

# TECHNICAL MANUAL

17-393

(FURNISHED IN LIEU OF TM - II - 5039)

GEREGISTREERD  
DKMG - Sectie B G

VS 11-100

## **AF AMPLIFIER AM-65 FR/GRC**

FRENCH PRODUCTION

*Le Matériel Téléphonique*

46-47, Quai de Boulogne - BOULOGNE-BILLANCOURT (Seine) FRANCE

JANUARY 1956



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### 1.1 Description and Use

The text of this manual has been revised exactly to reflect the production of the  
AF AMPLIFIER AM-65 FR/GRC made by the French Company

LE MATERIEL TELEPHONIQUE  
PARIS - FRANCE

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GENERAL PRINCIPLES

1. Before you begin, make sure the victim is lying on his back on a firm surface. If you are on a soft surface, such as a bed or rug, place your hands on the floor or the victim's back so that your hands are just below the level of the shoulders. Place your fingers at the tip of your index finger, spread your fingers downward and outward (Fig. 1).

2. Place the victim's head in a prone position so that his head will be tilted back. The respiratory passage, the head and shoulders extended and toward downward, is flexed forward. The chin should be raised and the mouth open. The respiratory passage is now open and the air can enter the lungs.

3. Remove any food or liquid from the mouth with your fingers. Draw the victim's tongue forward.

4. Begin artificial respiration. Continue it until the victim is breathing and the pulse is present. If the victim is breathing, stop artificial respiration. If the victim is not breathing, continue it until he is breathing.

5. When the victim is breathing, stop artificial respiration. If the victim is not breathing, continue it until he is breathing. If the victim is breathing, stop artificial respiration. If the victim is not breathing, continue it until he is breathing.

6. When the victim is breathing, stop artificial respiration. If the victim is not breathing, continue it until he is breathing. If the victim is breathing, stop artificial respiration. If the victim is not breathing, continue it until he is breathing.

7. Don't wear a respirator. If you are wearing a respirator, it is not approved. Use it only if it is approved. If you are wearing a respirator, it is not approved. Use it only if it is approved.

BACK PRESSURE AIR LIFT METHOD

1. Position of Victim: Place the victim in the prone position. Bend the elbow; place the hand over the other. Tilt the face to one side. Place the chin against the hand.

2. Position of Operator: Stand on your left or right knee at the victim's head, facing him. Your hands should be at the side of the victim's head.

should be at the side of the victim's head close to his forehead. Your feet should be near his elbow. Kneel on both knees if you need a more comfortable position. With one knee on each side of the head, place your hands on the top of the victim's back so that your hands are just below the level of the shoulders. Place your fingers at the tip of your index finger, spread your fingers downward and outward (Fig. 1).

3. Compression: Tilt the head forward until your arms are perpendicular to the chest and allow the weight of the upper part of your body to exert a slow steady even downward pressure upon your hands. The force at the end of the fingers. Keep your elbows straight and press almost directly downward on the chest (Fig. 2).

4. Release: Relax. Release the pressure. Avoid any other thrust and attempt to rock backward slowly. Place your arms over the victim's arms just below the elbow and draw his arms upward and outward. Your feet should be at the side of the victim's head.

5. Don't forget: Don't forget to rock backward. The victim's arms will be drawn toward you. The arms should be at the side of the head. The weight on the back and the weight on the ground or the ground. Drop the arms gently to the ground or the ground. Drop the arms gently to the ground or the ground.

6. Don't forget: Don't forget to rock backward. The victim's arms will be drawn toward you. The arms should be at the side of the head. The weight on the back and the weight on the ground or the ground. Drop the arms gently to the ground or the ground.

7. Don't forget: Don't forget to rock backward. The victim's arms will be drawn toward you. The arms should be at the side of the head. The weight on the back and the weight on the ground or the ground. Drop the arms gently to the ground or the ground.

8. Don't forget: Don't forget to rock backward. The victim's arms will be drawn toward you. The arms should be at the side of the head. The weight on the back and the weight on the ground or the ground. Drop the arms gently to the ground or the ground.

**WARNING**

**HIGH VOLTAGE**  
is used in the operation  
of this equipment.

**DEATH ON CONTACT**  
may result if operating personnel fail  
to observe safety precautions.



# ARTIFICIAL RESPIRATION

## GENERAL PRINCIPLES

1. Seconds count! Begin at once! Don't take time to move the victim unless you must. Don't loosen clothes, apply stimulants or try to warm the victim. Start resuscitation! Get air in the lungs! You may save a life!

2. Place the victim's body in a prone position, so that any fluids will drain from the respiratory passages. The head should be extended and turned sideward *never flexed forward*; the chin shouldn't sag, since obstruction of the respiratory passages may occur.

3. Remove any froth or debris from the mouth with your fingers. Draw the victim's tongue forward.

4. Begin artificial respiration. Continue it rhythmically and without any interruption until natural breathing starts or the victim is pronounced dead. Try to keep the rhythm smooth. Split-second timing is not absolutely essential.

5. When the victim starts breathing, or when additional help is available loosen the clothing; remove it, if it's wet; keep the victim warm. Shock should receive adequate attention. Don't interrupt the rhythmical artificial technique for these measures. Do them only when you have help or when natural breathing has started.

6. When the victim is breathing, adjust your timing to assist him. Don't fight his efforts to breathe. Synchronize your efforts with his. After resuscitation, keep him lying down until seen by a physician or until recovery seems certain.

7. Don't wait for mechanical resuscitation! If an approved model is available, use it, but, since mechanical resuscitators are only slightly more effective than properly performed "push-pull" manual technique, *never* delay manual resuscitation for it.

## BACK-PRESSURE ARM LIFT METHOD

1. *Position of Victim.* Place the victim in the prone (face-down) position. Bend his elbows; place one hand upon the other. Turn his face to one side, placing his cheek upon his hands.

2. *Position of Operator.* Kneel on your left or right knee, at the victim's head, facing him. Your knee

should be at the side of the victim's head close to his forearm, your foot should be near his elbow. Kneel on both knees if you find it more comfortable, with one knee on each side of the head. Place your hands on the flat of the victim's back so that their heels are just below the lower tip of his shoulder blades. With the tip of your thumbs touching spread your fingers downward and outward. (See A)

3. *Compression Phase.* Rock forward until your arms are approximately vertical and allow the weight of the upper part of your body to exert a slow, steady, even, downward pressure upon your hands. This forces air out of the lungs. Keep your elbows straight and press almost directly downward on the back. (See B)

4. *Expansion Phase.* Release the pressure, avoid any finish thrust, and commence to rock backward slowly. Place your arms upon the victim's arms just above the elbows, and draw his arms upward and toward you. Apply just enough lift to feel resistance and tension at the victim's shoulders.

Don't bend your elbows. As you rock backward, the victim's arms will be drawn toward you. (The arm lift expands the chest by pulling on the chest muscles, arching the back and relieving the weight on the chest.) Drop the arms gently to the ground or floor. This completes the cycle. (See C and D). Now repeat the cycle.

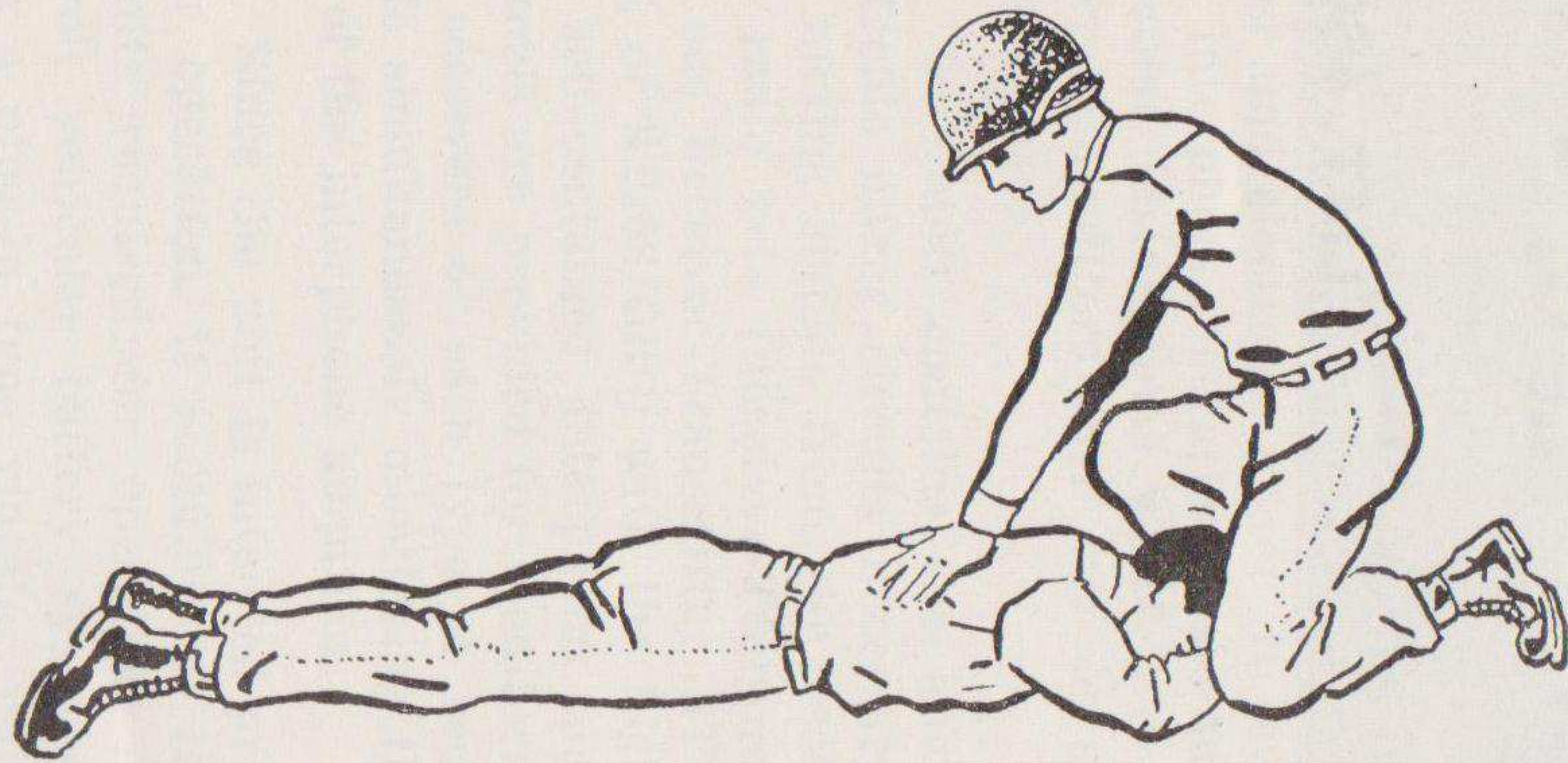
5. *Cycle Timing and Rhythm.* Repeat the cycle 10 to 12 times per minute. Use a steady uniform rate of Press, Release, Lift, Release. Longer counts of about equal length should be given to the "Press" and "Lift" steps of the compression and expansion phases. Make the "Release" periods of minimum duration.

