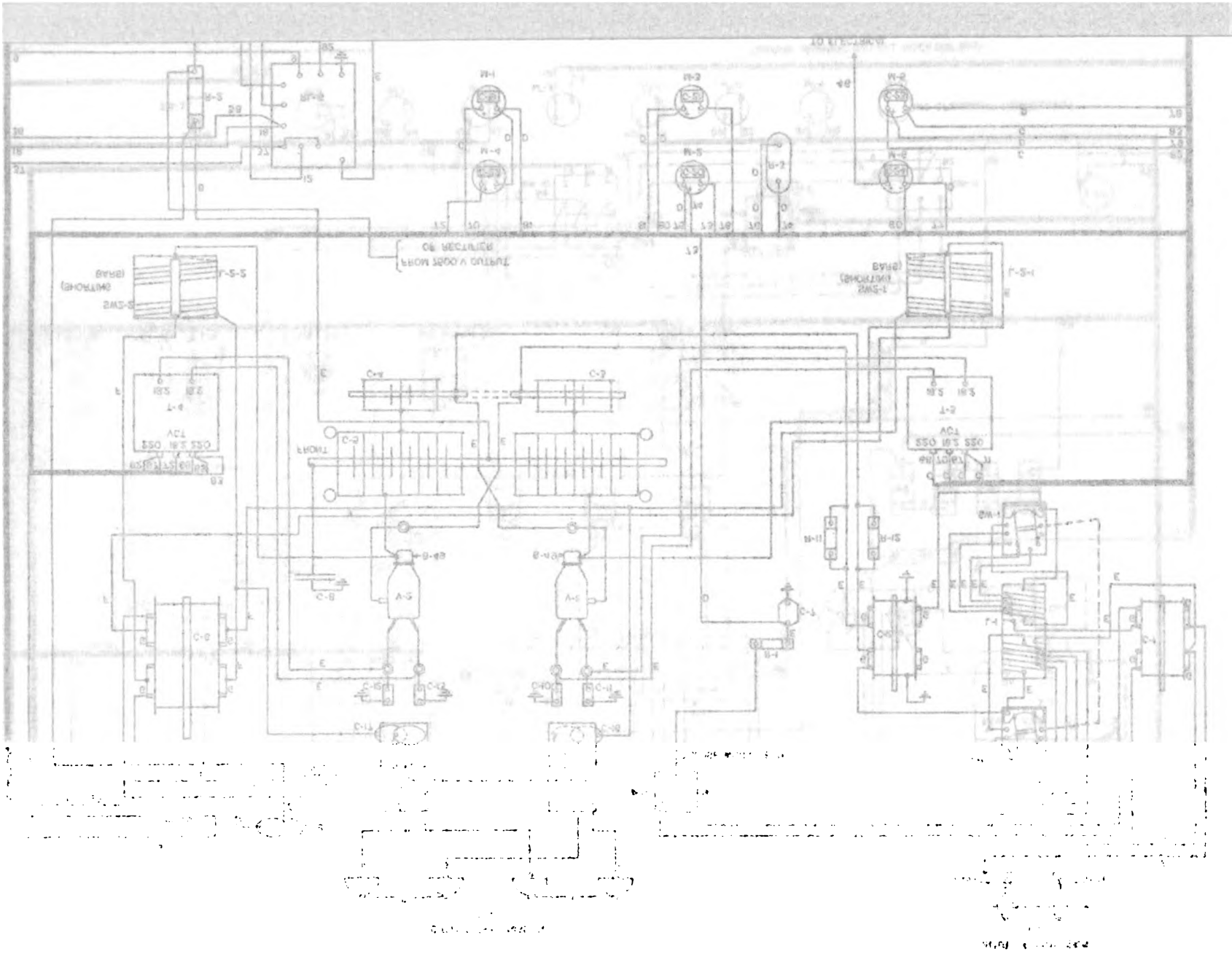

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APPENDIX I

REFERENCES

Note. For availability of items listed, check SR 310–20–3, SR 310–20–4, and the Department of the Army Supply Catalog SIG 1.

1. Army Regulations

AR 380–5 Safeguarding Military Information.

2. Supply Publications

SIG 1 Introduction and Index.

SIG 10 Fixed Plant Maintenance Lists.

SB 11–47 Preparation and Submission of Requisitions for Signal Corps Supplies.

SB 11–76 Signal Corps Kit and Materials for Moisture- and Fungi-Resistant Treatment.

3. Technical Manuals on Auxiliary Equipment and Test Equipment

TM 11–472 Repair and Calibration of Electrical Measuring Instruments.

TM 11–836 Radio Transmitters BC–339, BC–339–A, –B, –C, –E, –F, –G, –H, –J, –K, –L, –M, and –N.

TM 11–2532 Test Set I–153–A (Analyzer, Precision Model 856P).

TM 11–2626 Test Unit I–176.

4. Painting, Preserving, and Lubrication

TB SIG 13 Moistureproofing and Fungiproofing Signal Corps Equipment.

TB SIG 69 Lubrication of Ground Signal Equipment.

5. Camouflage

FM 5–20 Camouflage, Basic Principles.

6. Decontamination

TM 3–220 Decontamination.

7. Demolition

FM 5–25 Explosives and Demolitions.

8. Packaging and Packing Instructions

a. Joint Army-Navy Packaging Specifications.

JAN–D–169 Desiccants, Activated.

JAN–P–100 General Specifications.

JAN–P–106 Boxes, Wood, Nailed.

JAN–P–116 Preservation, Methods of.

JAN–P–125 Barrier Material, Waterproof, Flexible.

JAN–P–131 Barrier Material, Moisture-Vaporproof, Flexible.

b. U. S. Army Specification.

100–2E Marking Shipments by Contractors (and Signal Corps Supplement thereto).

c. Signal Corps Instructions.

720–7 Standard Pack.

726–15 Interior Marking.

9. Other Publications

SR 310–20–3 Index of Training Publications, Field Manuals, Training Circulars, Firing Tables and Charts, Army Training Programs, Mobilization Training Programs, Graphic Training Aids, Joint Army-Navy-Air Force Publications, and Combined Communications Board Publications.

SR 310–20–4 Index of Technical Manuals, Technical Regulations, Technical Bulletins, Supply Bulletins, Lubrication Orders, Modification Work Orders, Tables of Organization and Equipment, Reduction Tables, Tables of Allowances, Tables of Organization, Tables of Equipment, and Tables of Basic Allowances.

FM 24–18 Field Radio Techniques.

TB SIG 5 Defense against Radio Jamming.

TB SIG 25 Preventive Maintenance of Power Cords.

TB SIG 66 Winter Maintenance of Signal Equipment.

TB SIG 72 Tropical Maintenance of Ground Signal Equipment.

TB SIG 75 Desert Maintenance of Ground Signal Equipment.

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TB SIG 123 Preventive Maintenance Practices for Ground Signal Equipment.
TB SIG 178 Preventive Maintenance Guide for Radio Communication Equipment.
TM 1–455 Electrical Fundamentals.
TM 11–310 Schematic Diagrams for Maintenance of Ground Radio Communication Sets.
TM 11–314 Antennas and Antenna Systems.
TM 11–455 Radio Fundamentals.
TM 11–499 Radio Propagation Handbook.
TB 11–499–( )* Basic Radio Propagation Predictions.
TM 38–650 Basic Maintenance Manual.

10. Abbreviations

a-c alternating-current
cps cycles per second
c-w continuous-wave
d-c direct-current
h-f High-frequency
hp horsepower
h-v high-voltage
i-f intermediate-frequency
kc kilocycle
kv kilovolt
kw kilowatt
l-f low-frequency
ma milliampere
mc megacycle
meg megohm
p-a power-amplifier
uf microfarad
uuf micromicrofarad
r-f radio-frequency
v volt

11. Glossary

For an explanation of the terms used in this manual, refer to TM 11–455.

*A new TB in this series is issued monthly which gives propagation predictions 3 months in advance.

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APPENDIX II

IDENTIFICATION TABLE OF PARTS

Note. The fact that a part is listed in this table is not sufficient basis for requisitioning the item. Requisitions must cite an authorized basis, such as T/O&E, T/A, T/BA, SIG 7–8–10, SIG 10, list of allowances of expendable material, or another authorized supply basis. For an index of available supply catalogs in the Signal portion of the Department of the Army Supply Catalog, see the latest issue of SIG 1, Introduction and Index.

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Ref symbol	Model designation							Name of part and description	Function of part	Signal Corps stock No.
	A	B	D	E	F	G	H			
	*	*		*				POWER AMPLIFIER BC-340-A, -B, -E: 4.0-26.5 mc; output 10 kw; power input 220 v, 60 cyc, 3 ph, 29 kw; 8000 v DC max, 3 amp; incl tubes, station components; steel cabinet 83¾″ h x 59½″ d x 42¼″ wd o/a; floor mtd; u/w but does not incl Rectifier RA-22, Water Cooling Unit RU-2, and Radio Transmitter BC-339 as exciter.		2C2940.1
			*		*	*	*	POWER AMPLIFIER BC-340-D, -F, -G, -H: 4.0-26.5 mc; output 10 kw; power input 220 v, 50/60 cyc, 3 ph, 29 kw; 8000 v DC max, 3 amp; incl tubes, station components; steel cabinet 83¾″ h x 59½″ d x 42¼″ wd o/a; floor mtd; u/w but does not incl Rectifier RA-22, Water Cooling Unit RU-2, and Radio Transmitter BC-339 as exciter.		2C2940.3
	*	*	*	*	*	*	*	BLOWER, centrifugal vane: electric motor operated; nonportable; guarded; motor 1/6 hp 1425/1725 rpm 50/60 cyc, single ph 230 v AC; 15″ lg x 12½″ h x 11 7/16″ wd; 350 cfm at 1425 rpm against 0.5″ static pressure; 515 cfm at 1725 rpm against 0.5″ static pressure; single speed relay controlled; direct drive; clockwise up-blast; outlet 6¼″ x 5″; blade and housing die cut steel; pedestal mtg; three ⅜″ mtg holes on 5″ x 4¾″ mtg/c; Ilg Elec size #B12.		3H382
C-7, C-10 through C-13.	*	*	*	*	*	*	*	CAPACITOR, fixed: mica dielectric; 2000 μμf ±5%; 2500 vdcw; max body dimen 1 23/32″ lg x 1 11/32″ wd x 15/32″ thk; JAN type CM56B202J.	C-7: Grid circuit r-f bypass. C-10 through C-13: Filament r-f bypass.	3K5620222
C-16 through C-18	*	*	*	*	*	*	*	CAPACITOR, fixed: mica; 2000 μμf ±5%; 10,000 vdcw; max body dimen 3″ lg x 3½″ diam x 3″ h; JAN type CM80B202J.	C-16 and 17: Antenna d-c blocking. C-18: B+ r-f bypass.	3K8020222
C-19 through C-25.	*	*	*	*	*	*	*	CAPACITOR, fixed: mica; 10,000 μμf ±10%; 600 vdcw; max body dimen 1⅝″ lg x 1⅛″ wd x 23/64″ thk; JAN type CM45B103K.	R-f bypass, M-1 through 7, respectively.	3K4510321
C-27, C-28.	*	*	*	*	*	*	*	CAPACITOR, fixed: mica; 2000 μμf ±5%; 5000 vdcw; max body dimen 3 9/64″ lg x 1 27/32″ wd x 1 17/64″ h; JAN type CM70B202J.	R-f input blocking	3K7020222
C-26	*	*	*	*	*	*	*	CAPACITOR, fixed: paper; 10 μf ±10%; 1000 vdcw; max body dimen 3¾″ lg x 1¾″ wd x 4¾″ h; JAN type CP70E1FG106K (mts w/bracket CP07FD5).	Bias rectifier filter	3DB10-167
	*	*	*	*	*	*	*	CAPACITOR, fixed: paper; 15 μf +10%, -2½%; 660 vacw; HS metal case; 4⅝″ x 4 9/16″ x 3¾″ h; GE type #67X44.	VR-1 phase shifter	3DB15-23
	*	*	*	*	*	*	*	CAPACITOR, fixed: paper; 10 μf +10%, -2½%; 660 vacw; HS metal can; 4⅝″ x 3 3/16″ x 3¾″ h; GE type #67X42.	VR-1 phase shifter	3DB10-83
C-1	*	*	*	*	*	*	*	CAPACITOR, variable: air dielectric; 2 sect; 57-870 μμf per sect; 0.060″ air gap; 14 5/32″ lg x 4¼″ wd x 3¾″ h; ¼″ diam x 1″ lg shaft; 71 plates per sect; mycalex insulation; 2 mtg holes on 14 1/16″ mtg/c; Cardwell #XV-850-PD per dwg #SK-720.	INPUT COUPLING and impedance matching.	3D9850V

