

RADIO SETS

AN/GRC-3, -4, -5
-6, -7, AND -8



DEPARTMENT OF THE ARMY

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For explanation of distribution formula see SR 310-90-1.

WARNING

HIGH VOLTAGE

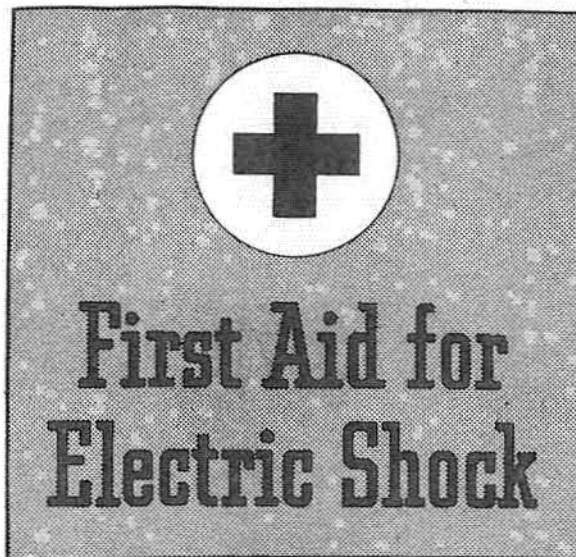
is used in the operation
of this equipment.

DEATH ON CONTACT

may result if operating personnel fail
to observe safety precautions.

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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:

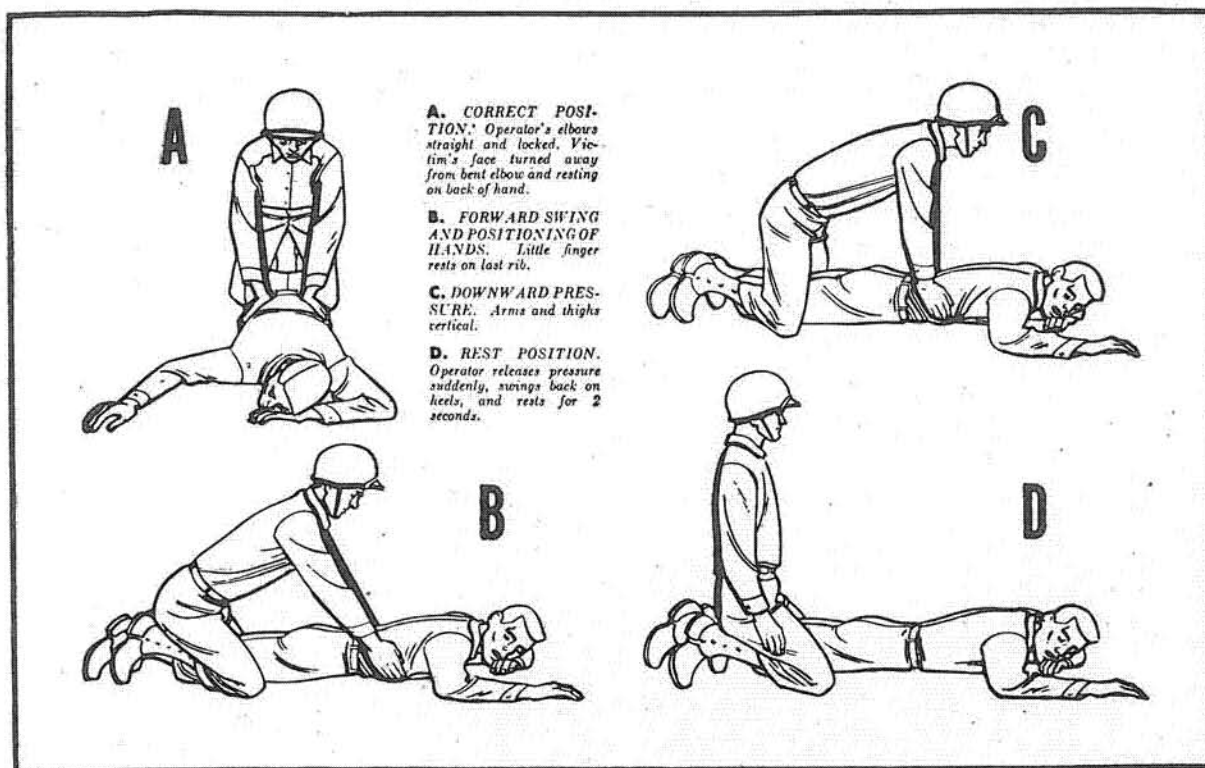
(1) Exert downward pressure, not exceeding 60 pounds, for 1 second.

(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 $\frac{1}{2}$ 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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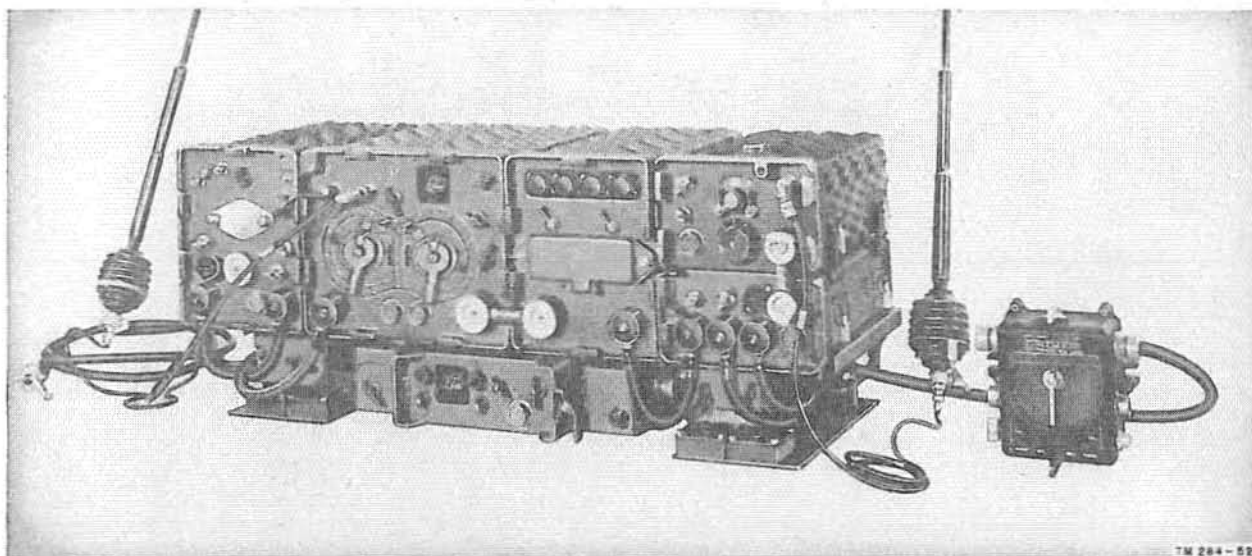


Figure 1. Radio Set AN/GRC-3.

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1. Scope

a. This technical manual contains instructions for the installation, operation, and organizational maintenance of Radio Sets AN/GRC-3, -4, -5, -6, -7, and -8. The information is intended primarily for operators and organization maintenance personnel and hence is restricted to system considerations. Detailed information on the various units which comprise the several systems is presented only insofar as system applications are involved. Detailed field maintenance instructions for the individual major components are published in separate manuals.

b. Certain schematic drawings for this equipment are included separately, because of their size, in an envelope following the index. These include figures 19, 49, 50, 51, 52, 58, 91, 96, 98, 99, 100, 101, 102, 103, 104, and 105. To this extent, therefore, figure numbers throughout the manual are not in strict numerical sequence, and whenever the instructions refer to figures 19, 49, 50, 51, 52, 58, 91, 96, 98, 99, 100, 101, 102, 103, 104, or 105, the illustration will be found in the envelope at the back of the manual.

2. Nomenclature

a. The basic similarities of Radio Sets AN/GRC-3, -4, -5, -6, -7, and -8 allow simultaneous treatment of these sets in most instances. To expedite this simultaneous treatment, an arbitrary collective nomenclature has been devised to refer to the sets and their respective units collectively. This expedient is outlined in *b* through *h* below.

b. The over-all systems, Radio Sets AN/GRC-3, -4, -5, -6, -7, and -8, are referred to collectively as the *radio sets*. Wherever instructions are lim-

ited to a particular set or group of sets, specific reference is made to that effect and full nomenclature (e. g., Radio Set AN/GRC-3) is used for the set involved. Differences among the radio sets are indicated in paragraph 6.

c. The terms *Set 1* and *Set 2* are used in this manual to designate the two receiver-transmitters included in each of the radio sets. Set 1 may be any one of Receiver-Transmitters RT-66/GRC, RT-67/GRC, and RT-68/GRC; the particular Set 1 which is used in each of the radio sets is listed in paragraph 6. Set 2 always refers to Receiver-Transmitter RT-70/GRC which is common to all the radio sets.

d. The term *Set 1 power supply* is used to designate either of Power Supplies PP-109/GR and PP-112/GR which may be used to supply operating voltages for the Set 1 receiver-transmitters. The battery voltage available, 12 or 24 volts, determines which power supply must be used (par. 11).

e. AF Amplifier AM-65/GRC, a common component of all the radio sets, is referred to in this manual as the *interphone amplifier*.

f. The term *auxiliary receiver* is used to designate any one of Radio Receivers R-108/GRC, R-109/GRC, and R-110/GRC which are components of Radio Sets AN/GRC-3, -5, and -7 respectively.

Note. It is the use of an auxiliary receiver which distinguishes Radio Sets AN/GRC-3, -5, and -7 from Radio Sets AN/GRC-4, -6, and -8 respectively. All other components of these sets are the same (par. 6).

g. The term *Set 2 power supply* is used in this manual to designate either Power Supply PP-281/GRC or PP-282/GRC which is used to supply operating voltages for the Set 2 receiver-transmitter and the interphone amplifier in all of the

radio sets and for the auxiliary receiver in Radio Sets AN/GRC-3, -5, and -7. The battery voltage available, 12 or 24 volts, determines which power supply must be used.

h. To identify the various control units of the radio sets in a functional manner, the following terms are used: Control Box C-375/VRC is referred to as the *interphone box*; Local Control C-434/GRC is referred to as the *local control unit*; Remote Control C-433/GRC is referred to as the *remote control unit*; and Control C-435/GRC is referred to as the *retransmission unit*.

3. Forms and Records

a. 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:

- (1) DD Form 6, Report of Damaged or Improper Shipment (Reports Control Symbol CS GLD-66), will be filled out and forwarded as prescribed in SR 745-45-5.
- (2) 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.

b. Use other forms and records as authorized.

Section II. DESCRIPTION AND DATA

4. Purpose of Equipment

a. Radio Sets AN/GRC-3, -4, -5, -6, -7, and -8 provide f-m (frequency-modulated) radio-telephone facilities within the frequency range of 20.0 to 54.9 mc (megacycles). The specific frequency ranges of each set and of other radio equipment with which the sets can communicate are indicated in the frequency spectrum chart (fig. 2). As listed on the chart, the frequency coverage of each radio set includes two bands. One band is covered by a Set 1 receiver-transmitter (Receiver-Transmitter RT-66/GRC, RT-67/GRC, or RT-68/GRC); the other band is covered by the Set 2 receiver-transmitter (Receiver-Transmitter RT-70/GRC). In Radio Sets AN/GRC-3, -5, and -7 the coverage of the Set 1 receiver-transmitter is duplicated by auxiliary receivers, Radio Receiver R-108/GRC, R-109/GRC, and R-110/GRC, respectively.

b. The radio sets can be installed and operated in trucks, personnel carriers, tanks, armored utility vehicles, weapons carriers, and other authorized vehicles (par. 8). They are designed primarily for short-range operation within and between armored, artillery, and infantry units. Specifically, Radio Sets AN/GRC-3 and -4 are intended for armored use; Radio Sets AN/GRC-5 and -6 are for the artillery; and Radio Sets AN/GRC-7 and -8 are for the infantry. Liaison between divisions is provided by Receiver-

Transmitter RT-70/GRC (Set 2), which is common to all the radio sets.

5. Technical Characteristics

Type of transmission Voice and 1,600-cycle f-m signals, and reception.

Frequency range----- 20 to 54.9 mc in the following bands:

Radio Set	Set 1	Set 2	Auxiliary Receiver
AN/GRC-3	20 to 27.9 mc.	47 to 58.4 mc.	20 to 27.9 mc.
AN/GRC-4	20 to 27.9 mc.	47 to 58.4 mc.	Not used.
AN/GRC-5	27 to 38.9 mc.	47 to 58.4 mc.	27 to 38.9 mc.
AN/GRC-6	27 to 38.9 mc.	47 to 58.4 mc.	Not used.
AN/GRC-7	38 to 54.9 mc.	47 to 58.4 mc.	38 to 54.9 mc.
AN/GRC-8	38 to 54.9 mc.	47 to 58.4 mc.	Not used.

Operational facilities:

- Monitoring.
- Push-to-talk operation from local or remote control stations.
- Interphone facilities.
- Automatic retransmission of received signals.
- Full-duplex radio operation.
- Full-duplex telephone circuit between local and remote control units.
- Remote (as well as local) control of power.

Type of tuning:

- Set 1----- Choice of detented channels (80, 120, and 170 for Receiver-Transmitters RT-66/GRC, RT-67/GRC, and RT-68/GRC, respectively) at every 100 kc (kilocycles) of the tuning range; provision is made for presetting any two of the detented channels.

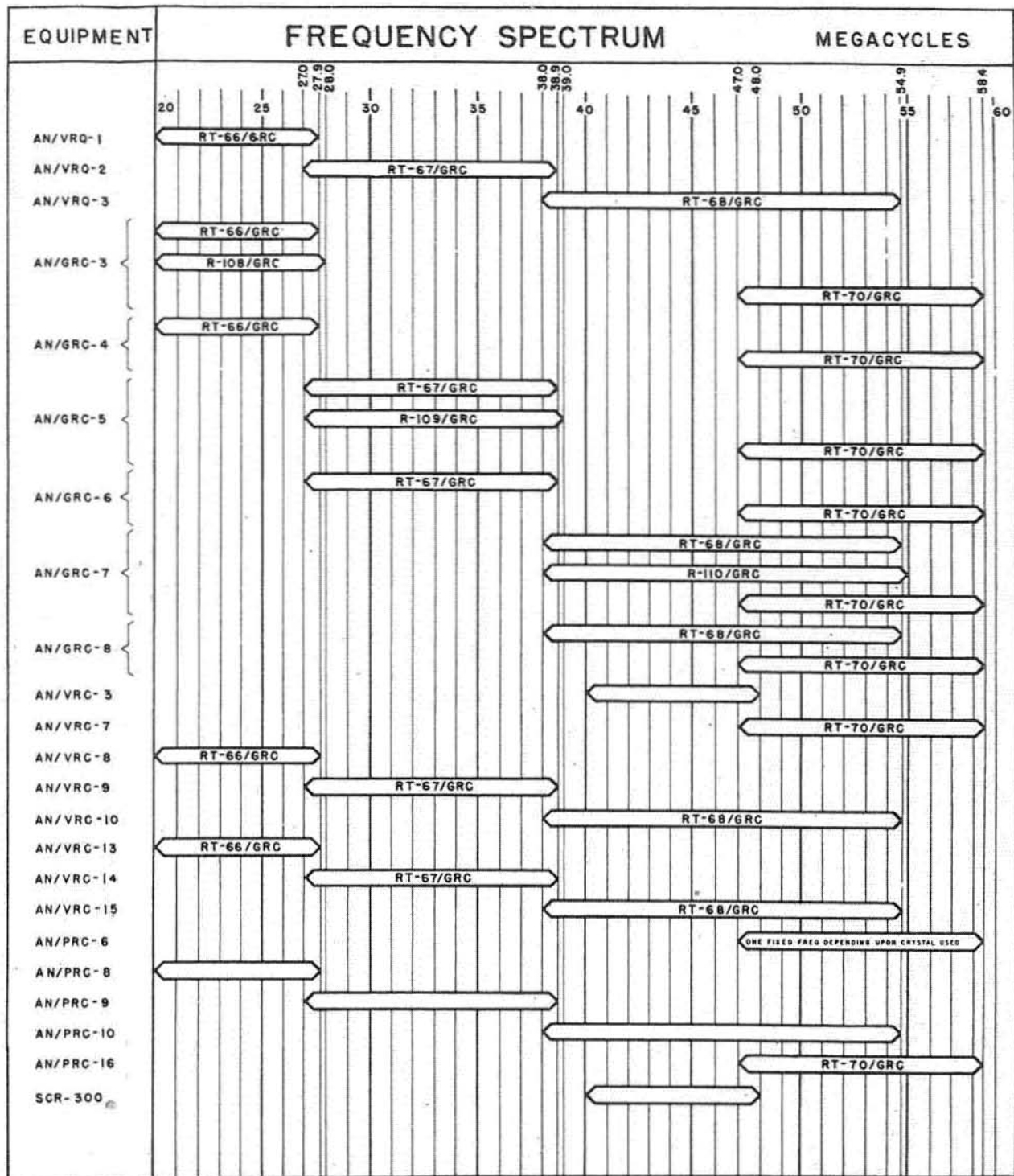


Figure 2. Frequency spectrum chart.

TM 289-2

Type of tuning—Continued

Set 2-----	Continuous tuning with detent provisions for preselection of any two frequencies.
Auxiliary receiver---	Continuous tuning with detent provisions for preselection of any three frequencies.
Communication range.	Approximately 10 miles on Set 1; approximately 1 mile on Set 2.
Total power drain---	From 110 to 280 watts depending upon mode of operation; power drains for individual units as follows:

Unit	Input voltage	Input amperage	
		Stand-by	Transmission
Set 1-----	12.6	2.3	11.9
	25.2	1.5	7.3
Set 2+-----	12.6	4.1	4.3
Interphone-----	25.2	2.3	2.5
Interphone-----	12.6	2.6	3.2
Amplifier-----	25.2	1.4	1.8
Auxiliary-----	12.6	2.5	
Receiver-----	25.2	1.5	

Transmitter r-f (radio-frequency) power output:

Set 1-----	9 to 16 watts on HIGH power; 1 to 2 watts on LOW power.
Set 2-----	Approximately 500 mw (milliwatts).

Receiver a-f (audio-frequency) power output:

Set 1-----	Approximately 1 watt and 50 mw at speaker and phone output terminals respectively; approximately 30 mw at fixed-level (retransmission) output terminals.
------------	--

Receiver a-f (audio-frequency) power output—Continued

Set 2-----	Approximately 75 mw.
Auxiliary receiver---	Approximately 1 watt and 50 mw at speaker and phone output terminals respectively; approximately 30 mw at fixed-level (retransmission) output terminals.

Interphone a-f power output:

Set 1+ Interphone--	350 mw.
Set 1+ Set 2+ Interphone.	1,800 mw.

Set 2+ Interphone--	350 mw.
Microphone input impedance.	150 ohms.

Audio output impedance.	150 ohms at set 1+ Set 2+ Interphone output of interphone amplifier; 600 ohms at all other audio output terminals.
-------------------------	--

Receiver bandwidth---	Approximately 80 kc, 6 db (decibel) down.
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Receiver sensitivity:

Set 1-----	30-db signal-plus-noise to noise ratio with 1/4-uv (microvolt) input signal.
Set 2-----	30-db signal-plus-noise to noise ratio with 1/4-uv input signal.
Auxiliary receiver---	30-db signal-plus-noise to noise ratio with 1/4-uv input signal.

6. Table of Components

A composite table of components for all the radio sets is presented below. All dimensions and weights are approximate. The table includes components of the basic sets only. For installation and operation in particular vehicles, the additional equipment listed in paragraph 8 is also required.

Component	Radio Sets						Dimensions of components				
	Radio Set AN/GRC-3	Radio Set AN/GRC-4	Radio Set AN/GRC-5	Radio Set AN/GRC-6	Radio Set AN/GRC-7	Radio Set AN/GRC-8	Height (in.)	Depth (in.)	Length (in.)	Volume (cu ft)	Unit weight (lb)
Receiver-Transmitter RT-66/GRC	1	1					9	13	11¼	0.76	35
Receiver-Transmitter RT-67/GRC			1	1			9	13	11¼	.76	35
Receiver-Transmitter RT-68/GRC					1	1	9	13	11¼	.76	35
Receiver-Transmitter RT-70/GRC	1	1	1	1	1	1	4¾	13	7¾	.31	25
Radio Receiver R-108/GRC	1						9	13	7¾	.50	35
Radio Receiver R-109/GRC			1				9	13	7¾	.50	35
Radio Receiver R-110/GRC					1		9	13	7¾	.50	35
AF Amplifier AM-65/GRC	1	1	1	1	1	1	4¼	13	7¾	.30	15.5
Power Supply PP-281/GRC or PP-282/GRC	2	2	2	2	2	2	4¼	6	3	.04	6
Power Supply PP-109/GR or PP-112/GR	1	1	1	1	1	1	8	13	9	.54	35
Control Box C-375/VRC	1	1	1	1	1	1	8	4	7	.1	3.5
Control Group AN/GRA-6	1	1	1	1	1	1	9	3	10	.15	12
Control C-435/GRC	1	1	1	1	1	1	3½	10½	8¾	.18	12
Mounting MT-297/GR	1	1	1	1	1	1	5	12	34	1.06	50
Adapter UG-273/U	2	2	2	2	2	2				.006	.34
Adapter UG-306/U	2	2	2	2	2	2	7/16	1	1	.006	.36
Bag CW-206/GR	1	1	1	1	1	1	(diam) 3 (thk)	5 wd	40	.34	3.5
Special Purpose Cable WM-46/U	1	1	1	1	1	1	.6		120	.4	9
RF, Cable Assembly CG-568/U	1	1					(diam)		50	.01	.5
RF, Cable Assembly CG-530/U	1	1	2	2	2	2			50	.01	.5
Special Purpose Cable Assembly CX-1211/U	1	1	1	1	1	1				.25	.4
Special Purpose Cable Assembly CX-1213/U	1	1	1	1	1	1				.25	.4
Case CY-684/GR	1	1	1	1	1	1				.17	3
Connector and bondnut, Appletone Electrical Company No. 61007 and B1-50, or equal	1	1	1	1	1	1				.01	.5
Mast Section MS-116-A	2	2	2	2					39.5	.046	1.6
Mast Section MS-117-A	2	2	2	2	2	2			39.5	.042	1.4
Mast Section MS-118-A	2	2	2	2					39.5	.016	.5
Mast Section AB-22/GR	2	2	2	2	2	2			23.5	.04	1.36
Mast Section AB-24/GR	2	2	2	2	4	4			23.5	.005	.13
Mast Base AB-15/GR	2	2	2	2	2	2					
Wire W-142	1		1		1				12	.001	.043
Technical Manual (TM 11-284)	2	2	2	2	2	2				.08	1

7. Packaging Data

The basic components of each of the radio sets (par. 6) are packed for shipment in four wooden boxes. The components are first individually packaged in moisture-vaporproof containers and then distributed in the four wooden boxes. Weights and volumes of the four over-all containers are listed in *a* below; the contents of each box are listed in *b*, *c*, and *d* below.

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

a. WEIGHT AND VOLUME OF BOXES.

Box No.	Weight (lbs)	Volume (cu ft)
1	100	2
2	90	1.70
3	131	4.1
4	120	2.68
Total	441	10.48

b. CONTENTS OF BOXES FOR RADIO SETS AN/GRC-3 AND -4. Boxes No. 1 and 4 are the same for Radio Sets AN/GRC-3 and -4. Boxes No. 2 and 3 are the same except for the two differences noted.

Box No.	Item	Quantity	Notes
1	Receiver-Transmitter RT-66/GRC	1 ea	PP-109/GR supplied for 12-volt systems; PP-112/GR supplied for 24-volt systems.
	Power Supply PP-109/GR or Power Supply PP-112/GR	1 ea	
2	Receiver-Transmitter RT-70/GRC	1 ea	R-108/GRC supplied only with AN/GRC-3.
	Radio Receiver R-108/GRC	1 ea	
	AF Amplifier AM-65/GRC	1 ea	Wire W-142 supplied only with AN/GRC-3.
3	Wire W-142	1 ft	
	Mast Base AB-15/GR	2 ea	
	Mast Section MS-116-A	2 ea	
	Mast Section MS-117-A	2 ea	
	Mast Section MS-118-A	2 ea	
	Mast Section AB-22/GR	2 ea	
	Mast Section AB-24/GR	2 ea	
	Control Group AN/GRA-6	1 ea	
	Adapter UG-273/U	2 ea	
	Adapter UG-306/U	2 ea	
	Special Purpose Cable Assembly CX-1211/U	1 ea	
	Special Purpose Cable Assembly CX-1213/U	1 ea	
	Bag CW-206/GR	1 ea	
	Case CY-684/GR	1 ea	
	Power Supply PP-281/GRC or Power Supply PP-282/GRC	2 ea	
	Technical Manual TM 11-284	2 ea	
4	Special Purpose Cable WM-46/U	10 ft	
	Control Box C-375/VRC	1 ea	
	Control C-435/GRC	1 ea	
	Mounting MT-297/GRC	1 ea	
	RF Cable Assembly CG-530/U	1 ea	
	RF Cable Assembly CG-568/U	1 ea	
	Connector and bondnut, Appleton Electrical Company No. 61007 and BL-50, or equal.	1 ea	

c. CONTENTS OF BOXES FOR RADIO SETS AN/GRC-5 AND -6. Boxes No. 1 and 4 are the same for Radio Sets AN/GRC-5 and -6. Boxes

No. 2 and 3 are the same except for the two differences noted.

Box No.	Item	Quantity	Notes
1	Receiver-Transmitter RT-67/GRC-----	1 ea	PP-109/GR supplied for 12-volt systems; PP-112/GR supplied for 24-volt systems.
	Power Supply PP-109/GR or Power Supply PP-112/ GR.	1 ea	
2	Receiver-Transmitter RT-70/GRC-----	1 ea	R-109/GRC supplied only with AN/GRC-5.
	Radio Receiver R-109/GRC-----	1 ea	
	AF Amplifier AM-65/GRC-----	1 ea	Wire W-142 supplied only with AN/GRC-5.
3	Wire W-142-----	1 ft	
	Mast Base AB-15/GR-----	2 ea	
	Mast Section MS-116-A-----	2 ea	
	Mast Section MS-117-A-----	2 ea	
	Mast Section MS-118-A-----	2 ea	
	Mast Section AB-22/GR-----	2 ea	
	Mast Section AB-24/GR-----	2 ea	
	Control Group AN/GRA-6-----	1 ea	
	Adapter UG-273/U-----	2 ea	
	Adapter UG-306/U-----	2 ea	
	Special Purpose Cable Assembly CX-1211/U-----	1 ea	
	Special Purpose Cable Assembly CX-1213/U-----	1 ea	
	Bag CW-206/GR-----	1 ea	
	Case CY-684/GR-----	1 ea	
	Power Supply PP-281/GRC or Power Supply PP-282/GRC.	2 ea	
	Technical Manual TM 11-284-----	2 ea	
4	Special Purpose Cable WM-46/U-----	10 ft	
	Control Box C-375/VRC-----	1 ea	
	Control C-435/GRC-----	1 ea	
	Mounting MT-297/GR-----	1 ea	
	RF Cable Assembly CG-530/U-----	2 ea	
	Connector and bondnut, Appleton Electrical Company No. 61007 and BL-50, or equal.	1 ea	

d. CONTENTS OF BOXES FOR RADIO SETS AN/GRC-7 AND -8. Boxes No. 1 and 4 are the same for Radio Sets AN/GRC-7 and -8. Boxes

No. 2 and 3 are the same except for the two differences noted.

Box No.	Item	Quantity	Notes
1	Receiver-Transmitter RT-68/GRC.....	1 ea	PP-109/GR supplied for 12-volt systems; PP-112/GR supplied for 24-volt systems.
	Power Supply PP-109/GR or Power Supply PP-112/GR.....	1 ea	
2	Receiver-Transmitter RT-70/GRC.....	1 ea	R-110/GRC supplied only with AN/GRC-7.
	Radio Receiver R-110/GRC.....	1 ea	
	AF Amplifier AM-65/GRC.....	1 ea	Wire W-142 supplied only with AN/GRC-7.
3	Wire W-142.....	1 ft	
	Mast Base AB-15/GR.....	2 ea	
	Mast Section MS-117-A.....	2 ea	
	Mast Section AB-22/GR.....	2 ea	
	Mast Section AB-24/GR.....	4 ea	
	Control Group AN/GRA-6.....	1 ea	
	Adapter UG-273/U.....	2 ea	
	Adapter UG-306/U.....	2 ea	
	Special Purpose Cable Assembly CX-1211.....	1 ea	
	Special Purpose Cable Assembly CX-1213.....	1 ea	
	Bag CW-206/GR.....	1 ea	
	Case CY-684/GR.....	1 ea	
	Power Supply PP-281/GRC or Power Supply PP-282/GRC.....	2 ea	
	Technical Manual TM 11-284.....	2 ea	
4	Special Purpose Cable WM-46/U.....	10 ft	
	Control Box C-375/VRC.....	1 ea	
	Control C-435/GRC.....	1 ea	
	Mounting MT-297/GR.....	1 ea	
	RF Cable Assembly CG-530/U.....	2 ea	
	Connector and bondnut, Appleton Electrical Company No. 61007 and BL-50, or equal.	1 ea	

8. Additional Equipment Required

a. To install and operate any of the radio sets, both a basic unit (par. 6) and an installation unit are required. The basic unit is common to all installations; the installation unit varies with the type of vehicle for which the installation is intended. Such items as audio accessories, cable lengths, junction boxes, and mounting hardware vary from vehicle to vehicle. For this reason, a separate installation unit is supplied (or must be requisitioned) for each vehicular installation.

b. The audio accessories for the radio sets (any of which may be supplied depending upon the

installation) are described in paragraph 21. The remaining contents of the installation units are not listed in detail but a table (table I) is included to indicate the particular unit (by stock number) which is required for any particular vehicular installation.

c. In addition to the equipment included in basic units and installation units the following dry-cells are required (par. 45).

- (1) Four 1½-volt batteries, type BA-30.
- (2) One 45-volt battery, type BA-414/U.

Table I. Vehicular installation units

Radio set	Type of vehicle	Stock No.		
		Complete equipment	Basic unit	Installation unit
AN/GRC-3	Medium Tank M4 Series 76 mm Wet	2S12-3-V8.2	2S12-3/24	2S12-3-V8.2/5
AN/GRC-3	Medium Tank M4 Series 105 mm and 75 mm Wet	2S12-3-V8.3	2S12-3/24	2S12-3-V8.3/5
AN/GRC-3	Light Armored Car M8	2S12-3-V17	2S12-3/12	2S12-3-V17/50
AN/GRC-3	Truck ¼ Ton 4 x 4 (12 volt)	2S12-3-V26	2S12-3/12	2S12-3-V26/50
AN/GRC-3	Truck ¾ Ton 4 x 4 Weapon Carrier	2S12-3-V36	2S12-3/12	2S12-3-V36/50
AN/GRC-3	Truck 2½ Ton 6 x 6 Cargo M34, M35, M36 (24 volt).	2S12-3-V56	2S12-3/24	2S12-3-V56/50
AN/GRC-3	Car Armored Utility M20	2S12-3-V63	2S12-3/12	2S12-3-V63/50
AN/GRC-3	Half-track Personnel Carrier M3A1	2S12-3-V68	2S12-3/12	2S12-3-V68/50
AN/GRC-3	Carrier Mortar 81 mm, M21	2S12-3-V71	2S12-3/12	2S12-3-V71/50
AN/GRC-3	Truck ¾ Ton 4 x 4 Cargo M37 (24-volt)	2S12-3-V74	2S12-3/24	2S12-3-V74/50
	Truck ¾ Ton 4 x 4 Weapons Carrier M42 (24 volt).			
AN/GRC-3	Truck ¼ Ton 4 x 4 Utility M38 (24-volt)	2S12-3-V76	2S12-3/24	2S12-3-V76/50
AN/GRC-3	Vehicle Tank Recovery M32	2S12-3-V79	2S12-3/24	2S12-3-V79/50
AN/GRC-3	Light Tank M24	2S12-3-V85	2S12-3/24	2S12-3-V85/50
AN/GRC-3	Vehicle Armored Utility M39	2S12-3-V91	2S12-3/24	2S12-3-V91/50
AN/GRC-3	Medium Tank M26 or M45	2S12-3-V93	2S12-3/24	2S12-3-V93/50
AN/GRC-4	Medium Tank, M44 Series 76 mm Wet	2S12-4-V8.2	2S12-4/24	2S12-3-V8.2/5
AN/GRC-4	Medium Tank, M4 Series 105 mm and 75 mm Wet	2S12-4-V8.3	2S12-4/24	2S12-3-V8.3/5
AN/GRC-4	Light Armored Car M8	2S12-4-V17	2S12-4/12	2S12-3-V17/50
AN/GRC-4	Truck ¼ Ton 4 x 4 (12-volt)	2S12-4-V26	2S12-4/12	2S12-3-V26/50
AN/GRC-4	Truck ¾ Ton 4 x 4 Weapons Carrier	2S12-4-V36	2S12-4/12	2S12-3-V36/50
AN/GRC-4	Truck 2½ Ton 6 x 6 Cargo M34, M35, M36 (24-volt).	2S12-4-V56	2S12-4/24	2S12-3-V56/50
AN/GRC-4	Car Armored Utility M20	2S12-4-V63	2S12-4/12	2S12-3-V63/50
AN/GRC-4	Half-track Personnel Carrier M3A1	2S12-4-V68	2S12-4/12	2S12-3-V68/50
AN/GRC-4	Carrier Mortar 81mm, M21	2S12-4-V71	2S12-4/12	2S12-3-V71/50
AN/GRC-4	Truck ¾ Ton 4 x 4 Cargo M37 (24-volt)	2S12-4-V74	2S12-4/24	2S12-3-V74/50
	Truck ¾ Ton 4 x 4 Weapons Carrier M42 (24-volt).			
AN/GRC-4	Truck ¼ Ton 4 x 4 Utility M38 (24-volt)	2S12-4-V76	2S12-4/24	2S12-3-V76/50
AN/GRC-4	Vehicle Tank Recovery M32	2S12-4-V79	2S12-4/24	2S12-3-V79/50
AN/GRC-4	Light Tank M24	2S12-4-V85	2S12-4/24	2S12-3-V85/50
AN/GRC-4	Vehicle Armored Utility M39	2S12-4-V91	2S12-4/24	2S12-3-V91/50
AN/GRC-4	Medium Tank M26 or M45	2S12-4-V93	2S12-4/24	2S12-3-V93/50
AN/GRC-5	Medium Tank, M4 Series 76-mm Wet	2S12-5-V8.2	2S12-5/24	2S12-3-V8.2/5
AN/GRC-5	Medium Tank, M4 Series 105 mm and 75 mm Wet	2S12-5-V8.3	2S12-5/24	2S12-3-V8.3/5
AN/GRC-5	Light Armored Car M8	2S12-5-V17	2S12-5/12	2S12-3-V17/50
AN/GRC-5	Truck Ton ¼4 x 4 (12-volt)	2S12-5-V26	2S12-5/12	2S12-3-V26/50
AN/GRC-5	Truck ¾ Ton 4 x 4 Weapon Carrier	2S12-5-V36	2S12-5/12	2S12-3-V36/50
AN/GRC-5	Truck 2½ Ton 6 x 6 Cargo M34, M35, M36 (24-volt).	2S12-5-V56	2S12-5/24	2S12-3-V56/50
AN/GRC-5	Car Armored Utility M20	2S12-5-V63	2S12-5/12	2S12-3-V63/50
AN/GRC-5	Half-track Personnel Carrier M3A1	2S12-5-V68	2S12-5/12	2S12-3-V68/50
AN/GRC-5	Carrier Mortar 81mm, M21	2S12-5-V71	2S12-5/12	2S12-3-V71/50
AN/GRC-5	Truck ¾ Ton 4 x 4 Cargo M37 (24-volt)	2S12-5-V74	2S12-5/24	2S12-3-V74/50
	Truck ¾ Ton 4 x 4 Weapons Carrier M42 (24-volt).			
AN/GRC-5	Truck ¼ Ton 4 x 4 Utility M38 (24-volt)	2S12-5-V76	2S12-5/24	2S12-3-V76/50
AN/GRC-5	Vehicle Tank Recovery M32	2S12-5-V79	2S12-5/24	2S12-3-V79/50
AN/GRC-5	Light Tank M24	2S12-5-V85	2S12-5/24	2S12-3-V85/50
AN/GRC-5	Vehicle Armored Utility M39	2S12-5-V91	2S12-5/24	2S12-3-V91/50
AN/GRC-5	Medium Tank M26 or M45	2S12-5-V93	2S12-5/24	2S12-3-V93/50
AN/GRC-6	Medium Tank, M4 Series 76 mm Wet	2S12-6-V8.2	2S12-6/24	2S12-3-V8.2/5
AN/GRC-6	Medium Tank, M4 Series 105 mm and 75 mm Wet	2S12-6-V8.3	2S12-6/24	2S12-3-V8.3/5
AN/GRC-6	Light Armored Car M8	2S12-6-V17	2S12-6/12	2S12-3-V17/50

Table I. Vehicular installation units—Continued

Radio set	Type of vehicle	Stock No.		
		Complete equipment	Basic unit	Installation unit
AN/GRC-6	Truck $\frac{1}{4}$ Ton 4 x 4 (12-volts).....	2S12-6-V26	2S12-6/12	2S12-3-V26/50
AN/GRC-6	Truck $\frac{3}{4}$ Ton 4 x 4 Weapons Carrier.....	2S12-6-V36	2S12-6/12	2S12-3-V36/50
AN/GRC-6	Truck $2\frac{1}{2}$ Ton 6 x 6 Cargo M34, M35, M36 (24-volt).....	2S12-6-V56	2S12-6/24	2S12-3-V56/50
AN/GRC-6	Car Armored Utility M20.....	2S12-6-V63	2S12-6/12	2S12-3-V63/50
AN/GRC-6	Half-track Personnel Carrier M3A1.....	2S12-6-V68	2S12-6/12	2S12-3-V68/50
AN/GRC-6	Carrier Mortar 81 mm M21.....	2S12-6-V71	2S12-6/12	2S12-3-V71/50
AN/GRC-6	Truck $\frac{3}{4}$ Ton 4 x 4 Cargo M37 (24-volt).....	2S12-6-V74	2S12-6/24	2S12-3-V74/50
	Truck $\frac{3}{4}$ Ton 4 x 4 Weapons Carrier M42 (24-volt).....			
	Truck $\frac{3}{4}$ Ton 4 x 4 Utility M38 (24-volt).....	2S12-6-V76	2S12-6/24	2S12-3-V76/50
AN/GRC-6	Vehicle Tank Recovery M32.....	2S12-6-V79	2S12-6/24	2S12-3-V79/50
AN/GRC-6	Light Tank M24.....	2S12-6-V85	2S12-6/24	2S12-3-V85/50
AN/GRC-6	Vehicle Armored Utility M39.....	2S12-6-V91	2S12-6/24	2S12-3-C91/50
AN/GRC-6	Medium Tank, M26 or M45.....	2S12-6-V93	2S12-6/24	2S12-3-V93/50
AN/GRC-7	Medium Tank, M4 Series 76 mm Wet.....	2S12-7-V8.2	2S12-7/24	2S12-3-V8.2/5
AN/GRC-7	Medium Tank, M4 Series 105 mm and 75 mm Wet.....	2S12-7-V8.3	2S12-7/24	2S12-3-V8.3/5
AN/GRC-7	Light Armored Car M8.....	2S12-7-V17	2S12-7/12	2S12-3-V17/50
AN/GRC-7	Truck $\frac{1}{4}$ Ton 4 x 4 (12-volt).....	2S12-7-V26	2S12-7/12	2S12-3-V26/50
AN/GRC-7	Truck $\frac{3}{4}$ Ton 4 x 4 Weapon Carrier.....	2S12-7-V36	2S12-7/12	2S12-3-V36/50
AN/GRC-7	Truck $2\frac{1}{2}$ Ton 6 x 6 Cargo M34, M35, M36 (24-volt).....	2S12-7-V56	2S12-7/24	2S12-3-V56/50
AN/GRC-7	Car Armored Utility M20.....	2S12-7-V63	2S12-7/12	2S12-3-V63/50
AN/GRC-7	Half-track Personnel Carrier M3A1.....	2S12-7-V68	2S12-7/12	2S12-3-V68/50
AN/GRC-7	Carrier Mortar 81 mm M21.....	2S12-7-V71	2S12-7/12	2S12-3-V71/50
AN/GRC-7	Truck $\frac{3}{4}$ Ton 4 x 4 Cargo M37 (24-volt).....	2S12-7-V74	2S12-7/24	2S12-3-V74/50
	Truck $\frac{3}{4}$ Ton 4 x 4 Weapons Carrier M42 (24-volt).....			
AN/GRC-7	Truck $\frac{3}{4}$ Ton 4 x 4 Utility M38 (24-volt).....	2S12-7-V76	2S12-7/24	2S12-3-V76/50
AN/GRC-7	Vehicle Tank Recovery M32.....	2S12-7-V79	2S12-7/24	2S12-3-V79/50
AN/GRC-7	Light Tank M24.....	2S12-7-V85	2S12-7/24	2S12-3-V85/50
AN/GRC-7	Vehicle Armored Utility M39.....	2S12-7-V91	2S12-7/24	2S12-3-V91/50
AN/GRC-7	Medium Tank, M26 or M45.....	2S12-7-V93	2S12-7/24	2S12-3-V93/50
AN/GRC-8	Medium Tank, M4 Series 76 mm Wet.....	2S12-8-V8.2	2S12-8/24	2S12-3-V8.2/5
AN/GRC-8	Medium Tank, M4 Series 105 mm and 75 mm Wet.....	2S12-8-V8.3	2S12-8/24	2S12-3-V8.3/5
AN/GRC-8	Light Armored Car M8.....	2S12-8-V17	2S12-8/12	2S12-3-V17/50
AN/GRC-8	Truck $\frac{1}{4}$ Ton 4 x 4 (12-volt).....	2S12-8-V26	2S12-8/12	2S12-3-V26/50
AN/GRC-8	Truck $\frac{3}{4}$ Ton 4 x 4 Weapon Carrier.....	2S12-8-V36	2S12-8/12	2S12-3-V36/50
AN/GRC-8	Truck $2\frac{1}{2}$ Ton 6 x 6 Cargo M34, M35, M366 (24-volt).....	2S12-8-V56	2S12-8/24	2S12-3-V56/50
AN/GRC-8	Car Armored Utility M20.....	2S12-8-V63	2S12-8/12	2S12-3-V63/50
AN/GRC-8	Half-track Personnel Carrier M3A1.....	2S12-8-V68	2S12-8/12	2S12-3-V68/50
AN/GRC-8	Carrier Mortar 81 mm M21.....	2S12-8-V71	2S12-8/12	2S12-3-V71/50
AN/GRC-8	Truck $\frac{3}{4}$ Ton 4 x 4 Cargo M37 (24-volt).....	2S12-8-V74	2S12-8/24	2S12-3-V74/50
	Truck $\frac{3}{4}$ Ton 4 x 4 Weapons Carrier M42 (24-volt).....			
AN/GRC-8	Truck $\frac{3}{4}$ Ton 4 x 4 Utility M38 (24-volt).....	2S12-8-V76	2S12-8/24	2S12-3-V76/50
AN/GRC-8	Vehicle Tank Recovery M32.....	2S12-8-V79	2S12-8/24	2S12-3-V79/50
AN/GRC-8	Light Tank M24.....	2S12-8-V85	2S12-8/24	2S12-3-V85/50
AN/GRC-8	Vehicle Armored Utility M39.....	2S12-8-V91	2S12-8/24	2S12-3-V91/50
AN/GRC-8	Medium Tank M26 or M45.....	2S12-8-V93	2S12-8/24	2S12-3-V93/50

9. General System Description

a. INTRODUCTION. Radio Sets AN/GRC-3 and -4 (figs. 1 and 3) are typical of all the sets discussed in this manual. The nomenclature outlined in paragraph 2 and the table of components (par. 6) will facilitate adaptation of the following general description to a particular radio set. The system cordage diagram (fig. 29), which is essentially a composite illustration of all sets, is also helpful in the understanding of the various systems.

b. COMMON COMPONENTS. All of the basic radio sets have the following items in common:

- (1) Two receiver-transmitters, an interphone amplifier, and suitable power supplies.
- (2) A mounting.
- (3) Four control units.
- (4) Suitable antenna systems and interconnecting cables.

c. AUXILIARY RECEIVER. In addition to the above items, three of the radio sets (Radio Sets AN/GRC-3, -5, and -7) have an auxiliary receiver.

d. RADIO SET AN/GRC-4. Figure 3 shows the major components of Radio Set AN/GRC-4 connected to simulate an operating installation. Receiver-Transmitter RT-66/GRC is utilized as Set 1; Power Supply PP-112/GR furnishes operating voltages for Set 1; Receiver-Transmitter RT-70/GRC is Set 2; and AF Amplifier AM-65/GRC is the interphone amplifier. Operating voltages for Set 2 and the amplifier are furnished by a plug-in power supply unit (Power Supply PP-282/GRC) contained within the amplifier. All of the above mentioned units are secured on Mounting MT-297/GR which is normally bolted to a vehicular mounting surface. The mounting also accommodates one of the control units (either Local Control C-434/GRC, pictured, or Control C-435/GRC) as a plug-in unit. From the mounting, connections are made to the vehicular battery, to the major units supported on the mounting, and to one or more Control Boxes C-375/VRC. When the local control unit is plugged into the mounting as shown, connection is made to Remote Control C-433/GRC by telephone wire. Connections to the antenna systems are made directly from the panels of the Set 1 and Set 2 receiver-transmitters (fig. 29).

e. 12-VOLT SYSTEM. The system described above is applicable to vehicles which have a 24-volt storage battery. To adapt the system for 12-volt operation, Power Supplies PP-109/GR and PP-281/GRC must be substituted for Power Supplies PP-112/GR and PP-282/GRC, respectively. Either installation constitutes a basic AN/GRC-4.

f. RADIO SETS AN/GRC-6 AND -8. If Receiver-Transmitter RT-67/GRC or RT-68/GRC is used as Set 1 and the antenna system for Set 1 is changed as indicated in figure 29, the basic installation becomes Radio Set AN/GRC-6 or Radio Set AN/GRC-8, respectively.

g. RADIO SETS AN/GRC-5 AND -7. If Radio Receiver R-108/GRC is added to the basic system (*d* and *e* above, and fig. 3), the installation becomes Radio Set AN/GRC-3 (fig. 1). (Control C-435/GRC is shown plugged into the mounting in figure 1, in place of the local control unit.) Substitution of Radio Receiver R-109/GRC or R-110/GRC for Radio Receiver R-108/GRC (along with the Set 1 and antenna substitutions of *f* above) changes the system to Radio Set AN/GRC-5 or Radio Set AN/GRC-7, respectively.

h. SUMMARY. To summarize the similarities and differences among the various radio sets, the following classifications are suggested. Reference to the table of components (par. 6) and figure 29 will aid in either a comparative analysis or in a study of any one particular system.

- (1) Radio Sets AN/GRC-3 and -4 are the same except for the inclusion of an auxiliary receiver (R-108/GRC) in the former system.
- (2) Radio Sets AN/GRC-5 and -6, and Radio Sets AN/GRC-7 and -8 are similarly related; Radio Receiver R-109/GRC being the point of difference between the first two sets and Radio Receiver R-110/GRC being the point of difference between the latter two sets.

10. Set 1 Receiver-Transmitter

a. One of Receiver-Transmitters RT-66/GRC, RT-67/GRC, or RT-68/GRC is used as Set 1 in each of the radio sets described in this manual. The particular systems in which each of the

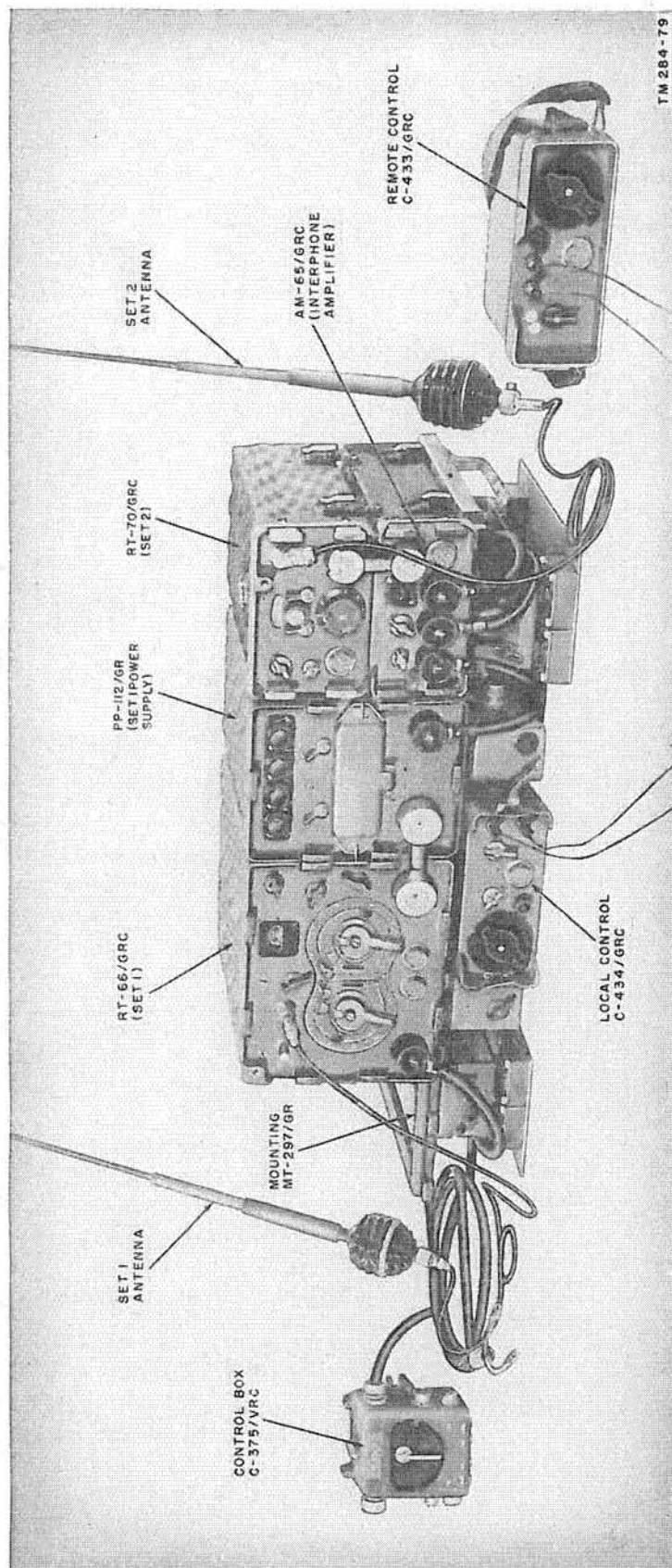


Figure 3. Radio Set AN/GRC-4.

receiver-transmitters are employed are indicated in the following chart.

Radio Sets	Set 1
AN/GRC-3 and -4	Receiver-Transmitter RT-66/GRC
AN/GRC-5 and -6	Receiver-Transmitter RT-67/GRC
AN/GRC-7 and -8	Receiver-Transmitter RT-68/GRC

b. The Set 1 receiver-transmitters are very similar in structure, function, and detailed circuit and mechanical arrangement; they differ from each other only in their operating frequency ranges and in those components which determine the frequency range. Hence Receiver-Transmitter RT-66/GRC (fig. 4) is externally similar to the other

receiver-transmitters except for the calibrations of the tuning dial. Characteristics pertinent to system operation are listed in paragraph 5; complete information on the receiver-transmitters is contained in a separate technical manual.

c. Each Set 1 consists of a double-conversion type, superheterodyne f-m receiver and f-m transmitter which use a common antenna. The tuning mechanism of each receiver-transmitter is detented at every 100 kc of its range to provide the channel selections indicated in the following chart.

Receiver-Transmitter	Frequency coverage	Number of channels
RT-66/GRC	20 to 27.9 mc	80
RT-67/GRC	27 to 38.9 mc	120
RT-68/GRC	38 to 54.9 mc	170

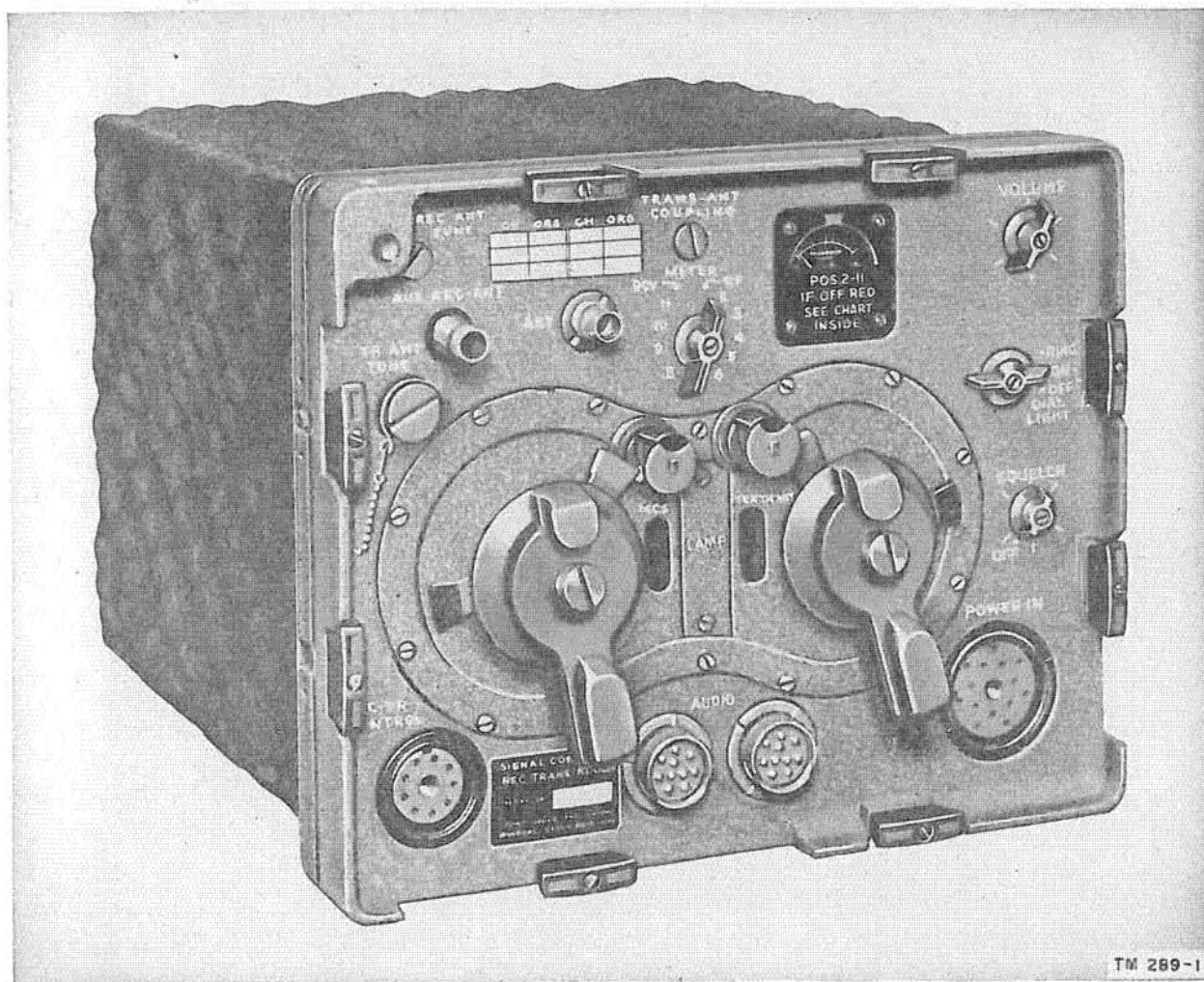


Figure 4. Receiver-transmitter RT-66/GRC.

In addition to the detent selections, any two of the channels may be preset (par. 68) to allow rapid selection, or the detent mechanism can be disengaged to allow continuous tuning.

d. Mechanically the receiver-transmitters are panel-chassis assemblies inclosed in a metal case (fig. 4). The bottom of the case is fitted with channel rails which are used to secure the unit to the vehicular mounting (par. 37). When the case is removed, the r-f and i-f chassis assemblies are available at either side of the unit (figs. 68, 69, and 70). All tubes are mounted on these vertical chassis.

e. In vehicular installations Set 1 is installed on Mounting MT-297/GR (fig. 3) and is powered by a vehicular power supply such as Power Supply PP-112/GR.

11. Set 1 Power Supply

a. Either Power Supply PP-109/GR or PP-112/GR is used to furnish operating voltages for Set 1, depending on whether the vehicular storage battery supplies 12 or 24 volts, respectively. The two units are externally similar (fig. 5) and differ internally only in those circuits necessary to convert the battery voltage to the proper operating

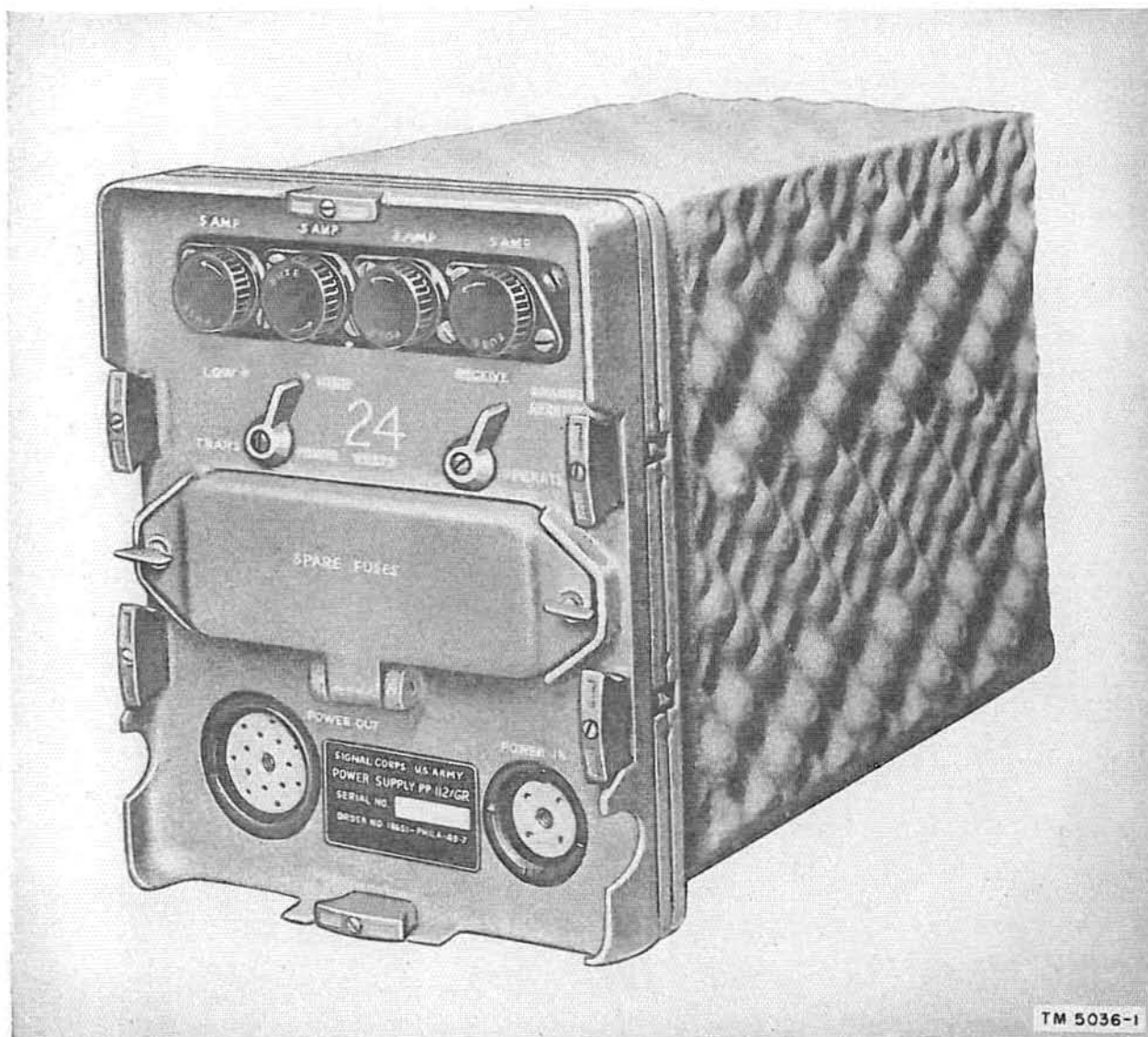


Figure 5. Power supply PP-112/GR, front view.

voltages for the receiver-transmitters. Detailed information on the power supplies is contained in a separate technical manual.

b. The power supplies develop plate, screen, bias, filament, and relay potentials for the receiver-transmitters. The plate, screen, and bias voltages are developed by vibrator type power-supply circuits. Input battery voltage is supplied through a POWER IN receptacle on the front panel (fig. 5) and all output voltages are available at the POWER OUT receptacle on the front panel.

c. Mechanically the power supply units are panel-chassis assemblies inclosed in a metal case. Channel rails on the bottom of the case permit the case to be installed on Mounting MT-297/GR. When the case is removed (figs. 65, 66, and 67), the replaceable parts on the chassis are accessible.

12. Set 2 Receiver-Transmitter

a. Receiver-Transmitter RT-70/GRC (fig. 6) is common to all the radio sets described in this manual and is arbitrarily designated as Set 2. A complete description is given in a separate technical manual. Characteristics pertinent to system operation are listed in paragraph 5.

b. Set 2 consists of a double-conversion type, superheterodyne f-m receiver and f-m transmitter which uses a common antenna circuit. Tuning is continuous over a range of 47 to 58.4 mc and a detent mechanism is provided for presetting any two frequencies (par. 69).

c. Mechanically the receiver-transmitter is a panel-chassis assembly contained in a metal case. Snap catches are provided on the case for mounting it on AF Amplifier AM-65/GRC (fig. 3). When the case is removed (figs. 62, 63, and 64) the r-f and i-f chassis assemblies are exposed. All tubes are mounted on these vertical chassis.

d. In vehicular installations Set 2 obtains its operating voltages from either Power Supply PP-281/GRC or Power Supply PP-282/GRC (12- or 24-volt operation, respectively) through AF Amplifier AM-65/GRC. The power supply plugs into the amplifier.

13. AF Amplifier AM-65/GRC

a. AF Amplifier AM-65/GRC (fig. 7) is a common component of all the radio sets described in this manual. Generally referred to as the interphone amplifier, this unit serves a dual



Figure 6. Receiver-transmitter RT-70/GRC.

purpose providing not only for intercommunication between control boxes but also for monitoring the receiver-transmitters. Detailed information on the amplifier is contained in a separate technical manual.

b. Electrically the interphone amplifier is a three-channel electronic mixer and a-f amplifier. The three channels provide a *Set 1 + interphone* output, a *Set 1 + Set 2 + Interphone* output, and a *Set 2 + Interphone* output. The interphone signal predominates on the *Set 1 + Set 2 + Interphone* channel; the signals from the receiver-transmitters are equal to the interphone signal on the other two channels.

c. Mechanically the interphone amplifier is a panel-chassis assembly inclosed in a metal case. Channel rails on the bottom of the case permit the unit to be installed on Mounting MT-297/GR; hooks on the case accommodate the snap catches of Receiver-Transmitter RT-70/GRC, which normally mounts on top of the amplifier in a vehicular installation (fig. 3). When the case is removed (fig. 60), all replaceable parts are accessible.

d. A compartment within the amplifier (fig. 60) accommodates a plug-in power supply unit (Power Supply PP-281/GRC or PP-282/GRC) for 12- and 24-volt operation, respectively, which supplies operating voltages for both the amplifier and the Set 2 receiver-transmitter. The voltages for Set 2 are made available at the RT-70 POWER receptacle on the front panel.

14. Auxiliary Receiver

a. Radio Receivers R-108/GRC, R-109/GRC, and R-110/GRC are used as auxiliary receivers in Radio Sets AN/GRC-3, -5, and -7, respectively. The receivers are very similar in structure, function, and detailed circuit and mechanical arrangement; they differ from each other only in their operating frequency ranges and in those components which determine the frequency range. Hence Radio Receiver R-108/GRC (fig. 8) is similar externally to the other receivers except for the calibrations of the tuning dial. Receiver characteristics pertinent to system operation are

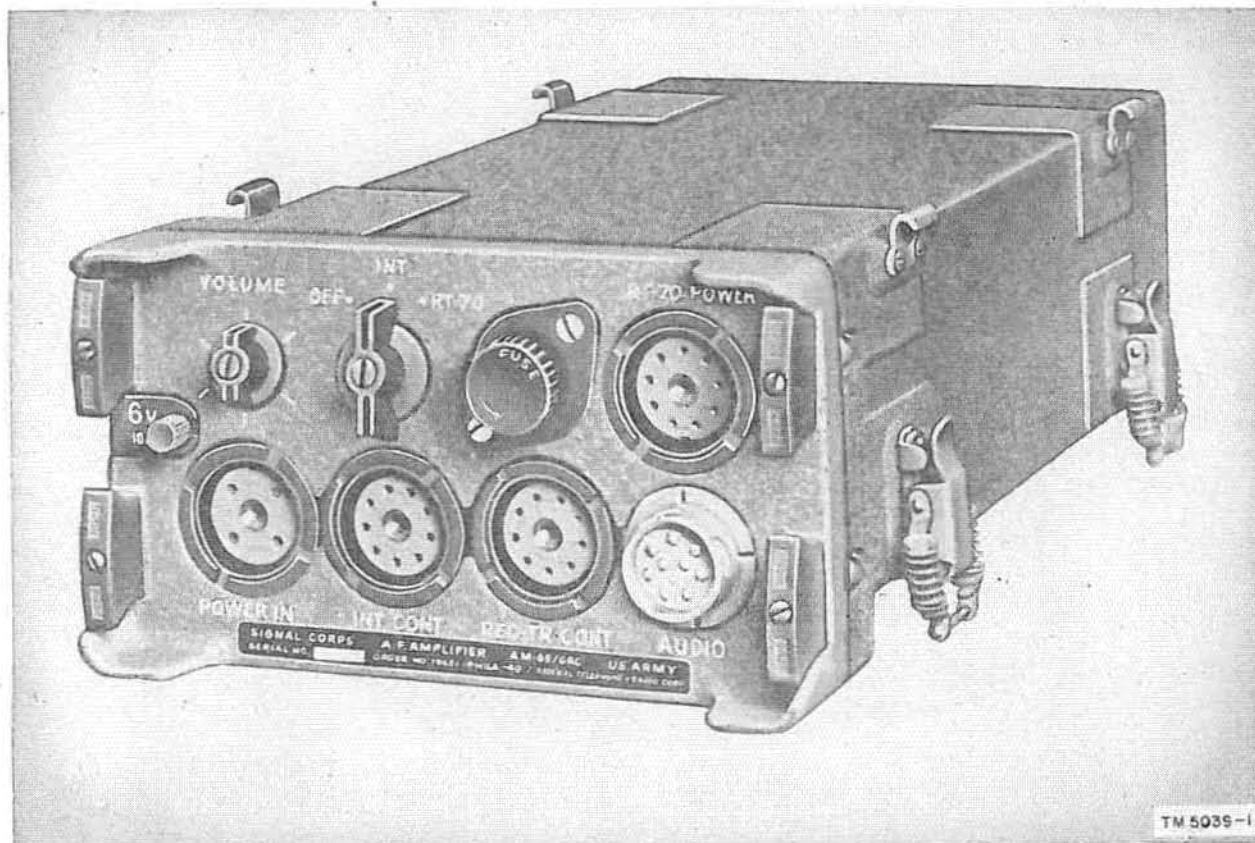


Figure 7. AF Amplifier AM-65/GRC.

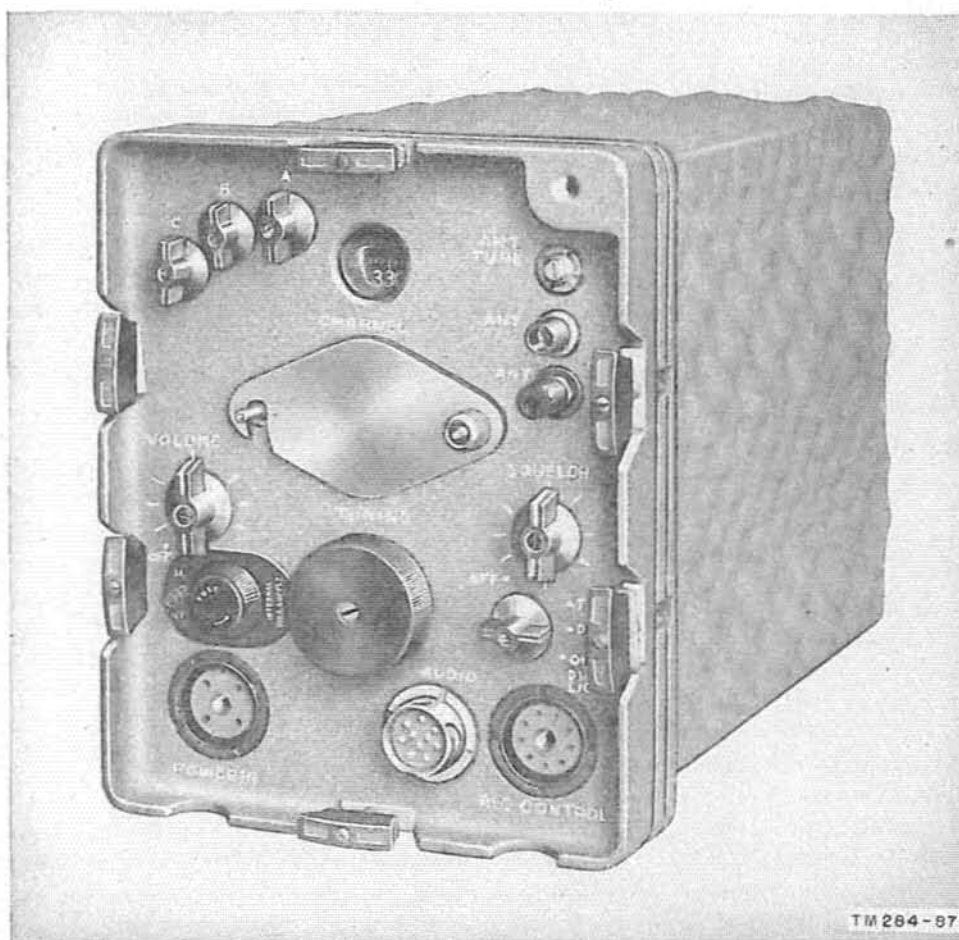


Figure 8. Radio Receiver R-108/GRC.

listed in paragraph 5; complete information on the receivers is contained in a separate technical manual.

b. Each receiver uses a single-conversion type, superheterodyne f-m circuit with continuous tuning over the ranges indicated in the following chart. A detent mechanism is provided on each receiver for presetting any three frequencies (par. 70).

Radio receiver	Frequency coverage
R-108/GRC.....	20 to 27.9 mc
R-109/GRC.....	27 to 38.9 mc
R-110/GRC.....	38 to 54.9 mc

It should be noted that the receivers duplicate the frequency coverage of the Set 1 receiver-transmitters with which they are commonly used.

c. Mechanically the receivers are panel-chassis assemblies inclosed in a metal case (fig. 8). The bottom of the case is fitted with channel rails which are used to secure the unit to the vehicular mounting (par. 38). When the case is removed, the replaceable parts on the receiver chassis are made accessible (fig. 71).

d. A compartment on the receiver chassis (fig. 71) accommodates a plug-in power supply unit (Power Supply PP-281/GRC or Power Supply PP-282/GRC for 12- or 24-volt operation, respectively) which normally furnishes the operating voltages for the receiver.

15. Mounting MT-297/GR

a. Mounting MT-297/GR (fig. 9) serves as a support for major units of the radio sets and as a junction box for interconnecting various units.

Figures 1 and 20 demonstrate the dual function of the mounting.

b. At either end of the mounting are two shock-mounted supports which are normally bolted to a vehicular mounting surface. A hinged mounting table is secured to these supports and a junction box is suspended from the under surface of the table near the center of the unit (fig. 9).

c. The mounting table is channelled to accept the rails on the bottom of the auxiliary receivers, Set 1 receiver-transmitters, Set 1 power supply, and interphone amplifier. Locking levers are provided on the front edge of the mounting table to secure the units on the table.

d. The junction box at the center of the unit contains the terminal boards and electrical circuits which serve to interconnect the units in an operating system. Cables are provided on either side of the junction box to connect the mounting to the vehicular battery and to the major units. Each cable is tagged to facilitate proper interconnection. A receptacle on the rear inner surface of the junction box serves to accommodate either Local Control C-434/GRC or Control C-435/GRC; a lever on the right side of the junction box serves to lock either control unit in the receptacle to effect a watertight connection.

e. Figure 19 shows the mounting table swung back on its hinges and the cover plates removed from the junction box so that access may be had to the interior of the junction box for installation and maintenance purposes.

