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For OFFICIAL USE ONLY

#4

INSTRUCTION BOOK

FOR

RADIO EQUIPMENT RS-1

Classification Changed
by authority of
OC-Classification Officer
28 January 1958

For Official Use Only

~~SECRET~~

WARNING

The voltage used in this equipment

may be FATAL

Dangerous voltages exist on the pins of the transmitter and receiver power sockets of the RP-1 and RP-2.

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RADIO STATION RS-1

GENERAL DESCRIPTION

The RS-1 is a portable, medium and long range, radio station complete in four waterproof containers. It is designed to provide reliable operation over a wide range of climatic conditions and to possess a "long shelf life" storage characteristic. It is intended to operate from a variety of primary power sources and over a wide range of input voltages. The RS-1 is primarily intended for manual C.W. operation by persons having only a rudimentary knowledge of the technical phases of radio communication.

The RS-1 consists of the following basic items of equipment:

1. Radio Transmitter, RT-3
2. Radio Receiver, RR-2
3. Power Supply, RP-1 or RP-2
4. A kit containing the operating spares and accessories.

In addition to the units above, various other items for special applications may be supplied, the details of which are beyond the scope of this manual. The approximate weight of the items listed, when packed for transport, will be from 40 to 55 pounds depending upon the type of power supply issued.

A. TECHNICAL SPECIFICATIONS

A-1. Transmitter RT-3

Frequency Range: 3-22 megacycles in 4 bands

Frequency Control: Quartz crystals cut to the fundamental, one half or one third the desired output frequency. Crystal input capacity is approximately 18 mmf.

Mode of Emission: C.W. Morse code (A1)

Power Input: 400 volts D.C. at 100 milliamperes

6 volts A.C. or D.C. at 1.2 amperes

Power Output: 12 - 15 watts, 3 - 15 megacycles

10 - 12 watts, 15 - 22 megacycles

Antenna Matching: Any single wire system having an impedance of 72 to 1200 ohms, zero phase angle and from 72 to 600 ohms with a phase angle not exceeding plus or minus 45°

Break in Operation: An automatic switching circuit is provided to allow the receiver to use the transmitting antenna.

Operating Conditions: Temperature minus 15° C. to plus 55° C. (minus 55° C. for storage)

Tube Compliment: 1 - 6AC7

1 - 2E26

Outer Case Material: Magnesium alloy, heat treated with a non-corrosive base finish

Overall Dimensions: 8- 5/8 inches x 5-1/2 inches x 5-7/16 inches

Weight: 9 pounds

Waterproofing: Unit is waterproofed and tested to a pressure of 7-1/2 pounds per sq. inch with or without top cover. A replaceable "tell-tale" desiccator cartridge is provided.

A-2. Receiver RR-2

Frequency Range: 3-24 megacycles in 3 bands

Frequency Control: Continuous tuning local oscillator or spot frequency operation from a quartz crystal. Crystal input capacity is approximately 26 mmf.

Mode of Reception: Amplitude modulated signals or continuous wave Morse code.

Power Input: 1.3 - 1.5 volts D.C. @ 300 milliamperes and 90-108 volts D.C. @ 20 milliamperes

Power Output: 30 milliwatts into 4,000 ohm load

Sensitivity: Not over 20 microvolts, 30% modulation, for 20 milliwatts output. 10 DB signal to noise ratio less than 1.5 microvolts C.W. and 2 microvolts A.M.

Selectivity: The average overall selectivity is 8 KC at 10 times down from normal signal and 15 KC at 100 times down throughout the range from 3-24 MC.

Image Ratio: The image rejection ratio is not less than 35 DB at 24 MC, rising to better than 60 DB at the lowest frequency, 3 MC.

Calibration: Directly calibrated dial in megacycles plus a zero to 180 logging scale operating in conjunction with a vernier control giving 1800 logging dial divisions per band. Direct calibration accuracy not less than .08%.

Beat Frequency Oscillator: The beat frequency oscillator is variable plus or minus 4 KC from center I.F. frequency of 455 KC.

Operating Conditions: Temperature minus 15° C. to plus 55° C. (minus 55° C. for storage)

Tube Compliment: 4 - 1T4
1 - 1L6
1 - 1U5

Outer Case Material: Magnesium alloy, heat treated with a non-corrosive base finish

Overall Dimensions: 8 5/8 inches x 5 1/2 inches x 5 7/16 inches

Weight: 10 pounds

Waterproofing: Unit is waterproofed and tested to a pressure of 7 1/2 pounds per sq. inch with or without top cover. A replaceable "tell-tale" desiccator cartridge is provided.

A-3. Power Supply RP-1

Power Input: 75-260 volts A.C., 40-400 cycles
6 volts D.C. @ 13 amperes (key down)
Hand cranked generator input provided for hand generator type SSP-11.

Power Output: 1.3 volts D.C. @ 300 milliamperes regulated to within ± 7%
100 volts D.C. @ 20 milliamperes regulated to within ± 1%
(The above regulation is for mains variations of plus or minus 20 volts).
400 volts D.C. @ 100 milliamperes
6.3 volts A.C. @ 1.5 amperes (6 volts D.C. when on battery operation)
3-4 amperes D.C. for charging a 6 volt storage battery.

Metering: A 0-300 volt A.C. meter is provided to permit input to be adjusted for proper A.C. mains voltages.

Fusing: Two fused circuits are provided. A two ampere fuse for the A.C. input and 20 ampere fuse for the 6 volt D.C. input circuit.

Operating Conditions: Temperature minus 15° C. to plus 55° C. (minus 55° C. for storage)

Tube Compliment: 1 - OB2 voltage regulator (all rectifiers and other regulators are of the selenium stack type)

Outer Case Material: Magnesium alloy, heat treated with a non-corrosive base finish

Overall Dimensions: 10 inches x 8 1/2 inches x 5 1/2 inches

Weight: 24 1/2 pounds

Waterproofing: Unit is waterproofed and tested to a pressure of 7 1/2 pounds per sq. inch with or without top cover. A replaceable "tell-tale" desiccator cartridge is provided.

A-4. Power Supply RP-2

Power Input: 75-260 volts A.C., 40 to 400 cycles

Power Output: 1.3 volts D.C. @ 300 milliamperes regulated to within plus or minus 7%.

100 volts D.C. @ 20 milliamperes regulated to within plus or minus 1%.

(The above regulation is for a mains variation of plus or minus 20 volts).

Metering: 400 volts D.C. @ 100 milliamperes

6.3 volts A.C. @ 1.5 amperes

Fusing: 2 ampere A.C. input fuse

Operation Conditions: Minus 15° C. to plus 55° C. (minus 55° C. for storage)

Tube Compliment: 1 - 0B2 voltage regulator, (all rectifiers and other regulators are of the selenium stack type).

Outer Case Material: Magnesium alloy, heat treated with a non-corrosive base finish

Overall Dimensions: 8 5/8 inches x 5 1/2 inches x 5 7/16 inches

Weight: 12 pounds

Waterproofing: Unit is waterproofed and tested to a pressure of 7 1/2 pounds per sq. inch with or without top cover. A replaceable desiccator cartridge is provided.

A-5. Accessories

The accessories and field spares are packed in a waterproof box having a quick release lid. Some of the less destructable accessories as antenna wire, glass insulators, ground clamps, etc. may not be packed within this box but will be included within the packing or carrying container for the complete equipment.

Dimensions of Spare Parts Box: 11 1/2 inches x 3 5/16 inches x 5 1/2 inches

Weight of Spare Parts Box Packed: 6 pounds

List of Accessories:

1 - 2E26 Tube	1 - 6AC7 Tube
4 - 1T4 Tubes	1 - 1L6 Tube
1 - 1U5 Tube	1 - 0B2 Tube
2 - Panel lamps #47	
1 - Set fuses	
1 - Set, headphones	
1 - Vibrator (with RP-1 only)	

1 - Spare H. V. filter capacitors

1 - Set wrenches for water tight seals and knobs

1 - Lamp base adaptor

1 - 100 ft. coil rubber covered wire

1 - 25 ft. coil rubber covered wire

1 - "C" type ground clamp

4 - Antenna insulators

1 - Screw/bayonet base adaptor

A-6. Batteries

The receiver may be operated from a dry battery pack of the 1 1/2 volt "A" and 90 volt "B" variety, instead of the RP-1 or RP-2 power supplies.

Typical Dry Batteries

Military: BA-48

Commercial: 4TA60 Burgess VS041 R.C.A.

5DA60 Burgess VS054 R.C.A.

6TA60 Burgess

The transmitter and receiver may be operated from a 6 volt storage battery, when the RP-1 power supply is supplied. The power drain is about 13 amperes (key down) and about 5 amperes key up. This heavy drain requires the use of a heavy duty battery, preferably 100 ampere hour capacity and never less than 60 ampere hour.