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C-2	*	*	*	*	*	*	*	CAPACITOR, variable: air dielectric; plate meshing type; 0.168″ air gap; 2 sect; 30-200 μμf; SLC characteristic; 6000 v peak; 12¼″ lg x 6¼″ wd x 5⅜″ h; ⅜″ diam shaft x 2″ lg; bracket mtg; 4 mtg holes ea end for #10-32 screws; mycalex insulation; Cardwell #TJ-200-UD.	Grid tuning	3D9200V-3
C-6	*	*	*	*	*	*	*	CAPACITOR, variable: air dielectric; plate meshing type; 2 sect; 60-750 μμf per sect; 0.168″ air gap; 20 7/16″ lg x 9″ wd x 7⅜″ h; shaft extends both ends; 0.375″ diam x 2″ lg; mycalex insulation; three ¼″ mtg holes on ea side of end plates; Cardwell type #PJ-750-QD.	Antenna LINE COUPLING and impedance matching.	3D9750V-1
C-3, C-4, C-5, C-8.	*	*	*	*	*	*	*	CAPACITOR ASSEMBLY, variable: c/o 2 neutralizing capacitors ea 20-27 μμf; plate tuning capacitor ganged and mtd in 2 sect ea 60-195 μμf; 15,000 vdcw peak; 26½″ lg x 14½″ wd x 14″ h o/a; 1 fixed capacitor, air dielectric, 265 μμf 10,000 v peak test volts, steel shaft 32¼″ lg x ¾″ diam, machined to 0.449″ for 3 9/16″ on one end and 6¼″ on other end; mycalex base mtd on ins columns 3″ lg x ⅞″ diam, 24″ x 7″ mtg/c; split stator arrangement; water cooled; Johnson EF per Fed Tele & Rad dwg #F13386-14-3.	C-3 and C-4: NEUTRALIZATION. C-5: PLATE TUNING. C-8: Plate circuit r-f bypass.	3D9185V-3
SW-10	*	*	*	*	*	*	*	CIRCUIT BREAKER: thermal; 3 pole; 100 amp, 250 v AC, 125-250 v DC; bakelite; 9⅜″ lg x 4 1/8″ wd x 4 11/16″ h o/a; instantaneous; manual reset; four 9/32″ diam mtg holes on 1⅜″ x 7¼″ ctr; Trumbull #ATB32100.	Main line control switch	3H900-100-17
SW-11	*	*	*	*	*	*	*	CIRCUIT BREAKER: thermal; 3 pole; 90 amp, 250 v AC, 50/60 cyc; 6 holes for #8 mtg screws, surface mtg; bakelite; 6″ lg x 4 15/32″ wd x 4¼″ d o/a; instantaneous; manual reset; four 9/32″ diam mtg holes on 1⅜″ x 7¼″ ctr; Trumbull #ATB32090.	Plate power control switch	3Z9652-3.2
A-1	*	*	*	*	*	*	*	CLEANER, air: glass wool fiber; paper container, 20″ x 25″ x 2″; steel frame mtd; Owens-Ill type #DUSTOP.	Air filter	6Z3856-3
RF-1, RF-2.	*	*	*	*	*	*	*	COIL, RF: choke; single wnd, single layer wnd; unshielded; 83 turns #20 SCE; 7⅜″ lg x 1 1/16″ diam; glass form; air core form 1″ OD x 7⅜″ lg; has ferrule on ea end ⅝″ lg clamped w/#6-32 x ⅜″ screw; mts in two 60 amp, 600 v fuse clips; marked RFC 1 and 2; 23 turns close wnd, 59 turns spaced approx 5″; Coil Winders Inc #CW944-2-3.	Grid circuit r-f choke coils	2C6339/15
RF-3, RF-4	*	*	*	*	*	*	*	COIL, RF: choke; single wnd, single layer wnd; unshielded; 81 turns spaced 5¼ turn per inch, #16 SCE; 17″ lg x 1⅛″ diam; glass form 1″ OD x 17″ lg; air core has ferrule on ea end ⅝″ lg clamped w/#6-32 x ⅜″ screw; mts in two 60 amp, 600 v fuse clips; marked RFC 3 and 4; Coil Winders Inc #CW1007-2-5.	Plate circuit r-f choke coils	2C2940A/C2
L-1	*	*	*	*	*	*	*	COIL, RF: grid tank; 2 wnd, single layer wnd; unshielded; 13 turns cad pl copper tubing ¼″ OD; 14 5/16″ lg x 4¾″ approx diam; ceramic form; air core; tapped at ¼, ½, 2, 3, 5, 7, 13 turns; Coil Winders Inc #CW13147-3-2.	Grid tuning coil	3C1084K-12
L-2-1	*	*	*	*	*	*	*	COIL, RF: plate tank; single wnd, single layer wnd; unshielded; 20 turns parallel copper tubing 7/16″ OD x ⅜″ ID; left-hand wnd; self supported; air core; approx 22½″ lg x 6″ OD; w/ 10″ free lg at bottom and 28″ free lg at top; water cooled; Continental Electronics #648-L.	Water cooled plate tuning coil.	

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Ref symbol	Model designation A	B	D	E	F	G	H	Name of part and description	Function of part	Signal Corps stock No.
L-2-2								COIL, RF: plate tank; single wnd, single layer wnd; unshielded; 20 turns parallel copper tubing 7/16" OD x 3/8" ID; right-hand wnd; self supported; air core; approx 22½" lg x 6" OD; w/ 10" free lg at bottom and 28" free lg at top; water cooled; Continental Electronics #648-L.	Water cooled plate tuning coil.	
F-3, F-4						*				
F-2	*	*	*	*	*		*	FUSE, cartridge: 3 amp, 250 v; renewable; ferrule cont; fibre body; nonindicating; 2" lg x 9/16" diam; Jeffsonelec #380-003, Fed spec W-F-803a, type II.	Bias and control circuit fuses.	3Z1901-3
F-3, F-5	*	*	*	*	*		*	FUSE, cartridge: 6 amp, 250 v; type II; renewable; ferrule cont; fibre body; nonindicating; 2" lg x 9/16" diam; Jeffsonelec #380-006, Fed spec W-F-803a.	Power amplifier and rectifier blower fuses.	3Z2606
F-5 through F-8.						*				
F-4	*	*	*	*	*		*	FUSE FU-15: cartridge; 40 amp, 250 v; renewable; ferrule cont; fibre body; nonindicating; 3" lg x ¾" diam; Jeffsonelec #380-040, Fed spec W-F-803, type II.	Water cooling unit driving motor fuses.	3Z1915
F-9 through F-11.						*				
F-1	*	*	*	*	*		*	FUSE FU-32: cartridge; 20 amp, 250 v; renewable; ferrule cont; fibre body; nonindicating; 2" lg x ½" diam; Jeffsonelec #380-020, Fed spec W-F-803, Type II.	Filament circuit fuses	3Z1932
F-1 and F-2.						*				
						*		FUSE LINK: 3 amp, 250 v; renewal link; per Fed spec #W-F-803, type II; Chase-Shawmut #3001 (for F-3 and F-4, used in model G) (for F-2 used in models A, B, D, E, F, H).	Spare fuse	3Z3003
	*	*	*	*	*		*			
	*	*	*	*	*		*	FUSE LINK: 6 amp, 250 v; ferrule cont mtg; 2¼" lg x ¼" wd; instantaneous action; GE type #1097 per spec #W-F-803; Jeffsonelec #380-006, (for F-3 and F-5, used in Models A, B, D, E, F, H) (for F-5 through F-8, used in model G).	Spare fuse	3Z3006
						*				
	*	*	*	*	*		*	FUSE LINK M-196: 20 amp, 250 v; per Fed spec #W-F-803, type II; Economy fuse #R-220; Jeffsonelec #381-020, (for F-1, used in models A, B, D, E, F, H) (for F-2, used in model G).	Spare fuse	3Z3020
						*				
	*	*	*	*	*		*	FUSE LINK M-201: 40 amp, 250 v; renewal link; Economy fuse #R-240; per Fed spec #W-F-803, type II (for F-4, used in models A, B, D, E, F, H) (for F-9, F-10, F-11, used in model G).	Spare fuse	3Z3040
						*				
A-9	*	*	*	*	*	*	*	GASKET: asbestos; rectangular; 1¾" lg x 1½" wd x 1/16" thk; w/elliptical hole 1¼" lg x 1½" wd, u/w connector, Lapp #10648; Lapp part #9806.	Porcelain water coil gasket	2C2940/G1
A-2	*	*	*	*	*	*	*	GASKET: feedthru bushing; sheet lead; single hole; 2½" OD x 1 15/16" ID x 1/16" thk; Fed Tele & Rad #F-4192-1-2.		2Z4868.39

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A-8	*	*	*	*	*	*	*	GASKET: felt covered metal; rectangular shape; 20″ x 25″ x 1/8″ o/a; ID of hole area 18½″ x 23½″; p/o Owens-Ill "Dustop" air filter.	Air filter gasket	6Z3856-3/1
A-3	*	*	*	*	*	*	*	GASKET: insulator; lead; 6 holes 17/64″ diam equally spaced on 4 5/8″ diam; 5¼″ OD x 3 13/16″ ID x 1/16″ thk; Fed Tele & Rad #F-13196-1.		2Z4868.40
A-6	*	*	*	*	*	*	*	GASKET: lead; for 1″ #10920 Lapp pipe; 1/16″ thk; 1″ ID x 1½″ OD; Lapp #11381 (1 gasket per Tube 2J129B).	1″ porcelain tube gasket	2C2940/G2
A-4	*	*	*	*	*	*	*	GASKET: lead; 1/32″ thk x 7/8″ OD x ½″ ID; for feedthru bushing B-23; Fed Tele & Rad #F-4192-1-19.	Antenna insulator gasket	2Z4868.41
A-5	*	*	*	*	*	*	*	GASKET: rubber; neoprene; for V-1 and V-2 tubes; 2 27/64″ OD x 2 3/64″ ID x 1/16″ thk; Fed Tele & Rad #F-1679-1.	V-1 and V-2 tube gaskets	2Z4868.42
B-37	*	*	*	*	*	*	*	INSULATOR, standoff: ceramic, round post; 4″ lg x 1″ diam, two ¼″-20 tapped holes; Isolantite #348-L-4.	Feedthru insulator	3G1250-64.4
B-36	*	*	*	*	*	*	*	INSULATOR: ceramic; square post; glazed; 1¼″ lg x 23/32″ sq; ea end tapped for #10-32 screw; Isolantite #334.		3G1450-20.5
B-23	*	*	*	*	*	*	*	INSULATOR, feedthru: umbrella shape; isolantite, glazed; 2 13/16″ o/a h x 5⅜ max OD; six 5/16″ mtg holes equally spaced on 4 5/8″ diam; antenna feedthru; Genceraco #1088-00.	Antenna feedthru insulator	3G1350-33
B-24	*	*	*	*	*	*	*	INSULATOR, standoff: column; ultra steatite w/brass end fittings; 4⅜″ x 1″ diam; end fittings 1½″ diam x 7/8″ h; hole in ctr of end tapped 5/16″-18 x 5/16″ d; 2 holes in other end ¼″-20 x 5/16″ d; 13/32″ ea side of ctr; AFS dwg #XMP10-C5-42; Fed Tele & Rad #F-9552-1.	Capacitor (C-5) assembly standoff insulator.	3G1300-70
B-25	*	*	*	*	*	*	*	INSULATOR, standoff: column; ultra steatite w/brass end fitting, 4 5/16″ lg x 1″ diam; brass fittings 1½″ h x 7/8″d; elliptical base 3″ x 1½″; two 9/32″ diam mtg holes on 2¼″ ctr; collar on base ½″ h on 1½″ diam; 1 ctr hole tapped 5/16″-18 x 5/16″ d; AFS dwg #XMP10-C5-41; Fed Tele & Rad #F-13071-1.	Capacitor (C-5) assembly insulator.	3G1350-82
B-26	*	*	*	*	*	*	*	INSULATOR, standoff: column, ceramic; 3″ lg x 1¾″ diam; 1 hole in ctr of ea end, tapped 5/16″-18 x ⅜″ d; 1⅛″ collar both ends; AFS dwg #XMP10-C5-40; Fed Tele & Rad #F-13046-1.	Capacitor (C-5) assembly insulator.	3G1250-48.12
B-27	*	*	*	*	*	*	*	INSULATOR, standoff: square pillar; grade #L-3 white glazed steatite; 1″ lg x ¾″ sq; one #10-32 x ⅜″ d tapped hole in ea end; JAN type NS3W1208.	Stand-off mounting insulator.	3G3512-08
B-28	*	*	*	*	*	*	*	INSULATOR, standoff: round post; glazed ceramic; metal base plates; 2″ lg x 1¼″ diam; one ¼″-20 hole, ½″ d in ea end; nickel pl cap one end; Isolantite #407-L2; Genceraco #D59A.	Stand-off mounting insulator.	3G1300-20

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Ref symbol	Model designation							Name of part and description	Function of part	Signal Corps stock No.
	A	B	D	E	F	G	H			
B–31	*	*	*	*	*	*	*	INSULATOR, standoff: cylindrical pillar; grade #L–3 white glazed steatite; 2″ lg x ¾″ OD; one #10–32 x ⅜″ d tapped hole ea end; JAN type NS3W0316.	Stand-off mounting insulator.	3G3503–16
B–32	*	*	*	*	*	*	*	INSULATOR, standoff: round post; white glazed steatite, grade #L–3; 3″ lg x 1″ diam; 1 hole ea end tapped ¼″–20 x ⅝″ d; JAN type NS3W0424.	Stand-off mounting insulator.	3G3504–24
B–33	*	*	*	*	*	*	*	INSULATOR, standoff: round post; white ceramic; glazed; 4″ lg x 1¼″ diam; oval flange w/2 mtg holes 11/32″ diam on 2⅝″ ctr; complete w/clamping plate and screws; AlSiMag #1854; Isolantite #414–D–4, Stupakoff #01449.	Stand-off mounting insulator.	3G1300–160.2
B–34	*	*	*	*	*	*	*	INSULATOR, standoff: round pillar; grade #L–3, ceramic; white glazed; 2½″ lg x 1″ diam; ¼″–20 x ⅝″ d in ea end; JAN type NS3W0420.	Stand-off mounting insulator.	3G3504–20
B–35	*	*	*	*	*	*		INSULATOR, standoff: round post; grade #G; ceramic; glazed; 2½″ lg x ¾″ OD; axial tap hole ea end #10–24 thd x ⅝″ d; AlSiMag type #1014, special tap.	Stand-off mounting insulator.	3G1250–40.10
B–38	*	*	*	*	*	*	*	INSULATOR, standoff: round post type; white ceramic, glazed; 5″ h x 1″ diam; elliptical mtg base w/two 9/32″ holes on 2¼″ mtg/c; chrome pl fittings; bracket on top has two mtg holes on 2¼″ ctr for ¼″ screw; water pipe support; Lapp #10924.	----------	3G1300–80.4
D–7	*	*	*	*	*	*	*	COIL, insulating: water; por; w/o fittings, 28 ft lg, 1¼″ inside pipe diam; for #232CH water cooling system; Lapp #9191.	High-voltage insulating water coils.	3G1460–28
D–23	*	*	*	*	*	*	*	INSULATOR: por pipe; 1″ size; 30½″ lg; w/bronze fittings, chromium pl; Lapp #10920	Water pipe	3C1300–488
M–9	*	*	*	*	*	*	*	INDICATOR, water flow: metal scale 0–12 GPM; 250 v, 20 w; mercury switch cont; adjusted to close at 8 GPM; complete w/1″ #19B steam orifice and #20B bronze orifice plate; 4¼″ d x 6″ h x 4″ wd; Morey-Jones #98.	Water flow meter	6Z6220
PL–1 through PL–6.	*	*	*	*	*	*	*	LAMP, pilot: 10 w; 230 v; candelabra screw base; clear; term box; GE Mazda #S–6; WECo #ESR–697364.	PL–1: MAIN ON signal light. PL–2: WATER ON signal light. PL–3: FIL ON signal light. PL–4: BIAS ON signal light. PL–5: PLATE OFF signal light. PL–6: PLATE ON signal light.	2Z5895–3