6. *Changing Position or Operator.*

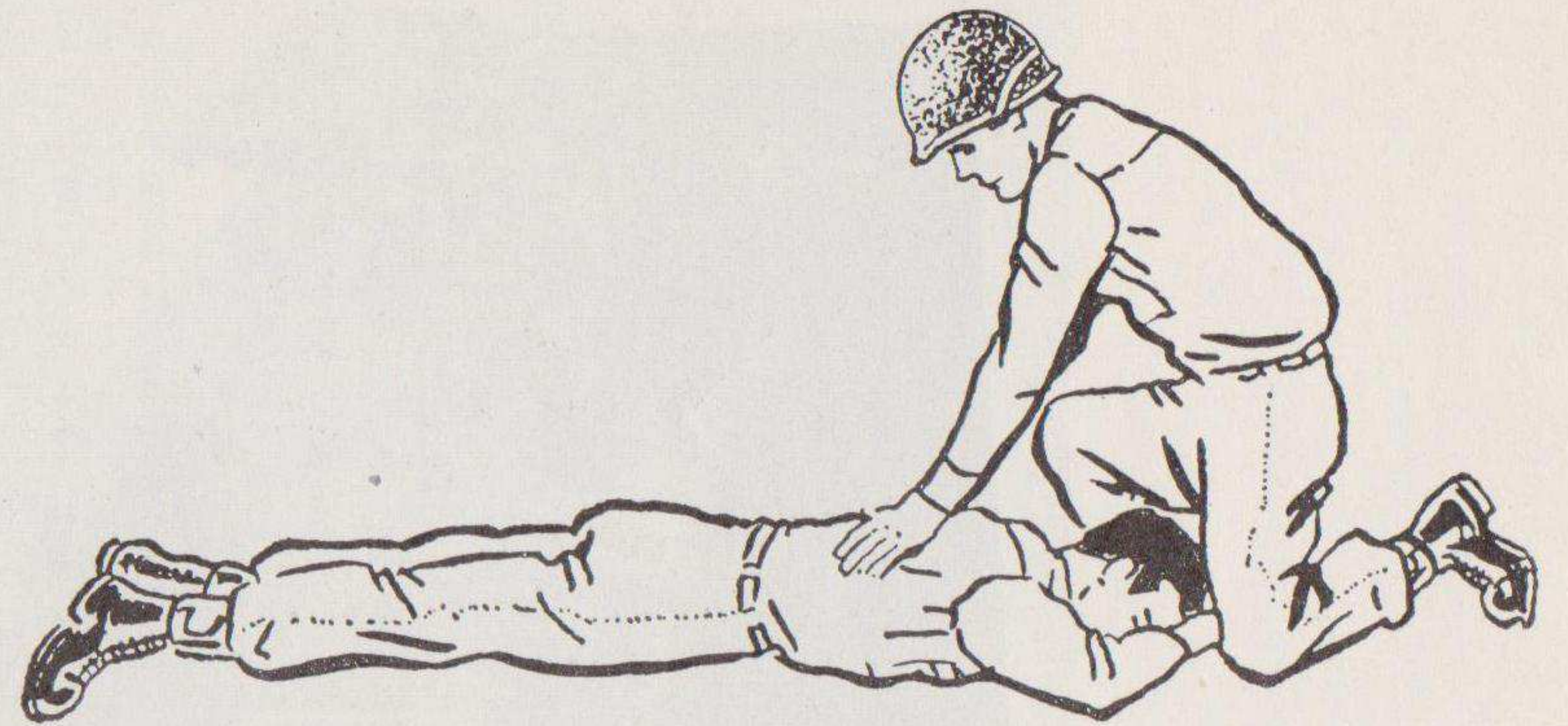
(a) Remember that you can use either or both knees or can shift knees during the procedure, provided you don't break the rhythm. Observe how you rock forward with the back-pressure and backward with the arm-lift. The rocking motion helps to sustain the rhythm and adds to the ease of operation.

(b) If you tire and another person is available, you can "take turns." Be careful not to break the rhythm in changing. Move to one side and let your replacement come in from the other side. Your replacement begins the "Press-Release" after one of the "Lift-Release" phases, as you move away.