16. Control Box C-375/VRC

a. One or more Control Box C-375/VRC (fig. 10) is used in every installation of the radio sets described in this manual. One unit is supplied with the basic radio set; additional units may be supplied in the installation kits (par. 8).

b. Control Box C-375/VRC is a remote junction point and switching unit for the control and audio lines to Sets 1 and 2 and the interphone amplifier. Switches on the control box may connect any of these lines to the 10-pin audio connectors on either side of the box (fig. 35) and to the MIC and PHONES jacks on the bottom of the box.

c. The control boxes are normally installed at some distance from Mounting MT-297/GR (in locations convenient for driver, gunner, commander, or other operator) and are connected to the mounting either directly or indirectly by means of Special Purpose Cable WM-46/U. Cable entries are provided at either side of the control box (figs. 72 and 73).

17. Control C-435/GRC

(fig. 11)

a. Control C-435/GRC, when used, plugs into Mounting MT-297/GR and extends the operational facilities of the radio sets to include duplex operation and retransmission. It is not essential to the normal push-to-talk operation of the sets from Control Box C-375/VRC, if duplex operation and retransmission facilities are not required.

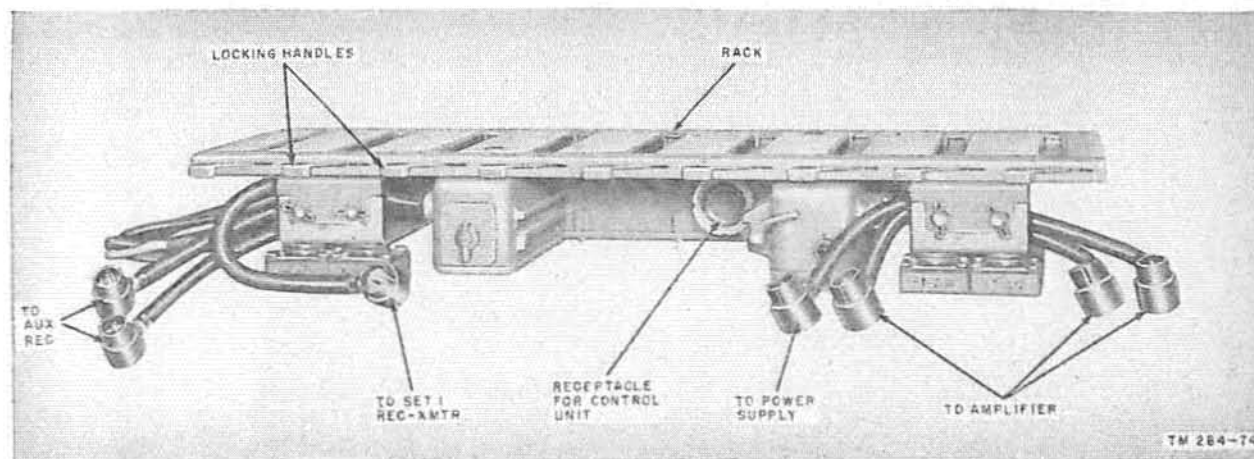


Figure 9. Mounting MT-297/GR, top view.

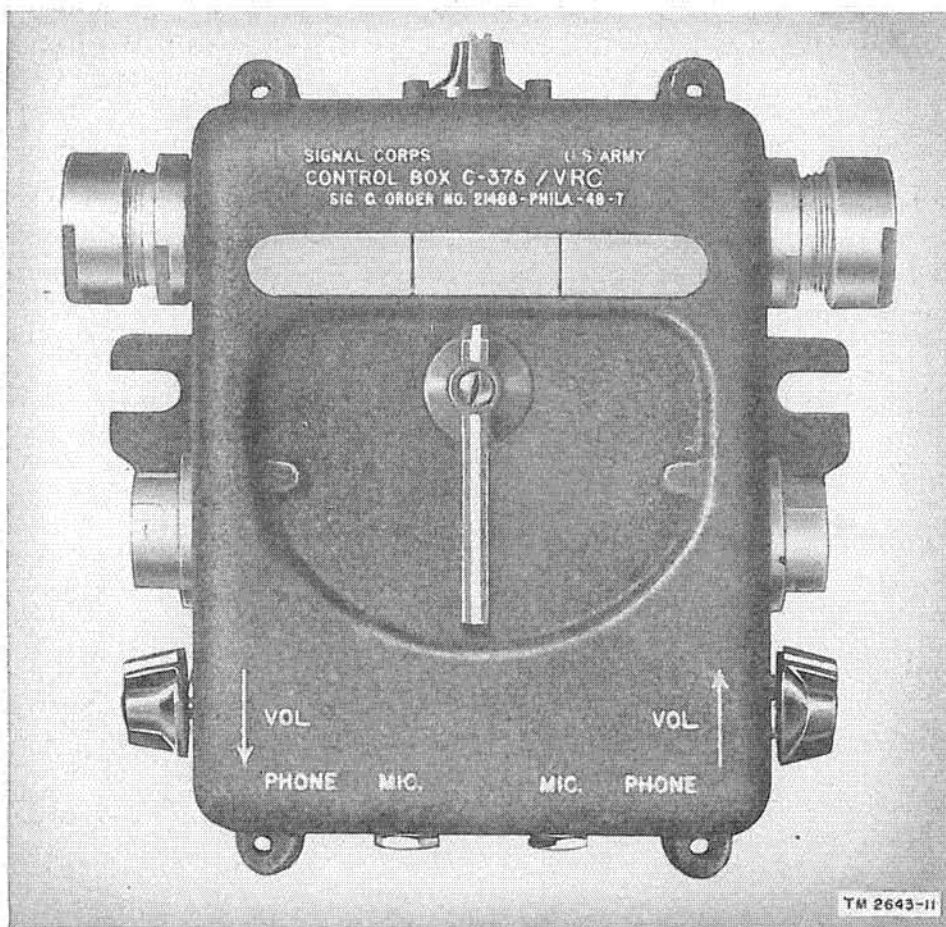


Figure 10. Control Box C-375/VRC.



Figure 11. Control C-435/GRC.

Control Box C-435/GRC may be removed from the mounting and replaced by Local Control C-434/GRC (par. 18).

b. Electrically, Control C-435/GRC is a junction box and switching unit for the control and audio lines of the receiver-transmitters and auxiliary receiver. Both automatic and manual switching facilities are provided. Mechanically, the unit is a panel-chassis assembly inclosed in a metal case. When the case is removed (figs. 74 and 75), the chassis is accessible for servicing.

18. Control Group AN/GRA-6

(fig. 12)

a. Control Group AN/GRA-6 may be used to provide local or remote control of power for, and/or transmission from, the radio sets and includes provision for telephone communication between local and remote control stations. The control group includes Local Control C-434/GRC, Remote Control C-433/GRC, Handset H-33/PT, and Bag CW-189/GR. Complete information on the control group is contained in a separate technical manual.

b. Local Control C-434/GRC may be plugged into Mounting MT-297/GR in place of Control C-435/GRC or it may be connected directly to the panels of Sets 1 and 2 by means of plug-terminated cords at the rear of the unit (fig. 30). In either case the switching facilities of the unit allow for push-to-talk transmission over either or both sets from a handset plugged into the AUDIO connector on the front panel.

c. Remote Control C-433/GRC may be as much as two miles removed from the local unit. A

telephone line is used to interconnect the two units. The combined switching actions of the two units make it possible to extend both power control and push-to-talk facilities to the remote unit. The remote unit will also accommodate a handset.

d. Handset H-33/PT may be used at the panel AUDIO connector of either control unit. The handset is equipped with a push-to-talk nonlocking switch which incorporates two electrically independent SPST (single-pole, single-throw) switches. The handset cord is terminated in a 10-pin connector which will mate with the receptacles on the panels of the unit.

e. Provisions for simple telephone communication (including ringing) are also incorporated in the control units. This facility makes the control group adaptable for field telephone usage.

f. Bag CW-189/GR is provided for storing and carrying purposes. The units may be stored in the bag when they are not used or when they are being transported, or Control C-435/GRC may be stored in the bag if Local Control C-434/GRC is plugged into the mounting.

19. Power Supplies PP-281/GRC and PP-282/GRC

Power Supply PP-282/GRC (shown with the minor components in figure 13) is used in the auxiliary receivers and the interphone amplifier in 24-volt installations of the radio sets. The unit in the amplifier supplies operating voltages for Receiver-Transmitter RT-70/GRC (Set 2) as well as the amplifier. Power Supply PP-281/GRC, similar in appearance and general character-

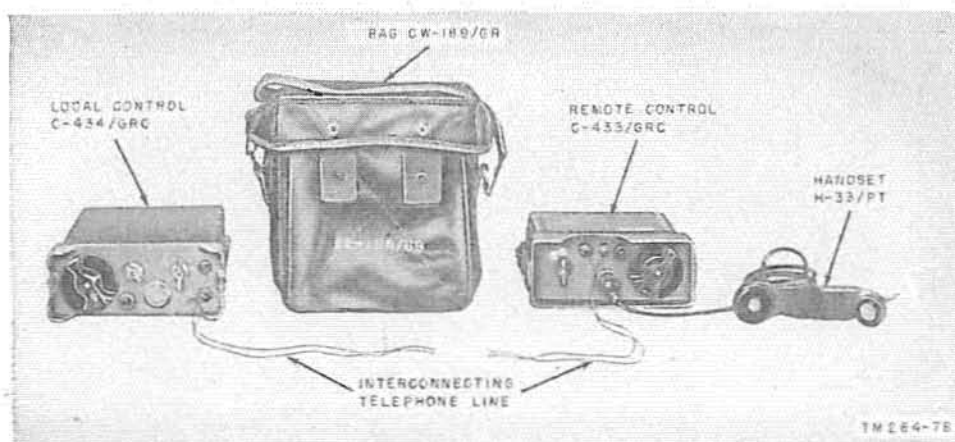


Figure 12. Control Group AN/GRA-6.

istics, is used for 12-volt installations. The units are vibrator type power supplies which can plug into the compartments on the receiver and amplifier chassis (figs. 71 and 60).

20. Minor Components

a. The following minor components are illustrated in figure 13:

- (1) Mast Base AB-15/GR.
- (2) Mast Sections MS-116-A, MS-117-A, and MS-118-A.
- (3) Mast Sections AB-22/GR and AB-24/GR.
- (4) Adapters UG-273/U and UG-306/U.
- (5) RF Cable Assembly CG-568/U.
- (6) RF Cable Assembly CG-530/U.
- (7) Special Purpose Cable Assembly CX-1211/U.
- (8) Special Purpose Cable Assembly CX-1213/U.
- (9) Wire W-142.
- (10) Special Purpose Cable WM-46/U.
- (11) Connector and bondnut, Appleton Electrical Company No. 61007 and BL-50, or equal.

(12) Case CY-684/GR.

(13) Bag CW-206/GR.

Note. Excepting the last three items listed, all of the above components are represented functionally on the system cordage diagram (fig. 29). For physical and electrical descriptions, refer to the identification table of parts.

b. The connector and bondnut is used for connecting the power cable of the radio set (W-8 on fig. 29) to the vehicular power terminal board. The connector is of the feed-through type and the bondnut locks the connector in place.

c. Case CY-684/GR is a metal box provided for storage of running spares. Compartments are provided for tubes, lamps, fuses, and other replaceable parts. The case will not accommodate all the running spares which are supplied with the various units (par. 22), but will accommodate some of each type. Refer to paragraph 46 for recommendations on the selection of spares to be stored in Case CY-684/GR.

d. Bag CW-206/GR is provided for storage of spare antenna masts, Case CY-684/GR, audio accessories (not in use), and technical manuals.

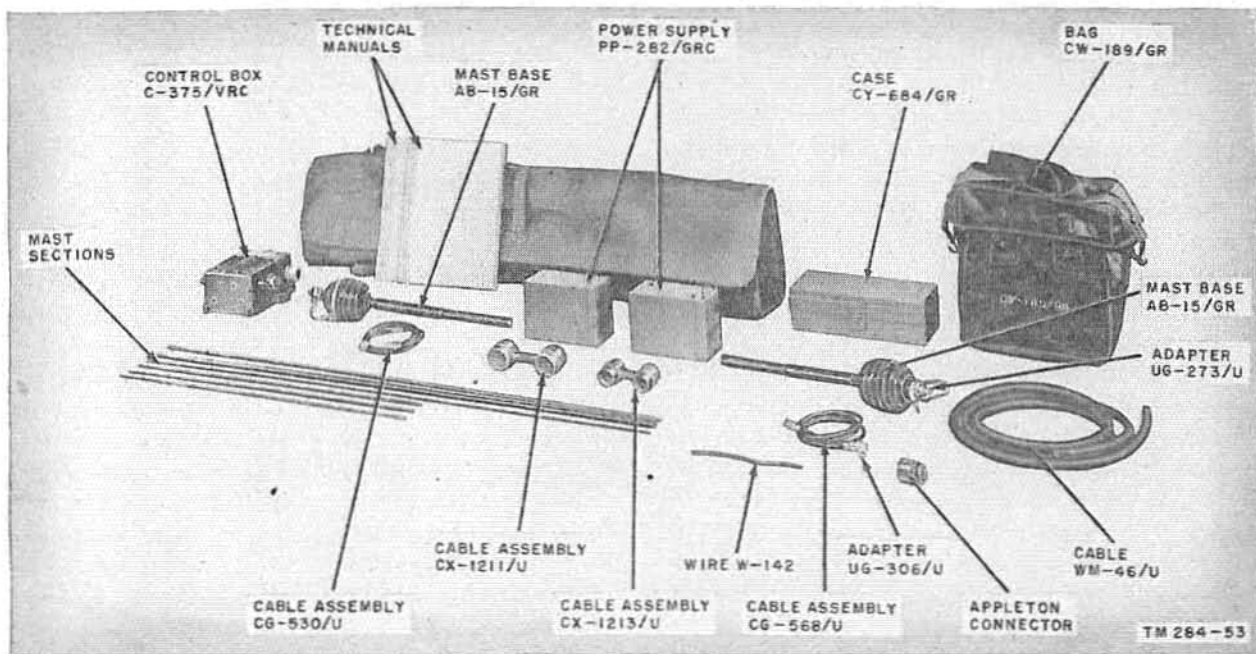


Figure 13. Minor Components of Radio Set AN/GRC-3.

21. Audio Accessories

a. TYPE. Audio accessories for operating the radio sets are supplied in the installation units and vary in type and number according to the type of vehicular installation. Some or all of the following items may be supplied:

- (1) Chest Set Group AN/GSA-6 and Headset-Microphone H-63/U.
- (2) Dynamic Loudspeaker LS-166/U.
- (3) Handset H-33/PT.
- (4) Microphone M-29/U.
- (5) Headset, Navy type CW-49507 and Cord CX-1334/U.

Note. The above listed audio accessories are the only types which can be connected to the 10-pin audio connectors on the radio sets. Control Box C-375/VRC is the only unit equipped with jacks which will accommodate any substitute accessories (h below).

b. CHEST SET GROUP AN/GSA-6. Chest Set Group AN/GSA-6, in conjunction with Headset-Microphone H-63/U (c below), is the audio accessory most commonly used with the radio sets. The chest set group consists of a chest-mounting switch box and a 5-foot cord which terminates in an 8-contact receptacle and a 10-pin audio connector. The receptacle mates with the plug on one end of the switch box and provides a quick-disconnect feature for the chest set. The audio connector will mate with any of the 10-pin connectors on the control units, the receiver-transmitters, the auxiliary receivers, and the interphone amplifier. Two plugs provided on the switch box will mate with the jacks on Headset-Microphone H-63/U. A two-position, rocker-arm type push-to-talk switch is provided on one side of the switch box; a push-button RADIO-INTERPHONE switch is provided on the other side of the box. Both positions of the rocker-arm switch are electrically identical, but one position is momentary, the other lock-on. The lock-on device may be released by means of an internal adjustment so as to make both positions momentary when so desired. The push-button switch is normally in the INTERPHONE position, allowing for interphone operation when only the push-to-talk switch is pressed. (This is true only when the chest set is connected to an audio receptacle which is wired for interphone operation; Control Box C-375/VRC is the only unit of the radio sets so wired.) Radio

transmission is accomplished by pressing both the RADIO-INTERPHONE button and the push-to-talk rocker arm. The push-button switch may be locked in the RADIO position by means of an internal adjustment. This feature should be utilized when the chest set is connected to a receptacle which is not wired for interphone operation.

c. HEADSET-MICROPHONE H-63/U. Headset-Microphone H-63/U (fig. 14) consists of two series-connected 300-ohm receivers and a 40- to 100-ohm microphone. The microphone is mounted on an adjustable boom attached to the receiver headband. Two 14-inch conductors from the microphone and headset are terminated in two-pin and three-pin jacks, respectively. These jacks will mate with the plugs on Chest Set Group AN/GSA-6.

d. DYNAMIC LOUDSPEAKER LS-166/U. Dynamic Loudspeaker LS-166/U (fig. 15) is a 4-inch, permanent-magnet dynamic Loudspeaker with a voice-coil impedance of 8 ohms. A 5-foot cord, terminated in a 10-pin audio connector, is provided for connecting the speaker to the audio receptacles wired for loudspeaker or phone operation. A rotary switch on the side of the speaker may be used to switch the unit from speaker to phone output or to disconnect the speaker circuit entirely.

e. HANDSET H-33/PT. Handset H-33/PT (fig. 16) is a combination microphone and receiver with a push-to-talk switch and connecting cord. Microphone impedance is 40 ohms; receiver impedance is 300 ohms. The push-to-talk switch provided consists of two electrically independent SPST switches. The cord is 5 feet long and is terminated in a 10-pin audio connector which will mate with the audio connectors on the receiver-transmitters, interphone amplifier, and control units.

f. MICROPHONE M-29/U. Microphone M-29/U (fig. 17) consists of a 300-ohm carbon-microphone element in a plastic case with a push-to-talk switch and connecting cord attached. The push-to-talk switch incorporates two electrically independent SPST switches. The connecting cord is 5 feet long and terminates in a 10-pin audio connector which will mate with the connectors on the receiver-transmitters, the interphone amplifier, and the control units.

g. HEADSET NAVY TYPE CW-49507 AND CORD CX-1334/U. Headset Navy Type CW-49507

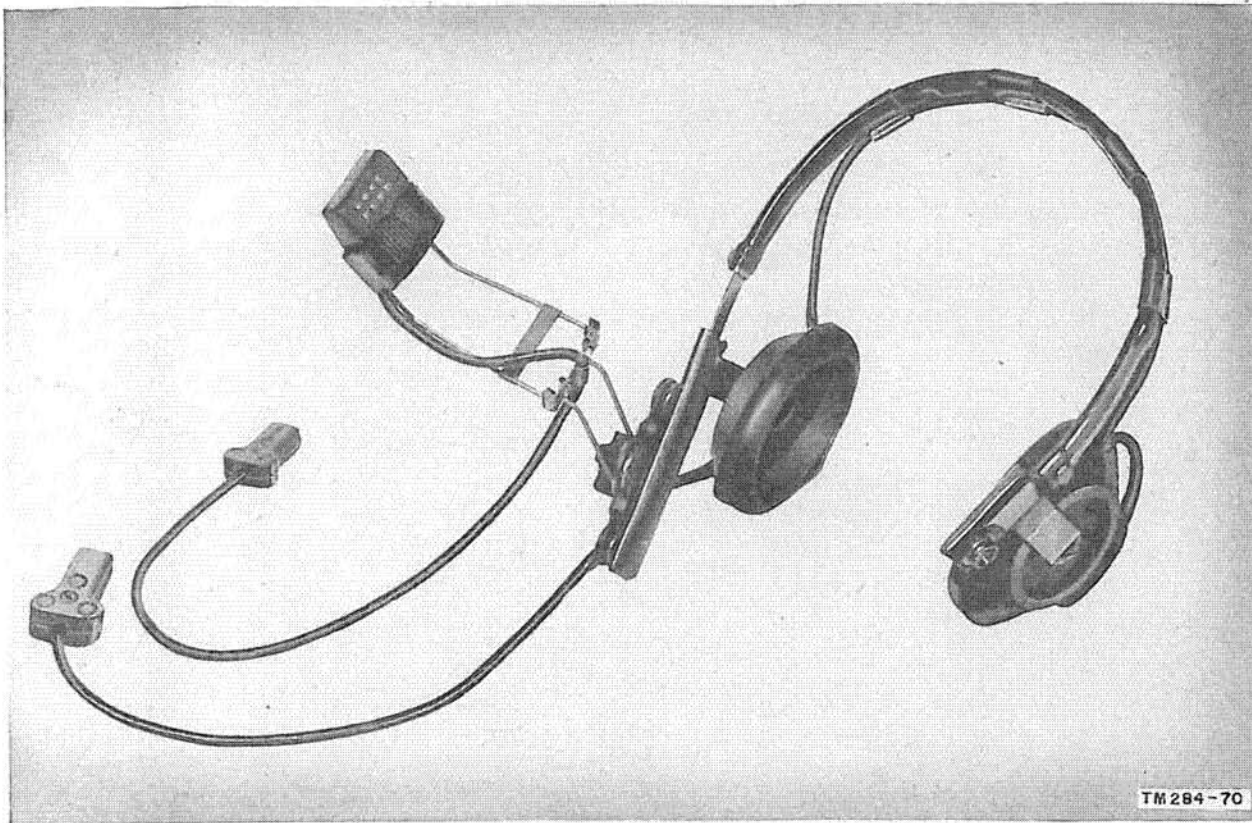


Figure 14. Headset-Microphone H-63/U.

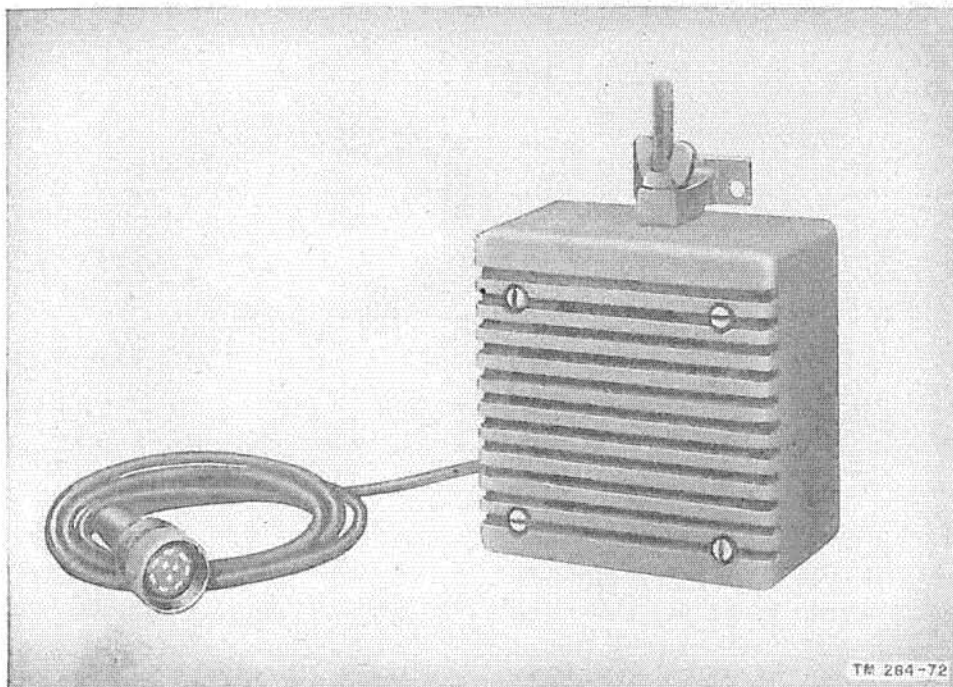


Figure 15. Dynamic Loudspeaker LS-166/U.

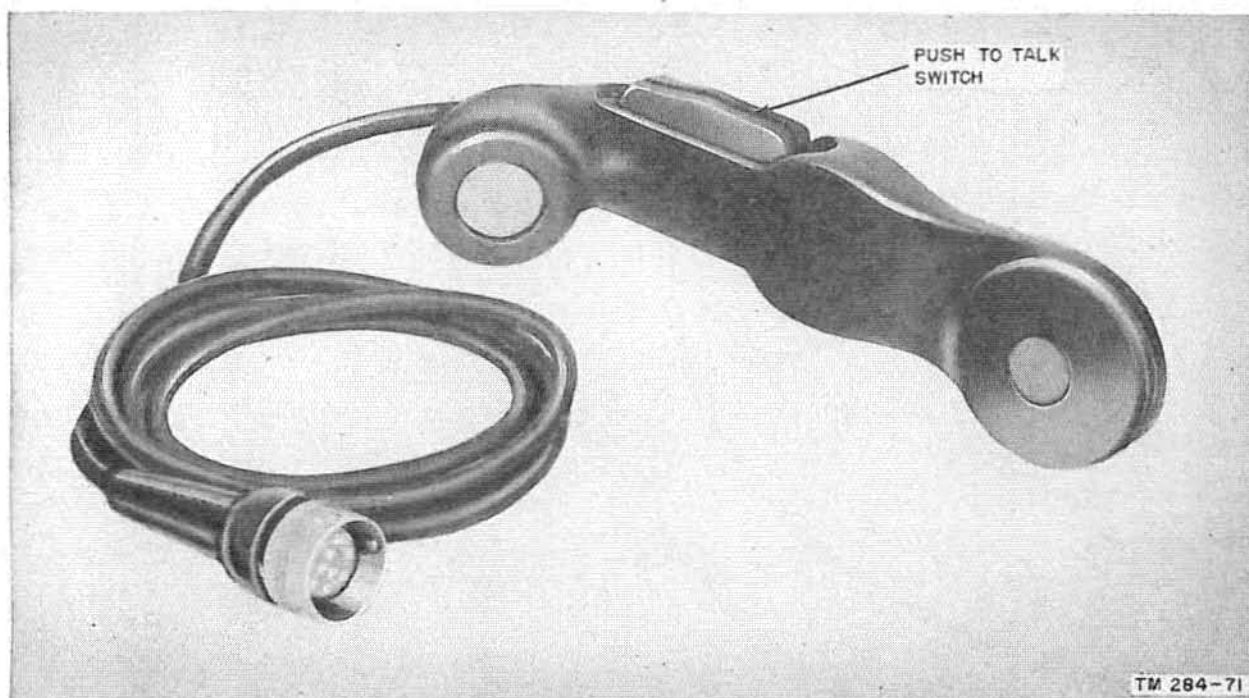


Figure 16. Handset H-53/PT.

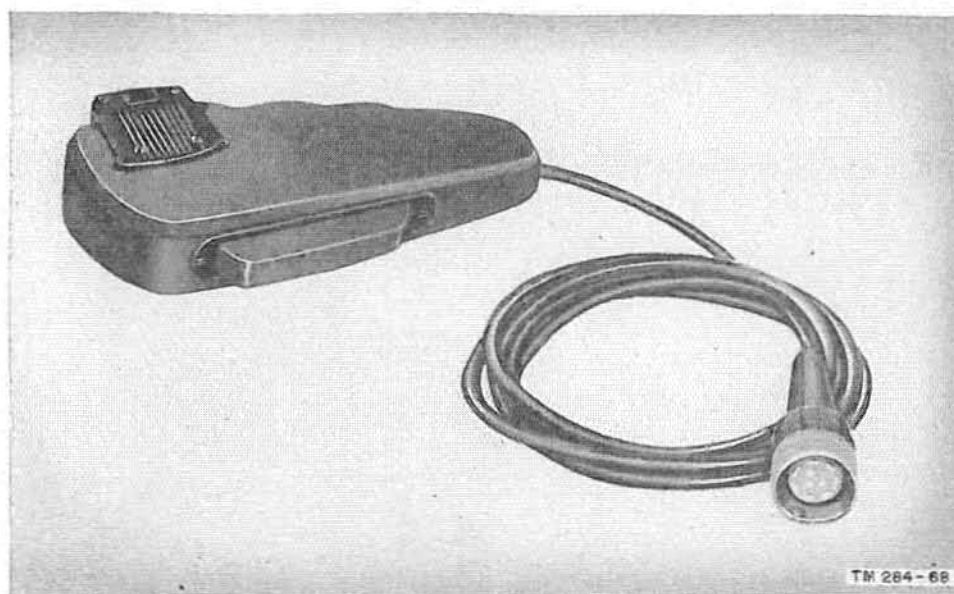


Figure 17. Microphone M-29/U.

(fig. 18) consists of two series-connected 300-ohm receivers. A 14-inch cord is connected to the receivers and is terminated in a Plug PL-54. The plug will mate with Jack JK-26, on one end of Cord CX-1334/U. Cord CX-1334/U is 5 feet long. It is terminated in a 10-pin audio con-

necter, and serves to connect the headset to the audio connectors on the receiver-transmitters, interphone amplifier, and control units.

Note. The audio accessories should not be used indiscriminately on any of the units, even though it is possible to connect them physically. Refer to chapter 3 for correct usage of the audio accessories.

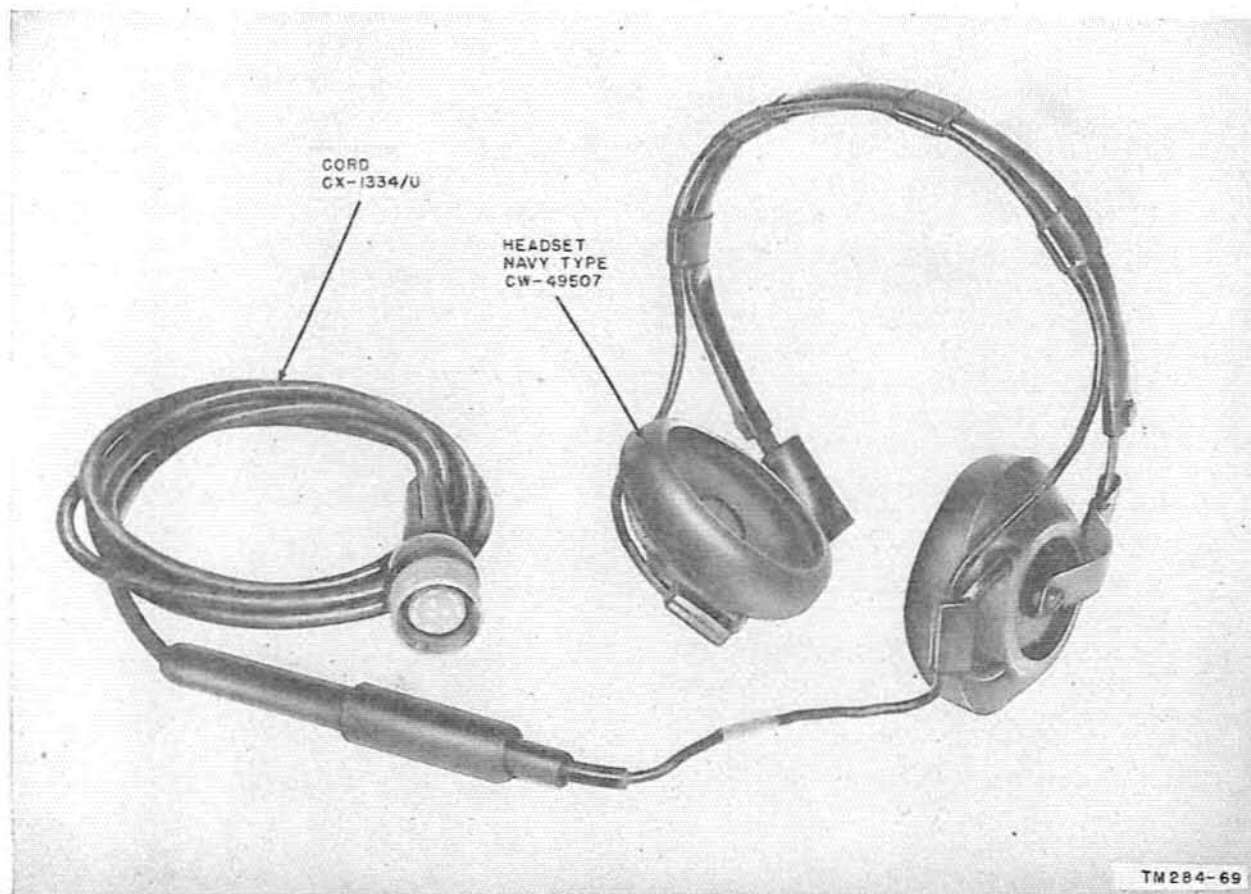


Figure 18. Headset Navy Type CW-49507 and Cord CX-1334/U.

h. SUBSTITUTE ACCESSORIES. The substitute audio accessories listed in the following table may be used if absolutely necessary. Performance will be inefficient, however, because of impedance mismatches, and operating facilities will be confined solely to Control Box C-375/VRC.

Standard item	Substitute item
Chest Set Group AN/GSA-6.	Chest Set TD-4 or Cords CD-307-A and CD-318.
Headset-Microphone H-63/U.	Headset H-16/U and Microphone T-45 or Headset HS-30 with Cord CD-933 and Microphone T-45.
Headset Navy Type CW-49507.	Headset H-16/U or Headset HS-30 with Cord CD-933.
Cord CX-1334/U.....	Cord CD-307-A.
Microphone M-29/U.....	Microphone T-17.
Dynamic Loudspeaker LS-166/U.	None.
Handset H-33/PT.....	None.

22. Running Spares

Running spares for normally expendable items, such as tubes, fuses, and vibrators are supplied with some of the system components. The spares supplied are listed in the following subparagraphs:

Note. Case CY-684/GR provided for carrying the spare parts is not ample for carrying all of the parts supplied; therefore it will be necessary to make a selection of those parts most likely to be needed. A suggested list of such parts is given in paragraph 46.

a. SPARE PARTS FOR RECEIVER-TRANSMITTERS RT-66/GRC, RT-67/GRC, AND RT-68/GRC. The spare parts supplied for each of these components are identical.

- 2 tubes, electron, type 1A3.
- 2 tubes, electron, type 1AE4.
- 2 tubes, electron, type 1L4.
- 4 tubes, electron, type 1R5.
- 1 tube, electron, type 1S5.
- 6 tubes, electron, type 1U4.

- 3 tubes, electron, type 2E24.
- 1 tube, electron, type 3A4.
- 5 tubes, electron, type 3A5.
- 2 tubes, electron, type 3B4.
- 6 tubes, electron, type 3Q4.
- 2 tubes, electron, type 6AK5.

b. SPARE PARTS FOR RECEIVER-TRANSMITTER RT-70/GRC. The following spare parts are provided for Receiver-Transmitter RT-70/GRC:

- 1 lamp, incandescent, 1.35-volt, .06 amp GE type No. 331.
- 1 tube, electron, type 1AE4.
- 2 tubes, electron, type JAN-114.
- 2 tubes, electron, type JAN-1R5.
- 1 tube, electron, type JAN-1S5.
- 10 tubes, electron, type JAN-1U4.
- 2 tubes, electron, type JAN-3A5.
- 1 tube, electron, type JAN-3B4.
- 6 tubes, electron, type JAN-3Q4.

c. SPARE PARTS FOR RADIO RECEIVERS R-108/GRC, R-109/GRC, AND R-110/GRC. Spare parts supplied for each of these receivers are identical.

- 1 fuse, cartridge, 4 ampere.
- 1 relay, thermal, SPST, (K-1).
- 1 tube, ballast, (R-59).
- 2 tubes, electron, type JAN-0B2.
- 1 tube, electron, type JAN-1A3.
- 1 tube, electron, type JAN-114.
- 2 tubes, electron, type JAN-1S5.
- 6 tubes, electron, type JAN-1U4.
- 4 tubes, electron, type JAN-3A5.
- 3 tubes, electron, type JAN-3Q4.
- 4 tubes, electron, type JAN-6AK5.

d. SPARE PARTS FOR AF AMPLIFIER AM-65/GRC.

- 1 fuse, cartridge, 4 amp. (F-1).
- 1 fuse, cartridge, 10 amp. (F-1).
- 1 tube, ballast (R-32).
- 1 relay, thermal (K-1).
- 2 tubes, electron, type JAN-6AK6.
- 3 tubes, electron, type JAN-12AU7.
- 2 tubes, electron, type JAN-0B2.

e. SPARE PARTS FOR POWER SUPPLIES PP-281/GRC AND PP-282/GRC.

(1) *Power Supply PP-281/GRC.*

- 2 vibrators, plug-in type, 6-volt input.

(2) *Power Supply PP-282/GRC.*

- 2 vibrators, plug-in type, 24-volt input.

f. SPARE PARTS FOR POWER SUPPLIES PP-109/GR AND PP-112/GR.

(1) *Power Supply PP-109/GR.*

- 2 fuses, cartridge, type AGU, 5 ampere.
- 2 fuses, cartridge, type AGU, 10 ampere.
- 1 relay, thermal (K-1, K-2).
- 2 tubes, ballast (R-24, R-25, R-31, R-37, R-38, R-40).
- 1 tube, electron, type JAN-1007.
- 2 tubes, electron, type JAN-0B2.
- 2 tubes, electron, type JAN-0A2.
- 3 vibrators, 6-volt (E-1, E-2, E-3).

(2) *Power Supply PP-112/GR.*

- 3 fuses, cartridge, type AGU, 5 ampere.
- 1 fuse, cartridge, type AGU 3 ampere.
- 1 relay, thermal (K-1, K-2).
- 3 tubes, ballast (R-24, R-25, R-31, R-37, R-38, R-40).
- 1 tube, electron, type JAN-1007.
- 2 tubes, electron, type JAN-0B2.
- 2 tubes, electron, type JAN-0A2.
- 3 vibrators, 24-volt (E-1, E-2, E-3).

g. SPARE PARTS FOR CONTROL GROUP AN/GRA-6.

- 4 lamps, glow, 125 v., 1/25 w. GE lamp No. NE-51.

h. SPARE MAST SECTIONS FOR RADIO SETS AN/GRC-3, -4, -5, and -6.

- 1 Mast Section MS-116A.
- 1 Mast Section MS-117A.
- 1 Mast Section MS-118A.
- 1 Mast Section AB-22/GR.
- 1 Mast Section AB-24/GR.

i. SPARE MAST SECTIONS FOR RADIO SETS AN/GRC-7 AND -8.

- 1 Mast Section MS-117A.
- 1 Mast Section AB-22/GR.
- 2 Mast Sections AB-24/GR.

CHAPTER 2

INSTALLATION INSTRUCTIONS

Section I. INTRODUCTION

23. Scope of Instructions

The installation instructions included in this manual are generalized to make them applicable to any installation. The variety of vehicles in which the radio sets may be installed necessarily limits the exactness of such details as location of units, routing of cables, placement of antennas, etc. Required clearances, interconnection data, and all other essential information are included. For specific details pertinent to particular vehicles, reference should be made to the installation instructions supplied with the installation units for the vehicles. Each of the installation units listed in paragraph 8 contains instructions pertinent to the particular vehicle for which the unit is intended.

24. General Unpacking Instructions

Take the usual precautions against damage to equipment during the unpacking procedure. The following points of procedure should be observed whenever possible:

a. Unless instructions are given to the contrary, unpack equipment as required, in the order described. Unpacking all boxes simultaneously may interfere with an orderly procedure and will complicate any possible division of labor.

b. As each box is unpacked, check its contents against the master packing slip.

c. Use cutters to clip metal bands.

d. Do not pry off the tops or sides of boxes; use a nail-puller to remove the nails and lift off the sides and/or the tops of boxes.

e. Save boxes, containers, and other packaging material, if practicable, for possible use for storage or reshipment.

Section II. VEHICULAR INSTALLATION DETAILS

Note. Vehicular installation procedures are those which involve modification of the vehicle (for example, the drilling of holes) or some special technique peculiar to a type of vehicle (for example, the routing of cables).

25. Unpacking

The material comprising the installation unit and the material contained in box 4 of the basic unit (par. 7) are required for the vehicular installation details. Unpack the installation unit and box 4 of the basic unit, observing the general precautions noted in paragraph 24.

26. Mounting MT-297/GR

Mounting MT-297/GR should be located and secured in place; all external connections should be completed.

a. Locate Mounting MT-297/GR according to the installation instructions for the particular vehicle. In any installation allow the minimum clearances indicated on figure 19.

b. Spot and drill the eight mounting holes in accordance with the dimensional data shown on figure 19. Bolt the mounting to the vehicle.

c. Loosen the four wing-nut fasteners which hold the mounting table firm against the shock mounts. Swing the mounting table back on its hinges to make the junction box available. Remove the three cover plates from the junction box (fig. 20).

d. If the vehicular supply is 12 volts, connect jumpers between terminals 14 and 15, 15 and 16, and 17 and 18. For 12-volt operation these jumpers are not required.

e. Prepare one end of the 10-foot length of Special Purpose Cable WM-46/U in accordance with instructions given on figure 21.

f. Loosen the bondnut on the cable clamp at one of the unused cable entries on the right-hand side of the junction box (fig. 20). Remove the nut, metal ring, and rubber washer from the cable clamp and slip them over the prepared end of the cable in reverse order (nut, ring, and washer). (The rubber plug which will be found in the cable entry is for waterproofing an unused entry; it will not be required in the final assembly.)

g. Insert the prepared end of the cable through the cable entry and solder the individual conductors to terminals of terminal board E-6 in the mounting (fig. 20); observe the color coding indicated on figure 22. The cable should be inserted until the outer insulation protrudes on the inside of the junction box. Sufficient slack should be allowed for all terminal connections.

h. When the connections are complete, tighten the bondnut on the cable clamp.

i. Before replacing the covers on the junction box, check the tightness of the solderless con-

nectors, E-1, E-3, E-4, E-9, and E-12 (fig. 20). Cable compression can cause these connectors to become loose over a period of time.

j. Replace the covers on the junction box.

k. In Radio Sets AN/GRC-4, -6, and -8, which do not use an auxiliary receiver, fasten the two receiver cables (W-1 and W-2 on fig. 20) to the unused cable mounts (fig. 73).

l. Swing the mounting table back to its normal position and tighten the wingnut fasteners at each end of the table.

m. Route the loose end of Special Purpose Cable WM-46/U in accordance with instructions outlined in the installation instructions supplied with the vehicular installation unit. (Although the units to be interconnected are Mounting MT-297/GR and Control Box C-375/VRC, vehicular layout will determine whether a direct connection will be made or whether junction boxes and/or slip rings will intervene (par. 27b).)

n. Place the power switch of the mounting in the OFF position. Do not turn this switch ON throughout the entire installation procedure.

o. Connect the battery cable (W-8 on fig. 20) in accordance with instructions furnished with the installation unit. Generally, the cable will connect to a vehicular junction box rather than

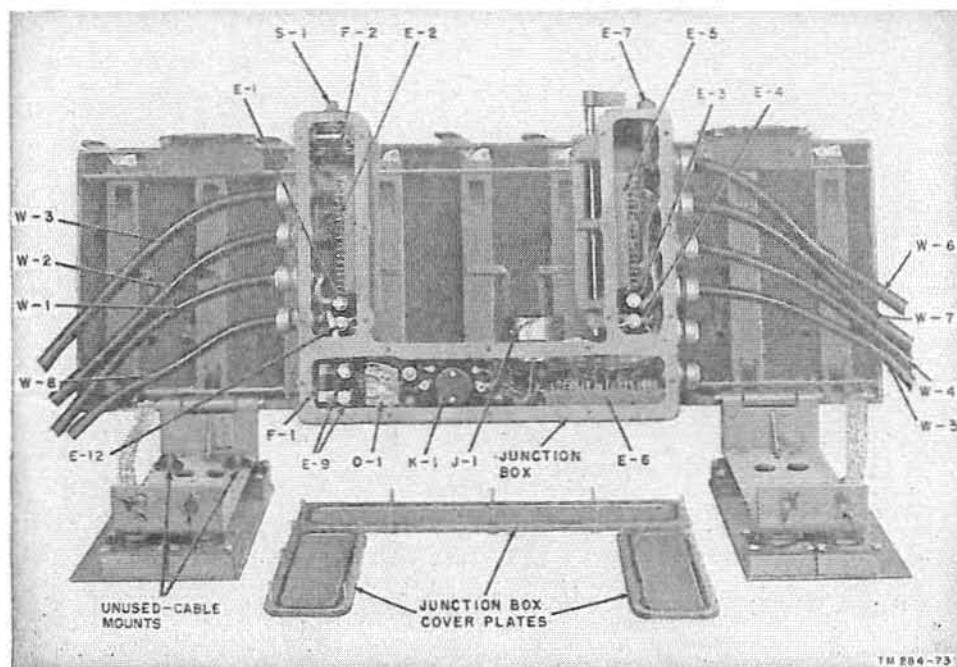


Figure 20. Mounting MT-297/GR, open view.

directly to the battery. Use the connector and bondnut supplied with the basic unit to secure the cable at its point of entry into the junction box. Leave enough slack to allow the mounting cable to be swung back without straining the cable.

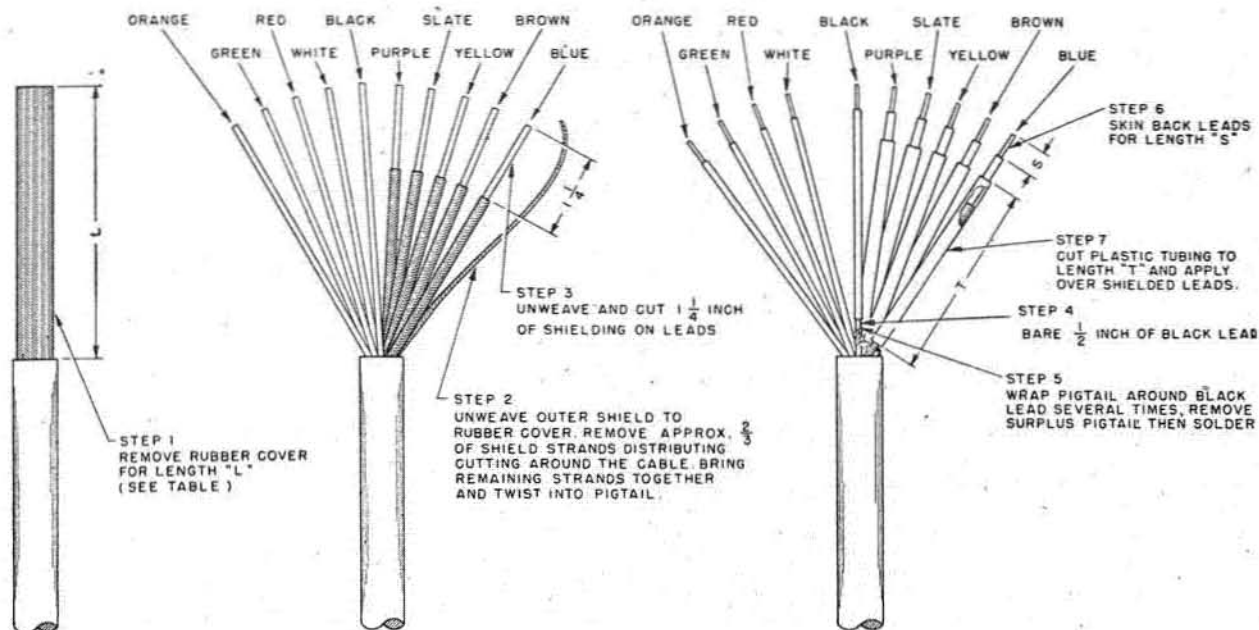
27. Control Box C-375/VRC

One or more Control Boxes C-375/VRC may be supplied in the installation units in addition to the box supplied with the basic unit. The boxes must be located, mounted, and interconnected with Mounting MT-297/GR.

a. Spot the location of the control boxes and drill the mounting holes. The exact locations will vary from vehicle to vehicle and must be determined from the specific instructions supplied

with the installation unit. In all cases minimum clearances of $2\frac{1}{2}$, 4, and $3\frac{3}{4}$ inches should be allowed on the top, the bottom, and the sides, respectively. Before mounting the units, make the connections described for each unit (b and c below).

b. Remove the cover from the control box, remove the bondnut, ring, and washer from one of the cable clamps at the side of the box, and slip the nut, ring, and washer over the loose end of Special Purpose Cable WM-46/U. (This may be the other end of the cable connected to Mounting MT-297/GR; more commonly it will be an extension of this cable from a vehicular junction box or another Control Box C-375/VRC. In all cases the cable end should be prepared in accordance with instructions shown on fig. 21.)



COMPONENT	LENGTH "L"	LENGTH "S"	LENGTH "T"
CONTROL BOX C-375/VRC	4	$\frac{3}{8}$	$3\frac{3}{8}$
MOUNTINGS MT-297/GR, MT-298/GR, MT-299/GR, MT-300/GR	6	$\frac{3}{8}$	$5\frac{3}{8}$
TERMINAL BOX SC-D-5319	6	$\frac{3}{8}$	$5\frac{3}{8}$
TURRET TERMINAL BOX IN MEDIUM TANK M46	10	$\frac{3}{8}$	$9\frac{3}{8}$
BENDIX - SCINTILLA CONNECTOR SIZE 28 SHELL	$1\frac{3}{8}$	$\frac{5}{16}$	NOT USED
BENDIX - SCINTILLA CONNECTOR SIZE 22 SHELL	$1\frac{1}{4}$	$\frac{1}{4}$	NOT USED

Figure 21. Preparation of Special Purpose Cable WM-46/U.

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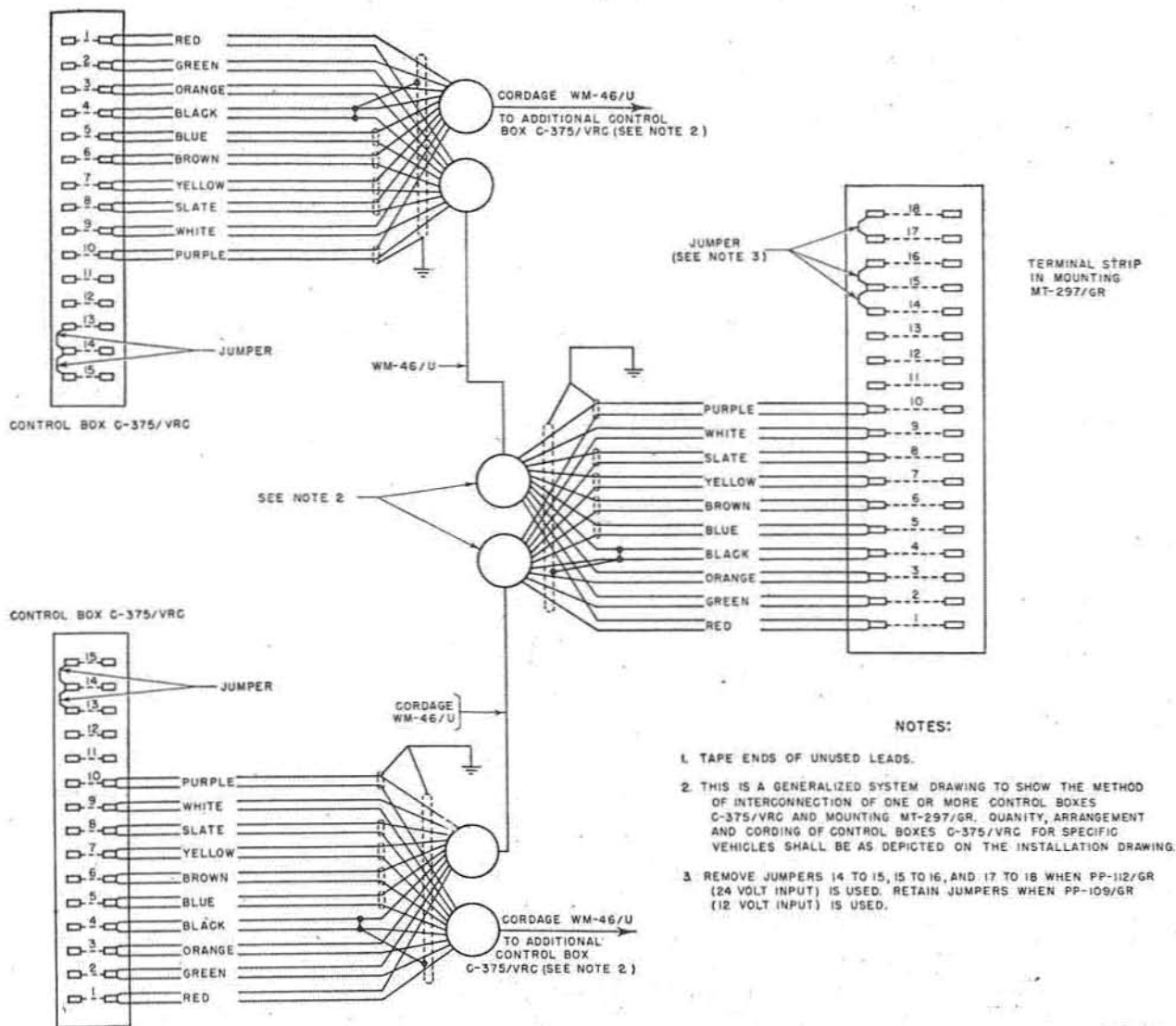


Figure 22. Interconnection of Mounting MT-297/GR and Control Box C-375/VRC.

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c. Solder the prepared conductors to terminals of terminal board E-2 in the control box, observing the color coding shown on figure 22.

d. When connections are complete, tighten the cable clamp, replace the cover, and mount the units in place.

e. On the composition strips above the selector switch on the panel of each control box, write the following designations from left to right, respectively: "Set 1+INT," Set 1+Set 2+INT," and "Set 2+INT."

28. Control C-435/GRC

Control C-435/GRC should be plugged into Mounting MT-297/GR as follows:

a. Remove the cover which protects the plug on the rear of the control unit (fig. 24). Fasten the cover to the clamp at the right of the plug.

b. Rotate the locking lever at the right-hand side of the junction box of the mounting in a counterclockwise direction.

c. Insert the control unit into the opening beneath the mounting table so that the plug of the control unit engages the jack on the junction box.

d. Turn the locking lever clockwise to effect a secure, watertight connection.

29. Routing Antenna Cables

The antenna cables are to connect from the receiver-transmitter panels to the antenna-mast

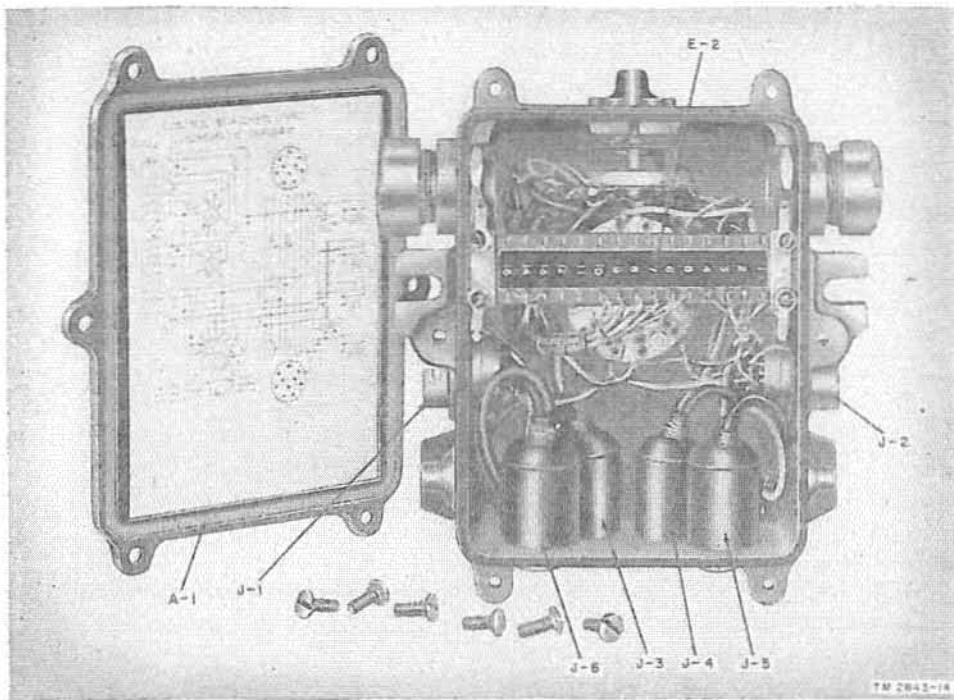


Figure 23. Control Box C-375/VRC, rear view.

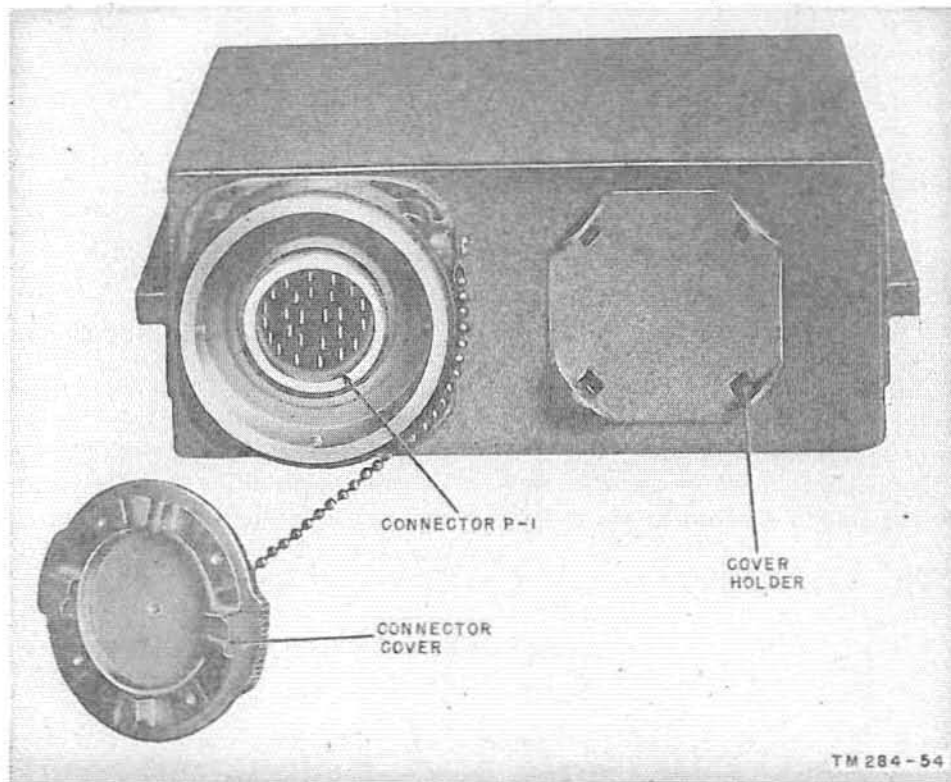


Figure 24. Control C-435/GRC, rear view.

bases. While actual connections cannot be made at this time, provisions must be made for routing the cables. RF Cable Assembly CG-568/U is provided for Set 1 with Radio Sets AN/GRC-3 and -4; all other antenna cables utilize RF Cable Assembly CG-530/U.

a. If the antenna cables are to run free (without clamping) between the panels of the receiver-transmitters and the antenna-mast bases, store the cables with the audio accessories (par. 31), and connect them after the units have been installed on the mounting (par. 39).

b. If holes must be drilled in the vehicle or any other vehicular modification must be made in order to route the antenna cables, follow the instructions supplied in the installation unit.

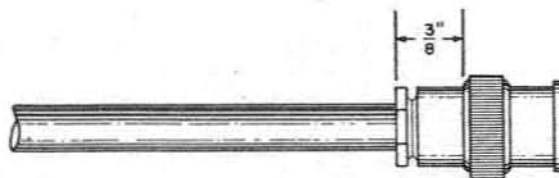
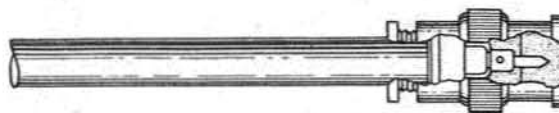
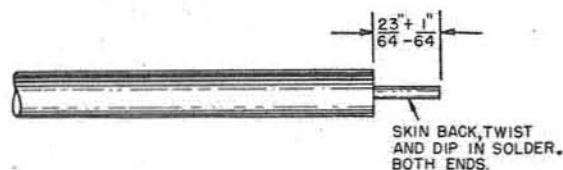
c. If the antenna cables are to be clamped to the vehicle, follow the instructions supplied in the installation unit. When a particular installation calls for the use of Adapter UG-306/U (supplied in the installation units), connect the adapter to the end of the cable which will connect to the mast base.

Note. In most cases the 50-inch antenna cables supplied with the basic units will be sufficiently long. In those cases where a longer length is required, cable and connectors will be supplied in the installation units. If the connectors are not already assembled to the cable, terminate the cables in accordance with instructions given on figures 25 and 26.

30. Vehicular Provisions for Antenna-mast Bases

a. Any drilling, installation of mounting brackets, and other vehicular details which are necessary for installing the antenna-mast bases should be made at this time. Location of masts and mounting provisions are different for each type of vehicle and necessary instructions will be supplied with the vehicular installation unit.

b. Because it is possible, in some instances, that the remaining installation procedures will not be



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Figure 25. Termination of RF Cable Assembly CG-568/U.

completed until after the vehicle has been shipped to a different depot or organizational unit, actual mounting of the antenna-mast bases is not included as a vehicular installation detail. (Its installation might complicate the shipment of the vehicle.) Whether the entire installation is carried through to completion in one or two steps, however, the antenna-mast bases are the next items to be installed (par. 33).

31. Storing of Audio Accessories

The audio accessories supplied in the installation unit will not be required until the equipment is ready for an operational test (par. 41). The accessories should be unpacked and stored within the vehicle until they are needed.

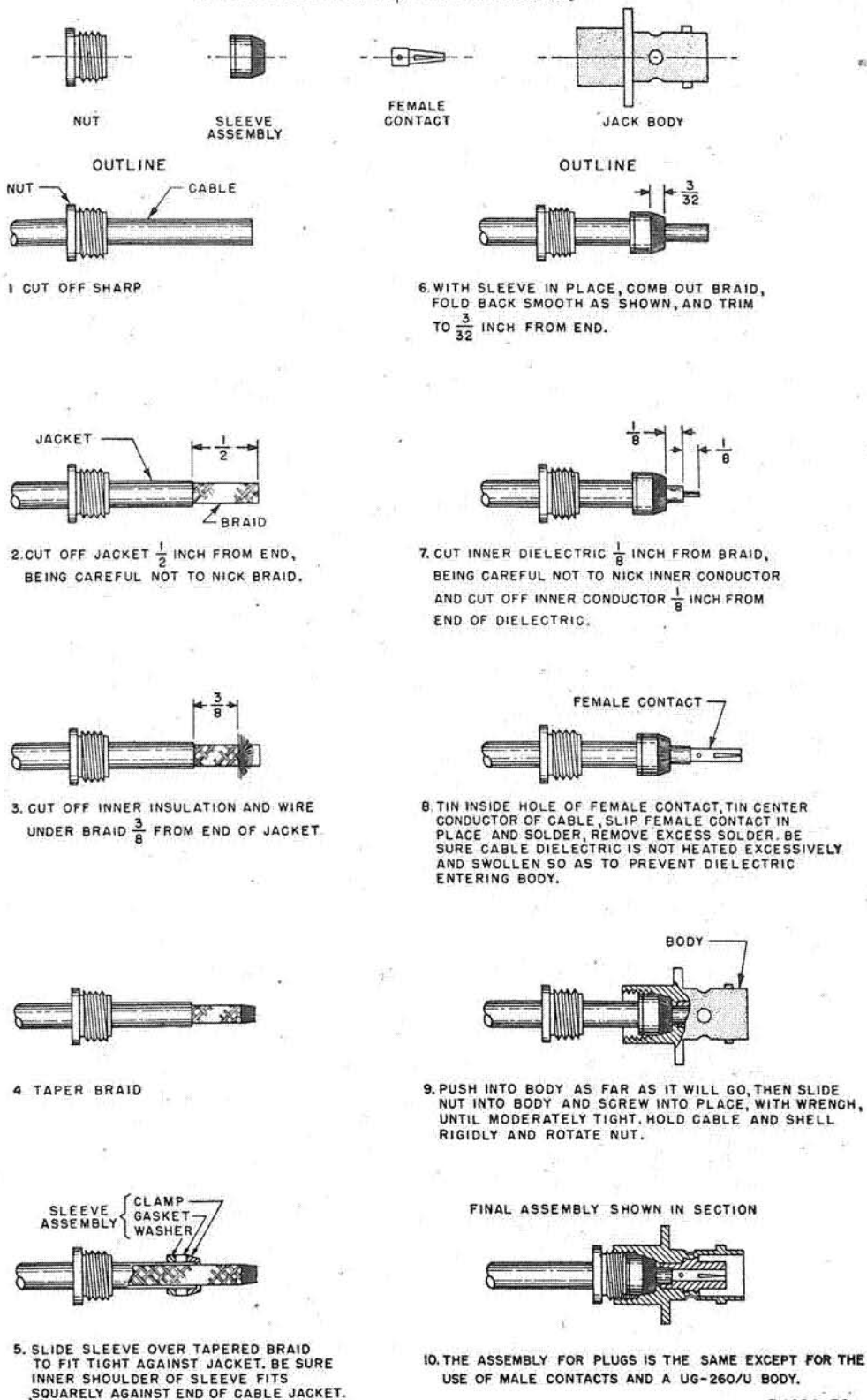


Figure 26. Termination of RF Cable Assembly CG-530/U.

Section III. EQUIPMENT INSTALLATION DETAILS

Note. The term "equipment installation" has been arbitrarily selected to refer to those installation procedures which are independent of the vehicle in which the radio sets are installed.

32. Unpacking.

When all vehicular installation details have been completed, unpack the remaining boxes (1, 2, and 3) of the basic unit (par. 7). Observe the general precautions noted in paragraph 24.

33. Mounting Mast Base AB-15/GR

(fig. 27)

The location of the mast bases is, in most cases, dependent upon the vehicle. In general, however, the mast bases should be placed as high as possible, with at least 40-inch spacing between the Set 1 and Set 2 mast bases, and with a maximum cable length of 50 inches between the bases and the receiver-transmitters. To install each of the mast bases, follow the instructions outlined below and on figure 27.

a. Loosen the ground clamp on the adapter which is supplied on the mast base. Remove the adapter and replace it with Adapter UG-273/U. Retighten the ground clamp on the new adapter.

b. Separate the two cup-insulators by unscrewing the body of the mast base.

c. Insert the body of the mast base, with upper-cup-insulator attached, through the hole in the mounting surface.

d. Bring the lower cup-insulator up from the under side of the mounting surface so that the bolt in the lower insulator engages the body of the mast base. The lockwasher and the ground braid from the clamp on the adapter should be between the mounting surface and the lower insulator (fig. 27).

e. Screw the body of the mast base in a clockwise direction to tighten the assembly.

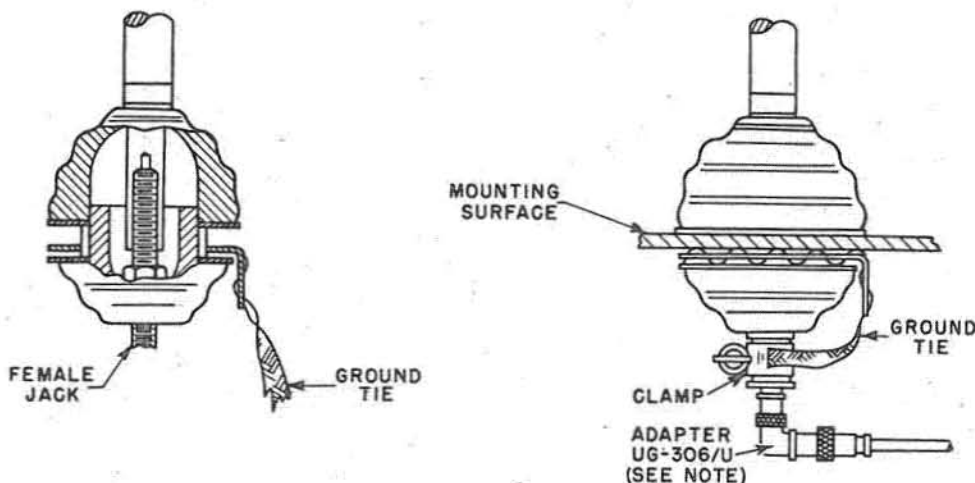
f. If the mounting surface does not provide a good ground, an additional ground bond must be made between the mounting surface and the vehicle.

34. Antenna Mast Sections

(fig. 29)

a. Set 1 of Radio Sets AN/GRC-3, -4, -5, and -6 utilizes three long mast sections, Mast Sections MS-116-A, MS-117-A, and MS-118-A. Screw the three sections together and screw the assembly into the Set 1 mast base.

b. Set 1 of Radio Sets AN/GRC-7 and -8 utilizes one long and one short mast section, Mast Sections MS-117-A and AB-24/GR, respectively. Screw the two sections together and screw the assembly into the Set 1 mast base.



NOTE:

ADAPTER UG-306/U USED ONLY WHEN SPECIFICALLY CALLED FOR.

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Figure 27. Mast Base AB-15/GR, installation drawing.

c. Set 2 (in all of the radio sets) utilizes two short mast sections, Mast Section AB-22/GR and AB-24/GR. Screw the two sections together and screw the assembly into the Set 2 mast base.

35. AF Amplifier AM-65/GRC

A power supply must be installed in the amplifier, and the fuse and internal power supply switch must be checked, before the amplifier is secured on the mounting. Perform the following steps:

a. Remove the panel-chassis assembly from the outer case (par. 123).

b. Insert and clamp the plug-in power supply unit (fig. 28) in the compartment on the amplifier chassis (fig. 60) so that the receptacle on the power supply mates with the plug within the amplifier compartment. Use Power Supply PP-281/GRC for 12-volt systems and Power Supply PP-282/GRC for 24-volt systems.

c. Turn the internal switch on the amplifier chassis (fig. 60) to the 12V or 24V position, depending upon the supply voltage being used.

d. Check the fuse in the fuse holder on the front panel of the amplifier. The amplifier is shipped with a 4-ampere fuse which is suitable for operation in a 24-volt system with Power Supply PP-282/GRC. For 12-volt systems, with Power Supply PP-281/GRC, replace the 4-ampere fuse with a 10-ampere fuse from the running spares supplied with the unit (par. 22). Place a spare fuse of the proper amperage for the system in the clips on the chassis (fig. 60).

e. Fasten the correct supply-voltage marker on the left-hand side of the amplifier panel. The amplifier is shipped with the 24v 4a marker in place (fig. 7). For 12-volt systems, the marker should be replaced by the 12v 10 marker which is supplied with the amplifier. The marker serves as a reminder that the plug-in power supply unit, the fuse, and the setting of the internal switch (c and d above) should correspond to the storage battery being used.

f. Replace the panel-chassis assembly in the case and turn the OFF-INT-RT-70 switch to the OFF position.

Caution: Before placing the amplifier or any of the units on the mounting, again check the position of the power switch on the mounting. Turn it to the OFF position.

g. Release the locking mechanism for the two right-hand channels of the mounting by rotating the locking handles (fig. 9) towards the right.

h. Place the amplifier on the mounting so that the rails on the bottom of the case rest in the two right-hand channels of the mounting. Rotate the locking handles to the left to secure the amplifier in place.

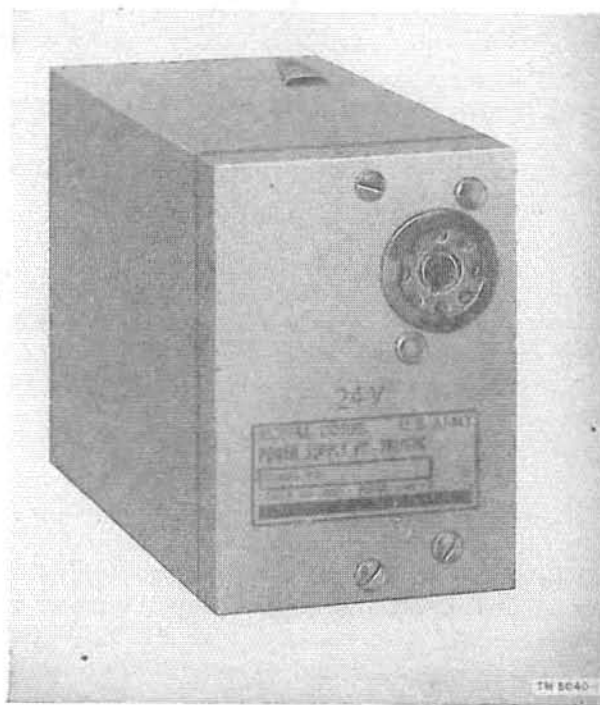


Figure 28. Power Supply PP-282/GRC, front view.