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M-6	*	*	*	*	*	*	*	METER, ammeter: DC; 0–50 ma; 3½″ molded phenolic case; round; flush mtg panel type; calibrated for use on nonmagnetic panel; white scale w/black markings and pointer; JAN type MR34W050DCMA.	Leakage current at water coil targets.	3F905–15
M-1, M-4	*	*	*	*	*	*	*	METER, ammeter: DC; 0–3 amp; 3½″ molded phenolic case; round; flush mtg panel type; calibrated for use on steel panel 0.091″ thk; white scale w/black markings and pointer; JAN type MR34W003DCAA.	M-1: Plate current of V-1 M-4: Plate current of V-2.	3F1003–21
M-2	*	*	*	*	*	*	*	METER, ammeter: DC, 0–800 ma; 3½″ molded phenolic case; round; flush mtg panel type; calibrated for use on steel panel 0.09″ thk; white scale w/black markings and pointer; JAN type MR34W800DCMA.	Grid current	3F980–11
M-7	*	*	*	*	*	*	*	METER, time: total hr; elapsed time indicator; synchronous self-starting elec clock; electro-mechanical control, direct reading; automatic start and stop; 5⅜″ h x 4 7/32″ wd x 3 1/32″ d; 230 v, 60 cyc; two #10–32 studs on 3½″ ctr; pressed steel case, lacquered gray; GE type #8KT-3A6, GE dwg #K–4115534; Fed Tele & Rad dwg #F–31945–1A.	Filament operating time	3F3359
M-5	*	*	*	*	*	*	*	METER, voltmeter: 0–300 v AC; round bakelite flush mtg; 3½″ diam flange x 2.80″ max diam x 1.66″ max diam body; ±2% accuracy; approx 167 ohms per v; calibrated for 0.09″ thk steel panel; white scale w/black markings and pointer; JAN type MR34W300ACVV.	Primary voltage of filament transformers.	3F8300–33
G-3	*	*	*	*	*	*	*	MOTOR, blower: AC; 220 v, 50/60 cyc, single ph; 1/6 hp; 1400–1750 rpm; Ilg Elec #KH–45; GE #5KH45AB2273 (for use with Ilg Elec Vent Blower #B–12).	Operates blower fan	3H3000–39
CH-1	*	*	*	*	*	*	*	REACTOR: filter choke; 4 hy at 0.60 amp; 32 ohms DC resistance; 3000 v RMS test; open frame; 6″ lg x 3¾″ wd x 4⅝″ h; two #8–32 screw term 1 3/16″ lg; four ¼″ diam holes 3″ x 5⅜″ ctr; Amertran #S–49372.	Bias rectifier circuit filter choke.	3C323–2F
VR-1	*	*		*				REGULATOR, voltage: steel; input 190–250 v, 13 amp, 60 cyc; single ph; output 220 v, 2130 w; 85% pf; 23¼″ lg x 16″ wd x 11¾″ h; 4 slots for mtg on 22″ x 7½″ mtg/c; uncased; w/four 3/16″–24 term studs; Raytheon #W–3456–A.	Filament circuit voltage regulator.	2Z7574.8
VR-1			*		*	*	*	REGULATOR, voltage: input 220 v ±10%; 50–60 cyc; single ph; output 220 v ±2%, 1% regulation; continuous duty; 2130 w, 2500 v AC, 2500 v peak insulation; 23¼″ x 16″; 4 mtg slots on 22″ x 7½″ ctr; Fed Tele & Rad #F39069–1.	Filament circuit voltage regulator.	3H4991–2
RL-4	*	*	*	*	*	*	*	RELAY, armature; SPST; normally open; cont rating 4 amp 220 v AC 50/60 cyc; ¼″ diam silver cont; single wnd coil, DC; closes at 0.6 amp but must not open at reduced current of 0.15 amp: 4 ohms DC resistance; four #8–32 studs on coil and cont; 2 3/16″ lg x 3″ wd x 1⅜″ h; ¼″ thk bakelite base w/three 0.144″ holes on 2″ x 1¾″ ctr; fast acting; Leach #1251, coil #336.	Grid bias interlock	2Z7587–10
	*	*	*	*	*	*	*	COIL: relay; 220 v, 60 cyc; operates at 0.6 amp; DC resistance 4 ohms; 1¼″ OD x ⅜″ ID x ⅝″ lg; lead term w/solder lug on end 1″ lg o/a; Leach #336 for #1251 relay (for RL–4).		3C1108–2

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Ref symbol	Model designation							Name of part and description	Function of part	Signal Corps stock No.
	A	B	D	E	F	G	H			
	*	*	*	*	*	*	*	CONTACT: relay; ¼" pure silver; slightly crowned; 6 amp, 115 v AC; SPST double break, normally open; for Leach #1251 relay; Collins Rad #409N34 (for RL–4).	----------	2Z7587-10/1
RL–5	*	*	*	*	*	*	*	RELAY, armature: single cont, single throw, double break; normally closed; cont rating 20 amp 220 v AC, 50/60 cyc; ⅜" diam silver cont; coil single wnd 220 v AC, 50/60 cyc; 0.098 amp; 4107 ohms impedance; ins; #10–32 studs on coil and cont; 5" lg x 3" wd x 2¾" h; four 0.169" holes on 2⅜" x 4⅜" ctr; fast acting; Dunco #BBUK–8 or #84XXH.	Water interlock	2Z7593–4
	*	*	*	*	*	*	*	COIL: relay; 220 v AC, 60 cyc; 0.076 amp w/armature open; 4590 ohm impedance at 60 cyc; 1¾" OD x 1$\frac{7}{32}$" lg; ½" ID; Dunco #80 (for RL–5, RL–7).	----------	2Z7593–4/2
	*	*	*	*	*	*	*	CONTACT: relay; DPDT; 135 deg bend; 1 movable "U" shaped metal strip ⅜" wd x 1/16" thk w/⅜" diam cont attached to open ends; 1$\frac{7}{16}$" x 2¾" o/a; four 3/16" diam cont attached on 1" sq ctr; ⅜" diam x ⅜" h tapped #10–32 hex cap nut; for Dunco #BBUK–8, new #84XXH relay; Dunco #1950 (for RL–5).	----------	2Z7593–4/1
RL–6	*	*	*	*	*	*	*	RELAY, armature: DPST; normally open; SPST auxiliary cont, normally closed; double pole cont rated 0.5 amp, 220 v AC, 50/60 cyc; single pole 0.5 amp; 7000 v DC insulation; ⅜" diam silver cont; single wnd coil; 220 v AC, 50/60 cyc; coil ins; #10–32 studs on coil and cont; 7" lg x 5" wd x 4" h; four mtg holes 6⅜" x 4⅜" ctr; fast acting; Dunco #CXE1324.	B + grounding	2Z7593–39
	*	*	*	*	*	*	*	COIL: relay; 220 v, 50/60 cyc; 1⅜" sq outside; 1$\frac{1}{16}$" sq inside, 1" h; wire leads w/solder lugs; 5" lg o/a; for Dunco relay #CXE–1324; Dunco #22–C–33 (for RL–6).	----------	3C1115–4
	*	*	*	*	*	*	*	CONTACT: relay; c/o 2 fixed cont ⅜" diam attached to end of hex cap nut ⅜" x ⅜" h tapped #10–32; 1 fixed cont ⅜" diam attached to one end of metal strip; 3 movable cont ea ⅜" diam; rated 0.5 amp, 220 v AC; normally closed pole cont ins for 7000 v; Dunco #CXE–1324 (for RL–6).	----------	2Z7593–39/1
RL–7	*	*	*	*	*	*	*	RELAY, armature: 3PST; normally open; cont rating 25 amp, 220 v AC, 50/60 cyc; ⅜" diam silver cont; coil, single wnd, 220 v AC 50/60 cyc; 0.098 amp; 4107 ohms impedance; ins; 8 stud term; 4¼" lg x 3" wd x 2⅞" h; four mtg holes to clear #10–32 screws, 2 on front on 1⅛" ctr and 2 on rear on 2⅜" ctr, 2⅝" between ctr; fast acting; Dunco #8CXX.	Water flow control	2Z7593–8
	*	*	*	*	*	*	*	CONTACT: relay; silvered; cont rated 25 amp, 220 v, 50/60 cyc; 3 pole normally open 3 fixed cont ⅜" diam attached to end of hex cap nut ⅜" x ⅜" h tapped #10–32; 3 movable cont 3¼" x ⅜" x 1/16" metal stubs; Dunco #600, #11899 for Dunco #ATBD–8 or #8CXX (for RL–7, RL–8).	----------	12Z7593–8/1

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RL-8	*	*	*	*	*	*	*	RELAY, armature: DPST; normally open; cont rating 3 amp, 220 v AC, 50/60 cyc; ¼" diam silver cont; single wnd, 220 v AC, 50/60 cyc; 0.041 amp; 9700 ohms impedance; ins; #6-32 stud term; 2¾" lg x 1⅞" wd x 2" h; four mtg holes to clear #6-32 screw, 2²³⁄₆₄" x 1½" ctr; fast acting; Dunco #1BXX.	Filament circuit control relay.	2Z7590-22
	*	*	*	*	*	*	*	COIL: relay; 220 v, 60 cyc; 930 ohms; 900 turns #36 ga wire; ½" diam x 1⁷⁄₃₂" lg core; 1⅜" OD; Dunco #90 for 1BXX relay (for RL-8).	----------	3C1115
RL-1	*	*	*	*	*	*	*	RELAY: time delay; dust proof cover; SPST, normally open 220 v AC, 60 cyc, 6 amp; mercury to mercury cont; multiple wnd coil 220 v AC, 1100 ohms noninductive; ins; pigtail leads on coil and cont; four ¼" mtg holes on 3⅛" horiz ctr; 2⅜" vert ctr; 6" lg x 2⅞" d x 3¾" wd; Adlake #902-72-1.	Plate grid bias circuit control relay.	2Z7587-9
	*	*	*	*	*	*	*	COIL: relay; 220 v, 60 cyc; 1100 ohms; 1⅞" lg x 2¹⁵⁄₃₂" diam coil form; for time delay relay #902-72-1; Adlake #187-1-171 (for RL-1, RL-2, RL-3).	----------	3C1113-1
	*	*	*	*	*	*	*	CONTACT: plunger; mercury cont; 220 v AC, ¼ amp; for time delay relay; 5⅞" lg x 1" diam; 2 leads protrude from bottom, 1 black #16 AWG lead, 12" lg; 1 green tracer #16 AWG lead, 12" lg; Adlake #P-463904 or #463266 (for RL-1).	----------	2Z7587-9/1
RL-2	*	*	*	*	*	*	*	RELAY: time delay; dust proof cover; SPST, normally open; 220 v AC, 60 cyc, 3 amp; mercury to mercury cont; multiple wnd coil 220 v AC, 60 cyc; 1100 ohms DC resistance; 6" lg x 2⅞" d x 3¾" wd, 15-30 sec make 3/10 sec release; Adlake #902-72-2.	Filament circuit time delay	2Z7598-8
	*	*	*	*	*	*	*	CONTACT: relay; for Adlake time delay relay #902-72-2; single cont normally open; mercury type; 3 amp noninductive load; 220 v, 50/60 cyc; 15-30 sec time delay; 0.3 sec release; 5⅝" lg w/12" lg leads; Adlake #463291 or #463912 (for RL-2).	----------	2Z7598-8/1
RL-3	*	*	*	*	*	*	*	RELAY: time delay; dust proof cover; SPST, normally closed; cont 3 amp 220 v, 60 cps; mercury to mercury cont; multiple wnd coil 220 v AC, 60 cyc; 1100 ohms DC resistance; 6" lg x 2⅞" d x 3¾" wd; four ¼" mtg holes on 3⅛" horiz, 2⅜" vert; 60 sec make 3/10 sec release; Adlake #902-72-3.	Water flow shut-down time delay.	2Z7587-36
	*	*	*	*	*	*	*	CONTACT: relay; mercury type; molybdenum electrodes; phenolic and glass tube; single cont, normally closed; 220 v, 50/60 cyc; 5 amp; 5⁷⁄₁₆" lg x 1" OD o/a; Adlake part #463293 or #463295 (for RL-3).	----------	2Z7587-36/1
R-11, R-12.	*	*	*	*	*	*	*	RESISTOR, fixed comp; 1000 ohms ±10%; 20 w; 6" lg x 1" diam; uninsulated; 2 sprayed monel metal ferrules on ends; Carborundum type #A (p/o parasitic suppressor).	Grid circuit parasitic suppressors.	3Z6100-151
R-1	*	*	*	*	*	*	*	RESISTOR, fixed: WW; 310 ohms ±5%; 120 w; max body dimen 8⅝" lg x 1⁵⁄₁₆" diam; JAN type RW11F311.	Grid bias	3RW21301
R-2	*	*	*	*	*	*	*	RESISTOR, fixed: WW; 1000 ohms ±5%; 120 w; max body dimen 8⅝" lg x 1⁵⁄₁₆" diam; JAN type RW11F102.	B + grounding circuit, current limiting.	3RW24302

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Ref symbol	Model designation							Name of part and description	Function of part	Signal Corps stock No.
	A	B	D	E	F	G	H			
R–4, R–5	*	*	*	*	*	*	*	RESISTOR, fixed: WW; 6.3 ohms ±5%; 120 w; max body dimen 8 5/8" lg x 1 5/16" diam; JAN type RW11F6R3.	Filament voltage dropping	3RW11104
R–6 through R–9.	*	*	*	*	*	*	*	RESISTOR, fixed: WW; 250 ohms ±5%; 120 w; max body dimen 8 5/8" lg x 1 5/16" diam; JAN type RW11F251.	Bias rectifier circuit bleeders	3RW20701
R–10	*	*	*	*	*	*	*	RESISTOR, variable: WW; 4 ohms ±10%; 1900 w; two 1/4–20 screw term; stamped steel frame, 13" diam x 4 3/4" d; open case; 1/2" diam round cad pl steel shaft approx 4" lg; linear taper; ins case; normal torque; mts on panel w/two #8–32 screws on 2 1/8" mtg/c; WL #63–009.	FILAMENT voltage control.	3Z7004
B–50	*	*	*	*	*	*	*	SOCKET, tube; 4 cont above chassis base mtg; 2 holes 7/32" diam on 2 3/4" mtg/c; ceramic base; 3 3/8" diam x 1" h; brass nickel pl shell; 2 1/4" h o/a; phosphor bronze cont, cad pl; no markings; Johnson EF #211.	Tube sockets for V–3 and V–4.	2Z8759.3
S–6	*	*	*	*	*	*	*	SWITCH, push: 1 form "C" break-make; 8 amp, 600 v AC; bakelite body; 6 3/8" lg x 2 3/4" wd x 4 19/32" d o/a; nonshorting; normally closed; screw term; wall or panel mtg; 3 mtg holes 9/32" diam on 6" x 6" x 2 1/4" ctr; cover marked "START-STOP" on 2 buttons; GE dwg #K7866222, part #CR–2940–2–R4.	Plate circuit push-button control.	3Z9824–29.3
S–7, S–8	*	*	*	*	*	*	*	SWITCH, push: SPST; 3 amp, 250 v; 6 amp, 125 v; 3 amp, 250 v; close ckt when depressed; normally open; por; mtd in steel box; plate 4 5/8" x 1 1/4"; hole required 1 1/16" wd x 2 3/8" lg x 1 1/2" d; AH&H #2023.	Door interlocks	3Z9824–31.3
S–1	*	*	*	*	*	*	*	SWITCH, rotary; 2 pole, 6 position; 6 cont hard drawn copper; cad pl 1/2" diam x 3/16" thk; shorting cont, mycalex insulation; o/a dimen 13 3/8" lg x 6" wd x 1 5/8" thk; 2 holes drilled for #10–32 mach screws; 4 3/4" mtg/c; 14 1/2" lg shaft; Fed Tele & Rad #F–20077–14, AFS #XMP10–SW1.	GRID RANGE selector	3Z9550.28
S–3	*	*	*	*	*	*	*	SWITCH, rotary: DPDT; 1 cont, copper coil pl; 3/16" thk x 1/2" diam; shorting type cont; mycalex insulation, 3/8" thk; 9 3/4" lg x 10 3/4" h x 5 1/4" wd; shaft 13 1/4" lg x 1/4" diam; 2 brass mtg brackets; Fed Tele & Rad #F–13173–14 (antenna change-over).	Transmission line selector	3Z9550.8
S–2–1	*	*	*	*	*	*	*	BAR SET, shorting: shorting bars w/clamps, set of 13; c/o 13 shorting bars, ranging from 3" lg to 22 1/2" lg; u/w tuning coils L–2–1; Fed Tele & Rad #F–13387–1–1 to 13.	Coarse tune plate tank coil L–2–1.	
S–2–2	*	*	*	*	*	*	*	BAR SET, shorting: shorting bars w/clamps; set of 13; c/o 13 shorting bars, ranging from 3" lg to 22 1/2" lg; u/w tuning coils L–2–2; Fed Tele & Rad #F–13387–1–1 to 13.	Coarse tune plate tank coil L–2–2.	