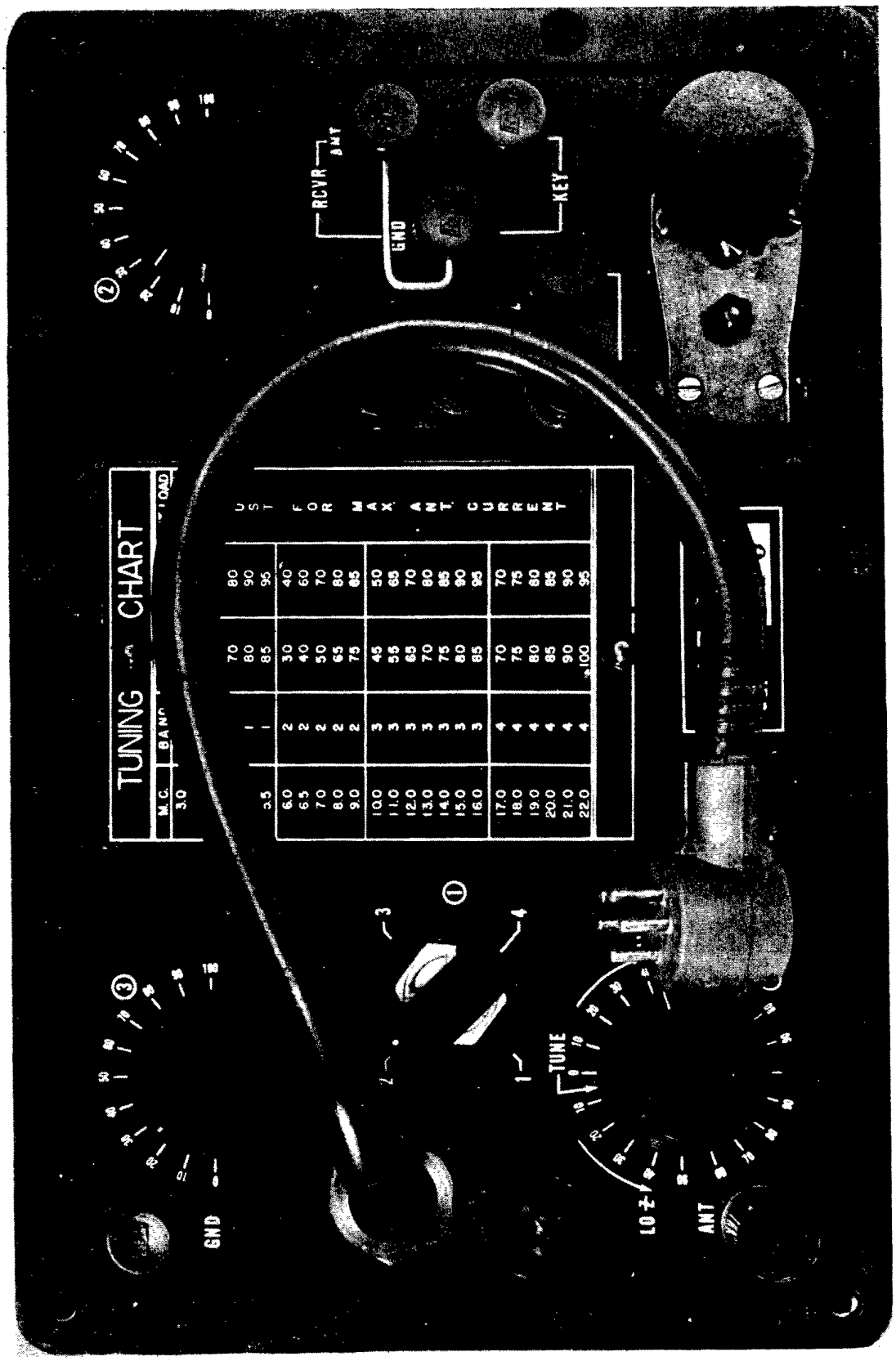

FIGURE 1 PANEL VIEW OF TRANSMITTER RT-3

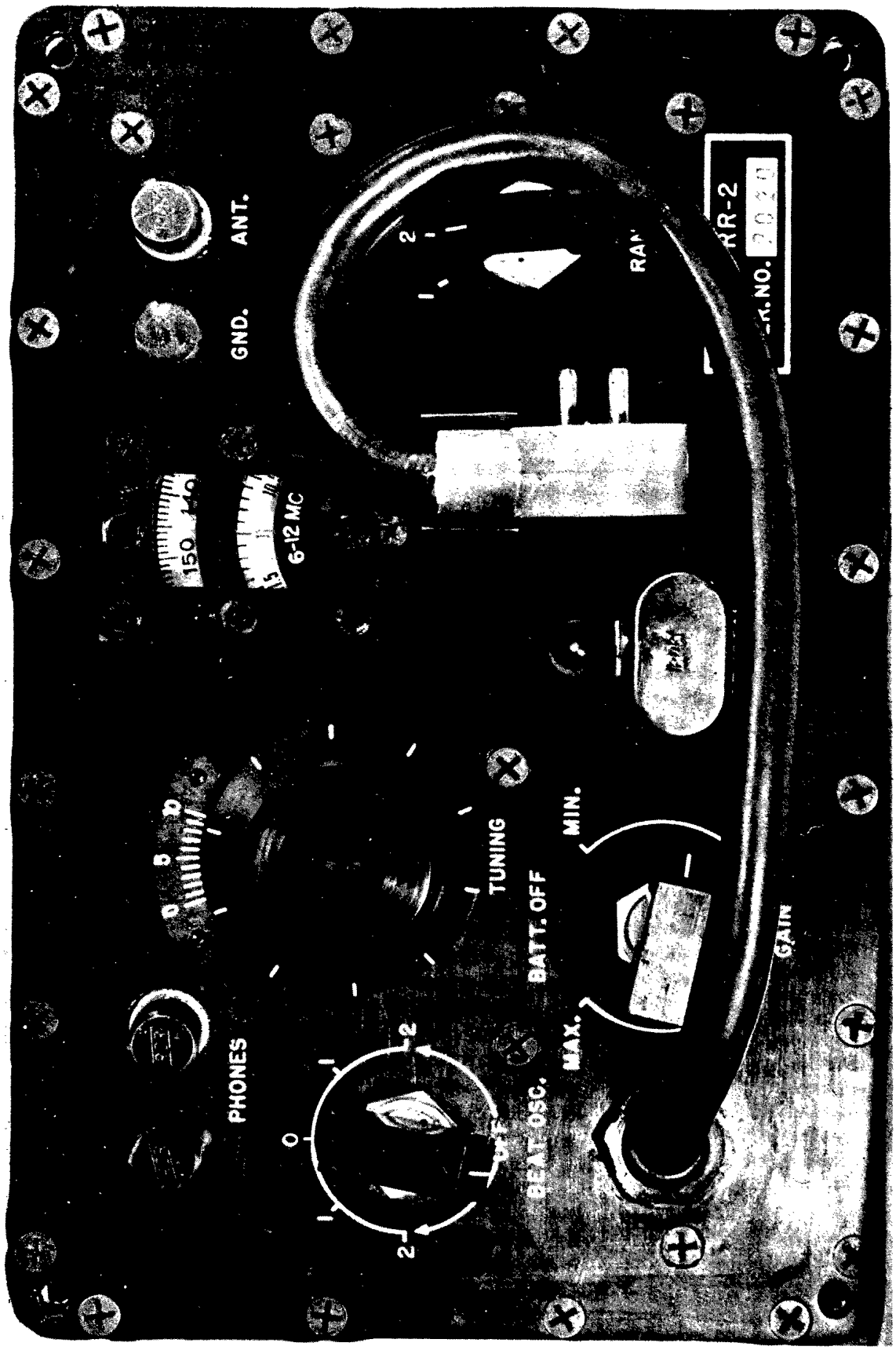

FIGURE 2 PANEL VIEW OF RECEIVER RR-2

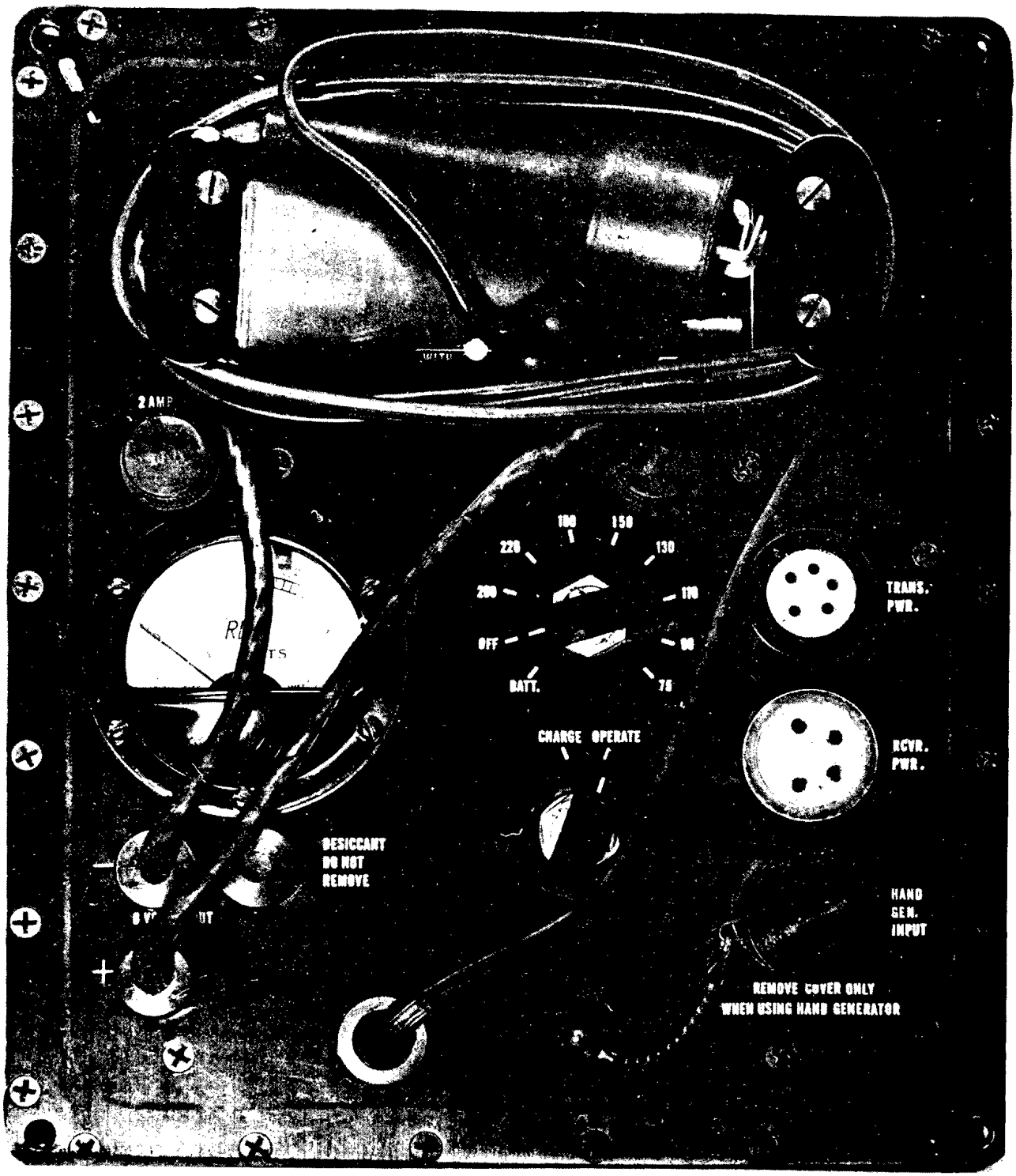

FIGURE 3 PANEL VIEW OF POWER SUPPLY RP-1

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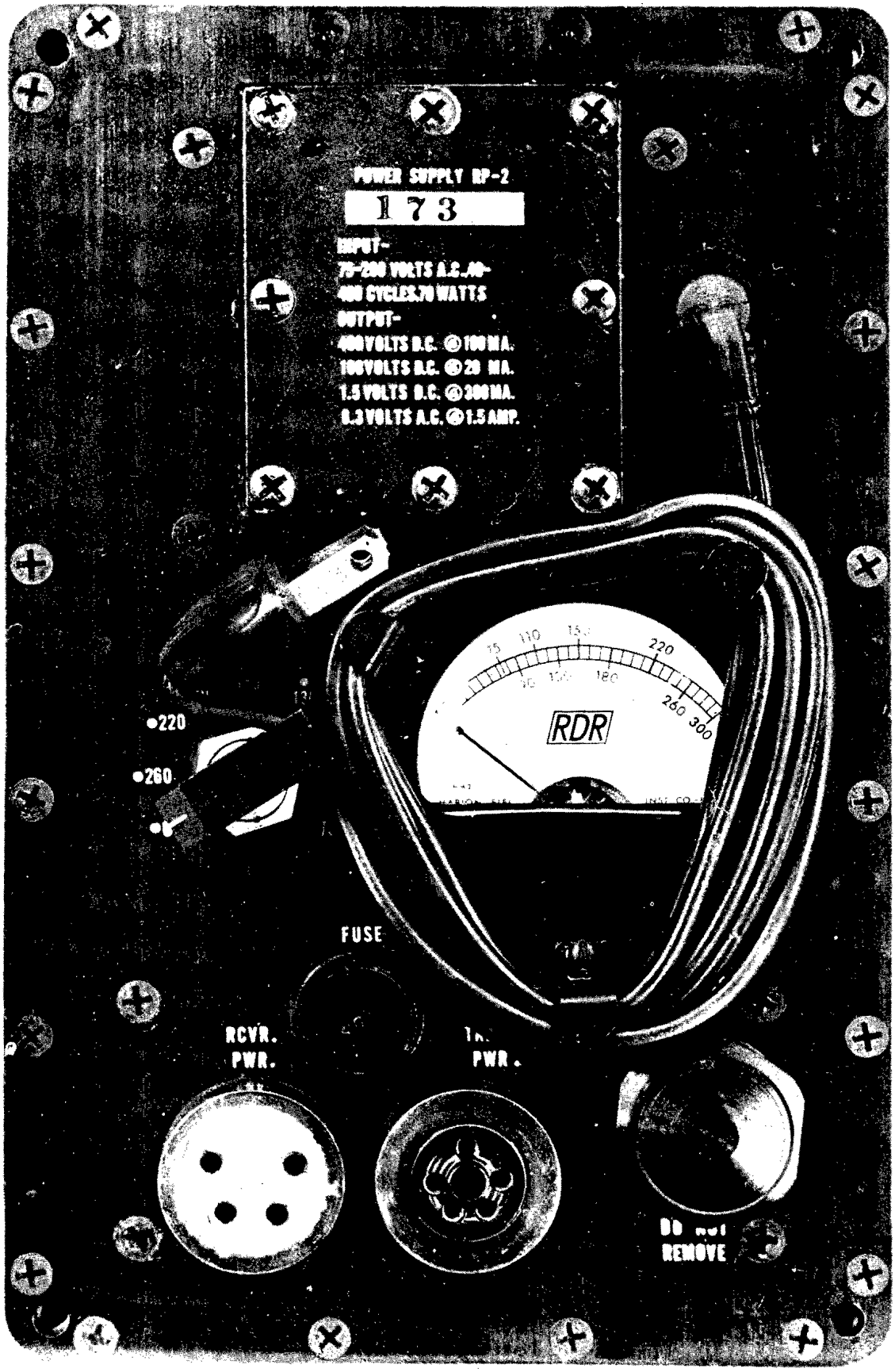

FIGURE 4 PANEL VIEW OF A.C. POWER SUPPLY RP-2

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B. OPERATING INSTRUCTIONS

B-1. Installation (See figure 5)

The RS-1 may be packed in a wide variety of containers and no specific instructions for unpacking can be given. Try to avoid scratching of the outer cases with sharp instruments or the non-corrosive finish may be damaged. The four units should be placed on a flat surface before attempting to remove the covers. The covers may be removed from the transmitter, receiver, and power supply by rotating the corner screws in a counter clockwise direction. These screws will not come free from the cover as they are fitted with retaining washers. If the units have been stored over a long period of time it may be necessary to pry off the covers by inserting of a thin knife blade, taking great care not to damage the sealing gasket.

It is recommended that the units not be operated within the packing or carrying case but rather on a table or other level surface. Leave as much space between units as the interconnecting cords will allow. This will improve the cooling of the units which will become quite warm, especially if operated continuously over long periods of time.

Examine the units carefully and study this manual thoroughly before proceeding further.

B-2. Antenna Systems

The RT-3 transmitter will put energy into almost any type of antenna. Putting energy into an antenna, however, does not necessarily mean that it will effectively radiate that energy. To provide reliable communication over long distances, an efficient antenna is essential. (See figure 5)

Supplied with the RS-1 are two coils of rubber covered wire, one a 100 foot length and the other a 25 foot length. In addition, will be found some small strain insulators and a metal pipe clamp. The ideal situation would permit installing the entire 100 foot length of wire as an inverted "L" antenna, making the "flat top" portion approximately 60 to 70 feet long and suspended 30 to 40 feet above the ground. The remaining length of wire would then serve as a "lead in" connection to the transmitter and receiver. Actually, fairly good results may be obtained using any combination of "flat top" and "lead in" length, provided the total length of 100 feet is used and the "flat top" is as high as possible. Do not run the antenna directly underneath or close to power lines or telephone wires, but try to keep it as far from surrounding objects as possible. If, for one reason or another, it is impossible to install the entire 100 foot length of wire, a shorter antenna may be used, following the rule of "as high as possible and free from surrounding objects". Remember, the shorter the antenna, the less effectively it will radiate the power of the transmitter. This is especially true for the lower frequencies. At no time should an antenna shorter than 1/4 of a wavelength be used. The shorter the antenna, the more important becomes the ground connection. The following table gives recommended minimum lengths of antenna for various frequencies.

Frequency in MC	Minimum Length in Ft.
3 to 5	75 ft.
5 to 7	50 ft.
7 to 9	35 ft.
9 to 22	25 ft.

Voltage fed antennas, that is antennas whose electrical wave length is equal to an even multiple of 1/4 wave lengths, may be difficult to load. If difficulty is experienced in loading any particular antenna, merely lengthen (or shorten) the antenna about 10 per cent. This may usually be done by adding a short piece of wire in series with the antenna lead-in wire.

A "good ground" connection, with the lead wire as short as possible, is desirable when operating from A.C. mains, and absolutely essential when operating from a storage battery or hand cranked generator. A good ground may be obtained by attaching the ground lead wire to a cold water pipe with the ground clamp. An alternate solution would be to drive a piece of water pipe, 4 to 6 feet in length into the ground and then periodically saturate the area around the pipe with water. If neither of these methods for obtaining a good ground can be used, a counterpoise must be installed. A counterpoise is one or more extended lengths of wire connected to the ground terminal of the transmitter and placed on the ground beneath the antenna "flat top". The length of the individual wires of the counterpoise should not be less than 75 to 100 feet.

B-3. Crystals

The crystals to be used in this transmitter should be of the "fundamental cut" type but their basic frequency may be equal to, or one half, or one third the desired operating frequency. Example: Suppose operation on 16,780 KC is desired. A 16,780 KC crystal is not recommended because of its fragility. Since it is possible to use one half or one third the output frequency, a crystal cut to

8,390 KC or 5,861.66 KC will give satisfactory operation. Actually slightly better performance is obtained by avoiding the use of crystals cut to one times the output frequency. The following rule for selecting the proper crystal may be set up, although other choices are possible:

3 to 7 MC - crystals equal to or 1/2 times output frequency.

7 to 14 MC - crystals of 1/2 times output frequency.

14 to 22 MC - crystals of 1/2 or 1/3 times output frequency.

Note: (Crystals equal to 1/4 the output frequency may be used with somewhat reduced output power).

Sockets are provided to accomodate either 1/2 inch or 3/4 inch crystal pin spacing.

B-4. Operation

B-4a. A.C. Mains Operation (See figure 6)

As shown in the technical specifications there are two types of power supplies for this equipment. Normally only one type, depending on the operational circumstances, will be supplied. The RP-1 is the larger universal type, whereas the RP-2 is a more compact unit but is designed for operation from A.C. mains only. The first step in operating the RS-1 from A.C. mains is to make certain that (1) the mains power is alternating current, not direct current and (2) that the A.C. frequency is not lower than 40 cycles per second. This can be determined by examing electrical appliances which may be used in the building or in nearby buildings. Normally, all electrical appliances carry a manufacturer's rating on a label

specifying voltage and line frequency. If any doubt exists as to the characteristics of the mains power, make inquiries and find out since application of direct current or low frequency A.C. (25 cycles) may damage the equipment.

Power supplies RP-1 and RP-2 come equipped with a special universal A.C. power plug and lamp base adaptor. The proper choice of plug pin size or adaptor may be made by inspection of the mains outlet to be used. If a wall or floor receptacle is available, the universal plug alone would be used. If an electric lamp socket is the only power outlet available, then the lamp base adaptor must be used. This adaptor will fit into either bayonet or screw base lamp sockets, thus providing a receptacle for the universal plug.

The transmitter and receiver should now be plugged into their proper sockets on the power supply and the telephone head set connected to the appropriately marked terminals on the receiver. It is assumed that paragraphs B-2 and B-3 have been studied, that the antenna and ground have been installed, and that a crystal of the proper frequency is available. Antenna and ground connections should be made to the transmitter and receiver only as shown in figure 5.

Before plugging the power supply into the A.C. power outlet, make certain that the voltage selector knob is in the "off" position, and the "charge-operate" switch is in the "operate position". With the power supply in the "off" condition, the panel A.C. voltmeter will indicate the power line voltage. Rotate the voltage selector knob in a clockwise direction to the voltage setting most closely corresponding to the meter indication. Do not turn the knob past

this position or the equipment may be damaged.

To place the transmitter in operation, set the control knobs (1), (2), and (3) to proper setting, according to the tuning chart on the panel. Set the control knob (4) to the tune position. Press the telegraph key, and adjust control knobs (2) and (3) for maximum brilliance in the two small glow lamps adjacent to each of these controls. Rotate knob (4) slowly, first counter clockwise and then clockwise, at the same time readjusting (3) to obtain maximum brilliance of the antenna current lamp. The maximum brilliance of the antenna current lamp is subject to a wide variation depending on the antenna length and the frequency in use. A barely perceptible glow is as effective as full lamp brilliance provided each is the maximum for the particular antenna and frequency. In some cases where the current indication is small, the initial load adjustment may be made by watching the light decrease in the glow lamp adjacent to control knob (3) when knob (4) is rotated toward the maximum load position. Knob (3) should be readjusted to give maximum brilliance in the glow lamp each time knob (4) is adjusted. After this method has obtained a perceptible glow in the antenna current lamp, readjust for maximum brilliance as already outlined. When no further adjustment of (3) and (4) produces any greater brilliance of the antenna current lamp, knob (2) may be adjusted very slightly to obtain the optimum output as indicated by the antenna current lamp. This final adjustment of (2) is important, especially if crystals of one times the output frequency are being used.

The operation of the receiver is relatively simple. Select the proper frequency band by rotating the range switch. Set tuning

dial to the frequency desired and turn receiver "on" by rotating the volume control in a clockwise direction until a soft rushing noise is heard in the phones. If Morse code signals are to be received, the "B.F.O." control must be rotated to the "on" position.

Do not depend on the dial calibration alone to find a station of known frequency. Rotate the tuning knob slowly, tuning the receiver to a slightly higher frequency than the frequency desired. Repeat this process tuning to a slightly lower frequency. Continue back and forth until the station is heard and properly tuned in. In this manner slight errors in the receiver dial calibration can be overcome. If a Morse station is being received, fine tuning may be accomplished with the B.F.O. knob. Once a station has been tuned in on the receiver, it may be accurately logged using the top numerical scale on the dial together with the tuning knob vernier. If it is necessary to find this station again, write down the dial readings. This will save much time, and help to provide fast efficient operation.

To use the receiver for "spot" frequency reception, merely plug an appropriate crystal into the crystal socket on the panel. The main tuning dial should be set to the frequency to be received and adjusted slightly to provide maximum sensitivity. The only variable frequency control is by means of the B.F.O. which will tune over a very small range serving mainly as a pitch control of the received signal. The crystals for use in the receiver must be of the F-243 type (1/2 inch pin spacing). Their frequency may be equal to, or one half, or one third the desired "control frequency". The control frequency is not the "receiving frequency".

To obtain the crystal frequency for a given "receiving frequency", add or subtract 455 KC from the "receiving frequency". This gives us the "control frequency". The crystal can now be selected as equal to, or one half, or one third this "control frequency". For convenience in operation, receiving crystals should be marked "receiver", and stamped with the proper "receiving frequency". The recommended rule for selecting crystals is applied in terms of the "control frequency" as follows:

2.5 to 7.5 MC — crystals equal to the "control frequency"

7.5 to 14.5 MC — crystals of 1/2 times the "control frequency"

14.5 to 24.5 MC — crystals of 1/3 times the "control frequency".

Important: Crystal must be correlated for use in this equipment or serious errors in the receiving frequency may result. (See A-2, Frequency Control). Always specify receiver type, serial number, and receiving frequency when ordering crystals!

B-4b. Storage Battery Operation (See figure 8)

This section is only applicable when using the RP-1 power supply. A heavy duty automobile type, 6 volt storage battery is required. In operating the RS-1 from a storage battery, the RP-1 power supply voltage selector knob should be placed in the "off" position. The battery cables may then be clipped to the battery terminals. Be sure to observe the polarity of the leads, the red clip to positive or plus battery terminal, and the black clip to the negative or minus terminal. To operate turn the voltage selector switch to "battery". All adjustments to transmitter and receiver are then identical to those described under B-4a.

To charge a 6 volt battery with the RP-1 power supply plugged into the A.C. mains, it is only necessary to place the "charge-operate" switch in the charge position, and adjust the voltage selector knob for the correct A.C. line voltage, as outlined in B-4a. When charging the battery, it may be well to loosen the filler caps on the cells to allow a free discharge of gas. Be certain that the electrolyte level is above the plates. For longest battery life replace water with distilled water; however, ordinary tap water may be used in emergencies. To change from battery charging to A.C. mains operation, having been once set up, it is only necessary to throw the charge-operate switch to the "operate" position.