36. Receiver-Transmitter RT-70/GRC (Set 2)

The internal FIELD-VEH-TANK switch of Set 2 must be set before the unit is installed. Perform the following steps:

a. Remove the panel-chassis assembly from the outer case (par. 123).

b. Set the FIELD-VEH-TANK switch, on the chassis of the receiver-transmitter (fig. 64), to the TANK or VEH position in accordance with one of the following conditions:

- (1) If more than one Control Box C-375/VRC is used in the system, set the switch at TANK.
- (2) If one Control Box C-375/VRC is used in the system, set the switch at VEH.

c. Replace the panel-chassis assembly in the case.

d. Fasten the receiver-transmitter on top of the interphone amplifier by means of the snap catches and hooks on the two units.

37. Set 1 and Set 1 Power Supply

a. Place the OPERATE switch of the Set 1 Power Supply PP-109/GR or PP-112/GR in the OFF position, and secure the unit on the mounting beside AF Amplifier AM-65/GRC (fig. 29). Use Power Supply PP-109/GR in 12-volt systems and Power Supply PP-112/GR in 24-volt systems.

b. Place and lock the Set 1 receiver-transmitter on the mounting next to the power supply. Refer to figure 29 for the particular receiver-transmitter used in each system.

38. Auxiliary Receivers

Instructions for the auxiliary receivers apply only to Radio Sets AN/GRC-3, -5, and -7. Figure 29 indicates which receiver is applicable to each set.

a. Remove the panel-chassis assembly from the outer case (par. 123).

b. Insert and clamp the plug-in power supply unit (fig. 28) in the compartment on the receiver chassis (fig. 71) so that the receptacle on the power supply mates with the plug within the receiver compartment. Use Power Supply PP-281/GRC for 12-volt systems and Power Supply PP-282/GRC for 24-volt systems.

c. Turn the internal switch on the right-hand side of the receiver chassis to the VEH position.

d. Replace the panel-chassis assembly in the case and place the combined power and VOLUME control of the receiver in the OFF position.

e. Place and lock the auxiliary receiver on the mounting beside the Set 1 receiver-transmitter. (This space on the mounting is left blank in Radio Sets AN/GRC-4, -6, and -8.)

39. Interconnections

Make the system interconnections outlined below and illustrated on figure 29.

a. Connect Adapter UG-306/U to the ANT connector on Set 2. Connect one end of the antenna cable (RF Cable Assembly CG-530/U) to the adapter; connect the other end to the adapter on the Set 2 mast base (par. 33).

b. Connect Adapter UG-306/U to the ANT connector on Set 1. Connect one end of the antenna cable (RF Cable Assembly CG-568/U or CG-530/U as indicated in figure 29) to the adapter; connect the other end of the cable to the Set 1 mast base (par. 33).

c. Connect Wire W-142 between the AUX REC ANT connector on Set 1 and the lower ANT connector on the panel of the auxiliary receiver. (This step applies only for Radio Sets AN/GRC-3, -5, and -7.)

d. Check that the power switch on the mounting, and the OFF-INT-RT-70 switch on the interphone amplifier are in the OFF positions, and connect Special Purpose Cable Assembly CX-1213/U between the RT-70 POWER receptacle on the amplifier and the POWER receptacle on Set 2. Tighten the screw handles on the cable-assembly connectors.

e. Check that the OPERATE switch of the Set 1 power supply is in the OFF position, and connect Special Purpose Cable Assembly CX-1211/U between the POWER OUT receptacle of the power supply and the POWER IN receptacle of Set 1. Tighten the screw handles on the cable-assembly connectors.

f. Connect cable W-6 from the mounting (fig. 20) to the REC-TR CONT receptacle on the amplifier. Tighten the screw handle on the cable connector.

g. Connect cable W-7 from the mounting to the INT CONT receptacle on the amplifier. Tighten the screw handle on the cable connector.

h. Connect cable W-5 from the mounting to the POWER IN receptacle on the amplifier. Tighten the screw handle on the cable connector.

i. Connect cable W-4 from the mounting to the POWER IN receptacle on the Set 1 power supply. Tighten the screw handle on the cable connector.

j. Connect cable W-3 from the mounting to the REC-TR CONTROL receptacle on Set 1. Tighten the screw handle on the cable connector.

k. On Radio Sets AN/GRC-3, -5, and -7, connect cables W-1 and W-2 from the mounting to the POWER IN and REC CONTROL receptacles, respectively, on the auxiliary receiver. Tighten the screw handles on the cable connectors.

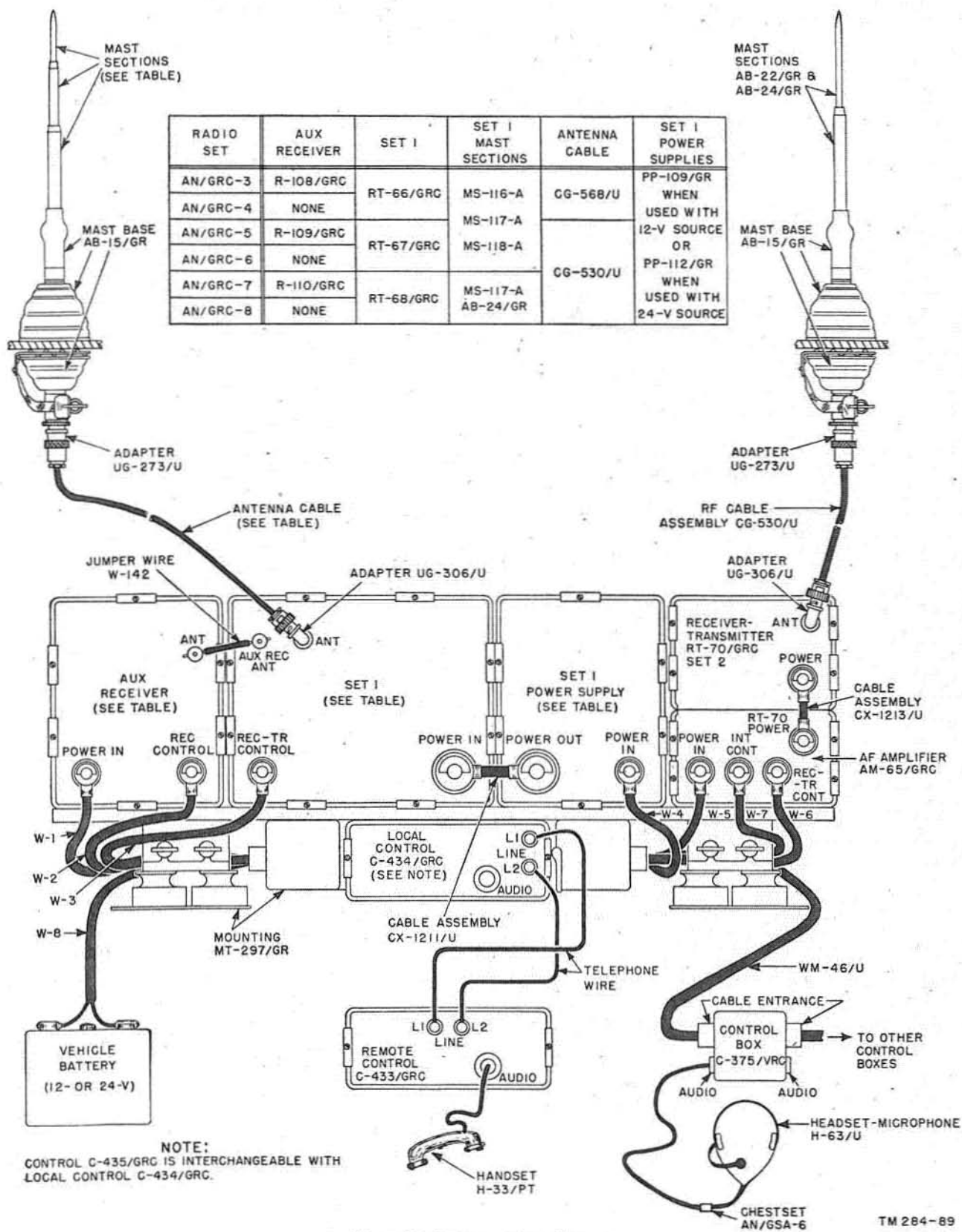


Figure 29. System cordage diagram.

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40. Audio Accessories

a. ASSEMBLY. The chest sets, headsets, and headset-microphone sets provided in the installation unit should be assembled and made ready for use. The remaining audio accessories are shipped assembled.

b. DISPOSITION. The specific disposition and usage of audio accessories depend, in part, upon vehicular conditions and modes of operation to be used. Probable dispositions are indicated below. (See chapter 3 for the operating modes possible at the various audio connectors.)

- (1) Chest Set Group AN/GSA-6 will be used with Headset-Microphone H-63/U at the audio connectors of Control Box C-375/VRC, Control C-435/GRC, and Local Control C-434/GRC.

- (2) Dynamic Loudspeaker LS-166/U, when supplied, will generally be used at the audio connector on Control C-435/GRC.
- (3) Microphone M-29/U can be used at an audio connector of Set 1, Set 2, or the interphone amplifier when some general means of monitoring (for example, a loudspeaker) is provided.
- (4) Headset Navy Type CW-49507 with Cord CX-1334/U will generally be used at an audio connector of Set 1, Set 2, or an auxiliary receiver for individual set monitoring.
- (5) Handset H-33/PT will generally be used at either Remote Control C-433/GRC or Local Control C-434/GRC.

Section IV. ADJUSTMENTS FOR OPERATION

Note. Personnel who are to perform the procedures described in this section should be familiar with the use of controls and instruments and with the operating procedures described in chapter 3.

41. Set 2 Antenna Tuning

Receiver-Transmitter RT-70/GRC (Set 2) is shipped completely aligned, but the antenna circuit must be tuned when the set is connected to a particular antenna system.

a. Perform steps 1 through 22 and 36 through 38 of the equipment performance-checklist (par. 114) to determine that the Set 2 receiver is operating. Leave the receiver in an operating condition.

b. Calibrate the receiver-transmitter at 58 mc (par. 69).

c. Remove the cap, which covers the antenna tuning control (fig. 6), on the top of the receiver-transmitter.

d. Insert an insulated screw driver or alinement tool through the opening in the case so as to engage the screw driver slot of the antenna tuning control. Hold the ANT ADJ-DIAL LIGHT-ON-OFF-CAL switch (fig. 34) in the ANT ADJ position and adjust the tuning control for a minimum noise in the headphones.

42. Set 1 Antenna Tuning

Receiving and transmitting antenna circuits must be tuned separately in the Set 1 receiver-

transmitters. Once the antenna circuits are tuned for a particular system antenna, it is not necessary to retune during normal operation.

a. RECEIVER TUNING. Perform steps 1 through 22, and 24 through 27 of the equipment performance checklist (par. 114) to determine that the receiver is operating. Leave the receiver operating and adjust as follows:

- (1) Tune for a signal in the top 900 kc of the tuning range (par. 68). If a signal is not heard, radiate the output of a signal generator to the receiver. The signal must be weak so as not to overload the receiver. The auxiliary receiver must be tuned at least 4 mc below set 1 during the following steps.
- (2) Using an ordinary screw driver, adjust the REC-ANT TUNE control on the Set 1 panel for a maximum signal in the headset. Reduce the r-f input signal strength as the audio output level increases. Repeat the adjustment.

b. TRANSMITTER TUNING. Perform steps 1 through 22 and 30 through 34 of the equipment performance checklist (par. 114) to determine that the transmitter is operating. To tune the transmitter antenna, proceed as follows:

- (1) Tune the receiver-transmitter (par. 68) to the extreme low end of its tuning range (MCS control at lowest mc calibration,

TENTH MCS control at zero). Leave the TENTHS MCS control at zero throughout the tuning procedure.

Caution: Do not turn the TENTH MCS control while the TR-ANT TUNE control is being adjusted. Serious damage to the tuning mechanism can result.

- (2) Turn the TRANS-ANT COUPLING control completely counterclockwise to obtain minimum coupling.
- (3) Press and hold the RADIO and press-to-talk switches on the chest set. (It may be more convenient to lock both of these switches in position by means of the internal adjustments provided.)

Note. Keep all personnel removed as far as possible from the antenna while making the following adjustments.

- (4) Using an ordinary screw driver, adjust the TR-ANT TUNE control on the Set 1 panel for a maximum r-f reading on the panel meter. If it is impossible to obtain a reading, advance the setting of the TRANS-ANT COUPLING control slightly and repeat the procedure. Keep the coupling as low as possible while adjusting the TR ANT-TUNE for a maximum r-f reading. When the maximum reading is obtained, release the RADIO or push-to-talk switch on the chest set.
- (5) Repeat steps 3 and 4 for each integral mc calibration on the MCS dial and for the highest detented frequency of each receiver-transmitter (27.9, 38.9, and 54.9 mc for Receiver-Transmitters RT-66/-GRC, RT-67/GRC, and RT-68/GRC, respectively).
- (6) When adjustments are complete for each setting of the MCS control, turn the MCS control to the approximate

center of the tuning range, and adjust the TRANS-ANT COUPLING control for a maximum r-f reading.

- (7) Repeat steps 3 through 6.

43. Auxiliary Receiver Tuning

The antenna circuits of the auxiliary receivers must be tuned for the particular antenna systems with which the receivers are used. The tuning procedure is outlined in *a* through *d* below:

a. Perform steps 1 through 22, and 43 and 44 of the equipment performance checklist (par. 114). Leave the receiver operating and adjust as follows:

b. Tune the receiver at the highest calibrate frequency of its range (par. 70*a* steps 1 through 5). Tune Set 1 at least 4 mc below the auxiliary receiver during this operation.

c. With the TUNE-OFF-ON-DIAL LIGHT switch held in the TUNE position, tune off the calibrate frequency until the beat note can no longer be heard but so that the quieting effect of the tuning signal is still apparent.

d. With the TUNE-OFF-ON-DIAL LIGHT switch still in the TUNE position, use an ordinary screw driver to adjust the ANT TUNE control for maximum quieting in the headset.

44. Operational Check

When both Sets 1 and 2 and, in Radio Sets AN/GRC-3, -5, and -7, the auxiliary receivers have been tuned, make a complete operational check of the system by performing the procedure outlined in the equipment performance checklist (par. 114). Omit steps 65 to 79 which pertain to Control Group AN/GRA-6. If abnormal indications are obtained, it will be necessary to troubleshoot the system. When required, follow the trouble-shooting suggestions contained in the checklist.

Section V. CONTROL GROUP AN/GRA-6 AND MISCELLANEOUS EQUIPMENT

45. Control Group AN/GRA-6

Control Group AN/GRA-6 should only be installed when its peculiar facilities are required (par. 52). An initial installation should be made, however, to determine that the equipment will operate properly. Make this initial installation in accordance with the following instructions after the rest of the system has been completely installed, tuned, and checked. Turn the power switch on the mounting to OFF before beginning the installation.

a. Loosen the screw fasteners on the panel of Local Control C-434/GRC and remove the panel-chassis assembly from the case.

b. Insert two 1½-volt Batteries BA-30 in the battery compartment and place the chassis-mounted switch (S-1) in the BELL position. Replace the panel-chassis assembly in the case.

c. Remove the protective cover plate from the plug at the rear of the local control unit. Open the hinged door to the right of the plug and store the cover in the clamp provided within the compartment (fig. 30).

d. Remove Control C-435/GRC from Mounting MT-297/GR and insert Local Control C-434/GRC in its place.

e. Loosen the fasteners which secure the case on Remote Control C-433/GRC. Remove the panel-chassis assembly from the case.

f. Insert two 1½-volt Batteries BA-30 in the compartment provided, and insert and connect a 45-volt Battery BA-414/U in its compartment. Place the chassis-mounted switch in the BELL position and replace the panel-chassis assembly in its case.

g. Interconnect the local and remote units with telephone wire over as great a distance (up to 2 miles) as desired. Strip the insulation off the wires approximately ¼ inch from the ends, and tin the bared wires before clamping them in the binding posts (designated LINE L1 and L2) on each of the units.

h. Perform the preliminary starting procedure (par. 72) and steps 65 through 79 of the equipment performance checklist.

i. When satisfactory performance has been ascertained, turn the power switch on the mounting

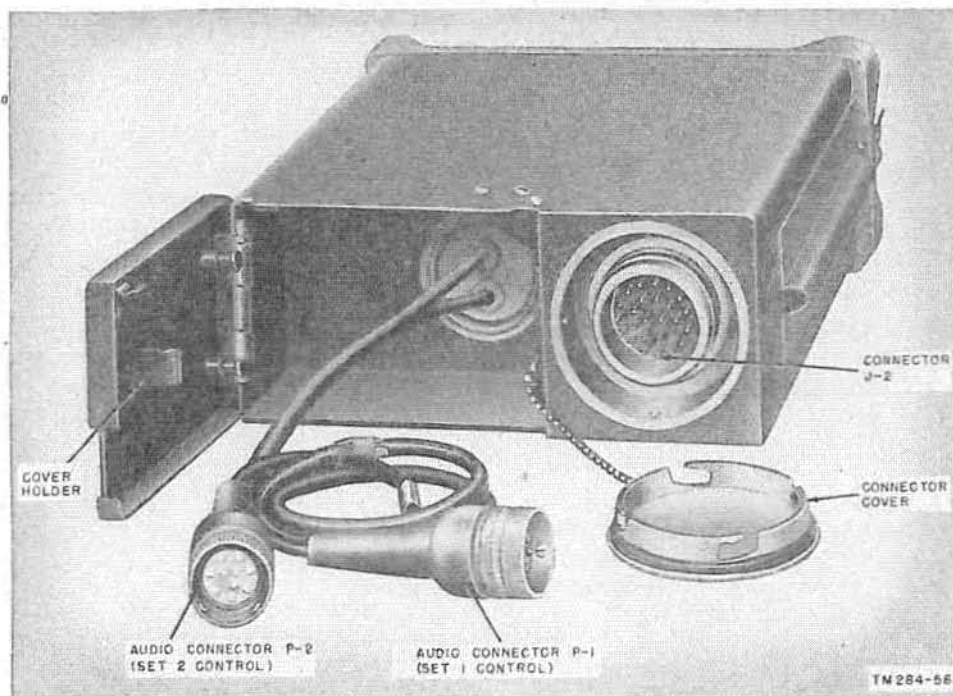


Figure 30. Local Control C-434/GRC, rear view.

to OFF and remove the local control unit from the mounting.

j. Replace the protective cover on the plug at the rear of the local control unit and connect the units to Sets 1 and 2 by means of the cables and plugs in the compartment at the rear of the unit. Plugs P-1 and P-2 (fig. 30) connect to AUDIO connectors on Sets 1 and 2, respectively.

k. Return the power switch on the mounting to ON and perform steps 72 and 73 of the equipment performance checklist.

l. After operation has been checked, disconnect the local control unit and remove the batteries from both local and remote units. Never leave the batteries installed unless the units will be used in a relatively short period of time.

Note. By connecting Local Control C-434/GRC directly to the panels of the receiver-transmitters, it is possible to utilize the retransmission unit in the mounting. Thus, retransmission, full-duplex, and remote control of transmission can be available simultaneously. Remote control of power for the radio sets cannot be obtained, however, with the local control unit so connected.

46. Storage of Equipment Not in Use

Equipment not immediately required for operation, such as running spares, audio accessories, Control Group AN/GRA-6, or Control C-435/GRC, should be packed in the containers provided and stored in a convenient location within the vehicle.

a. **RUNNING SPARES.** All spare mast sections should be placed in Bag CW-206/GR in the pockets provided. Case CY-684/GR should be filled with spare parts from the stock of running spares supplied with each unit, and it too should be stored in Bag CW-206/GR. Since Case CY-684/GR will not hold all the spare parts provided, a judicious selection should be made from the spares available. It is suggested that the following list be used as a

guide in selecting the spares for packaging in Case CY-684/GR.

Spare part	Quantity
Vibrator (6-v or 24-v for 12- and 24-volt systems, respectively).....	1
Relay, Ratheon CK-118.....	1
Ballast tube, 800 ma.....	1
Ballast tube, 600 ma.....	1
Tube type OA2.....	1
Tube type OB2.....	1
Tube type 2E24.....	1
Tube type 6AK6.....	1
Tube type 6AK5.....	2
Tube type 3A5.....	2
Tube type 3Q4.....	2
Tube type 3A4.....	1
Tube type 3B4.....	1
Tube type 1L4.....	2
Tube type 1S5.....	1
Tube type 1A3.....	2
Tube type 1U4.....	3
Tube type 1R5.....	3
Tube type 1AE4.....	1
Tube type 12AU7.....	1
Tube type CK-1007.....	1
Lamp NE-51.....	1
Lamp, Mazda 331.....	2
Fuse (10-ampere or 4-ampere for 12- and 24-volt systems, respectively).....	3

b. **AUDIO ACCESSORIES AND TECHNICAL MANUALS.** Audio accessories not required for operation can be stored in Bag CW-206/GR. Technical manuals can also be stored in the same bag.

c. **CONTROL GROUP AN/GRA-6.** When Control Group AN/GRA-6 is not required for operation, it should be stored in Bag CW-189/GR. If the control group is in use, and Control C-435/GRC is not being used, the bag can be used to accommodate the unused unit.

CHAPTER 3

OPERATING INSTRUCTIONS

Section I. MODES OF OPERATION

47. Monitoring

Listening to received signals with no attempt to communicate with the sending station constitutes monitoring. Each of the receivers in the radio sets can be operated strictly as a monitor if so desired. Generally, all receivers will be monitored simultaneously at the interphone box (par. 76), the retransmission unit (par. 77), or the local control unit (par. 78). It is also possible to monitor each receiver separately by means of a speaker or headset connected directly to the unit audio connector.

48. Push-to-talk Operation

a. Push-to-talk operation utilizes one-way reversible communication facilities. Receiving facilities are available, provided that power is supplied to the equipment, but transmission requires closure of one or more switches (generally the push-to-talk switch of a chest set, handset, or microphone). Communication is possible in one direction at a time and it is impossible for the receiving party to *break in* on the sending party.

b. Push-to-talk operation of either Set 1 or Set 2 may be selected at the interphone box, the retransmission unit, the local control unit, and the remote control unit (pars. 76, 77, and 78, respectively). The interphone box is most commonly used. It is also possible to operate each receiver-transmitter individually by means of a chest set or handset connected directly to the unit audio connector.

49. Interphone Facilities

Interphone facilities are available to the operators at each interphone box, the retransmission unit, and the panel of the interphone amplifier.

Normally, the panel of the interphone amplifier will not be used as an interphone station, but it is a convenient point for checking the operation of the amplifier itself (par. 116).

50. Retransmission Facilities

a. Facilities are provided for retransmission of any received signal. When this facility is used, the radio set acts as a relay or repeater station between two other radio sets (fig. 31). Retransmission facilities are important tactically since they provide a means of extending communication range and, through use of the Set 2 liaison receiver-transmitter, a means of establishing communication between two different tactical units.

b. The retransmission unit (Control C-435/GRC) provides for automatic retransmission of signals received by either receiver-transmitter (Set 1 or Set 2). The signal which arrives first controls the direction of retransmission, that is, whether the signal is received on Set 1 and transmitted on Set 2 or vice versa. In Radio Sets AN/GRC-3, -5, and -7, which have an auxiliary receiver, it is also possible to manually retransmit the output of the auxiliary receiver over the set 2 receiver-transmitter.

51. Duplex Radio Facilities

a. Duplex radio operation utilizes separate transmitting and receiving circuits to provide simultaneous communication in two directions. In the block diagram shown on figure 32, one receiver-transmitter is utilized for receiving while the other receiver-transmitter is used for transmitting. Both stations involved in the duplex network must have these separate facilities in order to make this simultaneous two-way or *break-in* operation possible.

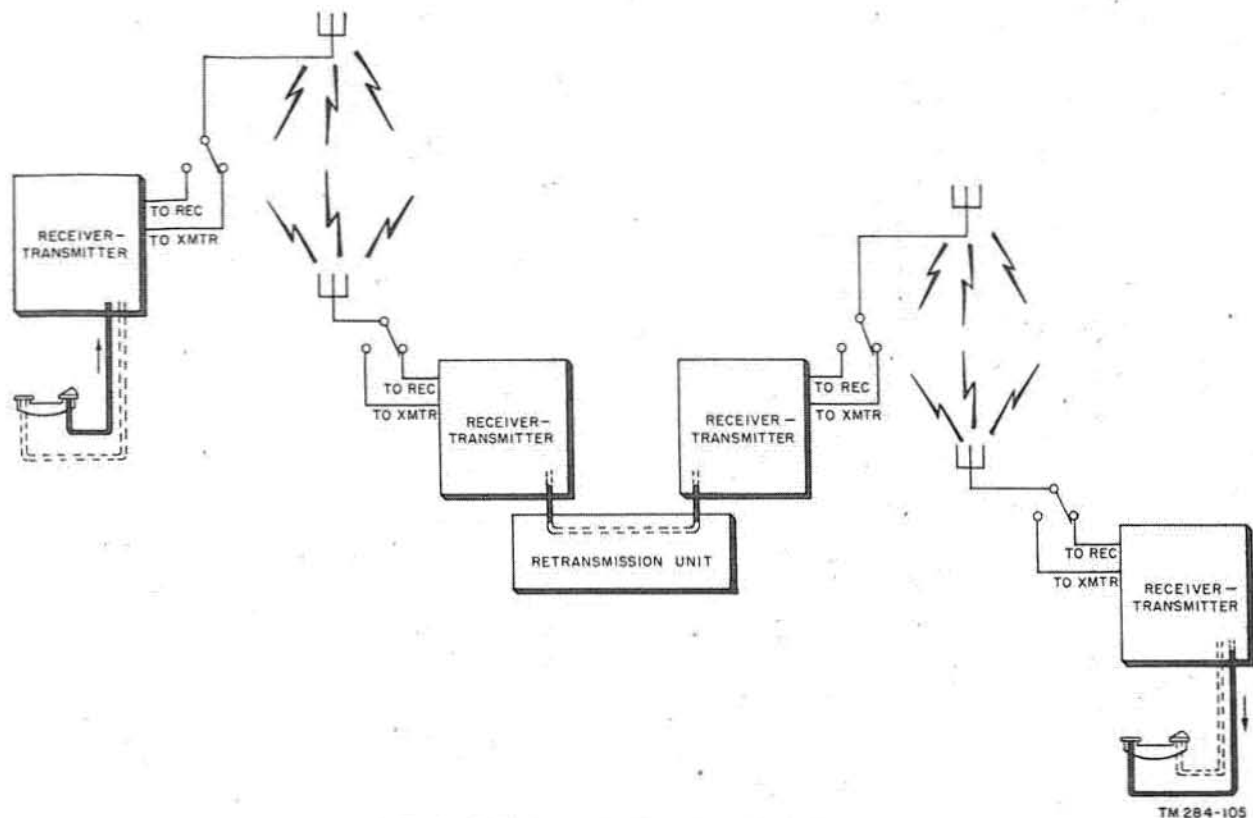


Figure 31. Retransmission system, block diagram.

b. The retransmission unit of the radio sets provides the switching circuits required for duplex operation. The duplex operation utilizes Set 1 for transmitting and Set 2 for receiving (par. 77). In Radio Sets AN/GRC-3, -5, and -7, which have an auxiliary receiver, it is possible to utilize the auxiliary receiver and Set 1 in a duplex set-up.

52. Remote Control Facilities

The use of Control Group AN/GRA-6 makes

it possible to control application of power for the radio sets and/or push-to-talk operation of either Set 1 or Set 2 from a control station 2 miles removed from the major installation. Refer to paragraph 78 for operating details.

53. Duplex Telephone Facilities

When Control Group AN/GRA-6 is used for remote control of the radio sets, duplex telephone facilities are available for communication between local and remote control units.

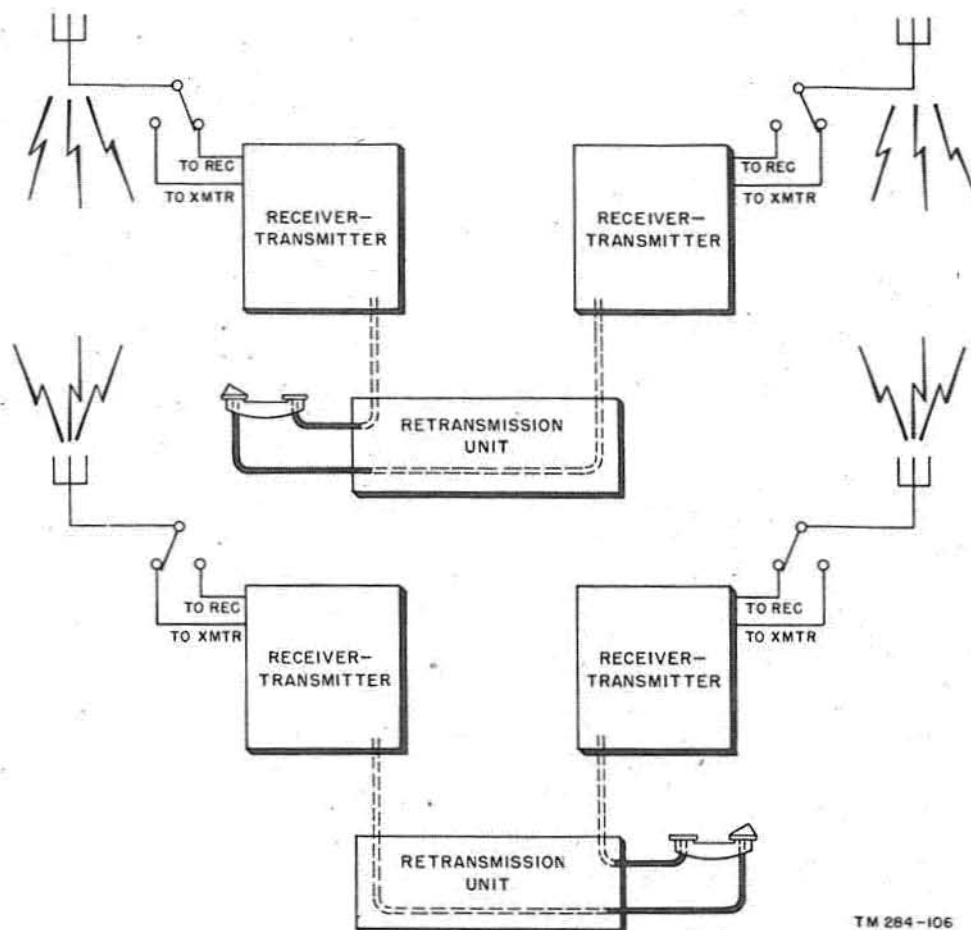


Figure 32. Duplex operation, block diagram.

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Section II. CONTROLS AND INSTRUMENTS

54. Introduction

Paragraphs 55 to 64 indicate the functions of operational controls and instruments on the panels of the various units. Although ordinary operating procedures are confined mainly to control units and audio accessories, an understanding of the controls and instruments on the individual units is essential to efficient operation and maintenance of the radio sets.

55. Mounting

The main power switch for the radio sets and a red pilot lamp are mounted on the junction-box portion of Mounting MT-297/GR (fig. 9).

Control or instrument	Function
OFF-REMOTE-ON switch (S-1).	Controls battery power to the radio sets. OFF: Opens battery circuit in the mounting.

Control or instrument	Function
OFF-REMOTE-ON switch (S-1).—Con.	REMOTE: Places power control in hands of operator at Remote Control C-433/GRC. ON: Connects battery power to the input terminals of the interphone amplifier, Set 1 power supply, and in the case of Radio Sets AN/GRC-3, -5, and -7, at the input terminals of the auxiliary receiver.
POWER lamp (E-7).	Indicates (when lit) that power has been made available at the input terminals of the interphone amplifier, Set 1 power supply, and, in the case of Radio Sets AN/GRC-3, -5, and -7, at the input terminals of the auxiliary receiver. Dimmer control provides for masking the glow of the lamp.

56. Interphone Amplifier

The controls of the interphone amplifier are shown in figure 33 and their functions are listed in the following chart:

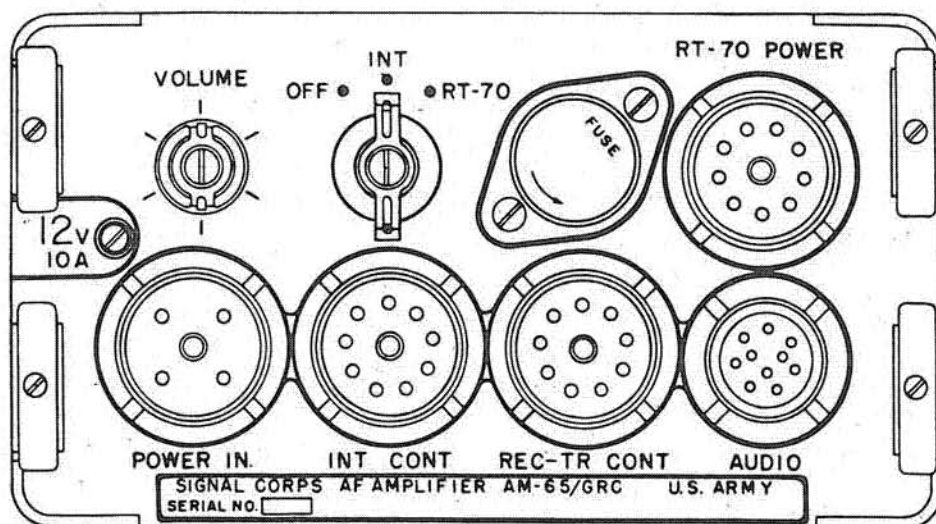
Control	Function
OFF-INT-RT-70 switch. (S-2).	Controls power for the interphone amplifier or for the Set 2 receiver-transmitter and the interphone amplifier. OFF: Breaks battery circuit at input terminals of the amplifier. INT: Completes power circuits for interphone amplifier. RT-70: Completes power circuits for interphone amplifier and Set 2 receiver-transmitter.
VOLUME control (R-26).	Controls output level from Set 1+Set 2+Interphone channel to retransmission unit and to panel-mounted AUDIO connector.
AUDIO connector (J-1).	Provides means for connecting a chest set (with microphone-headset) for monitoring and interphone operation over the Set 1+Set 2+Interphone channel.

panel of Receiver-Transmitter RT-70/GRC (Set 2) are illustrated in figure 34; their functions are listed in the following chart:

Control or instrument	Function
MCS dial and TENTH MCS tuning control.	Select and indicate operating frequency. MCS dial: Calibrations are in megacycles from 47 to 58 and indicate the integral portion of the operating frequency. TENTH MCS: Selects the operating frequency. Calibrations, in tenths of an mc indicate the decimal portion of the frequency selected.
PRESET 1 and PRE-SET 2 levers.	Provides means of presetting any two frequencies (par. 69).
Dial LAMP (E-201)	Illuminates tuning dial and tuning knob except when dial light switch (below) is in OFF position.
ANT ADJ-DIAL LIGHT ON OFF-CAL switch (S-202).	Controls antenna-tuning, dial light, and calibrating circuits. ANT ADJ: Turns on test signal for tuning antenna (par. 41); turns on dial LAMP. DIAL LIGHT-ON: Turns on dial LAMP. DIAL LIGHT-OFF: Turns off dial LAMP. CAL: Turns on test signals for calibrating tuning dial (par. 69).

57. Set 2

The controls and instruments mounted on the



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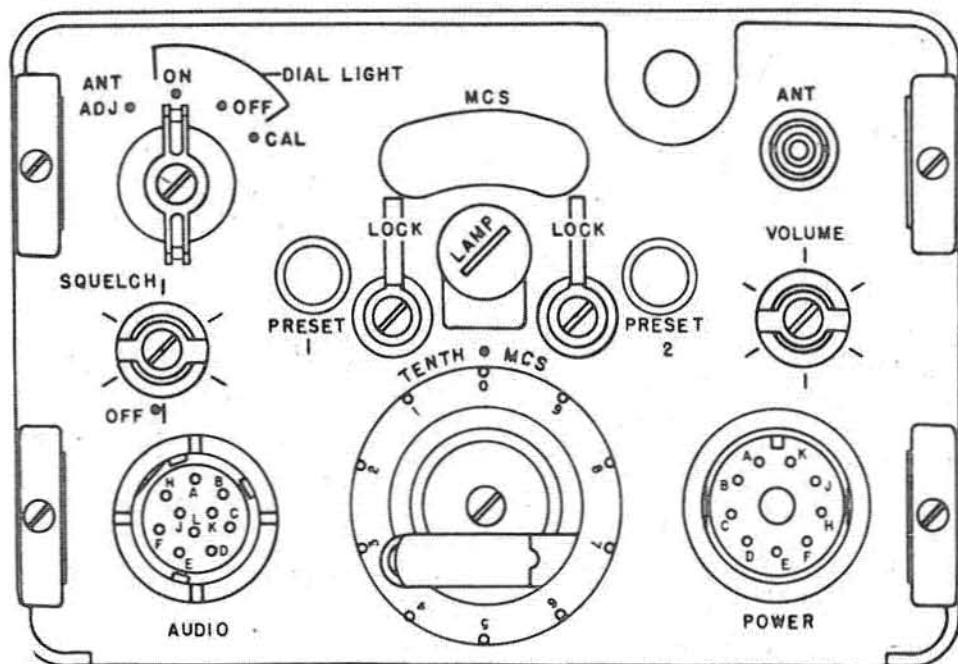
Figure 33. Interphone amplifier panel.

Control or instrument	Function
ANTENNA TUNING control (C-41)	Provides means of tuning receiver-transmitter antenna circuit. (Internal control accessible through the top of the case when protective cap is removed; not an operational control.)
VOLUME control (R-204).	Adjusts receiver audio-output level to the interphone box, retransmission unit, and panel-mounted AUDIO connector.
SQUELCH control (R-202 and S-201).	Controls noise suppression and determines what minimum level of input signal will be required for receiver operation. In OFF position it provides for no noise suppression and allows receiver to operate at maximum sensitivity.
AUDIO connector (J-202).	Provides means for connecting a chest set (with headset-microphone), a headset, a microphone, or a speaker, for separate local monitoring or push-to-talk operation of the receiver-transmitter.

58. Set 1 Power Supply

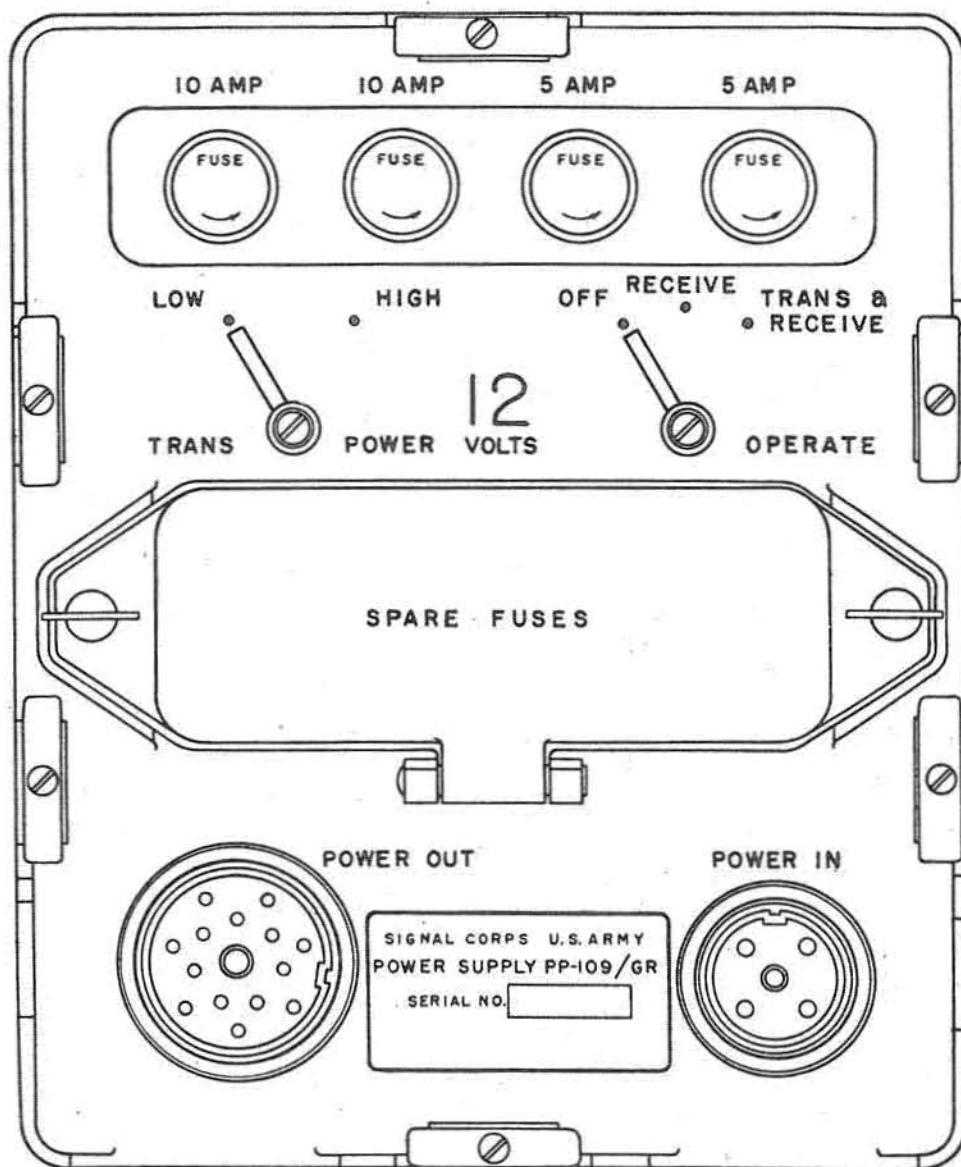
The controls for both the 12-volt and 24-volt Set 1 power supply (Power Supplies PP-109/GR and PP-112/GR, respectively) are the same. Figure 35 illustrates the panel layout of controls. The following chart lists the control functions:

Control	Function
OPERATE switch (S-1).	Controls power to Set 1 receiver-transmitter power supply. OFF: Opens battery circuit at input terminals of the power supply. RECEIVE: Completes battery circuit to receiver power-supply circuits and to receiver-transmitter relay-supply circuit. TRANS & RECEIVE: Completes battery circuit to transmitter power-supply circuits, in addition to those circuits listed under the RECEIVE position.
TRANS POWER switch (S-2).	Provides for HIGH or LOW r-f power operation of the transmitter in the HIGH and LOW positions, respectively.



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Figure 34. Set 2 panel.



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Figure 35. Set 1 power-supply panel.

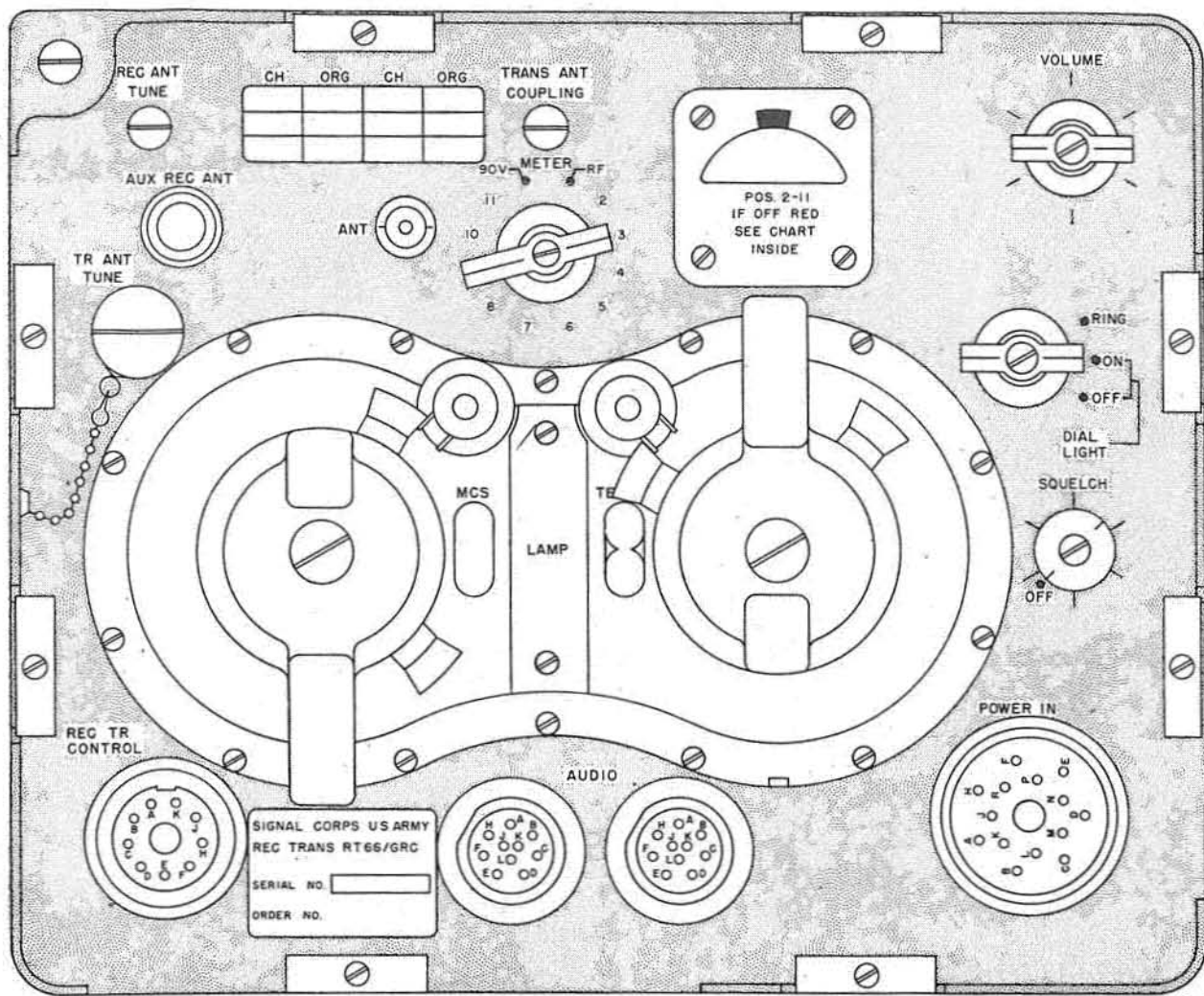


Figure 36. Set 1 panel.

59. Set 1 Receiver-Transmitter

The controls for the Set 1 receiver-transmitter (Receiver-Transmitter RT-66/GRC, RT-67/GRC, or RT-68/GRC) are illustrated in figure 36. Functions are listed in the following chart:

Control or instrument	Function
Dial LAMP (E-313)	Illuminates tuning dials except when DIAL LIGHT OFF-ON-RING switch is OFF.
DIAL LIGHT OFF-ON-RING switch (S-302).	Controls dial LAMP, microphone, and ringing oscillator circuits. OFF: Completes microphone circuit and turns dial LAMP off. ON: Completes microphone circuit and turns dial LAMP on.

Control or instrument	Function
VOLUME control (R-303).	Adjusts the audio output level to speaker and phones terminals of the panel-mounted AUDIO connectors.
SQUELCH control (R-302 and S-303).	Controls the noise suppression circuits of the receiver and determines what minimum level of input signal will be required for operation of the receiver. In OFF position, provides no noise suppression and allows receiver to operate at maximum sensitivity.

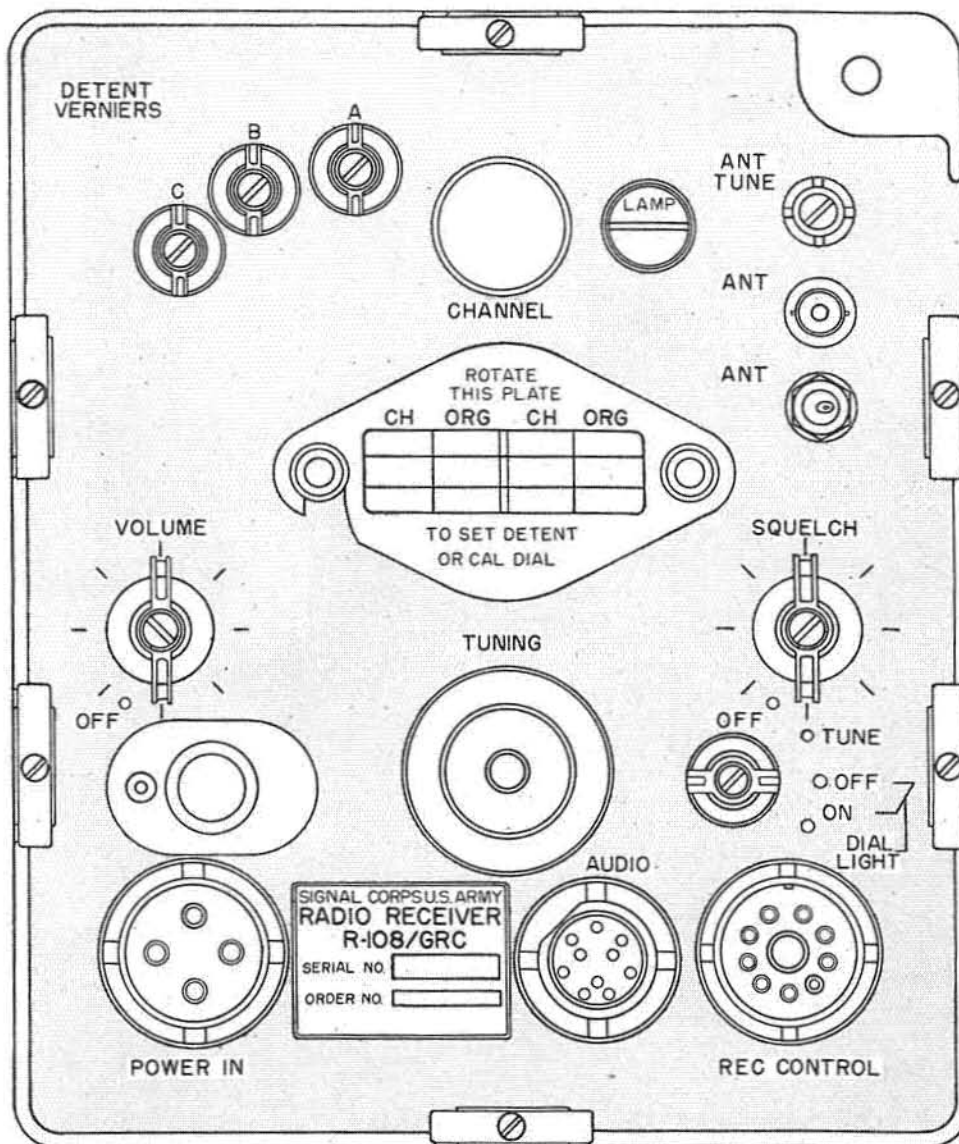
Control or instrument	Function
MCS and TENTH MCS tuning controls and dials.	Selects and indicates the operating frequency. MCS: Selects and indicates each integral mc of the tuning range in 1-mc steps. TENTH MCS: Selects and indicates the decimal portion of the operating frequency in either 100-kc steps or in a continuous sequence.
PRESET levers-----	Provide means of presetting one or two detented channels (par. 68).
METER (M-301)-----	Indicates transmitter r-f power output, filament continuity, and availability of d-c (85-volt) operating potential.
METER selector switch (S-301).	Connects METER to test points as indicated below: RF position: Connects meter to transmitter r-f output circuit. Positions 2 through 11: Connects meter to various filament circuits (par. 120). 90V position: Connects meter to 85-volt d-c supply circuit.
TR-ANT TUNE control (C-74).	Adjusts transmitter antenna-circuit tuning. (This is not an operational adjustment.)
TRANS-ANT COUPLING control (L-23).	Adjust coupling between transmitter output stage and the antenna. (This is not an operational adjustment.)
REC-ANT TUNE control (C-1A).	Adjusts receiver-antenna-circuit tuning. (This is not an operational adjustment.)
AUDIO connectors (J-310 and J-311).	Provide means of connecting chest set (with headset-microphone), microphone, headset, handset, or speaker, for separate local monitoring or push-to-talk operation of the receiver-transmitter.

60. Auxiliary Receiver

The controls and instruments of all the auxiliary receivers (Radio Receivers R-108/GRC, R-109/GRC, and R-110/GRC) are the same. The location of controls and instruments is illustrated

in figure 37; their functions are listed in the following chart:

Control or instrument	Function
Power switch and VOLUME control (S-2 and R-62).	Controls power to the receiver and audio output level to speaker and phones terminals. Battery circuit is broken at the input terminals of the unit when control is at OFF position.
Dial LAMP (E-14)---	Illuminates channel dial except when TUNE DIAL LIGHT OFF-ON switch is in OFF position.
TUNING control-----	Selects the operating frequency.
CHANNEL dial-----	Indicates the operating frequency selected by the TUNING control. Major calibrations are in mc and minor calibrations are indicated at 100-kc (.1-mc) intervals.
Detent adjustments---	Provide means of presetting any three frequencies within the range of the receiver. (Located beneath diamond-shaped plate near center of the panel).
DETENT VERNIERS.	Provide a fine adjustment on the setting of the detents.
TUNE DIAL LIGHT OFF-ON switch (S-3).	Controls operation of the tuning oscillator and dial light.
	TUNE: Turns on oscillator and couples oscillator output to r-f amplifier; turns on dial LAMP.
	DIAL LIGHT ON: turns on dial LAMP.
	DIAL LIGHT OFF: turns off dial LAMP.
SQUELCH control (R-65 and S-4).	Controls noise suppression and determines what minimum level of input signal will be required for receiver operation. In OFF position provides for no noise suppression and allows receiver to operate at maximum sensitivity.
ANT TUNE control (C-4).	Provides means of tuning antenna circuit.
AUDIO connector (J-7).	Provides means for connecting a headset or speaker for separate local monitoring of the receiver.



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Figure 37. Panel of auxiliary receiver.

61. Interphone Box

The controls on the interphone boxes (Control

Box C-375/VRC) are illustrated in figure 38. Functions are listed in the following chart:

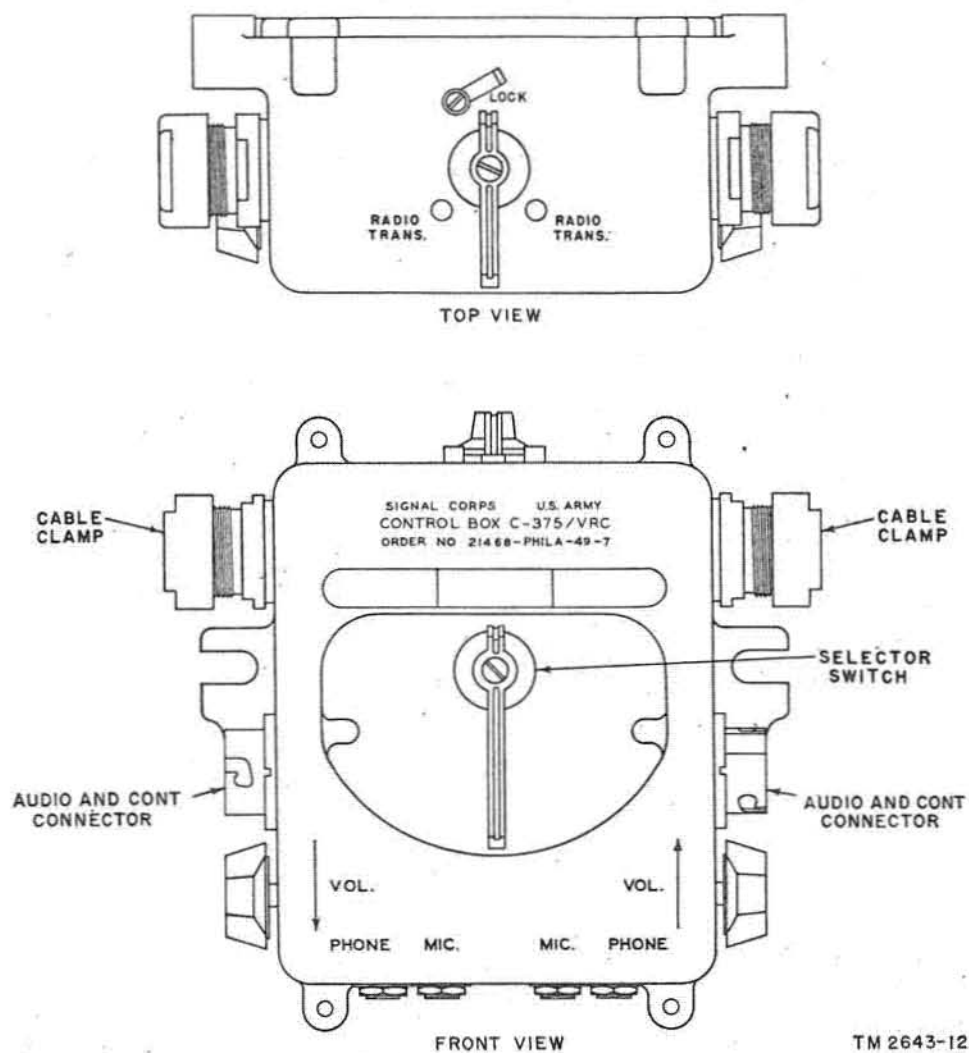


Figure 38. Panel views of interphone box.

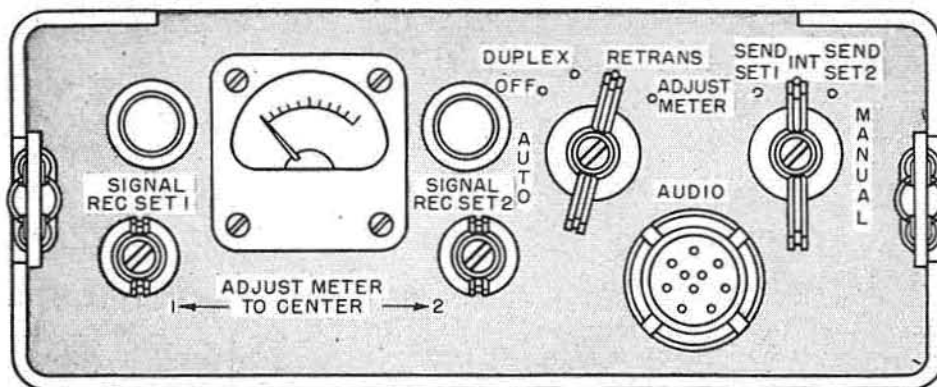
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Control	Function	Control	Function
Selector switch (S-1)	Selects inputs and outputs of receiver-transmitters and interphone amplifier for transmission, intercommunication, and monitoring. Counterclockwise position: Selects the output of Set 1 and the interphone amplifier for monitoring; selects the input of Set 1 for transmission if the RADIO TRANS switch is also operated. Center position: Selects the output of both Sets 1 and 2 and the interphone amplifier for monitoring; selects the input of the interphone amplifier for intercommunication. Clockwise position: Selects the output of Set 2 and the interphone amplifier for monitoring; selects the input of Set 2 for transmission if the RADIO TRANS switch is also operated.	VOL. controls (R-1 and R-2)	Determine signal levels at PHONE jacks and audio connectors. (Level at each PHONE jack and audio connector is affected by the VOL. control nearest the jack or connector.)
RADIO TRANS. switch (S-2)	Provides for either intercommunication or radio transmission.	Audio connectors (J-1 and J-2)	Provide for connection of Chest Set Group AN/GSA-6 (with Headset-Microphone H-63/U) for operation of the receiver-transmitters and interphone amplifier.
	Center position: Selects the interphone amplifier for intercommunication.	MIC. jacks (J-3 and J-4)	Provide for connection of Microphone T-17 for operation of receiver-transmitters and interphone amplifier. (Efficiency of operation will be affected by such usage and is not normally advisable if the standard audio accessories are available.)
	RADIO TRANS positions: Completes the Set 1 or Set 2 transmitting circuit as determined by the setting of the selector switch (above).	PHONE jacks (J-5 and J-6)	Provide for connection of Headset H-16/U or Headset HS-30 in combination with Cord CD-933 for monitoring the receiver-transmitters and interphone amplifier. (Efficiency of operation will be affected by such usage and is not normally advisable if the standard audio accessories are available.)

62. Retransmission Unit

The panel of the retransmission unit (Control C-435/GRC) is illustrated in figure 39. Func-

tions of the panel-mounted controls and instruments are listed in the following chart:



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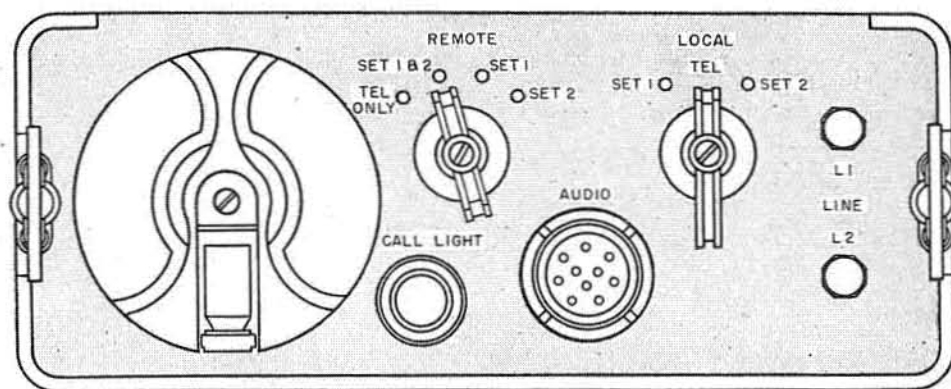
Figure 39. Panel of retransmission unit.

Control or instrument	Function
MANUAL switch (S-2).	Provides for push-to-talk operation over Set 1, Set 2, or the interphone amplifier in the SEND SET 1, SEND SET 2, or INT position, respectively.
AUTO switch (S-1)----	Provides for duplex and retransmission operation of Sets 1 and 2. OFF: Allows for the push-to-talk operation described above. DUPLEX: Allow for duplex operation utilizing Set 1 as a transmitter and Set 2 as a receiver. RETRANS: Allows for retransmission utilizing Sets 1 and 2. ADJUST METER: Connects panel-mounted meter into the retransmission circuit to act as a level indicator.
METER (M-1)-----	Provides means of monitoring the level of retransmitted signals.
ADJUST METER TO CENTER controls 1 & 2 (R-4 and R-5).	Provide means of setting the level of the retransmitted signals.

Control or instrument	Function
SIGNAL REC SET 1 or SIGNAL REC SET 2 lamps (E-1 E-2).	Indicate which set is receiving during retransmission operation. Dimmer controls provide means of masking the glow of the lamps.
AUDIO connector (J-2).	Provides means of connecting a chest set (with headset and microphone) for monitoring and push-to-talk operation of Set 1, Set 2 or the interphone amplifier, or for connecting a headset or speaker for monitoring retransmission. (In Radio Sets AN/GRC-3, -5, and -7, it provides the facility for monitoring auxiliary receiver also.)

63. Local Control C-434/GRC

Figure 40 illustrates the layout of controls and instruments on Local Control C-434/GRC. The following chart lists the functions of controls and instruments:



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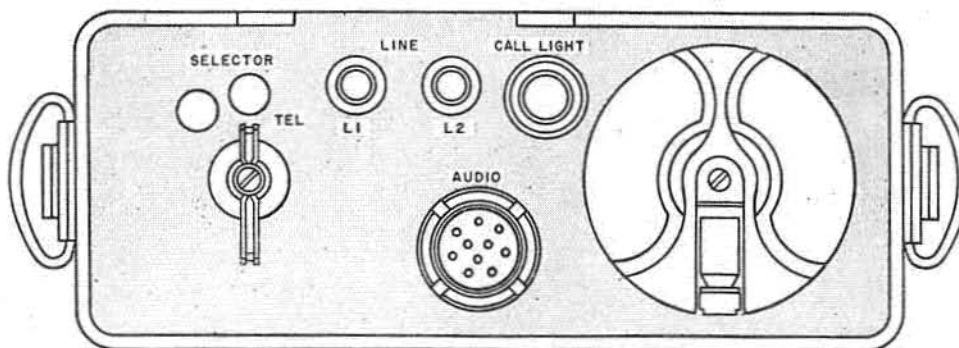
Figure 40. Panel view of local control unit.

Control or instrument	Function
LOCAL switch (S-3)---	Provides for push-to-talk operation of either Set 1 or Set 2 and for duplex telephone operation with the remote unit. SET 1: Allows push-to-talk operation of Set 1. SET 2: Allows push-to-talk operation of Set 2. TEL: Allows telephone operation with remote unit.
REMOTE switch (S-1).	In conjunction with controls at remote unit, provides for remote control of power for the radio set and/or remote control of push-to-talk operation of Sets 1 and 2. Also provides means of limiting operation (at the remote unit) to telephone communication. TEL ONLY: Allows for telephone communication between local and remote control units, and breaks power and push-to-talk remote control circuits. SET 1 & 2: Provides for remote control of push-to-talk operation of Sets 1 and 2. SET 1: Provides for remote control of power for the radio set and push-to-talk operation of Set 1.

Control or instrument	Function
LINE L1 and L2-----	Provide telephone-line connections.
Ringing generator-----	Provides means of sending a ringing signal to the remote unit.
CALL LIGHT (E-3)---	Indicates (when lit) that a ringing signal is being received from the remote unit. (CALL LIGHT indication can be replaced by a bell, by means of an internal switch.) Dimmer control provides for masking glow of the lamp.
AUDIO connector (J-1).	Provides means of connecting a hand-set or chest set (with headset and microphone) for telephone communication and push-to-talk operation of the radio set.

64. Remote Control C-433/GRC

Figure 41 illustrates the controls and instruments on Remote Control C-433/GRC. The following chart lists the functions of controls and instruments:



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Figure 41. Panel view of remote control unit.

Control or instrument	Function
SELECTOR switch (S-2).	In conjunction with controls at local unit, provides for remote control of power for the radio set and/or push-to-talk operation of Sets 1 and 2; also provides means of limiting operation to telephone communication. Left write-in position: A power-off position or Set 2 remote control position depending upon setting of REMOTE switch in local control unit.* Right write-in position: A power-on position, or a remote control position for Set 1, depending upon setting of REMOTE switch in local control unit.* TEL position: limits operation to telephone communication between local and remote units.

Control or instrument	Function
LINE L1 and L2-----	Provide telephone-line connections.
Ringin9 generator-----	Provide means of sending a ringing signal to the local control unit.
CALL LIGHT (E-3) --	Indicates (when lit) that a ringing signal is being received from the local unit. (CALL LIGHT indication can be replaced by a bell by means of an internal switch.) Dimmer control provides for masking glow of the lamp.
AUDIO connector (J-1).	Provides means of connecting a handset for telephone communication and operation of the radio set.

*The functions of the write-in positions will be reversed by the reversal of the telephone-line connections at either the local or remote control unit.

Section III. TUNING

65. Interference Charts for Sets 1 and 2

a. INTERFERENCE PROBLEMS. The tuning of Sets 1 and 2 involves not only the simple mechanics of control settings (pars. 68 and 69), but also a problem of frequency selection. Frequency selections must be made to avoid interference between the two receiver-transmitters. Interference charts (figs. 42 through 47) have been prepared to indicate those frequencies at which interference-free operation can be expected with Set 1 transmitting and Set 2 receiving or vice versa. Figures 42 and 43 pertain to Radio Sets AN/GRC-3 and -4 which utilize Receiver-Transmitter RT-66/s GRC as Set 1; figures 44 and 45 pertain to Radio Sets AN/GRC-5 and -6 which utilize Receiver-Transmitter RT-67/GRC as Set 1; and figures 46 and 47 pertain to Radio Sets AN/GRC-7 and -8 which utilize Receiver-Transmitter RT-68/GRC as Set 1.

b. NATURE OF CHARTS. Each square on the interference charts represents the intersection of two frequencies, one plotted from left to right for Set 2, the other plotted from bottom to top for Set 1. On figure 42, for example, Set 2 transmitting frequencies are plotted from left to right across the chart and Set 1 receiving frequencies are plotted from bottom to top of the chart. The

filled-in squares represent those frequencies at which interference can be expected for the particular mode of operation indicated on the chart; the blank squares represent the frequencies at which interference-free operation can be expected. (Note that the spaces, not the lines, are calibrated.)

c. USE OF CHARTS. To illustrate the use of the charts, assume that Set 1 is to be used for push-to-talk operation at 28 mc (in Radio Sets AN/GRC-5 or -6) and Set 2 is to be used for monitoring at 49.6 mc. Reference to figure 45 reveals that the intersection of the 28-mc squares (Set 1 transmitting) and the 49.6-mc squares (Set 2 receiving) is a filled-in square. Those particular frequencies, therefore, cannot be used simultaneously. If the transmitting frequency is changed to 28.1 mc, however, the intersection is a blank square. Therefore, monitoring at 49.6 mc on Set 2, with push-to-talk operation at 28.1 mc on Set 1, is possible without interference.

66. Set 1, Set 2 Frequency Selections

a. Frequency selections on Sets 1 and 2 should be made with the aid of the interference charts described in paragraph 65. The mode of operation desired; for example, push-to-talk operation

of Set 2 or duplex operation on Sets 1 and 2 should first be determined, and then the appropriate chart or charts should be consulted to determine what interference-free frequencies are available for the particular tactical application involved. The operational modes and the charts which apply to each mode are listed below.

Operational Modes	Radio Sets	Chart
Push-to-talk operation of Set 1; monitoring on Set 2.	AN/GRC-3 and -4.	fig. 43
Duplex operation, with Set 1 transmitting and Set 2 receiving.	AN/GRC-5 and -6. AN/GRC-7 and -8.	fig. 45 fig. 47
Push-to-talk operation of Set 2; monitoring on Set 1.	AN/GRC-3 and -4. AN/GRC-5 and -6. AN/GRC-7 and -8.	fig. 42 fig. 44 fig. 46

Operational Modes	Radio Sets	Chart
Retransmission involving Set 1 transmitting and Set 2 receiving and vice versa.	AN/GRC-3 and -4. AN/GRC-5 and -6. AN/GRC-7 and -8.	figs. 42 and 43 figs. 44 and 45 figs. 46 and 47

b. For retransmission each set may be used alternately as a receiver and as a transmitter. It is necessary, therefore, that the possibility of interference be checked for both conditions of operation. For example, when Radio Set AN/GRC-3 or -4 is being used for retransmission operation, the frequencies of operation must be checked on figure 42 for the Set 2 Transmitting-Set 1 receiving condition, and on figure 43 for the Set 2 Receiving-Set 1 transmitting condition.

RT-66/GRC (SET 1) RECEIVING
RT-70/GRC (SET 2) TRANSMITTING

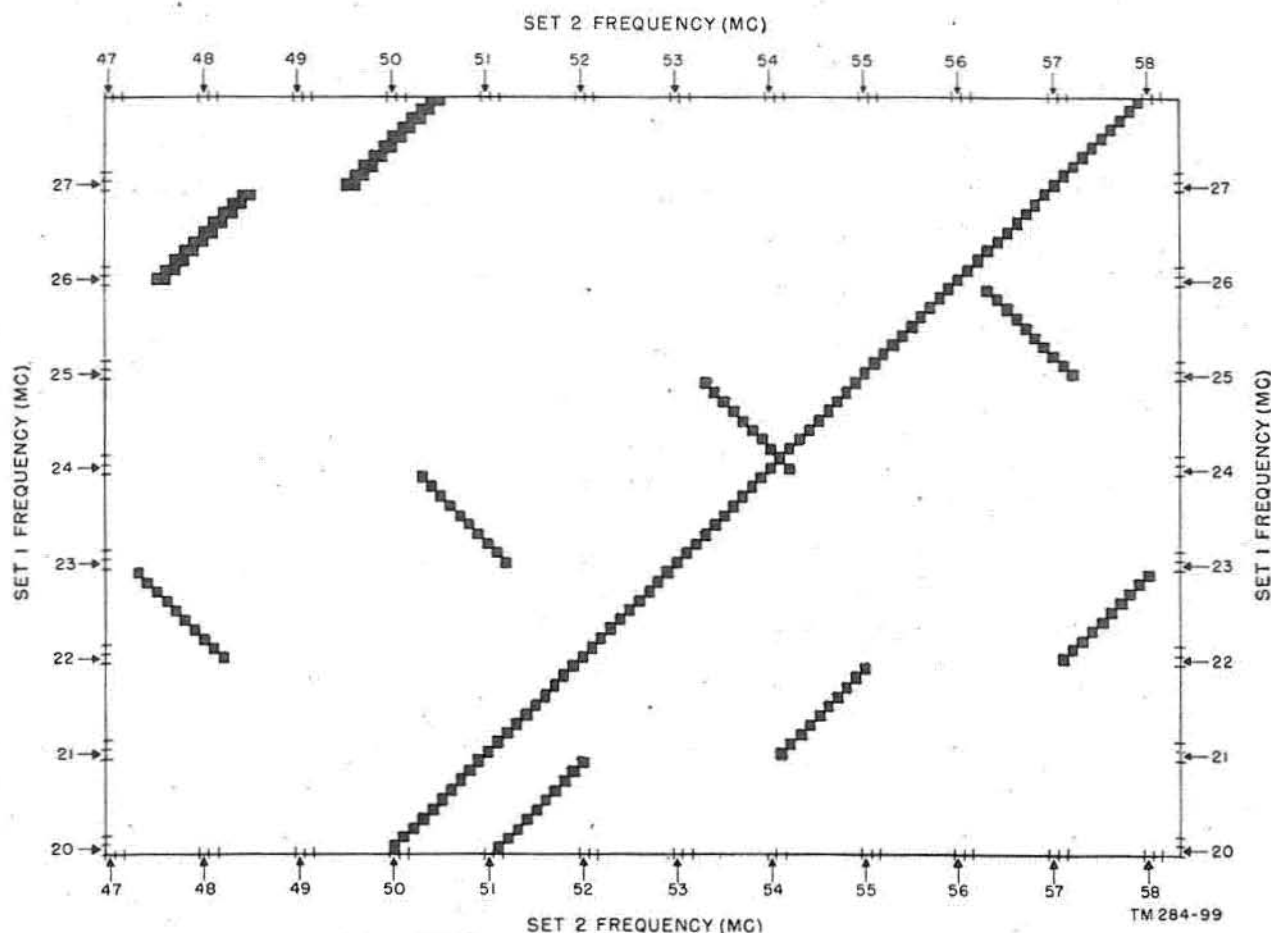


Figure 42. Set 1, Set 2 interference chart No. 1 for radio sets AN/GRC-3 and -4.