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TH–1	*	*	*	*	*	*	*	SWITCH, thermostatic: SPST; opens 160°F., closes 140°F.; nonadjustable; 4 amp 250 v; metal case; 2⅛″ diam x 2 9/16″ max wd x 25/32″ thk; nonshorting solder lug term; mtg holes 5/32″ diam on 2 5/32″ diam 90 deg apart; normally closed; operates on temp rise; Spencer Thermo "Klixon" #C–2851–1.	Operating temperature control.	2Z9489.20
SW–12			*		*	*	*	SWITCH, toggle: 3PDT; bakelite body; 2 7/8″ x 2 5/8″ x 2 25/64″ d; 20 amp, 110 v; 10 amp, 250 v; locking; mtg bracket w/2 mtg holes 3/16″ diam on 3⅜″ ctr; binding screw term; bakelite toggle arm 7/16″ x ⅜″ x 1 9/32″ lg; AH&H #80891.	50 to 60 cycle switch for VR–1.	3Z9858–8.68
S–4	*	*	*	*	*	*	*	SWITCH, toggle: DPST; phenolic; 3¾″ lg x 1 7/16″ wd x 2⅞″ d o/a; 30 amp, 250 v; 20 amp, 600 v; two #18–32 tapped mtg holes, 3 5/16″ mtg/c; 3 5/16″ c to c; screw term; 7/16″ x 1 3/16″ panel slot; AH&H #6808–U.	Bias rectifier circuit. BIAS ON-OFF control switch.	3Z9864.2
S–5	*	*	*	*	*	*	*	SWITCH, toggle: DPDT; 30 amp, 250 v; bakelite insulation; 2¾″ wd x 3″ lg x 2¾″ d; locking, normally closed; lug term; two 3/16″ diam mtg holes on 3 5/16″ mtg/c; 7/16″ x 1 3/16″ panel slot; AH&H #8807–U.	FILAMENT ON-OFF control switch.	3Z9862–1.3
S–9	*	*	*	*	*	*	*	SWITCH, toggle: SPST; 3 amp, 250 v; bakelite body; 3¾″ lg x 1″ wd x 2″ d; nonshorting; locking, normally open #10–32 screw term; 2 holes clear #10–32 on 3¼″ mtg/c; panel slot 7/16″ x 1 3/16″; AH&H #80149.	WATER ON-OFF control	3Z9857.39
T–1	*	*	*	*	*	*	*	TRANSFORMER, power: plate type; input 220 v, 50/60 cyc, single ph; tapped for 240 v; 2500 v RMS test; secd 556 va; 1310 v, 4000 v RMS test; uncased, coil and core open; air coolant; varnish impr; 7 5/16″ x 6¾″ x 7⅛″; 4 mtg slots, 6 3/16″ x 4½″ mtg/c; pri term 3 studs #8–32 thd on bakelite strip; secd term 3 studs #8–32 thd on ceramic insulation; Fed Tele & Rad #F–11911–1; Kenyon #S7753.	Bias rectifier plate supply	2Z9601.21
T–2	*	*	*	*	*	*	*	TRANSFORMER, power: fil type; input 220 v, 50/60 cyc; tapped at 216 v and 224 v; secd 5 v, 13.5 amp CT; uncased, assembled w/cast iron and plates; 5″ x 7 3/16″ x 4¼″; 5000 v insulation; 4 mtg slots 5/16″ wd x ⅝″ lg on 4″ x 3⅛″ mtg/c; 4 pri studs #8–32 thd spaced 1⅛″ on bakelite strip; 3 secd term stu ls #10-24 thd on bakelite strip; Fed Tele & Rad #F–11915–1.	Bias rectifier circuit filament.	2Z9600.90
T–3, T–4	*	*	*	*	*	*	*	TRANSFORMER, power: fil type; input 220 v 50/60 cyc; single ph; single output wnd; 18.2 v 58 amp CT; 2500 v RMS test; air coolant; 9″ lg x 8½″ wd x 7⅛″ h; 4 mtg slots on 6¾″ x 6¾″ mtg/c; Kenyon #F–36.	Tube 129–B (V–1 and V–2) filament supply.	2Z9600.44
	*	*		*				TRANSFORMER, power: voltage regulator; encl case; 6¾″ lg x 4½″ wd x 4½″ h; pri rated 190–260 v at 13 amp, 60 cyc; secd rated 220–230 v at 11.3 amp; pri 174 turns, secd 45.5 tapped at 35 and 40; 4 mtg feet on 6⅜″ x 6⅜″ mtg/c; eight #10–24 x ⅝″ lg stud term; Raytheon #U5575 (for VR–1).	Voltage regulator	2Z9614–76
			*		*	*	*	TRANSFORMER: regulator; pri rated 198–242 v at 13.3 amp; secd rated 220 v at 11.35 amp + 0.5%; 7 taps on secd; nine #8–32 x ½″ lg term mtd on term strip on side; encl case; 6¾″ lg x 3¾″ wd x 4⅛″ h; 4 mtg ft on 5¼″ x 6⅜″ ctr; Raytheon #U7185 (for V–R1).	Voltage regulator	2Z9614–77

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Ref symbol	Model designation							Name of part and description	Function of part	Signal Corps stock No.
	A	B	D	E	F	G	H			
M-8	*	*	*	*	*	*	*	THERMOMETER: general observation type; mercury thermo element; 0–100°C.; mercury filled bulb 5″ o/a; 2½″ sensitive portion, 2½″ extension w/elec cont rated 1/10 amp at 110 v 7 w; mtg flange 6¾″ diam; body 5 15/32″ diam; 5″ iron case; w/1″ union connection and 6½ ft of stainless steel flex tubing used to control water inlet; black face w/yellow numerals; Tagliabue #14600.	Temperature control of outgoing water.	6Z7010
M-10	*	*	*	*	*	*	*	THERMOMETER: temp; dial indicator; 0 to 100°C.; w/mercury filled bulb 5″ o/a; 2½″ sensitive portion, 2½″ extension; 5″ iron case; body 5 15/32″ diam x 2 3/16″ d; mtg flange 6¾″ diam w/1″ union connection; Tagliabue #14600 w/o elec cont.	Measures temperature of incoming water.	6Z7010.1
V-3, V-4	*	*	*	*	*	*	*	TUBE, electron: JAN-4B32	Half-wave rectifiers	2J4B32
V-1, V-2	*	*	*	*	*	*	*	TUBE, electron: JAN-129B	R-f amplifiers	2J129B
M-3	*	*	*	*	*	*	*	VOLTMETER IS-113: DC; 0–1000 v DC; 3½″ diam flange w/body 2.8″ diam x 1 5/8″ d behind fl; flush mtg equipped w/ext multiplier; accuracy ±2% D'Arsonval movement; 200 ohms per volt; calibrated for ⅛″ steel panel; 3 mtg holes 0.156″ diam on 1.58″ radius, 120 deg apart; 2 stud term ¼″-28 thd; ¾″ lg; Weston type #301.	Grid bias voltage	3F7313
	*	*	*	*	*	*	*	INSULATOR, plate: rectangular shape; white, glass fabric, silicon resin lam untreated; 12⅛″ lg o/a; 1″ wd x ¼″ thk, 6 drilled holes 0.209/ diam on ctr line 11/32″, 2.656″, and 4.656″ from ea end; Lewyt part/dwg #B-7395.		3G320-104
	*	*	*	*	*	*	*	INSULATOR, plate: rectangular shape; white, glass fabric, silicon resin lam untreated; 14″ lg o/a; 1″ wd x ¼″ thk, 8 drilled holes 0.147″ diam on ctr line spaced 0.250″, 1.50,″ 3.812″ and 6.124″ from ea end; Lewyt part/dwg #B-7396.		3G320-105
	*	*	*	*	*	*	*	INSULATOR, plate: rectangular shape; white, glass fabric, silicon resin lam untreated; 20 7/16″ lg o/a; 1″ wd x ¼″ thk, 4 drilled holes 0.209″ diam, 2 spaced ¼″ from 1 side 7/32″ from ea end, other 2 spaced ¼″ from opposite side 0.469″ from ea end, 4 drilled holes 0.272″ diam on ctr line spaced 3.25″ and 8.25″ from ea end: Lewyt part/dwg #B-7397.		3G320-106
	*	*	*	*	*	*	*	INSULATOR, plate: rectangular shape; white, glass fabric, silicon resin lam untreated; 20 7/16″ lg o/a; 1″ wd x ¼″ thk, 4 drilled holes 0.209″ diam, 2 spaced ¼″ from 1 side 7/32″ from opposite side 0.469″ from ea end; Lewyt part/dwg #B-7398.		3G320-103

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2. Identification Table of Parts for Power Amplifier BC–340–I

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	AMPLIFIER, RF: Sig C Amplifier BC–340–I; 4000 to 26,500 kc; output 10 kw; 59¾″ d x 42¼″ wd x 83¼″ h o/a; power input 220 v AC, 3 ph, 50/60 cyc, 130 amp; incl 1 set of spare tubes and lamps and 5 sets of spare fuses; mtd in metal cabinet.		
C–1	CAPACITOR, variable: air dielectric; plate meshing type; dual sect; 57 to 870 μμf per sect; SLC characteristic; 0.060″ air gap; 2500 v peak test v; 14$\frac{5}{32}$″ lg x 4¼″ wd x 3¾″ h; ¼″ diam x 1″ lg shaft; extension shaft adj; 72 brass N.P. plates per sect; 360 deg rotation; glass fabric silicon resin insulation; stud terms 2 mtg holes on 14$\frac{1}{16}$″ mtg/c; Cardwell part #XV–850–PD per dwg #SK–720.	INPUT COUPLING and impedance matching.	
C–2	CAPACITOR, variable: air dielectric; plate meshing type; dual sect; 30 to 211 μμf per sect; SLC characteristic; 0.168″ air gap; 15,000 v peak test v; 12¼″ lg x 6¼″ wd x 5⅜″ h; ⅜″ diam x 2″ lg shaft; extension shaft adj; 21 polished aluminum plates per sect; 360 deg rotation; glass fabric silicon resin insulation; stud term; bracket mtg; 4 mtg holes 4″ x 2½″ x 1⅝″ mtg/c ea end for #10–32 screws; Cardwell part #TJ–200–UD per dwg #A9027.	GRID TUNING.	
C–3, C–4, C–5, C–8.	CAPACITOR ASSEMBLY: c/o 2 variable neutralizing capacitors ea 20 to 27 μμf; plate tuning capacitor ganged and mtd in 2 sect ea 60 to 195 μμf, 15,000 vdcw and 1 fixed capacitor, air dielectric, 265 μμf, 10,000 v peak test v; 26½″ lg x 14½″ wd x 14″ h o/a; steel shaft 32¼″ lg x ¾″ diam, machined to 0.449″ for 3$\frac{9}{16}$″ on one end 6¼″ on other end; mtd on ins columns 3″ lg x 1¾″ diam, 24″ x 7″ mtg/c; Lewyt part/dwg #D7543–41.	C–3 and C–4: NEUTRALIZATION. C–5: PLATE TUNING. C–8: Plate circuit r–f bypass.	
C–6	CAPACITOR, variable: air dielectric; plate meshing type; dual sect; 60 to 750 μμf per sect; SLC characteristic; 0.168″ air gap; 15,000 v peak test v; 20$\frac{1}{16}$″ lg x 9″ wd x 7⅜″ h; shaft extends both ends; 0.375″ diam x 2″ lg; extension shaft adj; 35 polished aluminum plates per sect; 360 deg rotation; glass fabric silicon resin insulation; stud term; three ¼″ mtg holes on 6″ x 19$\frac{11}{16}$″ mtg/c; Cardwell part #PJ–750–QD per dwg #A–9208.	Antenna LINE COUPLING and impedance matching.	
C–7, C–10 through C–13.	CAPACITOR, fixed: mica; 2000 μμf ±5%; 2500 vdcw; JAN type CM56B202J; spec JAN–C–5.	C–7: Grid circuit r–f bypass. C–10 through C–13: Filament r–f bypass.	
C–16 through C–18.	CAPACITOR, fixed: mica; 2000 μμf ±5%; 10,000 vdcw; JAN type CM80B202J; spec JAN–C–5.	C–16 and C–17: Antenna d–c blocking. C–18: B+ r–f bypass.	
C–19 through C–25.	CAPACITOR, fixed: mica; 10,000 μf ±10%; 600 vdcw; JAN type CM45B103K; spec JAN–C–5.	C–19 through C–25: R–f bypass, M–1 through M–7, respectively.	
C–26	CAPACITOR, fixed: paper dielectric; 10 μf ±10%; 1000 vdcw; JAN type CP70E1FG106K; mts w/bracket CP07FD5; spec JAN–C–25.	Bias rectifier filter.	
C–27, C–28	CAPACITOR, fixed: mica; 2000 μμf ±5%; 5000 vdcw; JAN type CM70B202J; spec Jan–C–5.	R–f input d–c blocking.	