B-4c. Hand Generator Operation (See figure 9)

The RS-1 is designed to operate at somewhat reduced power from a hand cranked generator type SSP-11 (modified GN-58). There are two ways that this type of operation can be obtained; one, with the receiver operating from a small dry battery pack and the transmitter plugged directly into the hand generator; or two, by going through the RP-1, the dry battery may be eliminated. (The RP-2 power supply does not contain this feature.)

The first method is the most desirable since it requires the least amount of equipment (eliminates the RP-1) and the cranking load is reduced considerably since the generator need only be cranked while transmitting.

The second method is, of course, required where there can be no resupply of dry batteries. To operate with the second method, plug the hand generator power cord into the hand generator input

socket on the RP-1 and place the voltage selector knob in the "off" position. This knob remains in the "off" position during operation from the hand generator. The generator input cover cap must be in place during all other modes of operation or the power supply will not function.

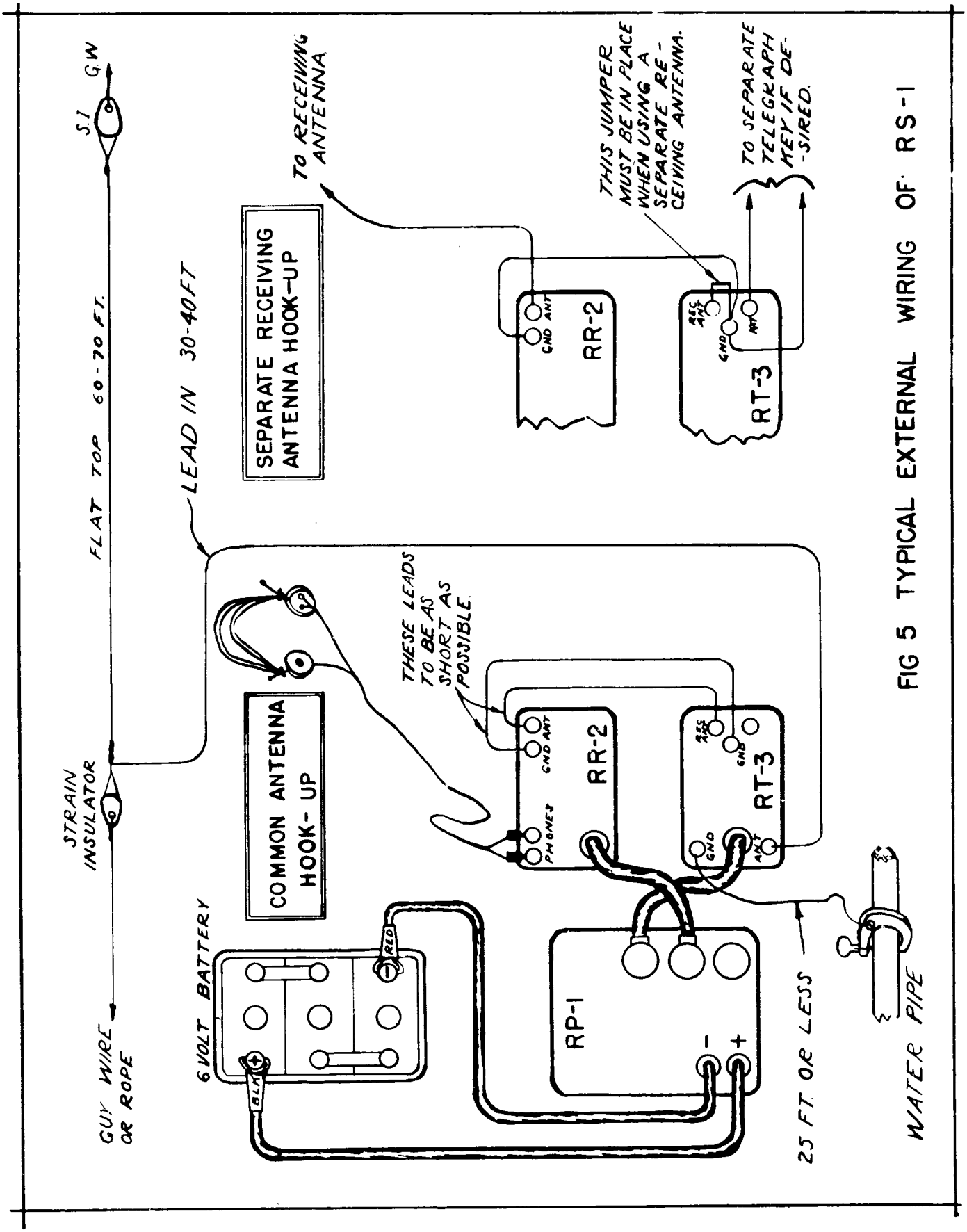


FIG 5 TYPICAL EXTERNAL WIRING OF RS-1

FIGURE 6 STATION SET UP FOR A.C. MAINS OPERATION WITH RP-1

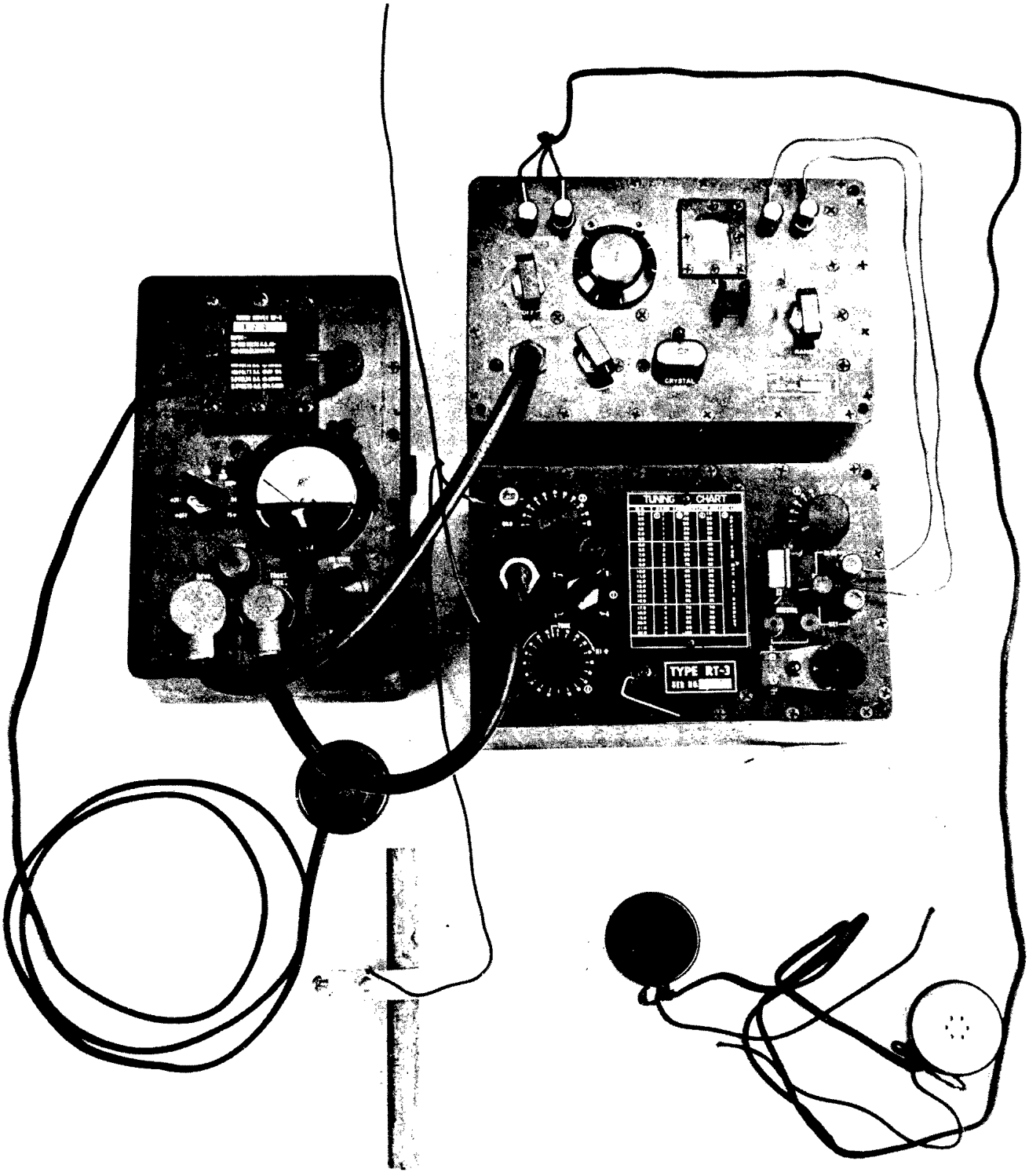


FIGURE 7 STATION SET UP FOR A.C. MAINS OPERATION WITH RP-2

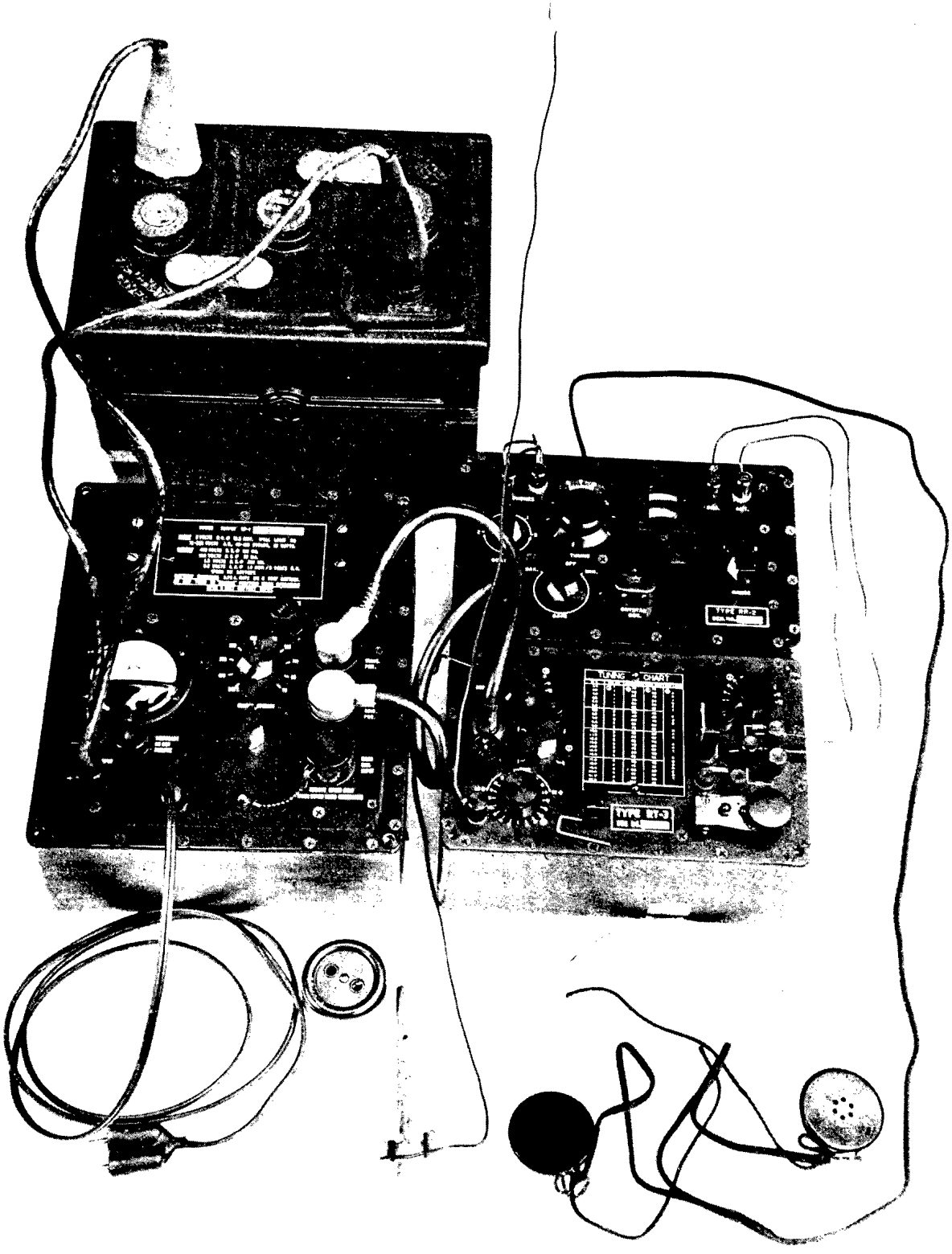


FIGURE 8 STATION SET UP FOR STORAGE BATTERY OPERATION

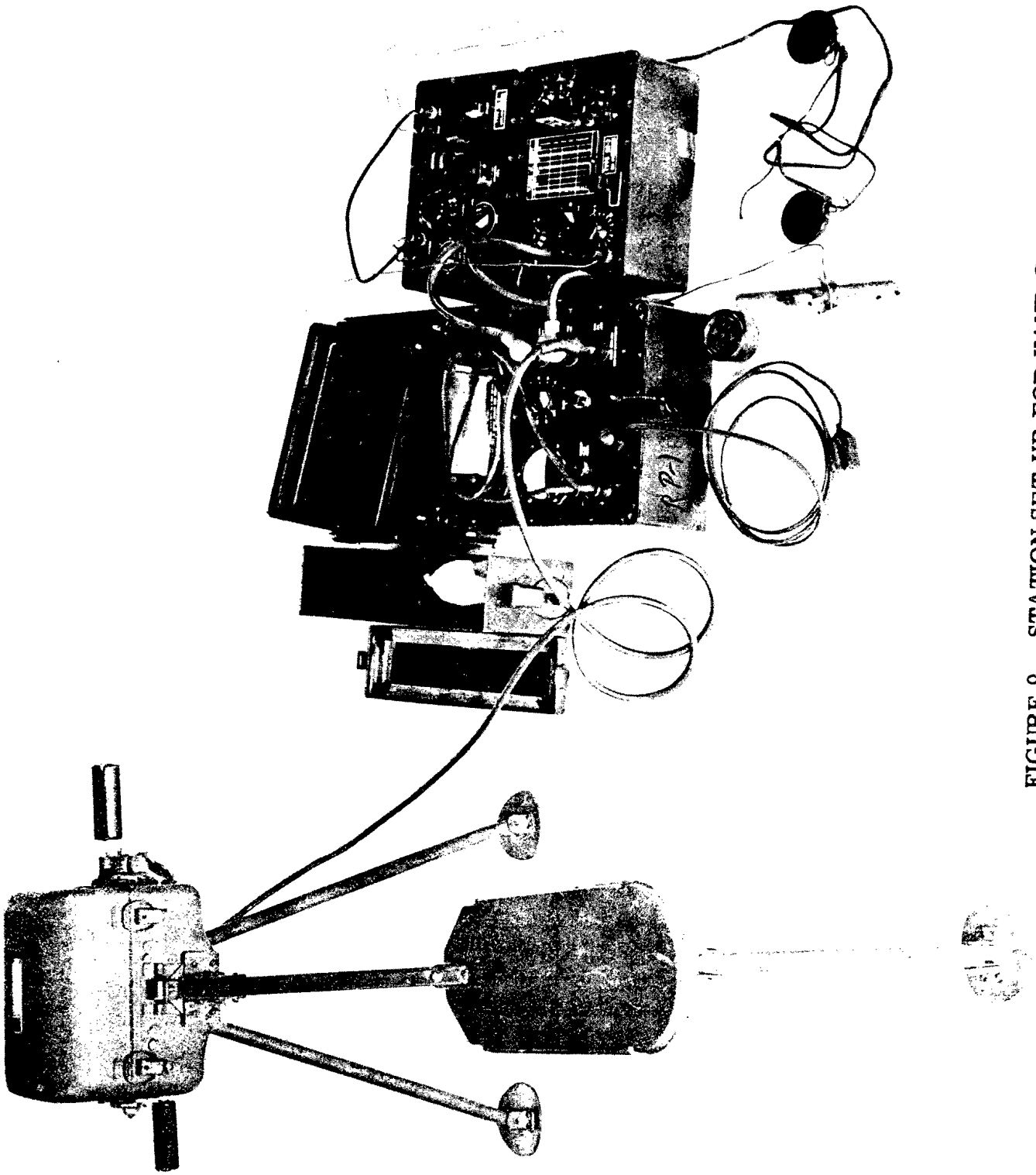


FIGURE 9 STATION SET UP FOR HAND GENERATOR OPERATION

C. MAINTENANCE

C-1. Transmitter, RT-3

C-1a. Circuit Description (See figure 11)

Radio transmitter RT-3 is a miniature two stage crystal controlled C.W. transmitter having a frequency range of 3 to 22 MC.

The crystal oscillator utilizes a type 6AC7 tube in a combination Pierce oscillator and radio frequency amplifier/multiplier circuit. In this circuit arrangement the control grid and screen grid perform the functions of an untuned Pierce oscillator and the plate circuit is electron coupled to the oscillator section. Resonance in the oscillator stage is indicated by neon lamp N1.

The output of the oscillator is capacitively coupled to the grid of type 2E26 tube used as a power amplifier. The plate circuit of the 2E26 is a combination tank and antenna matching network. Plate circuit resonance is indicated by neon lamp N2. The output or loading variable capacitor C16 is arranged to rotate through approximately 345°. When C16 is set in the "tune" position SW2 is closed which parallels capacitor C15 with C16 giving a total capacity of 380 mmf. Rotating C16 to the stop in the "Low Z" position reduces the total capacity to about 200 mmf. By turning C16 to the stop in "High Z" position, the minimum capacity is reduced to approximately 20 mmf. Actually as soon as C16 is rotated into the "High Z" range, SW2 opens disconnecting C15. This arrangement gives a continuous adjustment of output capacity from 20 to 380 mmf. and thus permits proper power amplifier adjustment over a wide range of antenna impedances. Antenna current is indicated by a miniature lamp (shunted by a 20 ohm resistor) placed in series with the antenna.