RT-66/GRC (SET 1) TRANSMITTING
RT-70/GRC (SET 2) RECEIVING

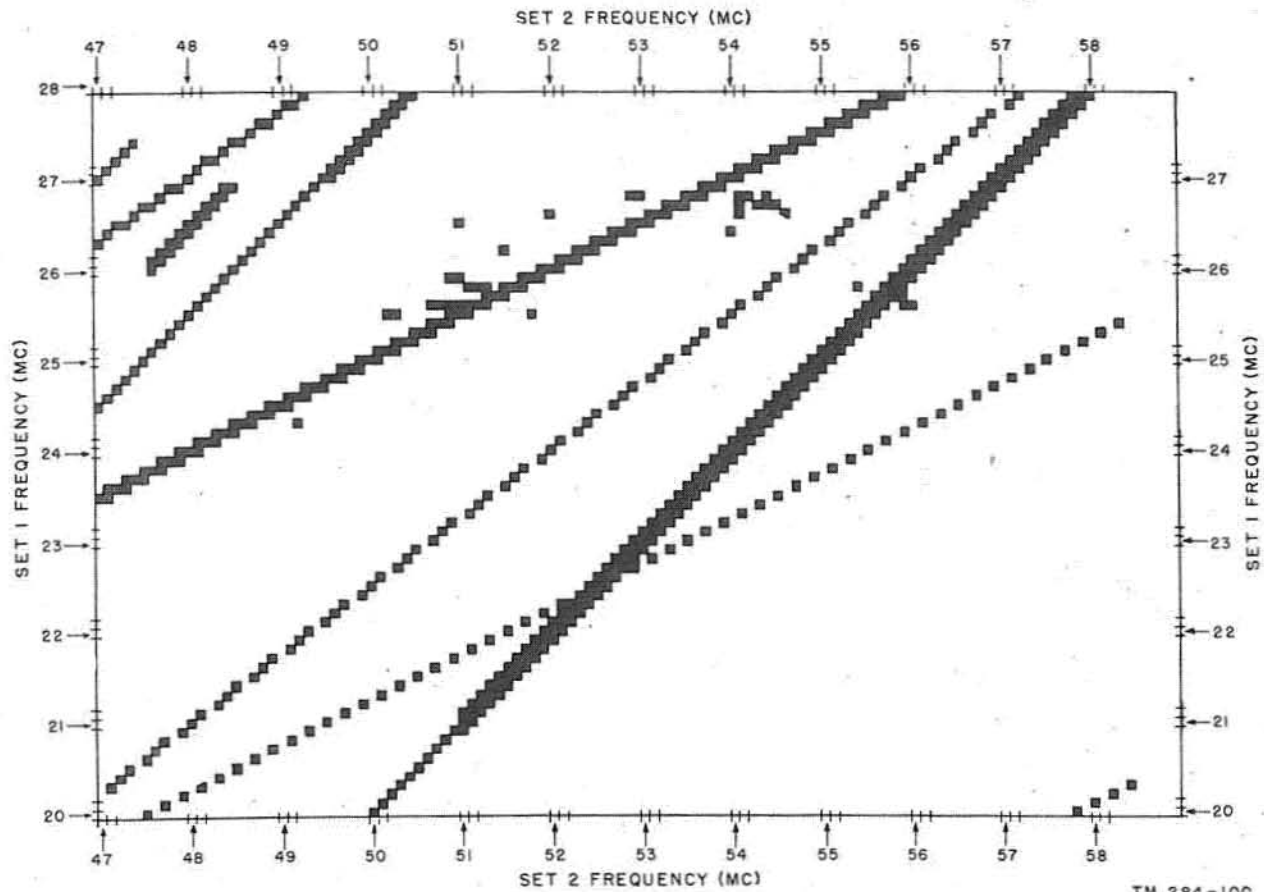


Figure 43. Set 1, Set 2 interference chart No. 2 for radio sets AN/GRC-3 and -4.

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RT-67/GRC (SET 1) RECEIVING
RT-70/GRC (SET 2) TRANSMITTING

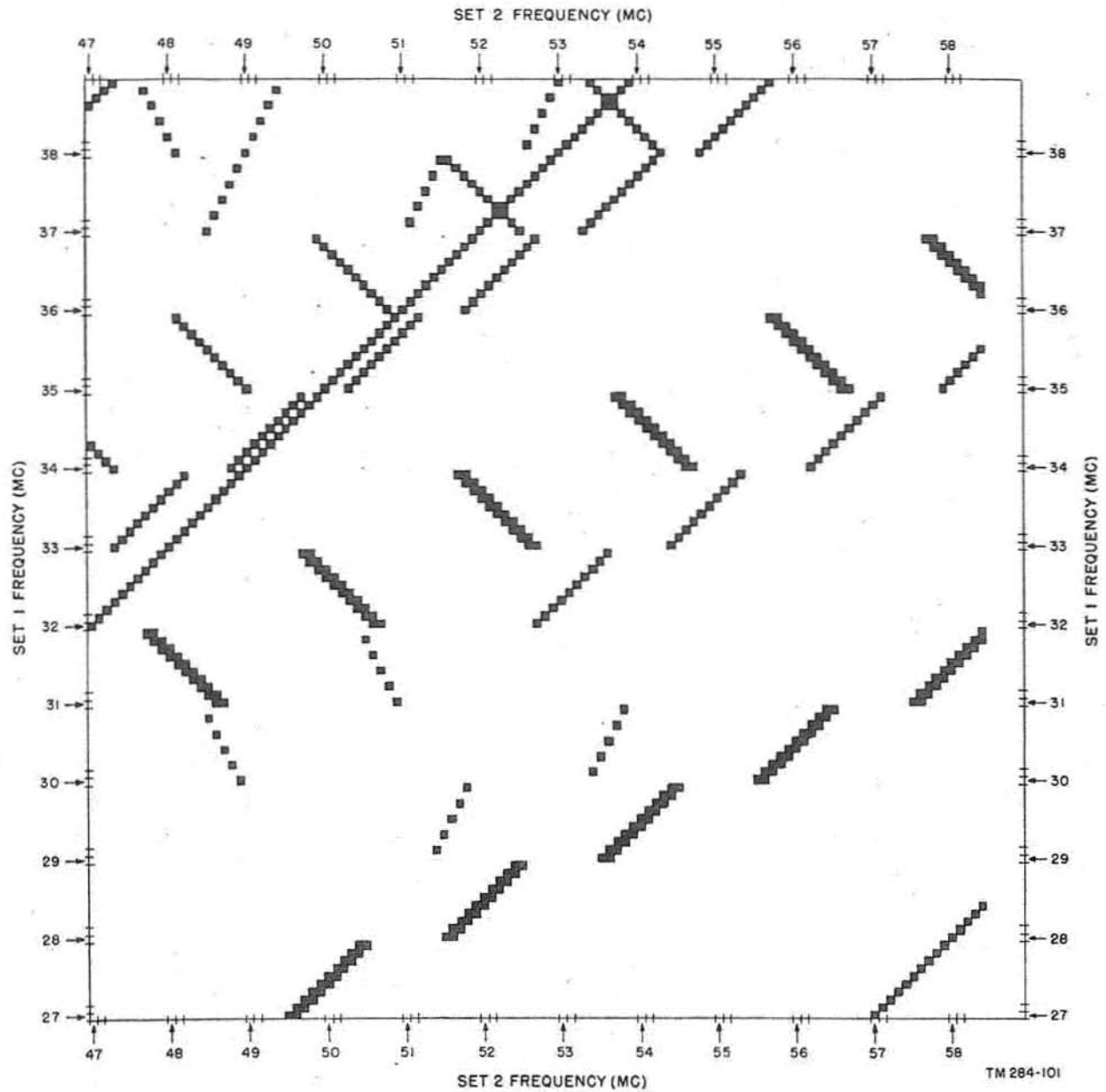
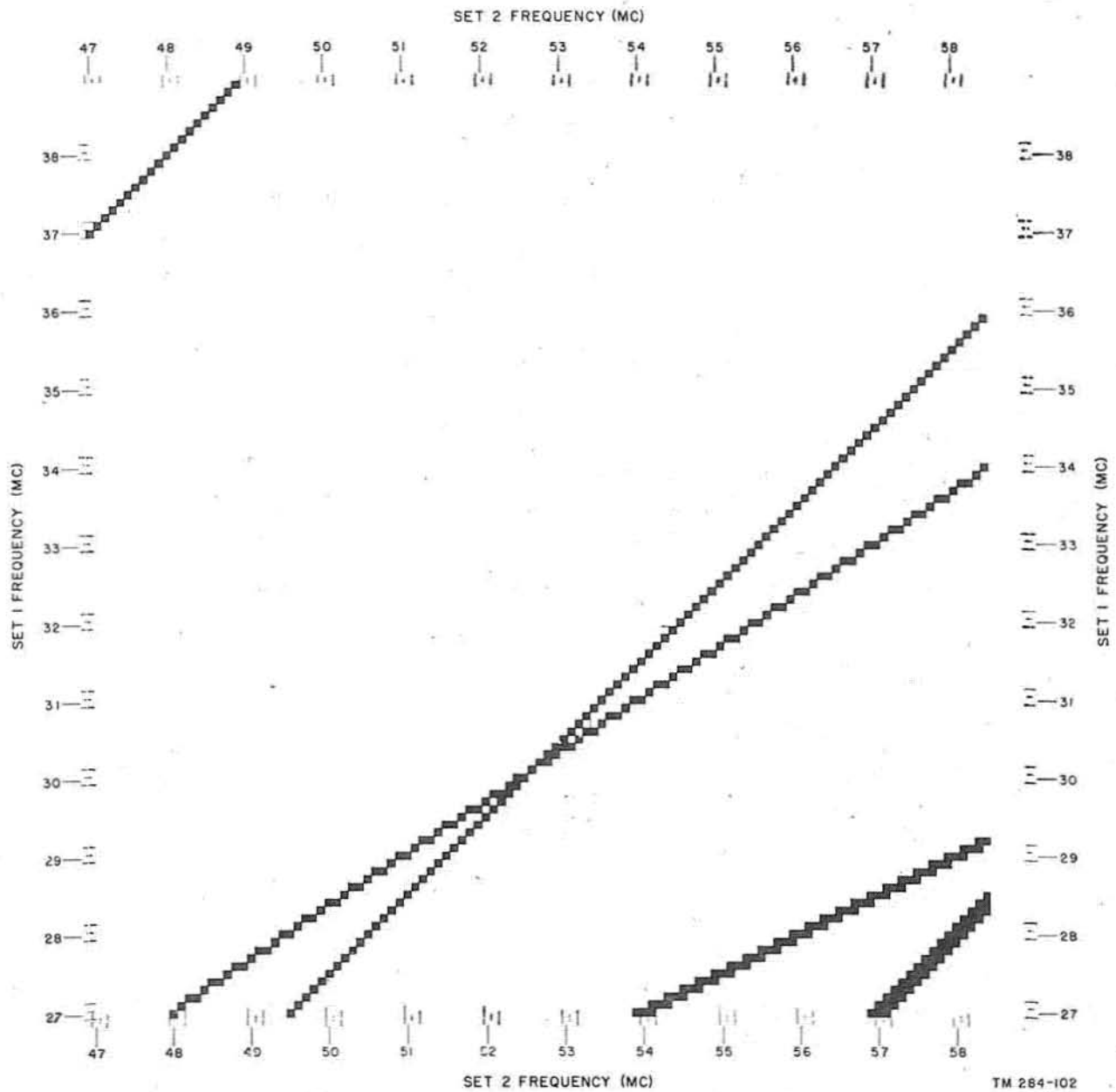


Figure 44. Set 1, Set 2 interference chart No. 1 for radio sets AN/GRC-5 and -6.

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RT-67/GRC (SET 1) RECEIVING
RT-70/GRC (SET 2) TRANSMITTING



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Figure 45. Set 1, Set 2 interference chart No. 2 for radio sets AN/GRC-5 and -6.

RT-68/GRC (SET 1) RECEIVING
RT-70/GRC (SET 2) TRANSMITTING

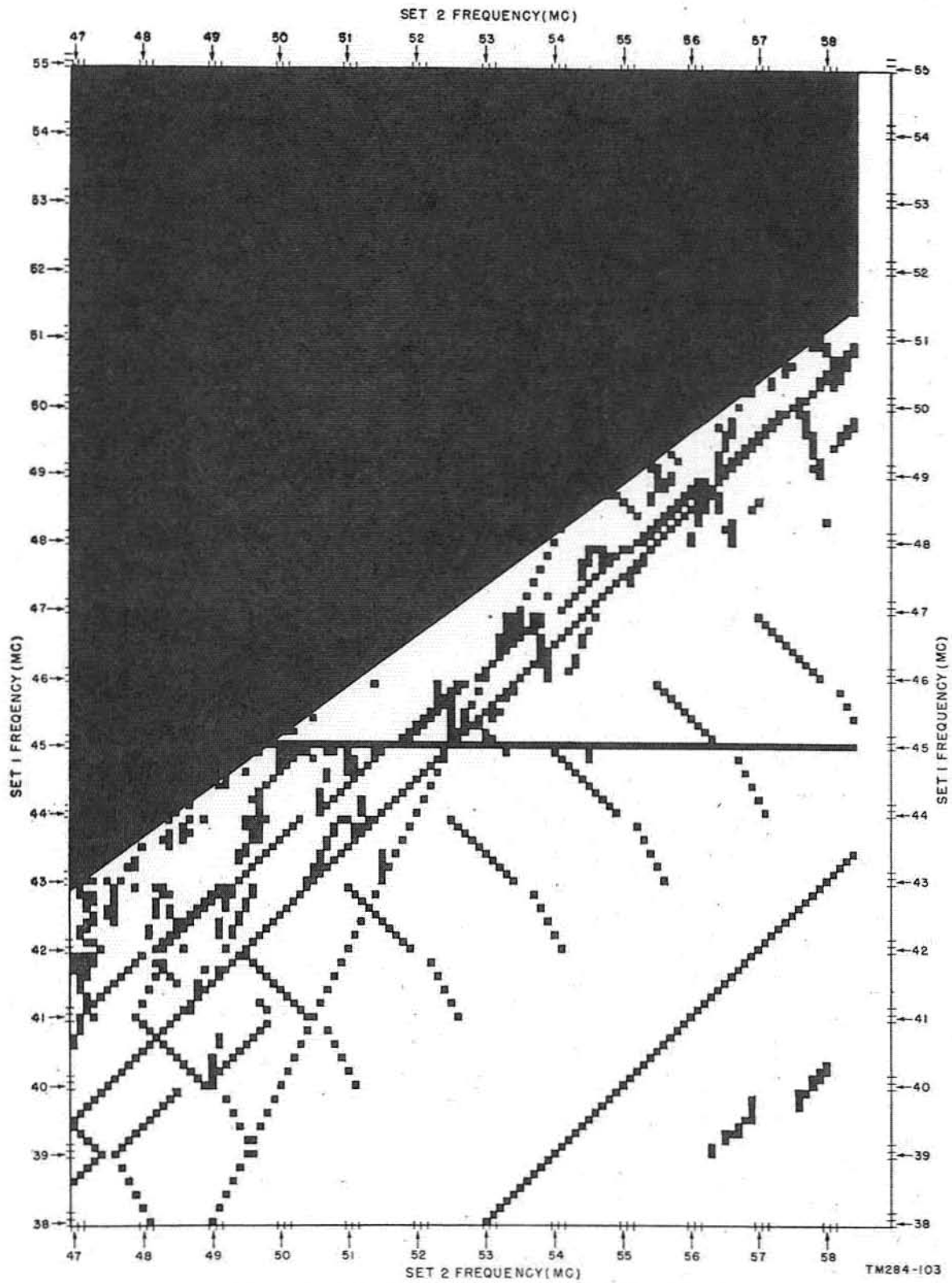


Figure 46. Set 1, Set 2 interference chart No. 1 for radio sets AN/GRC-7 and -8.

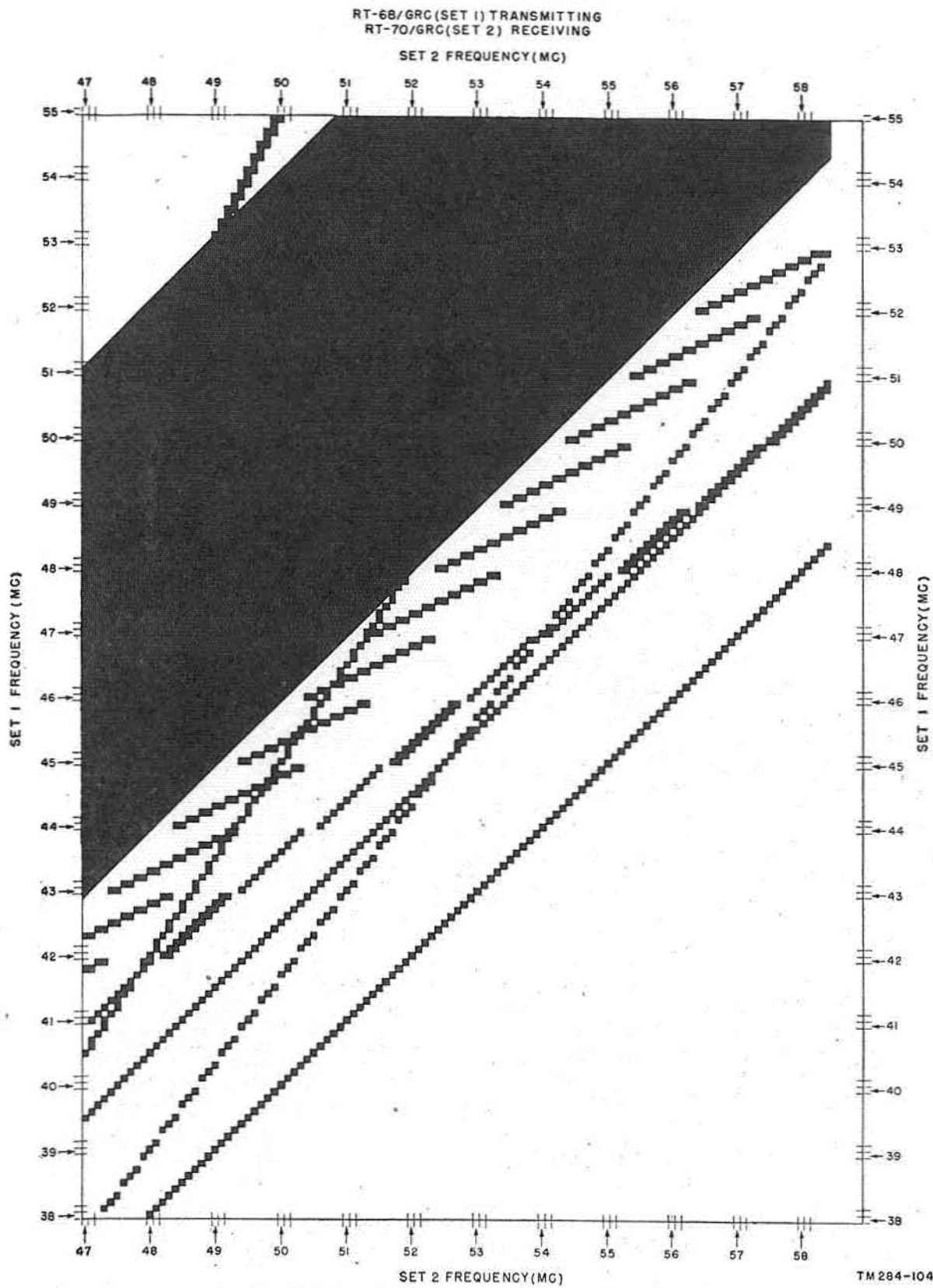


Figure 47. Set 1, Set 2 interference chart No. 2 for radio sets AN/GRC-7 and -8

67. Interference With Auxiliary Receivers

In Radio Sets AN/GRC-3, -5, and -7, which utilize auxiliary receivers, additional interference problems are present. Trial-and-error methods will have to be used to determine what transmitting frequencies are possible without interference. If the auxiliary receiver is not needed, it can be turned off so that the Set 1, Set 2 interference problems will be the only ones to combat.

68. Tuning Set 1

Once the antenna circuits have been properly tuned (par. 42), Set 1 can be tuned to any desired channel frequency by merely turning the MCS and TENTH MCS controls to the proper detent positions in *a* below. Continuous tuning between channels is possible by means of the procedure outlined in *b* below. Any two detented channels may be preset for rapid selection by means of the procedure outlined in *c* below.

a. CHANNEL TUNING. Channel tuning is possible at every 100-kc interval between the lower and upper ends of the tuning range.

- (1) Turn the MCS control until the MCS dial indicates the integral portion of the desired frequency, for example, until the dial indicates 24 when the desired frequency is 24.8 mc.
- (2) Turn the TENTH MCS control until the TENTH MCS dial indicates the decimal portion of the desired frequency, for example, until the dial indicates 8 when the desired frequency is 24.8 mc.

b. CONTINUOUS TUNING. Continuous tuning throughout the range of Set 1 is possible by releasing the channel-detent mechanism of the TENTH MCS dial.

- (1) Turn the MCS control (as for channel tuning) until the MCS dial indicates the integral portion of the desired frequency.
- (2) Turn the TENTH MCS control to the extreme counterclockwise position to release the detent mechanism.
- (3) Turn the TENTH MCS control clockwise until the TENTH MCS dial indicates the decimal portion of the desired frequency. (Calibration marks between the major 100-kc (0.1-mc) divisions represent 25-kc (0.025-mc) intervals; when the MCS dial indicates 24, a

frequency of 24.85 mc is selected by turning the TENTH MCS control until the second calibration mark between 8 and 9 appears opposite the indicator on the TENTHS MCS dial.)

c. PRESETTING DETENTED CHANNELS. Presetting is obtained by means of stops which limit the rotation of the tuning knobs. The stops can be swung into place for presetting (or removed when the presetting feature is not desired) by means of adjusting knobs. When in place for presetting, the stops will engage the green and the red levers on the tuning controls as the controls are rotated. The positions of the red and the green levers can be changed so that the stops will function for any desired frequency. To preset any two frequencies perform the following steps.

- (1) Turn the MCS and TENTH MCS tuning controls until the higher of the desired frequencies is indicated on the tuning dials.
- (2) Pull on the stop adjusting-knobs (against the spring tension which holds them locked against the panel) and turn the knobs so that the stops are positioned to engage the green and the red preset levers. Make certain that the stops lock into position.
- (3) Loosen (but do not remove) the screw which secures the MCS tuning control.
- (4) Turn the green lever on the MCS control in a clockwise direction until it strikes against the stop. Hold the lever against the stop and tighten the screw on the tuning control.
- (5) Loosen (but do not remove) the screw which secures the TENTH MCS tuning control.
- (6) Compare the tenths portions of the two frequencies which are to be preset and set the green preset lever on the TENTH MCS control in one of the following ways:
 - (a) If the tenths portion of the lower preset frequency is higher than the tenths portion of the higher preset frequency, turn the green lever in a clockwise direction until it strikes the stop. Hold the lever against stop and tighten the screw on the tuning control.
 - (b) If the tenths portion of the lower preset frequency is lower than the

tenths portion of the higher preset frequency, turn the green lever in a counterclockwise direction until it strikes the stop. Hold the lever against the stop and tighten the screw on the tuning control.

- (7) Turn the MCS and TENTH MCS controls until the lower of the desired frequencies is indicated on the tuning dials.
- (8) While holding the green lever in place, loosen the screw on the MCS tuning control and turn the red lever in a counterclockwise direction until it strikes the stop. Tighten the screw on the tuning control.
- (9) The setting of the red lever on the TENTH MCS control depends upon the setting of the green lever ((6) above). If the green lever was set in a counterclockwise position, set the red lever in a clockwise position and vice versa.

Note. In describing the presetting procedure, it was assumed that the green preset levers would be used for the higher frequency and the red levers for the lower frequency. The opposite convention is equally suitable, but consistency in either convention is desirable.

69. Tuning Set 2

a. TUNING AND CALIBRATING. When tuning Set 2, the tuning dial should always be calibrated at the nearest mc calibration. Perform the following steps:

- (1) Apply power to the set by placing the OFF-INT-RT-70 switch of the interphone amplifier in the RT-70 position, and the OFF-REMOTE-ON switch of the mounting in the ON position.
- (2) Provide a means of monitoring. (A headset at the panel AUDIO connector, at a convenient interphone box, or the retransmission unit will be adequate.)
- (3) Turn the TENTH MCS tuning control until the integral mc calibration nearest the desired frequency is indicated on the MCS dial.
- (4) Adjust the SQUELCH control to obtain noise output in the headset.
- (5) Turn the ANT ADJ-DIAL LIGHT ON-OFF-CAL switch to the CAL position

and listen for a beat note or zero-beat indication in the headset. Adjust the TENTH MCS tuning control slightly, if necessary, until the zero-beat indication is obtained. The zero beat is an indication that the receiver-transmitter is tuned to the integral mc indicated on the MCS dial.

- (6) If the zero calibration of the dial on the TENTH MCS control is not exactly opposite the calibration mark on the panel, hold the control and move the calibration plate physically until the calibrations are in line with each other.
- (7) Turn the TENTH MCS tuning control to obtain the exact frequency desired. Each calibration is .1 mc.

b. PRESETTING. Provisions are available for detenting any two frequencies. Perform the following steps:

- (1) Release the two PRESET levers by turning each of them to the horizontal position.
- (2) Turn the TENTH MCS tuning control over its entire range (from one end to the other) before selecting the desired frequency. Calibrate and tune the receiver-transmitter to one of the desired frequencies as outlined in subparagraph *a* above.
- (3) Turn one of the PRESET levers to the locking (vertical) position. Mark the preset frequency on the label provided.
- (4) Calibrate and tune the receiver-transmitter to the second desired frequency.
- (5) Turn the second PRESET lever to the locking (vertical) position and mark the preset frequency on the label.

Note. Unless the preset frequencies are labeled or recorded, it is impossible to tell which lever controls which detented frequency.

70. Tuning the Auxiliary Receiver

a. TUNING AND CALIBRATING. When the auxiliary receiver is tuned, it should be calibrated at the nearest calibration point. Perform the following steps:

- (1) Apply power to the receiver by turning the receiver VOLUME control in a clockwise direction and placing the OFF-

REMOTE-ON switch of the mounting in the ON position.

- (2) Provide a means of monitoring. A headset on the panel AUDIO connector, a convenient interphone box, or the retransmission unit is adequate.
- (3) Turn the TUNING control until the calibrate frequency nearest to the desired frequency is indicated on the CHANNEL dial. The calibrate frequencies for the respective receivers are shown in the following chart; they are indicated on the dial by red dots.

Radio Set	Radio Receiver	Calibrate Frequencies
AN/GRC-3----	R-108/GRC----	21.5 and 25.8 mc.
AN/GRC-5----	R-109/GRC----	30.1, 34.4, and 38.7 mc.
AN/GRC-7----	R-110/GRC----	38.7, 43.0, 47.3, and 51.6 mc.

- (4) Adjust the SQUELCH control to obtain noise output in the headset.
- (5) Hold the TUNE DIAL LIGHT-OFF-ON switch to the TUNE position and listen for a beat note or zero-beat indication in the headset. Adjust the TUNING control slightly, if necessary, until the zero-beat indication is obtained. The zero beat is an indication that the receiver is tuned to the calibrate frequency. If the dial setting is incorrect, it can be corrected mechanically by turning the screw which holds the dial index. The correction screw is located under the diamond-shaped plate beneath the channel dial.

- (6) Turn the TUNING control until the desired frequency is indicated on the CHANNEL dial.

b. PRESETTING. Provisions are available for presetting any three frequencies. Perform the following steps.

- (1) Loosen both thumbscrews on the diamond-shaped plate beneath the channel dial. Swing the plate out of the way to allow access to the detent adjustments beneath the plate.
- (2) Turn each of the detent adjustment-screws in a counterclockwise direction to release all previous adjustments. Turn the TUNING control from one end of its range to the other to make all of the detents available.
- (3) Calibrate and tune the receiver to one of the desired frequencies as outlined in a above.
- (4) Turn the DET A adjustment screw in a clockwise direction to set the detent mechanism for the frequency selected.
- (5) Check the tuning at the detented frequency when a signal is received. If the signal is distorted it may be possible to refine the tuning by adjustment of DETENT VERNIER A on the panel of the receiver.
- (6) Repeat steps (3), (4), and (5) for each of the other desired frequencies, using the DET B and DET C controls and DETENT VERNIER B and C controls.

Note. When the dial is set to a detented channel, a small flag drops down into position in the upper part of the window. The flag is identified by the letter (A, B, or C) of the detent adjustment which has been used to preset that particular frequency.

Section IV. OPERATION

71. Operational Procedures

a. Operation of the radio sets involves the following basic procedures:

- (1) Start-stop operations.
- (2) Squelch adjustments.
- (3) Volume-level adjustments.
- (4) Tuning.
- (5) Transmit-control operations.

b. The first four of the above-listed procedures are local operations (performed at the panels of the various major units) and are not necessarily repeated during a normal operating period. (It may be necessary to repeat tuning and squelch adjustments as occasion demands.) The transmit-control operations are performed at one or the other of the control units and are continually repeated during normal operating periods.

c. To facilitate ready reference, the local operations and the transmit-control operations are discussed under separate headings in the following paragraphs (pars. 72 through 78).

72. Preliminary Starting Procedure

The preliminary starting procedure prepares the equipment for routine operation by setting controls so that routine starting and stopping may be limited to use of the OFF-REMOTE-ON switch on the mounting. Unless control settings are disturbed subsequent to shut-down of the equipment, it will not be necessary to repeat the preliminary starting procedure during routine operation.

a. With the OFF-REMOTE-ON switch of the mounting in the OFF position, place the OFF-INT-RT-70 switch of the interphone amplifier in the RT-70 position.

b. Turn the SQUELCH control of Set 2 to the maximum clockwise position.

c. Turn the VOLUME control of Set 2 to the approximate mid-point of its range.

d. Turn the OPERATE switch of the Set 1 power supply to the TRANS and RECEIVE position.

e. Turn the TRANS POWER switch of the Set 1 power supply to the HIGH position.

f. Turn the SQUELCH control of Set 1 to the maximum clockwise position.

g. In Radio Sets AN/GRC-3, -5 and -7, turn the SQUELCH control of the auxiliary receiver to the maximum clockwise position.

73. Routine Starting Procedure

When the controls have been set (or left set) as outlined in the preliminary starting procedure, apply power to the radio set by placing the OFF-REMOTE-ON switch of the mounting in the ON position.

74. Squelch and Volume-Level Adjustments

The SQUELCH controls of Set 1, Set 2, and the auxiliary receiver should be set as soon as the equipment is placed in operation. The settings should be checked periodically to insure operation at maximum sensitivity for the particular noise conditions present. Set the controls as outlined below (steps a through d). While making the

Set 2 adjustment, also adjust the VOLUME control as directed in step below.

a. Provide a monitor for the receivers. The monitor may be a chest set (with headset and microphone) connected to the AUDIO connector on the retransmission unit, local control unit, or interphone box. If an interphone box is used, turn the selector switch of the box to the center position.

b. Turn the Set 1 SQUELCH control counter-clockwise until noise is audible in the headset. Note the approximate signal level present in the headset. Then advance the control in a clockwise direction to the point at which the receiver quiets.

c. Repeat step b above with the SQUELCH control of Set 2. Before silencing the receiver, adjust the VOLUME control to obtain approximately the same signal level as was obtained from Set 1.

d. Repeat step b above for the auxiliary receiver.

Note. When the tuning of the set is changed, it may be necessary to reset the SQUELCH controls.

75. Tuning

Simultaneous operation of Set 1, Set 2, and the auxiliary receiver involves interference problems. The interference problems must be considered as well as the mechanics of tuning.

a. Provide a monitor as instructed in paragraph 74a.

b. Consult the appropriate interference chart (par. 66) for the mode of operation to be used.

c. Tune Set 1 to the selected frequency as outlined in paragraph 68.

d. Tune Set 2 to the selected frequency as outlined in paragraph 69.

e. Tune the auxiliary receiver (in Radio Sets AN/GRC-3, -5, and -7) to the selected frequency as outlined in paragraph 70. Interference problems between the auxiliary receiver and Set 1 or Set 2 will have to be solved by a trial-and-error method.

f. Reset the SQUELCH controls (par. 74) if required.

76. Operation From Interphone Box

a. **MODES OF OPERATION.** When power has been supplied to the radio sets, squelch adjustments have been made, and Set 1, Set 2, and the

auxiliary receiver have been tuned, the following modes of operation are possible at the interphone box.

- (1) Monitoring of Set 1, Set 2, and the auxiliary receiver.
- (2) Push-to-talk operation of Set 1 or Set 2.
- (3) Interphone facilities between interphone boxes and retransmission unit (when used).

b. CONNECTION OF AUDIO ACCESSORIES. For all modes of operation connect Chest Set Group AN/GSA-6 to one of the audio connectors on the interphone box and connect Headset-Microphone H-63/U to the chest set. Lock the RADIO TRANS. switch of the interphone box in the RADIO TRANS. position. For additional monitoring facilities, Headset Navy Type CW-49507 may be connected by means of Cord CX-1334/U to the other AUDIO connector on the interphone box.

c. MONITORING. To monitor the various receiver signals use the selector switch of the interphone box as follows:

- (1) To monitor Set 1 and, in Radio Sets AN/GRC-3, -5, and -7, the auxiliary receiver, turn the Selector switch to the left-hand (counterclockwise) position. Adjust the volume level by means of the VOL. control next to the audio connector being used.
- (2) To monitor Set 1, Set 2, and, in Radio Sets AN/GRC-3, -5, and -7, the auxiliary receiver, turn the Selector switch to the center position. Adjust the volume level as in step 1 above.
- (3) To monitor Set 2, turn the Selector switch to the right-hand (clockwise) position. Adjust the volume level as in step 1 above. If the level is very high, adjust the Set 2 VOLUME control for a comfortable listening level.

d. INTERPHONE OPERATION. Interphone reception is possible for any position of the Selector switch. To communicate with an operator at any interphone box or the retransmission unit, press the rocker arm push-to-talk switch on the chest set and talk into the microphone. The operator can *break in* on a conversation at any time without waiting for the sending party to stop talking. *Do not press the RADIO push-button switch on the chest set. If the Selector switch*

is in either the left-hand or right-hand position, the transmit-control circuits will be operated.

e. PUSH-TO-TALK OPERATION OF SETS 1 AND 2.

- (1) For push-to-talk operation of Set 1, turn the Selector switch to the left-hand position, press the rocker arm push-to-talk switch and the push-button RADIO switch on the chest set, and talk into the microphone. Release the chest set switches to listen. If the auxiliary receiver interferes with operation of Set 1, turn the receiver VOLUME control to the OFF position.
- (2) For push-to-talk operation of Set 2, turn the Selector switch to the right-hand position, press the rocker arm push-to-talk and push-button RADIO switches on the chest set, and talk into the microphone. Release the chest set switches to listen.
- (3) If a signal is being received, and it is desired to transmit on the receiver-transmitter not in use, the Selector switch may be used to determine which receiver-transmitter is available. If no signal is heard for the right-hand setting of the Selector switch, Set 2 is available for use. If no signal is heard for the left-hand setting of the switch, Set 1 is available.

77. Operation from Retransmission Unit

a. MODES OF OPERATION. When power has been supplied to the radio sets, squelch adjustments have been made, and the receiver-transmitters and auxiliary receiver have been tuned, the following modes of operation are available from the retransmission unit:

- (1) Simultaneous monitoring of all received signals.
- (2) Interphone communication with all interphone boxes.
- (3) Push-to-talk operation of either Set 1 or Set 2.
- (4) Duplex operation utilizing Set 1 as a transmitter and Set 2 as a receiver.
- (5) Retransmission (relay) operation utilizing either of the receiver-transmitters as a receiver while the other receiver-transmitter transmits.

b. CONNECTION OF AUDIO ACCESSORIES. For all modes of operation connect Chest Set Group

AN/GSA-6 to the AUDIO connector on the retransmission unit and connect Headset-Microphone H-63/U to the chest set. For convenience, the push-button switch on the chest set may be locked in the RADIO position by means of the internal adjustment provided in the chest set. If only the retransmission or monitoring facilities are to be utilized, Dynamic Loudspeaker LS-166/U may be connected to the AUDIO connector; no microphone facilities will be necessary.

c. **MONITORING.** The outputs of each receiver and the interphone system are present in the headset at all times except when the AUTO switch is in the RETRANS or ADJUST METER position. (During retransmission the receiver audio circuits are opened in the set acting a transmitter.)

d. **INTERPHONE OPERATION.** Full duplex interphone operation is possible except when the AUTO switch is in the DUPLEX position. For communication with the operator at any interphone station, press the rocker-arm push-to-talk switch and the push-button RADIO switch (if it is not locked) and talk into the microphone. The output of the interphone system is present in the headset at all times.

Caution. If interphone operation is attempted with the AUTO switch at DUPLEX, the signal will be transmitted over Set 1.

e. **PUSH-TO-TALK OPERATION.** Place the AUTO switch in the OFF position and operate as follows:

- (1) For push-to-talk operation of Set 1, hold the MANUAL switch in the SEND SET 1 position, press the push-to-talk switch and RADIO switch (if it is not locked), and talk into the microphone. Release the chest set switches for listening.
- (2) For push-to-talk operation of Set 2, hold the MANUAL switch in the SEND SET 2 position, press the push-to-talk switch and RADIO switch, and talk into the microphone. Release the chest set switches for listening.

DUPLEX OPERATION. Normal duplex operation utilizes Set 1 as a transmitter and Set 2 as a receiver. Operate as follows:

- (1) Place the AUTO switch in the DUPLEX position.
- (2) Press the push-to-talk switch and RADIO switch (if it is not locked) and talk into

the microphone. It is not necessary to release the chest set switches to listen.

g. **RETRANSMISSION.** The retransmission facilities provide a radio link between two radio sets which either are too widely separated to permit direct communication or which have different frequency ranges. The retransmission operation is generally initiated by a push-to-talk contact from one of the distant stations. When such a contact is made, requesting communication facilities with another station, proceed as follows:

- (1) Turn and hold the AUTO switch at the ADJUST METER position.
- (2) With a signal being received from the contacting party, turn the appropriate ADJUST METER TO CENTER control (No. 1 if the signal is being received on Set 1, No. 2 if the signal is being received on Set 2) to obtain approximately center-scale deflection on the retransmission unit meter.
- (3) When the level adjustment has been completed, have the calling party stand by and make a push-to-talk contact with the other distant set on the second receiver-transmitter.
- (4) Adjust the level for second receiver-transmitter as outlined for the first set in steps 1 and 2 above. When the adjustment is complete, release the AUTO switch to the RETRANS position and have the second station stand by to await communication from the calling station.
- (5) Again contact the first station to inform the operator there that the retransmission circuit has been completed and that communication can take place. Stand by with the AUTO switch in the RETRANS position and the MANUAL switch in the INT position to let the retransmission procedure take place.
- (6) The two-way conversation can be monitored in the headsets at both the retransmission unit and the interphone boxes. The SIGNAL REC SET 1 and SET 2 lamps will indicate which station is being monitored at any particular time.
- (7) If reception occurs on the auxiliary receiver while Set 2 is transmitting, the receiver signal will be retransmitted

along with the Set 1 signal. To avoid such interference, the auxiliary receiver may be turned off.

Caution: Do not attempt radio operation from the interphone boxes while retransmission is taking place or the operation will be interrupted. Interphone operation is possible without interference.

78. Operation from Control Group AN/ GRA-6

a. MODES OF OPERATION. Although Control Group AN/GRA-6 is provided mainly to allow remote operation of the radio sets from points 2 miles or more away from the installation, local as well as remote operating facilities are available. The complete facilities are as follows:

- (1) Simultaneous monitoring of all received signals at both local and remote units.
- (2) Local push-to-talk operation of either Set 1 or Set 2.
- (3) Telephone communication, including ringing, between local and remote units.
- (4) Remote push-to-talk operation of either Set 1 or Set 2.
- (5) Remote control of power for the radio set and remote push-to-talk operation of Set 1.
- (6) Remote control of power for the radio set and remote push-to-talk operation of Set 2.

b. INSTALLATION. Turn the OFF-REMOTE-ON switch of the mounting to OFF and install Control Group AN/GRA-6 as outlined in paragraph 45, steps *a* through *g*. When the installation is completed, turn the OFF-REMOTE-ON switch to the REMOTE position.

c. MONITORING. It is possible to monitor the output of all receivers at either the local or remote control unit with the REMOTE switch set at any position but TEL ONLY. The setting of the LOCAL switch does not affect monitoring.

d. LOCAL PUSH-TO-TALK OPERATION.

- (1) Set the REMOTE switch to SET 1 & 2.
- (2) For push-to-talk operation of Set 1, hold the LOCAL switch in the SET 1 position, press the push-to-talk and RADIO switches on the chest set, and talk into

the microphone. Release the chest set switches to listen.

Note. The RADIO INTERPHONE switch on the chest set may be locked in the RADIO position for convenience by means of the internal adjustment.

- (3) For push-to-talk operation of Set 2, hold the LOCAL switch in the SET 2 position, press the push-to-talk and RADIO switches, and talk into the microphone. Release the chest set switches to listen.

e. TELEPHONE COMMUNICATION. Telephone communication between local and remote units is possible for any setting of the REMOTE switch. When the REMOTE switch is in the TEL ONLY position, only telephone operation is possible. When the SELECTOR switch at the remote unit is in the TEL position, telephone communication is the only operation possible from the remote unit; as long as the REMOTE switch is at the SET 1 & 2 position, however, local push-to-talk operation is possible. Telephone operation is as follows:

- (1) To send a ringing signal in either direction, turn the crank of the ringing generator at the sending unit (local or remote). Either a CALL LIGHT will glow or a bell will ring at the receiving end, depending upon the setting of internal switches in the local and remote units.

Note. A ringing signal may be sent at any time in either direction without interfering with radio operations. Hence it is possible to obtain the attention of a distant operator at any time.

- (2) To communicate, press the push-to-talk switch on the handset (at the remote unit) or the push-to-talk switch and RADIO switch on the chest set (at the local unit) and talk into the mouthpiece or microphone. Full duplex operation is possible; it is not necessary to release the push-to-talk switches to listen.

f. REMOTE PUSH-TO-TALK-OPERATION. The operator at the remote unit can inform the local operator by telephone of the mode of operation desired.

- (1) Place the REMOTE switch of the local unit in the SET 1 & 2 position.
- (2) For remote push-to-talk operation of Set 1, place the SELECTOR switch of the remote unit in the right-hand write-in

position, press the push-to-talk switch on the handset, and talk into the mouthpiece. Release the push-to-talk switch to listen.

- (3) For remote push-to-talk operation of Set 2, place the SELECTOR switch of the remote unit in the left-hand write-in position, press the push-to-talk switch on the handset, and talk into the mouthpiece. Release the push-to-talk switch to listen.

Note. If the telephone-line connections at either unit are reversed, the left-hand write-in position will control Set 1 and the right-hand write-in position will control Set 2. Operation will be unaffected otherwise.

g. REMOTE POWER CONTROL AND PUSH-TO-TALK OPERATION OF SET 1. The operator at the remote unit can inform the local operator by telephone of the mode of operation desired.

- (1) Place the REMOTE switch of the local unit in the SET 1 position.
- (2) Place the SELECTOR switch at the remote unit in the right-hand write-in position. Press the push-to-talk switch on the handset momentarily. If power is not applied at the radio set (as determined through telephone communication) the telephone-line connections are reversed.
- (3) After power is applied, push-to-talk operation of Set 1 is possible by pressing the push-to-talk switch and talking into the microphone. To listen, release the push-to-talk switch.
- (4) To remove power from the radio set, turn the SELECTOR switch to the opposite (left-hand) write-in position and press the push-to-talk switch momentarily.

Note. The use of the left-hand write-in position as an OFF position and the right-hand write-in position as an ON position is chosen for convenience. If the telephone line is reversed, the functions of the switch positions merely reverse.

h. REMOTE POWER CONTROL AND PUSH-TO-TALK OPERATION OF SET 2. Place the REMOTE switch of the local unit in the SET 2 position and follow the same procedure as outlined for Set 1 in steps 2 through 4 (*g* above).

i. ALTERNATE USAGE OF CONTROL GROUP AN/GRA-6.

- (1) Control Group AN/GRA-6 can also be used, with no provisions for remote power control, simultaneously with the retransmission unit. The complete facilities of each unit cannot be used simultaneously but the facilities are immediately available for alternate usage.
- (2) Connect the local control unit to the panel-mounted AUDIO connectors of Sets 1 and 2 by means of the cables at the rear of the local unit (fig. 30). It will then be possible to have remote control of push-to-talk operation as outlined in *f* above, whenever the interphone box or retransmission unit is not being used for control purposes. All functions of the control group will be the same as described in the preceding subparagraphs except the remote power control facilities.

79. Stopping Procedure

a. To remove power from the entire radio set, place the OFF-REMOTE-ON switch of the mounting in the OFF position. To remove power from a single unit, leave the OFF-REMOTE-ON switch in the ON position and operate the appropriate unit switch as indicated below (*b* through *f*).

b. To make the Set 1 transmitter inoperative, place the OPERATE switch of the Set 1 power supply in the RECEIVE position.

c. To remove all power from Set 1 place the OPERATE switch of the Set 1 power supply in the OFF position.

d. To remove power from the auxiliary receiver, turn the receiver VOLUME control to the OFF position.

e. To remove power from Set 2 only, place the OFF INT RT-70 switch of the interphone amplifier in the INT position.

f. To remove power from both Set 2 and the interphone amplifier, place the OFF INT RT-70 switch in the OFF position.

Note. When the interphone amplifier is turned off, it will be impossible to monitor any of the sets at the interphone box, the retransmission unit, the local control unit, or the remote control unit.

80. Miscellaneous Applications

a. **LOW POWER OPERATION OF SET 1.** If it is desired to operate Set 1 for short range communication, the power output can be reduced by placing the TRANS POWER switch of the Set 1 power supply in the LOW position.

b. **PANEL OPERATION.** Both Set 1 and Set 2 can be operated separately and locally by using a chest set (with headset and microphone) or a handset connected to an AUDIO connector on the front panel. In the case of Set 1, which has two AUDIO connectors, a microphone and headset or microphone and loudspeaker may be used. The interphone amplifier can be used as another interphone station by using a chest set (with headset and microphone) at the panel-mounted AUDIO connector. A headset or loudspeaker may be connected to the AUDIO connector of the auxiliary receiver for local monitoring of that unit.

c. **MANUAL RETRANSMISSION.** If retransmission is erratic, as indicated by chattering of the relays in the retransmission unit and interrupted flashing of the SIGNAL REC SET 1 and SIGNAL REC SET 2 lamps, the MANUAL switch may be used in place of the automatic switching circuits to complete the retransmission. If the signal is being received on Set 1, hold the MANUAL switch to SEND SET 2; if the signal is being received on Set 2, hold the MANUAL switch to SEND SET 1.

d. **RETRANSMISSION OF AUXILIARY RECEIVER OUTPUT.** The output of the auxiliary receiver may be retransmitted manually over Set 2 with the AUTO switch at either DUPLEX or RETRANS. If the DUPLEX position is used a separate antenna is required for the receiver. Connect the antenna (when required) and proceed as follows:

- (1) Turn the AUTO switch of the retransmission unit to either the RETRANS or the DUPLEX position.
- (2) Hold the MANUAL switch at the SEND SET 2 position.

e. **DUPLEX OPERATION WITH SET 1 AND AUXILIARY RECEIVER.** The auxiliary receiver may be used with Set 1 for duplex operation if a separate antenna is provided for the receiver. Connect the antenna and proceed as follows:

- (1) Connect a chest set (with headset and microphone) to the AUDIO connector on the retransmission unit.
- (2) Turn the AUTO switch to the DUPLEX position.
- (3) To transmit, press the RADIO and push-to-talk switches on the chest set and talk into the microphone. The received signal is always available in the headset.

CHAPTER 4

THEORY OF OPERATION

Section I. INTRODUCTION

81. Scope

a. System theory is presented to provide an understanding of how the several units are interrelated in the various operations of the radio sets. Such an understanding should be an effective aid in trouble shooting the equipment to isolate a defective unit and, in some cases, to isolate a defective part within a unit.

b. Detailed circuit theory of individual units is not discussed, except insofar as the units are interconnected in a common circuit. For example, the microphone circuits of Set 1 are described since they are interconnected with the control units through the mounting. Details of the Set 1 i-f amplifier are not important for system understanding and therefore are not discussed. Most of the information presented in this chapter is concerned with system applications of the several units. Complete details on the individual units are published in separate technical manuals. To provide a general acquaintance with the individual units, however, block diagrams of the major units are included and schematic diagrams of all units will be found at the end of the manual.

82. Basic System Block Diagram

a. Basically each of the radio sets consists of two receiver-transmitters and an interphone amplifier, with speech-input and monitoring facilities as shown in figure 48. In Radio Sets AN/GRC-3, -5, and -7, the output of an auxiliary receiver is paralleled with the output of the Set 1 receiver. These basic units are the essentials of the systems and the power supplies, cables, mountings, and miscellaneous equipment are supplied to make the

basic units perform their function of transmitting, receiving, or monitoring.

b. In an actual system installation, microphone and headset facilities are provided at each interphone box (Control Box C-375/VRC) and the switching provisions on the box allow selection of the mode of operation, namely, transmission on Set 1, interphone operation, transmission on Set 2, or monitoring. The control facilities are extended from the individual units to the interphone box through Mounting MT-297/GR and interconnecting cable (fig. 29).

c. An adaptation of the basic system (fig. 31) allows the radio set to function as a relay station to extend the range of another radio set, or to provide a link between two sets whose different frequency ranges make communication otherwise impossible. As indicated in figure 31, the signal picked up by one receiver-transmitter is retransmitted over the other receiver-transmitter. Communication can take place in either direction. In this application the microphone input of figure 48 is replaced by the signal received from a distant set. The retransmission unit (Control C-435/GRC) provides the necessary switching facilities for these functions; it also provides facilities for the basic mode of operation illustrated in figure 48.

d. Another facility provided by Control C-435/GRC adapts the basic system for duplex operation (fig. 32). In this adaptation a dual channel of communication is established with another radio set, with transmission taking place over one receiver-transmitter at one frequency while reception takes place over the other receiver-transmitter at a different frequency. Simultaneous two-way or *break-in* operation is possible. If the micro-

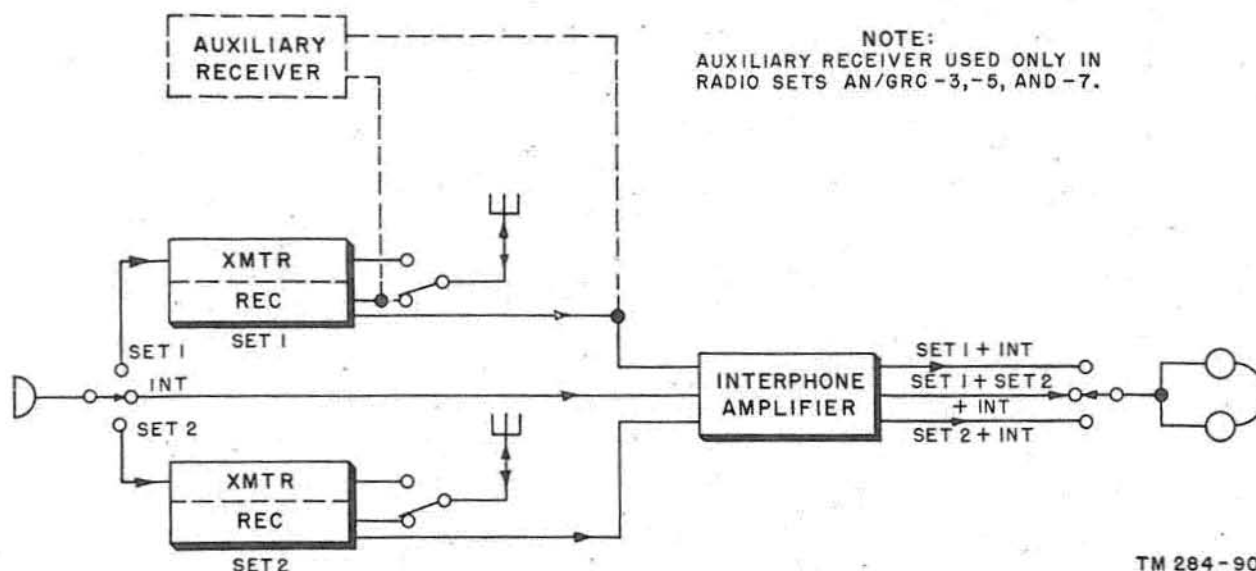


Figure 48. Basic system block diagram.

phone in figure 48 is switched to Set 1 while the headset is switched to monitor Set 2, the basic duplex function is illustrated. (This switching can be done only at the retransmission unit; microphone and headset switching occurs simultaneously at the interphone boxes.)

e. A final adaptation of the basic system is the extension of the microphone and monitoring facilities to a remote point by means of telephone lines. Control Group AN/GRA-6 is provided to accomplish this function. The extension of power control facilities to a remote point (another function of the control group) is not illustrated on the block diagram since power supply circuits are not shown.

83. System Diagrams

a. Four diagrams (figs. 49, 50, 51, and 52) are used to illustrate system interconnections and functioning. Complete power distribution circuits are shown on each of figures 49, 51, and 52, with much of the detail being common to the three diagrams. Figure 50 illustrates monitoring facilities.

b. A different control unit has been shown on each of the power distribution diagrams to illustrate how the transmitter control and audio input circuits are switched and connected for the various modes of operation. Figure 49 illustrates push-to-talk control circuits utilizing the interphone box (Control Box C-375/VRC); figure 51 illustrates push-to-talk, duplex, and retransmission

circuits utilizing the retransmission unit (Control C-435/GRC); and figure 52 illustrates the local and remote push-to-talk facilities, the remote power control facilities, and the telephone facilities which are provided by Local Control C-434/GRC and Remote Control C-433/GRC (units of Control Group AN/GRA-6).

c. Although the retransmission-unit functions and the local-remote-unit functions are illustrated separately from the functions available at the interphone box, it should be realized that the interphone box is always available. Generally, either the retransmission unit or Control Group AN/GRA-6 will be used in conjunction with the interphone boxes. The separation is made only for ease of representation and explanation.

d. Figure 50 illustrates all of the monitoring facilities which are available in the radio sets and the interconnections and switching which are necessary to utilize these facilities.

e. In paragraphs 85 through 105, the system diagrams are discussed in detail for each operational function. By following the discussion and the diagrams, it should be possible to determine what happens when each switch is thrown or pressed, what voltages are applied to what stage, how the microphone circuits are completed, the disposition of each received signal (from the outputs of the receivers), and other system functions. The passage of a signal through the transmitter (microphone to antenna) or the path of a received signal (antenna to receiver output circuit) is not

discussed. Such detail is peculiar to the units (not the system), and is covered generally in paragraphs 85 through 91. Complete details are published in separate manuals.

84. System Legend

a. A system legend has been devised and used on the system diagrams (figs. 49 through 52) to facilitate circuit tracing from unit to unit. Because each circuit is completed, generally, through one or more units, and similar reference symbols are used within each unit, it is impossible to tell, without some form of legend, when a circuit leaves one unit and enters another.

b. As indicated on the legends, a letter has been

used to identify each unit and the letter has been prefixed to the reference symbol of the part in a particular unit. Thus in the reference symbol H/P-5B at the upper left-hand corner of figure 49, H indicates Mounting MT-297/GR, P-5 is the reference symbol for a plug on the mounting (the termination of one of the mounting cables), and B indicates terminal B of the plug. Interconnection of H/P-5B and D/J-6B indicates that the circuit is continued to terminal B of receptacle J-6 in AF Amplifier AM-65/GRC.

c. To correlate the electrical interconnections with the physical interconnections the following chart indicates the cable and plug connections made between the mounting and other units:

Mounting cable	Cable termination*	Receptacle	Mating connector	
			Unit	Receptacle designation
W-1	P-1	J-1	Auxiliary receiver	POWER IN
W-2	P-2	J-8	Auxiliary receiver	REC CONTROL
W-3	P-3	J-312	Set 1	REC-TR CONTROL
W-4	P-4	J-6	Set 1 power supply	POWER IN
W-5	P-5	J-6	Interphone amplifier	POWER IN
W-6	P-6	J-4	Interphone amplifier	REC-TR CONT
W-7	P-7	J-2	Interphone amplifier	INT CONT
W-8	E-8 & E-11		Battery	

*Refer to figures 20 and 29.

Section II. POWER DISTRIBUTION AND PUSH-TO-TALK CONTROL CIRCUITS

85. Primary Power Application

(fig. 49)

When the OFF-REMOTE-ON switch of the mounting is placed in the ON position, relay H/K-1 is connected across the battery in series with fuses H/F-1 and H/F-2, the switch contacts, and resistor H/R-3. (In 12-volt systems, R-3 must be short-circuited.) Contacts of H/K-1 close to apply battery voltage to three supply buses (at the top of the drawing) which connect the battery circuit to the Set 1 power supply, the interphone amplifier, and in Radio Sets AN/GRC-3, -5, and -7, the auxiliary receiver. Closure of the relay contacts also completes a circuit for lamp H/E-7 (on the panel of the mounting) which indicates that power is available at the output terminals of the mounting.

Note. This paragraph is applicable only to Radio Sets AN/GRC-3, -5, and -7.

86. Auxiliary Receiver Circuits

(fig. 49)

a. **INPUT CIRCUIT.** When the VOLUME control in the auxiliary receiver is turned clockwise, switch G/S-2 closes and completes the battery circuit through fuse G/F-1 to the input terminal, U/X-1(3), of the plug-in power supply unit within the receiver (Power Supply PP-281/GRC or PP-282/GRC for 12-volt or 24-volt operation, respectively). The battery voltage is supplied directly to a vibrator power supply and, through jumpers on the power-supply input connector, to the receiver filament circuit.

b. **FILAMENT CIRCUIT.**

- (1) In 24-volt systems the filament voltage is made available at the VEH contacts of the EXT PWR SUPP, 130V-CFF-VEH switch through terminals U/X-1(6) and G/J-2(6) and a resistance network.

Dropping resistors G/R-58 and G/R-33 connect to the VEH contacts on section 1A of the switch; dropping resistor G/R-61 and ballast tube G/R-59 connect to the VEH contacts of section 1C of the switch. In 12-volt systems resistors G/R-58 and G/R-61 (in the input circuit) are short-circuited by jumpers on the plug-in power supply input connector. These jumpers are indicated by the dotted lines on figure 49. Ballast tube G/R-59 maintains a constant voltage for the receiver filaments despite variations in battery voltage.

- (2) In the VEH position, section 1A of the EXT PWR SUPP, 130V-CFF-VEH switch completes the battery circuit to the filaments of G/V-14; section 1C completes the battery circuit to the filaments of G/V-1 to G/V-13, inclusive and to dial LAMP G/E-14. Thermal relay G/K-1 and resistors G/R-55, G/R-56, and G/R-52 are included in the filament circuit to protect the tubes from overload. The filaments of G/V-1 through G/V-13 are connected in series-parallel strings (figs. 103, 104, and 105) so that an open filament in one string might cause the voltage on the other strings to increase excessively and burn out other tubes. Relay K-1 is designed so that an increase in voltage will cause its contacts to open and insert resistor G/R-52 in series with the filaments. The resistor limits the current through the filaments to a safe value. Resistors G/R-55 and G/R-56 determine the operating threshold of the thermal relay. Dial LAMP G/E-14 or dummy load G/R-64 parallels the filaments depending on the position of the TUNE DIAL LIGHT OFF ON switch.

c. PLATE AND SCREEN SUPPLY. The 135-volt vibrator supply furnishes plate and screen voltages for the receiver tubes. The 135-volt output is coupled through dropping resistor G/R-54 and section 1B of the EXT PWR SUPP, 130V-OFF-VEH switch to G/V-14. An additional dropping resistor, G/R-57 connects to the plate of voltage regulator G/V-15. The regulated 90-volt potential is supplied to tubes G/V-1 to G/V-8 through resistor G/R-60 and to G/V-13 through resistors

G/R-60 and G/R-47. The supply to G/V-13 is also connected to the squelch tube, G/V-11, when the SQUELCH control is turned clockwise from the OFF position; the switch is ganged to potentiometer G/R-65B which is in series with the screen supply to G/V-11.

d. MONITORING. When voltages have been made available to the receiver as described above, the receiver is in a monitoring condition. Signals received will be distributed to monitoring stations as indicated in figure 50. The signal path of the received signals may be traced through the block diagram (fig. 57). The output of the first audio and final audio stages are made available at terminals of the panel-mounted AUDIO connector G/J-7 (fig. 50). A headset or speaker may be connected for monitoring. A fixed level output which may be used for retransmission (par. 98) is supplied to the interphone amplifier through normally closed contacts on relay H/O-1 in the mounting when the retransmission unit is not plugged into the mounting. (For the routing of the signal when the retransmission unit is used, refer to paragraph 98.) The interphone amplifier amplifies the fixed-level signal and supplies a signal for monitoring to the AUDIO connectors of the interphone boxes, the amplifier panel, and the retransmission unit; if the local control unit is plugged into the mounting in place of the retransmission unit, the monitoring signal is routed to the AUDIO connector on the local unit. The signal supplied to the interphone boxes must be selected by the switch on the panel of the box (R/S-1 on fig. 50).

87. Interphone Amplifier

(fig. 49)

a. POWER INPUT. When the OFF-INT-RT-70 switch (D/S-2) on the interphone amplifier is placed in the INT position, the battery circuit from the mounting is completed to the filaments of the amplifier, a filament protection circuit for Set 2, and to the input connector, U/X-1, of the plug-in power supply in the amplifier.

b. AMPLIFIER FILAMENTS. When the 6V-12V-24V switch (D/S-1) on the amplifier chassis is set at 12V, the amplifier filaments (V-1 through V-5) are connected directly across the battery through section 1B of the switch; the Set 2 filament protection circuit (D/R-32, D/K-1, and associated

resistors) is connected in parallel with the amplifier filaments by sections 1D and 1A of the same switch. For 24-volt operation sections 1B and 1A connect the amplifier filaments in series with the filament protection circuit. Resistor D/R-36 parallels the Set 2 filament protection circuit as a dummy load when the OFF-INT-RT-70 switch is in the INT position. The filament protection circuit is discussed in more detail in conjunction with the Set 2 circuits (par 88).

c. **AMPLIFIER PLATE AND SCREEN SUPPLY.** The vibrator power supply develops a 135-volt output which is used to furnish the plate and screen requirements of the amplifier tubes and Set 2 (par 88).

d. **MONITORING.** When filament, plate, and screen voltages have been made available as described above, the amplifier can monitor any input signals from the auxiliary receiver and the Set 1 and Set 2 receivers (fig 50). The amplifier cannot be used for interphone operation until the microphone and control circuits (subpar. e following) are completed. The signal path through the interphone amplifier may be traced through the block diagram (fig. 56). The output of the interphone amplifier is routed to AUDIO connectors as described for the auxiliary receiver signals (par. 85).

e. **INTERPHONE MICROPHONE AND CONTROL CIRCUITS.**

- (1) The battery voltage at terminal U/X-1 (3) of the plug-in power supply is routed through resistors D/R-28 and D/R-27 to the coil of relay D/O-1. The relay circuit is not completed to ground, however, because of the open push-to-talk contacts of switch Y/S-2 on the chest set. In 12-volt circuits, resistor D/R-28 is short-circuited by a jumper on the plug-in power supply input connector.
- (2) The microphone input circuit parallels relay D/O-1 and consists of dropping resistor D/R-2, audio choke D/L-2, microphone transformer D/T-1, and the microphone. Contacts of relay D/O-1 and a second set of push-to-talk contacts on Y/S-1 hold this circuit open during monitoring periods.
- (3) When the push-to-talk switch is pressed, relay D/O-1 is energized and the microphone circuit is completed through the

relay contacts and the push-to-talk contacts. Microphone excitation current flows through the carbon element of the microphone and talking into the microphone develops voice signals across transformer D/T-1. The interphone signal is amplified and routed to the AUDIO connectors at control points, as described for the auxiliary receiver (par. 86).

- (4) The interphone circuits can also be completed through three paralleling circuits: through the center position of RADIO TRANS switch R/S-2, the RADIO contacts of Y/S-1, and the push-to-talk contacts of Y/S-2; through the center position of Selector switch R/S-1, RADIO TRANS contacts of R/S-2, RADIO contacts of Y/S-1, and push-to-talk contacts of Y/S-2; or through an audio accessory connected to the panel-mounted AUDIO connector (D/J-1) on the amplifier.

88. Set 2 Receiving Circuits

(fig. 49)

a. **FILAMENT CIRCUITS.**

- (1) When the OFF-INT-RT-70 switch of the amplifier is placed in the RT-70 position, the battery circuit from the mounting is completed to the Set 2 filament protection circuit as described for the amplifier (par. 87 above). Section 1A of the switch connects the Set 2 filaments in parallel with the protection circuit in place of dummy load D/R-36. Tubes C/V-2, C/V-4, C/V-106, and C/V-108 are energized directly. Tubes C/V-101 through C/V-105, C/V-107, and C/V-7 through C/V-11 are energized through normally closed contacts of C/O-101.
- (2) Ballast tube D/R-32 in the filament protection circuit maintains a constant voltage for the Set 2 filaments despite variation in battery voltage. (This constant potential is also utilized as bias for the output stage, D/V-5, of the interphone amplifier.) If the filament voltage rises because of a burned-out tube in one of the series-parallel Set 2 filament strings (fig. 59), the increased voltage causes relay D/K-1 to operate. Contacts of the relay open and insert resistors D/R-33 and

D/R-34 in series with the filaments to protect the remaining tubes from the overvoltage condition.

- (3) Dial LAMP C/E-201 parallels the Set 2 filaments when the ANT ADJ-DIAL LIGHT ON OFF-CAL switch is in any position but OFF. In the OFF position a dummy resistor C/R-137 is inserted in place of the lamp so that the regulation of the filament circuit will not be disturbed. The dummy load circuit is not completed for the FIELD position of the FIELD-VEH-TANK switch (C/S-101), since the dry batteries used in field applications provide sufficient regulation to make the circuit less sensitive. (See chapter 6 for field applications.)

b. PLATE AND SCREEN SUPPLY.

- (1) The output of the vibrator supply within the amplifier is used also for Set 2. When the OFF-INT-RT-70 switch is in the RT-70 position, a voltage regulating circuit utilizing tubes D/V-6 and D/V-7 is connected in series with the 135-volt supply so that a 90-volt potential is made available to Set 2. (Refer to figure 98 for the complete circuit detail of the regulating circuit.)

The 90-volt potential is distributed to C/V-108, C/V-6, C/V-1 through C/V-5, C/V-107, C/V-101 through C/V-107, and to C/V-11. If the ANT ADJ-DIAL LIGHT ON OFF CAL switch (C/S-202) is in the ANT ADJ position, the 90-volt potential is supplied also to the calibrate oscillator, C/V-7; when the switch is in the CAL position, the voltage is supplied to both the calibrate oscillator and the beat oscillator, C/V-106.

- (2) The 90-volt potential to C/V-108 is supplied through normally closed contacts of relay H/O-1 in the mounting when the retransmission unit is not plugged into the mounting. For the circuit detail when the retransmission unit is used, refer to figure 51 and paragraph 98.
- (3) A bleeder resistor, C/R-136, is connected across the 90-volt supply during the receiving condition through normally closed contacts of relay C/O-101 and contacts of the FIELD-VEH-TANK switch C/S-

101. (In field applications the bleeder is opened.) The bleeder serves as a dummy load during the receiving condition, in place of the load which the transmitter places on the regulated supply during transmit conditions.

c. MONITORING. When filament, plate, and screen voltages are available as described above, the receiver of Set 2 is operative. The signal path of received signals from antenna to audio output circuits can be traced on the block diagram (fig. 55). The output of the receiver is supplied to a panel-mounted AUDIO connector (fig. 50) and to the interphone amplifier. The output of the amplifier is available for monitoring at the various control units as described for the auxiliary receiver (par. 86).

89. Set 2 Push-to-Talk Circuits

(fig. 49)

a. RELAY CONTROL VOLTAGE. Battery voltage from the mounting is supplied to terminal 3 of connector U/X-1 on the power supply unit within the amplifier (par. 87e). In 24-volt systems this potential is applied to relay C/O-101 through dropping resistors D/R-29 and D/R-30 (fig. 49). In 12-volt systems resistor D/R-29 is short-circuited by jumpers on the plug-in power supply input connector. The relay circuit is not completed to ground until the switching action described in *b* below takes place.

b. TRANSMIT CONTROL. Four switches must be operated to complete the circuit for relay C/O-101 which controls transmission from Set 2. The Selector switch, R/S-1, on the interphone box must be in the right-hand position, the RADIO TRANS switch, R/S-2, should be locked in the RADIO TRANS position and switches Y/S-1 and Y/S-2 should be operated to the RADIO and push-to-talk positions. When these switches have been closed as described, relay C/O-101, becomes energized and performs the following switching functions:

- (1) Contacts 2-1 open and 2-3 close to switch filament voltage from receiver tubes to transmitter tubes C/V-1, C/V-3, C/V-5, and C/V-6, and to complete the circuit for microphone transformer C/T-1.
- (2) Contacts 8-9 close to supply screen voltage to microphone amplifier C/V-1 and power amplifier C/V-6.

- (3) Contacts 5-4 open to remove bleeder resistor R-136 from across the 90-volt supply.
- (4) Contacts 7-6 close to complete a sidetone circuit from the microphone transformer to the grid of audio amplifier C/V-106. A bleeder (C/R-138) across the sidetone circuit lowers the sidetone level when the FIELD-VEH-TANK switch is in either the FIELD or VEH position. In tanks, which have a high noise level, the sidetone level is increased by opening the bleeder circuit.

c. **TRANSMISSION.** When the switching actions described above have taken place, the transmitter will be operative and talking into the microphone will cause modulation of the transmitter carrier frequency. To trace the signal path through the transmitter refer to the block diagram (fig. 55) and to the schematic diagram (fig. 99).

90. Set 1 Receiving Circuits (fig. 49)

a. **POWER INPUT CIRCUITS.** As soon as the OFF-REMOVE-ON switch (H/S-1) of the mounting is placed in the ON position, the battery circuit is completed to contacts of the 4-section OPERATE switch (E/S-1) in the Set 1 power supply. When the OPERATE switch is placed in either RECEIVE or TRANS & RECEIVE, the Set 1 receiver-transmitter is ready for monitoring. As long as a push-to-talk switch or other transmit-control switch is not operated, operation is the same for either the RECEIVE or TRANS & RECEIVE position of the OPERATE switch. The RECEIVE position makes it impossible to transmit, even though transmit-control switches are operated.

b. **RECEIVER FILAMENT CIRCUITS.** In 24-volt systems the battery voltage is applied through section 1D of the OPERATE switch and dropping resistor E/R-39 to the receiver filament protection circuit and the receiver filaments. Ballast tubes D/R-40 and E/R-31 maintain a constant voltage for the filaments despite variations of battery voltage. In 12-volt systems, the dropping resistor and one of the ballast tubes (E/R-40) are not used. The filament protection circuit utilizes thermal relay E/K-2 whose normally closed contacts short-circuit resistor E/R-32. If an overload occurs in the filament circuit, the thermal

relay operates and its contacts open. Resistor E/R-32 is then placed in series with the filaments to absorb the overload. The filament circuits completed are those of A/V-1 through A/V-4, A/V-101 through A/V-103, and A/V-107 through A/V-116. Complete circuit detail of the series-parallel filament arrangement is shown in figure 58. Dial LAMP A/E-313 is connected in parallel with the filaments of A/V-113 and A/V-114 in two positions of the RING-DIAL LIGHT ON OFF switch, A/S-302. In the OFF position, dummy load A/R-304 is substituted for the lamp.