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Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	CAPACITOR, fixed: paper dielectric; 15 μf +10% −2½%; 660 vacw; HS metal can; 4⅝" lg x 4⁹⁄₁₆" wd x 3¾" h; pyranol filled and impr; 2 solder lug term on top; no int ground connections; no mtg furnished; p/o Voltage Regulator VR-1; GE part #67X44.	Voltage regulator phase shift.	
	CAPACITOR, fixed: paper dielectric; 10 μf +10% −2½%; 660 vacw; HS metal can; 4⅝" lg x 3⅜" wd x 3¾" h; pyranol filled and impr; 2 solder lug term on top; no int gnd connections; no mtg furnished; p/o Voltage Regulator VR-1; GE part #6X44.	Voltage regulator phase shift.	
D-7	COIL, insulating: water, white por glazed, 22" h x 12" diam, w/o fittings; 28 ft lg extended, 1½" inside pipe diam; four ½" holes on 4⅝" mtg/c; for water cooling system; Lapp #9191.	High-voltage insulating water coils.	
SW-10	CIRCUIT BREAKER: thermal; 3 pole; 100 amp, 220 v AC 50/60 cyc; bakelite case; 5⅜" lg x 4⅛" wd x 4¹¹⁄₁₆" h o/a; instantaneous; manual reset; four ⁹⁄₃₂" diam mtg holes on 1⅜" x 7¼" ctr; ¼"-20 studs protruding 1" from base; Trumbull #ATB32100.	MAIN ON-OFF line control switch.	
SW-11	CIRCUIT BREAKER: thermal; 3 pole; 90 amp, 220 v AC, 50/60 cyc; bakelite case; 5⅜" lg x 4⅛" wd x 4¹¹⁄₁₆" h o/a; instantaneous; manual reset; four ⁹⁄₃₂" diam mtg holes on 1⅜" x 7¼" ctr; ¼"-20 studs protruding 1" from base; Trumbull #ATB32090.	PLATE ON-OFF power control switch.	
	CLEANER, air: metal screen; steel container; 19¾" x 24¾" x 1⅞"; mtd in steel frame; Air-Maze type "Air Maze."	Air filter.	
RF-1, RF-2	COIL, RF: choke; single wnd plugs into two 60 amp, 600 v fuse clips; single layer wnd; unshielded; 83 turns #20 SCE; 7⅜" lg x 1¹⁄₁₆" diam; glass form, air core; form 1" OD x 7⅜" lg has ferrule on ea end ⅝" lg clamped w/#6-32 x ⅜" lg screw; fuse clip mtd; marked RF-1, RF-2; tropicalized; Coil Winders Inc part #CW944-2-3.	Grid circuit r-f choke coils.	
RF-3, RF-4	COIL, RF: choke; single wnd plugs into two 60 amp, 600 v fuse clips; single layer wnd; unshielded; 81 turns spaced 5¼ turns per inch #16 SCE; 17" lg x 1⅛" diam; glass form, air core; form 1" OD x 17" lg has ferrule on ea end ⅝" lg clamped w/#6-32 x ⅜" lg screw; fuse clip mtd; marked RF-3, RF-4; tropicalized; Coil Winders Inc part #CW1007-2-5.	Plate circuit r-f choke coils.	
L-1	COIL, RF: grid tank; 2 wnd, single layer wnd; unshielded; 13 turns cad pl copper tubing ¼" OD; 14¹⁵⁄₁₆" lg x 4¾" approx; ceramic form, 3⅝" OD x 12" lg approx air core; tapped at ¼, ½, 2, 3, 5, 7, 13 turns; 2 brackets on ea end, w/2⅛" mtg/c; 13 term lugs; Coil Winders Inc part #CW13147-3-2.	Grid tuning coil.	
L-2-1	COIL, RF: plate tank; single wnd; single layer wnd; no coil form; unshielded; 20 turns parallel copper tubing 7⁄16" OD x ⅜" ID; mtg block on top; left-hand wnd; approx 22½" lg x 6" OD; w/10" free lg on bottom and 28" free lg on top; self supported, air core; adj tap tuning marked L-2-1; water cooled; Lewyt part #7543-78.	Water cooled plate tuning coil.	

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L–2–2	COIL, RF: plate tank; single wnd; single layer wnd; no coil form; unshielded; 20 turns parallel copper tubing 7/16" OD x 3/8" ID; mtg block on top; right-hand wnd; approx 22½" lg x 6" OD; w/10" free lg on bottom and 28" free lg on top; self supported; air core; adj tap tuning marked L–2–2; water cooled; Lewyt part #7543–77.	Water cooled plate tuning coil.
F–1, F–2	FUSE, cartridge: Sig C Fuse FU–32; 20 amp, 250 v; renewable; fibre body; ferrule term; nonindicating; 2" lg x 9/16" diam; Jeffsonelec #380–020.	Filament circuit fuses.
F–3, F–4	FUSE, cartridge: 3 amp, opens in 60 min at 135% load and 2 min at 200% load, rated continuous 110% load; 250 v; renewable; fibre body; ferrule term; nonindicating; 2" lg x 9/16" diam; Jeffsonelec #380–003.	Bias and control circuit fuses.
F–5 through F–8.	FUSE, cartridge: 6 amp, 250 v; renewable; fibre body; ferrule term; nonindicating; 2" lg x 9/16" diam; Jeffsonelec #380–006.	F–5 and F–6: Power amplifier blower fuses. F–7 and F–8: Rectifier blower fuses.
F–9 through F–11.	FUSE, cartridge: Sig C Fuse FU–15; 40 amp, 250 v; renewable; fibre body; ferrule term; nonindicating; 2" lg x 9/16" diam; Jeffsonelec #380–040.	Water cooling unit driving motor fuses.
	FUSE LINK: 3 amp, 250 v; 2½" lg x ¼" wd; renewal link for Jeffsonelec #380–003 fuse; Jeffsonelec #381–003.	Spare for F–3 or F–4.
	FUSE LINK: 6 amp, 250 v; 2½" lg x ¼" wd; renewal link for Jeffsonelec #380–006 fuse; Jeffsonelec #381–006.	Spare for F–5, F–6, F–7, or F–8.
	FUSE LINK: 20 amp, 250 v; 2½" lg x ¼" wd; renewal link for Jeffsonelec #380–020 fuse; Jeffsonelec #381–020.	Spare for F–1 or F–2.
	FUSE LINK: 40 amp, 250 v; 2½" lg x ¼" wd; renewal link for Jeffsonelec #380–040 fuse; Jeffsonelec #381–040.	Spare for F–9, F–10, or F–11.
A–9	GASKET: pipe joint; asbestos; single hole; rectangular, 1¾" lg x 1½" wd x 1/16" thk; w/elliptical hole 1¼" lg x 1½" wd; u/w connector, Lapp #10648; Lapp part #9806.	Porcelain water coil gasket.
A–6	GASKET: pipe joint; lead; single hole; round, 1½" OD x 1" ID x 1/16" thk; u/w Lapp por pipe #10920; Lapp part #11381.	One inch porcelain pipe gasket.
A–4	GASKET: ins; lead; single hole; round, 7/8" OD x ½" ID x 1/32" thk; u/w feedthru bushing B–23; Fed Tele & Rad #F–4192–1–19.	Antenna insulator gasket.
A–5	GASKET: vacuum tube; neoprene rubber; round, 2 27/64" OD x 2 3/64" ID x 1/16" thk; u/w #129B tubes; Fed Tele & Rad #F–1679–1.	JAN–12 and JAN–13 tube seating gasket.
B–27	INSULATOR, standoff: sq pillar; JAN type NP2W1208; spec JAN–I–21	Stand-off mounting insulator.
D–23	LINE, water; connects plate coils to water system; straight, 1½" OD, 30½" lg; solid wall, por tubing; Lapp swivel fitting; mts w/three ¼" holes for bolts on ea end; Lapp part #10920.	Water pipe.

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Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
B–37	INSULATOR, feedthru: conical shape; JAN type NP2W4601; spec JAN–I–21	Feedthru insulator.	
B–31	INSULATOR, standoff: round post; JAN type NP2W0316; spec JAN–I–21	Stand-off mounting insulator.	
B–28	INSULATOR, standoff: round post; Grade L–3, white por glazed; 2″ lg x 1¼″ diam; one ¼″–20 hole, ½″ d in ea end; nickel pl cap on one end; Isolantite #407–L2.	Stand-off mounting insulator.	
B–35	INSULATOR, standoff: round post; JAN type NP2W0524; spec JAN–I–21	Stand-off mounting insulator.	
B–33	INSULATOR, standoff: round post; Grade L–4, white por glazed; 4″ lg x 1¼″ diam; oval flange w/2 mtg holes 11/32″ diam on 2⅝″ mtg/c complete w/clamping pl and screws; Isolantite #414–C4.	Stand-off mounting insulator.	
B–23	INSULATOR, feedthru: umbrella shape; Grade L–4, white por glazed; 5⅜″ lg x 2¾″ h, 9/16″ hole; six 9/32″ holes equally spaced on a 4⅝″ diam bolt circle; Isolantite #306.	Antenna feedthru insulator.	
B–34	INSULATOR, standoff: round post; JAN type NP2W0420; spec JAN–I–21	Stand-off mounting insulator.	
B–24	INSULATOR, standoff: round post; Grade L–4, white steatite glazed; 4⅜″ lg x 1″ diam; bronze cap both ends, 1″ lg x 1½″ diam, one cap 5/16″–18 tapped hole, one cap two ¼″–20 tapped holes, 13/16″ mtg/c; p/o variable capacitor assembly, Lewyt part #D7543–41; Lewyt part/dwg #7543–3.	Capacitor (C–5) assembly stand-off insulator.	
B–25	INSULATOR, standoff: round post; Grade L–4, white steatite glazed; 4 5/16″ lg x 1″ diam; 1″ lg x 1½″ diam; bronze cap w/5/16″–18 tapped hole in ctr, at one end, flanged bronze cap w/two 9/32″ diam holes, 2¼″ mtg/c at other end; p/o variable capacitor assembly, Lewyt #D7543–41; Lewyt part/dwg 07543–11.	Capacitor (C–5) assembly insulator.	
B–26	INSULATOR, standoff: round post; Grade L–4, white steatite glazed; 3″ lg x 1¾″ diam; ½″ lg x 1¾″ diam; bronze caps w/5/16″–18 tapped hole in ctr of both ends; Isolantite #BR247.	Capacitor (C–5) assembly stand-off insulator.	
M–9	INDICATOR, water flow: steel, black finish mercury switch cont, 250 v, 20 w ad to close at 8 GPM; metal scale 0–12 GPM; 4⅓″ d x 6″ h x 4″ wd; complete w/1″ #157A steam orifice and #158A orifice plate; two ¼″ mtg holes on 4½″ mtg/c; Morey-Jones #98, Class B.	WATER FLOW meter.	
PL–1 through PL–6.	LAMP, pilot: 240 v 10 w; bulb S–6 clear; 1½″ lg l/a; candelabra base; tungsten filament; burn any position; GE Mazda #S–6.	PL–1: MAIN ON signal light. PL–2: WATER ON signal light. PL–3: FIL. ON signal light. PL–4: BIAS ON signal light. PL–5: PLATE OFF signal light. PL–6: PLATE ON signal light.	

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M-1, M-4	METER, ammeter: DC; 0–3 amp; JAN type MR36W003DCAA; spec JAN–I–6; HS	M-1: PLATE 1 current of V-1. M-4: PLATE 2 current of V-2.
M-2	METER, ammeter: DC; 0–800 ma; JAN type MR36W800DCMA; spec JAN–I–6; HS	GRID current.
M-3	METER, voltmeter: DC; JAN type MR36W001DCKV w/0–1000 v DC, 50 division scale; spec JAN–I–6; HS.	Grid BIAS voltage.
M-5	METER, voltmeter: AC; 50 to 60 cyc; 0–300 v AC; JAN type MR36W300ACUV	Primary voltage of filament transformers.
M-6	METER, ammeter: DC; 0–50 ma; JAN type MR36WO50DCMA; spec JAN–I–6; HS	LEAKAGE current at water coil target.
M-7	METER, time: elapsed time indicator; synchronous self-starting elec clock; direct reading; automatic start and stop; 5 3/8" h x 4 7/32" wd x 3 1/32" d; 5 rotating drum counters, ea calibrated 0–9; calibrated in hr; operates on 220 v, 60 cyc, operable on 50 cyc by application of connection factor of 6/5 to all readings; steel dacquered gray; 2 #10–32 studs on 3 1/2" mtg/c; GE type #8KT–2A6.	Filament operating time.
G-3	MOTOR, AC: split-phase type; 1/6 hp, 1750/1425 rpm; closed frame; 50°C. temp rise; pulley not incl, plain shaft; 8 3/8" lg x 6 5/16" wd x 6 21/32" h, shaft 3/16" diam protruding 1 15/16" from frame; 220 v AC, 60/50 cyc, single ph, 2.6 amp, 63% pf; GE frame #45 solid base; 4 mtg holes on 4 7/8" x 3" mtg/c; tropicalized; GE type #KH, GE dwg #GEM–850B; Ilg Elec blower B–12.	Blower motor.
CH-1	REACTOR, filter choke: 4 hy at 0.60 amp; 32 ohms DC resistance; 3000 v RMS test; HS metal case; 6 1/4" lg x 5" h x 4 1/2" wd; four 1/4"–20 studs x 1/2" lg on 3" and 5 3/8" mtg/c; 2 stud term on top; spec JAN–T–27; Lewyt part #7204.	Bias rectifier circuit filter choke.
VR-1	REGULATOR, voltage: steel, gray finish; input, 220 v, ±10%, 50/60 cyc, 13 amp, output 220 v, ±2%, 2,500 va, 1% regulation; approx 23 1/4" lg x 16" wd x 11 3/4" h; 4 mtg slots on 22" x 7 1/2" mtg/c; spec JAN–T–27; Lewyt part #7208B.	Filament circuit voltage regulator.
RL-4	RELAY, armature: SPST; normally open; cont 4 amp 220 v AC; 1/4" diam silver cont; single wind coil, DC; closes at 0.6 amp but must not open at 0.15 amp; 4 ohms DC resistance; 4 #8–32 studs on coil and cont; 2 3/16" lg x 3" wd x 1 3/8" h; 1/4" thk bakelite base w/3 0.144" holes on 2" x 1 3/4" mtg/c; fast acting; Leach #1251, coil #366.	Grid bias interlock.
RL-5	RELAY, armature: single cont, single throw; double break; normally closed; cont rating 20 amp, 220 v AC; 3/8" diam silver cont; coil single wnd 220 v AC, 50/60 cyc; 0.098 amp; 4107 ohms impedance; ins; #10–32 studs on coils and cont; 5" lg x 3" wd x 2 3/4" h; four 0.169" holes on 2 3/8" x 4 3/8" mtg/c; fast acting; Dunco #BBUK–8 or #84XXH.	Water interlock.
RL-6	RELAY, armature: DPST; normally open; SPST auxiliary cont, normally closed; double pole cont rated 0.5 amp, 220 v AC 50/60 cyc; single pole 0.5 amp; 7000 v DC insulation; 3/8" diam silver cont; single wnd coil; 220 v AC, 50/60 cyc; coil ins; #10–32 studs on coil and cont; 7" lg x 5" wd x 4" h; 4 mtg holes 6 3/8" x 4 3/8" mtg/c; fast acting; Dunco #CXE1324.	B+ grounding.