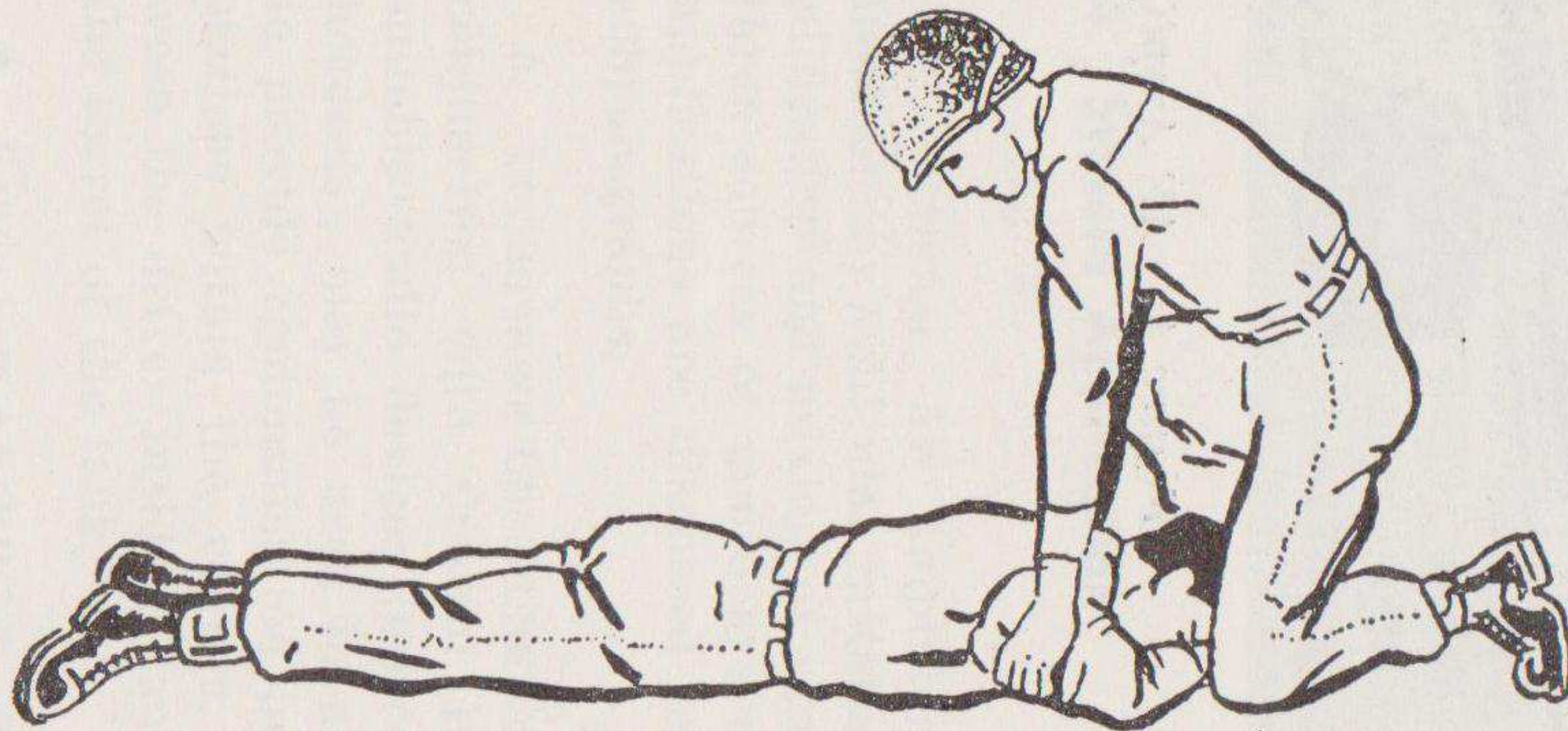




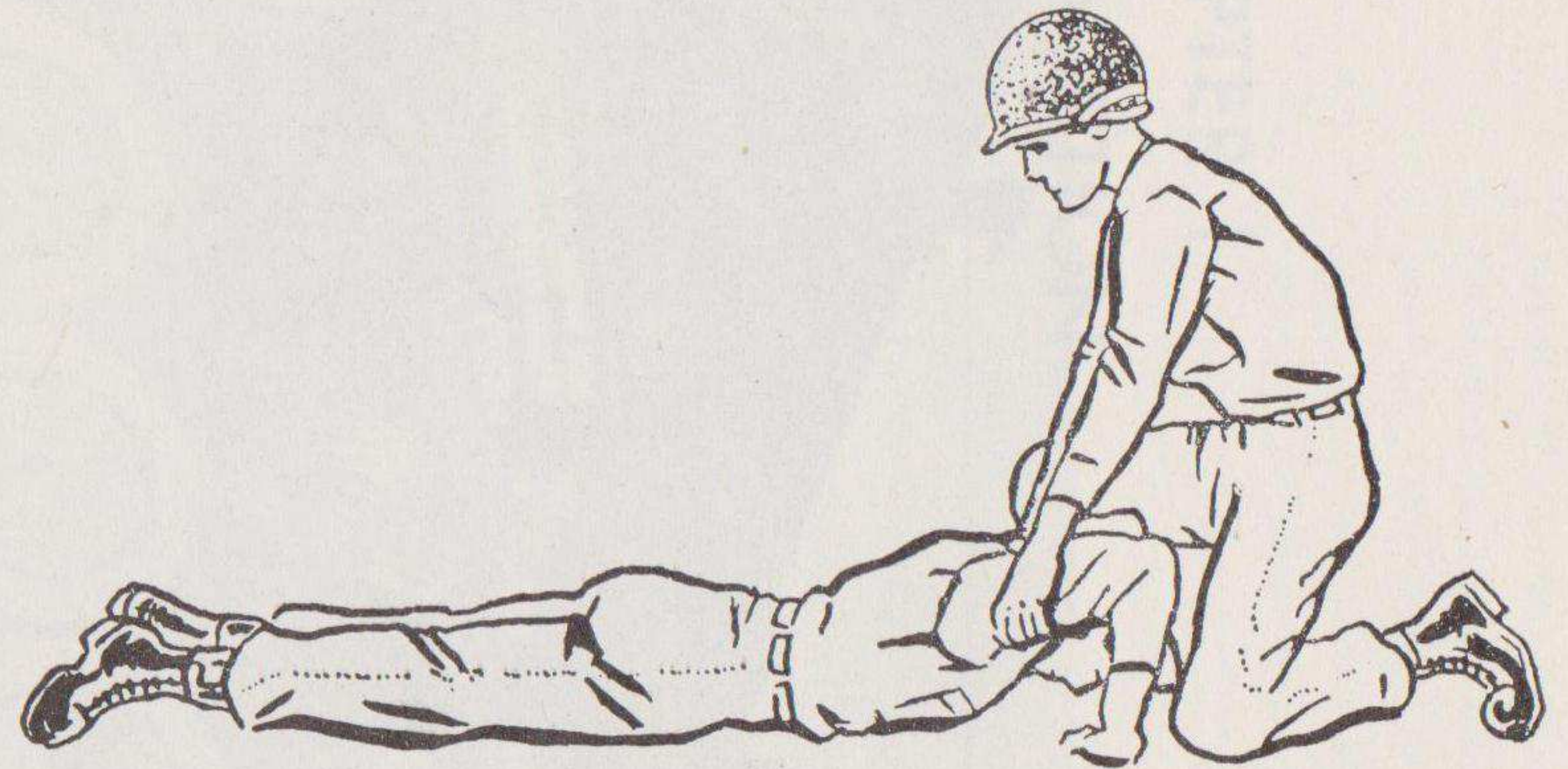
**A** Position of operator and victim



**B** Compression phase

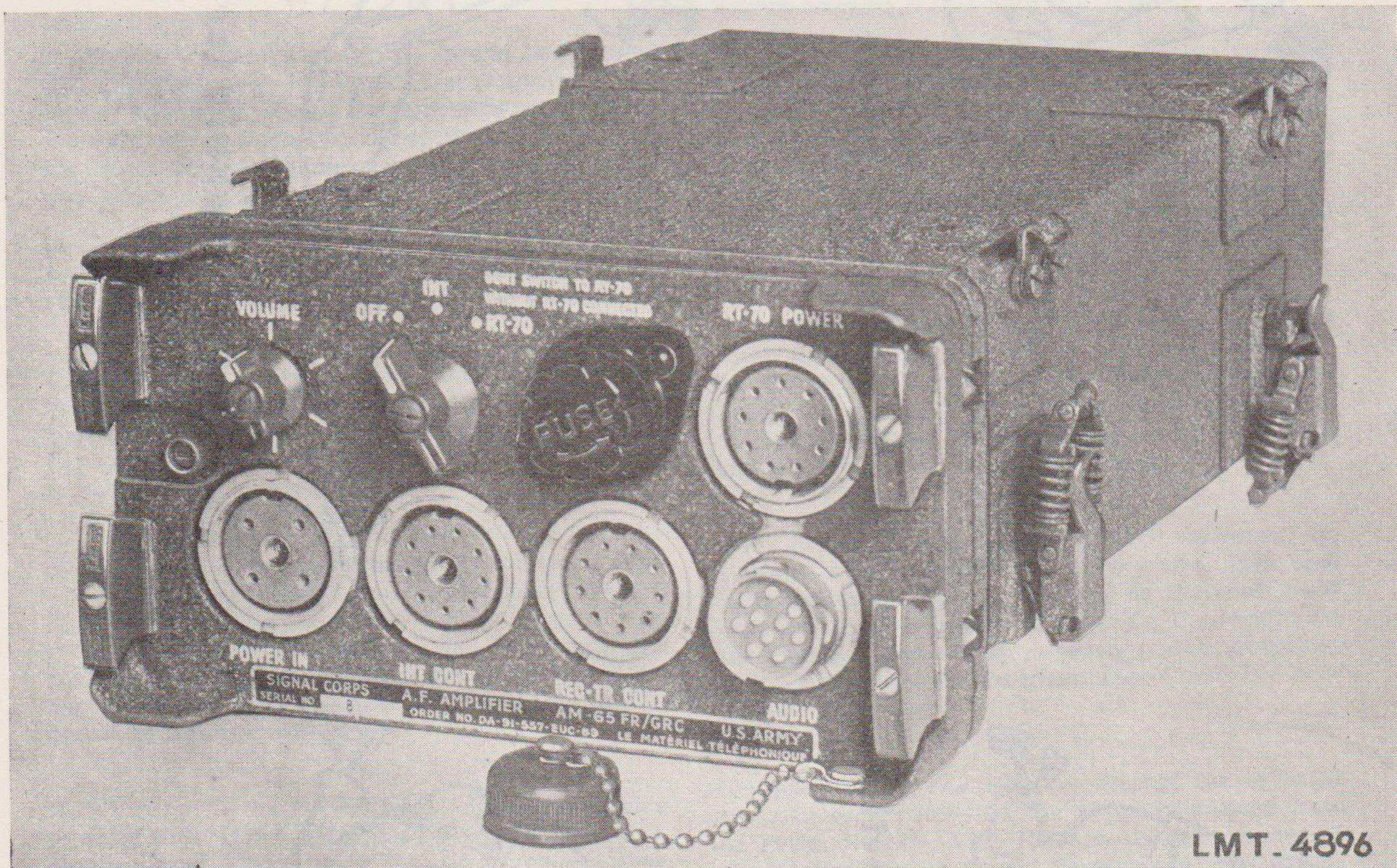


**C** Expansion phase (arm lift)



**D** Expansion phase (arm release)





LMT. 4896

Figure 1. AF Amplifier AM-65/GRC, front view



# CHAPTER I

## INTRODUCTION

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### Section I. GENERAL

#### 1. Scope

This technical manual contains information pertaining to the description and theory of AF Amplifier AM-65/GRC, and provides instructions for the maintenance, repair, and test of this unit. Two appendixes furnish a list of references and an identification table of parts.

#### 2. Forms and Records

The following standard forms will be used for reporting unsatisfactory conditions of matériel and

equipment, or improper preservation, packaging, packing, marking, loading, stowage, or handling thereof.

*a.* DD Form 6, Report of Damaged or Improper Shipment will be filled out and forwarded as prescribed in SR 745-45-5.

*b.* DA AGO Form 468, Unsatisfactory Equipment report will be filled out and forwarded to the Office of the Chief Signal Officer, as prescribed in SR 700-45-5.

*c.* Use other forms and records as authorized.

### Section II. DESCRIPTION AND DATA

#### 3. Purpose and Use

(figs. 1 and 2)

*a.* AF Amplifier AM-65/GRC is a lightweight, compact, three-channel a-f (audio-frequency) amplifier and electronic mixer. It is designed to provide interphone operation and radio monitoring in vehicular installations which use one or two receiver-transmitters and one or more interphone control boxes.

*b.* The unit contains the audio amplifier and electronic mixer circuits necessary for amplifying and mixing signals from the receiver portions of two radio sets (Receiver-Transmitter RT-70/GRC and one Receiver-Transmitter RT-66/GRC, RT-67/GRC, or RT-68/GRC) with the high-level output of the self-contained interphone amplifier. Separate channels are provided for monitoring the output of the receivers of each type of receiver-transmitter while simultaneously monitoring the low-level output of the interphone amplifier.

*c.* Since the unit is intended primarily for vehicular operation, it contains all the power supply circuits required for operation from 6-, 12-, or 24-volt vehicular battery systems in conjunction with a plug-in type vibrator unit, Power Supply PP-448/GR, PP-281/GRC, or PP-282/GRC, respec-

tively. Provisions are made within the amplifier for the power supply circuits required for the operation of Receiver-Transmitter RT-70/GRC. In addition, the unit acts as a junction box for all system conditions of that receiver-transmitter.

#### 4. System Application

(fig. 2).

*a.* GENERAL. AF Amplifier AM-65/GRC may be used in any vehicular installation in which the amplification and mixing of signals from one, two, or three sources of audio are required. Some typical applications are discussed briefly in the following subparagraphs.

*b.* INTERPHONE COMMUNICATION. The amplifier, in conjunction with Control Boxes C-375/VRC and suitable audio devices (microphones, loudspeakers, headsets), may be used in a vehicular installation to provide communication between several control stations within the vehicle, as for example, between the driver inside a tank and the observer in the turret of the tank.

*c.* RADIO SET AN/VRC-7. The combination of AF Amplifier AM-65/GRC, Receiver-Transmitter RT-70/GRC, Control Boxes C-375/VRC, Power