Note. For circuit details of the Set 1 power supply, refer to figures 96 and 97. A block diagram of the Set 1 power supply is shown in figure 54.

c. RECEIVER PLATE AND SCREEN SUPPLY.

- (1) The battery voltage is supplied through section 1C of the OPERATE switch to a 1-v vibrator supply. The 135-volt output from the vibrator is filtered by choke E/L-12 and supplied through dropping resistor E/R-17 to the second a-f amplifier of Set 1 (A/V-116). Dropping resistors E/R-21 and E/R-22 are connected in series with voltage regulator A/V-4 between the 135-volt potential and ground. (Resistor E/R-22 is in the circuit for the HIGH position of TRANS POWER switch E/S-2A; it is shorted out for low power operation since an increased drain is placed on the power supply for that type of operation.)
- (2) The 85-volt potential at the plate of A/V-4 is used (during reception) as a source of screen and plate voltage for tubes A/V-1 through A/V-4, A/V-101 through A/V-103, A/V-107 through A/V-112, and A/V-115. Plate and screen voltage for A/V-1 and screen voltage for A/V-2 are applied through normally closed contacts (9-10) of relay A/O-101.

d. MONITORING.

- (1) When the filament, plate, and screen potentials have been supplied as described above, the receiver of Set 1 is operative. Signals picked up by the receiver are routed from antenna to audio output circuits as indicated on the block diagram (fig. 53) and the schematic diagram (figs. 100, 101, and 102) for Receiver-Transmitters RT-66/GRC,

RT-67/GRC, and RT-68/GRC, respectively.

- (2) The outputs of the first and second a-f stages, A/V-115 and A/V-116, respectively (fig. 50) are supplied to the phone and speaker terminals of the panel-mounted AUDIO connectors, A/J-310 and A/J-311. A headset may be used to monitor these signals.
- (3) A fixed-level audio output from A/V-102 (fig. 50) is routed through normally closed contacts of H/O-1 in the mounting to the interphone amplifier. (The manner in which this signal is routed when the retransmission unit is plugged into the mounting is discussed in paragraph 98.) The output of the interphone amplifier is routed to the several control units for monitoring as indicated on figure 50 and explained (par. 86) for the auxiliary receiver.

91. Set 1 Transmitting Circuits (fig. 49)

a. POWER INPUT CIRCUITS. Until transmit-control circuits have been operated, the Set 1 power supply circuits for the Set 1 transmitting circuits remain unenergized. Battery voltage is supplied to sections 1B and 1A of the OPERATE switch in the 150-volt and 300-volt vibrator circuits, but contacts of relay E/O-1 in the power supply prevent the circuits from being completed. The circuit to relay E/O-1 is in turn broken by contacts of relay A/O-101 which is under control of the push-to-talk switch. The sequence of operation is described in *b* through *g* below.

b. OPERATIONAL CONTROLS. The following switches must be operated before the transmit-control circuits can be energized.

- (1) Selector switch R/S-1 on the interphone box must be placed in the Set 1 (left-hand) position.
- (2) Switch R/S-2 on the interphone box must be held or locked in the RADIO TRANS position.
- (3) Switches Y/S-1 (RADIO-INT) and Y/S-2 (push-to-talk) on the chest set must be pressed.

c. RELAY A/O-301. Contacts of relay A/O-301 switch the antenna from the receiver to the transmitter. In Radio Sets AN/GRC-3, -5, and -7

they break the antenna circuit of the auxiliary receiver also.

d. RELAY A/O-1.

- (1) Contacts 2-3 of relay A/O-1 close to shunt resistor A/R-109 across the squelch oscillator load resistor, A/R-110.
- (2) Contacts 6-7 of relay A/O-1 close in the B-plus leads of A/V-9 and A/V-10 and contacts 4-5 close in the screen circuit of A/V-11.

e. RELAY A/O-101.

- (1) Contacts 9-10 open and contacts 9-8 close to switch the 85-volt supply from receiver tubes A/V-1 and A/V-2 to transmitter tubes A/V-104A, A/V-105, A/V-106, and A/V-5 through A/V-8. If the DIAL LIGHT OFF-ON-RING switch is held in the RING position, voltage is made available to A/V-104B also.
- (2) Contacts 2-3 of relay A/O-101 open and contacts 2-1 close to switch the a-f input to A/V-115 from the normal receive tap on the discriminator output voltage divider to the lower voltage tap used for sidetone during transmission.
- (3) Contacts 4-5 of relay A/O-101 close in the microphone circuit and the filament lead to transmitter tubes A/V-5 through A/V-11 and A/V-104 through A/V-106.
- (4) Contacts 6-7 of relay A/O-101 close to complete a circuit for relay E/O-1 in the power supply. Relay E/O-1 operates to complete the power-input circuits for the transmitter filaments and the transmitter h-v supplies.

f. RELAY E/O-1.

- (1) Contacts 2-3 of relay E/O-1 complete the battery circuit from section 1D of the OPERATE switch to the filaments and filament protection circuit for the transmitter. In 24-volt systems dropping resistor E/R-36 and ballast tubes E/R-37, 38, 24, and 25 are included in the input circuit. In 12-volt systems, E/R-36 and ballast tubes E/R-37 and 38 are omitted. The filament protection circuit utilizes thermal relay E/K-1 which, when operated, causes resistor E/R-26 to be inserted in series with the transmitter filaments. The filaments supplied are those

listed in *e* above. Complete filament circuit details are shown on figure 58.

- (2) Contacts 4-5 of relay E/O-1 close to short-circuit resistor E/R-21 in the 85-volt supply circuit. This operation compensates for the increased drain on the power supply during transmission.
- (3) Contacts 7-8 and 9-10 of relay E/O-1 complete the battery input circuit from sections 1B and 1A of the OPERATE switch to the 150-volt vibrator power supply and 300-volt vibrator power supply, respectively.

g. H-V CIRCUITS.

- (1) The output of the 150-volt supply furnishes operating voltage for tubes A/V-9 and A/V-10 during high power operation (S-2A in HIGH position).
- (2) The 150-volt potential is also connected in series with the 300-volt supply to furnish a 450-volt potential for the power amplifier, A/V-11. A tap on the 450-volt supply provides approximately 250 volts for the screen of A/V-11.

h. HIGH POWER TRANSMISSION. When the transmitter circuits have been energized as described in the preceding subparagraphs, the transmitter generates a carrier signal which may be modulated by talking into the microphone or by holding the DIAL LIGHT-OFF-ON-RING switch in the RING position. The transmit-control circuits can also be energized by using a microphone at either of the panel-mounted AUDIO connectors A/J-310 or A/J-311.

i. LOW POWER TRANSMISSION. If the TRANS POWER switch (E/S-2) is placed in the LOW position, the following circuit changes are effected.

- (1) The input to the 300-volt vibrator supply is broken (E/S-2B).
- (2) Tube A/V-11 is switched from the 450-volt supply to the 150-volt supply by section 1A of switch E/S-2A.
- (3) Tubes A/V-9 and A/V-10 are switched from the 150-volt supply to the 85-volt supply.
- (4) Resistor E/R-22 in the 85-volt supply lead is short-circuited to compensate for the increased drain on the supply.

Section III. DUPLEXING AND RETRANSMISSION

92. Functions of Retransmission Unit

a. The main functions of the retransmission unit (Control C-435/GRC) are to provide for duplexing and retransmission. Simple push-to-talk facilities, however, are also available at the unit.

b. The use of the retransmission unit for controlling the radio sets constitutes a substitution of transmit-control switches and audio-input facilities for the control switches and microphone of the interphone box. Power distribution and over-all operation are essentially the same, with the exceptions noted.

93. Power Distribution

(fig. 51)

a. When the OFF-REMOTE-ON switch of the mounting is placed in the ON position, power is distributed to the three supply bases for the auxiliary receiver, the interphone amplifier, and the Set 1 power supply exactly as was described when the retransmission unit was not considered (par. 85). Power is also applied, however, to relay H/O-1 in the mounting through dropping resistor

H/R-2; in 12-volt systems a jumper must be connected across H/R-2.

b. Three sets of contacts are opened when H/O-1 is energized: sets 4-5 and 6-7 in the plate leads of the Set 1 a-f amplifier (A/V-115) and the Set 2 a-f amplifier (C/V-108), respectively; and set 2-3 in the audio monitoring circuit of Set 1 and the auxiliary receiver (fig. 50).

c. For monitoring push-to-talk, and duplex operations, the plate leads of tubes A/V-115 and C/V-108 are completed by contacts of the MANUAL and AUTO switches (fig. 51). For retransmission, relay P/O-1 and normally closed contacts of relay P/O-4 are inserted in series with the plate lead of A/V-115; relay P/O-3 and normally closed contacts of P/O-4 are inserted in series with the plate lead of C/V-108. The d-c plate current of these stages energizes the relays (one or the other) to operate the automatic retransmission circuits (par. 98).

94. Monitoring

a. When the power switches for the individual units have been closed and the OFF-REMOTE-

ON switch is in the ON position, all of the receiver circuits are energized. The only differences in power distribution are those which were mentioned in paragraph 92. The monitoring circuit from the Set 2 receiver (fig. 50) is exactly as described previously (par. 88), and contacts of either the AUTO switch (section 3H, rear) or the MANUAL switch (section 2E, rear) are substituted for the contacts of H/O-1 in the output leads from the Set 1 receiver and the auxiliary receiver.

b. Monitoring of all signals is possible simultaneously at the AUDIO connector (P/J-2) on the retransmission unit unless the MANUAL switch is turned to the SEND SET 1 position with the AUTO switch at DUPLEX, RETRANS, or ADJUST METER (fig. 50).

95. Interphone Operation

(figs. 50 and 51)

The interphone circuit from the retransmission unit is operative except when the AUTO switch is in the DUPLEX position. The interphone control line is completed to ground through the OFF, RETRANS, or ADJUST METER position of the AUTO switch (section 1C, front), the push-to-talk switch of the microphone, and the INT position of the MANUAL switch (section 1A, front). The microphone line is completed through similar positions of the AUTO switch (section 1A, front), the INT position of the MANUAL switch (section 1C, rear), and the push-to-talk switch of the microphone.

96. Push-to-Talk Operation from the Retransmission Unit

(fig. 51)

Push-to-talk operation from the retransmission unit is accomplished by means of the MANUAL switch with the AUTO switch in the OFF position. Sections 1C (rear) and 1A (front) of the MANUAL switch complete the microphone and control lines, respectively, of the sets. When the MANUAL switch is held in the SEND SET 1 position and the microphone switch is pressed, the Set 1 transmitting circuits are energized as outlined in paragraph 91c through i. The MANUAL switch merely takes the place of the Selector and RADIO TRANS switches of the interphone box (par. 91b). When the MANUAL switch is held in the SEND

SET 2 position and the microphone switch is pressed, the Set 2 transmitting circuits are energized as outlined in paragraph 89; again the MANUAL switch takes the place of the interphone controls.

97. Duplex Operation

a. The circuit detail for duplex operation differs from push-to-talk control only in that the transmitter of Set 1 is used for transmitting and the receiver of Set 2 is used for receiving in a two-way communication circuit.

b. The control line for the Set 1 transmit-control relays (fig. 51) is connected directly to ground through the DUPLEX position of the AUTO switch (section 1B, rear of P/S-1). The microphone line is completed to ground through section 1A (front) of the AUTO switch, section 1C (rear) of the MANUAL switch, and the microphone push-to-talk switch. These lines directly parallel the circuits described for operation from the interphone box.

c. Since the control line is completed to ground through the AUTO switch, instead of a push-to-talk switch, the Set 1 carrier is always transmitted. Only operation of the microphone switch and talking into the microphone are required for retransmission of intelligence.

98. Retransmission of Set 1 Signal

(fig. 51)

a. With the AUTO switch set at RETURNS and a signal being received on Set 1, the signal will be automatically retransmitted over Set 2. The relay and switching actions which make this possible are described in b below.

b. The d-c plate current of A/V-115 in Set 1 energizes relay P/O-1 which is connected in the circuit through the RETRANS position of the AUTO switch (section 2 E, front) and the INT position of the MANUAL switch (section 2 G, rear). When the relay is energized, contacts 1-7 close to complete a circuit for relay P/O-2 (near the left-hand side of figure 51) and SIGNAL REC SET 1 lamp P/E-1. Relay P/O-2 operates to perform the following functions.

- (1) Contacts 3-12 open to break the relay circuit of P/O-3 in the plate circuit of audio amplifier C/V-108 in Set 2. This makes it impossible for sidetone output

from Set 2 to energize P/O-3 which controls retransmission in the opposite direction (Set 2 receiver output over Set 1).

- (2) Contacts 6-7 break the circuit for the SIGNAL REC SET 2 lamp (P/E-2).
- (3) Contacts 2-11 close to ground the control line for the Set 2 transmitter. The transmitting circuits are energized as described in paragraph 89.
- (4) Contacts 1-10 close to complete the Set 1 receiver output circuit from Set 1 to auto-transformer P/T-1 and meter P/M-1. Potentiometer P/R-5 can be adjusted to set the level of the retransmitted signal. With the AUTO switch held at ADJUST METER, the potentiometer is adjusted for an approximate center-scale deflection on the meter.
- (5) Contacts 8-9 close to complete the audio circuit from the auto-transformer to the Set 2 microphone transformer.

99. Retransmission of Set 2 Signal

(fig. 51)

a. Retransmission of a Set 2 signal over Set 1 is similar to the action described above with relays P/O-3 and P/O-4 performing functions similar to those of P/O-1 and P/O-2. Relay P/O-3 is

energized by the d-c plate current of a-f amplifier C/V-108 in Set 2.

b. Contacts of relay P/O-3 complete the circuit for relay P/O-4 and the SIGNAL REC SET 2 lamp (P/E-2). Contacts of P/O-4 lock out the retransmission relay in Set 1, break the circuit for the SIGNAL REC SET 1 lamp, and complete the transmit-control and audio input lines of the Set 1 transmitter.

100. Retransmission of Auxiliary Receiver Signal

The auxiliary receiver signal may be retransmitted over Set 2 by placing the MANUAL switch in the SEND SET 2 position and the AUTO switch at either DUPLEX or RETRANS. If the DUPLEX position is used, a separate antenna is required for the receiver. The retransmitted signal is routed from the receiver output to the Set 1 audio-input circuits through section 1B (rear) of the MANUAL switch, section 2F (rear) of the AUTO switch, auto-transformer P/T-1; capacitor P/C-3, section 2D (front) of the AUTO switch, and section 2D front of the MANUAL switch. Section 1D (rear) of the MANUAL switch provides the ground return for the Set 2 transmit-control circuits.

Section IV. OPERATION FROM CONTROL GROUP AN/GRA-6

101. Ringing Circuit

(fig. 52)

a. It is always possible to ring from the local control unit to the remote control unit, or vice versa, when the units are connected by a telephone pair as indicated in figure 52 (lower right-hand end of the drawing). The ringing circuit is independent of the radio sets.

b. The ringing signal is transmitted in either direction through transformers N/T-1 and M/T-1 and the telephone line and operates either a CALL LIGHT on the panel of the receiving unit or a bell within the receiving unit. An internal switch (N/S-1 or M/S-1) selects the lamp or bell in the local and remote units, respectively.

102. Telephone Circuit

(fig. 52)

a. Duplex telephone operation is possible provided the LOCAL switch (N/S-3) is left in the TEL position. Local batteries (BT-1 and BT-2) are supplied in each unit in series with the microphones. If a push-to-talk switch on the handset at either unit is pressed, and the operator talks into the mouthpiece, the voice signals will be coupled through the transformers and telephone lines to the earpieces at the receiving end.

b. The TEL position of the REMOTE switch on the local unit and the TEL ONLY position of the SELECTOR switch on the remote unit provide for telephone operation only. For other positions

of these switches radio operation is also possible (pars. 103 through 105).

103. Monitoring and Local Push-To-Talk Operations

(fig. 52)

a. Monitoring and local push-to-talk operations are described for a REMOTE setting of the OFF-REMOTE-ON switch on the mounting, and a SET 1&2 setting of the REMOTE switch on the local control unit. The REMOTE switch completes the circuit for relay H/K-1 in the mounting (lower left-hand side of figure 52), and power is distributed to the interphone amplifier and all receiving circuits, as previously described. The sets are in a receiving condition and any signals received may be monitored at the interphone boxes and the local control unit (fig. 50). Section 2E, rear of the REMOTE switch (fig. 52), couples the signals from the interphone amplifier to the monitoring devices and the line transformer in the local unit. The signals are also coupled through the line transformers and telephone line to the earpiece at the remote unit (fig. 52).

b. If the LOCAL switch is turned to the SET 1 position, and the push-to-talk switch is pressed, sections 1C and 1B of the switch provide ground returns for the microphone and transmit-control lines, respectively, of Set 1. The Set 1 transmitting circuits are energized as described in paragraph 90c through i. Talking into the microphone at the local unit will cause modulation of the transmitted signal.

c. If the LOCAL switch is turned to the SET 2 position, the ground returns are provided for the audio-input and transmit-control lines of Set 2.

104. Remote Push-to-Talk Operation

(fig. 52)

a. In remote push-to-talk operations, the ground returns for the transmitter audio-input, and control lines are controlled by relays N/L-1 and N/O-2 which are in the local control unit but whose control voltage is obtained from the remote unit through the telephone line. Relay N/O-2 is polarized so that it is operated only when the potential applied to it is positive at terminal 2 with respect to terminal 3. Relay N/O-1 will operate regardless of the polarity of the applied potential.

b. The polarity applied to relay N/O-2 is controlled by the REMOTE switch in the local unit and the SELECTOR switch in the remote unit. For remote push-to-talk operation (without power control), the REMOTE switch is left in the SET 1 and 2 position, so that the SELECTOR switch has complete control of the relay operation.

c. When the SELECTOR switch is placed in the left-hand write-in position, and the remote push-to-talk switch is pressed, a 45-volt battery is connected across the line so that line L1 is negative with respect to line L2 (fig. 52). Relay N/O-2 is not operated under this condition and its contacts (7-6) remain closed in the control line for Set 2. Relay N/O-1 is operated and its contacts are operated. Contacts 6-4 open to break the ground connection for winding 7-9 of transformer N/T-1; this makes telephone communication between the local and remote units impossible. Contacts 6-7 close to complete the ground return for the Set 2 control line; contacts 5-8 close to complete the a-f ground return for the Set 1 microphone line. (They also complete the a-f ground return for the Set 1 microphone line but, since the Set 1 control line is open, this has no effect on the operation.) When the remote operator talks into the microphone, the voice signals are coupled through windings 5-6 and 1-2 of transformer M/T-1 to the telephone line. At the local end of the line, transformer N/T-1 couples the signal to the Set 2 microphone line.

d. When the SELECTOR switch at the remote unit is placed in the right-hand write-in position, and the remote push-to-talk switch is pressed, the battery connection to the telephone line is reversed, so that the potential applied to relay N/O-2 causes the relay to be energized. Contacts 7-6 in the Set 2 control line open, and contacts 7-4 in the Set 1 control line close. The operation of relay N/O-1 is the same as Set 2 operation (c above); contacts 5-8 are effective this time for Set 1 only, since the Set 2 control line is opened. When the remote operator talks into the microphone, the voice signals are coupled to the Set 1 microphone circuit (fig. 52).

Note. If the telephone line connections are reversed at either unit, the functions of the left-hand and right-hand write-in positions will be reversed. Operation is otherwise the same.

105. Remote Power Control and Push-to-Talk Operation

(fig. 52)

a. A third relay (N/O-3), which is also polarized, is effective in the remote control of power for the radio sets. Relay N/O-1 and N/O-2 function as before for control of the push-to-talk operation, but the REMOTE switch as well as the SELECTOR switch are both involved in the switching of the remotely located battery.

b. For remote control of power and remote push-to-talk control of Set 1, the OFF-REMOTE-ON switch on the mounting is placed in the REMOTE position, and the REMOTE switch of the local control unit is placed in the SET 1 position. Under these conditions, relay H/K-1 (at the left-hand side of figure 52) is de-energized and all power is removed from the radio sets until relay N/O-3 is energized. If the SELECTOR switch at the remote unit is placed in the left-hand write-in position, and the remote push-to-talk button is pressed, the battery is connected across the line so that line L1 is negative with respect to line L2. Under these conditions, relay N/O-3

will not be energized and no power will be applied to the radio sets; relay N/O-1 will be energized but it will have no operational effect.

c. If the SELECTOR switch is placed in the right-hand write-in position, and the remote push-to-talk switch is pressed, relays N/O-3 and N/O-1 are energized. Contacts 6-7 of N/O-3 (at the left-hand side of figure 52) complete the ground return for relay H/K-1 and power is applied to the radio set. Relay N/O-1 operates its contacts as described in paragraph 104c above, and push-to-talk operation of Set 1 is possible. Releasing the push-to-talk switch will not remove power from the radio set because the contacts of H/O-3 will remain closed until a voltage of the reverse polarity is applied to it. This is possible only by returning the SELECTOR switch to the left-hand position and pressing the push-to-talk switch.

d. For remote control of power and push-to-talk control of Set 2, the REMOTE switch of the local unit must be placed in the SET 2 position. Remote power control is accomplished exactly as described in *b* and *c* above, and remote push-to-talk operation of Set 2 is possible as described in paragraph 104d. All three relays (N/O-1, N/O-2, and N/O-3) are operative.

Section V. UNIT THEORY

106. General

The discussion of unit theory is limited to block diagram analyses of the major units. Although the maintenance information included in this manual is at an organizational level only, familiarity with the block diagrams of the units should be helpful in trouble-shooting. A knowledge of which tubes are receiving tubes and which tubes are transmitting tubes, for example, will aid in the replacement of parts for which the operator has running spares. The block diagrams are shown in figures 54 through 57. Complete schematic diagrams for all units are also included as additional information for maintenance personnel (figs. 88 and 105).

107. Set 1 Power Supply

(fig. 53)

a. Figure 53 is a functional block diagram of Power Supply PP-109/GR or Power Supply PP-112/GR. It shows the three h-v circuits and the

three l-v circuits supplied from the storage battery input terminals. The h-v circuits are used to provide the plate, screen, and bias voltages for the receiver and transmitter circuits in Receiver-Transmitter RT-66/GRC, RT-67/GRC, or RT-68/GRC. The l-v circuits supply the receiver-transmitter filament and relay potentials.

b. The 85-volt circuit (E-3 and T-3) is energized whenever the OPERATE switch S-1 is in either the RECEIVE or TRANS & RECEIVE position. The other two h-v circuits, E-2 and T-2, E-1 and T-1, and the transmitter filament supply circuit, are energized when switch S-1 is in the TRANS & RECEIVE position and relay O-1 is energized. E-1 and T-1 are controlled also by TRANS POWER switch S-2, which must be in the HIGH position for E-1 and T-1 to operate.

c. The l-v circuits include: the receiver filament supply circuit with output at terminal L of J-2; the transmitter filament supply circuit with output at terminal N of J-2; and the relay supply circuit with output at terminal A of J-2.

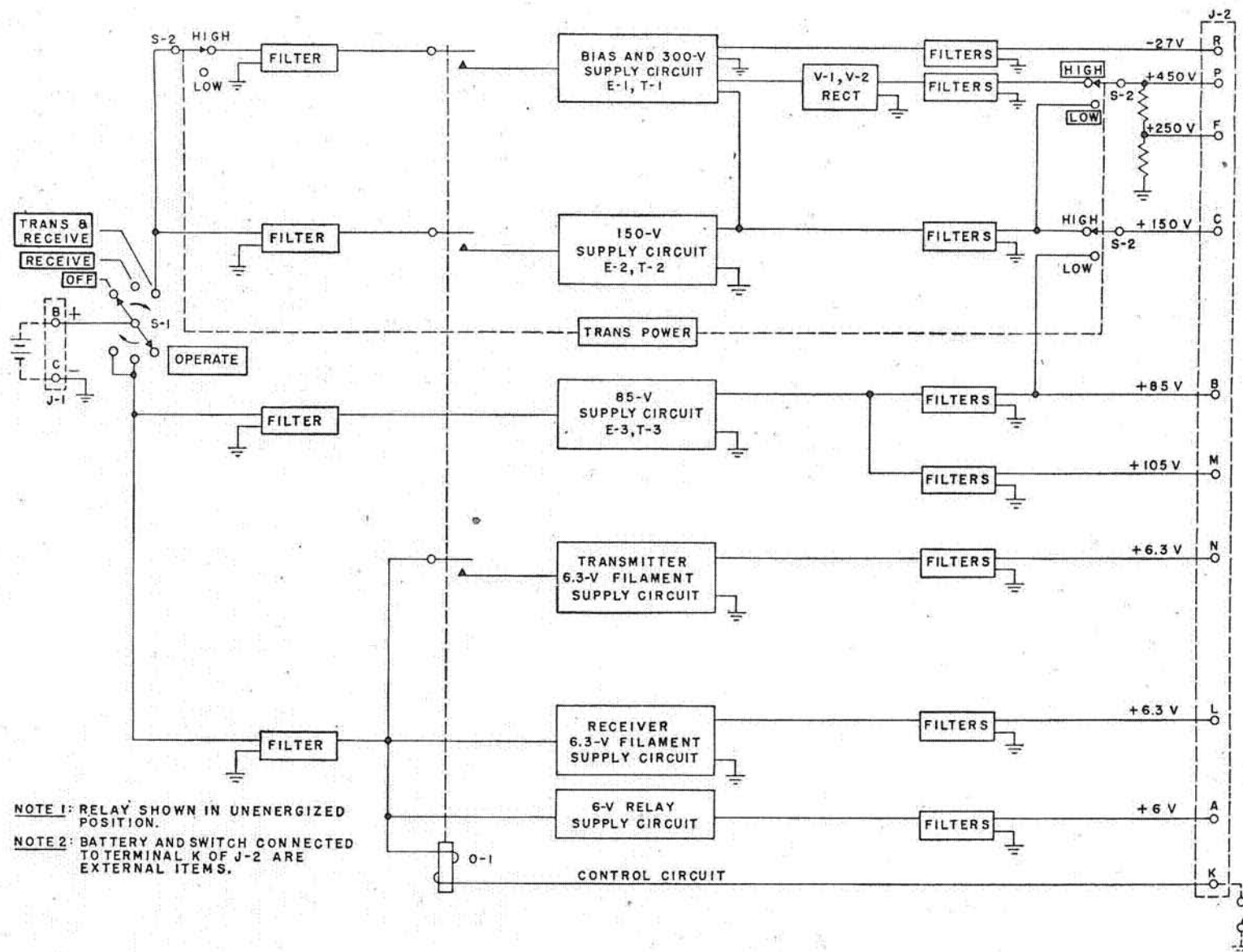


Figure 53. Set 1 power supply, block diagram.

d. Each of the h-v and l-v circuits is equipped with r-f noise suppression filters in both the input and output leads, and a-c ripple filters in the output of each circuit.

e. TRANS POWER switch S-2 consists of two sections, both of which are used in the h-v circuit. One section of S-2 is used to provide full or reduced voltages as required for HIGH or LOW power operation, respectively. The other section of S-2 opens the input to the transmitter h-v and bias supply circuit when the TRANS POWER switch is in the LOW position.

108. Set 1 Transmitting Circuits

(fig. 54)

The block diagram shown in figure 54 pertains equally to Receiver-Transmitters RT-66/GRC, RT-67/GRC, and RT-68/GRC. The transmitter circuits include a microphone input transformer, a reactance modulator (V-105 and V-106), a transmitter oscillator (V-104A), the common crystal oscillator-harmonic generator (V-3 and V-4), the transmitter harmonic amplifier (V-5), a mixer stage (V-6), an r-f stage (V-7 and V-8 in parallel), a driver stage (V-9 and V-10 in parallel), and the power amplifier stage (V-11), the transmitter antenna circuit, and the common receiver-transmitter antenna.

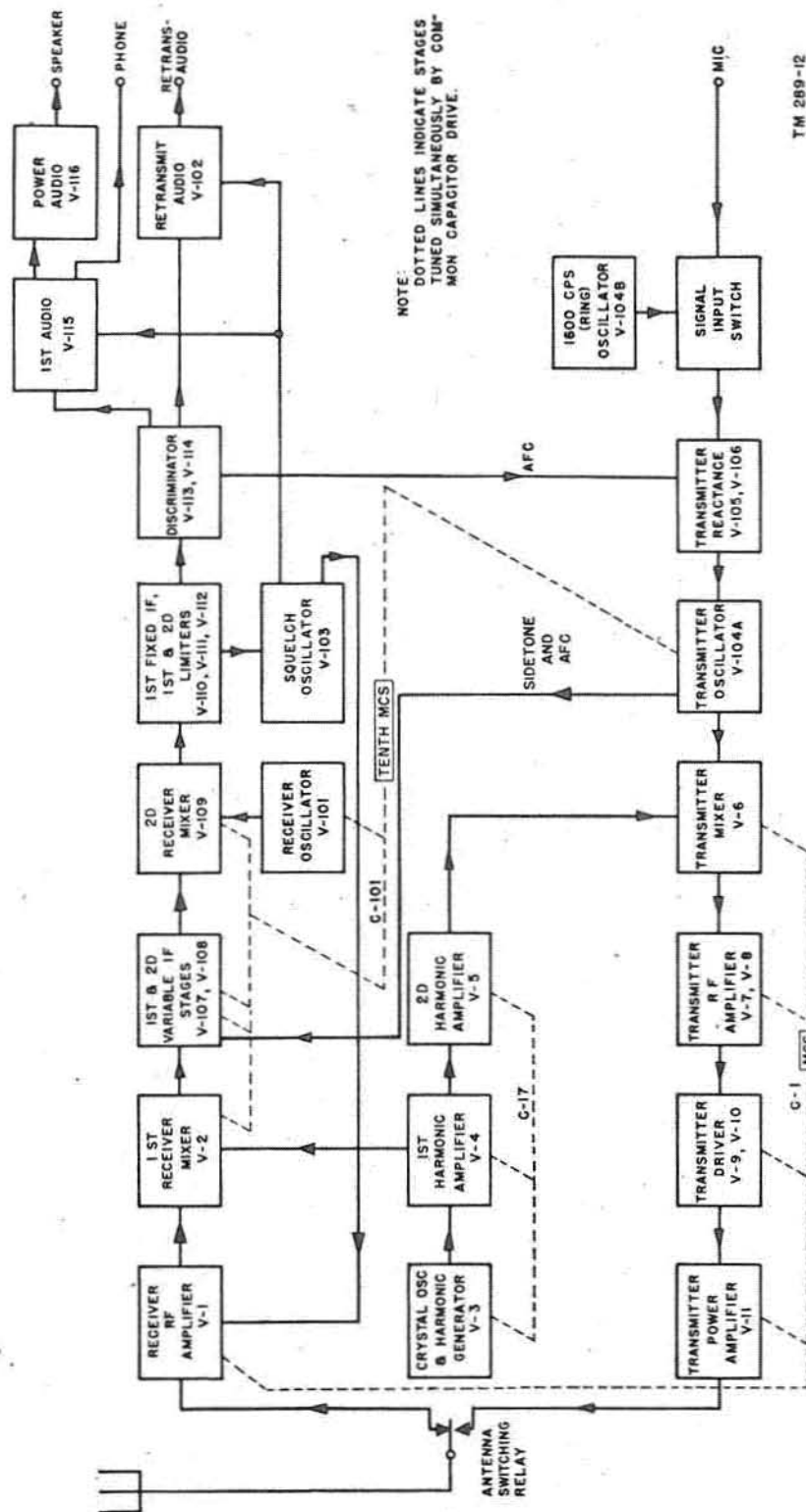
a. TRANSMITTER SIGNAL PATH. Voice signals from an external source are applied through a microphone transformer to the input of the transmitter reactance modulator. Under control of the audio signals, the reactance modulator causes the frequency generated by the transmitter oscillator (section A of V-104) to vary up or down in accordance with the amplitude and frequency of audio signals. Modulation is represented by a shift in the frequency generated by the transmitter oscillator, and ultimately by a corresponding shift of the over-all carrier frequency. The output of oscillator V-104A and the output of harmonic amplifier V-5 are combined in the transmitter mixer stage V-6. A tuned circuit, using one section of tuning capacitor C-1, selects the desired sum frequency at the output of the transmitter mixer and applies it to the transmitter r-f amplifier stage V-7 and V-8. The output of this stage

is tuned to resonance at the carrier frequency by capacitor C-1. Further amplification is provided by transmitter driver stages V-9 and V-10, using a section of the r-f tuning capacitor C-1, and by the transmitter power amplifier stage, V-11. The amplified output is then routed through a tuned circuit to the antenna. The output circuit of the power amplifier uses a section of the main tuning capacitor C1, while the antenna circuit is tuned to resonance by the TR-ANTTUNE capacitor.

b. AUTOMATIC FREQUENCY CONTROL. The purpose of the afc (automatic frequency control) circuit is to maintain a constant transmitter-oscillator carrier frequency. The output of the transmitter-oscillator V-104A is picked up by the variable i-f stages in the receiver through stray coupling and fed to the rest of the receiver circuit. If the difference between the receiver-oscillator frequency (used as the standard) and the transmitter-oscillator frequency varies from the fixed i-f frequency, a voltage is developed in the discriminator circuit. This voltage is used as the afc voltage and is fed to the transmitter reactance tubes, V-105 and V-106. The transmitter reactance stage then corrects the transmitter-oscillator frequency. The time constant of the afc coupling circuit from the discriminator is such that normal modulation of the i-f does not appear in the afc voltage.

c. SIDETONE. Sidetone voltage is obtained from the transmitter-oscillator, V-104A. This voltage is picked up by the variable i-f stages through stray coupling and is fed through the rest of the receiver circuit to the AUDIO output connector, and fixed-level audio output terminals.

d. RINGER CIRCUIT. A ringer circuit associated with the transmitter is energized when the DIAL LIGHT-OFF-ON-RING switch is in the RING position. This switch has the same function for the ringing circuit as the push-to-talk button of the microphone has for the transmitter, since it causes the control relays to be energized when it is in the RING position. In addition, it applies power to the 1,600-cycle ringer oscillator, section B of tube V-104. The output of the ringer oscillator is applied to the microphone transformer. Signal transmission is accomplished as described in a above for any other audio signal.



109. Set 1 Receiving Circuits

(fig. 54)

The receiver is of the double-conversion superheterodyne type arranged to receive f-m signals. The term *double conversion* means that the incoming carrier signal beats with one local oscillator frequency to produce a first i. f. (between 4.45 and 5.45 mc); this frequency in turn beats with another oscillator frequency to produce a second i. f. (in this case 1.4 mc). The discriminator demodulates the second i-f signal and the a-f section of the receiver amplifies the audio output of the discriminator. The amplified output is supplied to headphones, loudspeaker, retransmission circuits, and to monitoring circuits (fig. 50).

a. INPUT CIRCUIT. When the control relays are in the normal or unenergized position, the antenna is connected to the receiver circuits. Carrier signals from the antenna are developed in the antenna circuit, which is tuned by a section of the receiver-transmitter r-f tuning capacitor, C-1. The signals selected are applied to the r-f amplifier stage, V-1, the output of which is tuned by a section of the receiver-transmitter r-f tuning capacitor, C-1. The amplified output of this stage is routed to the receiver first mixer stage. When the SQUELCH control is turned clockwise from the OFF position, the gain of the r-f amplifier stage is controlled by the squelch circuit.

b. FIRST MIXER STAGE V-2. This stage combines the output of the harmonic amplifier, V-4, with the amplified output of the first r-f amplifier stage, V-1, to produce the first i. f. in the range of 4.45 to 5.45 mc. The frequency produced depends on the setting of the TENTH MCS control. The crystal oscillator-harmonic generator and first harmonic amplifier serve both the transmitter and the receiver. Since the output frequency of the first harmonic amplifier is below the frequency to which the receiver-transmitter is tuned (between 4.45 and 5.45 mc, depending on the setting of the tuning controls), the first i-f band resulting from the mixing of the incoming signal with the output of the frequency harmonic amplifier is a band centered about the difference frequency. The plate circuit of mixer stage V-2, located on the r-f chassis, is tuned by a section of the variable i-f tuning capacitor, C-101.

c. AMPLIFICATION OF FIRST I-F SIGNAL. The difference frequency band at the output of the

mixer stage, V-2, is amplified in a two-stage, tuned, variable i-f amplifier, V-107 and V-108. The variable i-f amplifier stages are tuned by sections of the variable tuning capacitor C-101.

d. RECEIVER-OSCILLATOR V-101. The free-running, self-excited oscillator, V-101, generates a frequency between 3.05 and 4.05 mc, depending on the setting of a section of the variable i-f tuning capacitor, C-101. The frequency to which the oscillator is tuned is always 1.4 mc below the frequency to which the variable i-f amplifier is tuned. Thus, if the variable i-f amplifier is tuned to 5 mc, the receiver-oscillator is tuned to 5 minus 1.4 or 3.6 mc.

e. RECEIVER SECOND MIXER V-109. The output of the variable i-f amplifier (a frequency between 4.45 and 5.45 mc), together with the output of receiver oscillator V-101 is combined in the receiver second mixer, V-109. The frequency generated by the oscillator subtracts from the first (variable) i-f signals to produce a second i.f. of 1.4 mc.

f. FIXED SECOND I-F AMPLIFIER AND LIMITER. The i. f. of 1.4 mc is again amplified by a three-stage fixed-tuned amplifier. The first stage, V-110, is a conventional i-f amplifier; the second and third stages, V-111 and V-112, are also designed to function as limiters to eliminate any amplitude variations of the signal. Such amplitude variations represent noise and are undesirable. Proper functioning of the discriminator, which follows the second limiter, requires that the level of the applied signal be fairly uniform for variations in the level of the incoming signal. A portion of the output of the first limiter is fed to the squelch circuit to provide silencing action.

g. DISCRIMINATOR. The output of the final limiter stage, V-112, is applied to the discriminator and V-114. This discriminator is a tuned circuit using two type 1A3 diode tubes as rectifiers. The term discriminator is typical for f-m receivers and signifies a circuit which corresponds to the detector in a-m (amplitude-modulated) receivers. The discriminator performs a function analogous to that of the a-m detector since it extracts the intelligence or audio modulation from the incoming and carrier signal. Since in frequency modulation the intelligence to be *detected* appears as frequency variations (that is, shifts of the carrier from a center frequency) instead of amplitude variations, the discriminator is a frequency sensitive, but not

an amplitude sensitive device. Thus the discriminator converts the variations from the center frequency of the incoming signal into audio signals.

h. AUDIO AMPLIFICATION. The a-f signals which appear at the output of the discriminator are amplified in two separate audio amplifier circuits.

- (1) One circuit is a two-stage audio amplifier, V-115 and V-116, with gain adjustable by means of the panel-mounted VOLUME control. The output of the first stage, V-115, is connected to pins A of each of the AUDIO connectors, and is used to provide enough volume to operate a headphone or the earpiece of a handset. The output of the final audio power amplifier stage, V-116, is connected to pins L of each of the AUDIO connectors and has sufficient output to drive a loudspeaker.
- (2) The other circuit, a one-stage amplifier, V-102, serves to provide an audio output signal for monitoring and retransmission (figs. 50 and 51). No panel adjustment of volume is provided. However, an internal potentiometer provides screwdriver adjustment of the gain of the amplifier to obtain the required level. The output of this stage is connected to pin B of the REC-TR CONTROL connector (J-312 on fig. 50).

i. SQUELCH OSCILLATOR V-103. A characteristic of very sensitive receivers is that in the absence of signals, a rushing noise is heard in the receiver phones or loudspeaker. The noise is the result of thermal agitation in the vacuum tubes and receiver components, and of external electrical disturbances. A *squelch* circuit is used to suppress this noise during no-signal intervals. In Set 1, the squelch circuit consists of a carrier-switched, 20-kc (approximately) oscillator and a diode rectifier, V-103. Squelch action is adjustable by means of the panel-mounted SQUELCH control. The squelch circuit can be disabled for test purposes or for reception of very weak or fading signals by turning the squelch control to the OFF position.

110. Interphone Amplifier

(fig. 55)

Figure 55 is a functional block diagram of AF Amplifier AM-65/GRC. The diagram shows the signal and power supply circuits which are provided by the amplifier.

a. GENERAL. The signal circuits consist of three input channels, a common amplifier, and three amplifying paths. The input circuits of the Set 1 and Set 2 channels are arranged to accept signals from the output of the Set 1 and Set 2 receivers, while the input circuit of the interphone channel will accept signals from a microphone. Microphones at Control Box C-375/VRC, Control C-435/GRC, and the panel of the amplifier may be switched into the interphone channel.

b. COMMON CHANNEL AMPLIFIER. Signals from Sets 1 and 2 are routed over separate paths to the common channel amplifier, are amplified there, and appear in the output circuits of that stage. When an operator presses the push-to-talk button on an interphone-connected microphone, relay O-1 is energized. Contacts of the relay close to complete the circuit to the external microphone and apply energizing potential to the microphone from the internal power supply circuits. Speech signals from the microphone enter the amplifier through the closed contacts of relay O-1, are amplified by V-1, and appear in the output circuits of that stage. An audio mixing arrangement in the common amplifier stage distributes the signals appearing at its output to the three output channels, as described in *c* below.

c. SIGNAL DISTRIBUTION. The Set 1 and interphone signals are applied at the required levels to Set 1 + Interphone and Set 1 + Set 2 + Interphone channels. In a similar manner, Set 2 and interphone signals are applied at the proper levels to Set 2 + Interphone and Set 1 + Set 2 + Interphone channels. Signals from Set 1 do not enter the Set 2 + Interphone channel nor do signals from Set 2 enter the Set 1 + Interphone channel. The Set 1 + Set 2 + Interphone channel carries signals from all three sources.

d. OUTPUT CIRCUITS. Signals passing through the Set 1 + Interphone channel are amplified in amplifier V-2, and appear at the output terminal

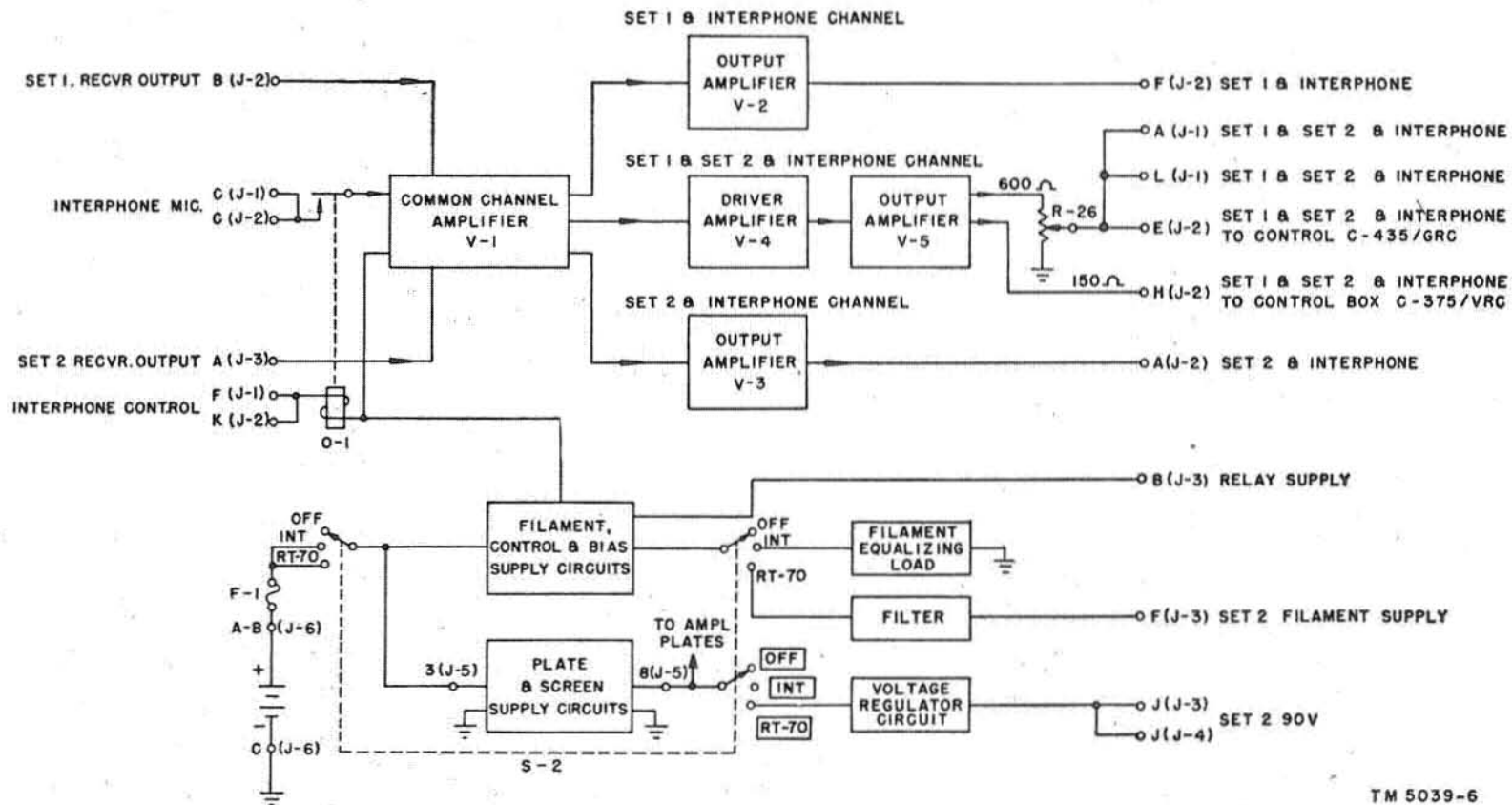


Figure 55. Interphone amplifier, block diagram.

TM 5039-6

for that channel. Similarly, signals passing through the Set 2 + Interphone channel are amplified in output amplifier V-3, and appear at the output terminals for that stage. Signals passing through the Set 1 + Set 2 + Interphone channel are amplified by driver amplifier V-4 and output amplifier V-5 and are applied through a VOLUME control to a 600-ohm output connector for application to Control C-435/GRC or Local Control C-434/GRC and to the AUDIO connector J-1 (fig. 50). These signals are also applied to a 150-ohm output connection for application to Control Box C-375/VRC (fig. 50).

e. POWER SUPPLY CIRCUITS. The battery input is connected through a panel-mounted connector (J-6), through a fuse, and through contacts of the panel-mounted OFF-INT RT-70 switch (S-2) to a h-v and l-v supply circuit. The switch serves as the power on-off switch for the amplifier and for Receiver-Transmitter RT-70/GRC. The h-v supply circuit includes a plug-in vibrator type power supply unit which converts the battery voltage into the required plate and screen voltages for the amplifier and for Receiver-Transmitter RT-70/GRC. The plate and screen voltages for the amplifier are taken directly from the output of the power supply unit. The voltages for the receiver-transmitter are routed through the contacts of switch S-2, and through a voltage regulator circuit to terminals of panel-mounted connectors. The l-v supply circuit provides the filament, relay, microphone, and bias voltages for the amplifier. The control and filament voltages for Receiver-Transmitter RT-70/GRC are supplied to panel-mounted connector J-3. The filament supply circuit includes contacts of switch S-2, in the RT-70 position, and an a-f filter. When Receiver-Transmitter RT-70/GRC is not used, a filament equalizing load is substituted across the filament supply circuit by placing switch S-2 in the INT position. This prevents over-loading the filament supply circuit.

111. Set 2

(fig. 56)

a. GENERAL. The signal path of the Set 2 receiver-transmitter is shown in the functional block diagram (fig. 56). A complete schematic diagram of the equipment is shown in figure 99. The block diagram shows that the equipment

consists of a separate transmitter circuit and a separate receiver circuit. The two circuits are associated with each other through a common antenna circuit, a common 32- to 42.3-mc oscillator and a common tuning control. Normally, the receiver is operative, while the transmitter is in a stand-by, or inoperative condition. When the microphone button is closed, that is, when the operator desires to talk, the receiver is effectively turned off and the transmitter is turned on. This function is accomplished by a relay control circuit, also indicated on the block diagram. The frequency range of the transmitter and of the receiver is from 47 to 58.4 mc. This range corresponds to 115 channels of 100 kc each.

b. TRANSMITTER SIGNAL PATH. The function of the transmitter is to convert speech signals from an external microphone, amplifier, telephone line, or other audio frequency source into frequency-modulated r-f signals. This is accomplished by allowing the audio frequency signals to shift the frequency of a locally generated carrier frequency which is then transmitted over the air. Voice signals from the external microphone, amplifier, or telephone line are amplified by microphone amplifier stage V-1 to the proper value for modulation. Audio voltages are applied to the variable reactance modulator coils (L-2A) to vary the frequency generated by the variable oscillator, V-2, in accordance with the amplitude and frequency of the audio signal. The output of the oscillator and the second harmonic of the frequency generated by a fixed crystal oscillator V-3 are combined in mixer stage V-4. The desired sum frequency at the output of the transmitter mixer is selected by a tuned circuit and is applied to the transmitter driver stage. The signal is again amplified and applied to the transmitter power amplifier stage V-6. The amplified output is then routed through a tuned antenna circuit to the antenna. No antenna switching is provided since the receiver is inoperative when the transmitter is energized and conversely the transmitter is disabled when the receiver is operative.

c. RECEIVER CIRCUITS. The function of the receiver is to accept frequency-modulated carrier signals and to convert them by a double conversion process and by means of an f-m discriminator into the originally transmitted audio signals. The audio signals are then applied to an external headset, an earpiece of a handset, an audio ampli-

fier, a telephone line, or some other suitable audio frequency receiving device. (Monitoring circuits are shown in figure 59.) Carrier signals from the antenna are applied through the common antenna circuit to the first r-f amplifier stage, V-8, the output of which is tuned by a section of the variable gang capacitor. The amplified output of this stage and the output of the common variable oscillator V-2 is applied to the mixer stage, V-9, which produces sum and difference frequencies. The difference frequency is selected by the tuning circuit of the mixer and is routed as a band of frequencies centered about 15 mc to a three-stage i-f amplifier (V-10, V-11, and V-101). The 15-mc output of V-101, in conjunction with the 13.6-mc output of a second crystal-controlled oscillator circuit (part of V-102) is combined in the receiver second mixer portion of V-102 to produce a second i. f. centered about 1.4 mc. This signal is again amplified in a three-stage amplifier (V-103, V-104, and V-105). The first stage (V-103) is a conventional 1.4-mc i-f amplifier. The second and third stages (V-104 and V-105) have the additional function of limiting (or eliminating) any amplitude variations of the signal. Such amplitude variations represent noise and are undesirable. In addition, the proper functioning of the discriminator (T-107), which follows the second limiter (V-105), requires that the level of the applied signal be fairly uniform for variations in the level of the incoming signal. The output of the second limiter stage is applied to the discriminator circuit (T-107) which functions to extract the intelligence or audio modulation from the incoming carrier signal. The discriminator converts variations from the center frequency of the incoming signal into audio signals. These audio signals, appearing at the output of the discriminator, are amplified in the two-stage audio amplifier V-106 and V-108 and are applied to the receiver output terminals of the panel-mounted AUDIO and POWER connectors. The panel-mounted VOLUME control is located between the output of the first audio amplifier stage and the input of the second audio amplifier stage.

d. SIDETONE. A portion of the audio signal applied to the transmitter is routed over a special path, called a sidetone path, to the receiver audio circuits where it is amplified and becomes audible in the earpiece of the handset or in the headset of the operator. This sidetone signal is useful for

two reasons: one, it permits monitoring the transmission; two, it imparts a natural effect in the earpiece of the handset. Without sidetone, the circuit would seem dead.

112. Auxiliary Receiver

The block diagram (fig. 57) is equally representative of Radio Receivers R-108/GRC, R-109/GRC, and R-110/GRC which are used in Radio Sets AN/GRC-3, -5, and -7, respectively. Each receiver is of the single-conversion, superheterodyne type, designed to receive f-m signals. Differences in the receivers lie in the frequency range covered by each, as indicated in the frequency spectrum chart (fig. 2).

a. INPUT CIRCUIT. Carrier signals from the antenna are developed in the antenna circuit, which is tuned by section A of receiver tuning capacitor C-3. The signals selected are applied to r-f amplifier stage V-1, the output of which is tuned by section B of tuning capacitor C-3. The amplifier output of this stage is routed to mixer stage V-2. When the SQUELCH control is turned clockwise from the OFF position, the gain of the r-f amplifier is controlled by the squelch circuit.

b. MIXER STAGE V-2 AND OSCILLATOR V-3. The mixer stage combines the output of local oscillator V-3 with the amplified output of the r-f amplifier stage to produce the i-f of 4.3 mc. The grid circuit of the mixer stage V-2 is tuned by section D of tuning capacitor C-3. The oscillator stage is tuned by section F of tuning capacitor C-3.

c. I-F AMPLIFIER AND LIMITER STAGES. The i-f signal is amplified by a four-stage fixed-tuned amplifier. The first two stages, V-4 and V-5, are conventional i-f amplifiers; the third and fourth stages, V-6 and V-7, are also designed to function as limiters to eliminate any amplitude variations of the signal. They act mainly to limit the variations of the very strong signals. The limiter stage (V-8) also provides limiting action on weak signals.

d. DISCRIMINATOR. The output of the final limiter stage, V-8, is applied to the discriminator and squelch oscillator V-11. This discriminator uses a type 1A3 diode tube (V-9) and one section of a type 1S5 tube (V-10). This discriminator performs a function analogous to that of the a-m detector, since it extracts the intelligence or audio

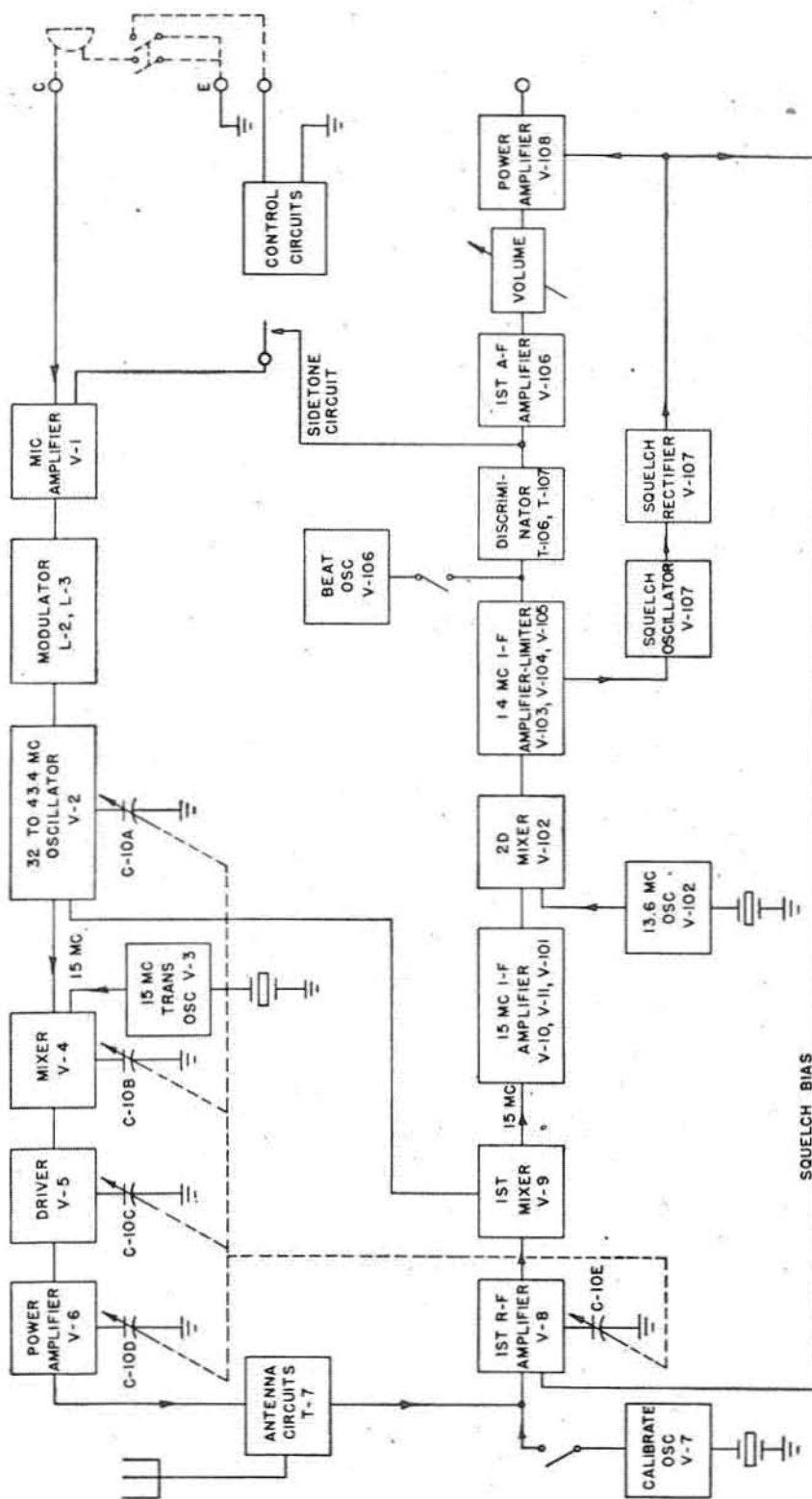
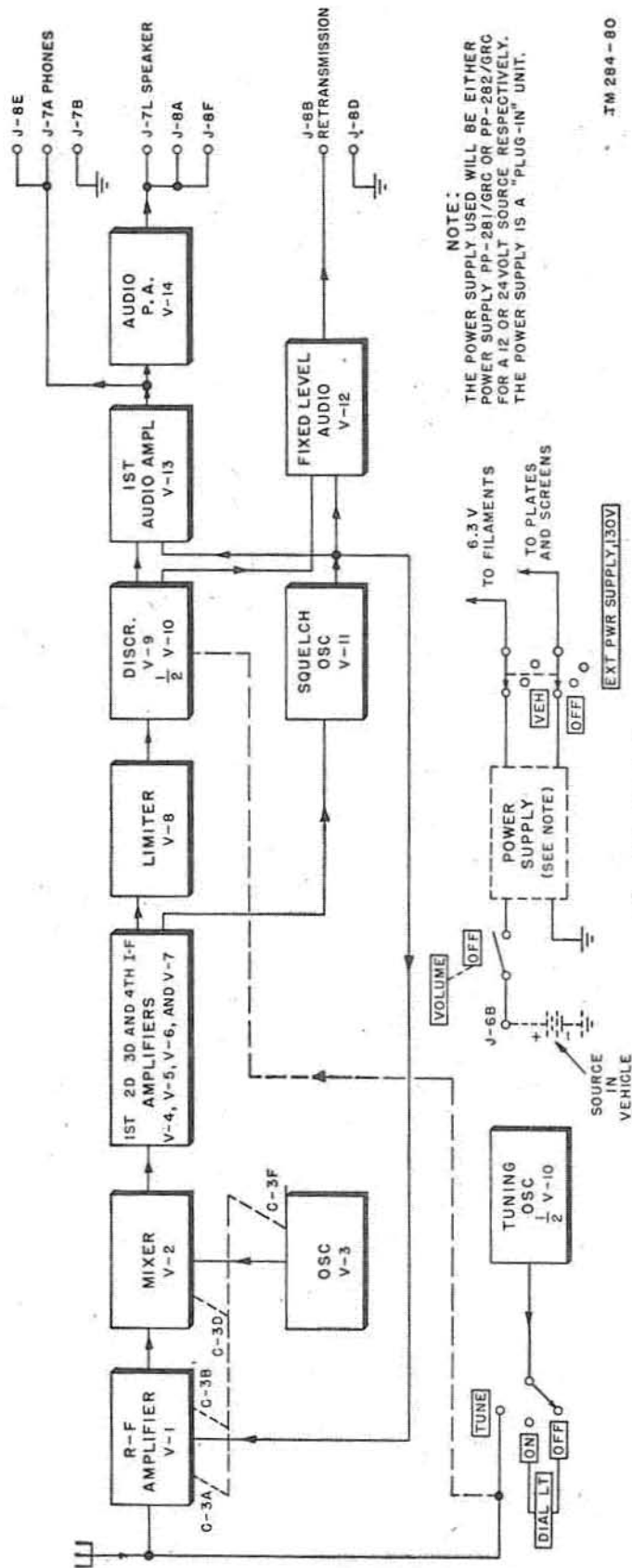


Figure 56. Set 2, block diagram.



modulation from the incoming carrier signal. The discriminator converts the variation in frequency (the intelligence) of the incoming signals into audible signals.

e. AUDIO AMPLIFICATION. The a-f signals that appear at the output of the discriminator are amplified in two separate audio amplifier circuits.

- (1) One circuit is a two-stage audio amplifier, V-13 and V-14, with gain adjustable by means of the panel-mounted VOLUME control. The output of the first stage, V-13, is connected to pin 7 of the AUDIO connectors, and is used to provide enough volume to operate a head-phone or the earpiece of a handset. The output of the final audio power amplifier stage, V-14, is connected to pin L of the audio connector and is used to provide a signal for a loudspeaker.
- (2) The other amplifier circuit, a one-stage amplifier, V-12, serves to provide an audio output signal for monitoring and retransmission (figs. 50 and 51). No panel adjustment of volume is provided. However, an internal potentiometer provides screw-driver adjustment of the gain of the amplifier to obtain the required

output level. The output of this stage is connected to pin B of J-8 (fig. 50).

f. SQUELCH OSCILLATOR V-11. A squelch circuit is used to suppress the noise that is heard during no-signal intervals. This noise is a result of thermal agitation in the vacuum tubes and receiver components, and of external electrical disturbances. Squelch action is adjustable by means of the panel-mounted SQUELCH control. The squelch circuit can be disabled for test purposes or for reception of very weak or fading signals by turning the SQUELCH control to the OFF position.

g. TUNING OSCILLATOR $\frac{1}{2}$ V-10. This oscillator is used mainly for calibration purposes. The fundamental is coupled within the tube to the circuit, since the dual-purpose type 1S5 tube is used as a discriminator and a tuning oscillator. The harmonic components of the output are fed into the r-f amplifier, which selects the frequency to be calibrated on the tuning dial. If a zero beat is obtained, the dial is correct, otherwise the dial must be adjusted mechanically.

h. POWER SUPPLY. For vehicular operation, the power is obtained from the battery of the vehicle and a vibrator power supply. The input to the vibrator power supply is 12 or 24 volts. An external source of power may be used.

CHAPTER 5

ORGANIZATIONAL MAINTENANCE

Section I. TROUBLE SHOOTING

113. General

Trouble shooting at an organizational level is limited to the sectionalizing of defective units which must be replaced as a unit, or to the localization of defective parts for which running spares are available. An equipment performance checklist (par. 114) is included primarily as a sectionalization aid; localizing procedures for the various units are outlined in paragraphs 115 through 121.

114. Equipment Performance Checklist

a. PURPOSE. The equipment performance checklist provides a detailed logical procedure for checking the operation of the radio sets. It should be practiced after the initial installation of the equipment before the equipment is placed in service, periodically thereafter, and as an aid to trouble shooting.

b. USE OF THE CHECKLIST FOR TROUBLE SHOOTING.

- (1) The checklist is arranged in the same sequence the operator would follow when initially applying power to the equipment. The simplest procedure, when using the checklist, is to perform the various items on the list in sequence until an abnormal indication is observed. When the operator has become familiar with the operation of the equipment, he can adapt the list to his own advantage, skipping those steps which do not pertain to the particular unit he wishes to check.
- (2) The first five columns of the checklist list item number, the units which are involved, the items to be checked, the action to take, and the normal indication to be expected, respectively. When an abnormal indication is obtained, the op-

erator is referred (in the sixth column) to a paragraph or paragraphs which outline localizing procedures for particular units.

c. CHECKLIST. The items comprising the equipment performance checklist are listed in the following chart.

115. Localizing Procedures

a. The following paragraphs include localizing procedures which are designed to isolate troubles to a particular unit, or to a particular part for which a running spare is available. These are the paragraphs which are referred to in the equipment performance checklist (par. 114); they are best used in conjunction with the checklist but can be used individually.

b. Whenever the procedure calls for checking a part, substitute an identical part which is known to be good for the part being checked. If no part is available for such use, a visual and/or continuity check may disclose the trouble.

116. Set 1 and Set 1 Power Supply

a. EQUIPMENT SET-UP. Operational checks of Set 1 and the Set 1 power supply are best performed at the panels of the units themselves. Set up the equipment as follows:

- (1) Turn the OPERATE switch to TRANS & RECEIVE.
- (2) With the mounting switch in the OFF position, disconnect the REC TR CONTROL cable from the panel of Set 1. Connect terminals H and J of the receptacle, using the prefabricated plug-in jumper provided with the Allen wrenches within Set 1. Reconnect the cable and turn the mounting switch to the ON position. (The jumper makes

Item No.	Unit	Item	Action or condition	Normal indications	Possible defective units
1	Mounting	OFF-REMOTE-ON switch.	Set at OFF		
2		Cabling	All connections properly made (fig. 29).		
3	Retransmission unit	Installation	Unit plugged into mounting and locked.		
4	Retransmission unit	AUTO switch	Set at OFF		
5	Interphone amplifier	OFF-INT-RT-70 switch	Set at OFF		
6	Interphone amplifier	VOLUME control	Turn to approximate midpoint of range.		
7	Set 2	VOLUME control	Turn to approximate midpoint of range.		
8	Set 2	SQUELCH control	Turn completely clockwise for maximum squelch operation.		
9	Set 2	ANT ADJ-DIAL LIGHT ON OFF-CAL switch.	Set at DIAL LIGHT ON		
10	Set 1 power supply	OPERATE switch	Set at OFF		
11	Set 1 power supply	TRANS POWER switch	Set at HIGH		
12	Set 1 receiver-transmitter.	SQUELCH control	Turn completely clockwise for maximum squelch operation.		
13	Set 1 receiver-transmitter.	DIAL LIGHT OFF-ON-RING switch.	Set at DIAL LIGHT ON		
14	Set 1 receiver-transmitter.	METER switch	Set at 90V		
15	Auxiliary receiver	VOLUME control	Set at OFF		
16	Auxiliary receiver	TUNE DIAL LIGHT OFF-ON switch.	Set at DIAL LIGHT ON		
17	Auxiliary receiver	SQUELCH control	Turn completely clockwise for maximum squelch operation.		
18	Interphone box	Chest set and headset-microphone.	Connect chest set to audio connector; plug headset-microphone into chest set.		
19	Interphone box	RADIO TRANS switch	Lock in RADIO TRANS position.		
20	Interphone box	VOLUME control	Turn completely clockwise for maximum volume.		
21	Mounting	OFF-REMOTE-ON switch.	Turn to ON	POWER lamp glows if dimmer control is properly adjusted.	Battery, battery cable, or mounting (par. 120).

22	Interphone amplifier	OFF-INT-RT-70 switch	Turn to INT position.		
23	Interphone box	Push-to-talk switch on chest set.	Press switch and talk into microphone.	Hear output in chest set	Interphone box (par. 120), mounting (par. 120), interphone amplifier (par. 117), or cables (par. 119).
24	Interphone box	Selector switch	Turn to Set 1 Interphone.		
25	Set 1 power supply	OPERATE switch	Turn to TRANS and RECEIVE.	LAMP on Set 1 panel glows. METER on Set 1 panel reads approximately center-scale (in shaded area). METER on Set 1 panel reads approximately center-scale. Rushing noise (or signal) is heard in headset.	Interphone box (par. 120), mounting (par. 120), Set 1 power supply (par. 116), or Set 1 (par. 116). Set 1 (par. 116).
26	Set 1	METER switch	Turn successively to positions 7 through 11.		
27	Set 1	SQUELCH control	Turn counterclockwise. Adjust VOLUME control on interphone box for comfortable noise level.		Interphone box (par. 120), mounting (par. 120), Set 1 (par. 116), or cables (par. 119).
28	Set 1	Tuning controls	Tune in signal (par. 68)	Signal heard in headset	Set 1 tuning circuit.
29	Set 1	SQUELCH control	Turn clockwise until receiver just squelches.	No signal heard in headset	Set 1 squelch circuit.
30	Chest set	RADIO and push-to-talk switches on chest set.	Press and hold for items 31, 32, and 33.		
31	Set 1	METER switch	Turn successively to positions 2 through 6.	Meter on Set 1 panel reads approximately center-scale.	Set 1 (par. 116), Set 1 power supply (par. 116), mounting (par. 120), interphone box (par. 120), or cables (par. 119).
32	Set 1	METER switch	Turn to RF position	Meter shows some deflection	Set 1 (par. 116).
33	Interphone box	Microphone	Talk into microphone	Sidetone heard in headset	Set 1 (par. 116).
34	Set 1	DIAL LIGHT-OFF-ON-RING switch.	Hold at ring position	Ringing signal is heard in headset. Meter deflects.	Set 1 (par. 116).
35	Interphone box	Chest set and headset microphone.	Press switches and talk into microphone.	Meter on Set 1 panel deflects and sidetone is heard in headset.	Audio accessory.
36	Interphone amplifier	OFF-INT-RT-70 switch	Turn to RT-70 position	LAMP on Set 2 panel glows	Interphone amplifier (par. 117), power supply (par. 117), Set 2 (par. 117), or cables (par. 119).
37	Interphone box	Selector switch	Turn to Set 2 interphone position.		
38	Set 2	SQUELCH and VOLUME controls.	Turn SQUELCH control counterclockwise. Turn VOLUME control on Set 2 to obtain the same level at the interphone box as obtained from Set 1 (item 27).	Rushing noise or signal heard in headset.	Interphone box (par. 120), mounting (par. 120), interphone amplifier (par. 117), Set 2 (par. 117), or cables (par. 119).
39	Set 2	Tuning knob	Tune in signal (par. 69)	Signal heard in headset	Set 2 tuning circuits.

Item No.	Unit	Item	Action or condition	Normal indications	Possible defective units
40	Set 2	ANTADJ-DIALLIGHT ON OFF-CAL switch.	Set switch at CAL and tune dial over entire range.	Zero-beat indications at each mc. Calibration should remain accurate, within 25 kc ($\frac{1}{4}$ space either side of mark) throughout range	Set 2 (par. 117).
41	Set 2	SQUELCH control	Turn clockwise until receiver just squelches.	No output at headset	Set 2 squelch circuit.
42	Interphone box	Push-to-talk and RADIO switches on chest set.	Press switches and talk into microphone. (Monitor signal with a good receiver.)	Sidetone output in headset. Signal heard by monitor.	Mounting (par. 120), interphone amplifier (par. 117), Set 2 (par. 117), or cables (par. 119).
43	Auxiliary receiver	VOLUME control	Turn clockwise	LAMP on receiver glows	Mounting (par. 120), auxiliary receiver (par. 118), power supply (par. 118), or cables (par. 119).
44	Auxiliary receiver	SQUELCH control	Turn counterclockwise	Noise heard in headset	Set 2 squelch circuit.
45	Auxiliary receiver	Tuning control	Tune in a signal	Signal heard in headset	Auxiliary receiver tuning circuits (par. 118).
46	Auxiliary receiver	SQUELCH control	Turn clockwise until receiver just squelches.	No output in headset	Auxiliary receiver squelch circuit.
47	Auxiliary receiver	VOLUME control	Turn to OFF	LAMP on receiver panel extinguishes.	
48	Set 1 and Set 2	Tuning controls	Set controls to frequency in accordance with interference charts (figs. 42 through 47).		
49	Interphone box	Selector switch	Turn to Set 1 + Set 2 + Interphone position.	No indication unless either or both receivers are operative.	Interphone box (par. 120) or interphone amplifier (par. 117).
50	Chest set	Push-to-talk switch	Repeat step 23 at each audio connector of each interphone box.	Output heard in headset	Interphone box (par. 120), mounting (par. 120), interphone amplifier (par. 117), or cable (par. 119).
51	Chest set (with headset and microphone).	Connect in turn to each audio connector at each interphone box.	Repeat steps 24, 35, 37, and 42.	Output heard in headset	Interphone box (par. 120) or cables (par. 119).
52	Retransmission unit	AUDIO connector	Attach chest set and headset-microphone.		
53	Retransmission unit	Chest set	Press RADIO and push-to-talk switches. Talk into microphone.	Signal heard in headset at interphone box. Sidetone heard in headset at retransmission unit.	Retransmission unit or mounting (par. 120).