Keying is accomplished by breaking the cathode returns on both the 6AC7 and 2E26. Capacitor C5 together with resistor R5 provide a key click filter.

Break in operation is accomplished by providing a receiver antenna terminal on the transmitter panel which is connected to the transmitting antenna through C14. With the key in the up position, the receiver antenna terminal is free from ground being effectively isolated by choke coil RFC2. With the key in the down position, the receiver antenna terminal is shorted directly to ground. This prevents the output of the transmitter from being fed into the receiver. The receiver antenna circuit is isolated from D.C. by capacitor C4. At the lower frequencies, say below 5 MC, slightly better receiver performance is obtained, if a separate receiving antenna is used. When using a separate antenna, be sure that a short wire jumper is connected between the receiver antenna terminal on the transmitter and the ground terminal. Failure to do this, reduces the effectiveness of the key click filter.

Do not use a single antenna with the receiver connected to the transmitter if an external telegraph key is to be used. The loop impedance of the leads to the key may allow enough R.F. voltage into the receiver to cause damage to the first tube and antenna coil. An external key is not recommended if maximum freedom from key clicks is important.

C-1b. Trouble Shooting The RT-3

No trouble should be experienced in servicing this unit. It is extremely simple in design and the only test instruments required

are a 20,000 ohm per volt volt-ohm-milammeter and a 25 watt 115 volt electric light bulb. When removing the transmitter from its case, be very careful not to damage the coils in the oscillator stage. Inspect these coils before reassembly for shorted turns.

The first step in attempting to service an inoperative RT-3 is to check the output of the Power Supply RP-1 or RP-2 with the transmitter and receiver disconnected. If voltages are normal, (see RP-1 and RP-2 voltage charts) then plug in receiver. If receiver is drawing normal power, there should be no change in transmitter supply voltage at the output of the power supply. After disassembly of the RT-3 from the case, plug into power supply and measure plate supply voltage at the junction of resistors R6, R7 and R10, R11. This voltage should measure between 390 and 420 volts (key down). If this voltage appears normal, the tubes should be checked, one at a time by substitution with a new tube of the same type. Always retighten the tube clamps after replacing tubes. If changing tubes does not correct the condition, a point to point check with the voltmeter should be made according to the following voltage chart:

Test Condition: Key up, A.C. mains operation, using RP-1, Power Supply.

V-1 (6AC7)	Voltage Reading to Chassis	V-2 (2E26)	Voltage Reading to Chassis
Pin 1	0 volts A.C.	Pin 1	+65 volts D.C.
" 2	0 " " "	" 2	0 volts A.C.
" 3	+65 volts D.C.	" 3	+510 volts D.C.
" 4	0 " " "	" 4	+65 " " "
" 5	+65 " " "	" 5	0 " " "
" 6	+510 " " "	" 6	+65 " " "
" 7	6.3 volts A.C.	" 7	6.3 volts A.C.
" 8	+510 volts D.C.	" 8	0 " " "
		Plate Cap	+510 volts D.C.

Test Condition: Key down, fully loaded, A.C. mains operation.

V-1 (6AC7)	Voltage Reading to Chassis	V-2 (2E26)	Voltage Reading to Chassis
Pin 1	0 volts D.C.	Pin 1	+50 volts D.C.
" 2	0 volts A.C.	" 2	0 volts A.C.
" 3	+7.5 volts D.C.	" 3	+260 volts D.C.
" 4	Do not check	" 4	+50 " " "
" 5	+7.5 volts D.C.	" 5	Do not check
" 6	Do not check	" 6	+50 volts D.C.
" 7	6.3 volts A.C.	" 7	6.3 volts A.C.
" 8	Do not check	" 8	0 " " "
		Plate Cap	Do not check

Note: These are average voltages only and variations up to 15% are normal.

The following is a list of possible troubles and the causes thereof:

Symptom	Probable Causes
1. No plate voltage on V1.....	L1 or L2 open, R6 and R7 both open, C7 shorted.
2. No screen voltage on V1.....	RFC1 open, R4 open, R6 and R7 open, C7 shorted, C3 shorted.
3. No plate voltage on V2.....	R12 open, contacts on SW1B not closing, C15, C11 shorted.
4. No screen voltage on V2.....	R10 and R11 both open, C10 shorted.
5. No change in plate or screen voltages with key up or down.	RFC2 open.
6. Transmitter on continuously, key has no effect.	C5 shorted.
7. Keying sluggish or chirpy.....	Low activity crystal, C6 not adjusted properly, defective 6AC7 tube.
8. Antenna will not load.....	Burned out antenna current lamp, antenna may be exactly 1/2 wave length giving little or no indication in lamp. (See B-4).
9. All voltages appear normal and transmitter tunes up well but output on higher frequencies is low.	Weak 6AC7 tube, low activity crystal.
10. Transmitter is unstable (Check for output with crystal removed).	C10 or C11 open, chassis ground springs not making contact at sides of case.

The 25 watt lamp with a pair of short leads soldered directly to the base makes a good dummy antenna for checking transmitter output, without putting a signal on the air. This lamp should light to nearly full brilliance on ranges one, two, and three, and drop to about half brilliance at the extreme end (22 MC) of range 4.

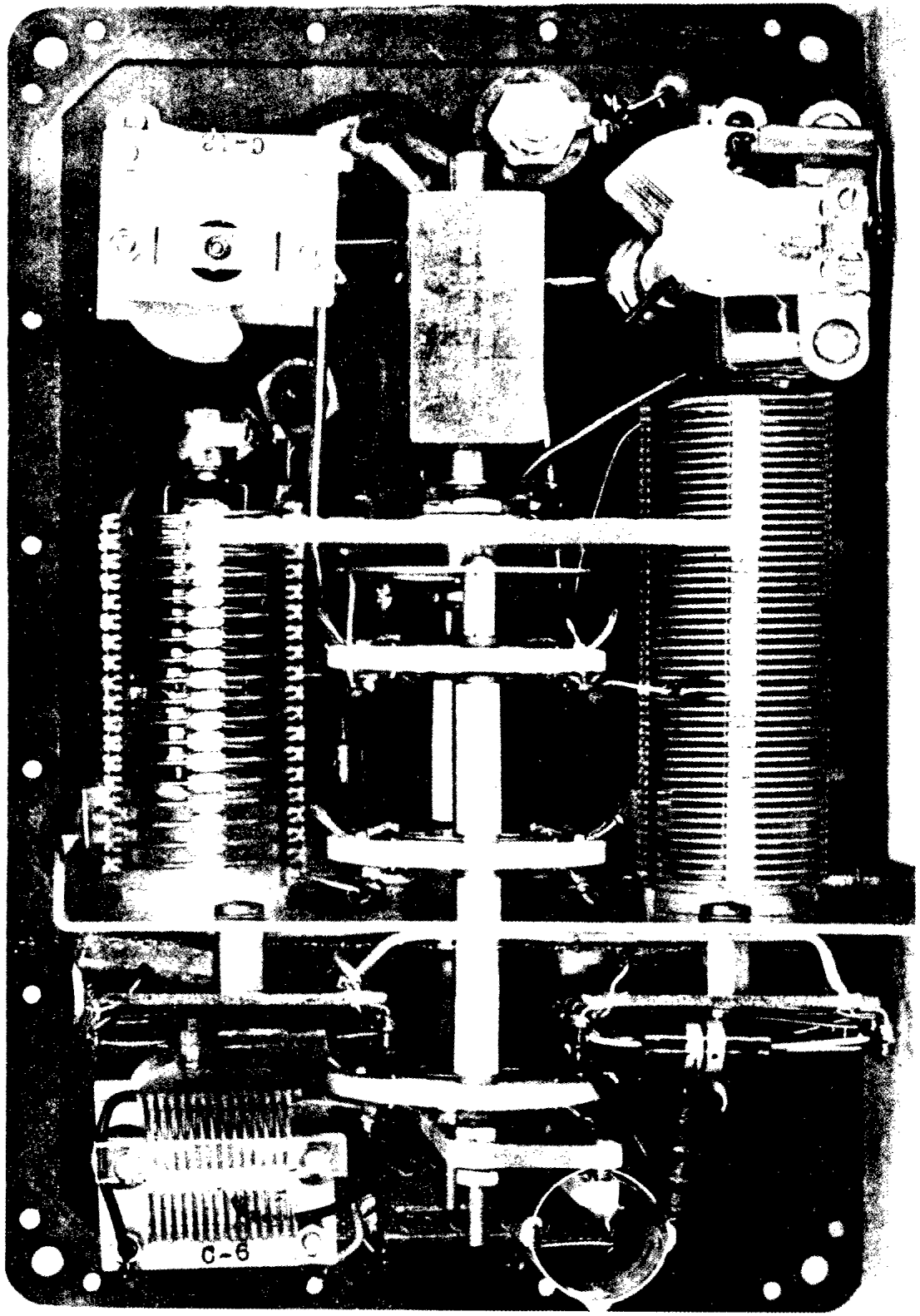
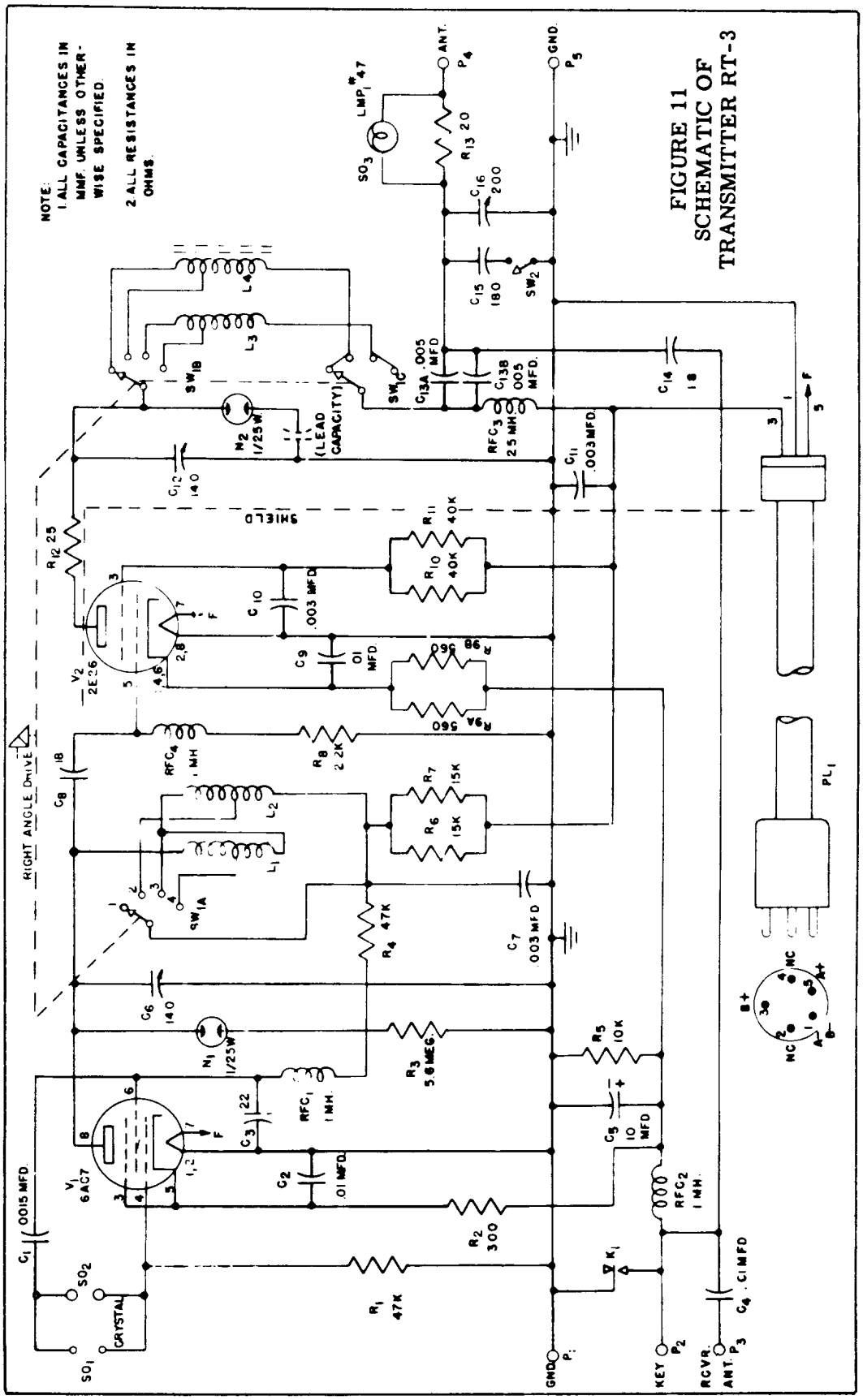


FIGURE 10 TRANSMITTER RT-3, REAR VIEW (CASE REMOVED)



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C-1c. List Of Electrical Components for Radio Transmitter, RT-3

SYMBOL	ITEM	QUANTITY
	Resistors	
R-1, R-4	Res. - 47,000 Ohm 1/2 W	2
R-5	Res. - 10,000 Ohm 1/2 W	1
R-8	Res. - 2,200 Ohm 1/2 W	1
R-3	Res. - 5.6 Megohm 1/2 W	1
R-2	Res. - 300 Ohm 1 W	1
R-12	Res. - 24 Ohm 1 W	1
R-10, R-11	Res. - 39,000 Ohm 2 W	2
R-6, R-7	Res. - 15,000 Ohm 2 W	2
R-9A, R-9B	Res. - 560 Ohm 2 W	2
R-13	Res. - 20 Ohm 1 W	1
	Capacitors	
C-13A, C-13B	Cap. - .005 mmf. 500 volt D.C. Mica	2
C-9, C-4, C-2	Cap. - .01 mmf. 500 volt D.C. Mica	3
C-3	Cap. - 22 mmf. 500 volt D.C. Mica	1
C-1	Cap. - .0015 mmf. 500 volt D.C. Mica	1
C-14, C-8	Cap. - 18 mmf. 500 volt D.C. Mica	2
C-10, C-11, C-7	Cap. - .003 mmf. 500 volt D.C. Mica	3
C-15	Cap. - 180 mmf. 500 volt D.C. Mica	1
C-5	Cap. - 10 MFD-70V Electrolytic	1
C-6	Cap. - 140 mmf. Variable	1
C-12	Cap. - 140 mmf. Variable with Back Plate	1
C-16	Cap. - 200 mmf. Variable	1
	Miscellaneous	
L-1	Oscillator Plate Coil, Ranges #1 and #2	1
L-2	" " " " #3 and #4	1

List of Electrical Components for Radio Transmitter, RT-3 (Continued)

SYMBOL	ITEM	QUANTITY
L-3	Amplifier Plate Coil, Ranges #1 and #2	1
L-4	Amplifier Plate Coil, Ranges #3 and #4	1
SW-1A, SW-1B, SW-1C	Bandswitch #163C-Modified	1
RFC-1, RFC-4	Radio Frequency Choke - 1MH 50MA	2
RFC-3	Radio Frequency Choke - 2.5 MH 125 MA	1
RFC-2	Radio Frequency Choke - 1MH 100 MA	1
K-1	Key Assembly	1
LMP #1	Pilot Light Cap Assembly	1
N-1, N-2	Neon Lamp Assembly	2
SO-1	Small Crystal Socket Assembly	1
SO-2	Large Crystal Socket Assembly	1
SO-3	Lamp Socket Assembly	1

C-2. Radio Receiver, RR-2

C-2a. Circuit Description (See figure 13)

Radio Receiver, RR-2 is a miniature communications receiver of the superheterodyne type, having a frequency range of 3 to 24 MC. It is capable of high performance operation with continuously variable tuning or spot frequency crystal control.

The receiver is constructed in a conventional manner except that two separate chassis are mounted behind the panel. The larger chassis, upon which the three section tuning capacitor is mounted, contains all of the components for the R.F. amplifier, mixer, and H.F. oscillator. The smaller chassis contains the I.F. amplifier, second detector, A.F. amplifier, and beat frequency oscillator.

The following is a step by step function of the stages in the receiver: The antenna is applied through S1 to the primary of L1, L2, or L3, depending on the range in use. The secondary for that particular range is selected by S2 and connected to the grid of V1 the R.F. amplifier. S3 shorts out the grid coils of the ranges not in use. C10 is the R.F. section of the main tuning capacitor C10, C11, C12 and resonates the secondary of L1, L2, or L3 to the desired signal frequency. S4 switches in the proper plate coil for V1 and C11 tunes it to the same frequency as the input circuit. S5 shorts out the plate coils of the ranges not in use.

This comprises the tuned R.F. amplifier with both input and output circuits of V1 tuned to resonance. Each coil has a small air trimmer in shunt for adjusting the minimum circuit capacity. In addition each coil has a powdered iron core which may be

adjusted to provide exact control of the individual inductances. The gain in this stage is controlled by a variable negative voltage applied to the grid of V1 through resistor R1.

The output of the R.F. amplifier is capacitively coupled to the control grid of V2 through C20. The grid return of V1 is directly to B minus through R4. The H.F. oscillator uses coils L7, L8, and L9 in a conventional tuned grid, inductively coupled plate, feed back circuit. The proper grid and plate coil for the range in use is selected by S7 and S8. S6 shorts out the grid coils of the ranges not in use. Individual control of inductances and of minimum circuit capacitance is provided in the same manner as the R.F. amplifier. C12 is the oscillator tuning section of the main tuning capacitor. C42, C43, and C44 are fixed padding capacitors which allow the oscillator tuned circuit to operate at frequency slightly higher than that of the R.F. amplifier. Resistors R18, R19, and R20 are used to provide a D.C. return to B minus of the oscillator grid circuit.