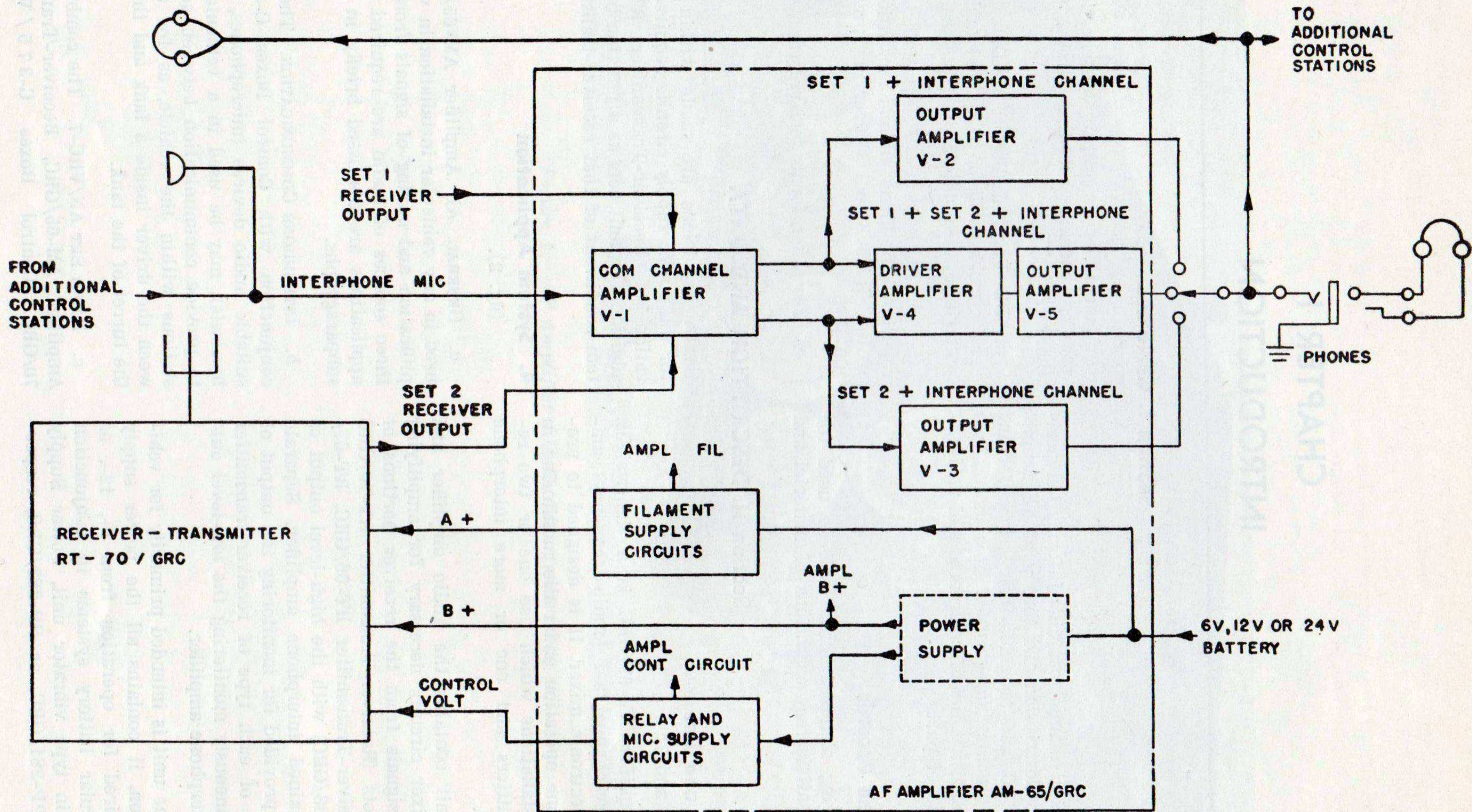


Figure 2. System application.



Supply PP-448/GR, PP-281/GRC, or PP-282/GRC, and suitable mountings, cables, audio accessories, and other installation components may be used in the radio installation known as Radio Set AN/VRC-7. Figure 2 is a functional block diagram of this set. In this arrangement, the amplifier provides an interphone channel between control stations, monitoring of the interphone channel and the receiver output of Receiver-Transmitter RT-70/GRC (Set 2), and all operating potentials for its own circuits and for those of the receiver-transmitter. These functions are described below.

(1) *Signal circuits.* Speech signals from the microphone, shown connected directly to the amplifier (fig. 2), or signals from any one of the control stations associated with the installation enter the common amplifier channel and are amplified there. Speech signals from the output of the receiver in Receiver-Transmitter RT-70/GRC (Set 2) enter the common channel amplifier over a separate path and are amplified also. (Set 1 is not used in Radio Set AN/VRC-7 and, therefore, does not enter into the discussion here.) An audio mixing arrangement associated with the common channel amplifier distributes the two signals at the proper levels to the three channels as follows: a portion of each of the two signals is routed to the Set 2 + Interphone channel, is amplified there, and appears at the output terminals of that channel; another portion of each of the two signals is routed through the Set 1 + Set 2 + Interphone channel and, after amplification, is made available at the output terminals of that channel. The arrangement of the audio mixer circuit is such that the Set 2 signal is blocked from entering the Set 1 + Interphone channel. However, the microphone signal, appearing at the output of the common channel amplifier, is permitted to enter the Set 1 + Interphone channel, is amplified there, and is made available at the output terminals of that channel. The signals appearing at the output terminals of the three channels may be monitored at any one of the control stations associated with the installation. The three-position switch, shown connected to the three-channel

output circuits, is a simplified representation of a control box, which provides connecting facilities for the audio devices used (a chest set with headset and microphone), and switching facilities for monitoring the output of any one of the amplifier channels.

(2) *Power supply circuits.* The power supply circuits within the amplifier unit, in conjunction with a plug-in vibrator unit, convert the storage battery voltage into the d-c (direct-current) potentials required for the operation of the amplifier and Receiver-Transmitter RT-70/GRC. The high-voltage supply circuit includes one of the plug-in type vibrator units, Power Supply PP-448/GR, PP-281/GRC, or PP-282/GRC, depending on whether the storage battery is 6, 12, or 24 volts, respectively. The vibrator unit converts the storage battery into the screen and plate potentials for the amplifier and the receiver-transmitter. A low-voltage circuit provides the filament potentials for the amplifier and the receiver-transmitter. Another low-voltage circuit supplies the control and microphone energizing potentials for both units.

d. RADIO SETS AN/GRC-3 THROUGH AN/GRC-8. These radio sets include all the components mentioned in *c* above and, in addition, one Receiver-Transmitter RT-66/GRC, RT-67/GRC, or RT-68/GRC. Also they may include one auxiliary Radio Receiver R-108/GRC, R-109/GRC, or R-110/GRC. By connecting either one of the receiver-transmitters or one of the receivers listed above to the Set 1 receiver output lead (fig. 2), the block diagram of figure 2 becomes representative of Radio Sets AN/GRC-3 through AN/GRC-8.

(1) *Signal circuits.* Speech signals from the microphone and from Set 2 enter the amplifier and are routed through the three channels (fig. 2), as described in *c* (1) above. Signals from Set 1 are applied to the common channel amplifier over a separate connection. After amplification, these signals are routed (together with the microphone signals) to both the Set 1 + Interphone and the Set 1 + Set 2 + Interphone channels. The Set 1 signals are blocked from the Set 2 + Interphone



channel, while the Set 2 signals are blocked from the Set 1+Interphone channel. All three signals may appear at the output of the Set 1+Set 2+Interphone channel. For other features of Radio Sets AN/GRC-3 through AN/GRC-8, refer to the applicable technical manual.

(2) *Power supply circuits.* The power supply circuits in the amplifier provide operating potentials to the amplifier and to Receiver-Transmitter RT-70/GRC as described in c (2) above. The circuits of Receiver-Transmitter RT-66/GRC, RT-67/GRC, or RT-68/GRC are powered by a separate power supply.

## 5. Technical Characteristics

	Set 1+ Interphone channel	Set 2+ Interphone channel	Set 1+Set 2+ Interphone channel
Signal input levels (volts maximum)-----	5	5	0.25
Signal output levels (milliwatts minimum):			
For 5-volt signal at terminal B of J-2 (Set 1 input)-----	350	—	800
For 5-volt signal at terminal A of J-3 (Set 2 input)-----	—	350	800
For .25-volt signal at terminal C of J-1 Interphone input)-----	280	280	1,200
Input impedances-----	1,500 ohms	1,500 ohms	150 ohms
Output impedances-----	600 ohms	600 ohms	600 ohms (adjustable) and 150 ohms
A-f reponse-----	Flat to within 4 db (decibels) for frequencies between 400 and 2,500 cycles, sharp cut-off beyond these limits		
Distortion-----	10% maximum each path.		
Crosstalk between Set 1+ interphone and Set 2+ Interphone channels.	50 db down minimum.		
Amplifier power requirements (stand-by):			
Plates-----	135 volts, 35 ma (milliamperes).		
Filaments:			
6-volt operation---	6.3 volts, 1.2 amperes.		
12- or 24-volt operation.	12.6 volts, .6 ampere.		
Relay-----	6.3 volts, 161 ma.		
Microphone-----	6.3 volts, 30 ma.		

Input voltage requirements for operation with vibrator power supply:

Power Supply PP-448/GR.	6 volts, 6.1 amperes.
Power Supply PP-281/GRC.	12 volts, 3.85 amperes.
Power Supply PP-282/GRC.	24 volts, 2.4 amperes.

Input voltage requirements for operation with external supply:

Filament, relay, and microphone supply.	6.3 volts.
Plate supply-----	135 volts.

Voltages made available to Receiver-Transmitter RT-70/GRC:

Plates-----	90 to 95 volts, 78 ma.
Filaments-----	6.3 volts, 360 ma.
Relay-----	6.3 volts, 161 ma.

Operating temperature range. From -40° F. (-40° C.) to +131° F. (+55° C).

## 6. Description

(figs. 1, 3, and 4)

a. GENERAL. AF Amplifier AM-65/GRC (fig. 1) consists of a metal panel-and-chassis assembly inclosed in a waterproof metal case.

b. CASE. The case is finished in wrinkled, olive-drab enamel, and it is arranged to permit installing the amplifier on a mounting such as Mounting MT-297/GR, MT-300/GR, or MT-673/UR. Runners are provided at the bottom of the case to secure it on Mountings MT-297/GR and MT-300/GR. Snap catches at the bottom edges serve to secure the case on Mounting MT-673/UR. The hooks at the sides of the case are used to secure Receiver-Transmitter RT-70/GRC on top of the amplifier. The unit is approximately 4¼ inches high by 12⅞ inches deep by 7⅞ inches wide. The total weight of the unit, including the vibrator power supply, is 15.5 pounds.

c. PANEL. The cast-aluminum panel mounts a fuse, five cable connectors, a switch, a volume control, and Dzus fasteners for securing the panel to the case. The functions of these items are described in paragraph 7.

d. CHASSIS. Figure 3 is a top view of the panel-and-chassis assembly removed from the case. Large components, such as transformers, electrolytic capacitors, tubes, etc., are mounted on top of the chassis. The screw-driver adjustable 6V-12V-24V switch, S-1, is also accessible from the top of the chassis. This switch adapts the



amplifier filament circuits for utilization of the 6-, 12-, or 24-volt storage battery used to power the amplifier. The small compartment at the rear of the chassis contains regulator tubes and associated resistors. A ballast tube and a thermal relay K-1 are mounted horizontally at the rear

of the chassis. The large metal box, also mounted at the rear of the chassis, houses the plug-in vibrator type power supply unit. Figure 4 is a bottom view of the chassis. The small circuit components, such as capacitors and resistors, and most of the wiring are shown in this view.