54	Retransmission unit...	MANUAL switch and chest set.	Hold MANUAL switch at SEND SET 1 and press RADIO and push-to-talk switches.	Meter on Set 1 panel reads. Sidetone is heard at both headsets.	Retransmission unit or mounting (par. 120).
55	Retransmission unit...	MANUAL switch and chest set.	Hold MANUAL switch at SEND SET 2 and press RADIO and push-to-talk switches.	Sidetone is heard at both headsets.	Retransmission unit or mounting (par. 120).
56	Retransmission unit...	AUTO switch.....	Turn to DUPLEX. (Arrange for duplex communication with another radio set.)		
57	Retransmission unit...	Chest set.....	Press RADIO and push-to-talk switches. Talk into microphone. Have other operator break in on conversation.	Meter on Set 1 panel reads. Sidetone is heard at headsets on retransmission unit and interphone box. Received signals are heard at both headsets.	Retransmission unit or mounting (par. 120).
58	Retransmission unit...	AUTO switch.....	Turn to RETRANS position. (Arrange for retransmission communication with another set if possible.)		
59	Set 2.....	SQUELCH control.....	Turn to OFF. Leave at OFF until item 61 is completed.	SIGNAL REC SET 2 lamp on retransmission unit glows. Noise (or signal) is heard at both headsets. Meter on Set 1 panel reads. Meter on retransmission unit reads.	Retransmission unit or mounting (par. 120).
60	Retransmission unit...	AUTO switch and ADJUST METER to CENTER control.	Hold switch at ADJUST METER and adjust the control for Set 2.	Same as step 59 but retransmission meter deflection is effected.	Retransmission unit (par. 120).
61	Set 1 and Set 2.....	SQUELCH controls.....	Turn Set 2 control counterclockwise to squelch the set; turn Set 1 control to OFF. (Arrange for transmission of signal by an external set if possible.)	SIGNAL REC SET 1 lamp on retransmission unit glows. Noise (or signal) is heard at both headsets. Meter on retransmission unit reads. Radio monitor, if available, hears signal.	Retransmission unit or mounting (par. 120).
62	Retransmission unit...	AUTO switch and ADJUST METER TO CENTER control.	Hold switch at ADJUST METER and adjust the control for Set 1. (When check is complete, advance SQUELCH control of Set 1 to quiet receiver.)	Same as Step 61 but retransmission meter deflection is effected.	Retransmission unit (par. 120).

Item No.	Unit	Item	Action or condition	Normal indications	Possible defective units
63	Auxiliary receiver	VOLUME, SQUELCH, and tuning controls.	Advance VOLUME SQUELCH controls and tune in a signal.	Lamp on receiver panel glows. Noise or signal is heard at both headsets. Meter on retransmission unit reads. Radio monitor, if available, hears signal.	Retransmission unit (par. 120), mounting (par. 120), or auxiliary receiver (par. 118).
64	Retransmission unit	AUTO switch	Turn to OFF		
65	Mounting	POWER switch	Turn to OFF. Replace retransmission unit with local control unit. Connect to remote control unit (par. 45). Connect a chest set (with headset-microphone) to the local control unit; place REMOTE switch of local until in TEL only position. Connect a handset to the remote control unit, turn POWER switch on mounting to REMOTE.		
66	Local control unit	Ringing generator	Crank generator	Ringing signal should be heard or CALL light should glow at remote control unit.	Local control unit (par. 120), remote control unit (par. 120), or telephone line.
67	Remote control unit	SELECTOR switch	Turn to TEL. Press push-to-talk switch on handset. Talk into mouthpiece and acknowledge call.	Full-duplex conversation possible between local and remote units.	Local or remote control unit (par. 120).
68	Remote control unit	Ringing generator	Crank generator	Ringing signal should be heard or CALL LIGHT should glow at local control unit.	Local or remote control unit (par. 120).
69	Local and remote control units.	Ringing generators	Repeat steps 66 and 68 with the internal CALL and RING switches set in their alternate position.	Ringing signals should be heard or CALL LIGHTS should glow.	Local or remote control unit (par. 120).
70	Local control unit	Remote switch	Turn to SET 1 and 2	Panel lamps on mounting, Set 1, Set 2, and auxiliary receivers light.	Local control unit (par. 120).

71	Local control unit.....	LOCAL switch.....	Turn alternately to Set 1 and Set 2. Press RADIO and push-to-talk switches. Talk into microphone. Release switch to TEL when finished.	Sidetone should be heard at chest set on interphone box.	Local control unit (par. 120) or mounting (par. 120).
72	Remote control unit....	SELECTOR switch and handset.	Turn to right write-in position, press push-to-talk switch, and talk into mouthpiece.	Set 1 panel meter reads, sidetone heard at both chest sets.	Local or remote control unit (part. 120).
73	Remote control unit....	SELECTOR switch and handset.	Turn to left write-in position, close push-to-talk switch, and talk into mouth piece.	Signal heard at both chest sets; sidetone can be heard at Set 2 panel audio-connector with headset or speaker.	Local or remote control unit or mounting (par. 120).
74	Local control unit.....	Remote switch.....	Turn to Set 1 position.....	All panel lamps extinguish.....	Local or remote control unit (par. 120).
75	Remote control unit....	SELECTOR switch and handset.	Turn to right write-in position. Press push-to-talk switch.	Power lamp on mounting glows. Meter on Set 1 panel reads as long as push-to-talk switch is pressed.	Local or remote control unit or mounting (par. 120).
76	Remote control unit....	SELECTOR switch and handset.	Turn to left write-in position. Press push-to-talk switch.	No indication.....	
77	Local control unit.....	Remote switch.....	Turn to Set 2.....	No indication.....	
78	Remote control.....	SELECTOR switch.....	Turn to right write-in position. Press push-to-talk switch.	All panel lamps glow.....	Local and remote control units (par. 120).
79	Remote control unit....	SELECTOR switch.....	Turn to left write-in position. Press push-to-talk switch.	All panel lamps extinguish.....	
80	Mounting.....	Power switch.....	Turn to OFF.		

Set 1 independent of interconnections normally made through the mounting.) When all checks have been completed, remove the jumper.

- (3) Connect a handset to one of the AUDIO connectors on the Set 1 panel.

b. LAMP CHECK. If the dial LAMP on Set 1 does not light, with the DIAL LIGHT-OFF-ON-RING switch in the ON position, turn the METER switch to position 7 and interpret the meter indications as follows:

- (1) If the meter reading is normal or slightly higher than normal, the lamp is probably bad.
- (2) If the meter reading is higher than normal, check tubes V-113, V-114, and the lamp (fig. 70 and par. 121).
- (3) If the meter reading is zero, turn the METER switch to position 9. If the reading is normal at position 9, check tubes V-116 and V-3 of Set 1 (fig. 69 and par. 121). If the reading is very low or zero, the trouble is probably in the power supply. Check fuse F-1, continuity of thermal relay K-2, and ballast tubes R-31 and R-40 in the power supply (figs. 65 and 66 and par. 126). (Ballast tube R-40 is included only in Power Supply PP-112/GR.)

c. VOLTAGE CHECK. Turn the METER switch to the 90V position and check for a normal reading. If no reading is obtained, make the following checks:

- (1) Check fuse F-2 in the power supply (par. 126).
- (2) If the fuse is good, check vibrator E-3 and voltage regulator V-4 (fig. 67 and par. 126).
- (3) If the above checks do not reveal a defective part, refer to paragraph 119 for additional check procedures.

d. RECEIVER FILAMENT CHECK. Turn the METER switch successively through positions 7, 8, 9, 10, and 11. If an abnormal meter reading is obtained, refer to the filament chart (par. 121) for the probable defective tube involved. Refer also to the filament schematic (fig. 58).

e. RECEIVER CHECK. Turn the SQUELCH control counterclockwise and check for noise output in the earpiece of the handset. If no noise is heard, check tubes V-2 and V-107 through V-116

for filament continuity (par. 121). If the filaments are good, replace the tubes one at a time with identical type tubes which are known to be good until the defective tube is isolated.

f. TRANSMITTER FILAMENT CHECK. Press the push-to-talk button on the handset and turn the METER switch successively through positions 2, 3, 4, 5, and 6. If an abnormal meter reading is obtained, refer to the filament chart (par. 121) for the probable defective tube involved. Refer also to the filament schematic (fig. 58). If all of the readings are very low or zero, the trouble is probably in the power supply (par. 126). Check fuse F-1, thermal relay K-1, and ballast tubes R-24, R-25, R-37, and R-38 in the power supply (figs. 65 and 66). (Ballast tubes R-37 and R-38 are included in Power Supply PP-112/GR only.)

g. TRANSMITTER OUTPUT CHECK. Turn the METER switch to the RF position, press the push-to-talk switch on the handset, and talk into the mouthpiece. Interpret the indications as outlined below.

- (1) If an abnormally low deflection is obtained on the meter, check the antenna tuning (par. 42). If it is impossible to obtain any output and the tubes have been checked as outlined in the preceding subparagraphs, the trouble may be due to misalignment.
- (2) If r-f output is obtained, sidetone should be audible in the earpiece. If no sidetone is heard, check tubes in the receiver section of Set 1 (figs. 69 and 70).

h. RINGING CHECK. Turn the DIAL LIGHT OFF-ON-RING switch to the RING position and check for r-f output on the meter and a ringing signal in the earpiece. If abnormal indications are obtained, check tube V-104 in Set 1 (fig. 69 and par. 127).

117. Set 2 and Interphone Amplifier

a. EQUIPMENT SET-UP. Operational checks of Set 2 and the interphone amplifier are best performed at the panels of the units themselves. Set up the equipment as follows:

- (1) Turn the OFF-INT-RT-70 switch to the RT-70 position.
- (2) With the mounting switch in the OFF position, disconnect the REC-TR-CONT cable from the panel of the amplifier.

Connect terminals H and J of the receptacle, using the prefabricated plug-in jumper provided in Set 1 or the auxiliary receiver. Reconnect the cable and turn the mounting switch to the ON position. When all checks have been completed, remove the jumper.

- (3) Connect a handset to the AUDIO connector of Set 2 and a chest set (with headset and microphone) to the AUDIO connector of the amplifier.
- (4) Turn the ANT ADJ-DIAL LIGHT ON-OFF-CAL switch to the ON position.

b. LAMP CHECK. If the dial LAMP does not light, or lights dimly, make the following checks:

- (1) Check the lamp (par. 125).
- (2) Check fuse F-1 in the amplifier (par. 124).
- (3) Check thermal relay K-1 and ballast tubes R-32 and R-33 in the amplifier (fig. 60 and par. 124).
- (4) If a 24-volt source is used in the vehicle, check all of the amplifier tubes (fig. 60 and par. 124).
- (5) If the above checks fail to reveal a defective component, make the cabling checks outlined in paragraph 119.

c. SET 2 RECEIVER AND INTERPHONE AMPLIFIER CHECK. Turn the SQUELCH control on Set 2 in a counterclockwise direction and listen for a rushing noise in the handset and headset. Interpret the results as follows:

- (1) If no noise is heard in the handset (and the LAMP is lit), the trouble is probably in the receiver section of Set 2 or the plug-in power supply in the amplifier. Check the tubes (figs. 63 and 64 and par. 125), and check the vibrator, E-1, in the power supply unit (fig. 61 and par. 124).
- (2) If there is noise output in the handset but not in the headset, the trouble is probably in the amplifier or interconnecting cables. Check the tubes (figs. 59 and 60 and par. 124) one at a time. If the tubes are good, check the cabling (par. 119).

d. CALIBRATION CHECK. Turn the ANT ADJ-DIAL LIGHT ON-OFF-CAL switch to the CAL position and tune Set 2 over its entire range. Quieting, beat notes, and finally a zero-beat should be audible in the handset as the dial passes each mc calibration. If no indication is heard, check tubes V-7 and V-106 in Set 2. Assuming

the amplifier is good (*c* above), the indications should also be audible in the headset. If no indications are obtained at either audio accessory, check the cabling (par. 119).

e. TRANSMITTER CHECK. Press the push-to-talk switch on the handset and talk into the mouthpiece. If possible, arrange for a monitor to check transmission from Set 2. If no monitor is available, hold a #331 lamp (the same type that is used for the Set 2 dial LAMP) near the Set 2 antenna.

- (1) If the lamp does not light or the radio monitor does not respond, check the transmitter tubes in Set 2 (fig. 63 and par. 125).
- (2) If the lamp lights but there is no sidetone in the earpiece, check the receiver tubes in Set 2 (*c* (1) above).

118. Auxiliary Receiver

a. EQUIPMENT SET-UP. Operational checks of the auxiliary receiver are best performed at the panel of the unit itself. Set up the equipment as follows:

- (1) With the mounting switch in the OFF position, disconnect the REC CONTROL cable from the panel of the receiver. Connect terminals H and J of the receptacle, using the prefabricated plug-in jumper provided within the receiver. Reconnect the cable and turn the mounting switch to the ON position. When all checks are completed, remove the jumper.
- (2) Connect a headset to the AUDIO connector on the panel of the receiver.
- (3) Turn the TUNE DIAL LIGHT OFF-ON switch to the ON position.
- (4) Turn the VOLUME control to the approximate midpoint of its range.

b. LAMP AND FILAMENT CHECK. If the dial LAMP is lit, all the filaments in the receiver are good. If the lamp is not lit, make the following checks:

- (1) Check fuse F-1 in the receiver (par. 128).
- (2) Check each receiver tube, one at a time, for filament continuity (fig. 71 and par. 128).
- (3) If fuse and filaments are good, check thermal relay K-1 in the receiver (fig. 71 and par. 128).



Figure 59. Set 2 filament circuit, schematic diagram.

c. **RECEIVER CHECK.** Turn the SQUELCH control of the receiver in a counterclockwise direction and listen for noise in the headset. If no noise is present (and the dial LAMP is lit), make the following checks:

- (1) Check the vibrator in the plug-in vibrator supply within the receiver (figs. 61 and 71 and par. 128.)
- (2) If the vibrator is good, check all the receiver tubes (fig. 71).
- (3) If tubes check good, the system cabling will have to be checked (par. 119).

d. **CALIBRATION CHECK.** Hold the TUNE DIAL LIGHT OFF-ON switch to the TUNE position and turn the tuning control throughout its range. Quieting, beat notes, and finally zero-beat indications should be audible in the headset as the calibration points of the receiver are passed. (The calibration points are indicated by red dots on the tuning dial.)

119. Cables

When normal indications are obtained at a panel AUDIO connector but not at an interphone box, the trouble may be caused by a poor cable connection or an open lead within a cable. Continuity checks must be made to determine such faults. In some instances the cables are terminated by solder connections on a terminal board within the mounting, an interphone box, or intermediate junction boxes. To obtain access to these points it will be necessary to open the unit involved. Figures 20 and 29 show an open view of the mounting and the system cordage diagram, respectively. The interior of the interphone box is shown in figure 23. The above-mentioned illustrations and the unit schematic diagrams should be used when making continuity checks.

120. Miscellaneous Components

The mounting, retransmission unit, interphone boxes, local control unit, and remote control unit may prove defective with regard to lamp, switch,

and relay operation. General trouble-shooting techniques are outlined below.

a. **MOUNTING.** If the mounting lamp lights, power should be available to all units. If the lamp is lit but all units do not have power, the trouble is probably caused by faulty wiring in the mounting. If the lamp is not lit but power is available to at least one unit, either the lamp is defective or the dimmer control is incorrectly adjusted. Continuity checks of the mounting should reveal any troubles which may arise within the mounting. A schematic diagram of the mounting is shown in figure 94.

b. **RETRANSMISSION UNIT.** To check operation of the retransmission unit, perform the applicable items of the equipment performance checklist (par. 114) and check for normal indications as listed. If abnormal indications are obtained, refer to the schematic diagram (fig. 91) and make continuity checks of the unit.

c. INTERPHONE BOX.

- (1) When normal indications are obtained at a panel AUDIO connector but not at an interphone box, the trouble must be in cable interconnections or the interphone box itself.
- (2) If none of the interphone boxes are operative for a particular function, the trouble is in either the mounting-interphone box interconnecting cable or in the internal wiring within the rack-mounted unit which is being checked.
- (3) If any one interphone box is operative and others are inoperative, the trouble is probably in the cables which are used to connect the interphone boxes in parallel.
- (4) If trouble is isolated to a particular interphone box, continuity checks on the box should reveal the defect. The following chart lists the measurements which should be taken to check the continuity of all parts and wiring within the interphone box. A schematic diagram is shown in figure 90.

Points of measurement	Position of RADIO TRANS switch S-2	Position of Selector switch S-1	Resistance reading
Terminal 1 of E-2 to tips of jacks J-3 and J-4 and to F contact of connectors J-1 and J-2.	Center RADIO TRANS	Counterclockwise Center Clockwise	Infinity. 0. Infinity. Infinity. 0.
Terminal 2 of E-2 to J contact of connectors J-1 and J-2.			
Terminal 2 of E-2 to tips of jacks J-3 and J-4 and to F contacts of connectors J-1 and J-2.	Center RADIO TRANS	Counterclockwise Center Clockwise	0. Infinity. 0. Infinity. Infinity. Infinity.
Terminal 3 of E-2 to tips of jacks J-3 and J-4 and to F contacts of connectors J-1 and J-2.	Center RADIO TRANS	Counterclockwise Center Clockwise	0. Infinity. Infinity. Infinity. 0. 0.
Terminal 4 of E-2 to B, E, and H contacts of connectors J-1 and J-2.			
Terminal 5 of E-2 to rings of jacks J-3 and J-4 and to C contacts of connectors J-1 and J-2.	Center RADIO TRANS	Counterclockwise Center Clockwise	Infinity. 0. Infinity. Infinity. 0.
Terminal 6 of E-2 to K contacts of connectors J-1 and J-2.			
Terminal 6 of E-2 to rings of jacks J-3 and J-4 and to C contacts of connectors J-1 and J-2.	Center RADIO TRANS	Counterclockwise Center Clockwise	0. Infinity. 0. Infinity. Infinity. Infinity.
Terminal 7 of E-2 to rings of jacks J-3 and J-4 and to C contacts of connectors J-1 and J-2.	Center RADIO TRANS	Counterclockwise Center Clockwise	0. Infinity. Infinity. Infinity. 0.
Terminal 8 of E-2 to tips of jacks J-5 and J-6 and to A contact of connectors J-1 and J-2.		Counterclockwise	0 to 10 k depending on position of VOLUME controls R-1 and R-2.
Terminal 9 of E-2 to tips of jacks J-5 and J-6 and A contacts of connectors J-1 and J-2.		Center	0 to 10 k depending on position of VOLUME controls R-1 and R-2.
Terminal 10 of E-2 to tips of jacks J-5 and J-6 and to A contact of connectors J-1 and J-2.		Clockwise	0 to 10 k depending on position of VOLUME controls R-1 and R-2.
Terminals 11 and 12 of E-2 to chassis.			Infinity.
Terminal 13 of E-2 to terminals 14 and 15 of E-2.			0.

d. LOCAL AND REMOTE CONTROL UNITS. To check operation of the local and remote control units, perform the applicable items of the equipment performance checklist (par. 114) and check for normal indications as listed. If abnormal indications are obtained, refer to the schematic diagrams (figs. 92 and 93) and make continuity checks of the units.

121. Set 1 Filament-Circuit Trouble Localization Chart

The following chart lists the Set 1 tubes checked for each position of the METER switch on the Set 1 panel. A center-scale reading is the normal reading for all positions of the switch. If the normal reading is not obtained, the probable defective tube is listed under the type of reading

which is obtained. To obtain a reading in positions 2 through 6 of the METER switch, the

push-to-talk button must be pressed. Observe the notes at the end of the chart.

METER switch position	Zero reading	Too low but not zero reading	Too high but not full-scale reading	* Full-scale reading
2	V-7	V-7	V-9	V-9.
3	V-8	V-8	V-10	V-10.
4	V-6			V-5.
5	V-106	V-106		V-104.
6	V-105			
7	V-116, V-114		V-113, V-3	V-3.
8	V-4		V-2	V-2.
9	V-102			V-107, V-103.
10	V-108, V-110		V-112	V-111, V-112.
11	V-115		V-109, V-101	V-109, V-101.

Note 1. The transmitter power amplifier tube, V-11, and the receiver first r-f amplifier tube, V-1, are not checked by the meter switch. These tubes must be checked by visual inspection. Observe whether (with power applied) the tube filaments are lit. The filament of V-11 is energized when the microphone push-to-talk button is operated.

Note 2. Because of the series-parallel arrangement of the tube filaments, a break in the filament of one tube in a series string of tubes will cause all the

other tubes in the string to go out and will produce indications of a faulty stage involving those tubes.

Note 3. A high reading for all filaments on positions 7 through 11 may be due to a faulty V-1. A high reading on positions 2 through 6 may be due to a faulty V-11. A low voltage for all tubes may be due to the operation of the overload relay in the power supply or trouble in the power supply itself.

Note 4. Turn off all power when replacing tubes.

Section II. REPLACEMENT OF PARTS

122. General

The following paragraphs list procedures for the replacement of parts for which running spares are provided. Running spares for each unit are listed in paragraph 22. The procedures described will be necessary as a result of sectionalizing trouble to a particular unit and as an aid to localizing trouble to a particular component part.

Note. No lubrication is required for Radio Sets AN/GRC-3, -4, -5, -6, -7 and -8.

123. Removing Immersionproof Cases

Replacement of pluck-out parts (excepting fuses) necessitates the removal of the immersion-proof cases which house the panel-chassis assemblies of the various units. To remove the case of Set 1, Set 2, the interphone amplifier, the Set 1 power supply, or the auxiliary receiver, perform the following steps:

- Remove all external connections from the unit involved.
- Remove the unit from the mounting.
- Loosen the Dzus fasteners located at the edges of the unit.
- Slide the panel-chassis assembly out of the case. Take care not to damage any wiring or

components while removing and handling the panel-chassis assembly.

124. Interphone Amplifier

The replacement of pluck-out parts for which spares are available is described in the following subparagraphs.

a. FUSE. The panel-mounted fuse may be removed by unscrewing the fuse cap which also serves as a fuse extractor. A spare fuse is located in a fuse clip on the amplifier chassis (fig. 60).

b. THERMAL RELAY AND BALLAST TUBE. Thermal relay K-1 and ballast tube R-32 are mounted in a horizontal position at the rear of the amplifier chassis (fig. 60). After removing the panel-chassis assembly from the case, remove the relay or ballast tube with a straight horizontal pull. Do not rock or jiggle the component in its socket; the socket prongs may be damaged.

c. TUBES. All tubes are accessible from the top of the chassis when the case has been removed (fig. 60). To remove any tube, first remove the tube shield and then use a tube puller. Do not rock or jiggle a tube in its socket; the tubes are easily damaged by careless handling.

d. PLUG-IN POWER SUPPLY. Although it can

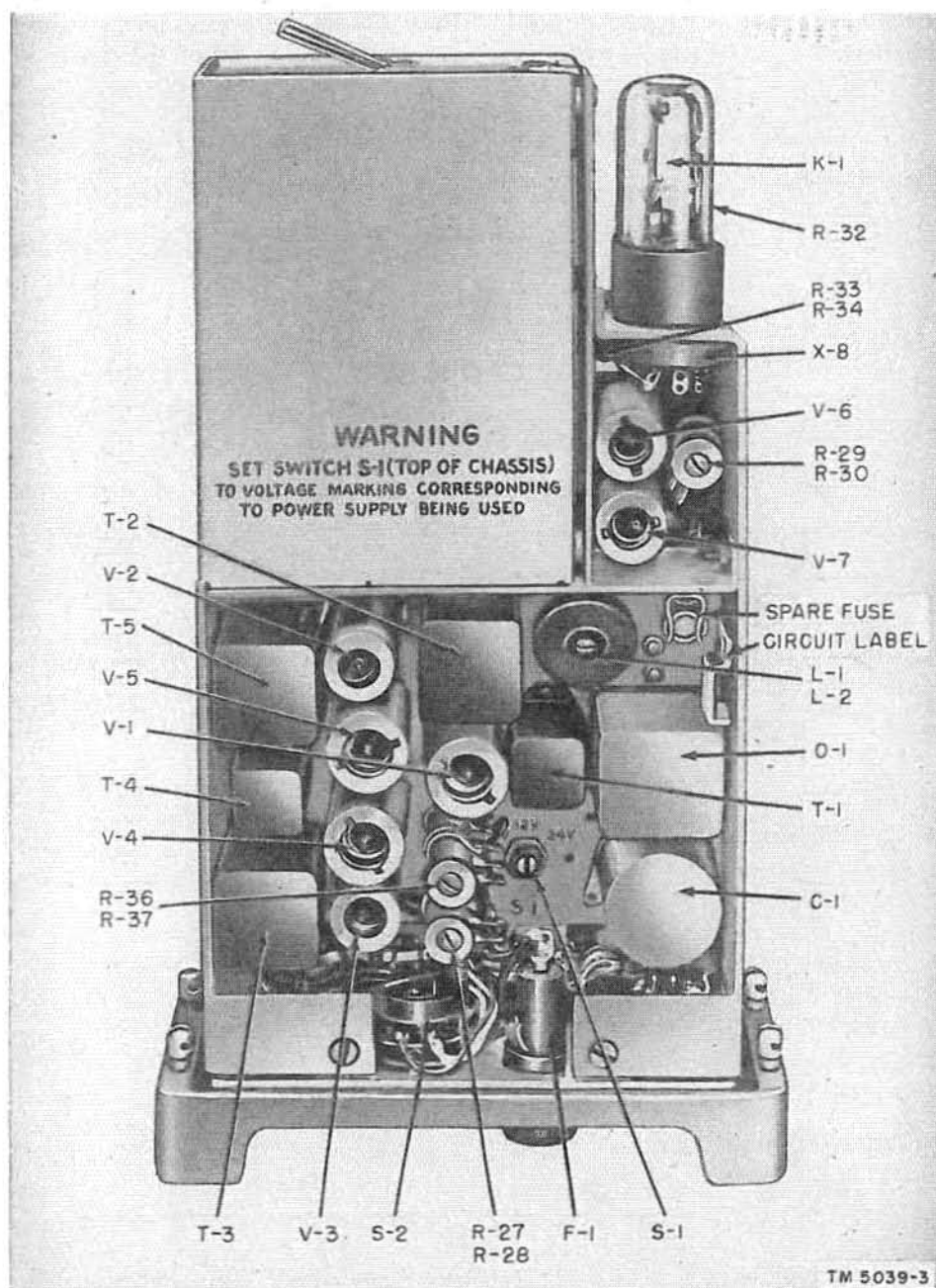


Figure 60. AF amplifier AM-65/GRC, top view of chassis.

be replaced as a single unit, the plug-in power supply is not furnished as a running spare. However, a spare is provided for the vibrator within the power supply (fig. 61). Remove the amplifier case and replace the vibrator as follows:

- (1) Loosen the clamp at the rear of the power supply compartment and swing it out of the way.

- (2) Grasp the handle at the rear of the power supply unit and pull straight out.
- (3) Remove the three green screws which fasten the top cover on the power supply chassis.
- (4) Using the handle on the cover, lift the cover off with a straight upward movement. If the cover is stuck, use a small

- screw driver and gently pry the cover.
- (5) Pull the vibrator (fig. 61) out of its socket with a straight upward movement. Do not rock or jiggle the vibrator while attempting to remove it from its socket. If necessary, use a small screw driver to gently pry the vibrator out of its socket, but take care not to enlarge the ring clip which holds the vibrator near the base

125. Set 2

The only replaceable parts in Set 2 are the dial lamp and the tubes. The tubes are located on the vertical r-f and i-f chassis (fig. 62).

a. To gain access to the tubes, remove the panel-chassis assembly from the case (par. 123). To remove any tube, first remove the tube shield and then use a tube puller. Do not rock or jiggle the tube; a tube may be easily damaged by careless handling. Tube locations are shown on figures 63 and 64.

b. The lamp is accessible from the front panel. Remove the screw which is located just below the tuning dial and which holds the lamp in its socket against a spring tension. When replacing the lamp, insert it glass forward in the socket so that the retaining screw supplies a contact at the base of the bulb.

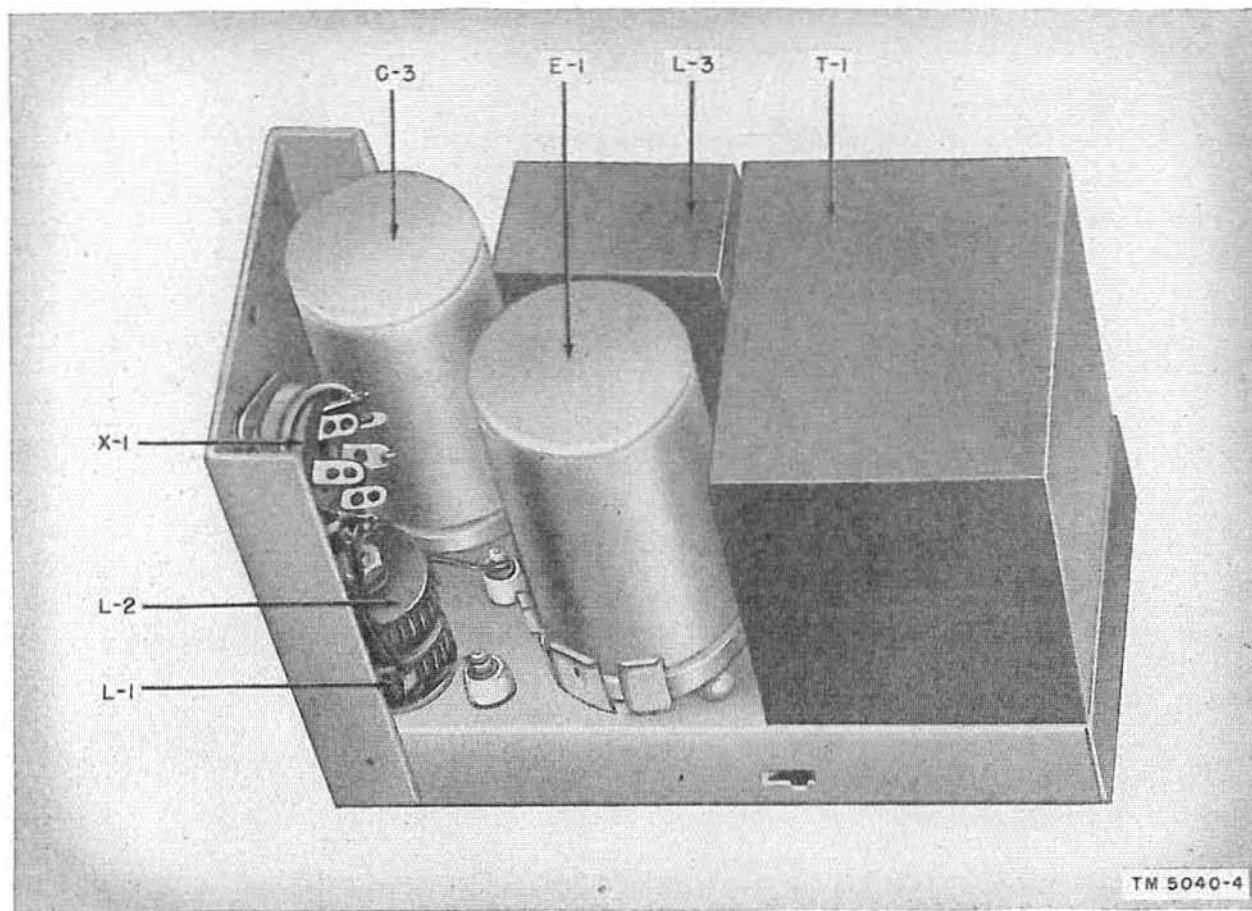


Figure 61. Power supply PP-282/GRC, top view of chassis.

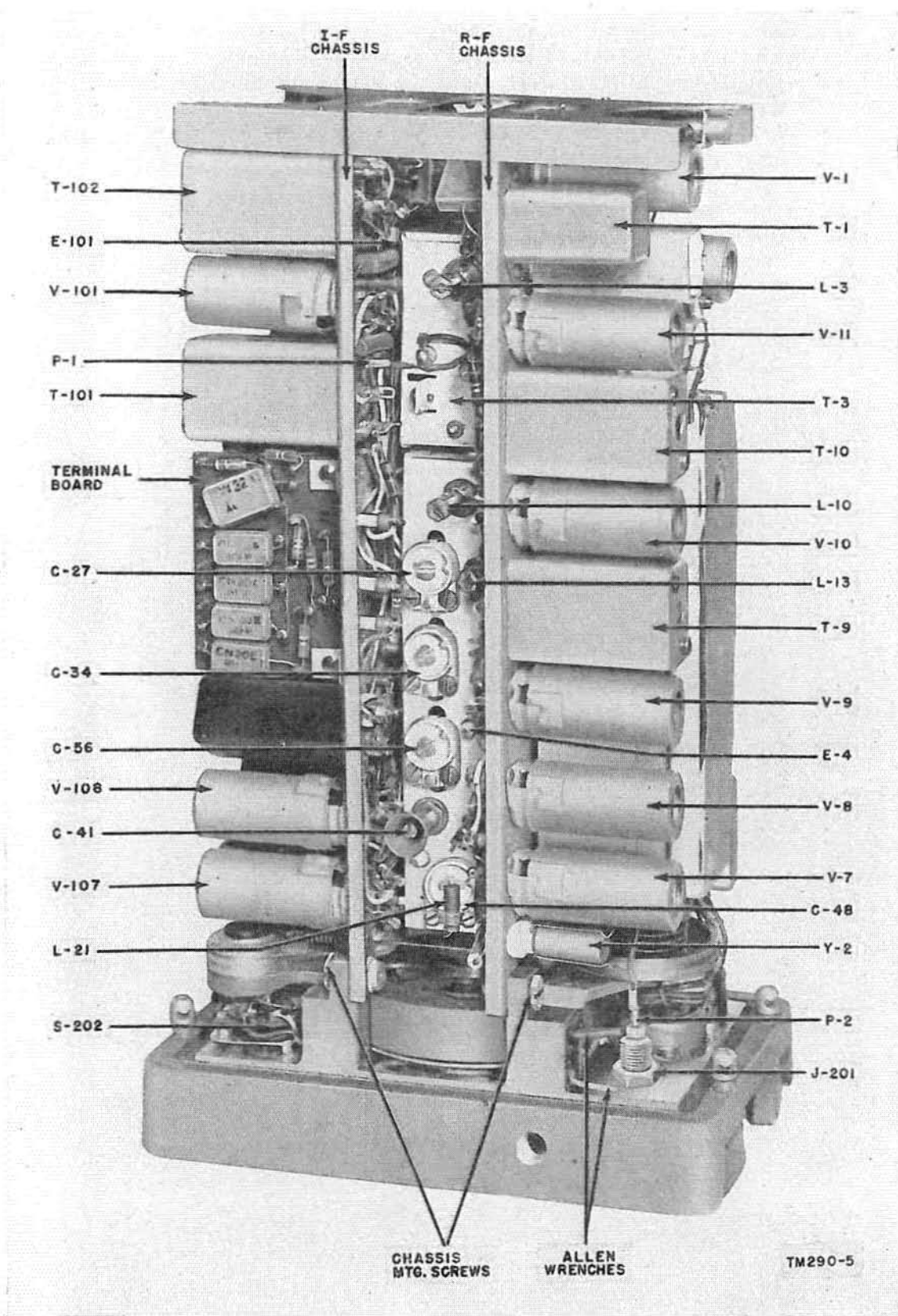


Figure 62. Set 2, top view of panel-chassis assembly.

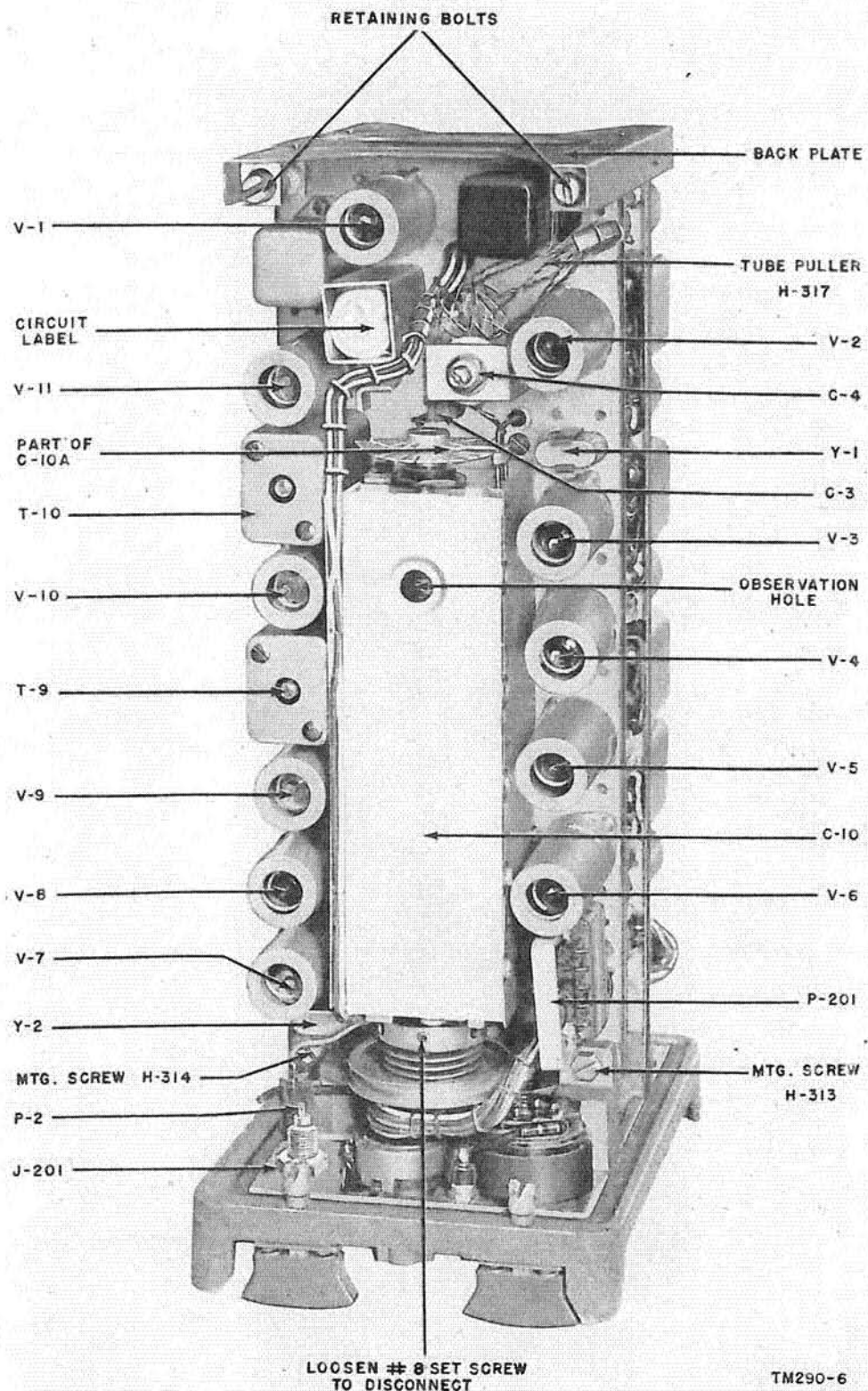


Figure 63. Set 2, view of r-f chassis.

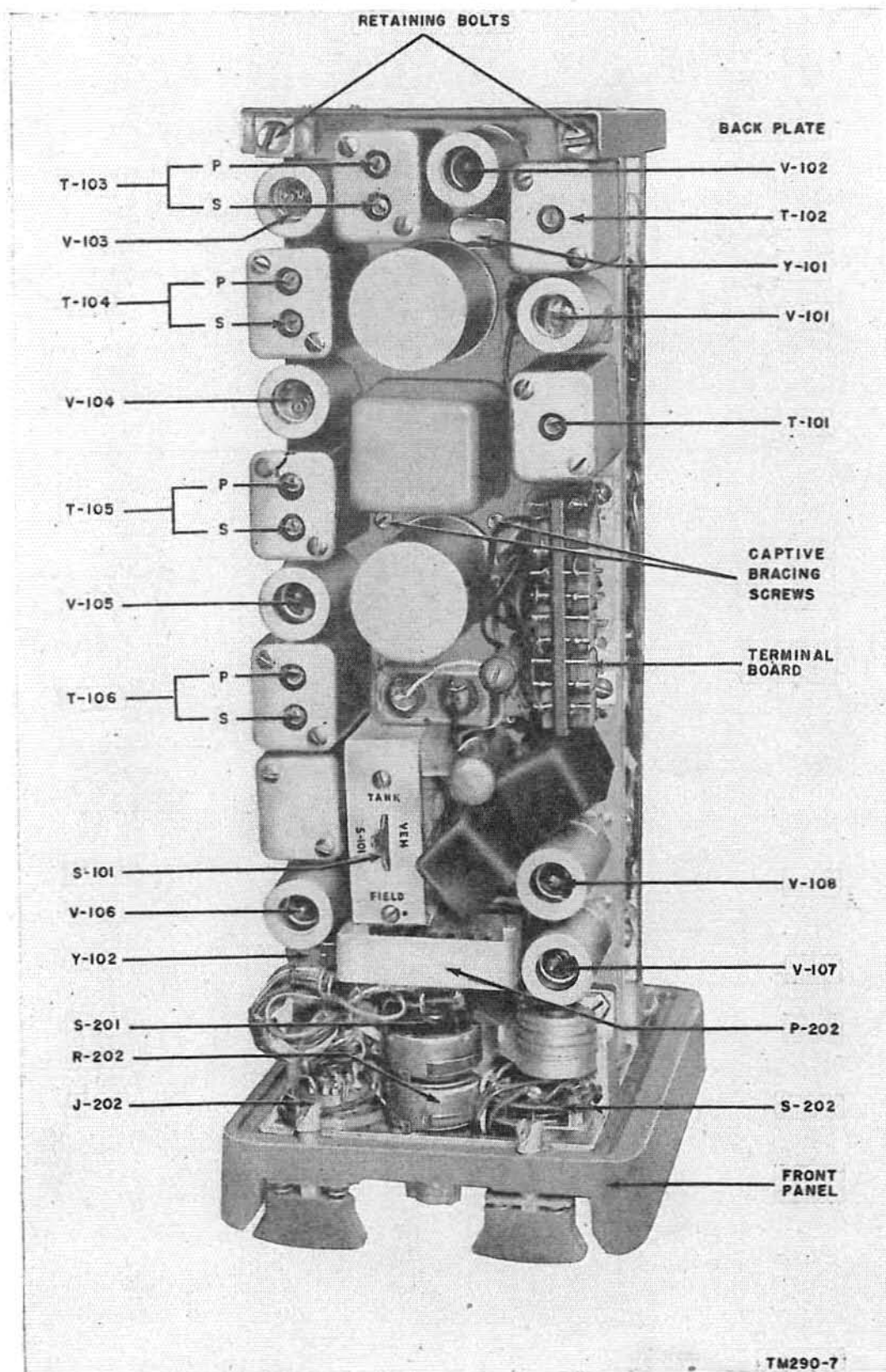


Figure 64. Set 2, view of i-f chassis.

126. Set 1 Power Supply

The replacement of pluck-out parts for which spares are available is described in the following subparagraphs.

a. FUSES. The panel-mounted fuses may be removed by unscrewing the fuse caps which serve also as fuse extractors. Spare fuses are provided in the front-panel compartment marked SPARE FUSES. To gain access to the spares, loosen the two wingnuts, which hold the cover plate of the compartment and remove the plate.

b. THERMAL RELAYS AND BALLAST TUBES. To gain access to the thermal relays and ballast tubes, it is necessary to remove the panel-chassis assembly from the case (par. 123). All of these parts are accessible from the top of the chassis (figs. 65 and 66). Remove the relays or ballast tubes in

the same manner as any standard octal-base tube, with a straight upward pull. Do not rock or jiggle the components in their sockets. (Note that similarly designated parts are located differently in the 12- and 24-volt supplies.)

c. TUBES. The four-power supply tubes are also accessible from the top of the chassis. To remove V-1 or V-2, pull the tube straight upward. To remove V-3 or V-4, use a tube puller. Do not rock or jiggle the tubes in their sockets; the socket prongs and tubes may be damaged.

d. VIBRATORS. The three vibrators (E-1, E-2, and E-3) are located on the right-hand side of the power supply chassis (fig. 67). To remove a vibrator, pull straight upward without jiggling. If necessary, use a small screw driver to pry the vibrator out of its socket but take care not to spread the ring clip at the base of the vibrator.

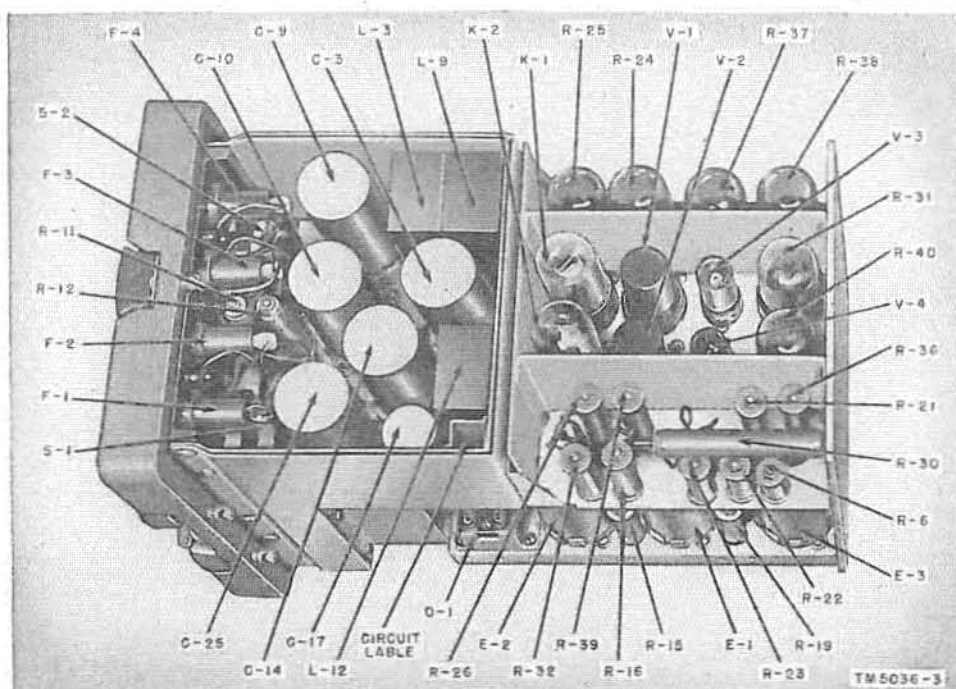


Figure 65. Power supply PP-112/GR, top view of chassis.

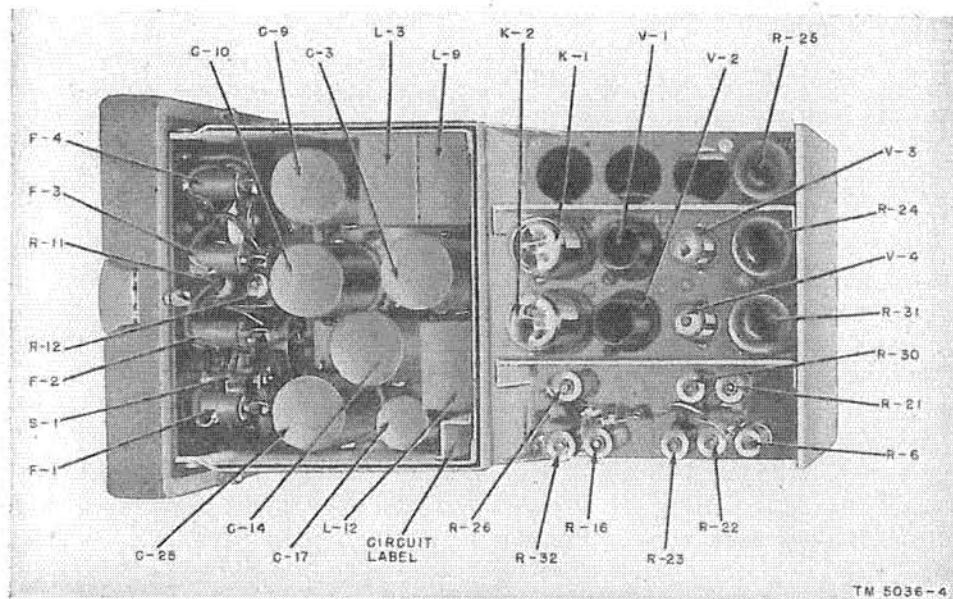


Figure 66. Power supply PP-109/GR, top view of chassis.

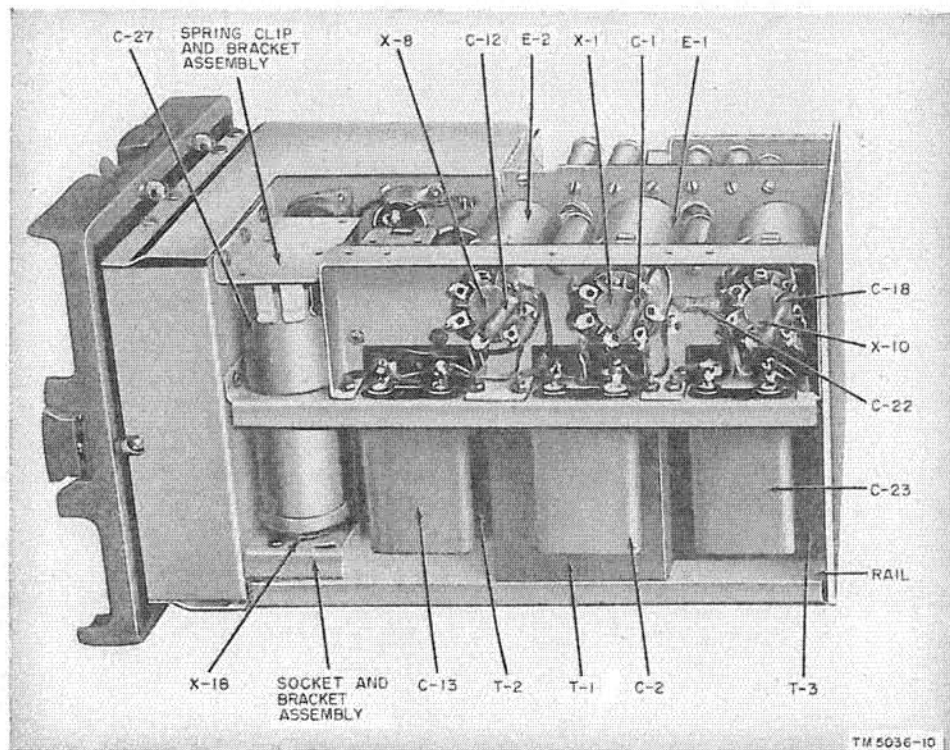


Figure 67. Power supply PP-109/GR, bottom view of chassis.

127. Set 1

The tubes, which are the only replaceable parts in Set 1, are mounted on the vertical r-f and i-f

chassis (fig. 68). To gain access to the tubes, the panel-chassis assembly must be removed from its case (par. 123).

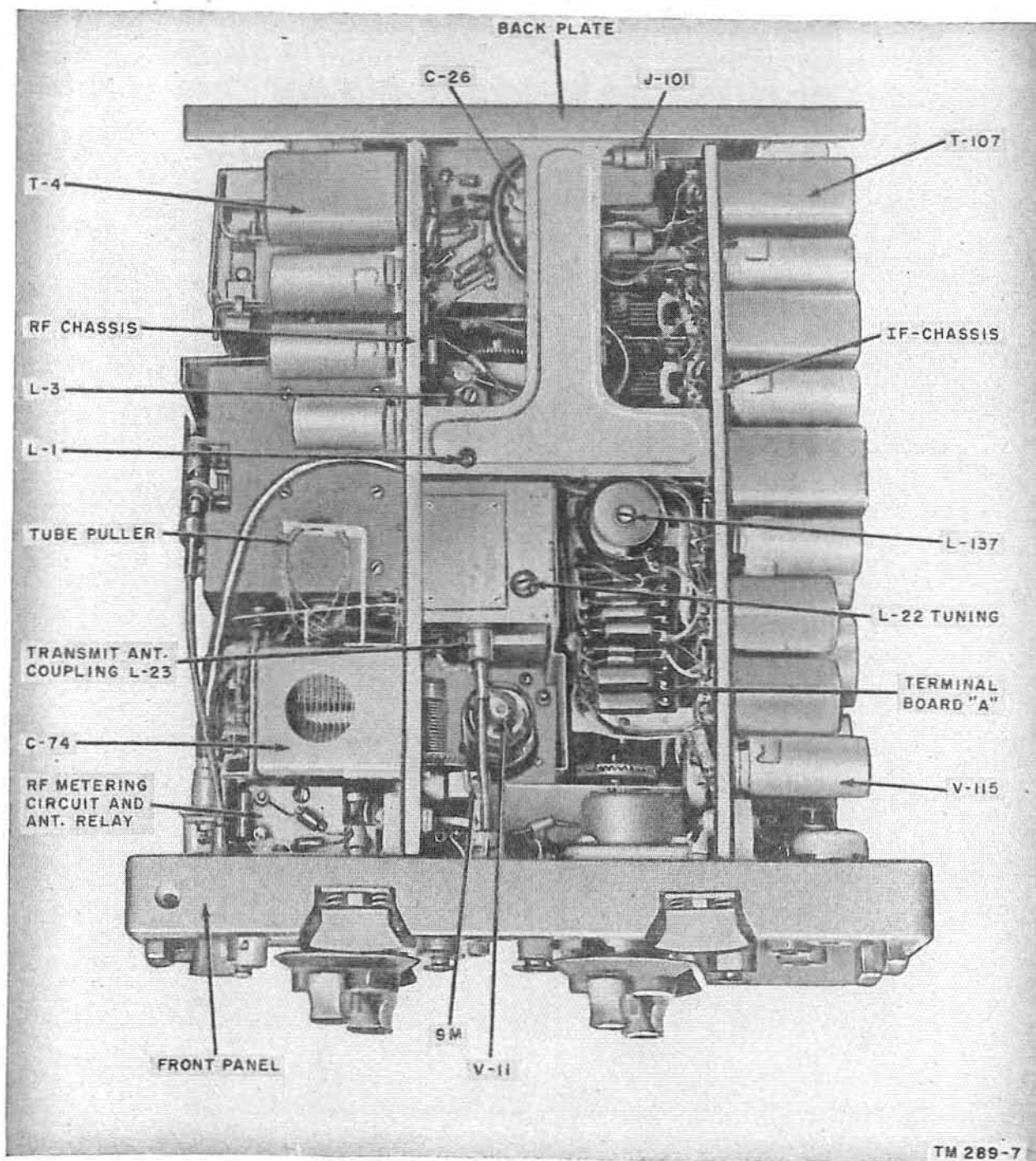


Figure 68. Set 1, top view of panel-chassis assembly.

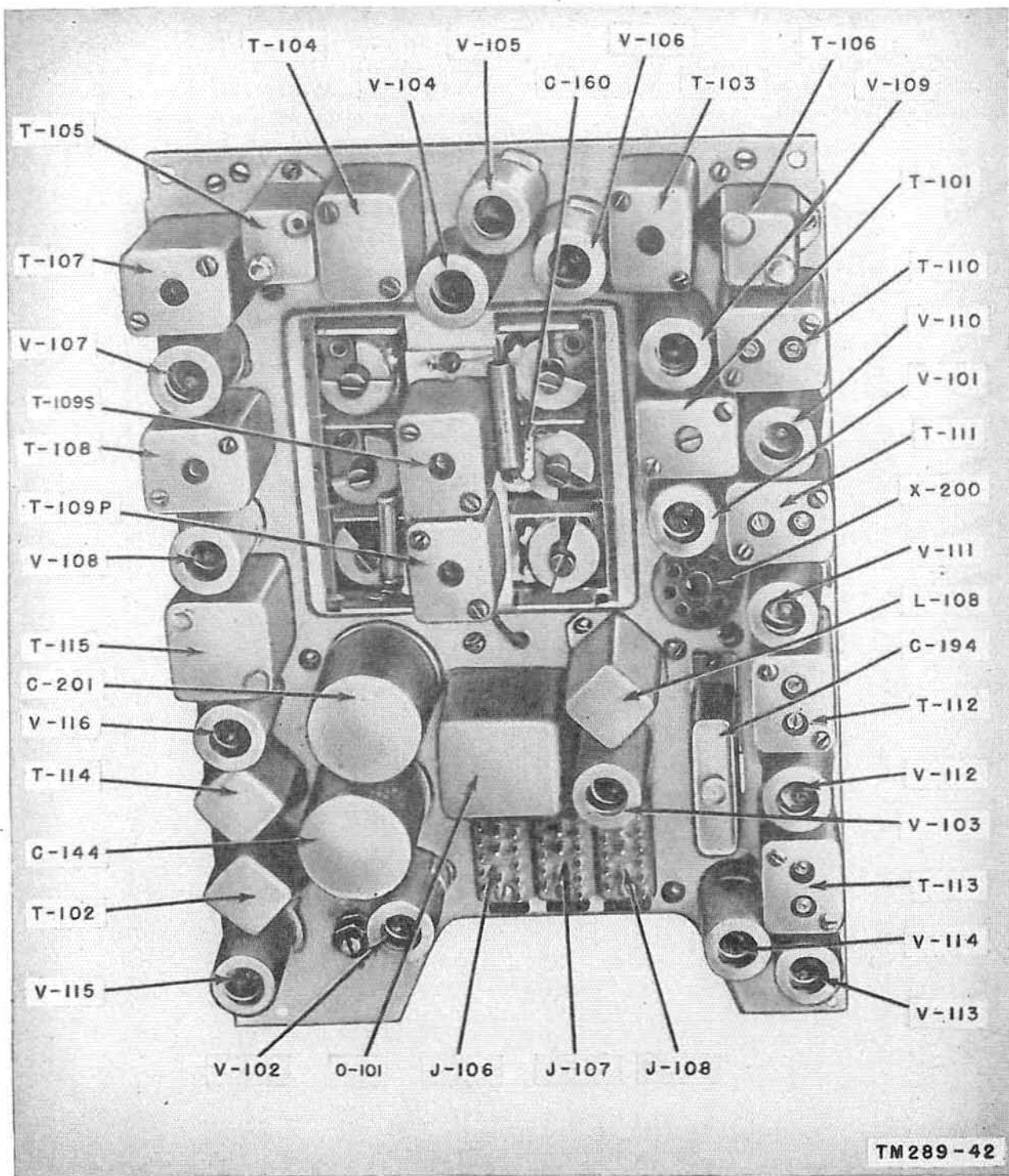


Figure 70. Set 1, view of i-f chassis.

b. Before removing V-11 it is necessary to disconnect the plate cap at the top of the tube. When the cap is disconnected, the tube can be

removed with a straight upward pull. Do not rock or jiggle the tube in its socket; the sockets and tubes may be damaged through careless handling.

128. Auxiliary Receiver

The replacement of pluck-out parts for which running spares are available is described in the following subparagraphs.

a. FUSE. The panel-mounted fuse can be removed by unscrewing the fuse cap which serves

also as an extractor. A spare fuse is located in a fuse clip within the receiver, at the upper right-hand side of the panel-chassis assembly.

b. THERMAL RELAY AND BALLAST TUBE. To gain access to the thermal relay and ballast tube, remove the panel-chassis assembly from the case (par. 123). Both the relay and ballast tube are

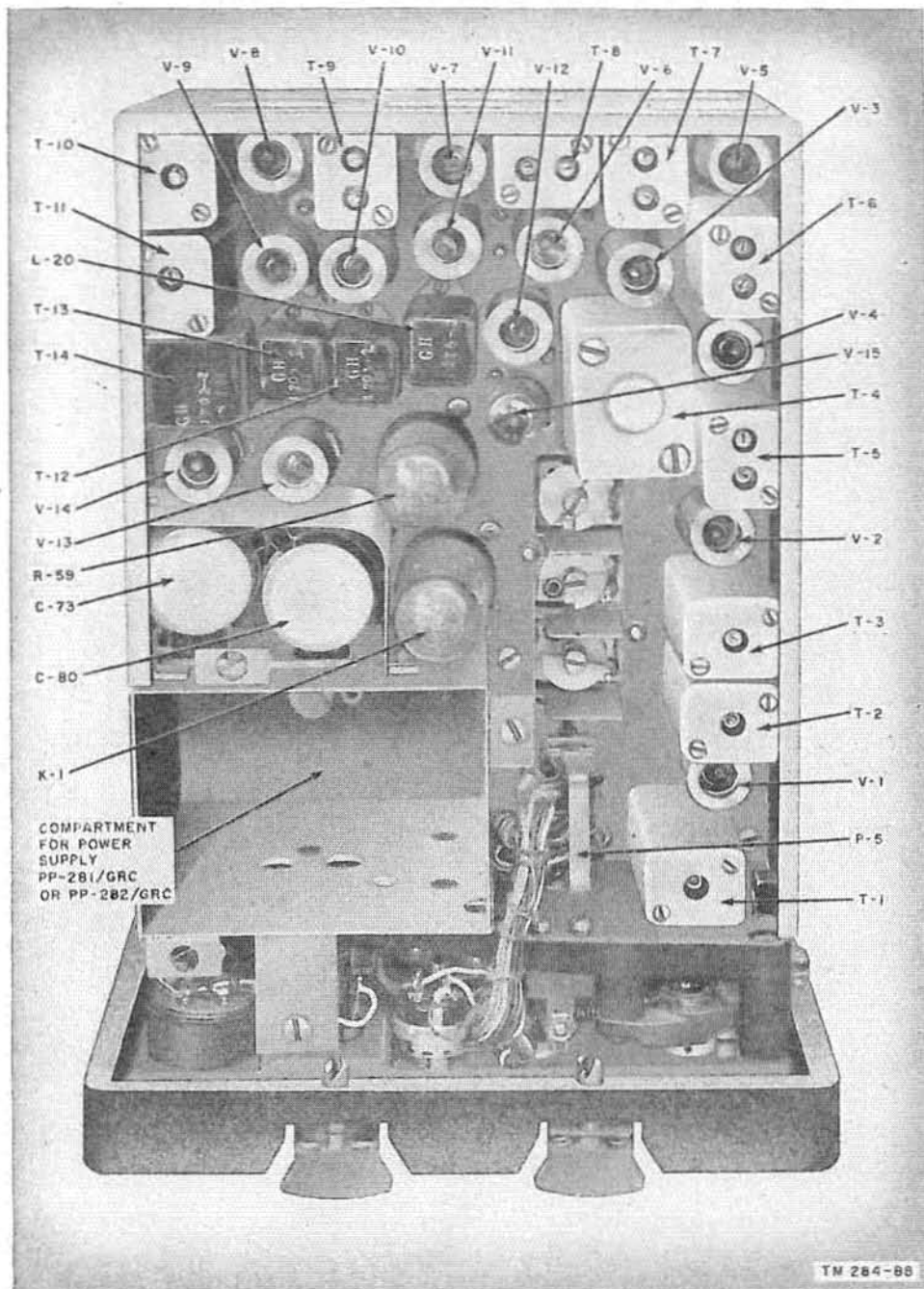


Figure 71. Receiver panel-chassis assembly, top view.

located on the top of the chassis (fig. 71). Either component can be removed in the same manner as any standard octal-base tube. Pull straight upward; do not rock or jiggle the tube in its socket.

c. TUBES. All of the tubes are accessible from the top of the chassis when the case is removed (fig. 71). To remove any tube first remove the shield and then use a tube puller. Do not rock or jiggle the tubes; they may be easily damaged by careless handling.

d. PLUG-IN POWER SUPPLY. Although it can be replaced as a single unit, the plug-in power supply is not furnished as a running spare. A spare is provided, however, for the vibrator within the power supply (fig. 61). Remove the receiver case and replace the vibrator as follows:

- (1) Loosen the clamp at the rear of the power supply compartment and swing it out of the way.
- (2) Grasp the handle at the rear of the power supply unit and pull straight out.
- (3) Remove the three green screws which fasten the top cover on the power supply chassis.
- (4) Using the handle on the cover, lift the cover off with a straight upward movement. If the cover is stuck, use a small screw driver and gently pry the cover.

- (5) Pull the vibrator (fig. 61) out of its socket with a straight upward movement. Do not rock or jiggle the vibrator while attempting to remove it from its socket. If necessary, use a small screw driver to gently pry the vibrator out of its socket, but take care not to enlarge the ring clip which holds the vibrator near the base.

129. Control Group AN/GRA-6

The lamps are the only pluck-out parts in either local or remote control unit for which running spares are supplied. The lamps are accessible from the rear of the front panels after the panel-chassis assemblies have been removed from the cases.

a. To gain access to the lamp in the local control unit, unscrew the two wingnut fasteners at the edge of the front panel and slide the unit out of its case. Slide the lamp socket (with lamp) out of the bakelite sleeve. The lamp may then be replaced.

b. To gain access to the lamp in the remote control unit, loosen the spring clips which secure the panel-chassis assembly in the case. Slide the unit out of its case and replace the lamp as directed for the local unit (*a* above).

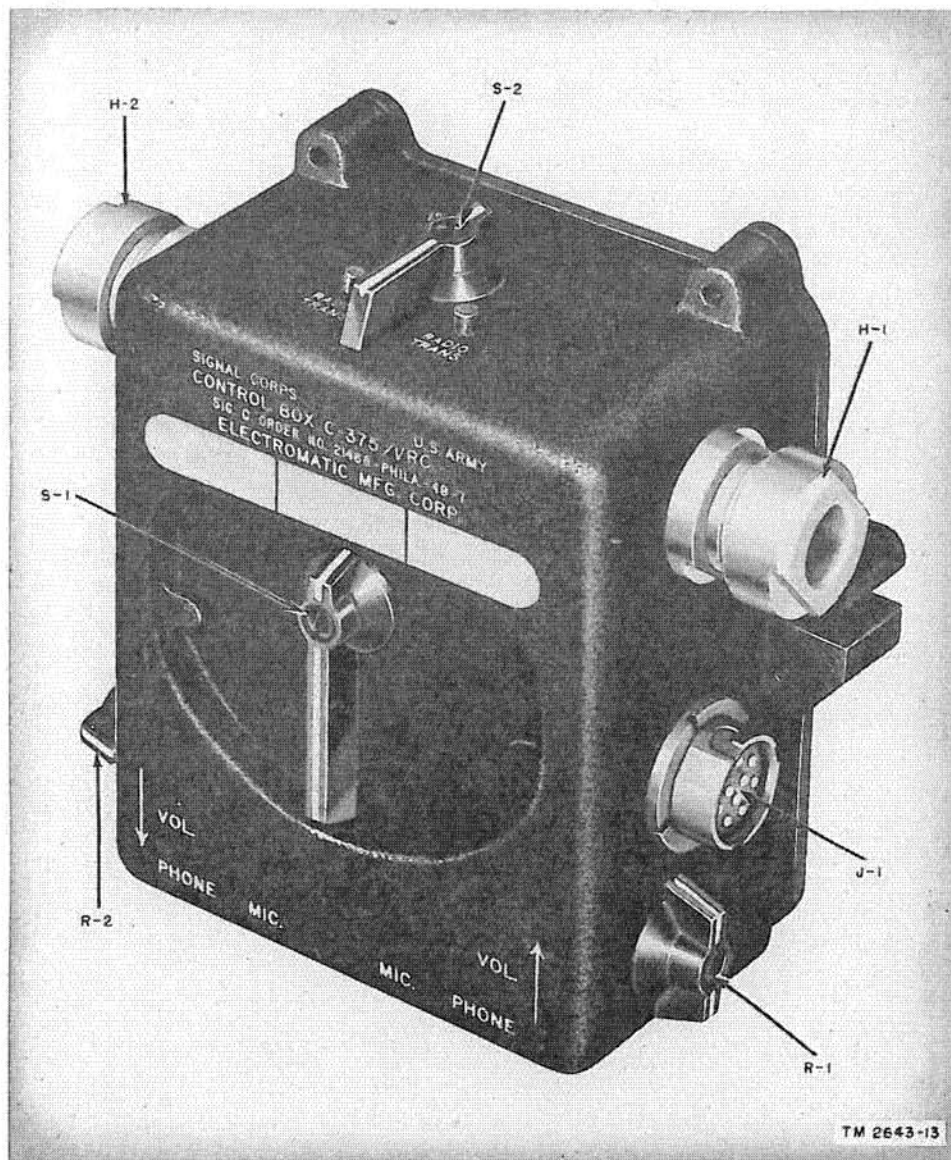


Figure 72. Control box C-375/VRC, right oblique view.

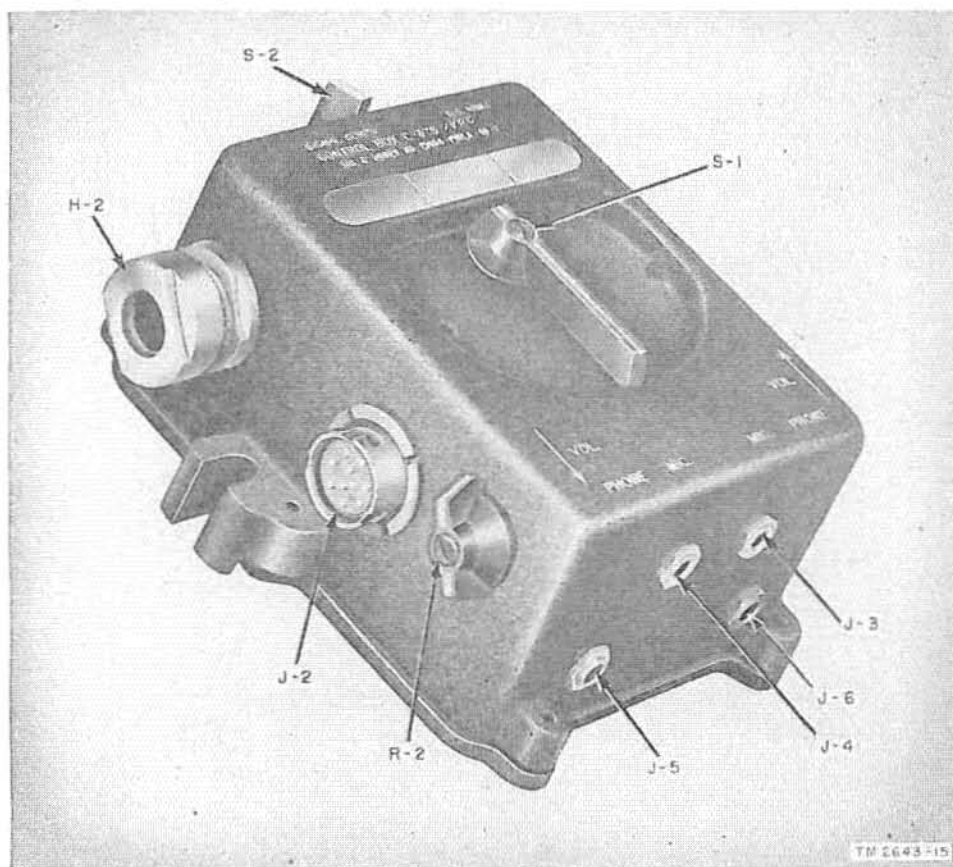


Figure 73. Control box C-375/VRC, left oblique view.

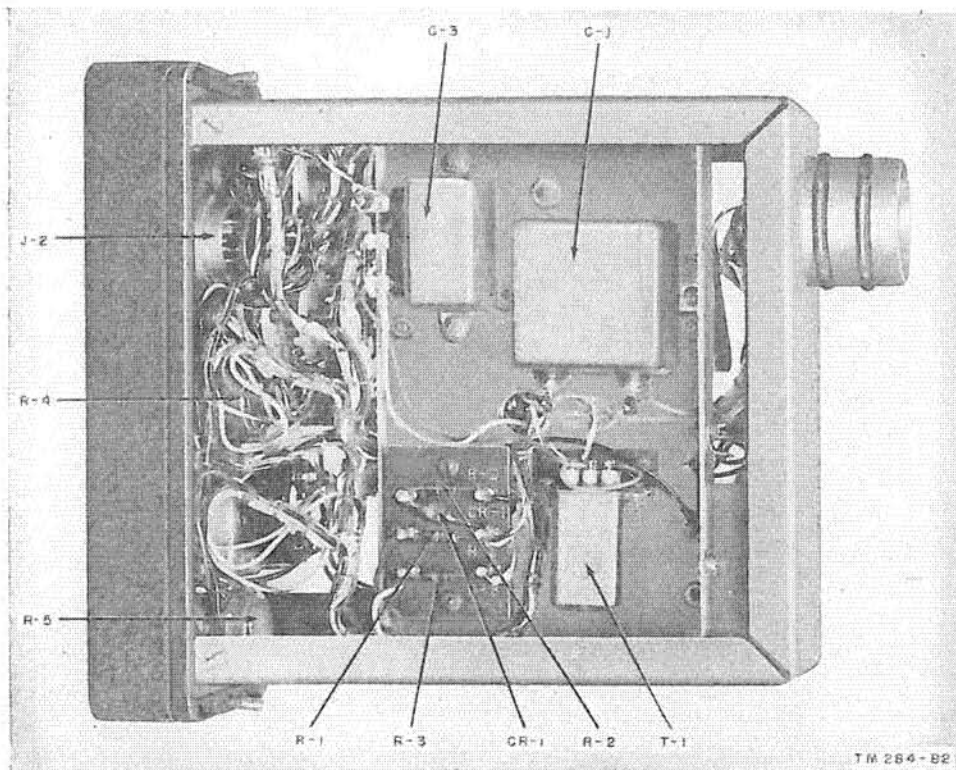


Figure 74. Control C-435/GRC, bottom view of chassis.