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Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
RL–7	RELAY, armature: 3PST; normally open; cont rating 25 amp, 220 v AC; ⅜″ diam silver cont; coil, single wnd, 220 v AC, 50/60 cyc; 0.098 amp; 4107 ohms impedance; ins; 8 stud term; 4¼″ lg x 3″ wd x 2⅞″ h; 4 mtg holes to clear #10–32 screws, 2 on front on 1⅛″ mtg/c, 2 on rear on 2⅜″ mtg/c, 2⅝″ between ctr; fast acting; Dunco #8CXX.	Water flow control.	
RL–8	RELAY, armature: DPST; normally open; cont rating 3 amp, 220 v AC; ¼″ diam silver cont; single wnd, 220 v AC, 50/60 cyc; 0.041 amp; 9700 ohms impedance; ins; #6–32 stud term; 2¾″ lg x 1⅞″ wd x 2″ h; 4 mtg holes to clear #6–32 screw, 2 23/64″ x 1½″ ctr; fast acting; Dunco #1BXX.	Filament circuit control relay.	
RL–1	RELAY, time delay: dust proof cover; SPST normally open; 220 v AC; 6 amp, mercury to mercury cont; multiple wnd coil 220 v AC, 50/60 cyc; 1100 ohms noninductive; ins; pigtail leads on coil and cont; four ¼″ mtg holes on 3⅛″ horiz ctr; 2⅜″ vertical mtg/c; 6″ lg x 2⅞″ d x 3¾″ wd; Adlake #902–72–1.	Plate and grid bias circuit time delay.	
RL–2	RELAY, time delay: dust proof cover; SPST, normally open; 220 v AC; 3 amp; mercury to mercury cont; multiple wnd coil, 220 v AC, 50/60 cyc; 1100 ohms DC resistance; wire leads on coil and cont; 6″ lg x 2⅞″ d x 3¾″ wd, 15–30 sec make, 3/10 sec release; Adlake #902–72–2.	Filament circuit time delay.	
RL–3	RELAY, time delay; dust proof cover; SPST normally closed; cont 3 amp, 220 v AC; mercury to mercury cont; multiple wnd coil 220 v AC 50/60 cyc; 1100 ohms DC resistance; wire leads on coil and cont; 6″ lg x 2⅞″ d x 3¾″ wd; four ¼″ mtg holes on 3⅛″ horiz, 2⅜″ vertical; 60 sec make, 3/10 sec release; Adlake #902–72–3.	Water flow shut-down time delay.	
R–11, R–12	RESISTOR, fixed: comp; 1000 ohms ±10%; 20 w; 6″ lg x 1″ diam; uninsulated; 2 sprayed monel metal ferrules on ends, 1″ OD x ¾″ lg; noninductive; Carborundum Co, Globar type A.	Grid circuit parasitic suppressors.	
R–1	RESISTOR, fixed: WW; 310 ohms ±5%; 120 w; JAN type RW11F311; spec JAN–R–26	Grid bias.	
R–2	RESISTOR, fixed: WW; 1000 ohms ±5%; 120 w; JAN type RW11F102; spec JAN–R–26	B+ grounding circuit current limiting.	
R–4, R–5	RESISTOR, fixed: WW; 6.3 ohms ±5%; 120 w; JAN type RW11F6R3; spec JAN–R–26	Filament voltage dropping.	
R–6 through R–9	RESISTOR, fixed: WW; 250 ohms ±5%; 120 w; JAN type RW11F251; spec JAN–R–26	Bias rectifier circuit bleeders.	
R–10	RESISTOR, variable: WW; 4 ohms ±10%; 1900 w; two ¼″–20 screw term; stamped steel frame, 13″ diam round cad pl steel; shaft approx 4″ lg; linear taper; ins cont arm; normal torque; mts on panel w/two #8–32 screws on 2⅛″ mtg/c; WL #63–009.	FILAMENT voltage control.	
B–50	SOCKET, tube: 4 cont above chassis base mtg; 2 holes 7/64″ diam on 2¾″ mtg/c; ceramic base; 3⅜″ diam x 1″ h; brass nickel pl shell; 2¼″ h o/a; phosphor bronze cont; cad pl; no markings; Johnson EF #211.	Tube sockets for V–3 and V–4.	

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S–6	SWITCH, push: 1 form "C" break-make; 8 amp, 600 v AC; bakelite body, 6⅜" lg x 2¾" wd x 4³⁰⁄₃₂" d o/a; nonshorting; normally closed; screw term; wall or panel mtg; 3 mtg holes ⁹⁄₃₂" diam on 6" x 6" x 2¼" ctr; cover marked "START-STOP" on 2 buttons; GE dwg #K7866222, part #CR–2940–NB–102A.	Plate circuit push-button control.
S–7, S–8	SWITCH, push: SPST; 3 amp, 250 v; 6 amp, 125 v; close ckt when depressed; normally open; por; mtd in steel box; plate 4⅝" x 1¼"; hole required 1⅛" wd x 2⅜" lg x 1½" d; AH&H #2023.	Door interlocks.
S–1	SWITCH, rotary: 2 pole, 6 position; 6 cont hard drawn copper; cad pl; ½" diam x ⅜" thk; shorting cont, mycalex ins; o/a dimen 13⅜" lg x 6" wd x 1⅝" thk; 2 holes drilled for #10–32 mach screws; 4¾" mtg/c; 14½" lg shaft; Fed Tele & Rad #F–20077–14, AFS #XMP10–SW1.	GRID RANGE selector.
S–3	SWITCH, rotary: DPDT; 1 cont, copper coil pl; ⅜" thk x ½" diam; shorting type cont; mycalex ins, ⅜" thk; 9¾" lg x 10¾" h x 5¼" wd; lug term; 13¼" lg x ¼" diam; 2 brass mtg brackets; four ⁷⁄₃₂" holes on 11" x 4" mtg/c; Fed Tele & Rad #F–13173–14 (antenna change-over).	Transmission line selector.
TH–1	SWITCH, thermostatic: SPST; opens 160°F., closes 140°F.; nonadjustable; 4 amp, 250 v; metal case; 2⅛" diam x 2⁹⁄₁₆" max wd x ²⁵⁄₃₂" thk; nonshorting solder lug term; mtg holes ⁵⁄₃₂" diam on 2⁵⁄₃₂" diam 90 deg apart; normally closed; operates on temp rise; Spencer Thermo "Klixon" #C–2851–1.	Operating temperature control.
SW–12	SWITCH, toggle: 3PDT; bakelite body; 2⅞" x 2⅝" x 2²⁵⁄₆₄" d; 30 amp, 110 v; 10 amp, 250 v; locking; mtg bracket w/2 mtg holes ⅜" diam on 3⅜" mtg/c; binding screw term; bakelite toggle arm 7⁄16" x ⅜" x 1⁹⁄₃₂" lg; AH&H #80891 (for VR–1).	Line frequency switch.
S–4	SWITCH, toggle: DPST; phenolic; 3¾" lg x 1⁷⁄₁₆" wd x 2⅞" d o/a; 30 amp, 250 v; 20 amp, 600 v; bakelite handle approx ½" lg; two #18–32 tapped mtg holes, 3⁵⁄₁₆" mtg/c; screw term; 7⁄16" x 1³⁄₁₆" panel slot; AH&H #6808–U.	Bias rectifier circuit BIAS ON-OFF control switch.
S–5	SWITCH, toggle: DPDT; 30 amp, 250 v; bakelite insulation; 2¾" wd x 3" lg x 2¾" d; bakelite handle approx ½" lg; locking, normally closed; lug term; two ⅜" diam mtg holes on 3¹⁵⁄₁₆" mtg/c; 7⁄16" x 1³⁄₁₆" panel slot; AH&H #8807–U.	FILAMENT ON-OFF control switch.
S–9	SWITCH, toggle: SPST; 3 amp, 250 v; bakelite body; 3¾" lg x 1" wd x 2" d; bakelite handle approx ½" lg; nonshorting; locking, normally open; #10–32 screw term; 2 holes clear #10–32 on 3¼" mtg/c; panel slot 7⁄16" x 1³⁄₁₆"; AH&H #80149.	WATER ON-OFF control.
T–1	TRANSFORMER, power: plate type; input 220 v, 50/60 cyc, single ph; tapped for 240 v; 1 output wnd; 556 va, 1310 v CT; 2500 v pri, 4000 v secd insulation; air coolant, potted; HS metal case; 7⁵⁄₁₆" lg x 6¾" wd x 5½" h; 6 sealed stud term on top, 1" h x ⁹⁄₁₆" wd; four ¼"–20 x ½" stud on 3¹⁵⁄₁₆" x 3¾" mtg/c; Lewyt part #7201; spec JAN–T–27.	Bias rectifier plate supply.
T–2	TRANSFORMER, power: fil type; input 220 v, 50/60 cyc, single ph; tapped at 216 v and 224 v; 1 output wnd; 5 v, 13.5 amp CT; 5000 v insulation; air coolant, potted; HS metal case; 5" lg x 4¾" wd x 4" h; 7 sealed stud term on top, 1" h x ⁹⁄₁₆" wd; four ¼"–20 x ½" lg studs on 3¹⁵⁄₁₆" x 3¾" mtg/c; Lewyt part #7203; spec JAN–T–27.	Bias rectifier circuit filament.

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Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
T-3, T-4	TRANSFORMER, power: fil type; input 220 v, 50/60 cyc; single ph; 1 output wnd; 18.2 v, 58 amp CT; 2500 v insulation; air coolant, potted; HS metal case; 8½" lg x 8" wd x 6½" h; 5 sealed stud term, 2 on side, 3 on top; top term 1" h x 9/16" wd; side term, 1½" h x 1" wd; four ¼"-20 x ½" lg studs on 6¾" mtg/c; Lewyt part #7202; spec JAN-T-27.	Tube JAN-129B (V-1, V-2) filaments.	
M-8	THERMOMETER: general observation type; mercury thermal element; 0-100°C; mercury filled bulb 5" o/a; 2½" sensitive portion, 2½" extension w/electrical cont rated 1/10 amp at 110 v, 7 w; mtg flange 6¾" diam; body 5 15/32" diam; 5" iron case; w/1" union connection and 6½ ft of stainless steel flex tubing used to control water inlet; black face w/yellow numerals; Tagliabue #14600.	Measures temperature of outgoing water; also water temperature control.	
M-10	THERMOMETER: general observation type, mercury thermal element; 0-100°C; mercury filled bulb 5" o/a; 2½" sensitive portion, 2½" extension, no electrical cont; mtg flange 6¾" diam; body 5 15/32" diam; 5" iron case; w/1" union connection and 6½" ft of stainless steel flex tubing used to control water inlet; black face w/yellow numerals; Tagliabue #14600.	Measures temperature of incoming water.	
V-3, V-4	TUBE, electron: JAN-4B32; half-wave rectifier	Grid bias rectifier circuit, mercury vapor half-wave rectifiers.	
V-1, V-2	TUBE, electron: JAN-129B; triode	Water cooled r-f amplifier vacuum tubes.	

3. Identification Table of Parts for Rectifier RA-22-A, -C, -D, -E, -F, and -G

Ref symbol	Model designation						Name of part and description	Function of part	Signal Corps stock No.
	A	C	D	E	F	G			
	*		*				RECTIFIERS RA-22-A and -D: electronic; output 7500 v DC, 3.45 amp; input 220 v, 60 cyc, 3 ph regulated; 79¼" x 53¾" x 39¼" o/a; 6 type F-872A rect tubes; 3 ph full-wave rectification; filter reactor and capacitor incl; mtd in metal cabinet; controls (except voltage) located on Power Amplifier BC-340-( ).		3H4662
		*		*	*	*	RECTIFIERS RA-22-C, -E, -F, and -G: electronic; output 7500 v DC, 3.45 amp; input 220 v, 50/60 cyc, 3 ph regulated; 79¼" x 53¾" x 39¼" o/a; 6 type F-872A rect tubes; 3 ph full-wave rectification; filter reactor and capacitor incl; mtd in metal cabinet; controls (except voltage) located on Power Amplifier BC-340-( ).		3H4662C
C-1	*	*	*	*	*	*	CAPACITOR, fixed: paper; 4 uf ±10%; 10,000 vdcw; oil impr; steel case; 13" h x 12" lg x 6" wd; 4 7/16" pillar type term; w/7/16"-14 thd studs, ¾" h; 6" mtg/c; Dubilier type #TK-10040.	Filter capacitor	3DB4-62.1