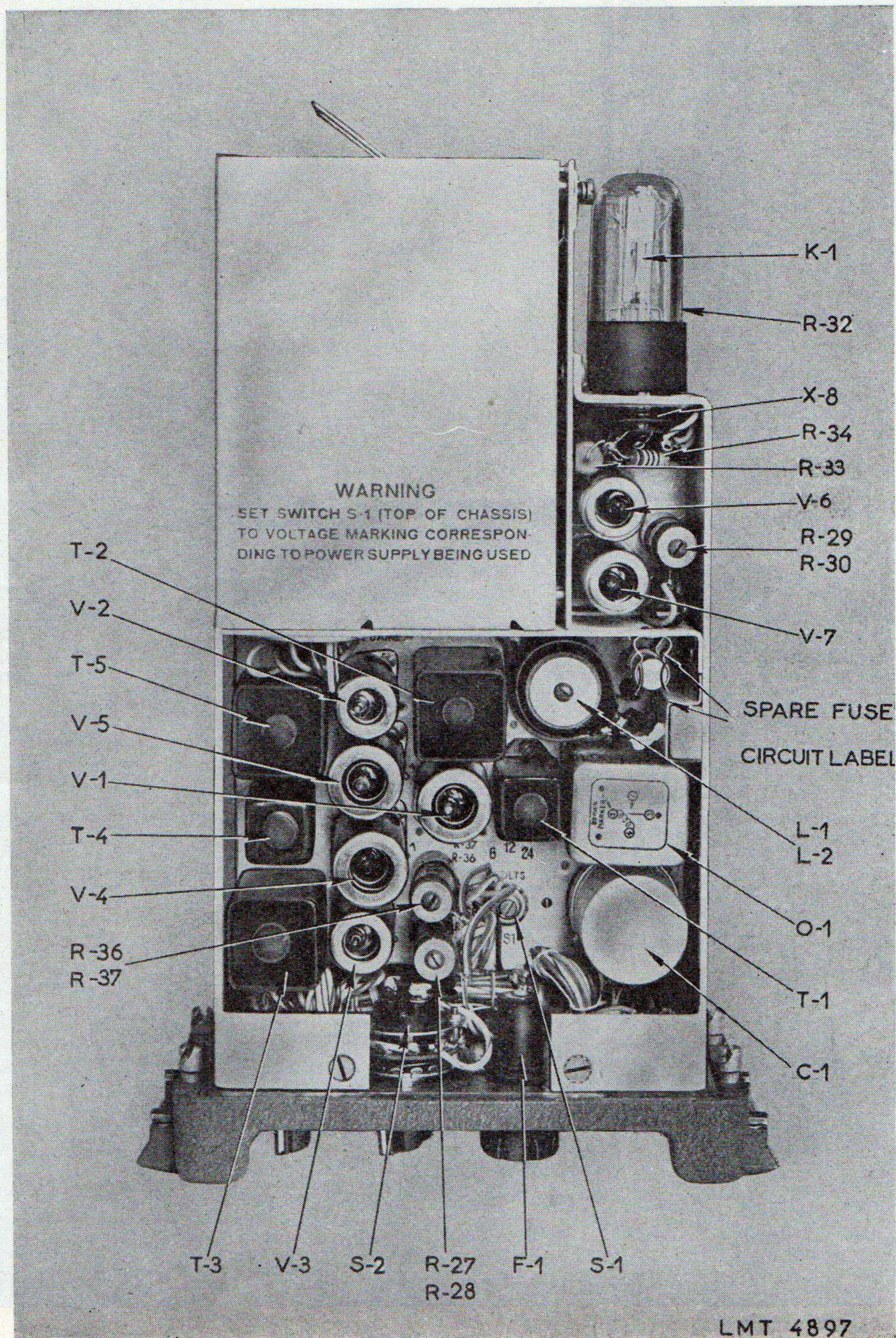
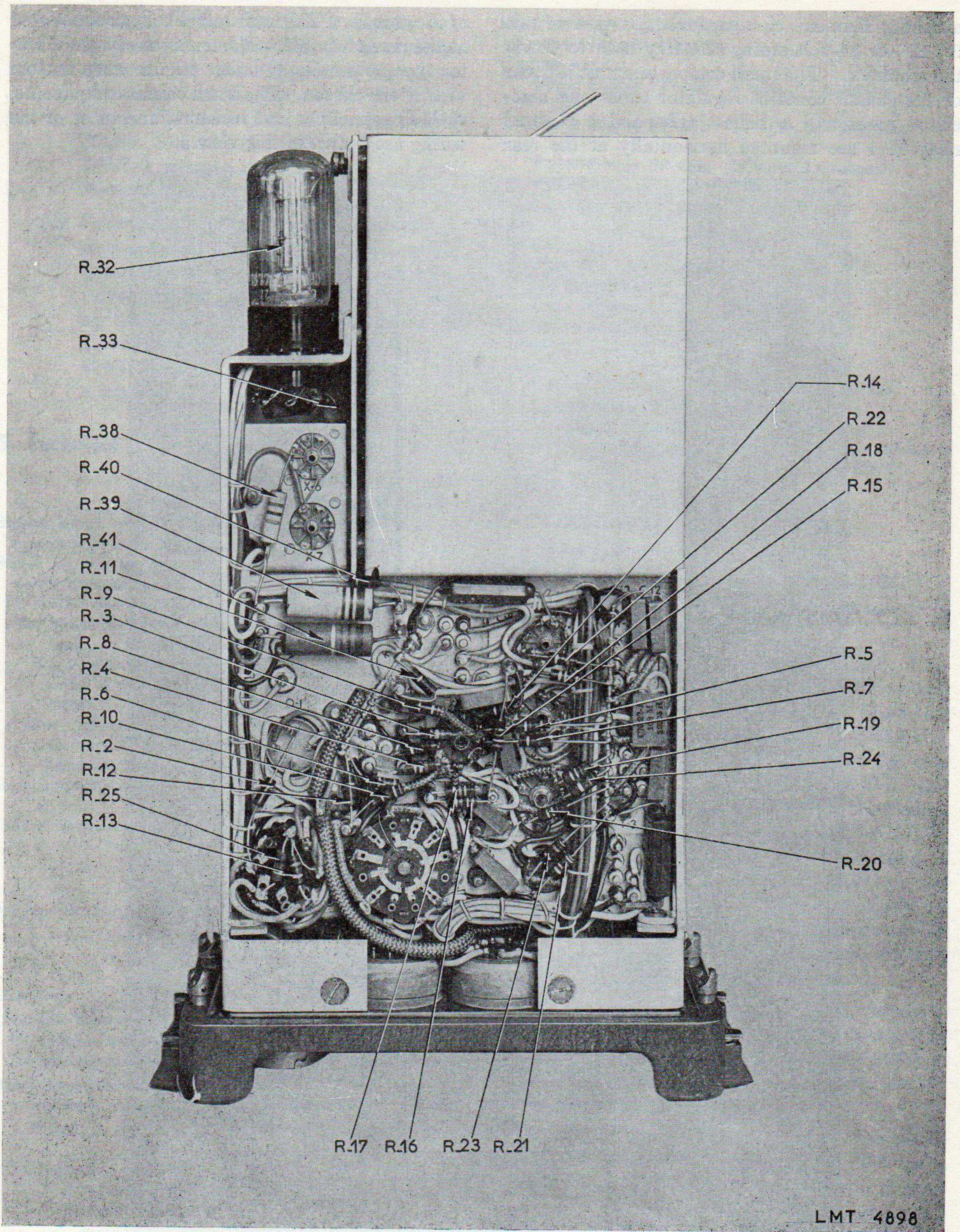


Figure 3. AF Amplifier AM-65/GRC, top view of chassis.





R.32

R.33

R.38

R.40

R.39

R.41

R.11

R.9

R.3

R.8

R.4

R.6

R.10

R.2

R.12

R.25

R.13

R.14

R.22

R.18

R.15

R.5

R.7

R.19

R.24

R.20

R.17

R.16

R.23

R.21

LMT 4898

Figure 4. AF Amplifier AM-65/GRC, bottom view of chassis.



## 7. Front Panel Controls and Connectors

(figs. 1 and 5)

The following table lists the controls, connectors, fuse, and other facilities located on the front panel of the amplifier and indicates their functions.

Control or connector	Function
VOLUME (R-26)	The potentiometer serves to adjust the level of the 600-ohm output of the set 1+Set 2+Interphone channel.
OFF-INT-RT-70 switch (S-2).	This three-pole, three-position switch serves as the power on-off switch for the amplifier and for Receiver-Transmitter RT-70/GRC. OFF position: Disconnects all power from the amplifier and receiver-transmitter. INT position: Applies plate, screen, filament, and control voltages to the amplifier. RT-70 position: Applies plate, screen, filament, and control voltages to the amplifier and to Receiver-Transmitter RT-70/GRC.
AUDIO connector (J-1)	Provides means for connecting a chest set (with microphone and headset), for monitoring, and talking over the Set 1+Set 2+Interphone channel.
INT CONT connector (J-2)	(1) Provides for connection of audio and control facilities to permit monitoring the output of Set 1 and Set 2, and for monitoring and talking over the interphone system from a control station.
INT CONT connector (J-2)—Con.	(2) Connects the receiver output of Set 1 to the amplifier for monitoring.
RT-70 POWER connector (J-3).	(1) Provides for connection of the power supply circuits to Receiver-Transmitter RT-70/GRC (Set 2). (2) Serves as a junction point for microphone and control circuits between Set 2 and the control boxes. (3) Connects the receiver output of Set 2 to the amplifier for monitoring and, through J-4, to the mounting for retransmission.
REC-TR CONT (J-4)	(1) Serves as a junction point between control boxes and the Set 2 microphone circuit. (2) Serves as a junction point between Set 2 and the circuits which control retransmission of the Set 2 receiver output.
POWER IN connector (J-6).	Provides d-c power input connections.
FUSE	In fuse holder, protects battery circuit from overloads or short circuits. <b>Caution:</b> The rating of the fuse inserted into the fuse holder must correspond with the voltage of the storage battery used as indicated by the voltage and fuse rating marker.
Supply voltage and fuse rating marker.	A small marker plate for indicating operating voltage. Serves as a reminder that the plug-in power supply unit, fuse F-1 and the setting of internal 6V-12V-24V switch S-1 (par. 8) should correspond with the storage battery being used.