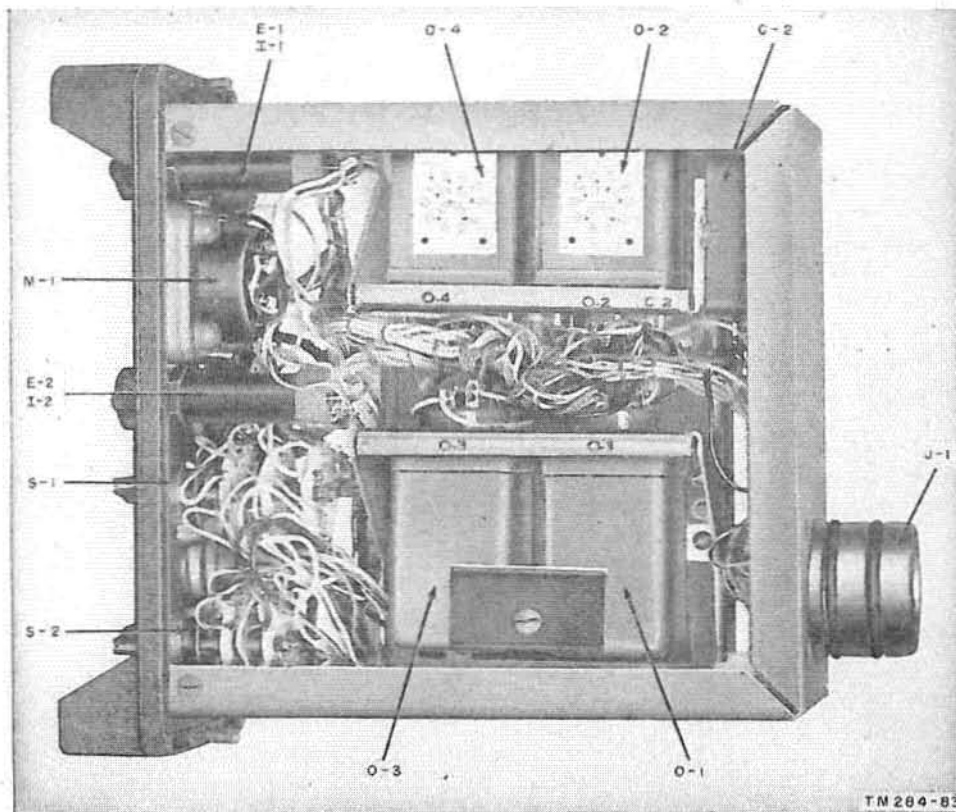


Figure 75. Control C-435/GRC, top view of chassis.

CHAPTER 6

AUXILIARY EQUIPMENT

130. General

Auxiliary equipment is equipment which is not supplied as a part of the basic radio sets (par. 6) but which extends the application of the radio sets in some manner. The auxiliary equipment described in this chapter is Modification Kit MX-898/GR.

Note. Elevated Antenna RC-292 may also be used as auxiliary equipment to Radio Sets AN/GRC-3 through -8 to extend the communication range to 25 miles.

131. Purpose and Use of Modification Kit MX-898/GR

The modification kit is used to provide temporary field operation of the individual receiver-transmitters (Sets 1 and 2) when they are removed from a vehicle. If the modification kit is used in conjunction with Control Group AN/GRA-6 to operate Set 2, remote and local control of Set 2 is possible in a field installation.

132. Components of Modification Kit MX-898/GR

The components of Modification Kit MX-898/GR are listed and briefly described below in the following subparagraphs.

a. GENERATOR G-8/GRC (fig. 76). Generator G-8/GRC is a hand-powered power source. It consists of a generator unit with cranks and mounting legs (fig. 76). Complete details on the generator are published in a separate manual.

b. CASE CY-590/GRC (fig. 77).

(1) Case CY-590/GRC is a battery box which holds five series-connected 1.5-volt batteries (type BA-403/U) and one 90-volt battery (type BA-419/U).

(2) Two receptacles and a switch are mounted on the front panel of the battery

case (fig. 78). The receptacles are used for interconnecting the battery case with the receiver-transmitter (Set 1 or Set 2) and, in the case of Set 1, to the hand generator. The switch is used to complete or break the battery circuits to the receiver-transmitters with which the battery case is used. The REMOTE position of the switch applies only when the battery case is used with Set 2 and Control Group AN/GRA-6 is connected to Set 2 for remote control purposes.

c. POWER CABLE ASSEMBLY CX-1210/U. This cable is used to connect the battery case to Set 1 in field installations of Set 1, utilizing both battery case and hand generator (par. 134), or to connect the hand generator to Set 1 in field installations utilizing the hand generator only.

d. POWER CABLE ASSEMBLY CX-1209/U. This cable is used to connect the battery case to the hand generator in field installations of Set 1, or to connect the battery case to Set 2 in field installations of Set 2.

e. MOUNTING MT-652/GR. Mounting MT-652/GR (fig. 81 or 83) is used to hold the antenna masts used in field installations. The overhanging flange of the receiver-transmitter front panel has a boss which will accept the base of Mounting MT-652/GR. When the mounting is secured, the mast sections supplied with the modification kit (f below) can be screwed into the mounting. A rubber-covered lead-in wire, which is part of the mounting, is used to connect the antennas to the ANT post on the receiver-transmitters.

f. MAST SECTIONS AB-22/GR, AB-23/GR, AND AB-24/GR. These are short mast sections, approximately 23 inches long, which can be screwed together to obtain a whip antenna of various lengths.

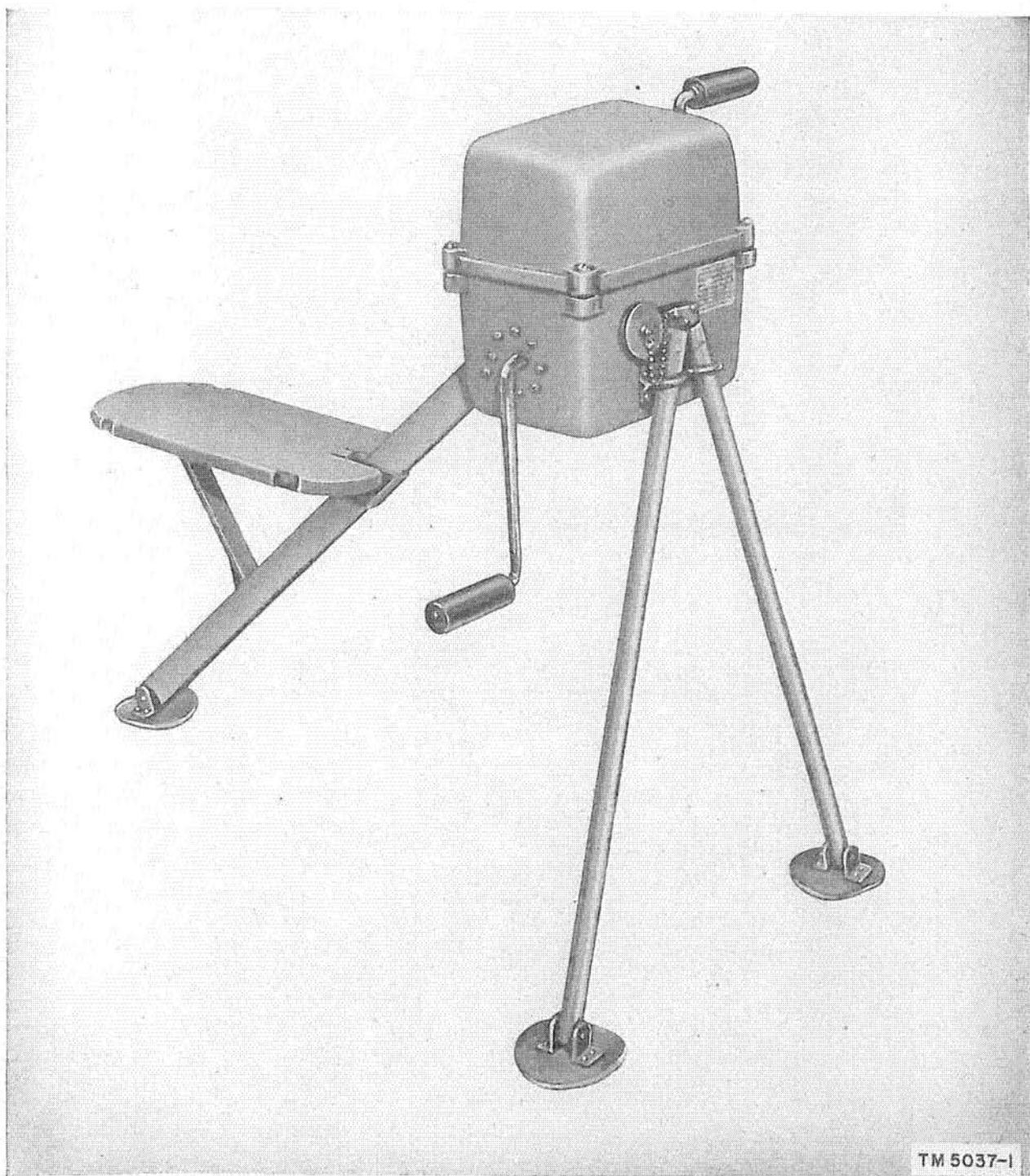


Figure 76. Generator G-8/GRC.

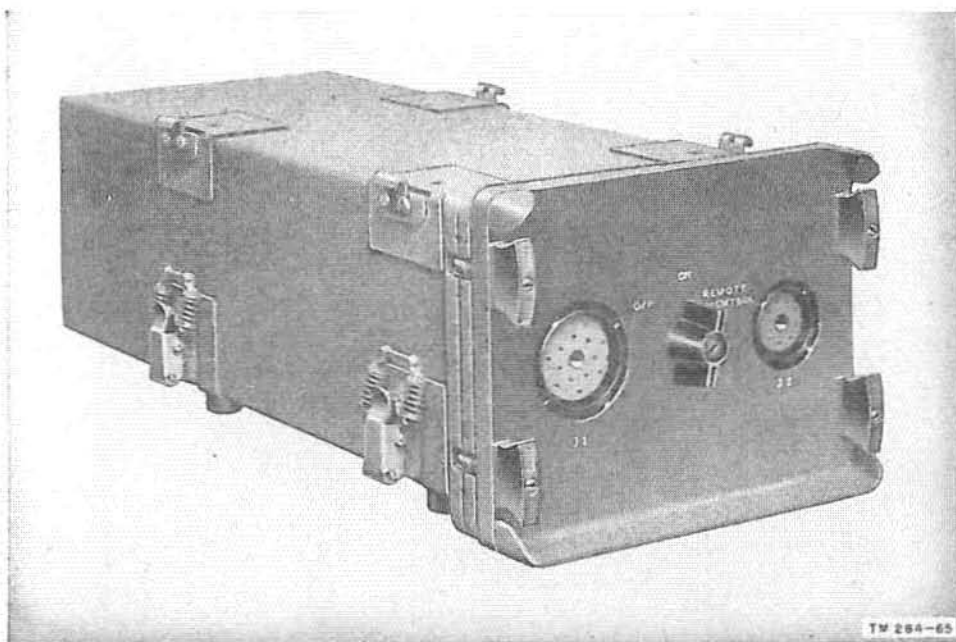
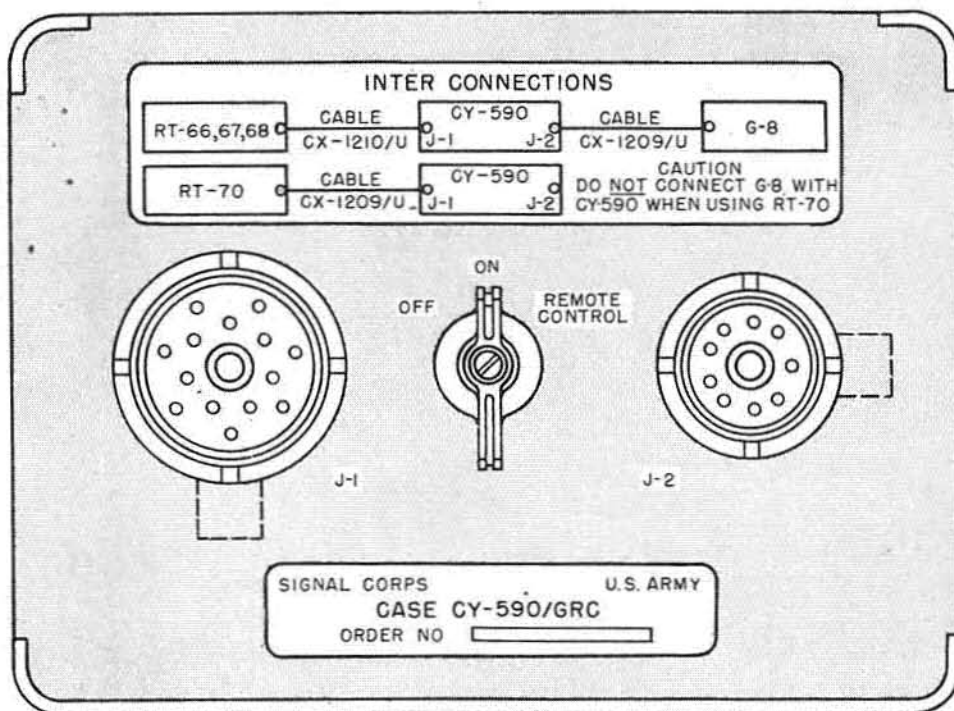


Figure 77. Case CY-590/GRC, front view.



TM 284-59

Figure 78. Case CY-590/GRC, front panel.

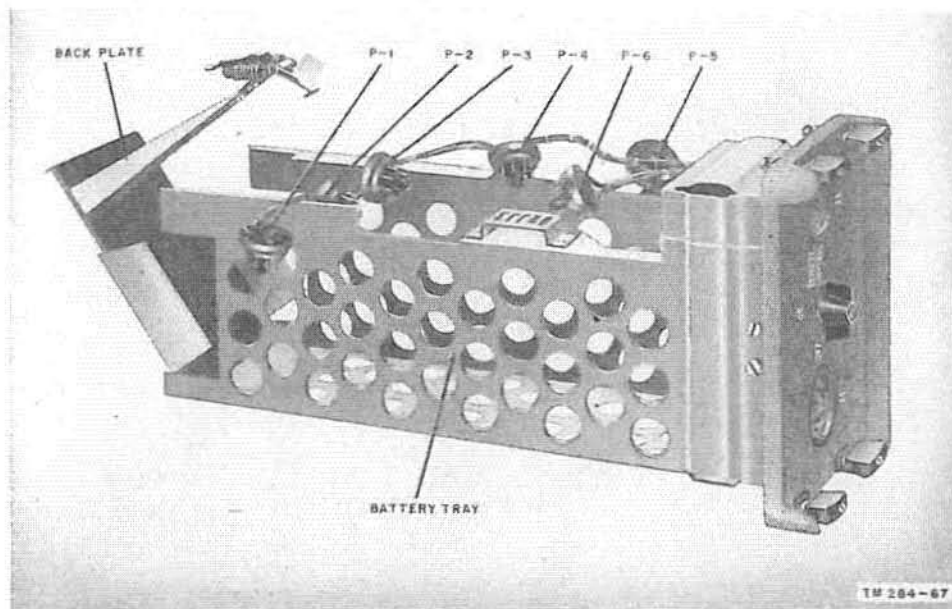


Figure 79. Case CY-590/GRC, case and batteries removed

g. HANDSET H-33/PT (fig. 16). The same handset which is supplied with Control Group AN/GRA-6 is also supplied with the modification kit. A description of the handset is given in paragraph 21.

h. BAG CW-187/GR. Bag CW-187/GR is a canvas bag which will accommodate the handset, antenna mounting, mast sections, cables, generator legs, and the technical manuals supplied with the generator.

i. BAG CW-188/GR. Two of these canvas bags are supplied with each kit. One bag is to carry the battery case and hand generator; the other bag is to carry a receiver-transmitter. The bag for the receiver-transmitter is normally stored in the other bag of the same type, when the modification kit is stored away in the vehicle.

133. Packaging

The components of Modification Kit MX-898/GR are individually packed in cardboard contain-

ers but are shipped collectively in a single wooden case. Unpack as follows:

a. Remove the components from the case and remove the wrappings.

b. Loosen the Dzus fasteners on the panel of the battery case and remove the battery tray from the case (fig. 79).

c. Install five 1.5-volt batteries (type BA-403/U) and one 90-volt battery (type BA-419/U) in the case. Connect the batteries as indicated in figures 80 and 84. Replace the battery tray in the case.

d. Store the handset, antenna mounting, mast sections, cables, generator legs, and generator technical manuals in Bag CW-187/GR. Store the bag in any convenient location in the vehicle.

e. Store the battery case and the hand generator and one of Bags CW-188/GR in the other Bag CW-188/GR. Store the packed bag in some convenient location in the vehicle.

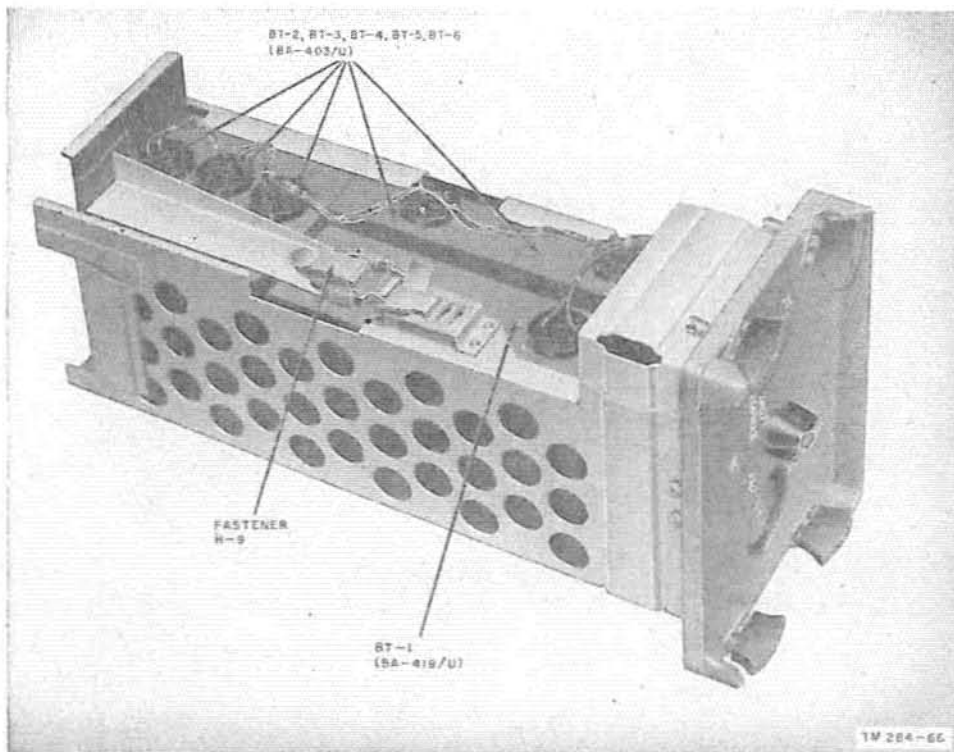


Figure 80. Case CY-590/GRC, case removed, batteries installed.

134. Operation of Set 1 with Generator and Battery Case (fig. 81)

a. Remove Set 1 from Mounting MT-297/GR and pack it in the unused Bag CW-188/GR. Carry the three bags (two Bags CW-188/GR and one Bag CW-187/GR) to the location selected for field operation of the set.

b. Set up the generator, battery case, and receiver-transmitter as illustrated in figure 81. Refer to the manual supplied with the generator for detailed information on that unit. Turn the OFF-ON-REMOTE switch of the battery case to the OFF position.

c. Connect one end of Power Cable Assembly CX-1209/U to the generator and the other end to the 9-pin connector on the battery case.

d. Connect one end of Power Cable Assembly CX-1210/U to the 14-pin connector on the battery case and the other end to the POWER IN receptacle on Set 1.

e. Insert the antenna mounting into the boss

at the top front of the receiver-transmitter and turn the mounting 90 degrees to lock it in place. Connect the lead-in wire to the ANT connector. For Receiver-Transmitters RT-66/GRC and RT-67/GRC, assemble the five mast sections and screw the assembly into the antenna mount. For Receiver-Transmitter RT-68/GRC, assemble three of the mast sections and screw the assembly into the antenna mount.

f. Connect the handset to one of the AUDIO connectors on the front of the receiver-transmitter.

g. Set the OFF-ON-REMOTE switch of the battery case to ON. The receiver section of Set 1 is then ready for operation. It is not necessary to crank the generator while monitoring.

h. To transmit, crank the generator at a steady speed of approximately one revolution per second, press the push-to-talk button, and talk into the mouthpiece. Release the push-to-talk button and stop cranking to listen.

i. To turn off the set, stop cranking and turn the OFF-ON-REMOTE switch to OFF.

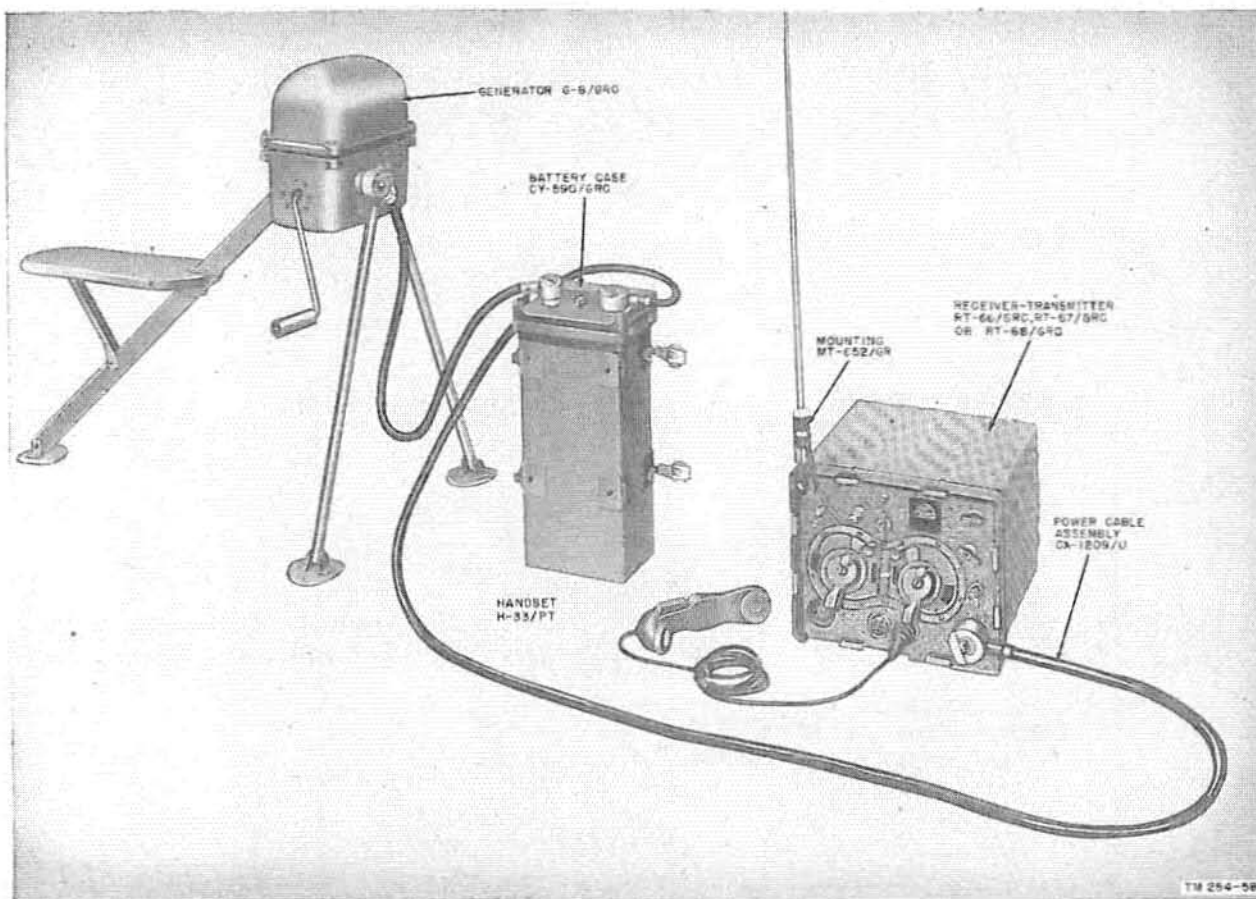


Figure 81. Field operation of Set 1 with Generator G-8/GRC and Case CY-590/GRC.

135. Operation of Set 1 with Generator G-8/GRC (fig. 83)

a. Remove Set 1 from Mounting MT-297/GR and pack it in Bag CW-188/GR. If the battery case is definitely not going to be used, it can be removed from the other Bag CW-188/GR to lighten the burden. Take the three bags to the location selected for field operation of the set.

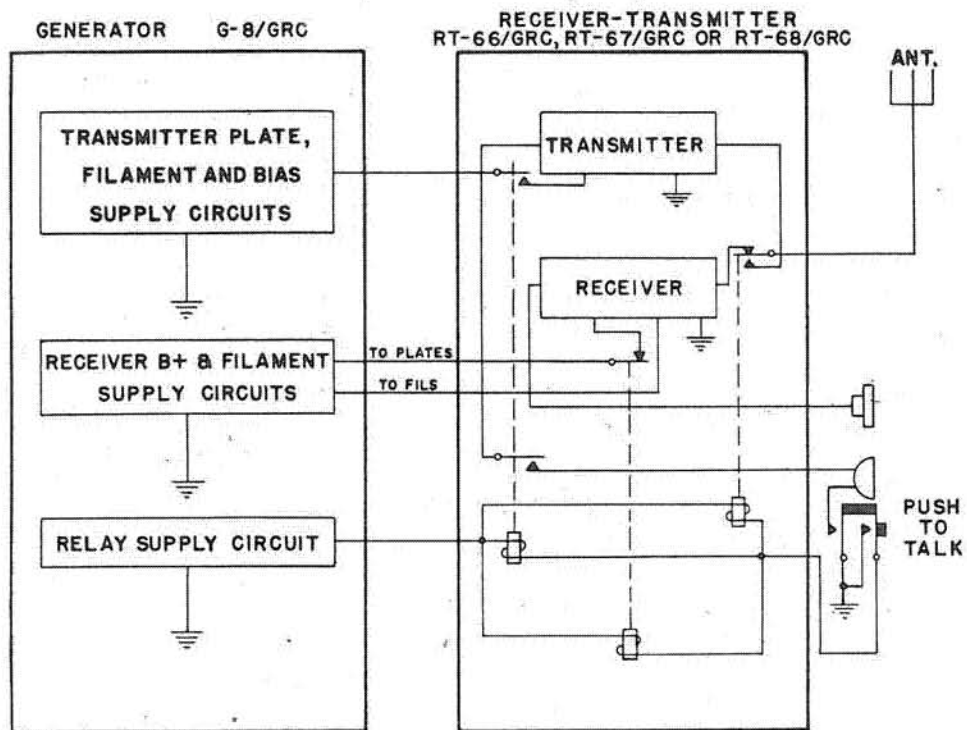
b. Set up the generator and Set 1 as indicated in figure 83. Connect Power Cable Assembly CX-1210/U to the generator and the other end to the POWER IN connector on Set 1. (When Set 1 is used with Generator G-8/GRC alone, the gen-

erator supplies all the operating voltages for both the receiver and the transmitter. The block diagram (fig. 82) illustrates the function of the generator.)

c. Connect the antenna mount and mast sections as directed in paragraph 134e. Connect the handset to an AUDIO connector on the Set 1 panel.

d. To receive, crank the generator at a steady speed of approximately 1 revolution per second, and listen with the handset. To transmit, crank the generator, press the push-to-talk button, and talk into the mouthpiece.

e. To stop the equipment, stop cranking the generator.



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Figure 82. Auxiliary operation of Set 1, block diagram.

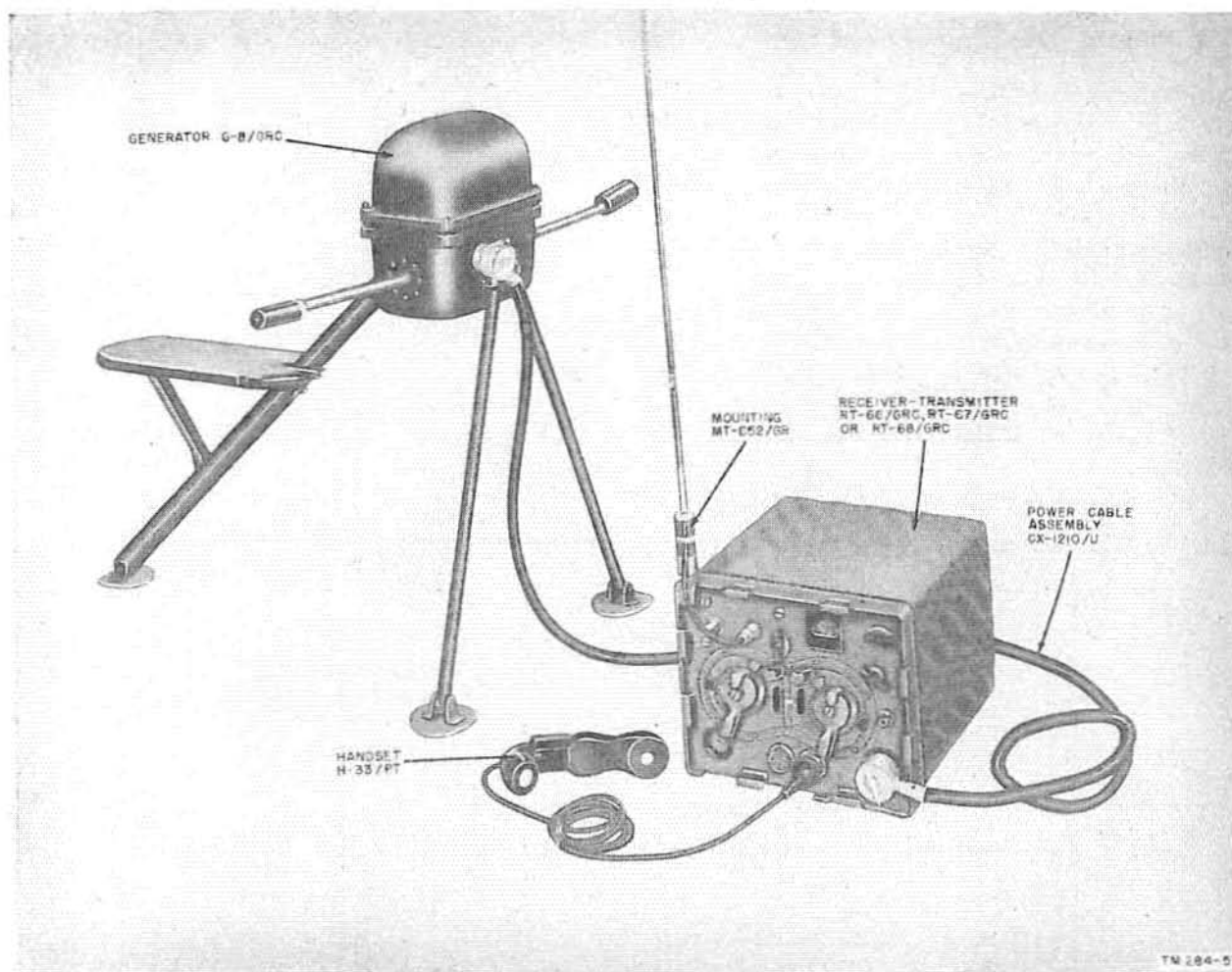


Figure 83. Field operation of Set 1 with Generator G-8/GRC.

136. Operation of Set 2 With Case CY-590/GRC

a. Remove Set 2 from the vehicular mounting and pack it in Bag CW-188/GR. The generator unit and legs may be removed from the other two bags. Take the three bags to the location selected for field operation of the set. If remote control is desired, Control Group AN/GRA-6, packed in Bag CW-189/GR, must also be carried to the field site.

b. Remove Set 2 from its case and set the FIELD VEH TANK switch in the FIELD position. Replace the unit in its case.

c. Set up the battery case and Set 2 at the desired location. Turn the OFF-ON-REMOTE switch to OFF. Connect the 14-pin connector of Power Cable Assembly CX-1209/U to the

14-pin connector on the battery case; connect the 9-pin connector of the cable to the POWER IN receptacle on Set 2.

d. Insert the antenna mount into the boss at the top right-hand corner of the Set 2 case and turn the mounting 90 degrees to lock it in place. Connect the lead-in wire to the ANT connector on the Set 2 panel. Assembly Mast Sections AB-24/GR and AB-22/GR and screw the assembly into the antenna mount.

e. Connect the handset to the AUDIO connector on the front of the receiver-transmitter.

f. Turn the OFF-ON-REMOTE switch to ON. Tune the antenna circuit as outlined in paragraph 41. The receiver-transmitter is then ready for operation.

g. To remove power from the unit, turn the OFF-ON-REMOTE switch to the OFF position.

137. Remote Field Operation of Set 2

- a. Perform steps a through f, paragraph 136.
- b. Adjust the receiver-transmitter SQUELCH control to the point where the receiver quiets.
- c. Remove the handset and connect Local Control C-434/GRC to the AUDIO connector by means of the Set 2 cable and plug in the compartment at the rear of the unit (fig. 30).
- d. Connect the local and remote units by telephone wire as outlined in paragraph 45.
- e. Place the REMOTE switch of the local unit in the SET 2 position and place the OFF-ON-REMOTE switch of the battery case in the REMOTE position.

f. Connect the handset into the AUDIO connector at the remote unit.

g. To apply power to Set 2, turn the SELECTOR switch at the remote unit to the right-hand write-in position and press the push-to-talk switch. Push-to-talk operation is then possible.

h. To remove power from Set 2, turn the SELECTOR switch to the left-hand write-in position.

Note. Reversal of the telephone line connections will reverse the functions of the write-in positions on the SELECTOR switch.

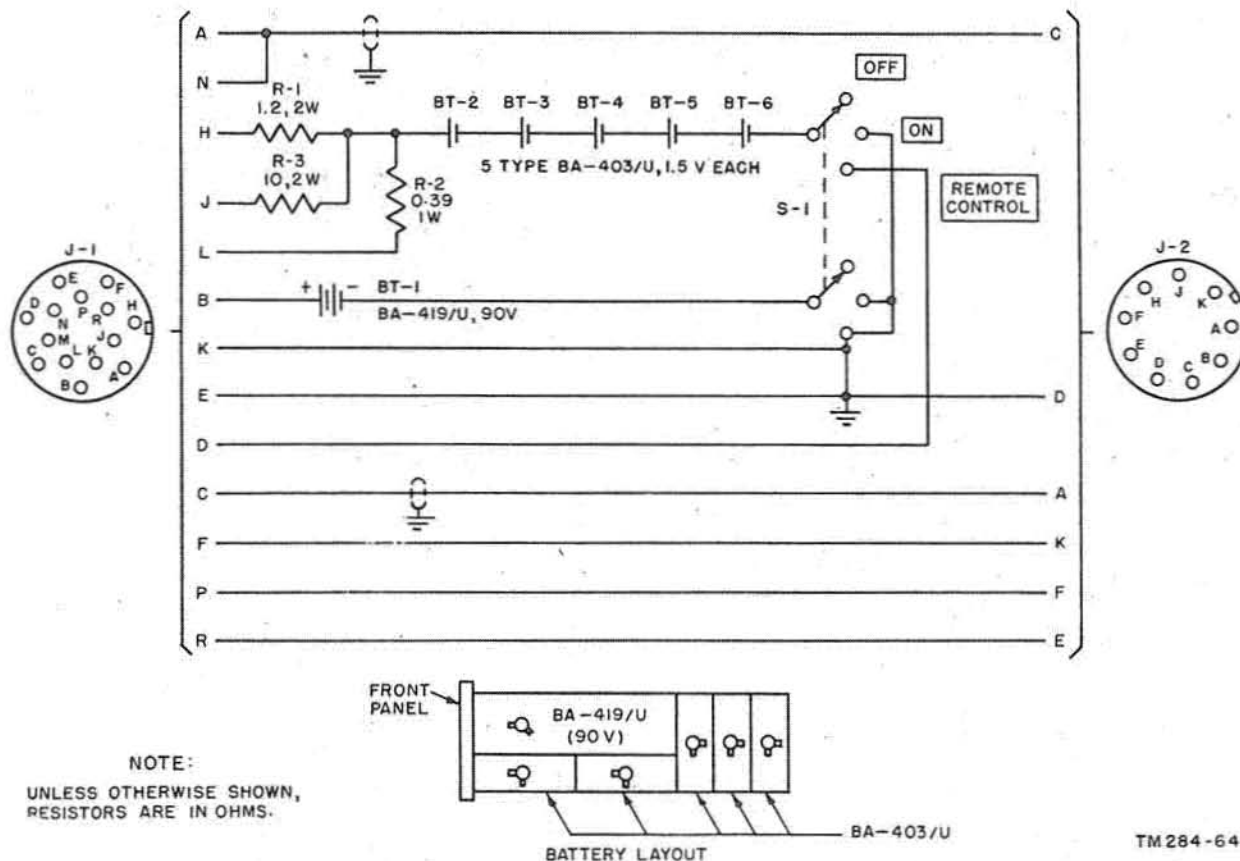
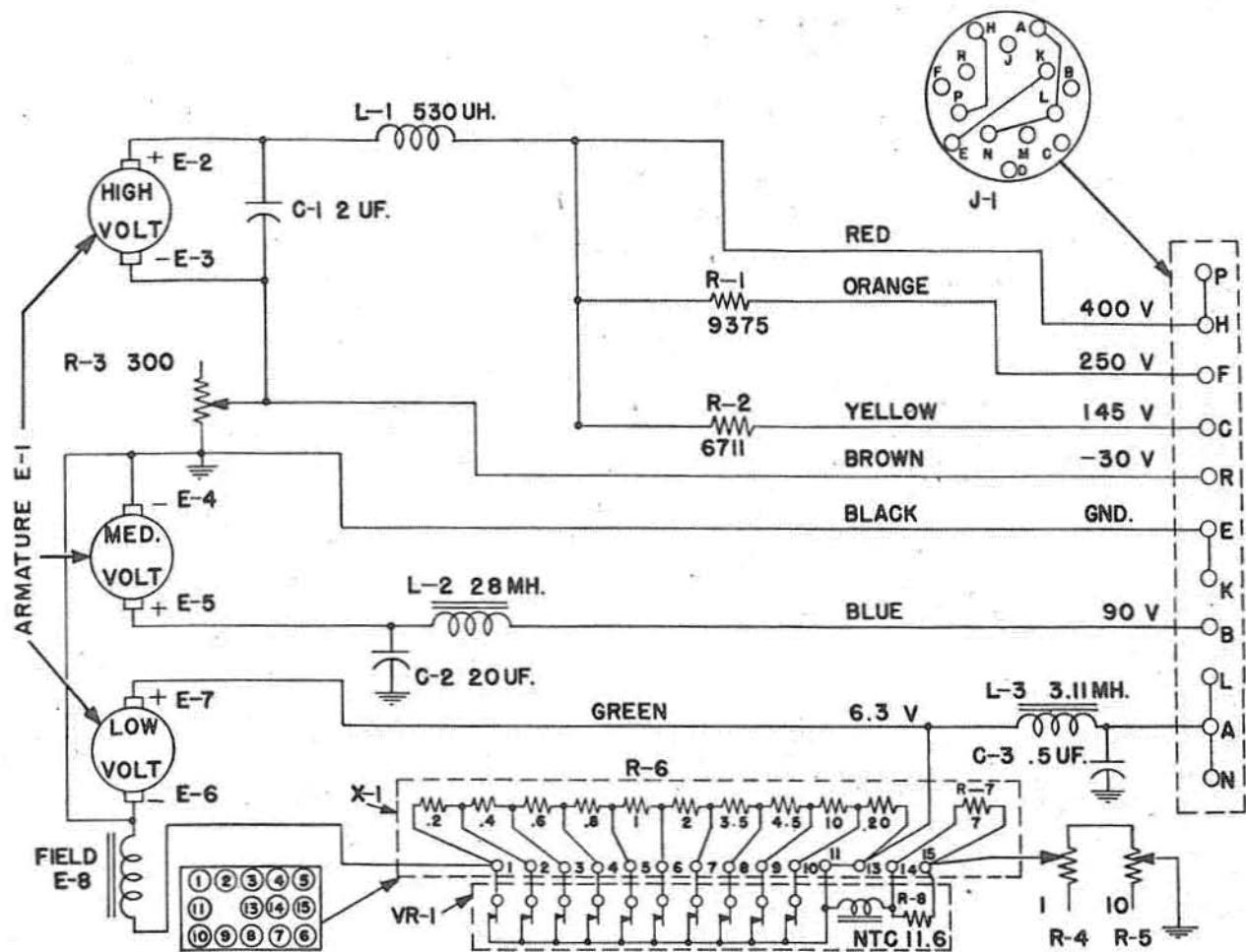


Figure 84. Case CY-590/GRC, schematic diagram.



NOTE:

ALL RESISTOR VALUES IN OHMS

Figure 85. Generator G-8/GRC, schematic diagram.

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APPENDIX I

REFERENCES

Note. For availability of items listed, check SR 310-20-3 and SR 310-20-4. Check Department of the Army Supply Catalog SIG 1 for Signal Corps supply catalogs.

1. Army Regulations

AR 380-5 Safeguarding Military Information.

2. Supply Publications

SIG 1----- Introduction and Index.
 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 Manual on Test Equipment

TM 11-2627--- Tube Tester I-177.

4. Painting and Preserving

TB SIG 13--- Moistureproofing and Fungiproofing Signal Corps Equipment.
 TM 9-2851--- Painting Instructions for Field Use.

5. Demolition

FM 5-25----- Explosives and Demolitions.

6. Packaging and Packing Instructions

JAN-D-169--- Desiccants, Activated.
 JAN-P-100--- General Specifications (100-14B).
 JAN-P-106A--- Boxes, Wood, Nailed (100-22A).

6. Packaging and Packing Instructions—Con.

JAN-P-116--- Preservation, Methods of (100-49).
 JAN-P-125--- Barrier Material, Waterproof (100-37).
 JAN-P-131--- Barrier Material, Moisture-Vaporproof, Flexible (100-35).

7. Other Publications

FM 24-18----- Field Radio Techniques.
 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.
 TB SIG 66----- Winter Maintenance of Signal Equipment.
 TB SIG 72----- Tropical Maintenance of Ground Signal Equipment.

7. Other Publications—Continued

TB SIG 75	Desert Maintenance of Ground Signal Equipment.
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 9-2857	Storage Batteries Lead-Acid Type.
TM 11-430	Batteries for Signal Communication. Except those pertaining to Aircraft.
TM 11-453	Shop Work.
TM 11-455	Radio Fundamentals.
TM 11-483	Suppression of Radio Noises.
TM 11-486	Electrical Communication Systems Engineering.
TM 11-660	Introduction to Electronics.
TM 11-4000	Trouble Shooting and Repair of Radio Equipment.
TM 38-650	Basic Maintenance Manual.

8. Abbreviations

ac	alternating current.
af	audio frequency.
afc	automatic frequency control.
C	centigrade.
db	decibel (s).
dc	direct current.
F	Fahrenheit.
f-m	frequency-modulation.
hf	high frequency.
hv	high voltage.
i. f.	intermediate frequency.
lv	low voltage.
kc	kilocycle.
ma	milliampere.
mc	megacycle.
mw	milliwatt.
rf	radio frequency.
rms	root mean square.
ua	microampere.
uf, uuf	microfarad, micromicrofarad.
uv	microvolt.

9. Glossary

For explanation of terms used in this manual, refer to TM 11-455.

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, SIG 7-8-10, SIG 10, or list of allowances of expendable material. 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.

1. Scope of Identification Table of Parts

Only those units that are not covered in separate technical manuals are covered in the following identification table of parts. These units are Mounting MT-297/GR, Control C-435/GRC, and Control Box C-375/VRC. For the other units refer to the individual technical manuals.

2. Identification Table of Parts for Mounting MT-297/GR

Reference symbol	Name of part and description	Function of part	Signal Corps Stock No.
	ARMY-NAVY MOUNTING MT-297/GR: radio set mtg; p/o Army-Navy Radio Sets AN/GRC-3 thru 8; metal rack w/eight-metal rack surface plates and nine metal channels ea w/locking strip, mtd on two rectangular metal mtg bkt hinged at rear end, ea w/two wing nut fasteners at front joint, ea mtg bkt supported by four shock mts mtd on metal hold down plate U shaped metal junction box mtd on under side of rack between mtg bkt, 8 cables w/connectors terminate in junction box; olive drab finish; main power ckt term 80 amp cap; rectangular box shape; $33\frac{3}{8}"$ lg x $13\frac{3}{8}"$ d x $4\frac{13}{16}"$ h o/a; four 0.343" diam mtg holes in ea hold down plate on $3\frac{1}{4}"$ x $4\frac{1}{8}"$ mtg/c; mp and fp, rails on inner part of U shaped casting, and locking connector accom slide in type control unit; Fed Tele & Rad part/dwg #GA-1834-14; U. S. Army spec #71-3326.		2Z6763-297
E-6	BOARD, terminal: wiring term board; 18 solder type term; $\frac{1}{4}"$ between centers; molded plastic board segmented; $5\frac{3}{8}"$ lg x $2\frac{1}{16}"$ wd x $1\frac{1}{8}"$ h o/a; two 0.169" x 0.25" oval mtg holes on $4\frac{1}{8}"$ mtg/c; term marked from 1 to 18, mtg bkt on each end; p/o Fed Tele & Rad GA-1973.14 housing assem; Fed Tele & Rad part/dwg #GA-1451-2.	Cable terminating board	3Z770-18.45
E-2, E-5	BOARD, terminal: wiring term board; 18 solder type term; $\frac{1}{4}"$ between ctr; moded segmented plastic board; $5\frac{3}{8}"$ lg x $2\frac{1}{16}"$ wd x $1\frac{1}{8}"$ h o/a; two 0.169" x 0.25" oval mtg holes on $4\frac{1}{8}"$ mtg/c; term marked from A to K and from A-1 to K-1, omitting G and I; mtg bkt on each end; p/o Fed Tele & Rad GA-1973-14 housing assem; Fed Tele & Rad part/dwg #GA-1452-2.	Cable terminating boards	3Z770-18.46
O-2, O-3	BUSHING: shock absorber for mtg connector not in use; neoprene; $\frac{1}{2}"$ lg x $\frac{1}{2}"$ OD x $\frac{3}{4}"$ ID; p/o Army-Navy Mounting MT-297/GR; Fed Tele & Rad part/dwg #GR-2150-2.	Unused cable connector. Mounting shock absorber bushing.	2Z1409-191

Reference symbol	Name of part and description	Function of part	Signal Corps Stock No.
H-11	BUTTON, plug: rubber substitute; fits $1\frac{1}{32}$ " diam hole; 0.587" diam x $1\frac{3}{8}$ " lg o/a; 70 to 80 durometer hardness; p/o Army-Navy Mountings MT-297, 298, 299, 300/GR; Fed Tele & Rad part/dwg #GR-2261-2-2; Army spec #71-4945.	Cable clamp plug-----	4Z3152
W-8	CABLE ASSEMBLY, power: Sig C type CO-212 cordage; length 8' 6" lg excluding terminations; 2 Fed Tele & Rad GH-2025-2 term lugs on one end, 1 on ea cond, other end term in 2 leads, one ins 4" lg w/end bared and tinned $\frac{3}{4}$ " lg; other bare $2\frac{1}{4}$ " lg; p/o Army-Navy Mountings MT-297, 298/GR; Fed Tele & Rad part/dwg #GA-2186-12-1; cordage covered by U. S. Army spec #71-1618A.	Battery cable-----	3E7350.1-102.1
W-1	CABLE ASSEMBLY, power: Sig C type CO-212 cordage; $19\frac{1}{2}$ " lg excluding terminations; one end terminated in Fed Tele & Rad #GH-2200-12 plug, other end terminated in 2 leads, one bare 3" lg, other ins 2" lg w/end bared and tinned $\frac{3}{4}$ " lg; p/o Army-Navy Mounting MT-297/GR; Fed Tele & Rad part/dwg #GA-2199-14-1; cordage covered by U. S. Army spec #71-1618A.	Power cable-----	3E7350.1-19.3
W-4	CABLE ASSEMBLY, power: Sig C type CO-212 cordage; $18\frac{1}{2}$ " lg excluding terminations; one end terminated in Fed Tele & Rad #GH-2200-12 plug, other end terminated in two leads, one ins and one bare ea $3\frac{1}{2}$ " lg, end bared and tinned $\frac{3}{4}$ " lg; p/o Army-Navy Mounting MT-297/GR; Fed Tele & Rad part/dwg #GA-2199-14-2; cordage covered by U. S. Army spec #71-1618A.	Power cable-----	3E7350.1-18.3
W-5	CABLE ASSEMBLY, power: Sig C type CO-212 cordage; 20" lg excluding terminations; one end terminated in Fed Tele & Rad #GH-2200-12 plug, other end terminated in 2 leads, one bare $3\frac{1}{2}$ " lg, other ins $1\frac{1}{2}$ " lg w/end bared and tinned $\frac{3}{4}$ " lg; p/o Army-Navy Mounting MT-297/GR; Fed Tele & Rad part/dwg #GA-2199-14-3; cordage covered by U. S. Army spec #71-1618A.	Power cable-----	3-7350.1-20.4
W-3	CABLE ASSEMBLY, special purpose: Sig C type WM-46/U cable; $24\frac{1}{2}$ " lg excluding terminations; one end terminated in Fed Tele & Rad #GH-2196-2 plug; other end terminated in 11 leads, 10 ins 6" lg w/ends bared and tinned $\frac{1}{2}$ " lg, other bare 5" lg; p/o Army-Navy Mounting MT-297/GR; Fed Tele & Rad part/dwg #GA-2085-14-3; cable covered by U. S. Army spec #71-3373.	Control cable-----	3E7350-1.24.3
W-6	CABLE ASSEMBLY, special purpose: Sig C type WM-46/U cable; 21" lg excluding terminations; one end terminated in Fed Tele & Rad GH-2196-12 plug; other end terminated in 11 leads, 10 ins 6" lg w/ends bared and tinned $\frac{1}{2}$ " lg, other bare 5" lg; p/o Army-Navy Mounting MT-297/GR; Fed Tele & Rad part/dwg #GA-2085-2-7; cable covered by U. S. Army spec #71-3373.	Control cable-----	3E7350-1.21

Reference symbol	Name of part and description	Function of part	Signal Corps Stock No.
W-7	CABLE ASSEMBLY, special purpose: Sig C type WM-46/U cable; 23" lg excluding terminations; one end terminated in Fed Tele & Rad GH-2196-12 plug, other end terminated in 11 lead; 10 ins 6" lg w/ends bared and tinned 1/2" lg, other bare 5" lg; p/o Army-Navy Mounting MT-297/GR; Fed Tele & Rad part/dwg #GA-2085-14-8; cable covered by U. S. Army spec #71-3373.	Control cable.....	3E7350-1.23.1
W-2	CABLE ASSEMBLY, special purpose: Sig C type WM-46/U cable; 23" lg excluding terminations; one end terminated in Fed Tele & Rad GH-2196-12 plug other end terminated in 11 leads, 10 ins 6" lg w/ends bared and tinned 1/2" lg, other bare 5" lg; p/o Army-Navy Mounting MT-297/GR; Fed Tele & Rad part/dwg #GA-2085-14-9; cable covered by U. S. Army spec #71-3373.	Control cable.....	3E7350-1.23.1
O-4 through O-12	CAM: mounting plate lock cam; p/o Fed Tele & Rad GA-1236-14 and GA-1263-14 rack assem, p/o Army-Navy Mountings MT-297, 298, 299, 300/GR; brass; generally triangular shape w/rounded corners and bottom side; approx 1 1/2" lg x 3/8" wd x .475" thk; two etb #6-32 NC-2 mtg holes on .562" mtg/c; slotted through approx center of thickness; Fed Tele & Rad part/dwg #GC-1021-2.	Locking cams.....	4Z3185-1
O-13	CAM: p/o Fed Tele & Rad GA-1973-14 housing assem; stainless steel, passivated; tear drop shape; 3.7725" lg x 2.484" wd x 1.016" h o/a; mts by means of hole in round portion, hole 1.937" diam etb 2.062" diam x .188" d; four locking type slots in outer edge of round portion slot in arm portion .187" wd x 1.065" lg; Amphenol dwg #164-400; Fed Tele & Rad part/dwg #GB-1367-12.	Connector locking cam.....	4Z3185-2
H-1 through H-6	CLAMP: steel; cad pl and olive drab iridite; 1 1/16" lg x 1 1/4" diam o/a; accommodate .61" diam cable; compression type clamp, has rubber gland to provide wp seal between cable and clamp, wp seal between clamp and mtg hole; p/o Army-Navy Mountings MT-297, 298, 299, 300/GR; Fed Tele & Rad part/dwg #GH-1966-2.	Cable clamps.....	2Z2642.305
H-7 through H-10	CLAMP: steel; cad pl and olive drab iridite; 1 1/16" lg x 1 1/4" diam o/a; accomo .516" diam cable; compression type clamp has rubber gland to provide wp seal between cable and clamp wp seal between clamp and mtg hole; p/o Army-Navy Mountings MT-297, 298, 299, 300/GR; Fed Tele & Rad part/dwg #GH-1965-2.	Cable clamps.....	2Z2642.300
J-1	CONNECTOR, receptacle: 26 round female cont; straight; 2.047" diam excluding mtg nut and lockwasher x 1.719" lg excluding term; cylindrical passivated stainless steel body; molded phenolic insert; single hole mtg, 1 1/4"-16NS-2 x .813" lg mtg bushing; has O ring wp seal on mtg bushing, supplied w/spanner type mtg nut and lockwasher; p/o Army-Navy Mountings MT-297, 298/GR; Amphenol dwg #164-10; Fed Tele & Rad part/dwg #GH-2385-12.	Receptacle, control unit connector.	2Z3082-84

Reference symbol	Name of part and description	Function of part	Signal Corps Stock No.
A-9, A-10	COVER: p/o Fed Tele & Rad #GA-1973-14 housing assem; aluminum alloy, olive drab finish; rectangular plate shape w/rounded corners; $9\frac{1}{16}$ " lg x $2\frac{29}{32}$ " wd x $\frac{3}{8}$ " thk o/a; six #10-24NC-2 tapped holes; three on ea longitudinal edge $3\frac{3}{4}$ " c to c; groove in bottom surface for O ring seal; Fed Tele & Rad part/dwg #GC-1706-12.	Junction box covers-----	2Z3351-209
A-11	COVER: p/o Fed Tele & Rad #GA-1973-14 housing assem; aluminum alloy, olive drab finish; rectangular plate shape w/rounded corners; $15\frac{1}{4}$ " lg x $2\frac{31}{32}$ " wd x $\frac{3}{8}$ " thk o/a; eight #10-24NC-2 tapped holes; three on ea longitudinal edge 4" c to c and one ctr on ea end; groove in bottom surface for O ring seal; Fed Tele & Rad part/dwg #GC-1707-14.	Junction box cover-----	2Z3351-210
F-1	FUSE, cartridge: 50 amp; opens in 1 hr at 135% load, 2 min at 200% load rated continuous at 110% load; 32 v max; one time; glass body; ferrule term; $1\frac{1}{2}$ " lg x $1\frac{1}{32}$ " diam o/a; term $1\frac{1}{32}$ " diam x $\frac{3}{8}$ " lg; anti-vibration construction; Buss catalog #5AG50.	Overload protection, battery--	3Z2650.11
F-2	FUSE, cartridge: 2 amp; opens in 1 hr at 135% load, 2 min at 200% load, rated continuous at 110% load; 250 v max; one time; glass body; ferrule term; $1\frac{1}{2}$ " lg x $1\frac{1}{32}$ " diam o/a; term $1\frac{1}{32}$ " diam x $\frac{3}{8}$ " lg; anti-vibration construction; Buss catalog #5AG2.	Circuit fuse-----	3Z2602.23
O-28	GASKET: JW60 crude rubber compound; single hole; w/round cross sec, $10\frac{1}{4}$ " OD x 10" ID x $\frac{1}{8}$ " thk; p/o Fed Tele & Rad GA-1973-14 housing assem, p/o Army Navy Mountings MT-297, 298/GR; Linear Inc. #1866-52; Fed Tele & Rad part/dwg #GS-1946-1-3.	Cover to junction box water-proof gasket.	2Z4868.785
O-29, O-30	GASKET: JW60 crude rubber compound; single hole; cir w/round cross sec, $6\frac{3}{4}$ " OD x $6\frac{1}{2}$ " ID x $\frac{1}{8}$ " thk; p/o Fed Tele & Rad GA-1973-14 housing assem, p/o Army Navy Mountings MT-297, 298/GR; Linear Inc. #1866-38; Fed Tele & Rad part/dwg #GS-1946-1-2.	Cover to junction box water-proof gasket.	2Z4868.786
H-12 through H-20	HANDLE: steel, zinc pl and olive drab iridite; $2\frac{5}{16}$ " lg x $1\frac{1}{2}$ " wd x 7-16 h o/a; flanged grip $1\frac{1}{16}$ " lg x .059" wd x $\frac{3}{8}$ " h; two .154" diam mtg holes on .562" mtg/c; p/o Fed Tele & Rad GA-1236-14 and GA-1263-14 rack assem; p/o Army-Navy Mountings MT-297, 298, 299, 300/GR; Fed Tele & Rad part/dwg #GB-1029-2.	Mounting strip locking handle.	4Z4691
E-9	HOLDER, fuse: block type; for single type 5AG cartridge fuse; phenolic base w/tinned brass term and fuse holder; 80 amp, 32 v DC max; $1\frac{13}{16}$ " lg x $1\frac{1}{16}$ " wd x $1\frac{13}{16}$ " h o/a; two .169" diam etb mtg holes in base on 1" mtg/c; 2 slotted compression type binding post term, one post having solder lug term at base; phosphor bronze locking type spring fuse clips; p/o Army-Navy Mountings MT-297, 298, 299, 300/GR; Burndy type KF2517G1; Fed Tele & Rad part/dwg #GH-1645-2.	Fuse holder-----	3Z3282-1.1

Reference symbol	Name of part and description	Function of part	Signal Corps Stock No.
E-10	HOLDER, fuse: block type; for single type 5AG cartridge fuse; phenolic base w/silver pl beryllium copper fuse clips; 30 amp, 32 v DC max; 1 $\frac{5}{8}$ " lg x $\frac{3}{8}$ " wd x 1 $\frac{1}{16}$ " h o/a; surface mtg, two etb .169" diam mtg holes on .313" x .25" mtg/c; two solder lug term; p/o Fed Tele & Rad GA-1973-14 housing assem; Fed Tele & Rad part/dwg #GH-1876-2.	Fuse holder-----	3Z3282-20.6
E-13, E-14	INSULATOR, plate: rectangular shape; type LTS-E-3 phenolic, natural; 1 $\frac{1}{2}$ " lg; 1 $\frac{1}{16}$ " wd x .062" thk, two .169" diam mtg holes on 1" mtg/c; p/o Fed Tele & Rad GA-1973-14 housing assem; Fed Tele & Rad part/dwg #GP-1974-2-1.	Terminal assembly mounting insulator.	3G320-165
E-15	INSULATOR, plate: rectangular shape; type LTS-E-3 phenolic, natural; 1 $\frac{3}{16}$ " lg; 1 $\frac{1}{16}$ " wd x .062" thk; two .169" diam mtg holes on 1" mtg/c; p/o Fed Tele & Rad GA-1973-14 housing assem; Fed Tele & Rad part/dwg #GP-1975-2.	Fuseholder mounting insulator.	3G320-166
E-16	INSULATOR, plate: rectangular shape; type LTS-E-3 phenolic, natural; 1 $\frac{5}{8}$ " lg; $\frac{5}{8}$ " wd x .062" thk; two .169" diam mtg holes on .313" x .25" mtg/c; p/o Fed Tele & Rad GA-1973-14 housing assem; Fed Tele & Rad part/dwg #GP-1976-2.	Fuseholder mounting insulator.	3G320-167
E-17	JUNCTION BOX: cable terminating and connector, term board, fuseholder and switch mtg box; ten .828" diam outlet holes; aluminum alloy, olive drab finish; w/o covers; U-shaped, 15 $\frac{3}{8}$ " lg x 12 $\frac{1}{16}$ " wd x 3 $\frac{3}{8}$ " h o/a; four mtg bosses on top side ea/w $\frac{1}{4}$ "-20 NC-2 x $\frac{5}{16}$ " d tapped hole on 7" 11 $\frac{1}{4}$ " mtg/c; has slotted rails on ea side of inside of U to accommodate control unit and has provision for installing lever shaft and connector locking cam, and chassis connector; p/o Fed Tele & Rad GA-1973-14 housing assem; Fed Tele & Rad part/dwg #GA-2099-12.	Cable terminating junction box.	2Z5687-35
E-18	KNOB: round w/bar; olive drab zinc alloy; for $\frac{1}{4}$ " diam double flatted shaft; single #6-32 screw thru hole in face of knob screws into axially tapped hole in end of shaft; two white luminous lines on bar portion; 1 $\frac{1}{16}$ " lg x $\frac{7}{8}$ " wd x 1 $\frac{5}{16}$ " h o/a; shaft hole .359" d from bottom surface; luminous markings; p/o Army-Navy Receiver-Transmitters RT-66, 67, 68, 70/GRC, Case CY-590/GRC, Remote Control C-433/GRC, Local Control C-434/GRC, Control C-435/GRC, and Mountings MT-297, MT-298/GR; Fed Tele & Rad part/dwg #GC-1690-2.	Switch knob-----	2Z5822-401
N-1	LABEL: decalcomania; 1 $\frac{1}{16}$ " wd x 9 $\frac{7}{8}$ " lg x .007" thk; white print on black background; individually packed; p/o Army-Navy Mounting MT-297/GR; Meyer cord type G; Fed Tele & Rad part/dwg #GD-1240-26; Sig C dwg #SC-D-40605-A.	Circuit label for Mounting MT-297.	6D16777-9
E-7	LAMP, incandescent: Lamp LM-38; 28 v .17 amp; bulb T-3- $\frac{1}{4}$ clear; 1 $\frac{1}{8}$ " lg o/a; miniature bayonet base; C-2 fil; burn any position; Mazda catalog #313.	Pilot light-----	2Z5938

Reference symbol	Name of part and description	Function of part	Signal Corps Stock No.
W-9, W-10	LEAD, electrical: single #5 AWG, 36180 cir mil, braided conductor, 360-#30 AWG strands, un-insulated, flat ribbon shape approx $\frac{5}{8}$ " wd x $\frac{1}{8}$ " thk; $5\frac{1}{2}$ " lg excluding term; flattened tubing ends w/.257" diam hole other w/.328" diam hole; p/o Army-Navy Mounting M-297/GR; Fed Tele & Rad part/dwg #GB-1179-2-2.	Grounding straps-----	3E7998-5.9
I-1	LIGHT, indicator: with lens; $\frac{1}{16}$ " diam clear lens; for miniature bayonet base, T-3- $\frac{1}{4}$ bulb; 110 v, $\frac{1}{4}$ amp; encl shell; aluminum alloy olive drab; $2\frac{5}{8}$ " lg x $1\frac{1}{16}$ " diam o/a; $\frac{1}{16}$ " diam mtg hole required, $\frac{1}{4}$ " max panel thk; vertically mtg socket, lamp replaceable from rear of panel; threaded jewel; 2 solder lug term located together on rear end of socket; built in mechanical dimmer, two clear wp internal lenses, wp seal between bushing and panel; p/o Army-Navy Mountings MT-297, 298/GR, Control C-435/GRC, Local Control C-434/GRC, and Remote Control C-433/GRC; Dialco dwg #832210-XP4-721; Fed Tele & Rad part/dwg #GH-1964-2.	Pilot light socket-----	2Z5991-184
A-1 through A-8	MOUNT, vibration: Sig C Shock Mount M-449; sq mtg; load rating 17 to 30 lb; $2\frac{3}{8}$ " sq x 1.058" thk o/a; rubber shock cushion on either side of metal mtg plate $1\frac{1}{2}$ " diam x $\frac{5}{8}$ " thk; steel sleeve w/.251" diam hole, hole extends thru sleeve untapped for $\frac{1}{16}$ " d ea end, tapped on center $\frac{1}{4}$ "-28 NF-2; four .199" diam mtg holes on 1.937" x 1.937" mtg/c; olive drab finish; marked with M-449, load rating and mfr name; Sig C dwg #SC-D-19169 Group 3, spec #12-121.	Shock mounts-----	2Z8415-449
H-21	NUT, castellated: steel, cad pl and olive drab iridited; finished per dwg; $\frac{3}{8}$ "-32 NS-2; $\frac{1}{8}$ " thk; $\frac{5}{16}$ " OD; 4 slots $\frac{1}{16}$ " wd x $\frac{3}{16}$ " d spaced 90 deg apart; p/o Fed Tele & Rad GA-1973-14 housing assem; p/o Army-Navy Mountings MT-297, 298/GR; Fed Tele & Rad part/dwg #GB-1106-2.	Switch mounting nut-----	6L3006-325
H-22, H-23	PIN, hinge: p/o Army-Navy Mountings MT-297, 298/GR; steel zinc pl and olive drab iridite; .312" diam x $4\frac{1}{2}$ " lg; both ends chamfered $\frac{1}{32}$ " x 45 deg, one .076" diam hole thru ea end of pin $\frac{1}{8}$ " from end; Fed Tele & Rad part/dwg #GB-1325-2.	Pin for hinges-----	6L3945-72-1
E-4, E-12	POST, binding: compression screw type; $1\frac{1}{2}$ " lg x $\frac{1}{2}$ " wd x $1\frac{1}{2}$ " h, no mtg stud; two .169" diam ctb mtg holes on 1.062" mtg/c; brass tinned; slotted wire hole accom wp to two #8 wires; hexagon compression nut w/wire cont insert, has solder lug term on side of base; p/o Army-Navy Mountings MT-297, 298, 299, 300/GR; Burndy type #KFF17G1; Fed Tele & Rad part/dwg #GH-1647-2.	Ground terminals-----	3Z741-2

Reference symbol	Name of part and description	Function of part	Signal Corps Stock No.
E-1, E-3	POST, binding: compression screw type; $1\frac{1}{2}$ " lg x $\frac{1}{16}$ " wd x $1\frac{1}{2}$ " h; no mtg stud; two .169" diam etb mtg holes on 1" mtg/c; brass stud, tinned, w/ phenolic mtg base; slotted wire hole accom wp to two #8 wires; hexagon compression nut w/wire cont insert, has solder lug term on side of base; p/o Army-Navy Mountings MT-297, 298/GR; Burndy type #KF1S17G1; Fed Tele & Rad part/dwg #GH-1646-2.	Cable terminals-----	3Z741-2.1
O-1	RELAY, armature: 3B; cont rated 100u at 150v; palladium cont; single winding, 12.6v DC nominal, pull in voltage 8v DC, max oper voltage 16v DC, 144 ohm, ins; solder lug term on coil and cont; $2\frac{3}{16}$ " lg x $1\frac{1}{8}$ " wd x $2\frac{7}{16}$ " h max o/a; two .221" diam holes on $1\frac{1}{4}$ " mtg/c; fast acting; BS, circuit diagram, mfr name and catalog # marked on side, term #1 indicated by brown marker; p/o Army-Navy Mountings MT-297, 298/GR; Adv Elec type A8775-1Y, Dunco type #181XXC100; Fed Tele & Rad part/dwg #GH-1648-2.	Control relay-----	2Z7599A-251
K-1	RELAY, solenoid: SPST, normally open cont rated 50 amp DC at 28v; silver cont; single winding, operates on 10v DC, continuously withstands; 16v DC, 27.5 ohms resistance, insul; two #10-32NF2 stud term on cont; two #6-32NC-2 stud term on coil; $3\frac{1}{4}$ " lg x $1\frac{1}{8}$ " wd x $2\frac{1}{2}$ " max h; two clearance holes for #10-24 screws on $2\frac{3}{4}$ " mtg/c; fast acting; mp and fp, marked w/mfr name and catalog #; p/o Army-Navy Mountings MT-297, 298/GR; Dunco type 101HXX107 or Adv Elec type B5-12Y, or Leach Relay type 7064-91B; Fed Tele & Rad part/dwg #GH-1679-12.	Power relay-----	2Z7586-193
R-3	RESISTOR, fixed: WW; JAN type RW32G280; 28 ohms $\pm 5\%$; 12 w; spec JAN-R-26A.	Dropping resistor, K-1 voltage.	3RW15002
R-1,	RESISTOR, fixed: WW; JAN type RW29G141; 140	Dropping resistor.	3RW19216
R-2	ohms $\pm 5\%$; 8 w; spec JAN-R-26A.	Dropping resistor, O-1 voltage.	
H-24 through H-27	SCREW, cap: slotted hex head drive; hexagon head, finished per dwg; steel, normal hardness, cad pl and olive drab iridite; $\frac{1}{4}$ " 20NC-2; $\frac{3}{8}$ " lg; thd entire length; slot $\frac{1}{16}$ " wd x $\frac{3}{32}$ " d; p/o Army-Navy Mountings MT-297, 298/GR; Fed Tele & Rad part/dwg #GB-1110-2-1.	Rack to bracket mounting screws.	6L4904-20-6
H-28 through H-37	SCREW, cap: slot drive, hex head semifinished; steel, cad pl and olive drab iridite; $\frac{5}{16}$ " x 24NF-2; $1\frac{1}{4}$ " lg; thd $1\frac{1}{16}$ " of length; slot in head $\frac{1}{16}$ " wd x $\frac{3}{32}$ " d; p/o Army-Navy Mountings MT-673/UR, and MT-297, 298, 299, 300/GR; Fed Tele & Rad part/dwg #GB-2065-2-1.	Equipment installation screws	6L4905-205
H-38 through H-47	SCREW, cap: slot drive, hex head, semifinished; steel, cad pl and olive drab iridite; $\frac{5}{16}$ " x 24NF-2; $\frac{3}{4}$ " lg; thd $\frac{5}{16}$ " of length; slot in head $\frac{1}{16}$ " wd x $\frac{3}{32}$ " d; p/o Army-Navy Mountings MT-673/UR, and MT-297, 298, 299, 300/GR; Fed Tele & Rad part/dwg #GB-2065-2-2.	Equipment installation screws	6L4905-125