The oscillator control grid and anode grid of V1 are connected to the oscillator coils through the crystal socket. The crystal socket consists of two shorting type pin jacks and a pair of capacitors C55 and C56 molded into a single unit. When a crystal is inserted, the tuned circuit is disconnected from the tube and the crystal is shunted across the oscillator control and anode grids to from a "Pierce" type oscillator. The pins of the crystal holder also make contact with C55 and C56 which serve to raise the input capacity of the circuit. This increasing of the input capacity is required to permit accurate correlation of the input which is

necessary if accurate crystal control is to be achieved. The output of V2 is transformer coupled to the grid of V3. T1 is a slug tuned I.F. transformer which has both primary and secondary tuned to 455 KC.

The secondary of T1 is connected directly to the grid of the first I.F. amplifier V3. The output of V3 is coupled to the grid of V4 by a transformer T2, identical to T1. The operation of V4, the second I.F. amplifier is identical to and serves the same function as V3. Gain is controlled in V3 and V4 by means of a variable negative grid voltage applied through R9 and R12.

The output of V4 is transformer coupled to the diode section of V5. Rectification of the signal takes place at 455 KC and audio output voltage is developed across the diode load resistor R16. C37, C38, and R15 are R.F. filter components in the diode load circuit.

Audio frequency voltage developed across R16 is coupled through C39 to the control grid of V5. V5 is a high gain diode-pentode audio amplifier. The output of the audio amplifier is coupled to the headphone terminals by means of transformer T4. The audio characteristic of this receiver is primarily intended for the reception of C.W. and voice only, and has a limited frequency response.

Mounted on the I.F. and A.F. subchassis is an additional subassembly. This is the Beat Frequency Oscillator and Bias Generator. This stage utilizes V6 in a conventional "Hartley" oscillator normally tuned by C51 and C52 to a frequency of 455 KC and variable plus or minus 4 KC. C52 is a specially constructed

variable capacitor having 360° rotation. It short circuits for 180° and is effective through the other 180° of rotation. The R.F. voltage appearing across L10 is coupled to a diode rectifier VR1. The output of VR1 is filtered by means of an RC filter, R24 and C47. Approximately 20 volts negative with respect to B minus is obtained in this manner. This negative voltage is used as control voltage for R.F. and I.F. gain. Resistors R21 and R22 provide a voltage divider to obtain minus 3 volts for the grid of the A.F. amplifier V5. This circuit then provides both a B.F.O. and negative bias voltages for the receiver. To receive amplitude modulated signals, C52 is rotated to the shorting position. The frequency of oscillation is now determined by L10 and C51 alone and is sufficiently removed from the I.F. frequency so that no beat note is audible. Stray wiring capacitances serve to couple the output of V6 to V5 for C.W. reception. Coil L11 and capacitor C53 prevent coupling of the B.F.O. or its harmonics through the filament circuit wiring into the other stages.

The receiver is turned on and off by means of S9 which is part of the gain control P1. The plate supply is not switched. All R.F. plate circuits are provided with decoupling R-C filters to provide a high degree of stability.

C-2b. Trouble Shooting the RR-2

To properly service this unit the following test equipment will be required:

1. A dry battery pack. (See section A-6)
2. An accurately calibrated R.F. and I.F. signal generator.

3. A calibrated audio output meter.

4. A very high input resistance volt ohmmeter.

(Similiar or equal to R.C.A. volt-ohmyst).

When removing the receiver from the case IT IS ABSOLUTELY NECESSARY TO FIRST REMOVE THE DESICCATOR CARTRIDGE. Failure to do this and then attempt to remove the chassis may cause serious damage to the receiver. Due to the fact that very low voltages are used throughout the receiver, little or no trouble with component failure is to be expected.

The use of a dry battery pack rather than one of the power supplies is recommended for servicing because of the better regulation of the battery filament supply. The first step after disassembly from the case is to check the vacuum tubes. Substitution testing is recommended, but an initial continuity check with an ohmmeter across pins 1 and 7 of each tube will quickly spot an open filament and will save much time. If all tubes should be found burned out, the trouble probably lies in the power supply and not in the receiver. This filament burnout could be caused by excessive filament voltage from either the RP-1 or RP-2, hence, the reason for using a dry battery pack for checking. In any case where more than one filament failure at a time is observed, never plug receiver back into a power supply without checking power supply filament voltage. (See C-3) To measure voltages at the tube sockets from the top of the chassis, a short piece of wire may be attached to the test probe of the volt ohmmeter. This wire should be approximately the same diameter as the pins on the tubes, so that contact may be made in the socket.

Preferably use a dry battery pack when checking voltages at the tube socket and replace tubes in all sockets except the one under test. Do not try to adjust R.F. or I.F. tuning without proper test equipment.

The following is a step by step alignment procedure:

I.F. ALIGNMENT

1. Set signal generator to exactly 455 KC, modulation "on".
2. Couple generator to pin 6 of V2 with 0.1 mfd capacitor.
3. Connect output meter to headphone terminals.
4. Set receiver to 3 MC, short antenna post to ground and turn off B.F.O.
5. Turn gain control to about two thirds from the maximum position.
6. Adjust output of signal generator to give a reading of approximately 6 milliwatts at the output meter.
7. Adjust primary and secondary slugs of T3, T2, and T1 to give maximum output. After each adjustment reduce signal generator output to keep receiver output level at 6 milliwatts or less. Repeat until adjustments have reduced the output of the signal generator to the minimum amount that will give 6 milliwatts output from the receiver.

B.F.O. ALIGNMENT

1. Do not change settings of signal generator from that for the I.F. alignment but turn off modulation.
2. Replace output meter with a pair of headphones.
3. Turn down gain control until audio level is about that normally used for reception.
4. Set the B.F.O. knob to the center of the "on" position.
5. Adjust the slug in L10 to obtain zero beat.

R.F. ALIGNMENT

Range #1

1. Set signal generator, modulation on, to 3 MC and connect to antenna and ground posts with a 270 ohm carbon resistor in series to the antenna terminal. Connect output meter to headphone terminals.
2. Set receiver dial to 3 MC, gain control approximately two thirds open, B.F.O. turned off.
3. Adjust L7 for maximum output.
4. Set receiver and signal generator to 3.2 MC and adjust L1 and L4 for maximum output.
5. Set receiver and signal generator to 6 MC and adjust C7 for maximum output. (See Note 1)
6. Set receiver and signal generator to 5.5 MC and adjust C1 and C4 for maximum output.
7. Repeat 1 through 6, if necessary to obtain proper dial calibration.

Range #2

1. Set signal generator, modulation on, to 6 MC and connect to antenna and ground posts with a 270 ohm carbon resistor in series to the antenna terminal. Connect output meter to headphone terminals.
2. Set receiver dial to 6 MC, gain control approximately two thirds open, B.F.O. turned off.
3. Adjust L8 for maximum output.
4. Set receiver and signal generator to 6.5 MC and adjust L2 and L5 for maximum output.

5. Set receiver and signal generator to 6 MC and adjust C8 for maximum output. (See Note 1)
6. Set receiver and signal generator to 11.5 MC and adjust C2 and C5 for maximum output.
7. Repeat 1 through 6, if necessary to obtain proper dial calibration.

Range #3

1. Set signal generator, modulation on, to 12 MC and connect to antenna and ground posts with a 270 ohm carbon resistor in series to the antenna terminal. Connect output meter to headphone terminals.
2. Set receiver dial to 12 MC, gain control approximately two thirds open, B.F.O. turned off.
3. Adjust L9 for maximum output.
4. Set receiver and signal generator to 13 MC and adjust L3 and L6 for maximum output.
5. Set receiver and signal generator to 24 MC and adjust C9 for maximum output. (See Note 1)
6. Set receiver and signal generator to 22 MC and adjust C3 and C6 for maximum output.
7. Repeat 1 through 6, if necessary to obtain proper dial calibration..

Note 1: Two peaks may be found for adjustment of C7, C8, and C9. The correct peak will always be that obtained with the minimum capacity setting.

The following are typical tube socket voltage readings to chassis for the RR-2 Receiver.

Test Conditions: Dry battery plate and filament supply, gain control on full, P.C.A. volt-ohmyst test meter, tube removed from socket under test.

V1(1T4)		V2(1L6)		V3(1T4)	
Pin 1	0 volts D.C.	Pin 1	0 volts D.C.	Pin 1	0 volts D.C.
" 2	+90 " " "	" 2	+90 " " "	" 2	+90 " " "
" 3	+90 " " "	" 3	+90 " " "	" 3	+90 " " "
" 4	Do not check	" 4	0 " " "	" 4	Do not check
" 5	0 volts D.C.	" 5	+90 " " "	" 5	0 volts D.C.
" 6	-0.5 " " "	" 6	0 " " "	" 6	-0.5 " " "
" 7	+1.4 " " "	" 7	+1.4 " " "	" 7	+1.4 " " "

V4(1T4)		V5(1U5)		V6(1T4)	
Pin 1	0 volts D.C.	Pin 1	0 volts D.C.	Pin 1	0 volts D.C.
" 2	+90 " " "	" 2	+90 " " "	" 2	+90 " " "
" 3	+90 " " "	" 3	+90 " " "	" 3	+90 " " "
" 4	Do not check	" 4	0 " " "	" 4	Do not check
" 5	0 volts D.C.	" 5	Do not check	" 5	0 volts D.C.
" 6	-0.5 " " "	" 6	-3 volts D.C.	" 6	0 " " "
" 7	+1.4 " " "	" 7	+1.4 " " "	" 7	+1.4 " " "

Voltage on pin 6 of V1, V3, and V4 rises to approximately -20 volts D.C. as gain control is rotated to minimum gain position.

The following is a list of possible troubles with the RR-2 and the causes thereof:

Symptom	Probable Cause
1. Receiver dead	Defective tube, dead dry battery, defective power supply, defective headphones.
2. Low sensitivity	Defective tube, poor antenna, R.F. or I.F. misalignment, wrong impedance headphones.
3. Calibration in error	R.F. misalignment, dial has been loosened and is improperly positioned.
4. No B.F.O. action, no control of receiver gain.	V6 defective.
5. B.F.O. action normal, no control of receiver gain.	Rectifier VR1 defective.
6. No B.F.O. action, normal control of volume.	C52 stays shorted through 360°, L10 out of adjustment.
7. Receiver inoperative on all ranges but I.F. noise can be heard when gain control is advanced.	Contacts in crystal jack assembly not closed. V2 defective.
8. Low sensitivity on one range, other two ranges normal.	Open antenna coil. Check for continuity of antenna to chassis.
9. Receiver inoperative on one range, other two ranges normal.	Defective oscillator coils, range switch not contacting properly.

10. Receiver blocks on strong signals and is slow to recover.	Defective R.F. or I.F. tubes, R1, R9, R12, or R17 open.
11. Battery pack has very short life.	Switch S9 not opening in off position, high resistance leak in bypass capacitors.
12. Receiver noisy.	Microphonic tubes, defective battery pack or power supply. (See vibrator hash under C3).
13. Noticable hum in receiver when operating from RP-1 or RP-2.	Open filter capacitors in power supply. (See C3, C4).
14. Receiver operates normally, repeatedly blows tubes after very short time in use.	RP-1 or RP-2 receiver filament voltage excessive. (See C3, C4).
15. Receiver self oscillates at maximum gain setting of gain control.	Loose tube shields, loose screws in chassis covers, poor contact at base of I.F. transformers to chassis, open screen bypass on V3 or V4.
16. Noticable spurious responses throughout range of receiver with antenna disconnected, B.F.O. on.	L11 shorted, C53 open, poor contact to shield of B.F.O. subassembly.

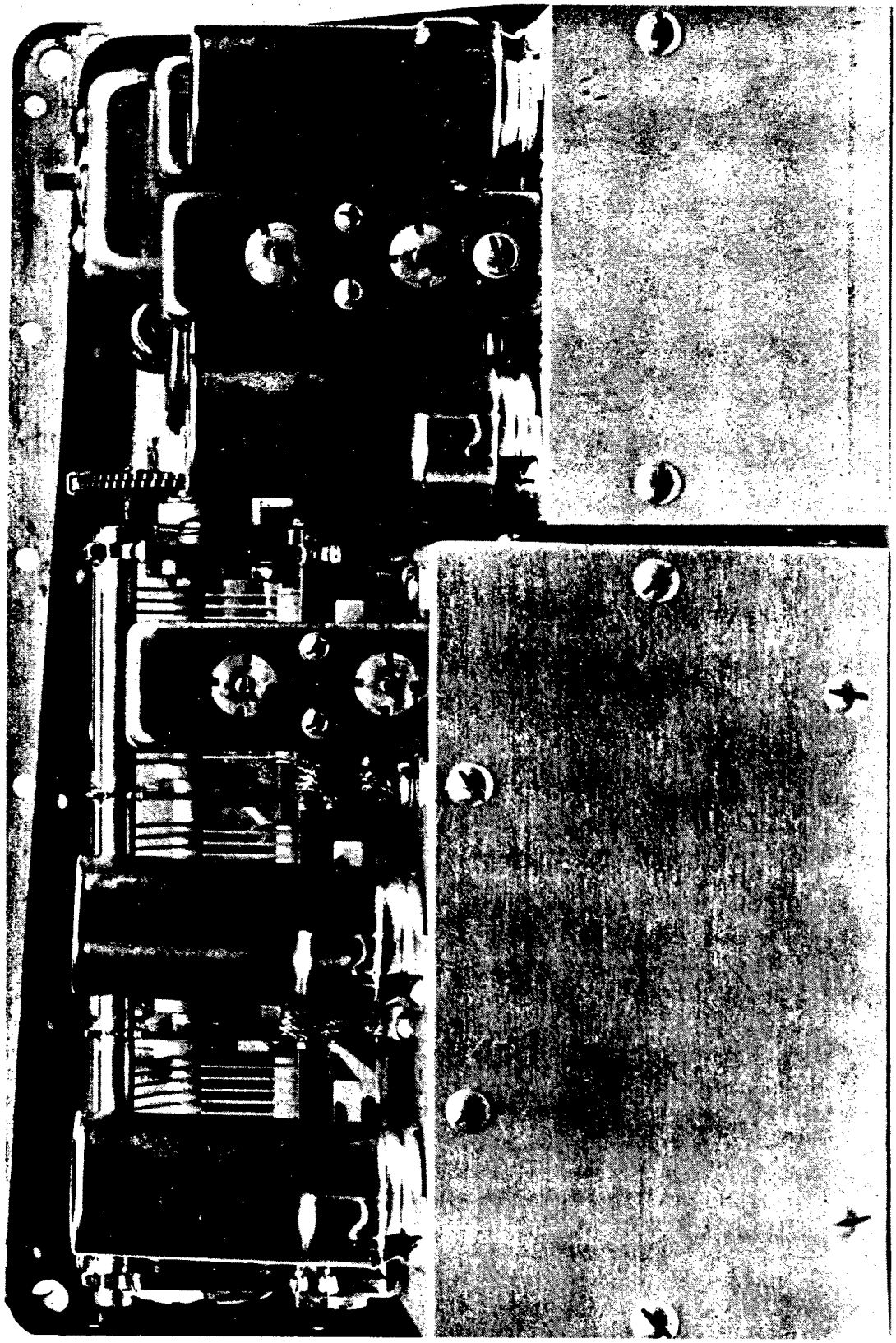


FIGURE 12 RECEIVER RR-2, REAR VIEW (CASE REMOVED)