6 V	10 A
12 V	10 A
24 V	4 A



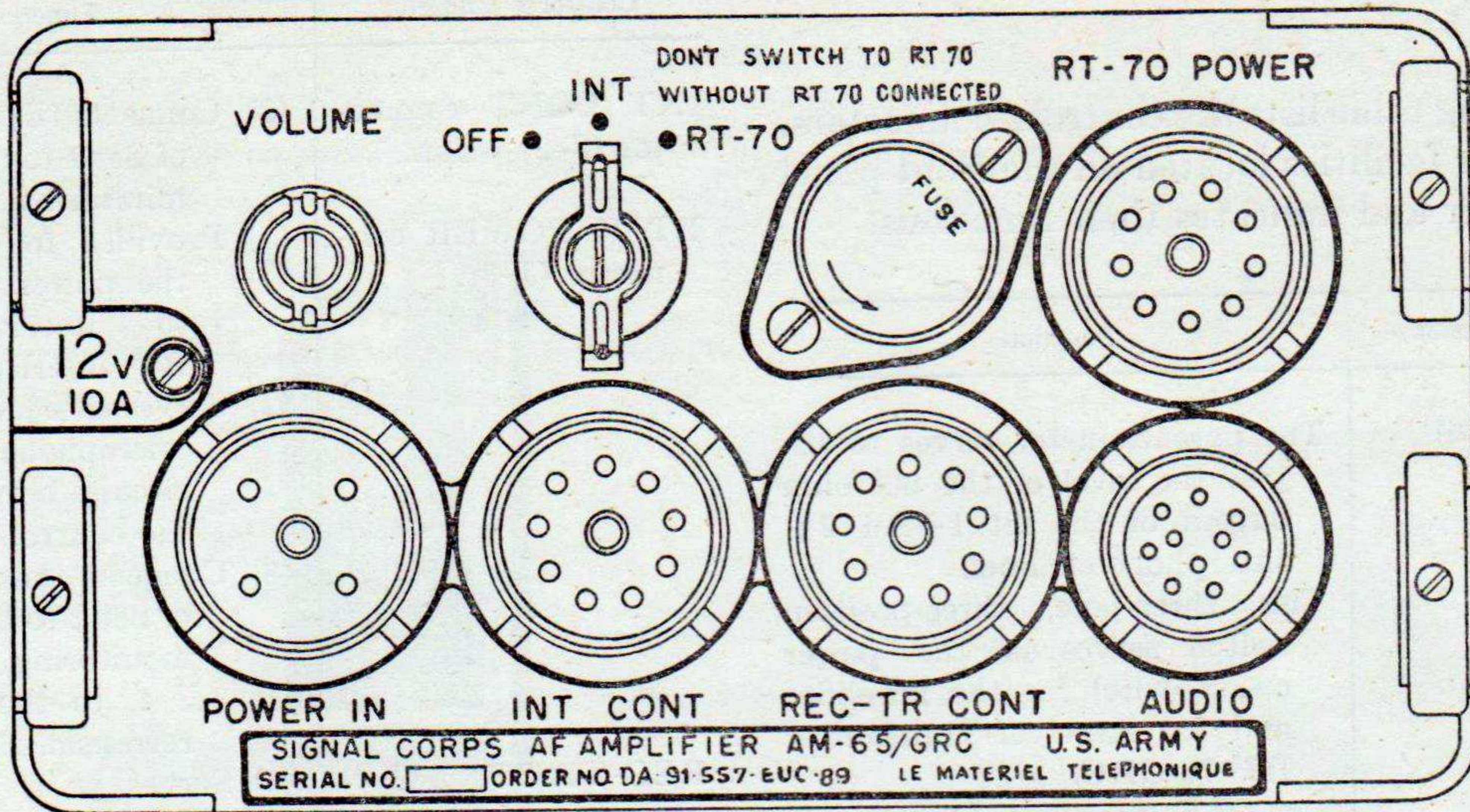


Figure 5. AF Amplifier AM-65/GRC, panel controls and connectors.

## 8. Internal Switch and Connector

In addition to the controls, connectors, and other items mounted on the panel (par. 7), the following internal switch and connector are provided:

Control	Function
6V-12-V-24V switch (S-1) (fig. 3).	Serves to arrange the circuits in amplifier for operation with a 6-, 12-, or 24-volt power supply, Power Supply PP-448/GR, PP-281/GRC, or PP-282/GRC, respectively. <i>Note.</i> This switch is set in the 6V position when an external 135-volt and 6-volt supply is used. The plug-in power supply unit must be removed when an external supply is used.
Power supply connector (J-5) (fig. 11).	This male eight-prong connector, located in the power supply compartment, provides connection between the amplifier and the plug-in power supply unit.

## 9. Additional Equipment Required

To operate AF Amplifier AM-65/GRC, the following components are required:

a. **POWER SUPPLY.** This may be Power Supply PP-448/GR and a 6-volt storage battery, Power

Supply PP-281/GRC and a 12-volt storage battery, or Power Supply PP-282/GRC and a 24-volt storage battery. Alternatively, any source providing 135 volts d-c and 6 volts d-c may be used.

b. **AUDIO TRANSMITTING AND RECEIVING DEVICES.** Chest Set Group AN/GSA-6 may be connected to AUDIO connector J-1 on the panel of the amplifier. The chest set will accommodate Headset-Microphone H-63/U. For listening only, Headset Navy type CW-49507 or Dynamic Loudspeaker LS-166/U may be connected. For talking only, Microphone M-29/U may be connected.

## 10. Running Spare Parts Supplied

Running spares for normally expendable items, such as tubes and fuses, are provided with each amplifier. These parts are listed below—

- 3 fuses, cartridge, 4 amperes (F-1) (table 1, fig. 17).
- 5 Fuses, cartridge, 10 amperes (F-1) (table 1, fig. 17).
- 1 tube, ballast (thermal resistor R-32).
- 1 relay, thermal (K-1).
- 2 tubes type 6AK6, electron (V-2, V-3).
- 2 tubes type 12AU7, electron (V-1, V-4, V-5)
- 2 tubes type 0B2, electron (V-6, V-7).



## CHAPTER 2

# THEORY OF AF AMPLIFIER AM-65/GRC

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### 11. Block Diagram

(fig. 6)

Figure 6 is a functional block diagram of AF Amplifier AM-65/GRC. The diagram shows in simplified form the signal and power supply circuits provided by the amplifier.

*a. GENERAL.* The signal circuits include three input circuits (identified as Set 1 Rec Output, Interphone Mic, and Set 2 Rec Output), a common channel amplifier V-1, and three amplifying paths or channels (identified as the Set 1+Interphone, Set 1+Set 2+Interphone, and Set 2+Interphone channels). The input circuits of the Set 1+Interphone and Set 2+Interphone channels are arranged to accept signals from the output of a radio receiver, while that of the Set 1+Set 2+Interphone channel accepts signals from a microphone.

*b. COMMON CHANNEL AMPLIFIER.* Signals from the receiver output circuits of Set 1 or 2 are routed over separate paths to the common channel amplifier, are amplified there, and appear in the output circuits of that stage. Before the operator can talk over the interphone channel, the push-to-talk button must be pressed. This operation causes system circuits to connect a ground return to relay O-1, and causes this relay to become energized. Contacts of the relay close, complete the circuit to the external microphone, and apply energizing potential to it from the internal power supply circuits. Speech signals from the microphone enter the amplifier over 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 stage V-1 distributes the signals appearing at its output to the three channels, as described in subparagraph *c* below.

*c. SIGNAL DISTRIBUTION.* Signals from Set 1 and from the microphone are applied at the required levels to Set 1+Interphone and Set 1+Set 2+Interphone channels. In a similar manner, signals from set 2 and from the microphone 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+Interphone channel are amplified in output amplifier V-2, and appear at the output terminal 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 channel. Signals entering the Set 1+Set 2+Interphone channel are amplified in driver amplifier V-4 and output amplifier V-5 and are applied through a VOLUME control to a 600-ohm output connection for application to Control C-435/GRC (if used) and to the front panel AUDIO connector, J-1. These signals also are applied to a 150-ohm output connection for application to Control Box C-375/VRC.

*e. POWER SUPPLY CIRCUITS.* The storage battery is connected through terminals of a panel-mounted POWER IN connector (J-6), through a fuse (F-1), and through contacts of the panel-mounted OFF-INT-RT-70 switch (S-2) to a high-voltage and a low-voltage supply circuit. The switch serves as the power on-off switch for the amplifier and for Receiver-Transmitter RT-70/GRC. The high-voltage supply circuit includes the plug-in vibrator type power supply unit, which converts the battery voltage into the plate and screen voltages for the tubes of the amplifier and of Receiver-Transmitter RT-70/GRC. The plate and screen voltages for the amplifier tubes are taken directly at 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 low-voltage supply circuit provides the filament, relay, microphone, and bias voltages for the amplifier. In addition, control and filament voltages are brought to terminals on a panel-mounted connector RT 70