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	*	*	*	*	*	*	COIL: relay; 200 to 240 v at 8.3 ma, 50/60 cyc; 22 ohm DC resistance; tape wnd hollow solenoid; 2½″ x 2½″ x 2½″ o/a; two 2¼″ lg flex ins pigtail leads; Monitor Cont #23069 (for controller assembly SW-1).	----------	3C1117-6
SW-1, w/R-22, R-23, R-24.	*	*	*	*	*	*	CONTROLLER: open type; 50/60 cyc; c/o one 100 amp, 220 v, 3 pole magnetic contractor w/Adlake #902-72-5 mercury time-delay relay attached; 3 sec delay; one 100 amp, 220 v, 3 pole resistor short circuiting contactor; 3 intermittent duty resistors 3.5 ohms in each ph, 35 amp rated to carry 70 amp; Controller Co #6632AS2.	High-voltage time-delay control.	3H1098
A-1	*	*	*	*	*	*	CLEANER, air: glass wool-fiber; paper cntr; 20″ x 25″ x 2″, steel frame mtd; Owens-Ill type #DUSTOP.	Air filter	6Z3856-3
B-6	*	*	*	*	*	*	INSULATOR, standoff: round post; white glazed steatite, Grade #L-3; 3″ lg x 1″ diam; 1 hole ea end tapped ¼″-20 x ⅝″ d; JAN type NS3WO316.	Stand-off mounting insulator	3G3504-24
B-7	*	*	*	*	*	*	INSULATOR, standoff: ceramic; 6″ lg x 1″ diam; 1 hole in ea end tapped ¼″-20 x ⅝″ d; Isolantite #348-L-6.	Stand-off mounting insulator	3G1250-96.6
G-3	*	*	*	*	*	*	MOTOR, blower: AC; 220 v, 50/60 cyc, single ph; 1/6 hp; 1400/1750 rpm; Ilg Elec #KH-45; GE #5KH45AB2273 (u/w Ilg Elec Vent Blower #B-12).	Operates blower fan	3H3000-39
M-3	*	*	*	*	*	*	METER, voltmeter: 0-10 kv DC; 1000 ohms per v, accuracy 2%; black on white scale 2.36″ lg; 50 scale divisions; rectangular bakelite case; flange 3″ x 3⅛″; body 2¾″ diam x 1¾″ d; 4 mtg studs 0.112″ diam; 2¼″ apart mtg/c; Weston type #301.	Rectifier output voltage	3F13999-1.2
M-1, M-2	*	*	*	*	*	*	Meter, voltmeter: 0-300 v AC; round bakelite flush mtg; 3½″ diam flange x 2.80″ max diam x 1.66″ max diam body; 2% accuracy; approx 167 ohms per v; calibrated for 0.09″ thk steel panel; JAN type MR34W300ACVV.	M-1: Primary of filament transformers. M-2: Line voltage.	3F8300-33
CH-1	*	*	*	*	*	*	REACTOR: filter choke; integral type; 0.9 hy at 220 ma, 0.13 hy at 3 amp, 0.2 hy at 3.45 amp; 1.1 ohm DC resistance; 19,000 v RMS, 60 cyc; drawn steel case 11″ lg x 5¾″ wd x 7⅞″ h; 2 flange mtg feet w/4 slotted holes ¼″ wd on 7⅛″ x 6⅜″ mtg/c; Amertran #S-4927-1.	Filter choke with protective spark.	3C315-12
RL-1, RL-2	*	*	*	*	*	*	CIRCUIT BREAKER: overload; solenoid; cont arrangement 1A1B; 2-8 amp, 110 v AC or DC; glass case; approx 5¼″ h x 4⅞″ d x 2⅞″ wd o/a; instantaneous; manual indicator reset; two #10-32 inserts molded into case for mtg on 2½″ mtg/c; 6 tapped stud term in back; Wemco type #SC-1, style #1096945A.	A-c overload relays	2Z7588-6
	*	*	*	*	*	*	COIL: relay; single wnd; min oper v 0.3 v DC; 6 amp max cont cur; 0.16 ohm DC resistance; 2$\frac{3}{32}$″ OD x 1$\frac{1}{64}$″ ID x 1$\frac{29}{32}$″ lg; 2000 v AC, 60 cyc insulation test; no case; 2 leads w/wire preformed to fit relay term; for Wemco type #SC-1 relay; Wemco #1003398 (for RL-1, RL-2).	----------	2Z7590-20/2

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Ref symbol	Model designation						Name of part and description	Function of part	Signal Corps stock No.
	A	C	D	E	F	G			
	*	*	*	*	*	*	CONTACT: set of 2; for DC to 60 cyc overload relay; 1 amp DC, 5 amp AC; brass; 1″ x 2″ x 3/8″ wd spring cont; double cont on ins strip 1 5/8″ x 1 1/8″; WECo #1055993 (for RL-1, RL-2, RL-3).		2Z3196-5
RL-3	*	*	*	*	*	*	RELAY: overload; DPST; pick-up amp range 0.5 to 2 amp; continuous 1.5 amp; AC-DC; self resetting cont 5 amp at 125 v DC or 115 v AC; glass cover; 5 1/32″ x 2 15/16″ x 5 11/32″; 3″ term studs back of panel; for Wemco #SC-1; Fed Tele & Rad #F24259-1, Wemco #1096943A.		2Z7590-20
	*	*	*	*	*	*	COIL: relay; magnetic coil; 0.5-2 amp, 60 cyc; 2″ OD x 1 3/4″ thk; for Wemco type #SC-1; Wemco style #1003396 (for RL-3).	D-C OVERLOAD relay	3C1118-1
	*	*	*	*	*	*	RELAY, thermal: mercury; SPST; 2 cont, normally open; slow make 3 sec, quick break; noninductive; cont rating 220 v AC, 10 amp, 50/60 cyc; 6 1/2″ x 3 3/4″ x 3″ o/a; 4 mtg holes in mtg plate on 3 1/8″ x 2 3/8″ mtg/c; Adlake #902-72-5 (p/o SW-1).		2Z7587-64
	*	*	*	*	*	*	COIL: relay; 200-240 v, 50/60 cyc; 60 ma; 1090 ohms DC resistance; wnd on bakelite spool 2 1/4″ OD; 15/16″ ID x 1 1/4″ wd; two 5 1/2″ lg leads; Adlake #1040-62-23 (p/o Adlake #187-1-102).		3C1113-3
	*	*	*	*	*	*	CONTACT: relay; starter switch; 220 v, 10 amp, 50/60 cyc; noninductive; 5 5/8″ lg w/12″ leads; metal sleeve; Adlake #PC-463924.		2Z7587-64/1
	*	*	*	*	*	*	RELAY, thermal: mercury; contactor; 3 pole silver cont; 1-100 amp, 220 v; coil 220 v, AC; bakelite case 16″ x 19″ x 21 1/2″; chassis mtd 4 holes 3/8″ diam on 18 3/8″ x 19 1/2″ ctr; Monitor Cont #6632AS2 (p/o SW-1).		2Z7593-23
	*	*	*	*	*	*	CONTACT: relay; stationary; 220 v, 100 amp; copper cont; for use on Monitor Cont Starter #6632AS2; Monitor Cont #19879 or #5-32-3.		2Z7593-23/1
	*	*	*	*	*	*	CONTACT: relay; stationary; 220 v, 5 amp; silver cont; for Monitor Cont #23538 or #3-75-2; Monitor Cont Starter #6632AS2.		2Z7593-23/2
	*	*	*	*	*	*	CONTACT: relay; movable 220 v, 5 amp; silver cont; normally closed for Monitor Cont Starter #6632AS2; Monitor Cont #23540 or #3-66.		2Z7593-23/3
	*	*	*	*	*	*	CONTACT: relay; movable; 220 v, 100 amp; copper cont; for Monitor Cont Starter #6632AS2; Monitor Cont #20431 or #5-32-2.		2Z7593-23/4
	*	*	*	*	*	*	CONTACT: relay; movable; 220 v, 5 amp; silver cont, normally open; for Monitor Cont Starter #6632AS2; Monitor Cont #23539 or #3-65.		2Z7593-23/5

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R-1	*	*	*	*	*	*	RESISTOR, fixed: WW; 1.4 ohms ±5%; 120 w; 8⅝" lg x 1 5/16" max diam; JAN type RW11F1R4.	Overload resistor	3RW7201
R-2 through R-19.	*	*	*	*	*	*	RESISTOR, fixed: WW; 2000 ohms ±5%; 120 w; 8⅝" lg x 1 5/16" max diam; JAN type RW11F202.	Bleeder resistors	3RW26101
R-20, R-21	*	*	*	*	*	*	RESISTOR, fixed: WW; 5 meg ±½%; 1 ma max; 8 11/16" lg x 1 5/16" diam; JAN type MFA-505.	Multiplier resistors for M-3	3Z6805-17
SG-1	*	*	*	*	*	*	SPARK GAP: approx 1¼" lg x ½" diam; c/o Amertran support #S-34410 and sphere gap #S-34411; for protection of set; Amertran dwg #S-34409.	Spark gap	2Z8808-1
S-2	*	*	*	*	*	*	SWITCH, door: push button; SPST; 6 amp, 125 v; 3 amp, 250 v; close ckt when depressed; por; mtd in steel box, plate 4⅝" x 1¼"; hole required 1 1/16" wd x 2⅜" lg x 1½" d; AH&H #2023.	Interlock	3Z9824-31.3
S-3	*	*	*	*	*	*	SWITCH, rotary: 4 position w/off position; 3 ckt; 3 stage voltmeter; 3 ph; ph to ph; cont rating 20 amp, 600 v; case 2 13/16" x 4 5/16" x 3 9/16" d behind panel; 3 point mtg by mach screws to ¼" thk panel; GE #16-SB1CF-1.	Selector switch, throws M-2 across any phase.	3Z9825-74.12
T-2	*	*	*	*	*	*	TRANSFORMER: fil; pri 216, 220, 224 v, 50/60 cyc; test 2500 v; secd 5.0 v at 20.25 amp; 10½" lg x 7¼" wd x 6¼" h o/a; 4 mtg holes ⅝" diam; four #8-32 screws; Kenyon #S7768.	Filament transformer for V-1, V-2, and V-3.	2Z9600.43
T-3 through T-5.	*	*	*	*	*	*	TRANSFORMER: fil; pri 216, 220, 224 v, 50/60 cyc; secd 5.0 v, 6.75 amp CT; pri test 2500 v; secd test 19,000 v; 10¼" lg x 5⅞" wd x 4⅞" h; four #8-32 screws, 4 mtg holes ⅝" diam; Kenyon #S-18713.	T-3: V-4 filament transformer. T-4: V-5 filament transformer. T-5: V-6 filament transformer.	2Z9600.46
T-1	*	*	*	*	*	*	TRANSFORMER, power: plate type; delta pri 220 v, 50/60 cyc, 3 ph, 30 kva; secd 6150/5620/5050/4500/3940/2820 v; 60 cyc output; pri tested to 2500 v RMS; secd tested to 19,000 v RMS; steel case 32" lg x 23" wd x 48¼" h; Amertran #S-49376.	High-voltage supply	3H5630-1
T-6, T-7	*	*	*	*	*	*	TRANSFORMER, power: current type; unshielded; pri 150 amp, secd 5 amp; 5000 v impulse; open type, coil wnd on frame, 9½" lg x 4⅜" wd x 6 17/32" h o/a; mts by 2 mtg ft, ea w/4 openings; 2 holes, 2 slots on 2⅜", 4 5/16", 3 7/16", and 1⅝" mtg/c; Wemco #KO, style #S-651911.	Operate a-c overload relays	2Z9933-1911
TH-1	*	*	*	*	*	*	THERMOSTAT: 500 w; 230 v AC; bimetal cartridge type; 2¼" x ⅝" diam; cont, heavy electrolytic silver; adj to 700°F. max temp; Ulanet "Firecracker" type #F.	Operating temperature control.	2Z9489.15
V-1 through V-6.	*	*	*	*	*	*	TUBE, electron: JAN-47332	Mercury vapor half-wave rectifiers.	2J4B32

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4. Identification Table of Parts for Rectifier RA–22–H

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	RECTIFIER RA–22–H: electronic; output 7500 v DC, 3.45 amp; input 220 v, 50/60 cyc, 3 ph regulated; 79¼″ x 53¾″ x 39¼″ o/a; 6 type JAN 872-A rectifier tubes 3 ph full-wave rectification; filter reactor and capacitor incl; mtd in metal cabinet; controls (except voltage) located on Power Amplifier BC–340–( ).		
C–1	CAPACITOR, fixed: paper dielectric; 4μf ±10%; 10,000 vdcw; HS metal can; 13″ h x 12″ lg x 6″ wd; oil impr; two 4⁷⁄₁₆″ pillar type term, w/⁷⁄₁₆″–14 thd studs; ¾″ h; no mtg; Dubilier type #TK–10040; spec JAN–C–25.	Filter capacitor.	
SW–1 w/R–22 R–23, R–24.	CONTROL UNIT: open type; c/o one 100 amp, 220 v, 3 pole solenoid type contactor; one 100 amp, 220 v, 3 pole resistor short-circuiting contactor; 3 intermittent duty resistors, 3.5 ohms in ea ph rated 15 amp continuous, 70 amp intermittent and 1 Adlake #902–72–5 mercury time-delay relay; steel, gray finish; 220 v AC, 100 amp, 3 ph; approx 21½″ lg x 19″ wd x 16″ d; four ⅝″ holes on 19¾″ x 22″ mtg/c; Lewyt part #7559–100.	High-voltage time-delay control.	
RL–1, RL–2	CIRCUIT BREAKER: magnetic; cont arrangement 1A1B; 2–8 amp, 50/60 cyc; glass case; 5¼″ h x 4⅞″ d x 2⅞″ wd o/a; instantaneous; manual reset; two #10–32 inserts molded into case for mtg on 2½″ mtg/c; 6 tapped stud term in back; Wemco type #SC–1, style #1096945A.	A-c overload relays.	
RL–3	CIRCUIT BREAKER: magnetic; DPST, 0.05 to 2 amp, DC; glass case; 5¼″ h x 4⅞″ d x 2⅞″ wd o/a; instantaneous; manual reset; two #10–32 inserts molded into case for mtg on 2½″ mtg/c; 6 tapped stud term in back; Wemco type #SC–1, style #1096943A.	D-C OVERLOAD relay.	
B–7	INSULATOR, standoff: round post; JAN type NP2WO448; spec JAN–I–21	Stand-off mounting insulator.	
B–11	INSULATOR, standoff: round post; JAN type NP2WO424; spec JAN–I–21	Stand-off mounting insulator.	
M–1, M–2	METER, voltmeter. 0–300 v AC; JAN type MR36W300ACVV	M–1: Primary of Filament transformers. M–2: Line voltage.	
M–3	METER, voltmeter: DC; JAN type MR36WO10DCKV w/0–10 kv, 50 division scale; spec JAN–I–6; HS.	Rectifier output voltage.	
	RELAY, time delay: dust proof cover; SPST; normally open; 220 v AC; 10 amp; mercury to mercury; single wnd coil, 220 v AC, 50/60 cyc; 1100 ohms DC resistance, wire leads on coil and cont; 6″ lg x 2⅞″ d x 3¾″ wd, 3 sec make, quick break; 4 mtg holes on 3⅛″ x 2⅜″ mtg/c; Adlake #902–72–5.	Time-delay relay of controller (SW–1).	
CH–1	REACTOR, filter choke: swinging type; 0.9 hy at 220 ma, 0.13 hy at 3 amp, 0.2 hy at 3.45 amp; 1.1 ohm DC resistance; 19,000 v RMS test; HS case; 7⅞″ lg x 8¼″ wd x 6″ h; four ¼″–20 studs x ½″ lg on 6⅜″ x 7⅞″ mtg/c, 2 stud term on side, 2¾″ lg x 1¾″ diam; spec JAN–T–27; Lewyt part #7205.	Filter choke with protective spark gap.	
R–1	RESISTOR, fixed: WW; 1.6 ohms ±5%; 120 w; JAN type RW11F1R6; spec JAN–R–26	Overload resistor.	