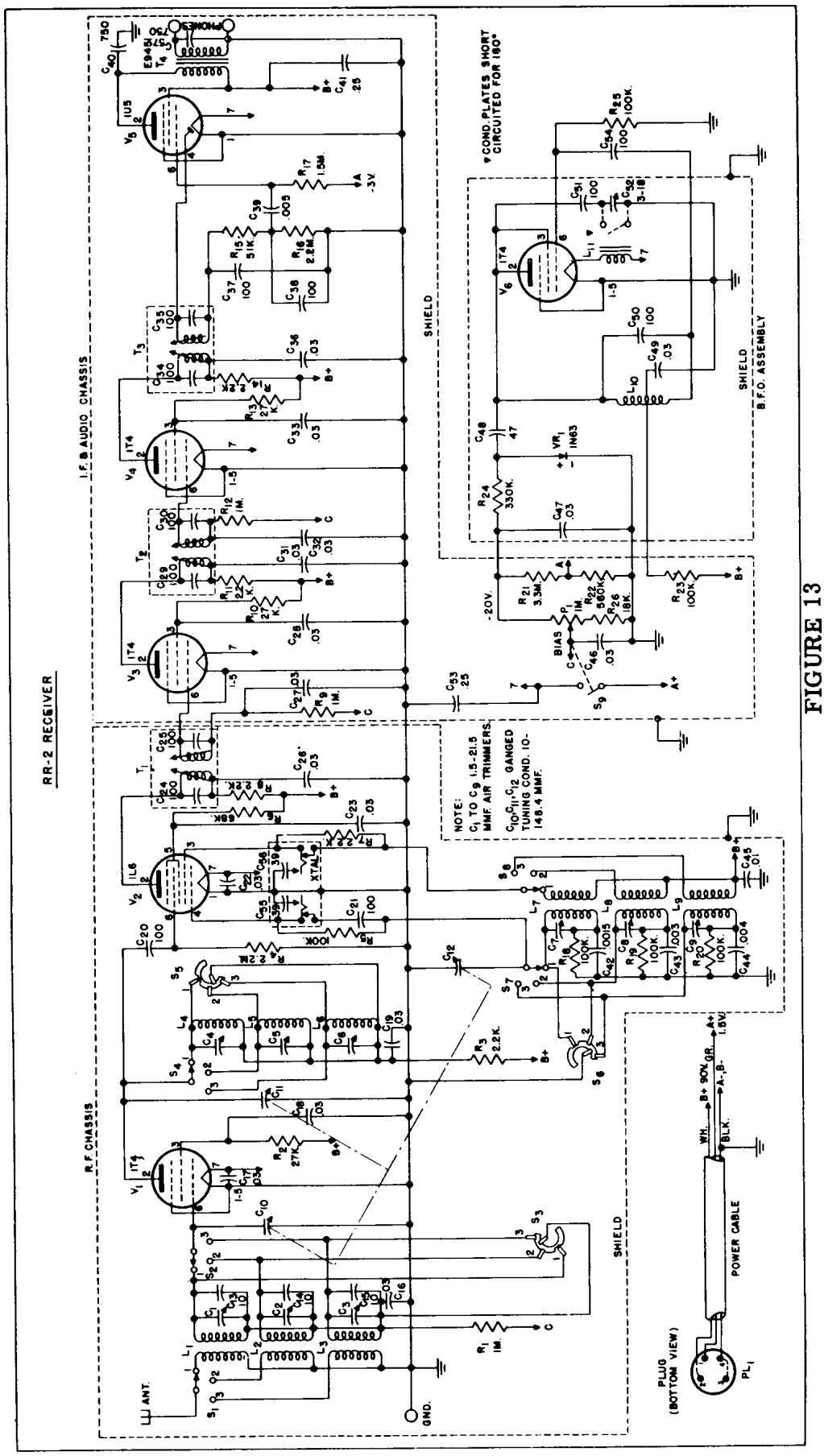


FIGURE 13
SCHEMATIC OF RECEIVER RR-2

C-2c. List of Electrical Components for Radio Receiver, RR-2

SYMBOL	ITEM	QUANTITY
	Coils and Transformers	
L1	3 - 6 MC Antenna Coil	1
L2	6 - 12 MC Antenna Coil	1
L3	12 - 24 MC Antenna Coil	1
L4	3 - 6 MC R.F. Amp. Plate Coil	1
L5	6 - 12 MC R.F. Amp. Plate Coil	1
L6	12 - 24 MC R.F. Amp. Plate Coil	1
L7	3 - 6 MC R.F. Oscillator Coil	1
L8	6 - 12 MC R.F. Oscillator Coil	1
L9	12 - 24 MC R.F. Oscillator Coil	1
L10	455 KC B.F.O. Coil	1
L11	Filament Choke Coil	1
T1, T2, T3	455 KC I.F. Transformer	3
T4	Audio Output Transformer, Plate to 4000 ohms	1
	Switches	
S1, S2, S3	Switch Assembly for Grid of R.F. Amp.	1
S4, S5	Switch Assembly for Plate of R.F. Amp.	1
S6, S7, S8	Switch Assembly for H.F. Oscillator	1
S9	SPST Switch Plate on P1	1

Resistors

		Res.	Watt	Tol.	
R1, R9, R12	Insultated Resistor	1 M	1/2	10%	3
R2, R10, R13	" "	27 K	"	"	3
R4, R16	" "	2.2 M	"	"	2
R3, R8	" "	2.2 K	"	"	2
R5, R18, R19, R20, R23, R25	" "	100 K	"	"	6

C-2c. List of Electrical Components for Radio Receiver, RR-2 (Continued)

SYMBOL	ITEM				QUANTITY
		Resistors			
		Res.	Watt	Tol.	
R6	Insultated Resistor	68 K	1/2	10%	1
R7	" "	22 K	"	"	1
R11, R14	" "	E.C.N. 2.2 K	"	"	2
R15	" "	E.C.N. 51 K	"	"	1
R17	" "	1.5 M	"	"	1
R21	" "	E.C.N. 3 M	"	5%	1
R22	" "	E.C.N. 560 K	"	"	1
R24	" "	330 K	"	"	1
R26	" "	18 K	"	10%	1
P1	Potentiometer (linear taper)	1 M			1

Note: M - Megohm

K - Kilohm

Capacitors

		Cap.	Tol.	Volt	
C1,C2,C3,C4 C5,C6,C7,C8,C9	Air Trimmer Cap.	1.5-21.5 mmf		500	9
C10,C11,C12	3 Gang Tuning Cap.	10 - 148.4 mmf		500	1
C13,C14,C15	Ceramicon Cap.	10 mmf	10%	500	3
C16,C17,C18, C19,C22,C23, C26,C27,C28, C31,C32,C33, C36,C46,C47, C49	Paper Cap.	.03 mf		400	16

C-2c. List of Electrical Components for Radio Receiver, RR-2 (Continued)

SYMBOL	ITEM				QUANTITY
		Capacitors			
		Cap.	Tol.	Volt	
C20,C21,C37 C38,C51,C54	Ceramicon Cap.	100 mmf	10%	500	6
C24,C25,C29, C30,C34,C35	Ceramicon Cap.	100 mmf	10%	500	6
C50	Ceramicon Cap.	100 mmf	10%	500	1
C41,C53	Paper Cap.	.25 mf		200	2
C39	Ceramic Disc. Cap.	.005 mf		500	1
C45	Ceramic Disc. Cap.	.01 mf		500	1
C42	Silvered Mica Cap.	.0015 mf	1%	500	1
C43	Silvered Mica Cap.	.003 mf	1%	500	1
C44	Silvered Mica Cap.	.004 mf	1%	500	1
C40	Ceramicon Cap.	750 mmf	10%	500	1
C52	Air Trimmer Cap.	25 mmf		500	1
C48	Ceramicon Cap.	47 mmf	10%	500	1
C55, C56	Ceramicon Cap.	39 mmf	10%	500	2
		Miscellaneous			
VR1	Bias Rectifier, Type 1N63				1
PL-1	Power Cord & Cable Assembly				1
XTAL	Crystal Socket Assembly				1

C-3. Power Supply, RP-1 (See figure 19)

C-3a. Circuit Description

Power Supply, RP-1 is a universal power unit designed specifcally to provide power for the RT-3 Transmitter and RR-2 Receiver. The operation of the RP-1 can best be understood if the four modes of operation are considered separately.

A.C. Mains Operation (See figure 15)

A.C. power is applied through PL2 to pins 1 and 2 on the panel plug assembly. The A.C. voltmeter is connected across PL2 and reads applied mains voltage even though switch S2 is in the "off" position. From the panel plug assembly the A.C. power is applied to transformer T1 through a special switching arrangement of S2A, S2B, and S2C. There are two A.C. primary windings on T1, PR-1, and PR-2. These two windings are operated in parallel for voltage steps 75, 90, 110, and 130. For voltage steps 150, 180, 220, and 260, the two primary windings are in series. (See par. B-4a) The vibrator primary is unused for A.C. operation.

There are three secondaries on T1 and all three are used for A.C. operation. The high voltage secondary, sec-1, supplies A.C. voltage to a combination bridge and full wave selenium rectifier. The output of the bridge rectifier is fed to a filter consisting of L1, C4a, C4b, C5a, and C5b. This combination adequately reduces power supply ripple to a negligible amount. R8 and R9 are used to insure equal voltage distribution across the series connected electrolytic capacitors. The output voltage is 400 volts D.C. and provides plate voltage for the transmitter.

The output of the same rectifier but functioning as a full

wave is fed through L3 and R6 to the voltage regulator V1. Capacitors C7a and C7b are connected across the input to R6 and output from R7. R7 is required to prevent the gas type regulator from acting as a low frequency relaxation type oscillator. This combination gives an output voltage of 100 volts D.C. which provides plate voltage for the receiver.

Secondary 2 is used when on A.C. mains operation to provide power for the receiver filament circuit. The receiver uses six 1.4 volts D.C., 50 MA filaments connected in parallel and requires 300 MA total current. The amount of ripple voltage that can be tolerated is extremely low, hence the large values of filter components. The A.C. output voltage of Sec-2 is rectified by means of a full wave selenium stack assembly. The rectified A.C. is applied to a filter consisting of C8, L2 and C9 through dropping resistors R3 and R4. R3 and R4 are both in the circuit only for A.C. mains operation and are connected in series by the action of S2E. The output voltage is held to 1.3 volts D.C. (design center of tubes) by means of shunt connected selenium stack SS7. This regulation is achieved by virtue of the non-linear conduction characteristic of the selenium and by proper adjustment of R3.

6.3 volts A.C. for the transmitter filaments is supplied from Sec-3. This secondary is only used when on A.C. mains operation and is controlled through S2D.

Receiver plate and filament power is brought out via Socket S02. Transmitter power is brought out via Socket S01.

6 Volt Battery Operation (See figure 16)

6 volts D.C. is applied through the battery cables from J2

and J3 to pin 3 and ground on the panel plug assembly PL1. The positive side of the 6 volts D.C. input is fed to the center tap on primary PR-3 of T-1 through S2D, S2E, S2F, and "hash" choke L4. C1 and C2 are "hash" filters capacitors. The fixed contacts on the vibrator are connected across the total primary PR-3. The center contact or reed of the vibrator is connected to the chassis which is the negative side of the 6 volt supply. The normal position of the reed in the vibrator, with battery disconnected, is in contact with the fixed contacts connected to pins 3 and 4 of the vibrator. Application of battery power cause the small "motor coil" to become energized, and shift the reed to the contacts connected to pins 2 and 5. This causes the current applied to PR-3 to reverse. The process repeats itself at a high rate of speed changing the 6 volts D.C. applied to the transformer to 6 volts, A.C. The transformer turns ratio is such that the same secondary voltage at Sec-1 is obtained as when operated on A.C. mains. Capacitor C3 tunes the secondary, Sec-1, of T1 to resonance at the vibrator frequency making the reflected load on the primary resistive. This prevents excessive sparking and permits proper operation of the vibrator. Resistors R1 and R2 are damping resistors which reduce contact sparking further and assist in elimination of radiated "hash". Chokes L1 and L3 are plate supply "hash" filters. The rectification and filtering of transmitter and receiver plate power is identical to that used on A.C. operation.

The operation of the receiver filament circuit differs from that on A.C. power only slightly. Resistor R3 is no longer in the circuit and the input to the filter regulator is supplied directly

from the 6 volts battery rather than from Sec-2 and its associated rectifier. This function is obtained via S2E in position #1.

Transmitter filament power is obtained directly from the battery via S2D in position #1.

The elimination of vibrator "hash" is afforded by proper shielding of the unit. There are really two unit cases, an inner and an outer, with the inner case connected at only one point to the outer case. Capacitors C10, C11, serve to prevent "hash" from being radiated by the power leads to the transmitter and receiver.

Hand Generator Operation (See figure 17)

The hand generator used with this equipment already puts out proper power for the transmitter. The only function of the RP-1 is the distribution of this power and stepping down of the plate and filament voltages for the receiver.

The output of the hand generator is applied to plug PL3. PL3 has a screw on cover, containing a shorting link between pins 2 and 3, which must be in place for all types of operation except hand generator.

The plate voltage for the transmitter is applied to the center tap of Sec-1. The selenium rectifiers offer little resistance to D.C. and the full output is obtained at SO1 plus the fact that additional filtering is afforded.

The full output of the hand generator is applied to the receiver plate supply filter and regulator circuit through R5. Resistor R5 is normally shorted out by the jumper across pins 2 and 3 of PL3.

Receiver filament supply is obtained exactly in the same manner as in battery operation, except that the input of 6 volts comes from the hand generator via S2D and S2E in position #2. The transmitter filament power is obtained directly from the 6 volts D.C. generator output via S2D in position #2.

Battery Charging (See figure 18)

Battery charging is accomplished by utilizing the rectified output of Sec-2 of T1. The high voltage secondary, Sec-1 of T1 is disconnected and the output of rectifiers SS5 and SS6 is applied to the battery leads through R10, when S1A, S1B, and S1C are in the "charge" position. The selection of primary A.C. voltage is accomplished in the same manner as for A.C. mains operation.

C-3b. Trouble Shooting the RP-1

The following test equipment will be required:

1. A 20,000 ohm per volt volt-ohm-milammeter.
2. A 0-15 amp. D.C. ammeter.
3. A continuously variable auto-transformer, to allow precise adjustment of mains voltage.
4. A heavy duty storage battery.

To properly locate trouble in this unit, it is essential that the preceeding paragraphs on circuit description be understood and referred to. The output voltages under no load should be measured first before any disassembly is undertaken. This is done to make certain that the trouble is with the RP-1 and not one of the other units. For the greatest accuracy use the auto-transformer to adjust the mains voltage to the exact value indicated by the voltage selector knob. When checking on battery operation, insert the D.C. ammeter in series with the positive battery lead, the positive

terminal on the battery, the negative terminal on the meter to the positive lead from the power supply.

The following charts give typical output voltages as measured at the output sockets under no load. The voltages under load are given in section A-3.

A.C. Operation (110 Volts A.C. 60 Cycles)

SO1	Voltage Reading to Chassis	SO2	Voltage Reading to Chassis
Pin 1	0 volts D.C.	Pin 1	0 volts D.C.
" 3	±510 " " "	" 2	0 " " "
" 5	6.3 volts A.C.	" 3	±108 " " "
		" 4	±1.7 " " "

Output of battery leads when on "charge" position and no battery attached is 8 volts D.C.

6 Volt Battery Operation

SO1	Voltage Reading to Chassis	SO2	Voltage Reading to Chassis
Pin 1	0 volts D.C.	Pin 1	0 volts D.C.
" 3	±510 " " "	" 2	0 " " "
" 5	±6 " " "	" 3	±108 " " "
		" 4	±1.7 " " "

Battery drain, key down, transmitter fully loaded is 12 to 13 amperes.

The following is a list of possible troubles with the RP-1 and the causes thereof.

Symptom	Probable Cause
1. No high voltage on Pin 3 of SO1. All other voltages proper.	.....L1 open and/or either or both C4 and C5 shorted. SS2 and/or SS4 defective.

2. Abnormally high voltage at pin 3 of S02.	.....	V1 defective.
3. Unit completely dead, A.C. voltmeter does not register when plugged into mains.	.....	Fuse F2 blown.
4. A.C. voltmeter indicates but no output voltages A.C. or D.C. present.	.....	Check contacts on S2a, S2b, S2c for alignment, T1 defective.
5. High voltage present at pin 3 of S01 but no voltage at pin 3 of S02.	.....	L3 open, check resistance of R5, R6, and R7. C7a or C7b shorted.
6. No voltage present at pin 4 of S02.	.....	R3 or R4 open, L2 open, C8 or C9 shorted. Contacts on S2E defective.
7. No voltage at pin 5 of S01.	.....	S2e or S2d defective.
8. No high voltage on either pin 3 of S01 or pin 3 of S02.	.....	SS3 or SS4 defective. S1a and S1b not closing, C3 shorted.
9. Excessive drain on 6 volt battery, all voltages present but low.	.....	Vibrator defective, C3 open or changed in value.
10. Hash audible in receiver when operation on 6 volt battery.	.....	Check all chassis connections within case of power supply, check C1, C2, C3, R1, R2, C11, and C10.

11. Battery charging rate low or zero. .....Check R10. SS5 and SS6 may be defective and will show up as low receiver filament voltage.

12. Excessive voltage at pin 4 of S05. .....SS7 defective, R3 or R4 out of adjustment.

13. Low voltage at pin 3 of S02.....Shorting jumper across pins 2 and 3 of P6 not making contact.

If it should ever be necessary to replace SS7, the following adjustments must be made before plugging the receiver into the power supply. After replacing SS7, shunt a 4.5 ohm one watt resistor across pins 1 and 4 of S02 and operate the power supply from a 6 volt fully charged battery. Read D.C. voltage across the 4.5 ohm resistor and adjust R4 until the voltage is 1.3 volts D.C. Now operate unit on A.C. mains voltage. Set the voltage selector knob to 110 volts and by means of the auto-transformer adjust the mains voltage to exactly 110 volts. Adjust R3 to give same voltage as on battery operation. Do not change adjustment of R4 when operating from mains power.