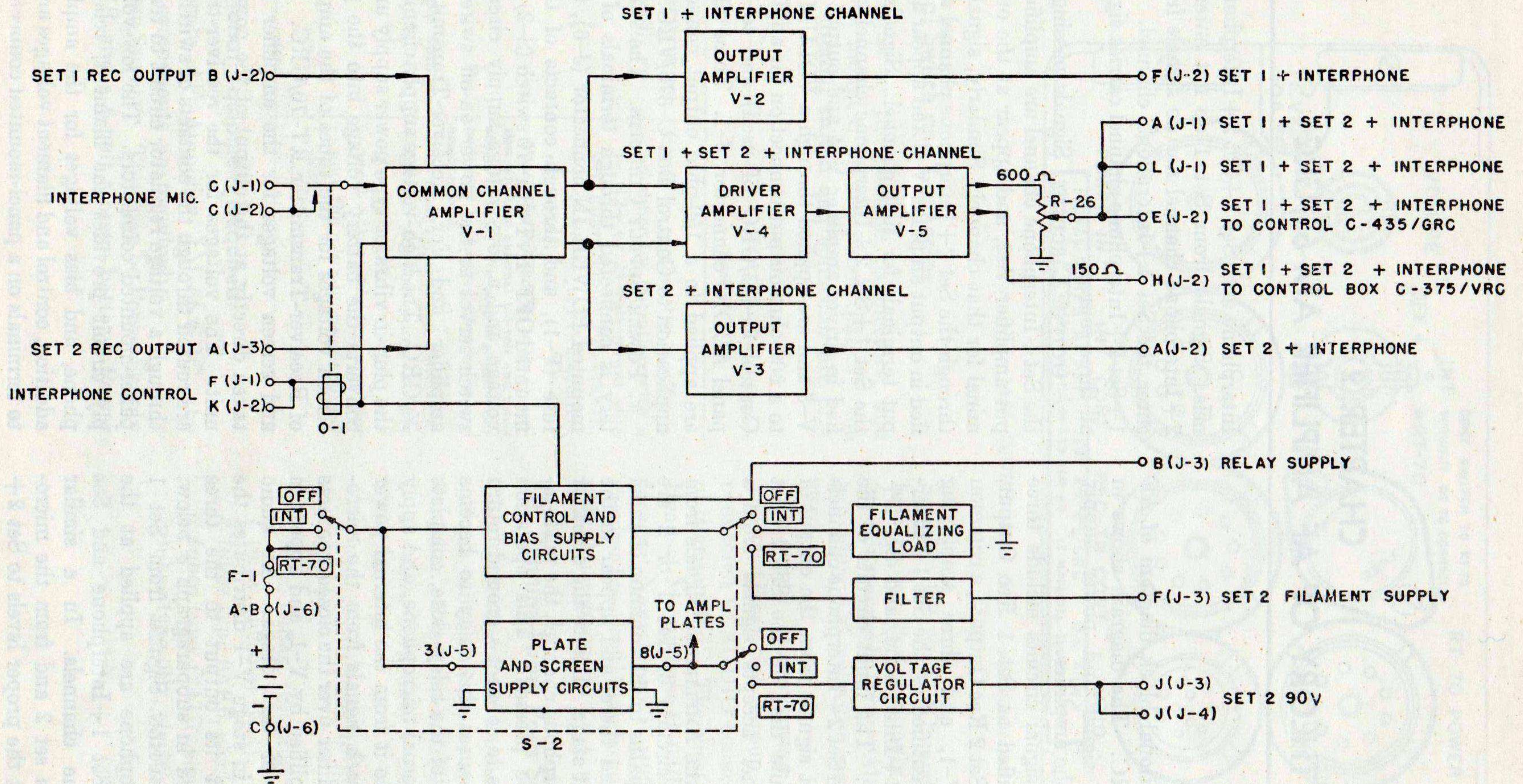


Figure 6. AF Amplifier AM-65/GRC, block diagram.



POWER (J-3) for application to the relays and filaments, respectively, of Receiver-Transmitter RT-70/GRC. The filament supply circuit includes contacts of the OFF-INT-RT-70 switch (RT-70 position) and an a-f filter. When Receiver-Transmitter RT-70/GRC is not used, contacts of the switch (INT position) substitute a load equivalent to the filaments of that unit across the filament supply circuit. This prevents overloading the filament supply circuit.

## 12. Signal Input and Common Channel Amplifier Circuits

(fig. 7)

*a. INTERPHONE CHANNEL INPUT CIRCUIT.* The carbon element of the microphone used for talking through the interphone channel may be connected directly between terminals C and B (ground) of AUDIO connector J-1 or through a control box and a mounting to terminals C and D (ground) of INT CONT connector J-2. The microphone push-to-talk button is connected directly between terminals F and H (ground) of J-1 or through the mounting and control box between terminals K and D (ground) of J-2. In either case, operation of the microphone push-to-talk button applies external ground return for relay O-1.

(1) *D-c circuit.* When a ground return is completed for relay O-1, that relay becomes energized. Contacts 2 and 3 of the relay close, completing the circuit for the carbon element of the microphone

and causing a d-c energizing potential to be applied to it. The d-c circuit for the microphone extends through normally open contacts 2 and 3 of relay O-1, primary winding 6-7 of microphone transformer T-1, choke L-2, and current-limiting resistor R-2 to the microphone supply circuit. This includes resistors R-27 and R-28, strapped as shown in figure 17 for 6-, 12-, or 24-volt operation; section 2C of the OFF-INT-RT-70 switch S-2; fuse F-1; and the storage battery connected between terminals A-B and C (ground) of POWER IN connector J-6. Power supply circuit details are described in paragraphs 16 through 19.

(2) *Signal circuit.* Audio signals from the microphone are developed across the primary winding (terminals 6 and 7) of T-1. The lower end of T-1 is returned to ground through capacitor C-1A which bypasses the d-c supply for the microphone circuit. The secondary voltage between terminals 1 and 2 of T-1 is applied to the voltage-divider network, R-3 and R-5, in the grid circuit of V-1A; the secondary voltage between terminals 3 and 2 of T-1 is applied to the voltage-divider network, R-4 and R-6, in the grid circuit of V-1B. The voltages across R-5 and R-6, 180° out of phase with each other, are applied to the grids of V-1A and V-1B respectively.

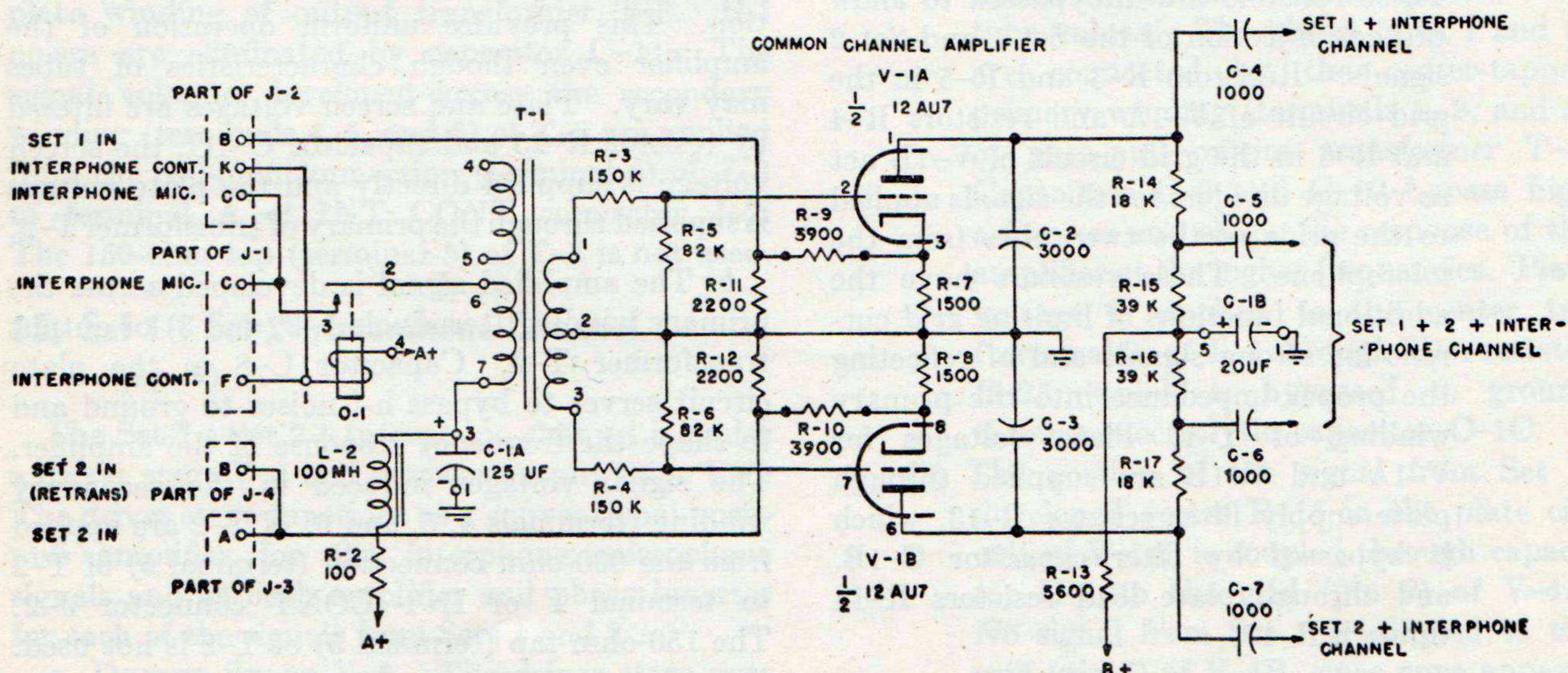


Figure 7. Signal input and common channel amplifier circuits.



b. SET 1 INPUT CIRCUIT. Audio signals from the receiver output of Set 1 (normally Receiver-Transmitter RT-66/GRC, RT-67/GRC, or RT-68/GRC) enter the amplifier between terminal B of INT CONT connector J-2 and ground, and are developed across load resistor R-11. These signals are applied to the cathode of V-1A from the junction of resistors R-9 and R-7, which form a voltage divider across R-11.

c. SET 2 INPUT CIRCUIT. Audio signals from the receiver output of Set 2 (normally Receiver-Transmitter RT-70/GRC) enter the amplifier between terminal A of RT-70 POWER connector J-3 and ground and are developed across load resistor R-12. These signals are applied to the cathode of tube V-1B from the junction of resistors R-10 and R-8, which form a voltage divider across R-12. A strap connection between terminal A of J-3 and terminal B of connector J-4 routes these signals to Control C-435/GRC for retransmission through another receiver-transmitter (if used).

d. COMMON CHANNEL AMPLIFIER V-1. The common channel amplifier uses the two triode sections, V-1A and V-1B, of tube type 12AU7.

The twin triode is connected in push-pull for signals from the microphone; triode section V-1A serves as a single-ended amplifier for signals from Set 1, while V-1B serves as a single-ended amplifier for signals from Set 2.

- (1) Cathode bias for V-1A and V-1B is provided by the voltage drop across cathode resistors R-7 and R-8, respectively. These resistors are unbypassed to allow cathode injection of the Set 1 and Set 2 signals. Resistors R-3 and R-5 in the grid circuit of V-1A and resistors R-4 and R-6 in the grid circuit of V-1B act as voltage dividers for the signals applied to the grids of the two tubes from the microphone. These resistors have the additional functions of limiting grid current for strong signals and of reflecting the proper impedance into the primary winding of T-1. Plate voltages for V-1A and V-1B are supplied through plate supply filter resistor R-13, which is bypassed by filter capacitor C-1B, and through plate load resistors R-14 through R-17.