Reference symbol	Name of part and description	Function of part	Signal Corps Stock No.
H-48 through H-67	SCREW, captive: slot drive; finished fillister Bind H per dwg; cold finished steel, cad pl and olive drab iridited; #10-24 NC-2; .937" lg; thd portion .281" lg; head $\frac{5}{16}$ " diam x $\frac{1}{8}$ " thk; p/o Fed Tele & Rad GA-1973-14 housing assem, p/o Army Navy Mountings MT-297, 298, 299, 300/GR; Fed Tele & Rad part/dwg #GB-1772-2.	Junction box cover mounting screws.	6L4770-15.19C
H-68 through H-76	SCREW, dowel: p/o Fed Tele & Rad GA-1236-14 and GA-1263-14 rack assem; p/o Army-Navy Mountings MT-297, 298, 299, 300/GR; cold finished steel, zinc pl and olive drab iridite; .625" lg x .278" diam o/a; thd portion #6.32 NC-2 x $\frac{1}{4}$ " lg; slot drive, slot $\frac{3}{4}$ " wd x $\frac{1}{16}$ " d; Fed Tele & Rad part/dwg #GB-2520-2-1.	Handle, cam, and locking strip assembly screws.	6L5014-10
H-77 through H-85	SCREW, dowel: handle and cam assembly screw; p/o Fed Tele & Rad GA-2136-14 and GA-1263-14 rack assem; p/o Army-Navy Mountings MT-297, 298, 299, 300/GR; cold finished steel zinc pl and olive drab iridited; .42" lg x .278" diam o/a; thd portion #6-32 NC-2 x $\frac{1}{4}$ " lg; slot drive, slot $\frac{3}{4}$ " wd x $\frac{1}{16}$ " d; Fed Tele & Rad part/dwg #GB-2520-2-2.	Handle and cam assembly screws.	6L5014-6-1
H-86 through H-89	SCREW, thumb: wing head; steel, cad pl and olive drab iridite; $\frac{5}{16}$ "-18 NC-2; $1\frac{1}{4}$ " lg; thd entire length; flat point; head $1\frac{1}{32}$ " wd x $\frac{5}{16}$ " h; hole thru thd portion .076" diam, $\frac{5}{32}$ " from end; p/o Army-Navy Mountings MT-297, 298/GR; Fed Tele & Rad part/dwg #GH-1201-2.	Stand assembly (hinged) locking screws.	6L17504-4
O-14	SHAFT ASSEMBLY: p/o Fed Tele & Rad GA-1973-14 housing assem; consists of 1 Fed Tele & Rad GB-1773-2 shaft, 1 GC-1316-2 handle and 1 GC-1796-2 arm; $10\frac{1}{4}$ " lg x $1\frac{1}{4}$ " wd x $2\frac{3}{8}$ " h approx o/a; mts by means of shaft; knob on one end of shaft, arm on other end, shaft flush at both ends; Fed Tele & Rad part/dwg #GA-1774-2.	Connector locking cam operating shaft.	2Z8201.69
O-15 through O-18	SLEEVE, spacer: p/o Fed Tele & Rad GA-1236-14 and GA-1263-14 rack assem, p/o Army-Navy Mountings MT-297, 298/GR; steel, zinc pl and olive drab iridited; tubr shape; $\frac{1}{2}$ " OD x .282" ID x .678" lg; mts by means of ID; Fed Tele & Rad part/dwg #GB-1232-2.	Rack to bracket mounting spacers.	2Z8552-71
O-19 through O-27	SPRING: helical extension type; .04" diam music wire, zinc pl and olive drab iridited; 1.86" lg x .375" diam; 27 $\frac{1}{2}$ turns, close wound; parallel hook term; term bent on .1375" rad on 1.51125" mtg/c; heat treated after plating; p/o Fed Tele & Rad GA-1236-14 and GA-1263-14 rack assem p/o Army-Navy Mountings MT-297, 298, 299, 300/GR; Fed Tele & Rad part/dwg #GB-1104-2.	Locking strip tension springs.	2Z8879-323
S-1	SWITCH, rotary: 2 pole, 3 position; single sect; silver pl brass cont; ceramic wafer; $1\frac{1}{8}$ " lg x $1\frac{1}{8}$ " wd x 1" d; locking action; solder lug term; single hole mtg, bushing $\frac{3}{8}$ "-32 x $\frac{5}{16}$ " lg, shaft $\frac{1}{4}$ " diam x $\frac{3}{8}$ " lg w/double flats and axially tapped hole #6-32 NC-2 x $\frac{1}{4}$ " d, flush mtg; has wp seal in bushing and in mtg flange; p/o Army-Navy Mountings MT-297, 298/GR; Oak type FC or equal; Fed Tele & Rad part/dwg #GH-1641-2.	Control switch.	3Z9825-62.516

Reference symbol	Name of part and description	Function of part	Signal Corps Stock No.
E-8, E-11	TERMINAL, lug: ring type; copper hot tin dipped; for #8 AWG wire; $1\frac{1}{8}$ " lg x $\frac{1}{16}$ " wd x $\frac{3}{8}$ " thk o/a w/ $\frac{1}{32}$ " diam stud hole; solder connects to wire; marked 70A; Atlas Products Corp type #W-70-A; Fed Tele & Rad part/dwg #GH-2025-2.	Battery cable terminals-----	3Z12073-53
H-90, H-91	WASHER, flat: neoprene; round $1\frac{1}{16}$ " OD x $1\frac{1}{32}$ " ID x $\frac{1}{4}$ " thk; 50-60 durometer hardness; p/o Army-Navy Mounting MT-297/GR; Fed Tele & Rad part/dwg #GR-2149-2.	Unused cable connector mounting shock absorbing washers.	6L54006-21

3. Identification Table of Parts for Control C-435/GRC

Reference symbol	Name of part and description	Function of part	Signal Corps Stock No.
	ARMY-NAVY CONTROL C-435/GRC: p/o Army-Navy Radio Sets AN/GRC-3 thru -8 AN/VRQ-1 thru -3; c/o wp metal case, cast aluminum panel w/controls, etc., and metal chassis w/electrical parts; olive drab finish; rectangular box shape; $8\frac{1}{16}$ " wd x $3\frac{3}{16}$ " h x $10\frac{1}{16}$ " lg o/a; mts in compartment of mounting w/which used by means of two metal rails, one on each side of case, slide in mtg; has control designations on panel and is marked w/nomenclature mfr designation and order number; immersion and fungus resistance, has cap on rear to cover connector opening, and cap retainer; Fed Tele & Rad part/dwg #GA-2308-12; US Army spec #71-3328.	Radio set control unit-----	2C684-435
E-3	BOARD, terminal: 6 solder type silver pl brass stud term; term 1" between centers and $\frac{1}{2}$ " c to c apart; laminated phenolic board; $2\frac{1}{4}$ " lg x $1\frac{1}{16}$ " wd x $\frac{1}{2}$ " thk o/a; two .169" diam mtg holes on $1\frac{3}{4}$ " mtg/c; white character designation for term and symbol numbers of items mtd; p/o Fed Tele & Rad GA-2307-14 chassis assem; Fed Tele & Rad part/dwg #GA-2644-2.	Resistor and crystal mounting board.	3Z770-6.62
O-5	CAP: p/o Army-Navy Control C-435/GRC and Local Control C-434/GRC; consists of 1 Fed Tele & Rad GB-2702-2 cap, 4 GB-2750-12 springs, 1 GA-25392-2 chain assem, and 5 rivets; aluminum cap, olive drab finish; round; $2\frac{3}{4}$ " diam x $\frac{3}{4}$ " thk o/a, has 4 spring clips on under side of cap for mtg, clips are 90 deg apart; has bead retaining chain for attaching to case, straight knurl on outside edge; Fed Tele & Rad part/dwg #GA-2756-2.	Waterproof cap for connector aperture.	2Z1619-57
C-1, C-2	CAPACITOR, fixed: metallized paper dielectric; 8 μ f $\pm 20\%$; 150 vdew; BS metal can; 2" lg x 2" wd x 1" h; mineral oil impregnated; two solder lug term on side of case; no internal ground connection; two mtg feet w/ $3/16$ " diam hole in each on $2\frac{3}{8}$ " centers; p/o Army-Navy Control C-435/GRC; Aerovox type Aerolite #P3OE; Fed Tele & Rad part/dwg #GH-1978-2.	Audio brasses-----	3DB8-218

Reference symbol	Name of part and description	Function of part	Signal Corps Stock No.
C-3	CAPACITOR, fixed: metallized paper dielectric; 2 sect; $2 \mu\text{f} \pm 20\%$ term 1 to 2, $2 \mu\text{f} \pm 20\%$ term 1 to 3; 200 vdew; BS metal can; $1\frac{1}{16}$ " lg x 1" wd x $\frac{7}{8}$ " h; mineral oil impregnated; three solder lug term on side of case; no internal ground connection; two mtg feet w/ $\frac{3}{16}$ " diam hole in ea on $2\frac{1}{8}$ " centers; p/o Army-Navy Control C-435/GRC, Local Control C-434/GRC, and Remote Control C-433/GRC; Aerovox type Aerolite #P308; Fed Tele & Rad part/dwg #GH-1977-2.	D-c blocking capacitor-----	3DB2-249
H-2	CLAMP: steel; cad pl and iridited; 1 screw used to mount; U-shaped, $1\frac{1}{2}$ " wd x $1\frac{1}{32}$ " lg x $\frac{3}{8}$ " d o/a, material .047" thk; one .343" wd x .587" mtg hole in center; p/o Army-Navy Control C-435/GRC; Fed Tele & Rad part/dwg #GB-2471-2.	0-2 and 0-4 relay holding clamp.	
H-1	CLAMP: steel; cad pl and olive drab iridited; 1 screw used to mount; U-shaped angle, $1\frac{1}{8}$ " lg x 1" wd x $\frac{3}{16}$ " h o/a, .0598" thk material, single .205" diam mtg hole; p/o Army-Navy Control C-435/GRC; Fed Tele & Rad part/dwg #GB-2958-2.	0-1 and 0-3 relay holding clamp.	
J-2	CONNECTOR, receptacle: 10 round button contacts; straight; 1.286" max OD x 1.197" max lg; cylindrical stainless steel body, sand blast finish, locking; molded phenolic insert; single hole mtg, 1"-32 NS-2 x $\frac{1}{16}$ " lg mtg bushing; has "O" ring wp seal on mtg flange, supplied w/spanner type mtg nut, immersion and salt spray resistant, has index flat on mtg bushing; p/o Army-Navy Receiver-Transmitter RT-66, 67, 68, 70/GRC, Radio Receivers R-108, 109, 110/GRC, AF Amplifier AM-65/GRC, Control C-435/GRC, Local Control C-434/GRC, and Remote Control C-433/GRC; Amphenol dwg #164-7 or Cannonelec dwg #17651-1; Fed Tele & Rad part/dwg #GH-2079-12.	Audio connector-----	2Z3030-27
J-1	CONNECTOR, receptacle: 26 round male cont; straight; 1.852" diam x 1.312" lg excluding term; cylindrical aluminum body; molded phenolic insert; mts in single hole when used w/retainer plate not supplied as part of connector; has two grooves in outer circumference for "O" ring seals which are supplied w/connector, flange on rear end 1.852" diam x .093" thk; p/o Army-Navy Control C-435/GRC and Local Control C-434/GRC; Amphenol dwg #164-9; Fed Tele & Rad part/dwg #GH-2387-12.	Chassis connector-----	2Z3045-57

Reference symbol	Name of part and description	Function of part	Signal Corps Stock No.
CR-1	CRYSTAL UNIT, rectifying: p/o Army-Navy Control C-435/GRC, Receiver-Transmitters RT-66, 67, 68, 70/GRC; plastic case; .83 ma max inverse current at -50v, 5 ma min forward current at +lv, shunt capacity 1.0 μ f; .5" lg x .24" diam o/a; two axial wire leads; marked IN-43; RMA type IN-43; WECO catalog #IN-43. OR ALTERNATE	Meter rectifier----- OR ALTERNATE	2JIN43
CR-1	CRYSTAL UNIT, rectifying: p/o Army-Navy Control C-435/GRC, Receiver-Transmitters RT-66, 67, 68, 70/GRC; glass case; .8 ma max inverse current at -50 v, 5 ma min forward current at +lv, shunt capacity 1.0 μ f $\frac{7}{8}$ " lg x $\frac{1}{4}$ " diam; two axial wire leads; Sylvania Prod catalog #IN-34A.	Meter rectifier-----	2JIN34A
O-8	GASKET: Buna N; 1 hole; circular w/circular cross section; $1\frac{1}{4}$ " OD x $1\frac{1}{4}$ " ID x $\frac{1}{8}$ " thk; p/o Army-Navy Control C-435/GRC and Receiver-Transmitters RT-66, 67, 68/GRC; Linear Inc part #1820-23; Fed Tele & Rad part/dwg #GS-1948-1-14.	Meter mounting waterproof gasket.	2Z4868.737
O-9	GASKET: neoprene; 1 hole; rectangular, 7.937" lg x 3.312" wd x .187" thk, hole 7.563" lg x 2.938" wd; 50-60 durometer hardness; p/o Army-Navy Control C-435/GRC and Local Control C-434/GRC; Fed Tele & Rad part/dwg #GR-1378-2.	Panel to case waterproof gasket.	6Z4051-22
O-10	GASKET: JW60 crude rubber compound; 1 hole circular w/circular cross section; $3\frac{1}{4}$ " OD x 3" ID x $\frac{1}{8}$ " thk; p/o Army-Navy Control C-435/GRC and Local Control C-434/GRC; Linear Inc part #1866-12; Fed Tele & Rad part/dwg #GS-1946-1-7.	Connector guide block mounting gasket.	6Z4049-6
E-4, E-5	KNOB: round; olive drab zinc alloy; for $\frac{1}{4}$ " diam double flatted shaft; single #6-32 screw thru hole in face of knob screw into axially tapped hole in end of shaft; two white luminous lines; $2\frac{3}{32}$ " max diam at bottom tapers to $2\frac{1}{32}$ " max diam at top, $1\frac{1}{2}$ " h o/a; shaft hole .359" d from bottom surface; luminous markings; p/o Army-Navy Radio Receiver R-108, 109, 110/GRC, Receiver-Transmitter RT-70/GRC, AF Amplifier AM-65/GRC, and Control C-435/GRC; Fed Tele & Rad part/dwg #GC-1245-2.	E-4: R-4 variable resistor knob. E-5: R-5 variable resistor knob.	2Z5822-403
E-6	KNOB: round, w/bar; olive drab zinc alloy; for $\frac{1}{4}$ " diam double flatted shaft; single #6-32 screw thru hole in face of knob screws into axially tapped hole in end of shaft; two luminous white lines on bar portion; $1\frac{1}{10}$ " lg x $\frac{7}{8}$ " wd x $1\frac{1}{32}$ " h o/a; shaft hole .359" d from bottom surface; luminous markings; p/o Army-Navy Receiver-Transmitters RT-66, 67, 68/GRC, Case CY-590/GRC, Remote Control C-433/GRC, Local Control C-434/GRC, Control C-435/GRC, and Mountings MT-297, 298/GR; Fed Tele & Rad part/dwg #GC-1690-2.	S-1 switch knob-----	2Z5822-401

Reference symbol	Name of part and description	Function of part	Signal Corps Stock No.
E-7	KNOB: round w/bar; olive drab zinc alloy; for $\frac{1}{4}$" diam double flattened shaft; single #6-32 screw thru hole in face of knob screws into axially tapped hole in end of shaft; two white luminous lines on bar portion; $1\frac{1}{16}$" lg x $\frac{7}{8}$" wd x $\frac{1}{32}$" h o/a; shaft hole .359" d from bottom surface; luminous markings; p/o Army-Navy Radio Receivers R-108, 109, 110/GRC, Receiver-Transmitters RT-66, 67, 68, 70/GRC, AF Amplifier AM-65/GRC, Control C-435/GRC, and Local Control C-434/GRC; Fed Tele & Rad part/dwg #GC-1246-2.	S-2 switch knob.....	2Z5822-402
N-1	LABEL: decalcomania; $2\frac{3}{4}$" wd x $4\frac{1}{16}$" lg x .007" thk; white print on black background; individually packed; p/o Army-Navy Control C-435/GRC; Meyercord type G; Fed Tele & Rad part/dwg #GD-1052-14; US Army spec #71-4944, Sig C dwg #SC-C-40599-A.	Circuit label.....	6016777-6
E-1, E-2	LAMP, incandescent: Sig C Lamp LM-38; 28v, .17 amp; bulb T-3-$\frac{1}{4}$ clear; $1\frac{1}{8}$" lg o/a; miniature bayonet base; C-2 filament; burn any position; Mazda catalog #313; Fed Tele & Rad part Mazda #313.	E-1: "A" carrier indicator.... E-2: "B" carrier indicator....	2Z5938
I-1, I-2	LIGHT, indicator: with lens; $\frac{5}{16}$" diam clear lens; for miniature bayonet base, T-3$\frac{1}{4}$ bulb; 110v, $\frac{1}{4}$ amp; enclosed shell; aluminum alloy, olive drab; $2\frac{1}{8}$" lg x $1\frac{1}{16}$" diam o/a; $\frac{5}{16}$" diam mtg hole required, $\frac{1}{4}$" max panel thk; vertically mtd socket, lamp replaceable from rear of panel; threaded jewel; 2 solder lug term located together on rear end of socket; built in mechanical dimmer, two clear wp internal lenses, wp seal between bushing and panel; p/o Army-Navy Control C-435/GRC, Remote Control C-433/GRC, and Local Control C-434/GRC; Dialco dwg #832210-XP4-721; Fed Tele & Rad part/dwg #GH-1964-2.	Indicator lampholders.....	2Z5991-184
M-1	METER, arbitrary scale: Sig C type MR13S500DCUA or MR155500DCUA; DC; range 0 to 500 ua; round plastic or metal panel mtg case, w/59 mtg flange; $1\frac{1}{2}$" max diam case, $\frac{1}{16}$" d behind flange, $1\frac{1}{4}$" sq flange .334" thk; accuracy $\pm 3\%$; 2.57.5 mv drop across term; calibrated for nonmagnetic panel; 10 white scale divisions on black background, first center and last scale mark and $\frac{1}{4}$" tip of pointer are luminescent; self-contained; four .122" diam mtg holes on 1.312" x 1.312" mtg/c, four #4-40 machine screws are included, one in ea mtg hole, screws extend $\frac{1}{4}$" .000-.03125" behind flange, nut and lockwasher on ea screw to hold face plate on meter for shipment, to be removed at assembly; two solder lug term on back of case; moisture resistant and wp, w/external black phenolic face plate per JAN-M-() Sig C project 139, w/single red line at center of scale opening; p/o Army-Navy Control C-435/GRC; Weston Model 1101 or Simpson Elec spec 3086; Fed Tele & Rad part/dwg #GH-2601-12-1; U. S. Army spec #73-3.	Audio level.....	3F3312-6.6

Reference symbol	Name of part and description	Function of part	Signal Corps Stock No.
H-3 through H-6	NUT, castellated: steel, cad pl and olive drab iridite; finished per drawing; $\frac{3}{8}$ "-32 NS-2; $\frac{1}{8}$ " thk; $\frac{5}{16}$ " OD; 4 slots $\frac{3}{32}$ " wd x $\frac{3}{64}$ " d; spaced 90 deg apart; p/o Fed Tele and Rad #GA-2140-12 panel assem; Fed Tele & Rad part/dwg #GB-1106-2.	R-4 mounting nut. R-5 mounting nut. S-1 mounting nut. S-2 mounting nut.	6L3006-32S
O-6, O-7	PLATE, retainer: p/o Fed Tele & Rad #GA-2140-12 front panel assem; zinc plate and zinc chromated steel; rectangular w/round ends; $\frac{1}{16}$ " lg x $\frac{5}{16}$ " wd x .0897" thk; two .154 diam esk mtg holes on $\frac{5}{8}$ " mtg/c; has tapped retaining hole centered between mtg holes; #10-32 NF-2 thd; Fed Tele & Rad part/dwg #GB-1376-2.	Panel thumbscrew retaining plates.	2Z7093-243
O-11	PLATE, retainer: p/o Army-Navy Control C-435/GRC and Local Control C-434/GRC; aluminum, caustic etch and water dip lacquer finish; circular; $2\frac{1}{2}$ " diam x $\frac{3}{16}$ " thk; mts on connector flange by means of shouldered hole in ctr $1\frac{1}{4}$ " diam, mts on chassis by means of four .159" diam holes on $1\frac{1}{8}$ " rad, 45 deg apart; marked J-1 in black ink; Fed Tele & Rad part/dwg #GA-2763-2.	Connector retaining plate.	2Z7093-242
O1, O-3	RELAY, armature: SPDT; contact rating 1 amp, 28v DC; silver contacts, $\frac{1}{8}$ " diam; 2 single windings, operates at 3 ma DC max, releases at .75 ma DC min, 800 ohms, inductive, insulated coil; coil and contact leads terminate in octal base; $2\frac{1}{16}$ " lg x $1\frac{1}{2}$ " sq excluding octal base; mts by standard octal base; fast acting; HS metal case, marked with mfr name or trade mark, part #; and circuit diagram; p/o Army-Navy Control C-435/GRC; Sigma lostr type #77912, Dunco type #212XAXDC; Fed Tele & Rad part/dwg #GH-1971-2-2.	Retransmit control, A to B. Retransmit control, B to A.	2Z7586-182
O-2, O-4	RELAY, armature: 3A3B; contact rating 100 ma at 150v DC; $\frac{1}{16}$ " diam, palladium cont; single winding, coil voltage 12.6v DC nominal, pull-in voltage 8v DC, max operating voltage 16v DC, 144 ohms $\pm 10\%$, insulated coil; coil and contact leads terminate in 14 pin round male miniature plug on bottom of case; $2\frac{3}{16}$ " lg x $1\frac{1}{8}$ " wd x $1\frac{1}{16}$ " d o/a; 3 plain or #6-32 thd mtg studs on $\frac{1}{8}$ " x 1.187" mtg/c fast acting; HS metal case marked with mfr name or trade mark, part # and circuit diagram; p/o Army-Navy Control C-435/GRC; Adv Elec dwg #B8905-4AY or Dunco type #18CXC100; Fed Tele & Rad part/dwg #GH-1354-2.	Retransmit control, A to B (slave). Retransmit control, B to A (slave).	2Z7599A-226
R-2	RESISTOR, fixed: comp; JAN type RC20BF821J; 820 ohms $\pm 5\%$; $\frac{1}{2}$ w; spec JAN-R-11.	Meter multiplier.	3RC20BF821J
R-3	RESISTOR, fixed: comp; JAN type RC20BF332K; 3300 ohms $\pm 10\%$; $\frac{1}{2}$ w; spec JAN-R-11.	Audio dropping resistor.	3RC20BF332K
R-1	RESISTOR, fixed: comp; JAN type RC20BF912J; 9100 ohms $\pm 5\%$; $\frac{1}{2}$ w; spec JAN-R-11.	Meter multiplier.	3RC20BF912J

Reference symbol	Name of part and description	Function of part	Signal Corps Stock No.
R-4, R-5	RESISTOR, variable: comp; 50,000 ohms $\pm 20\%$; 2w, 70 deg max cont operation; 3 solder lug term; metal case $1\frac{1}{16}$ " diam x $2\frac{3}{32}$ " d, enclosed; round metal shaft $\frac{1}{4}$ " diam x $2\frac{3}{32}$ " lg w/double D flats $\frac{5}{16}$ " lg, tapped hole in end of shaft #6-32 thd, $\frac{1}{4}$ " d; A taper; insulated contact arm, w/o off position; normal torque; bushing $\frac{3}{8}$ "-32 x $\frac{5}{32}$ " lg, nonturn device located on $\frac{1}{32}$ " radius at 9 o'clock; tropicalized, wp seal between shaft and bushing, and bushing and mtg surface; p/o Army-Navy Control C-435/GRC; AB type JW modified; Fed Tele & Rad part/dwg #GH-2251-2.	"A" audio level adjust..... "B" audio level adjust.	3Z7450-129
H-7	SCREW, captive: slot drive; finished fillister Bind H per dwg; cold finished steel, cad pl and olive drab iridite; #10-32 NF-2; 2" lg; thd portion $\frac{3}{4}$ " lg; head .313" diam .136" thk max; cone pointed end; p/o Army-Navy Control C-435/GRC; Fed Tele & Rad part/dwg #GB-2022-2-1.	Relay clamp holding screw...	6L4770-32.21S
H-8.....	SCREW, captive: slot drive; finished fillister Bind H per dwg; cold finished steel, cad pl and olive drab iridite; #10-32 NF-2; 2 $\frac{3}{4}$ " lg; thd portion $\frac{3}{4}$ " lg; head .313" diam, .136" thk max; cone pointed end; p/o Army-Navy Control C-435/GRC; Fed Tele & Rad part/dwg #GB-2022-2-2.	Relay clamp holding screw...	6L4770-44.21S
H-9, H-10	SCREW, thumb: winghead; steel, cad pl and olive drab iridited; #10-32 NF-2; $\frac{7}{8}$ " lg; thd portion $\frac{5}{16}$ " lg; flat point; head $1\frac{5}{16}$ " wd x $\frac{5}{16}$ " h; shoulder $\frac{3}{8}$ " diam; p/o Army-Navy Control C-435/GRC and Local Control C-434/GRC; Central Screw Co style D-60; Fed Tele & Rad part/dwg #GM-1750-2.	Panel to case fastenings.....	6L17110-14S
X-1, X-3	SOCKET, tube: octal; one piece molded in mtg plate; two .156" diam mtg holes on $1\frac{1}{2}$ " mtg/c; round molded plastic body, 1.14 diam x .49" h excluding term; beryllium copper silver plated contacts; p/o Army-Navy Control C-435/GRC, Power Supplies PP-281, 282/GRC, PP-448, 109, 112/GR, AF Amplifier AM-65/GRC, Radio Receivers R-108, 107, 110/GRC, and Receiver-Transmitters RT-66, 67, 68/GRC; Amphenol dwg #59-103; Fed Tele & Rad part/dwg #GH-2039-2.	Relay socket, 0-1 Relay..... Relay socket, 0-3 Relay.	2Z8678.289
X-2, X-4	SOCKET, tube: 14 contact miniature; one piece saddle mtg; two .125" diam mtg holes on $1\frac{1}{8}$ " mtg/c; round molded plastic body, .93" diam x .326" h excluding term; silver plated phosphor bronze contacts; #1 cont marked w/identification button; w/o metal shock and center shield; p/o Army-Navy Control C-435/GRC; Amphenol dwg #59-106; Fed Tele & Rad part/dwg #GH-2131-2.	Relay socket, 0-2 Relay..... Relay socket, 0-4 Relay.	2Z8684-24

Reference symbol	Name of part and description	Function of part	Signal Corps Stock No.
S-2	SWITCH, rotary: 7 pole, 3 position; 2 sections; silver pl brass contacts; ceramic wafers; $1\frac{1}{16}$ " wd x $1\frac{1}{4}$ " h x $1\frac{1}{8}$ " d from mtg surface; nonshorting type contacts; momentary action, spring loaded to return to center position; solder lug term; single hole mtg, $\frac{3}{8}$ "-32 thd bushing $\frac{5}{16}$ " lg, shaft $\frac{1}{4}$ " diam x $\frac{1}{16}$ " lg from mtg surface, flush mtg; shaft has double D flat and is tapped #6-32 x $\frac{1}{4}$ " d on end, tropicalized, wp seal between shaft and bushings, and bushing and mtg surface; p/o Army-Navy Control C-435/GRC; Oak type FC; Fed Tele & Rad part/dwg #GH-1539-2.	Manual selector switch-----	3Z9825-62.474
S-1	SWITCH, rotary: 9 pole, 4 position; 3 section; spring silver contacts, coin silver blades; ceramic wafers; $1\frac{1}{16}$ " wd x $1\frac{1}{4}$ " h x $1\frac{1}{8}$ " d from mtg surface; shorting type contacts; locking action positions 1, 2, and 3, momentary action position 4 w/spring loaded return to position 3; solder lug term; single hole mtg, $\frac{3}{8}$ "-32 thd bushing, $\frac{5}{16}$ " lg, shaft $\frac{1}{4}$ " diam x $\frac{1}{16}$ " lg from mtg surface flush mtg; shaft has double D flat and is tapped #6-32 x $\frac{1}{4}$ " d on end, tropicalized, wp seal between shaft and bushing, and bushing and mtg surface; p/o Army-Navy Control C-435/GRC; Oak type FC; Fed Tele & Rad part/dwg #GH-1540-2.	Audiomatic selector switch---	3Z9825-62.473
T-1	TRANSFORMER, AF: plate coupling type; pri 22,000 ohms impedance CT, .006 amp DC, secd #1, 600 ohms impedance CT, 160 mw, secd #2, 5,200 ohms impedance CT, 140 mw, 500 v RMS; HS steel case, silicon steel core; $1\frac{3}{8}$ " lg x $\frac{3}{8}$ " wd x $2\frac{1}{16}$ " h o/a; 160 mw output; turns ratio pri to secd #1 6.28:1, to secd #2 2.03:1; freq response +2 to -2 db between 250 and 2500 cps; 9 solder type stud term on bottom of case; two .128" diam mtg holes on $1\frac{1}{8}$ " mtg/c; part number marked on top of case; p/o Army-Navy Control C-435/GRC, AF Amplifier AM-65/GRC, Radio Receivers R-108, 109, 110/GRC, and Receiver-Transmitters RT-66, 67, 68, 70/GRC; Fed Tele & Rad part/dwg #GH-1203-2; spec JAN-T-27.	Retransmission coupling transformer.	2Z9632.562

4. Identification Table of Parts for Control Box C-375/VRC

Ref symbol	Name of part and description	Function of part	Signal Corps Stock No.
	CONTROL BOX C-375/VRC: interphone and radio push-to-talk operation.	Remote control for interphone amplifier and radio sets.	2C666-375
	BOARD, terminal: general purpose; 2 solder lug term, copper silver pl; $1\frac{1}{16}$ " lg x $2\frac{3}{32}$ " h x $\frac{3}{16}$ " thk o/a.	Junction point for interunit connections.	3Z770-2.49
H-1, H-2	CLAMP: used to hold cable and wp cable entrance; wp.	Secure interconnecting Special Purpose Cables WM-46/U.	2Z2642.241
J-1, J-2	CONNECTOR, receptacle: AN Receptacle Connector U-79/U; 10 cont, pol; straight.	Connectors for audio input, output, and control circuits.	2Z7250-79
A-2	COVER	Used to waterproof Jacks JK-33-C and JK-34-C.	2Z3352.224
J-3, J-4	JACK JK-33-C: for 3 cond plug .2065" diam x 1.093" lg.	Connect microphone to audio input circuit.	2Z5533C
J-5, J-6	JACK JK-34-C: for 2 cond plug .250" diam x $1\frac{1}{32}$ " lg.	Connect headset to output of audio circuit.	2Z5534C
	KNOB: bar; aluminum, olive drab finish; for $\frac{1}{4}$ " diam double flattened shaft; luminous ctr line; $1\frac{3}{16}$ " lg x $\frac{7}{8}$ " wd x $1\frac{1}{32}$ " thk.	For shaft of volume controls.	2Z5821-147
	KNOB: bar; aluminum, olive drab finish; for $\frac{1}{4}$ " diam double flattened shaft; luminous ctr line; $1\frac{1}{16}$ " lg x $\frac{7}{8}$ " wd x $1\frac{1}{32}$ " thk.	For shaft to switch S-2 (RADIO TRANS).	2Z5821-148
	KNOB: bar; aluminum, olive drab finish; for $\frac{1}{4}$ " diam double flattened shaft; luminous ctr line; $2\frac{1}{16}$ " lg x $\frac{7}{8}$ " wd x $\frac{7}{16}$ " thk.	For shaft of selector switch S-1.	2Z5821-149
R-1, R-2	RESISTOR, variable: comp; 10,000 ohms $\pm 10\%$; 2.25 w.	Volume controls for audio output.	3Z7410-149
S-2	SWITCH, rotary: 2 pole, 3 position	Selects interphone amplifier and radio sets for transmitting.	3Z9825-34.2
S-1	SWITCH, rotary: 3 pole, 3 position	Selects interphone amplifier and radio sets for monitoring and transmitting.	3Z9825-34.1

APPENDIX III

RELATED RADIO SETS

1. Basis of Relationship

The major components of the radio sets discussed in this manual are common to numerous other sets which utilize common or overlapping frequency ranges. The frequency spectrum chart (fig. 2) indicates how the sets are related insofar as frequency coverage is concerned. Physical similarities among the sets are indicated in the comparison chart included below.

2. Comparison Chart

The following chart lists the components of the radio sets discussed in this manual and the components of related radio sets. Analysis of the chart will reveal the high degree of similarity which exists among the sets.

Radio Sets

Components	Radio Set AN/GRC-3	Radio Set AN/GRC-5	Radio Set AN/GRC-7	Radio Set AN/GRC-4	Radio Set AN/GRC-6	Radio Set AN/GRC-8	Radio Set AN/VRC-8	Radio Set AN/VRC-9	Radio Set AN/VRC-10	Radio Set AN/VRC-13	Radio Set AN/VRC-14	Radio Set AN/VRC-15	Radio Set AN/VRQ-1	Radio Set AN/VRQ-2	Radio Set AN/VRQ-3	Radio Set AN/VRC-7	Radio Set AN/PRC-16	Intercommunication Set AN/UIC-1	Modification Kit MX898/GRC
Case CY-684/GR	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	1			
Case CY-590/GRC																	1		1
Mounting MT-297/GR	1	1	1	1	1	1				1	1	1							
Mounting MT-299/GR							1	1	1										
Mounting MT-298/GR													1	1	1				
Mounting MT-300/GR																1		1	
Mounting MT-673/GR																	1		
Antenna Mounting MT-652/GR																	1		1
Receiver-Transmitter RT-66/GRC	1			1			1			1			2						
Receiver-Transmitter RT-67/GRC		1			1			1			1			2					
Receiver-Transmitter RT-68/GRC			1			1			1			1			2				
Receiver-Transmitter RT-70/GRC	1	1	1	1	1	1										1	1		
AF Amplifier AM-65/GRC	1	1	1	1	1	1				1	1	1				1		1	
Power (PP-282/GRC or Supply (PP-281/GRC	2	2	2	1	1	1				1	1	1				1		1	
Power Supply PP-448/GR																1			
Radio Receiver R-108/GRC	1																		

Components	Radio Set AN/GRC-3	Radio Set AN/GRC-5	Radio Set AN/GRC-7	Radio Set AN/GRC-4	Radio Set AN/GRC-6	Radio Set AN/GRC-8	Radio Set AN/VRC-8	Radio Set AN/VRC-9	Radio Set AN/VRC-10	Radio Set AN/VRC-13	Radio Set AN/VRC-14	Radio Set AN/VRC-15	Radio Set AN/VRC-1	Radio Set AN/VRC-2	Radio Set AN/VRC-3	Radio Set AN/VRC-7	Radio Set AN/VRC-16	Intercommunication Set AN/UIC-1	Modification Kit MX888/GRC
Radio Receiver R-109/GRC		1																	
Radio Receiver R-110/GRC			1																
Power Supply { PP-109/GR or PP-112/GR	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2				
Control Group AN/GRA-6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
Control C-435/GRC	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
Control Box C-375/VRC	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		2	
Mast Base AB-15/GR	2	2	2	2	2	2	1	1	1	1	1	1	2	2	2	1			
Mast Section MS-116-A	2	2		2	2		2	2		2	2		4	4					
Mast Section MS-117-A	2	2	2	2	2	2	2	2	2	2	2		4	4	4				
Mast Section MS-118-A	2	2		2	2		2	2		2	2		4	4					
Mast Section AB-22/GR	2	2	2	2	2	2			2							2	2		1
Mast Section AB-24/GR	2	2	4	2	2	4			2						4	2	2		1
Mast Section AB-23/GR																			3
Hand Generator G-8																			1
Handset H-33/PT																	1		1
Special Purpose Cable Assembly CX-1211/U	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2				
Special Purpose Cable Assembly CX-1213/U	1	1	1	1	1	1										1			
Special Purpose Cable WM-46/U	1	1	1	1	1	1				1	1	1	1	1	1				
RF Cable Assembly CG-568/U	1			1			1			1			2						
RF Cable Assembly CG-530/U	1	2	2	1	2	2		1	1		1	1		2	2	1			
Power Cable Assembly CX-1209/U																	1		1
Power Cable Assembly * CX-1210/U																			1
Bag CW-187/GR																			1
Bag CW-188/GR																			1
Adapter UG-273/U	2	2	2	2	2	2	1	1	1	1			2	2	2				
Installation Kit	1	1	1	1	1	1	1	1	1				2	2	2				
Wire W-142	1	1	1																
Adapter UG-306/U	2	2	2	2	2	2				1	1	1							
Bag CW-206/GR	1	1	1	1	1	1				1	1	1							
Connector and Bond Nut (Appl.)	1	1	1	1	1	1				1	1	1						1	

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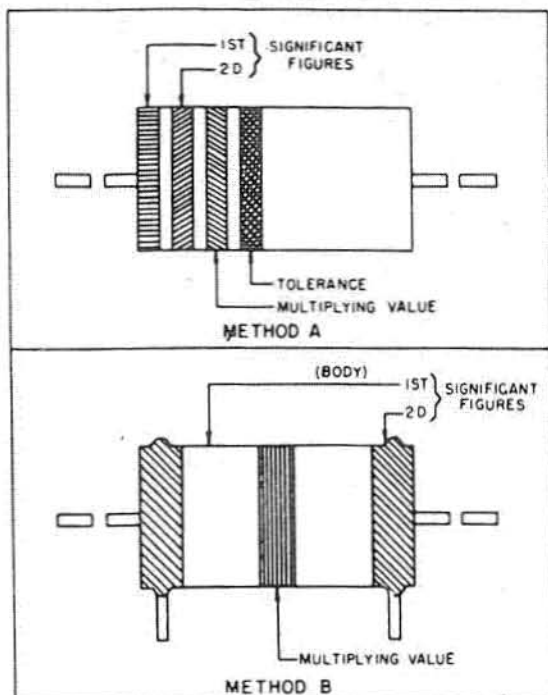
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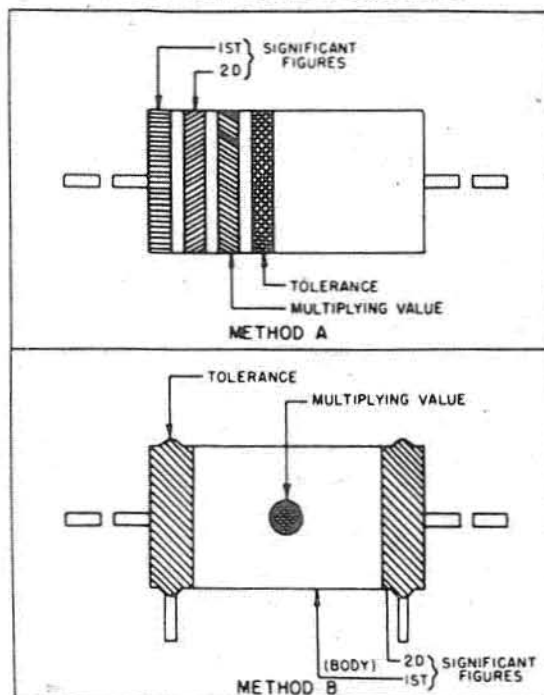
RESISTOR COLOR CODES

RMA COLOR CODE FOR FIXED COMPOSITION RESISTORS*



A

JAN COLOR CODE FOR FIXED COMPOSITION RESISTORS†



B

COLOR	SIGNIFICANT FIGURE	MULTIPLYING VALUE	TOLERANCE (%)
BLACK	0	1	± -
BROWN	1	10	± 1
RED	2	100	± 2
ORANGE	3	1,000	± 3
YELLOW	4	10,000	± 4
GREEN	5	100,000	± 5
BLUE	6	1,000,000	± 6
VIOLET	7	10,000,000	± 7
GRAY	8	100,000,000	± 8
WHITE	9	1,000,000,000	± 9
GOLD	-	0.1	± 5
SILVER	-	0.01	± 10
NO COLOR	-	-	± 20

NOTES

* INSULATED FIXED COMPOSITION RESISTORS WITH AXIAL LEADS ARE DESIGNATED BY A NATURAL TAN BACKGROUND COLOR. NON-INSULATED FIXED COMPOSITION RESISTORS WITH AXIAL LEADS ARE DESIGNATED BY A BLACK BACKGROUND.

† RESISTORS WITH AXIAL LEADS ARE INSULATED. RESISTORS WITH RADIAL LEADS ARE NON-INSULATED.

RMA RADIO MANUFACTURERS ASSOCIATION

JAN JOINT ARMY-NAVY

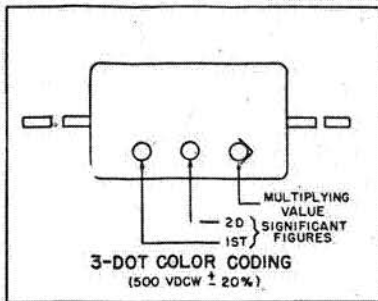
THESE COLOR CODES GIVE ALL RESISTANCE VALUES IN OHMS

TL 32454S

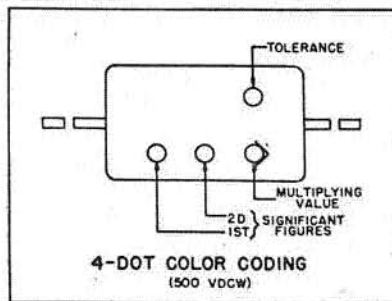
Figure 86. Resistor color code.

CAPACITOR COLOR CODES

RMA 3-4-5-6-DOT COLOR CODES FOR MICA-DIELECTRIC CAPACITORS

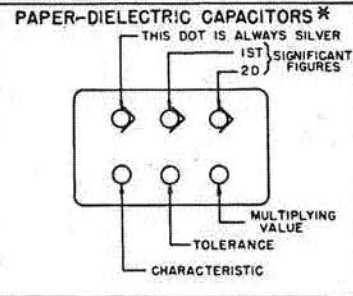


A

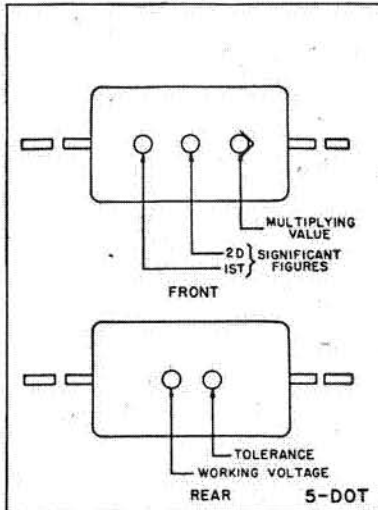


B

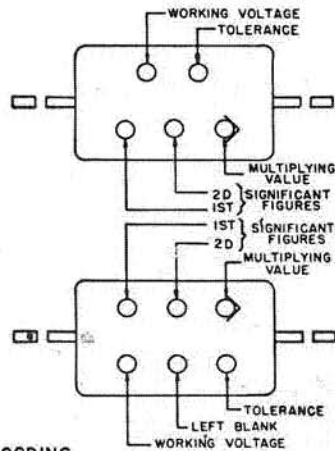
JAN 6-DOT COLOR CODES FOR:



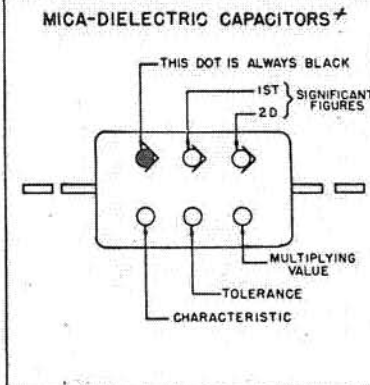
F



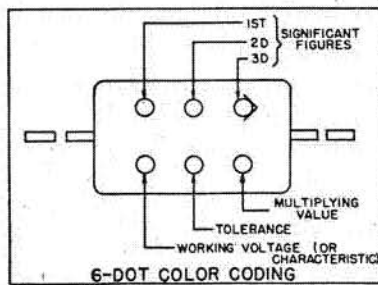
C



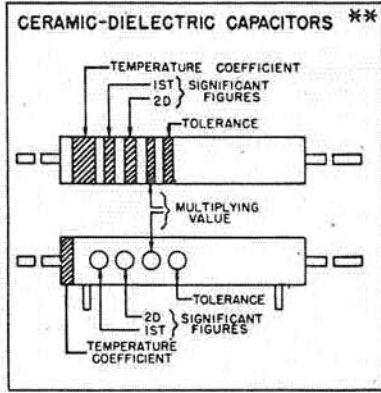
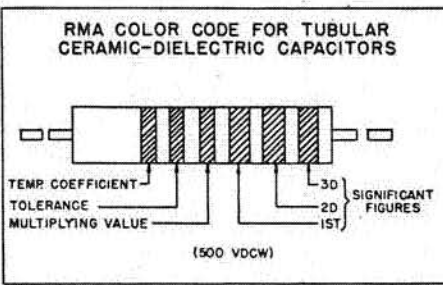
E



G



D



H

COLOR	SIGNIFICANT FIGURE	MULTIPLYING VALUE			RMA VOLTAGE RATING
		RMA MICA-AND CERAMIC-DIELECTRIC	JAN MICA-AND PAPER-DIELECTRIC	JAN CERAMIC-DIELECTRIC	
BLACK	0	1	1	1	-
BROWN	1	10	10	10	100
RED	2	100	100	100	200
ORANGE	3	1,000	1,000	1,000	300
YELLOW	4	10,000	10,000	10,000	400
GREEN	5	100,000			500
BLUE	6	1,000,000			600
VIOLET	7	10,000,000			700
GRAY	8	100,000,000		0.01	800
WHITE	9	1,000,000,000		0.1	900
GOLD	-	0.1	0.1		1,000
SILVER	-	0.01	0.01		2,000
NO COLOR	-				500

NOTES
* THE SILVER DOT IDENTIFIES THIS MARKING FOR WORKING VOLTAGES SEE JAN TYPE DESIGNATION CODE.
† THE BLACK DOT IDENTIFIES THIS MARKING FOR WORKING VOLTAGES SEE JAN TYPE DESIGNATION CODE.
** CAPACITORS MARKED WITH THIS CODE HAVE A VOLTAGE RATING OF 500 VDCW. EITHER THE BAND OR DOT CODE MAY BE USED FOR BOTH INSULATED (AXIAL-LEAD) OR UNINSULATED (RADIAL-LEAD) CAPACITORS.
RMA: RADIO MANUFACTURERS ASSOCIATION
JAN: JOINT ARMY-NAVY
THESE COLOR CODES GIVE CAPACITANCES IN MICROMICROFARADS.

TL324535

Figure 87. Capacitor color code.

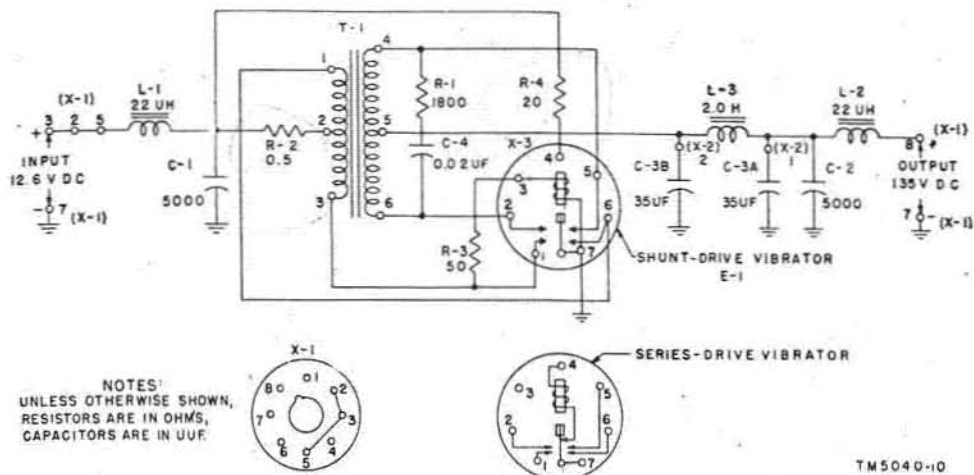


Figure 88. Power Supply PP-281/GRC, schematic diagram.

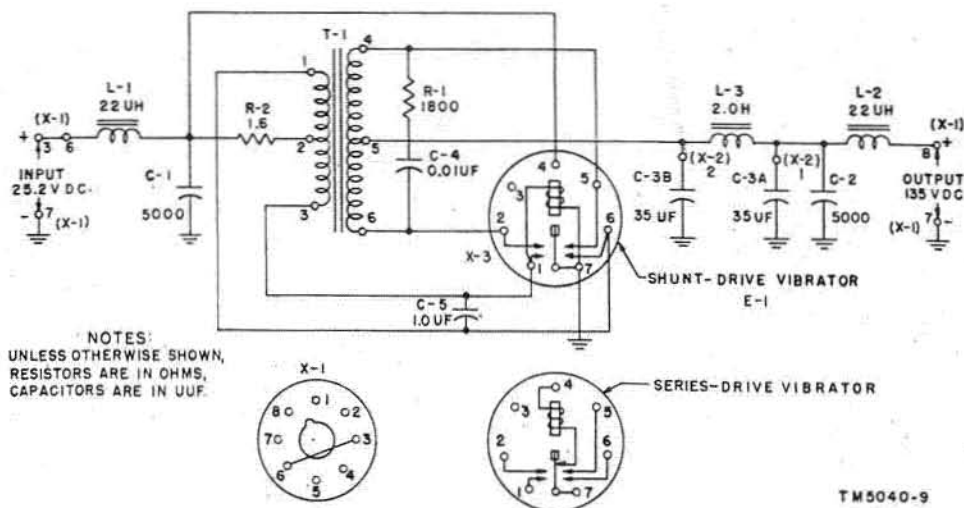
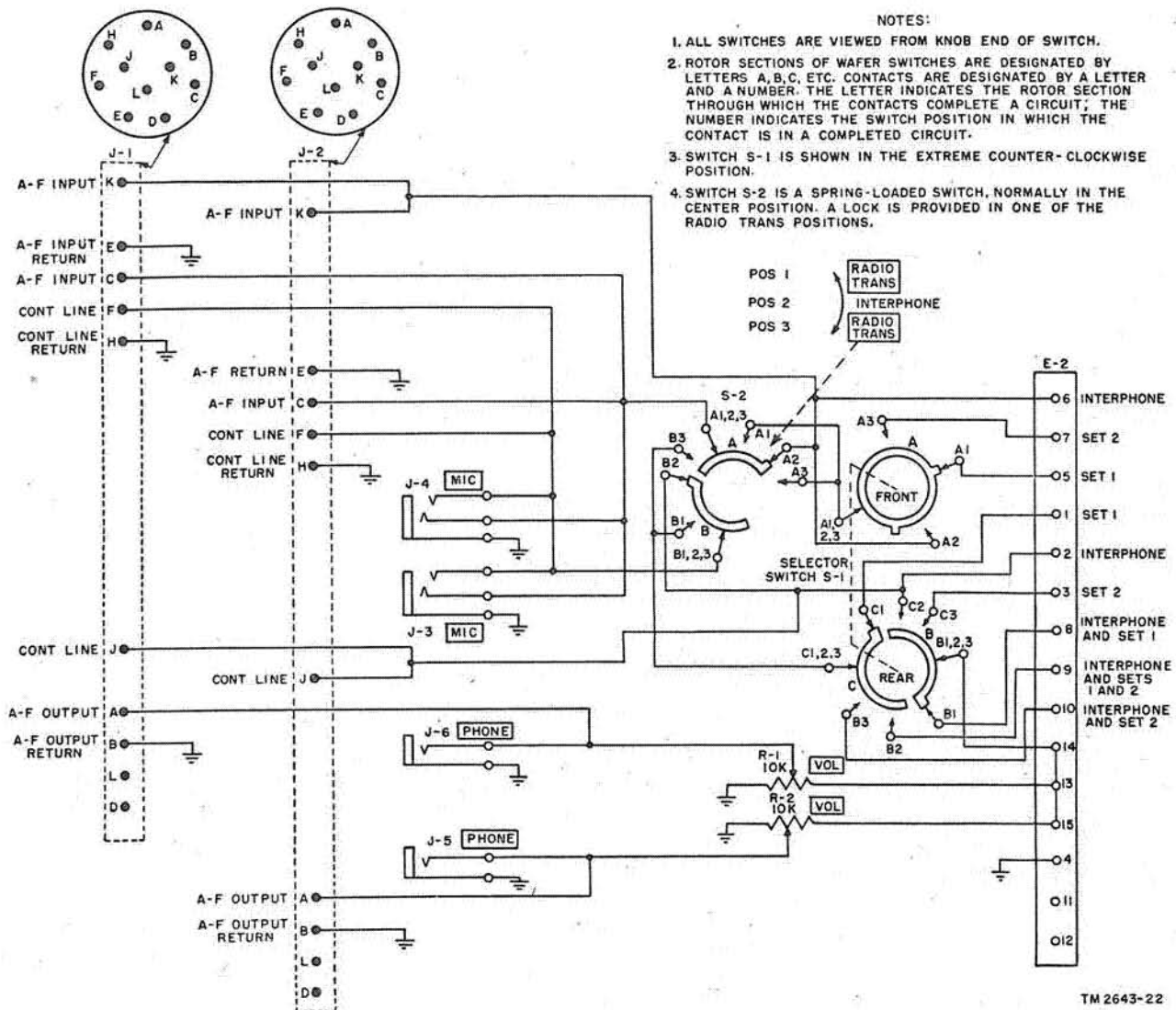
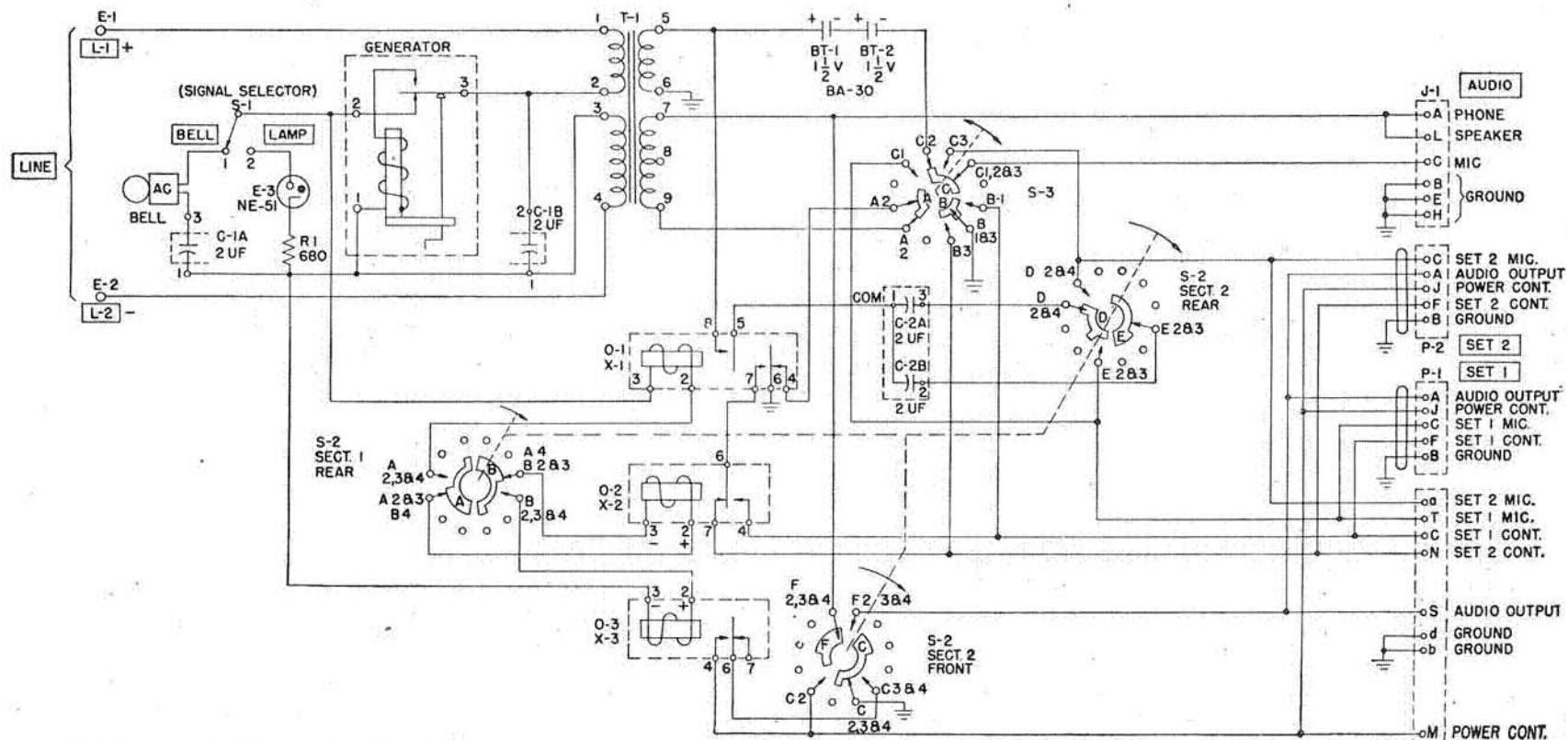


Figure 89. Power Supply PP-282/GRC, schematic diagram.



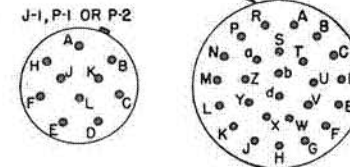
TM 2643-22

Figure 90. Control Box C-375/VRC, schematic diagram.



SWITCH:	S-2 (REMOTE)	S-3 (LOCAL)
POS. 1	TEL ONLY	SET 1
POS. 2	SET 1 & 2	TEL
POS. 3	SET 1	SET 2
POS. 4	SET 2	

- NOTES: 1) ALL SWITCH SECTIONS VIEWED FROM KNOB END OF SWITCH.
 2) S-2 SHOWN IN EXTREME COUNTERCLOCKWISE POSITION.
 3) S-3 SHOWN IN CENTER POSITION.
 4) ROTOR SECTIONS OF WAFER SWITCHES ARE DESIGNATED BY LETTERS A, B ETC. AND, CONTACTS ARE DESIGNATED BY A LETTER AND A NUMBER. THE LETTER INDICATES THE ROTOR SECTION THRU WHICH THE CONTACTS COMPLETE A CIRCUIT; THE NUMBER INDICATES THE SWITCH POSITION IN WHICH THE CONTACT IS IN A COMPLETED CIRCUIT.
 5) RELAY O-1 SHOWN DE-ENERGIZED
 6) RELAYS O-2 AND O-3 SHOWN WITH NO OPERATING VOLTAGE APPLIED, AND LATCHED BY THE PREVIOUS APPLICATION OF A VOLTAGE OPPOSITE IN POLARITY TO THAT SHOWN ON COIL. COIL MARKINGS (+ AND -) REFER TO VOLTAGE POLARITY REQUIRED TO SWING ARMATURE TO OPEN CONTACT.



TM 284-91

Figure 92. Local Control C-434/GRC, schematic diagram.

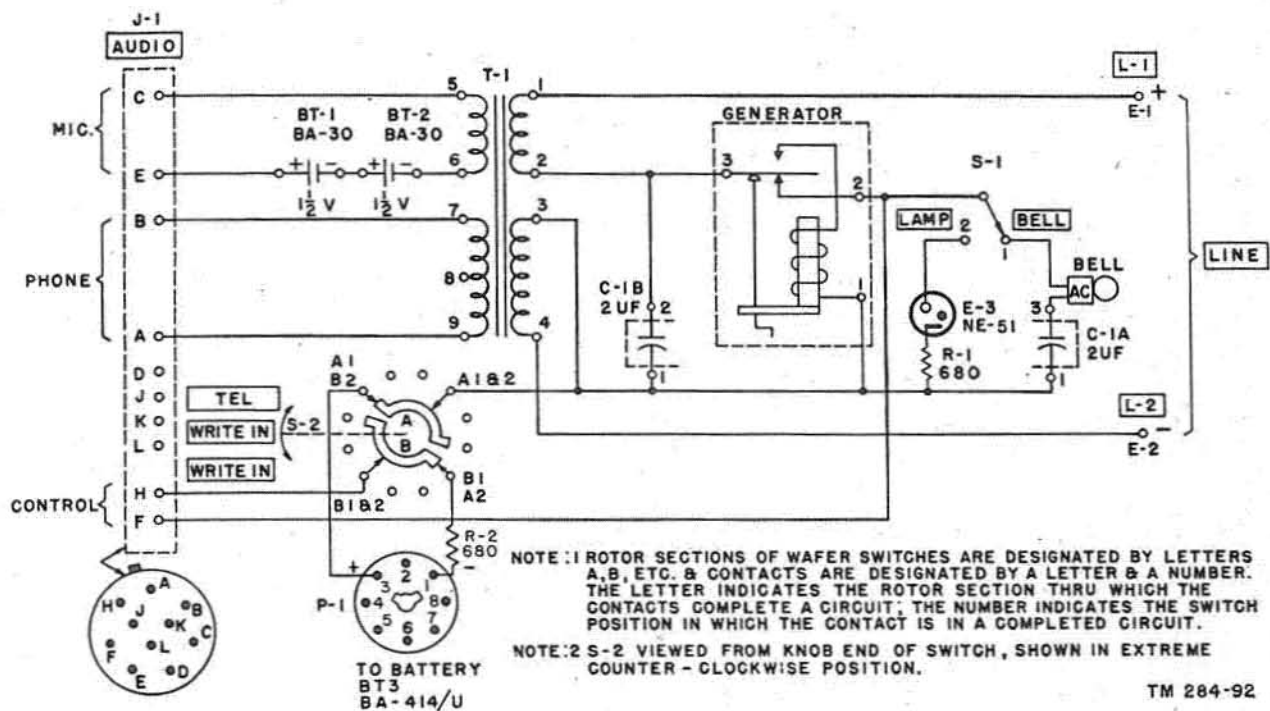


Figure 93. Remote Control C-433/GRC, schematic diagram.

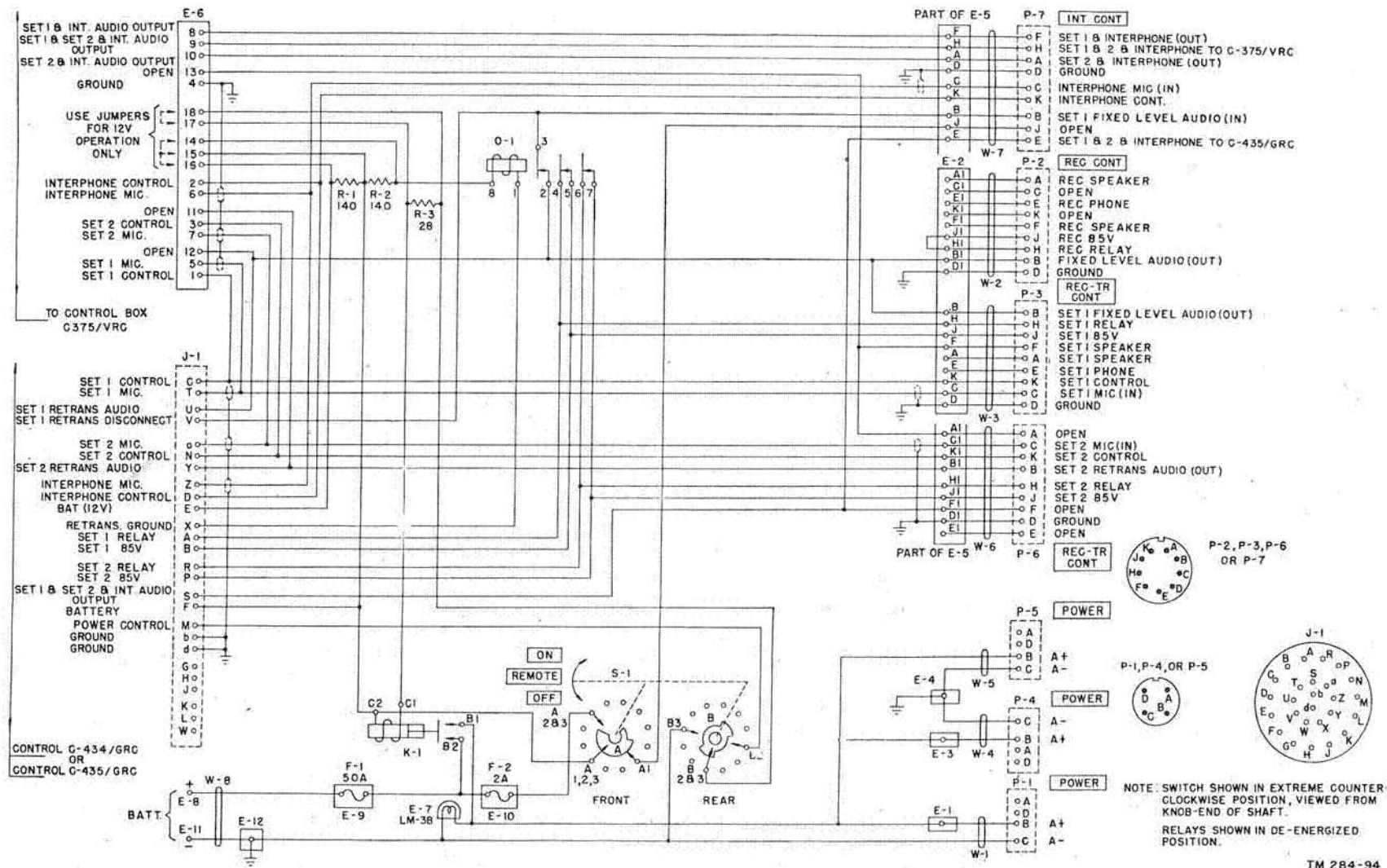
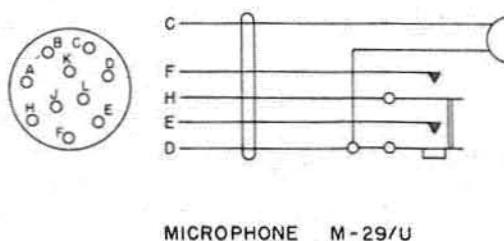
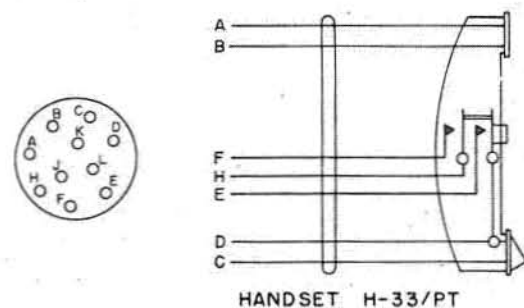
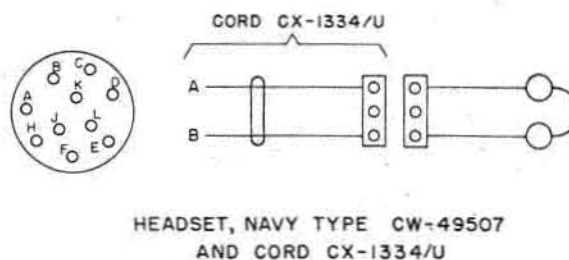
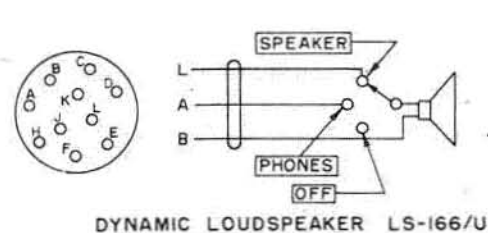
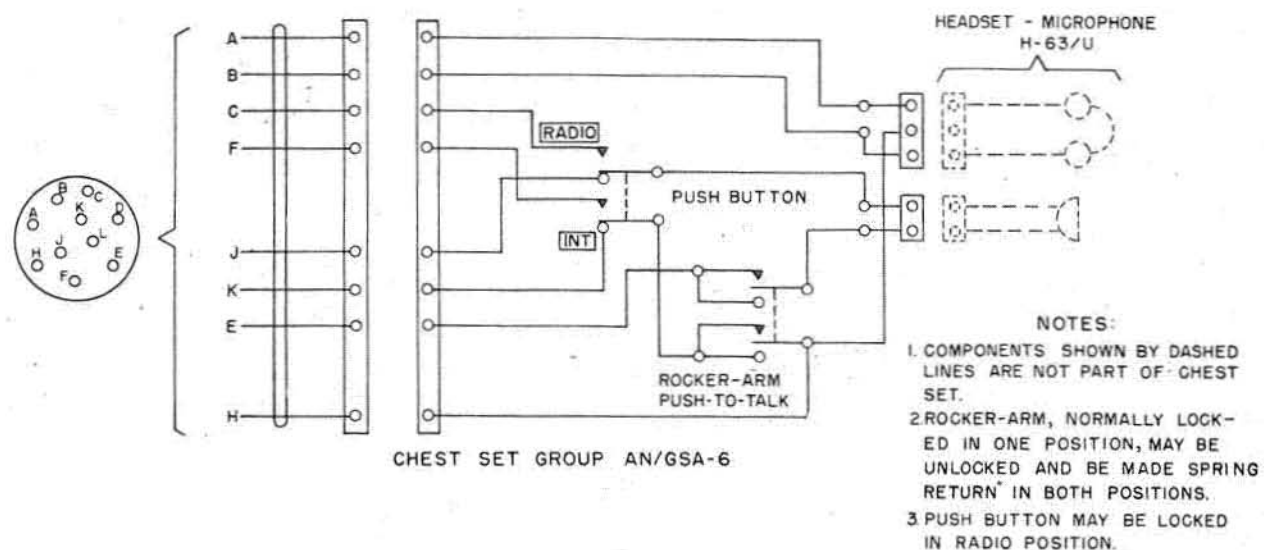
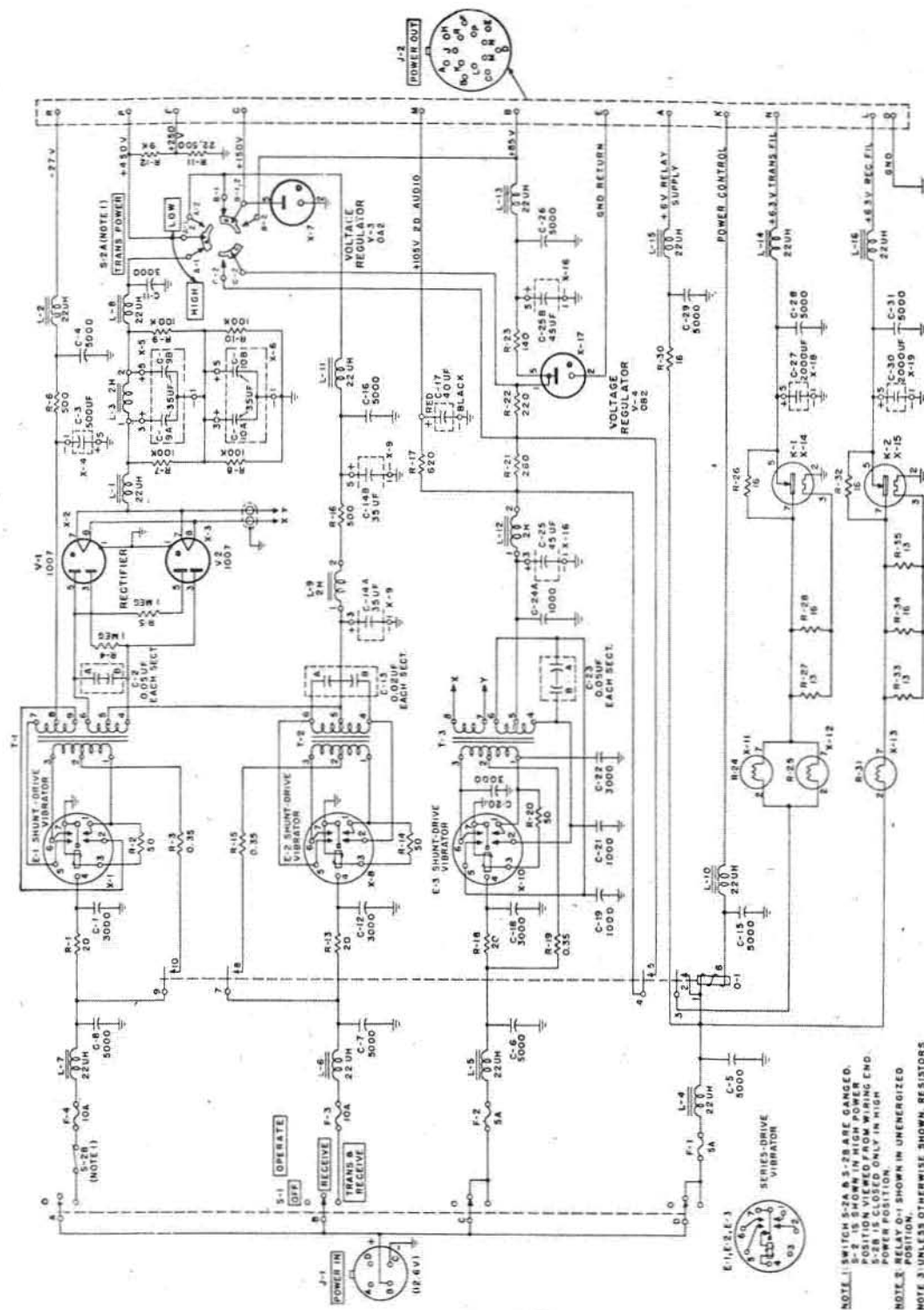


Figure 94. Mounting MT-297/GR, schematic diagram.



TM 284-107

Figure 95. Audio accessories, schematic diagram.



TM 5030-18

Figure 97. Power Supply PP-109/GR, schematic diagram.