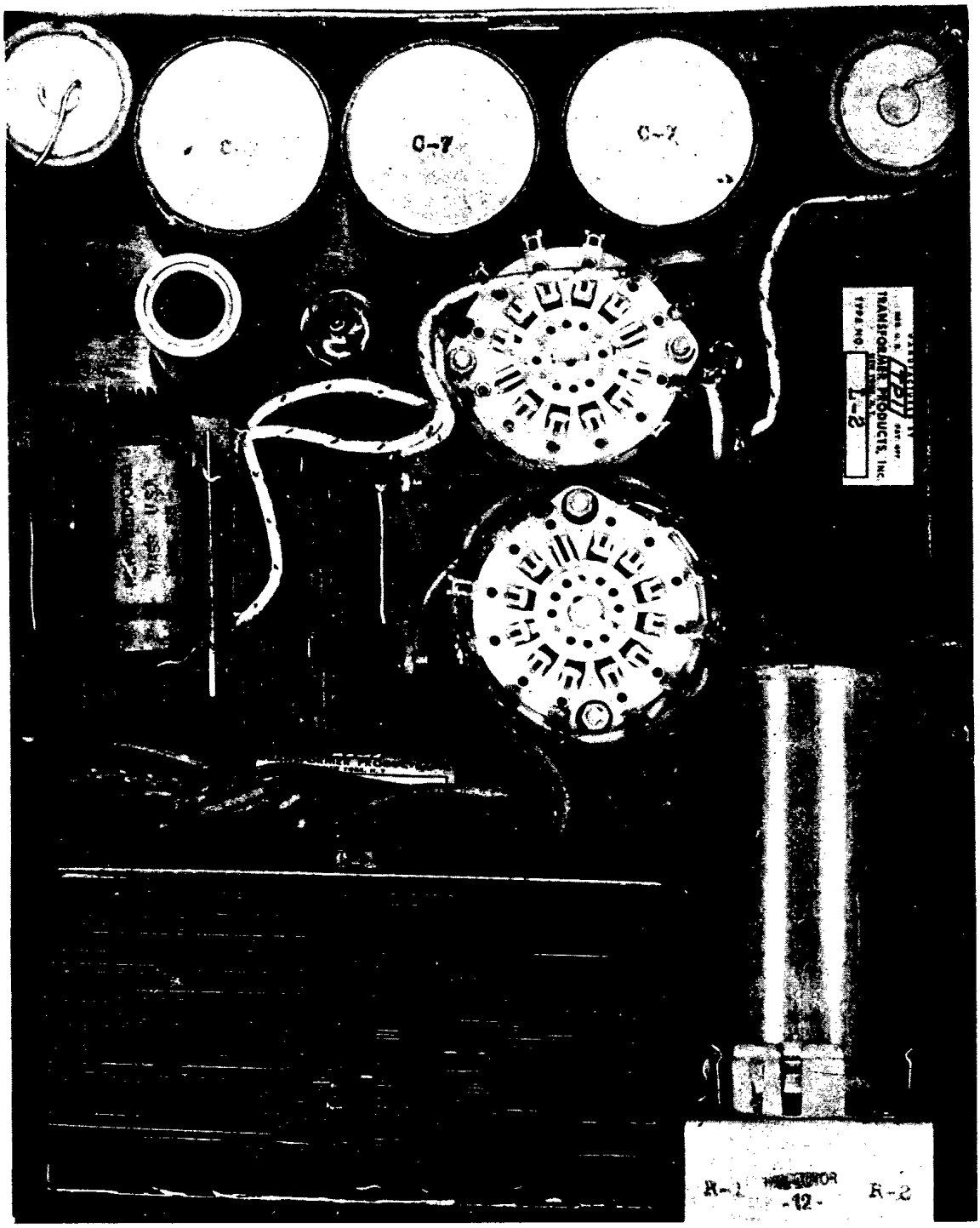
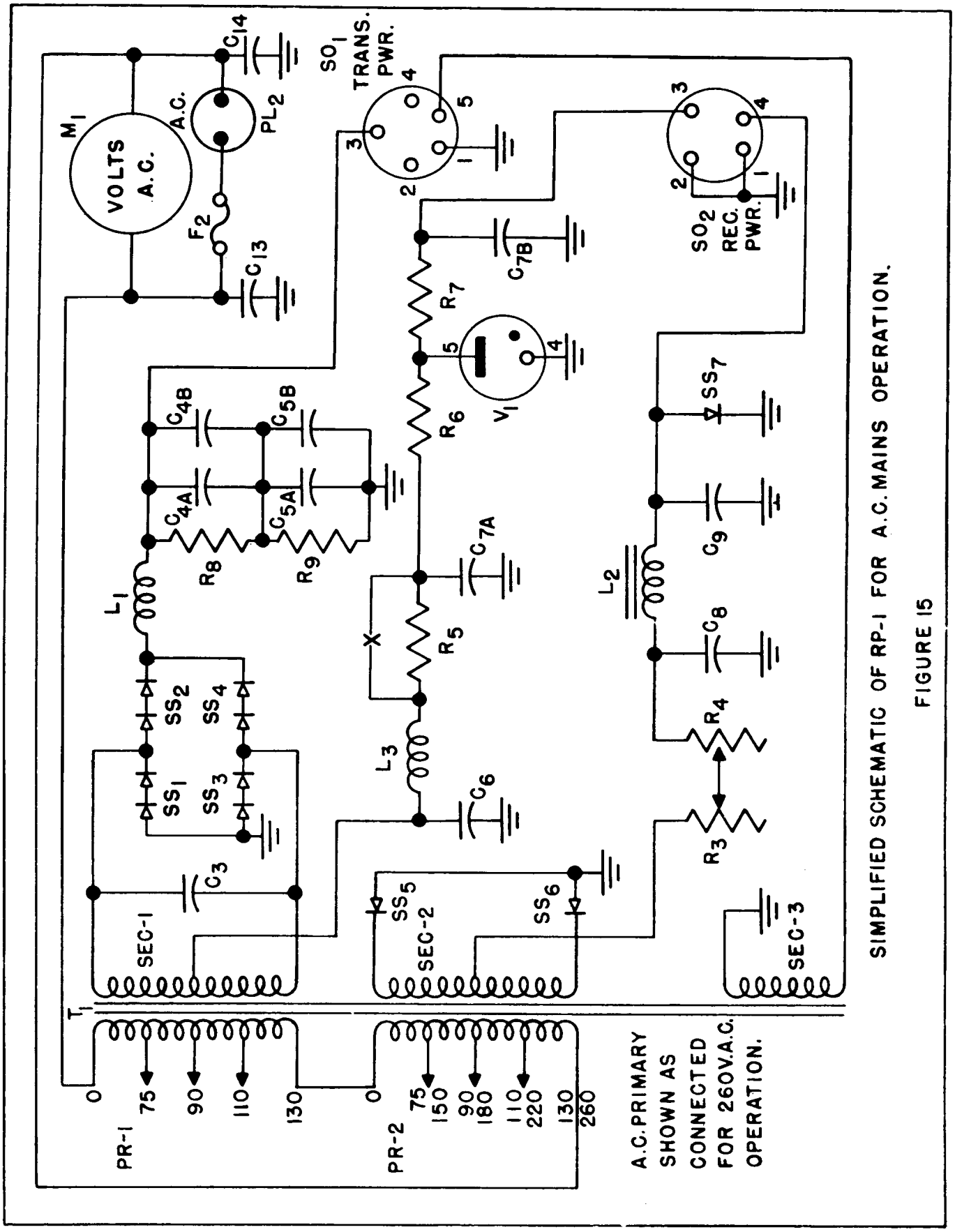
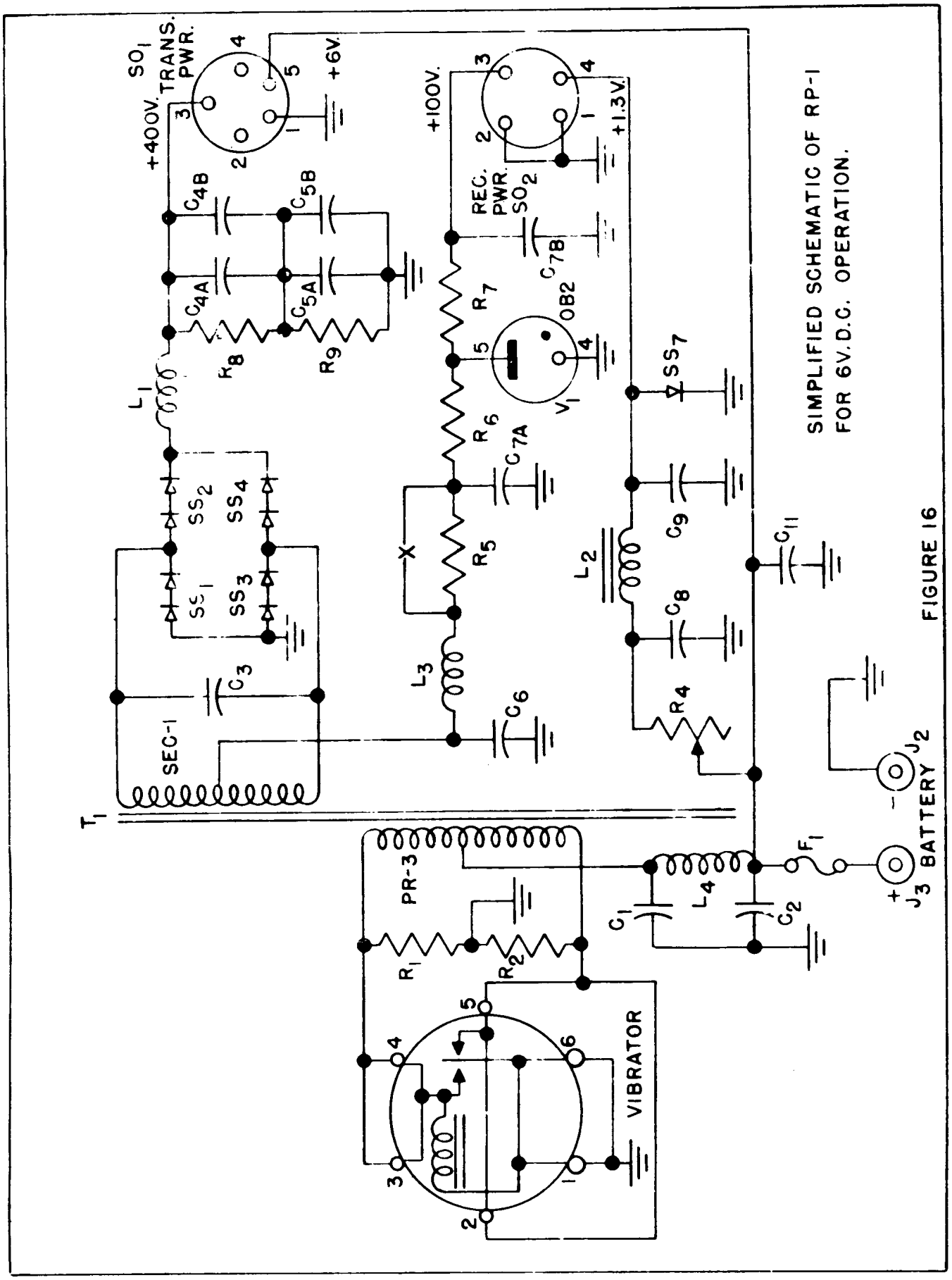


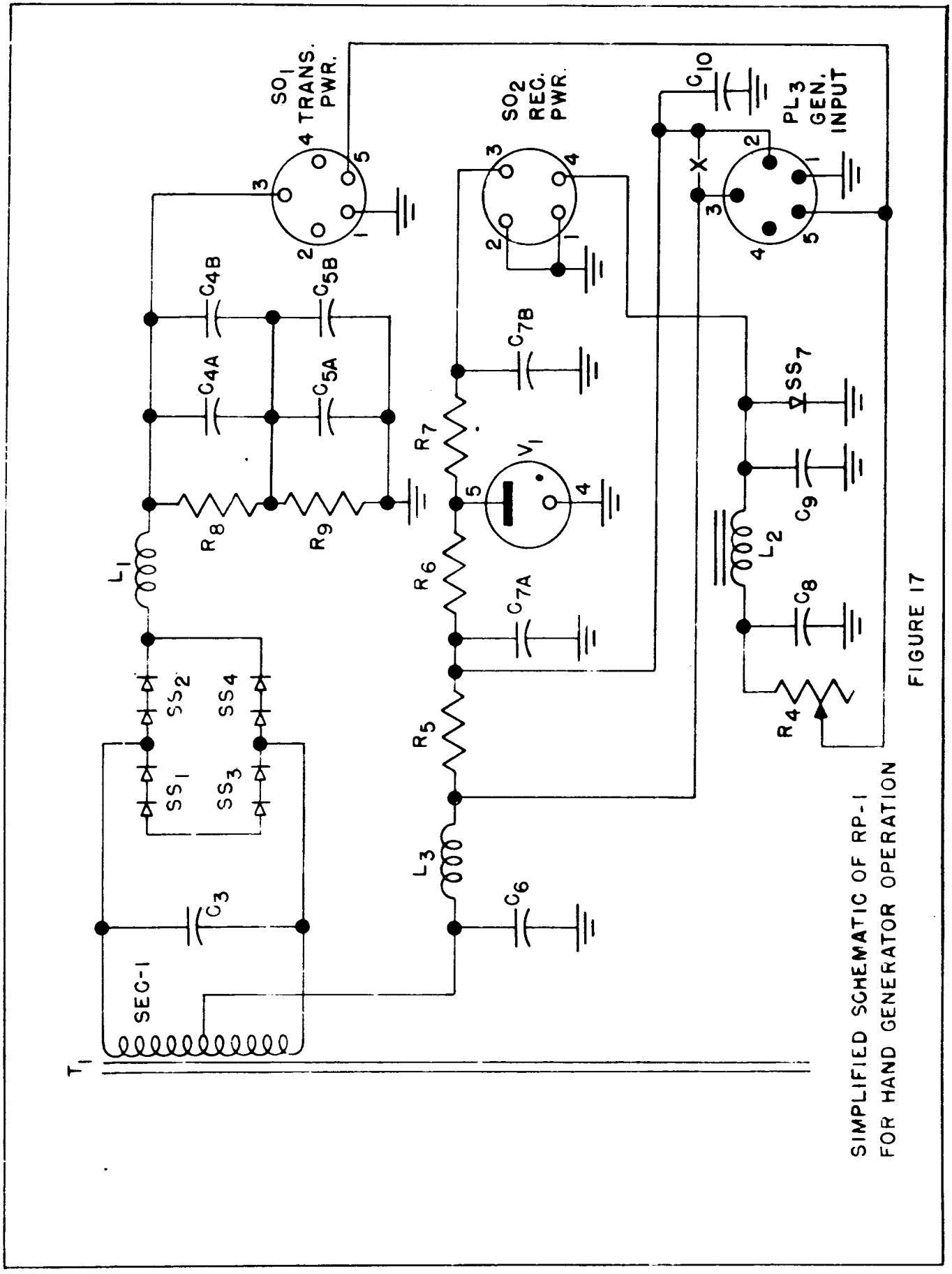
FIGURE 14 POWER SUPPLY RP-1, REAR VIEW (CASE REMOVED)

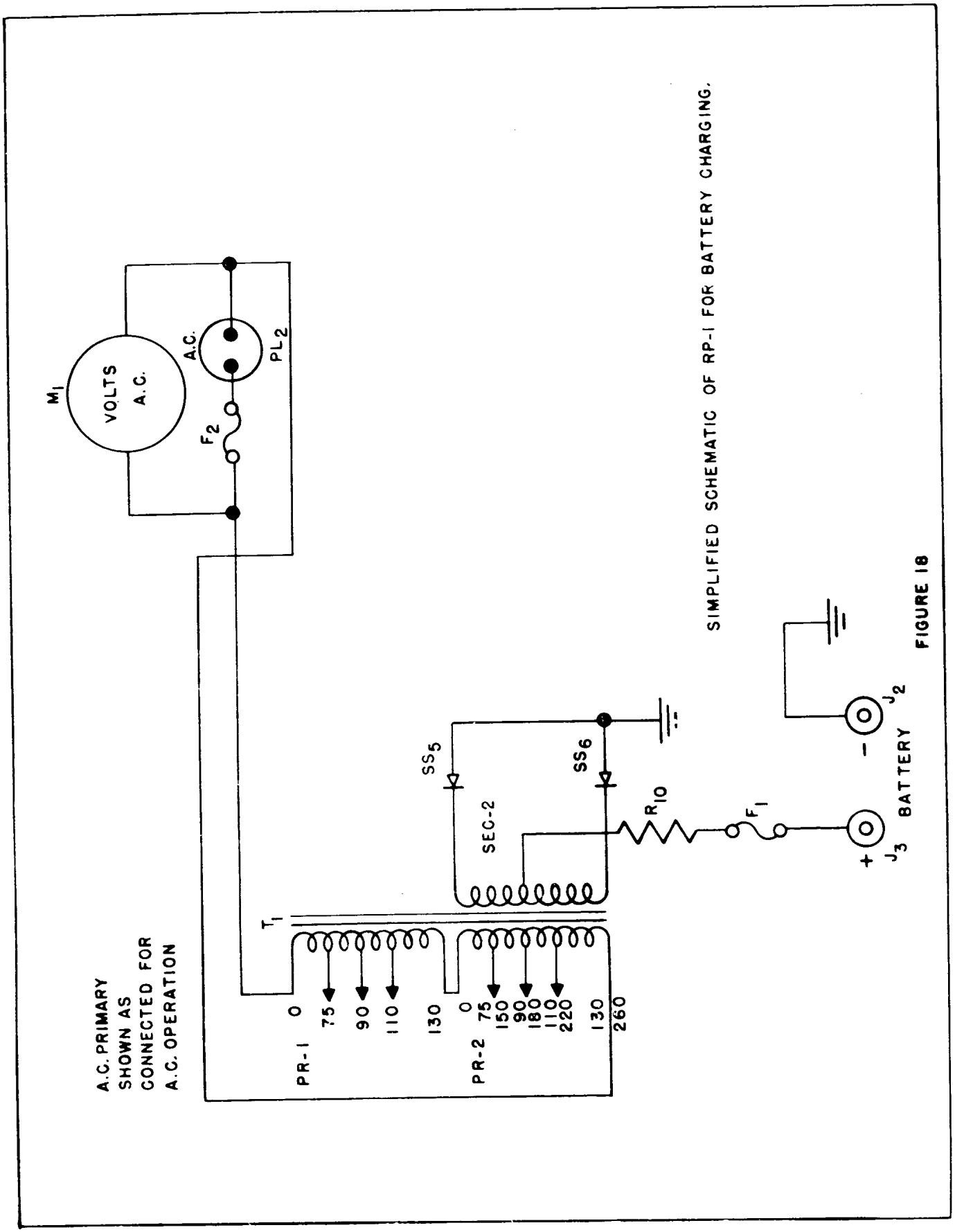


SIMPLIFIED SCHEMATIC OF RP-1 FOR A.C. MAINS OPERATION.