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R–2 through R–9	RESISTOR, fixed: WW; 2000 ohms ±5%; 120 w; JAN type RW11F202; spec JAN–R–26	Bleeder resistors.
R–20, R–21	RESISTOR, fixed: WW; 5 meg ±½%; 1 ma max; JAN type MFA–505; spec JAN–R–29	Multiplier resistors for M–3.
S–2	SWITCH, door: push button; SPST; copper cont; steel case; 1 1/16″ wd x 2 3/8″ lg x 1½″ d; momentary, normally open; screw type term; mtg w/two #6–32 screws on 3¼″ mtg/c; AH&H part #2023.	Door interlock switch.
S–3	SWITCH, rotary: 2 pole, 3 position w/off position; copper cont; bakelite body; case 2 13/16″ x 4 5/16″ x 3 9/16″ d behind panel; screw term; 3 point mtg by mach screws to ¼″ thk panel; 3 stage voltmeter; 3 ph; ph to ph; GE part #16SB–1CF11, w/round knob.	Selector switch, throws M–2 across any phase.
T–1	TRANSFORMER, power: plate type; delta pri 220 v, 50/60 cyc, 3 ph, 30 kva; secd 6140/5600/5030/4470/3920/2810 v; 2500 v pri, 19,000 v secd insulation; oil coolant; steel case; 32″ lg x 48¼″ h x 23″ wd; 8 stud term on top, 5⅝″ lg; no mtg; Lewyt part #7212 per Lewyt dwg #B–7194.	High-voltage supply.
T–2	TRANSFORMER, power: fil type; input 220 v, 50/60 cyc, single ph; tapped at 216 v and 224 v; single output wnd; 5 v, 20.25 amp; 2500 v pri, 19,000 v secd insulation; air coolant, potted; HS metal case; 7¼″ lg x 6¾″ wd x 7″ h; stud term, 2 on one side 1″ lg x 9/16″ diam, 4 on other side 2¾″ lg; four ¼″–20 x ½″ lg studs on 6⅛″ x 3⅝″ mtg/c; Lewyt part #7206.	Filament transformer for V–1, V–2, and V–3.
T–3 through T–5.	TRANSFORMER, power: fil type; input 220 v, 50/60 cyc, single ph; tapped at 216 v and 224 v; single output wnd 5 v, 6.75 amp; 2500 v pri, 19,000 v secd insulation; air coolant potted; HS metal case; 6¾″ lg x 5⅞″ wd x 5½″ h; stud term 2 on one side 1″ lg x 9/16″ diam, 4 on other side 2¾″ lg; four ¼″–20 x ½″ lg studs on 4 13/16″ x 4½″ mtg/c; Lewyt part #7207.	T–3: V–4 filament transformer. T–4: V–5 filament transformer. T–5: V–6 filament transformer.
T–6, T–7	TRANSFORMER, power: instr current; permanent installation; 150 amp pri, to 5 amp secd; 50/60 cyc 5000 v max; single ph; current ratio 150:5, compensated for 2½ va, 90% pf at 60 cyc; bar pri; steel frame, uncased; 9½″ wd x 6¾″ h x 4½″ d o/a; 2 busbar pri term, 2″ wd, 3/16″ thk w/0.562″ hole at each end; 2 lug term on secd; 40 slots for ⅜″ bolt on 2¼″ x 3⅛″ ctr for mtg; Wemco type #KO, part #S651911.	Current transformers operate a-c overload relays RL–1 and RL–2.
TH–1	SWITCH, thermostatic: adj to 700°F. max temp; 500 w, 230 v AC; ceramic case; 2¼″ x ⅝″ diam cont heavy electrolytic silver; normally open; screw type term; Ulanet "Firecracker" type #F.	Operating temperature control.
V–1 through V–6.	TUBE, electron: JAN–4B32; half-wave rectifier	Mercury vapor half-wave rectifier.

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5. Identification Table of Parts for Water Cooling Units RU–2, –A, and –B

Ref symbol	Model designation			Name of part and description	Function of part	Signal Corps stock No.
		A	B			
	*		*	WATER COOLING UNITS RU–2, –B: water coolant; 2 hp, 220 v, 60 cyc, 3 ph motor; 48″ x 45⅜″ x 42½″ o/a; 1¼″ pipe inlet and outlet; ½″ pipe to surge tank; dual "V" belt drive to fan and pump; mts in steel frame; 4⅞″ diam holes for anchor bolts on 23¹³⁄₁₆″ x 46½″ mtg/c; u/w Power Amplifier BC–340–( ).		2ZA1002
		*		WATER COOLING UNIT RU–2–A: water coolant; 2 hp, 220 v, 50/60 cyc, 3 ph motor; var sheaves on motor; 48″ x 45⅜″ x 42½″ o/a; 1¼″ pipe inlet and outlet; ½″ pipe to surge tank; dual "V" belt drive to fan and pump; mts in steel frame; 4⅞″ diam holes for anchor bolts on 23¹³⁄₁₆″ x 46½″ mtg/c; u/w Power Amplifier BC–340–( ).		2ZA1002A
	*	*	*	BEARING, ball: self-alining; extended inner ring; 1¾″ bore, 3.937″ OD, 0.9832″ wd; Fafnir #SMN112.		3H304–8
	*	*	*	BEARING, ball: single row radial, plain steel; 30 mm bore, 72 mm OD, 19 mm wd; Fafnir #306K.		3H320–51
	*	*	*	BEARING, ball: steel; single row radial, 1.378″ OD x 0.5906″ ID x 0.4431″ thk; p/o Sturtevant Westco #BR–515 Pump.		3H305–1
	*	*	*	BELT: "V" type; 86.4″ lg; ²¹⁄₃₂″ top x 7⁄16″ thk x 40 deg angle; Worthington Pump #B–85	Drives water pump and fan	2ZA1002/2
	*	*	*	BOLT, eye: bronze; ¼″–20; 2″ lg; Westco #57; p/o Sturtevant Westco #BR–515 Pump		6L304–4
	*	*	*	CUP, grease: for pump; bronze; 1″ diam cap x 1½″ h; ⅜″ diam base; Westco Div Pomona Pump Co #13; p/o Sturtevant Westco #BR–515 Pump.		2ZA1002/5
	*	*	*	GASKET: pump cover; gasket sheet cork; 9″ OD x 7½″ ID x 1⁄16″ thk; Westco Div Pomona Pump Co part #4; p/o Sturtevant Westco #BR–515 Pump.	Pump gasket	2ZA1002/16
	*	*	*	HOSE: molded rubber; 1½″ ID x 50″ lg; ends extend 2″ beyond wire end; wire encl; U S rubber per Sturtevant #1713.		6Z6015
	*	*	*	HOSE: special grease; heavy canvas; 50″ lg; 1¼″ ID x 2″ OD, Stu rt evant Co #BF–5105		2ZA1002/17
	*	*	*	MOTOR, AC: 2 hp; 220 v AC, 3 ph 50/60 cyc; 5.8 amp full load; 1750 rpm; Sturtevant #225 IMK.	Drives motor	3H3002–1
	*	*	*	PACKING: pump; cotton wick; flake graphite covered; ¼″ sq x 3″ lg; Wemco #55		2ZA1002/9
	*	*	*	PUMP, water: complete; 11″ h x 14″ lg x 11″ wd; inlet and outlet opening for 1½″ std pipe; std pipe thd, 11½ thds per inch; 900 gal per hr capacity; Joshua Hendy Iron Works; Model #BR–515, Westco Series "E."	Cooling motor pump	2ZA1002A/1

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6. Identification Table of Parts for Water Cooling Unit RU–2–C

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	WATER COOLING UNIT RU–2–C: water coolant; 3 hp, 220 v, 50/60 cyc, 3 ph motor; 48″ x 46″ x 54″ o/a; 1¼″ pipe inlet and outlet; ½″ pipe to surge tank; mts in steel frame; u/w Power Amplifier BC–340–( ).		
	BEARING, ball: single row radial; plain; med duty; bore 0.787″, 1.8504″ OD, 0.5512″ outer ring wd; 1 11/32″ inner wd; packed w/std grease; std fit; ABEC–1 std tol; wd inner ring; Fafnir part #SM1012K–2; Lewyt part #B–5102–14.		
	COUPLING, flexible: c/o 2 steel zinc pl jaw bodies separated by Lovejoy Flex Cplg #1A–100 neoprene spider load cushion; 5 hp max load; 2 9/16″ OD x 3½″ lg o/a 1⅛″ diam bore at one end w/slot for ¼″ sq key; 0.7875″ diam bore other end w/slot for #8 Woodruff key; 2 tapped mtg holes ⅜″–16 thd spaced 90 deg apart on each end; Lewyt part #D–7559–101–15 coupling w/Lovejoy Flex Cplg #1A–100 spider.	Connects motor to pump.	
	GASKET: p/o Lewyt part #B–5102 pump; seal pump covers to shell; ¼″ diam solid rubber tubing; circular gasket 6⅞″ ID; Lewyt part #B–5102–20.		
	IMPELLER, centrifugal: p/o Lewyt part #B–5102 pump; bronze; approx 0.758″ bore x 23/64″ wd x 6″ diam x 1 3/32″ wd hub o/a; single 5/16″–24 mtg hole on hub, slot for SAE 5/32″ x ¾″ Woodruff Key Lewyt part #B–5102–9.		
	KEY, machine: sq; carbon steel; ¼″ sq x 2⅜″ lg; Lewyt part #6762	Part of motor to pump connection.	
	KEY, machine: Woodruff #8; carbon steel ¾″ diam x 5/32″ thk; Lewyt part #6748	Part of motor to pump connection.	
	MOTOR, AC: squirrel-cage type; 3 hp 1800 rpm at 60 cyc, 1500 rpm at 50 cyc; closed frame; 40°C. temp rise at 60 cyc; keyed shaft for ¼″ sq x 2⅜″ lg key; 17 9/32″ lg x 12½″ wd x 12¾″ h o/a; shaft 1⅛″ diam protruding 3⅛″ from frame; 220/440 v AC 50/60 cyc, 3 ph, 7.8/3.9 amp; 85% pf; GE frame #254; fixed base; 4 mtg holes on 8¼″ x 10″ mtg/c; GE model #SK254D2271; Lewyt part #D–7559–101–14.	Fan and pump drive motor.	
	PACKING: p/o Lewyt part #B–5102 pump; graphite impr; asbestos braid; approx ¼″ sq x 3½″ o/a; Lewyt part #B–5102–11.		
	PUMP: liquid centrifugal; electric motor driven horiz mtg; cap 16 gal per min, 200 ft head, 1750 rpm; 1¼″ female pipe thd inlet and outlet fittings; 14 11/16″ lg x 8″ wd x 12¼″ d o/a; 3 hp 220/240 v AC, 50/60 cyc 3 ph motor; all bronze construction except shaft; exterior painted bronze; shaft stainless steel; four ⅜″ mtg holes on 4″ x 8″ mtg/c; motor totally encl, tropicalized; Lewyt part/dwg #B–5102.	Water pump.	
	RADIATOR, cooling system: steel casing, aluminum fins, copper tubes, painted grey; capacity to cool 8 gal per min of water from 150°F. to 140° removing 40,000 Btu per hr w/2850 cfm of air entering at 122°F; 28½″ h x 30″ lg x 9½″ wd; mts w/2 13/32″ diam holes on 18″ mtg/c on ea side and 2 13/32″ holes on 21″ mtg/c on bottom; Lewyt part #7559–101–11.		

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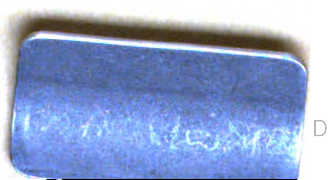
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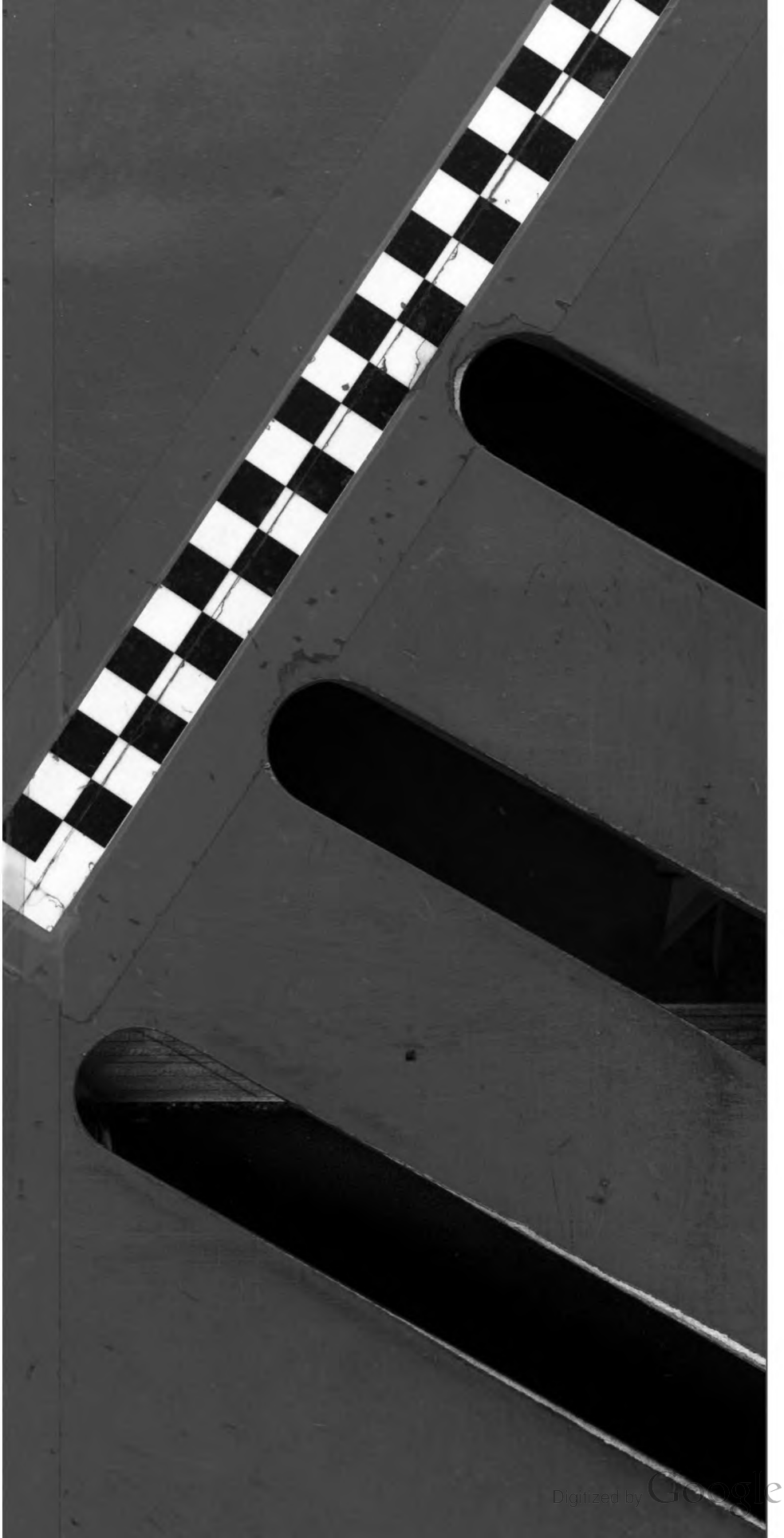
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