FIGURE 15

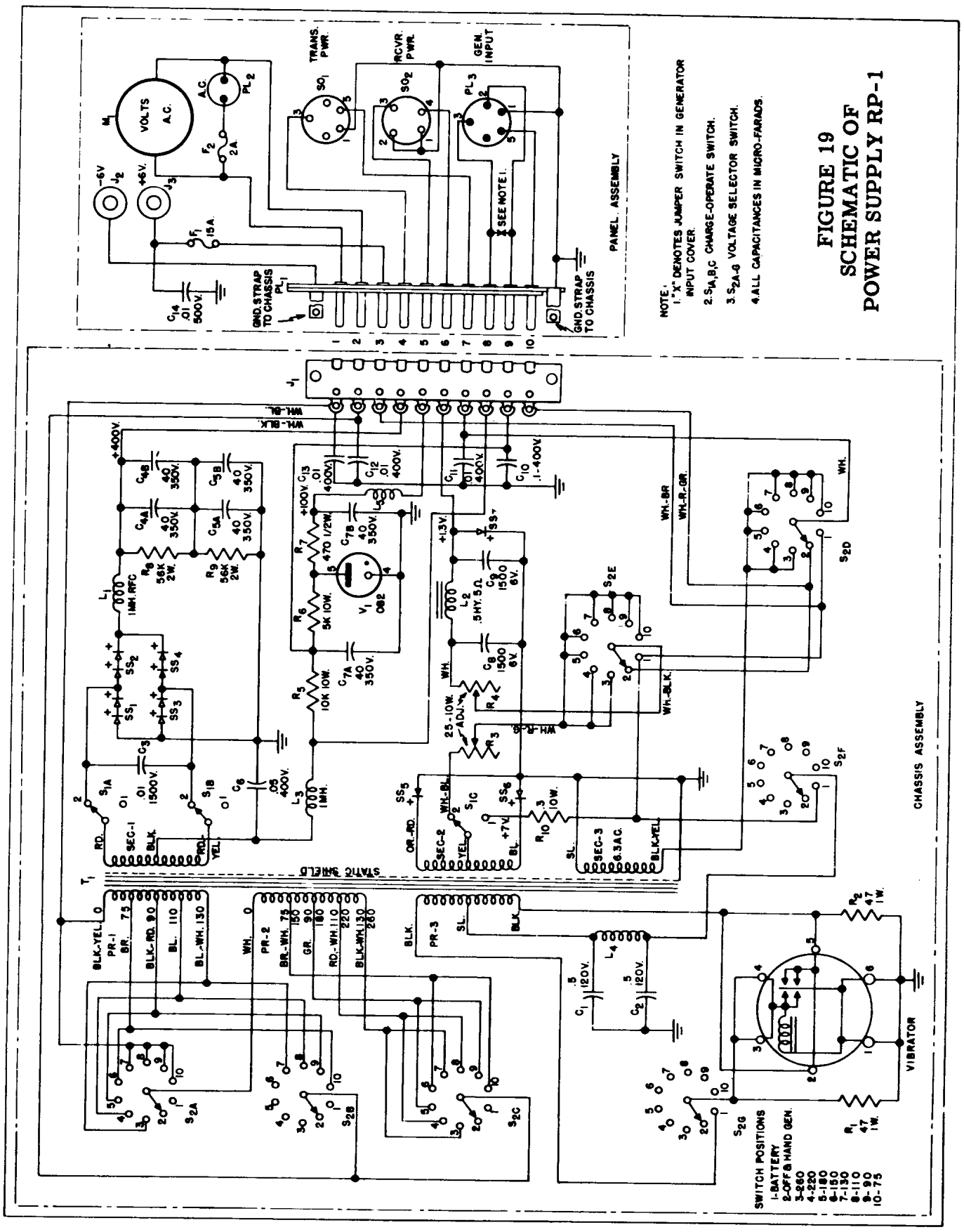



SO1 4 TRANS. PWR.
SO2 REC. PWR.
PL3 GEN. INPUT
C10
C4B
C5B
C4A
C5A
C7B
C7A
R7
R8
R9
R6
R5
R4
V1
SS7
C9
L2
C8
L1
SS2
SS4
SS1
SS3
C3
L3
C6
SEC-1
T1
SIMPLIFIED SCHEMATIC OF RP-1
FOR HAND GENERATOR OPERATION
FIGURE 17



SIMPLIFIED SCHEMATIC OF RP-1 FOR BATTERY CHARGING.

FIGURE 18



NOTE:
1. "X" DENOTES JUMPER SWITCH IN GENERATOR INPUT COVER.
2. $S_{1A,B,C}$ CHARGE-OPERATE SWITCH.
3. S_{2A-G} VOLTAGE SELECTOR SWITCH.
4. ALL CAPACITANCES IN MICRO-FARADS.

FIGURE 19
SCHEMATIC OF
POWER SUPPLY RP-1

 ET

C-3c. List of Electrical Components for Power Supply, RP-1

SYMBOL	ITEM	QUANTITY
	Resistors	
R-1, R-2	Res. - 47 Ohm 1 W	2
R-3, R-4	Res. - 25 Ohm 10 W - Adj. Vitreous	2
R-5	Res. - 10 K Ohm 10 W - Vitreous Fixed	1
R-6	Res. - 5 K Ohm 10 W - Vitreous Fixed	1
R-10	Res. - 0.3 Ohm 10 W - Vitreous Fixed	1
R-7	Res. - 470 Ohm 1/2 W	1
R-8, R-9	Res. - 56 K Ohm 2 W	2
	Capacitors	
C-3	Capacitor - .01 mf 1500 V.	1
C-1, C-2	" - .5 mf 100 V. Hash	2
C-8, C-9	" - 1500 mf 6 W.V.	2
C-4A,B;C-5A,B; C-7A,B	" - 40 x 40 mf 350 W.V.	3
C-6	" - .05 mf 400 V. Tubular	1
C-10	" - .1 mf - 400 V. Tubular	1
C-11,C-12,C-13	" - .01 mf - 400 V. Tubular	3
C-14	" - .01 mf - 500 V. Mica	1
	Rectifiers	
SS-1,SS-2,SS-3, SS-4	Selenium Rectifier Stack - 200 MA, H.V.	4
SS-7	" " " - Regulator	1
SS-5, SS-6	" " " - 5 amp., L.V.	2
	Miscellaneous	
M-1	Voltmeter 0-300 volt A.C.	1
PL1	Male Connector Strip Plug, 10 contact	1

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C-3c. List of Electrical Components for Power Supply, RP-1 (Continued)

SYMBOL	ITEM	QUANTITY
	Miscellaneous	
PL2	Molded Line Cord and Plug	1
PL3	Molded 5 Contact Panel Plug	1
J1	Female Connector Strip Jack, 10 Contact	1
J2, J3	Female Battery Terminal Jack	2
SO1	Molded 5 Contact Socket	1
SO2	Molded 4 Contact Socket	1
F-1	15 Amp. Fuse, Type 3 AG	1
F-2	2 Amp. Fuse, Type 3 AG	1
S-1A,S-1B,S-1C	3 Pole, 2 Position Switch	1
S-2A,S-1B,S-1C, S-1D,S-1E,S-1F, S-1G	7 Pole, 11 Position Switch	1
T-1	Power Transformer	1
L-4	Choke - Hash - 15 Amp.	1
L-1	Choke - R.F. - 1 MH. - 100 MA	1
L-2	Choke - Filter - 5 HY. - 5 Ohms	1
L-3	Choke - R.F. - 1 MH. - 50 MA	1
VB1	Synchronous Full Wave Vibrator, 6 Volt	1

C-4. Power Supply, RP-2

C-4a. Circuit Description (See figure 20)

Power Supply, RP-2 is an A.C. operated power supply designed specifically to provide power for the RT-3 transmitter and the RR-2 receiver. The electrical circuit functioning of the RP-2 is very similiar to the RP-1 when the latter is operated from A.C. mains. The construction of this unit is somewhat different, however, since it is intended for operation from A.C. mains only.

A.C. power is applied through plug PL3 to 2 and 3 on the terminal strip. The A.C. voltmeter is connected across PL3 and reads the applied mains voltage even though switch S1 is in the "off" position. From the terminal strip TS-1, the A.C. power is applied to transformer T1 through a special switching arrangement of S1A, S1B, and S1C. There are two primary windings on T1, PR-1, and PR-2. These two windings are operated in parallel for voltage steps 75, 90, 110, and 130. For voltage steps 150, 180, 220, and 260, the two primary windings are in series.

There are three secondaries on T1. The high voltage secondary Sec-1 supplies A.C. voltage to a combination bridge and full wave selenium rectifier. The output of the bridge rectifier is fed to a filter consisting of a single capacitor C5 connected across the high voltage output terminals 1 and 3 of socket SO-1. The output voltage is 400 volts D.C. and provides plate voltage for the transmitter.

The output of the same rectifier, but functioning as a full wave, is fed through R2 to the voltage regulator V1. Capacitors C1 and C2 are connected across the input to R2 and output from R3.

R3 is required to prevent the gas type regulator from acting as a low frequency relaxation oscillator. The output from the full wave circuit is 100 volts D.C. which provides plate voltage for the receiver. This voltage appears across pins 1 and 3 of SO2.

The output of secondary, Sec-3, is rectified by means of a full wave selenium stack assembly. The rectified output is applied to a filter consisting of C3, L1, and C4 through a dropping resistor R1. The output voltage is held to 1.3 volts D.C. (design center of tubes) by means of a shunt connected selenium stack SS5. The voltage is brought out through pins 1 and 4 of SO2 and supplies filament voltage for the receiver.

6.3 volts A.C. for the transmitter filaments is supplied to pins 1 and 5 of SO-1 directly from Sec-2 of T-1.

C-4b. Trouble Shooting the RP-2

The following test equipment will be required:

1. A 20,000 ohm per volt volt-ohm-milliammeter.
2. A continuously variable auto-transformer, to allow precise adjustment of line voltage.

As with the RP-2, first measure the no load output voltages to make certain that the trouble is in the power supply and not in one of the other units. For greatest accuracy use the auto-transformer to adjust the mains voltage to the exact value indicated by the voltage selector knob.

The following chart gives typical voltages as measured at the output sockets under no load. The voltages under load are given in section A-4.

Output Voltages (Input 110 V 60 Cycles)

SO1	Voltage Reading to Chassis	SO2	Voltage Reading to Chassis
Pin 1	0 volts D.C.	Pin 1	0 volts D.C.
" 3	+545 " " "	" 2	0 " " "
" 5	6.3 volts A.C.	" 3	+108 " " "
		" 4	+1.7 " " "

The following is a list of possible troubles with the RP-2 and the causes thereof.

Symptom	Probable Causes
1. No high voltage on Pin 3 of SO-1, all other voltages proper.	C5 shorted and SS2 and SS4 open.
2. Abnormally high voltage at pin 3 of SO-2.	V1 defective.
3. Unit completely dead, A.C. voltmeter does not register when plugged into mains.	Fuse F1 blown.
4. A.C. voltmeter indicates but no output voltages A.C. or D.C. present.	Check contacts on S1A, B, and C, T1 defective.
5. High voltage present at pin 3 of SO-1 but no voltage present at pin 3 of SO2.	R2 open, R3 open, C1 or C2 shorted.
6. No voltage present at pin 4 of SO2.	R1 open, L1 open, C3 or C4 shorted.
7. Excessive voltage at pin 4 of SO2.	SS5 defective.

If it should ever be necessary to replace SS5, the following adjustment must be made before plugging the receiver into the power supply. After replacing SS5, remove the screws holding the metal box on the panel. Underneath this box are two resistors. The adjustable resistor is R1 which controls the filament voltage for the receiver. Plug unit into mains and set for 110 volts operation. By means of the auto-transformer, adjust mains voltage to exactly 110 volts. Shunt pins 1 and 4 of S02 with a 4.5 ohm, 1 watt resistor and measure the D.C. voltage across the resistor. Adjust R1 until this voltage is 1.3 volts D.C. Replace metal box and tighten all screws evenly.

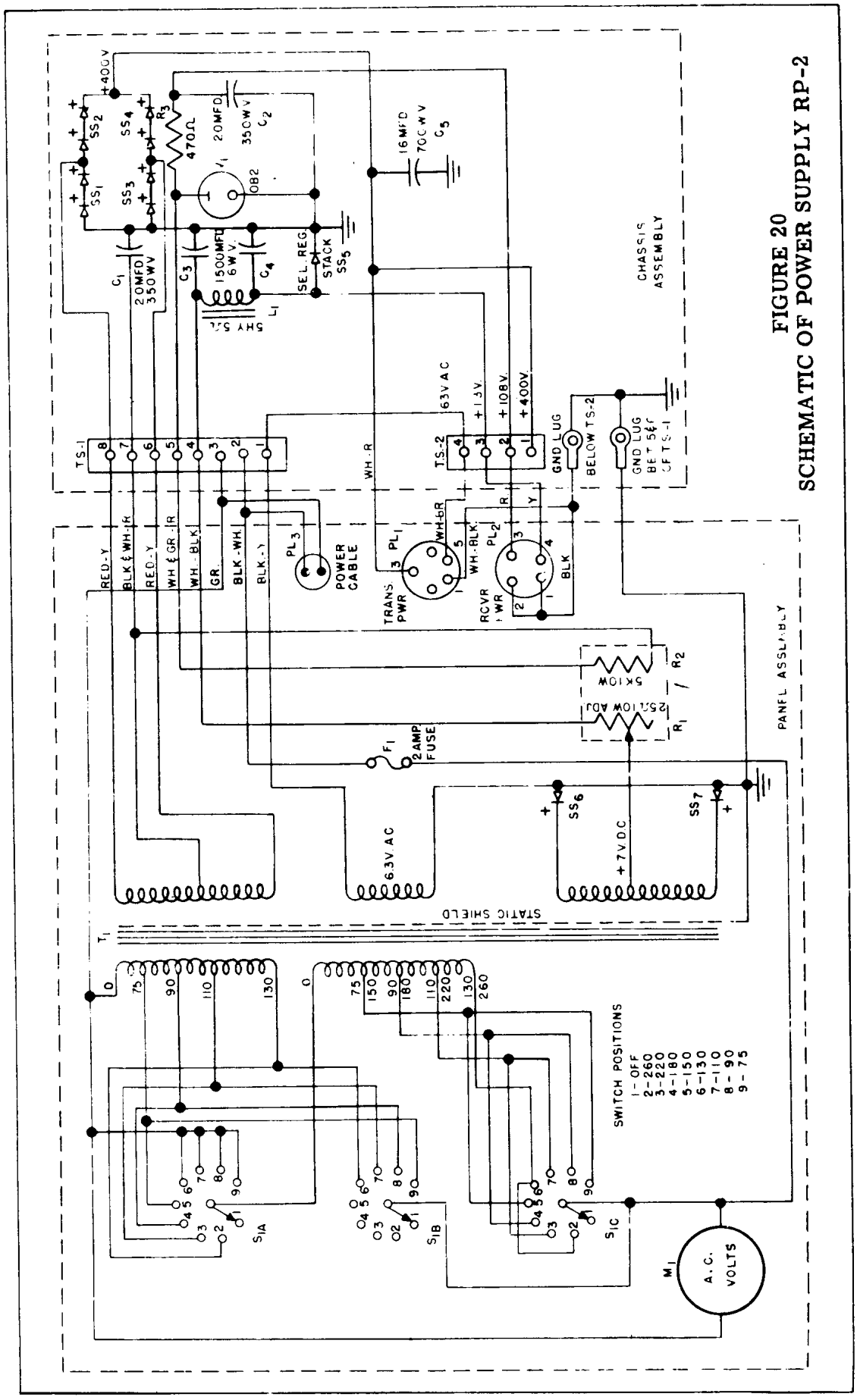

FIGURE 20
SCHEMATIC OF POWER SUPPLY RP-2

C-4c. List of Electrical Components for Power Supply, RP-2

SYMBOL	ITEM	QUANTITY
	Resistors	
R-1	Resistor - 25 Ohm 10 Watt Adj. Vitreous	1
R-2	Resistor - 5 K Ohm 10 Watt Adj. Vitreous	1
R-3	Resistor - 470 Ohm 1/2 Watt Carbon	1
	Capacitors	
C-1, C-2	Capacitor - 20 x 20 mf 350 Volt Working	1
C-3, C-4	Capacitor - 1500 mf 6 Volt Working	2
C-5	Capacitor - 16 mf 700 Volt Working	1
	Miscellaneous	
SS-1, 2, 3, 4	Selenium Rectifier Stack - 200 MA, H.V.	4
SS-5	Selenium Rectifier Stack - Regulator	1
SS-6, SS-7	Selenium Rectifier Stack - 1 Amp., L.V.	2
F-1	2 Amp. Fuse-Type 3 AG	1
T-1	Power Transformer	1
L-1	Choke - Filter - 5 HY. - 5 Ohms	1
SO-1	Molded 5 Contact Socket	1
SO-2	Molded 4 Contact Socket	1
PL-3	Molded Line Cord and Plug	1
S1A,S1B,S1C	Switch - 3 Pole, 9 position	1
M-1	Voltmeter 0-300 Volts A.C.	1
TS1	Terminal Board (TS1) Assembled	1
TS2	Terminal Board (TS2) Assembled	1

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