- (2) Signals from the microphone, applied in push-pull to the grids of V-1A and V-1B, are amplified by these tubes, and are developed across the series arrangement of resistors R-14 and R-15 in the plate circuit of V-1A and across the series arrangement of resistors R-17 and R-16 in the plate circuit of V-1B. Signals from Set 1, applied to the cathode of V-1A, are amplified in that tube and appear across load resistors R-14 and R-15 but not across R-17 and R-16. Similarly, signals from Set 2 are amplified in V-1B and appear across load resistors R-17 and R-16 but not across R-14 and R-15. Capacitors C-2 and C-3 bypass h-f (high-frequency) noises to ground and shape the h-f response of the amplifier.

### 13. Set 1 + Interphone Channel

(fig. 8)

Signals from the interphone microphone and from Set 1, appearing across load resistors R-14 and R-15, are coupled through capacitor C-4 to the grid (pin 1) of output amplifier tube V-2. This stage uses a tube type 6AK6 power pentode as a class A amplifier. Resistors R-18 and R-22 are the grid return and cathode resistors, respectively.

a. Cathode bias is developed across R-22, which is unbypassed to allow cathode degeneration. This provides uniform operation of the amplifier even though characteristics of tubes may vary. Plate and screen voltages are filtered by resistor R-25 and capacitor C-1C; the screen voltage is supplied directly and the plate voltage is supplied through the primary of transformer T-2.

b. The amplified signal is developed across the primary winding (terminals 1, 2, and 3) of output transformer T-2. Capacitor C-8 in the plate circuit serves to bypass h-f noises to ground and to shape the frequency response of the amplifier. The signal voltages induced in the secondary winding (terminals 4, 5, and 6) of T-2 are applied from the 600-ohm connection (terminal 6) of T-2 to terminal F of INT CONT connector J-2. The 150-ohm tap (terminal 5) of T-2 is not used.



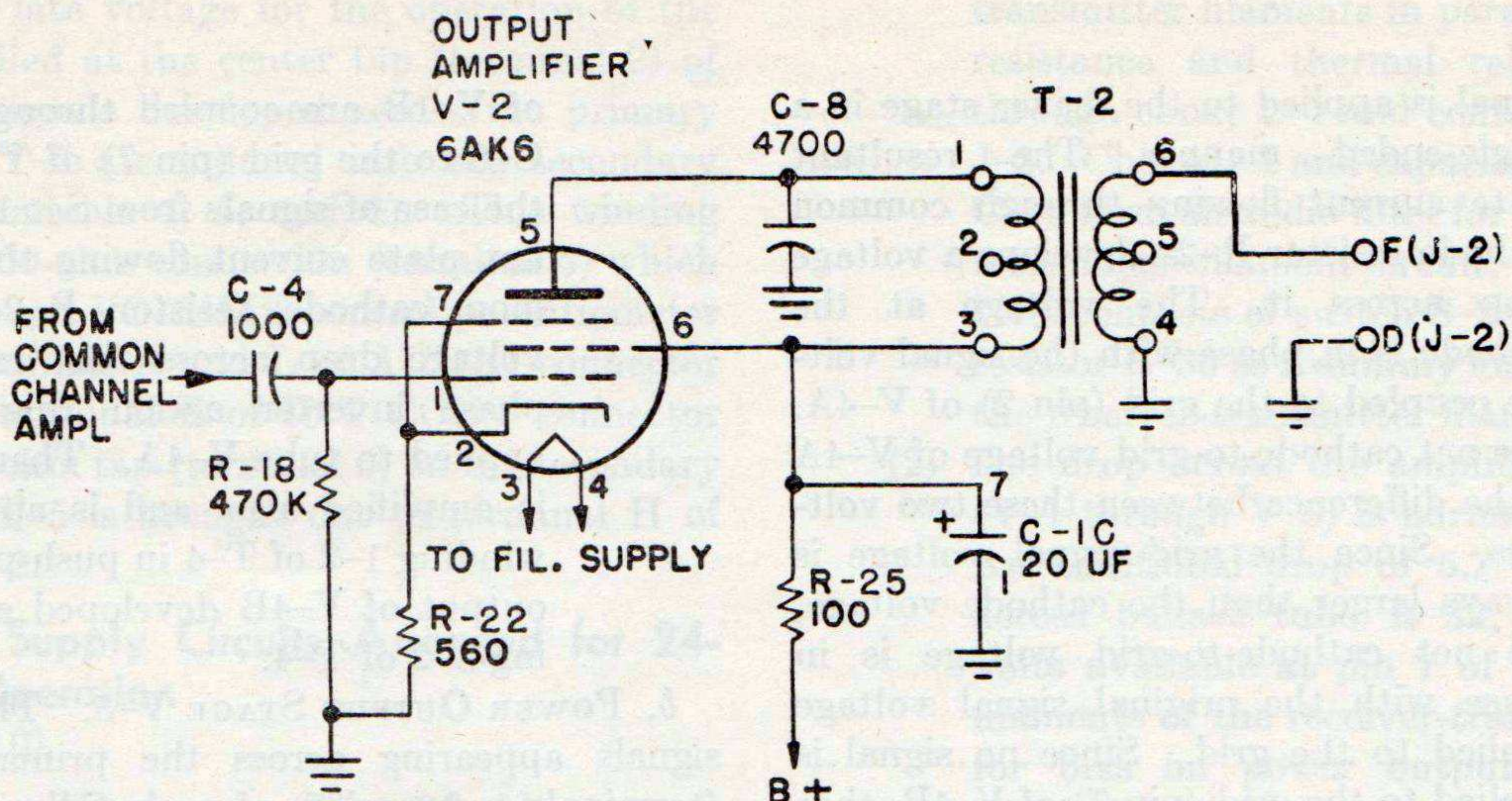


Figure 8. Set 1 + Interphone channel circuits.

#### 14. Set 2 + Interphone Channel (fig. 17)

The Set 2 + Interphone channel is similar to the Set 1 + Interphone channel (par. 13). Signals from the interphone microphone and from Set 2, appearing across V-1B plate load resistors R-17 and R-16, are coupled through capacitor C-7 to the grid (pin 1) of output amplifier V-3 also a tube type 6AK6 pentode. Resistors R-21 and R-23 are the grid return and cathode bias resistors, respectively. Plate and screen voltages are filtered by resistor R-25 and capacitor C-1C; the screen voltage is supplied directly and the plate voltage is supplied through primary transformer T-3. The amplified signal appears across the plate winding of output transformer T-3. H-f noises are eliminated by capacitor C-11. The signal voltages developed across the secondary winding (terminals 4, 5, and 6) of T-3 are applied from the 600-ohm connection (terminal 6) of T-3 to terminal A of INT CONT connector J-2. The 150-ohm tap (terminal 5) of T-3 is not used.

#### 15. Set 1 + Set 2 + Interphone Channel (fig. 9)

The Set 1 + Set 2 + Interphone channel includes a driver stage V-4 and a power output stage V-5. The driver stage functions as a conventional push-pull amplifier for the interphone microphone signals and as both amplifier and phase inverter for each of the signals from Sets 1 and 2.

a. DRIVER STAGE V-4. The driver stage uses the two triode sections, V-4A and V-4B, of type

12AU6 tube in a push-pull class A amplifier circuit.

- (1) Microphone signals appearing across load resistor R-15 (in the plate circuit of V-1A) and across R-16 (in the plate circuit of V-1B) are coupled in push-pull through capacitors C-5 and C-6 to the grids (pins 2 and 7) of V-4A and V-4B, respectively. The grid circuits are returned to ground through resistors R-19 and R-20, respectively. Cathode bias is provided by the voltage drop across the common cathode resistor, R-24. This resistor provides current degeneration to balance the push-pull circuit against variations in component and tube values. The plates (pins 1 and 6) are connected by the center-tapped primary winding (terminals 1, 2, and 3) of push-pull output transformer T-4. Capacitors C-9 and C-10 bypass high a-f noises and shape the response of the amplifier at the higher frequencies. Plate voltage is applied to the center tap (terminal 2) of T-4 through filter resistor R-25, which is bypassed to ground through electrolytic capacitor C-1C.
- (2) The portion of the signal from Set 1, developed across R-15 in the plate circuit of V-1A, is coupled through capacitor C-5 to the grid (pin 2) of V-4A. No signal from Set 1 is coupled to the grid (pin 7) of V-4B, since none appears across resistor R-16. Thus, the Set 1



signal is applied to the driver stage in a single-ended manner. The resultant plate current flowing through common cathode resistor R-24 develops a voltage drop across it. The voltage at the cathode is in phase with the signal voltage coupled to the grid (pin 2) of V-4A. The net cathode-to-grid voltage of V-4A is the difference between these two voltages. Since the grid signal voltage is always larger than the cathode voltage, the net cathode-to-grid voltage is in phase with the original signal voltage applied to the grid. Since no signal is applied to the grid (pin 7) of V-4B, that grid is effectively at a-c (alternating-current) ground potential, and the net cathode-to-grid potential of V-4B is 180° out of phase with respect to the net cathode-to-grid potential of V-4A. Thus, since the signal voltages appearing in the cathode-to-grid circuits of V-4A and V-4B are inverted in phase with respect to each other, a push-pull relationship is established between the amplified signal voltages appearing in the plate circuits (winding 1-2-3 of T-4) of the stage.

(3) In a manner similar to that described in (2) above, signals from Set 2 appearing across resistor R-16 in the plate circuit

of V-1B are coupled through capacitor C-6 to the grid (pin 7) of V-4B. As in the case of signals from Set 1, the resultant plate current flowing through common cathode resistor R-24 causes a voltage drop across that resistor. By phase inverter action this voltage is applied to tube V-4A. There the signal is amplified also, and is applied across winding 1-2 of T-4 in push-pull with the output of V-4B developed across winding 3-2 of T-4.

b. POWER OUTPUT STAGE V-5. The amplified signals appearing across the primary winding (terminals 1, 2, and 3) of push-pull output transformer T-4 are developed across the secondary winding (terminals 4, 5, and 6) and are applied directly to the grids (pins 2 and 7) of V-5A and V-5B. These two triode sections of the type 12AU7 tube are arranged in push-pull for class B operation. Each grid is returned to ground (terminal 5) on T-4 through one half of the secondary winding of T-4. Fixed bias is obtained by connection of the two cathodes (pins 3 and 8) to the filament supply circuit. (The bias supply arrangement is described in paragraphs 16 through 19.) The plate circuits include the primary winding (terminals 1, 2, and 3) of center-tapped push-pull output transformer T-5. Bypass capacitors C-12 and C-13 serve to bypass h-f noises to ground and to shape the h-f response of the

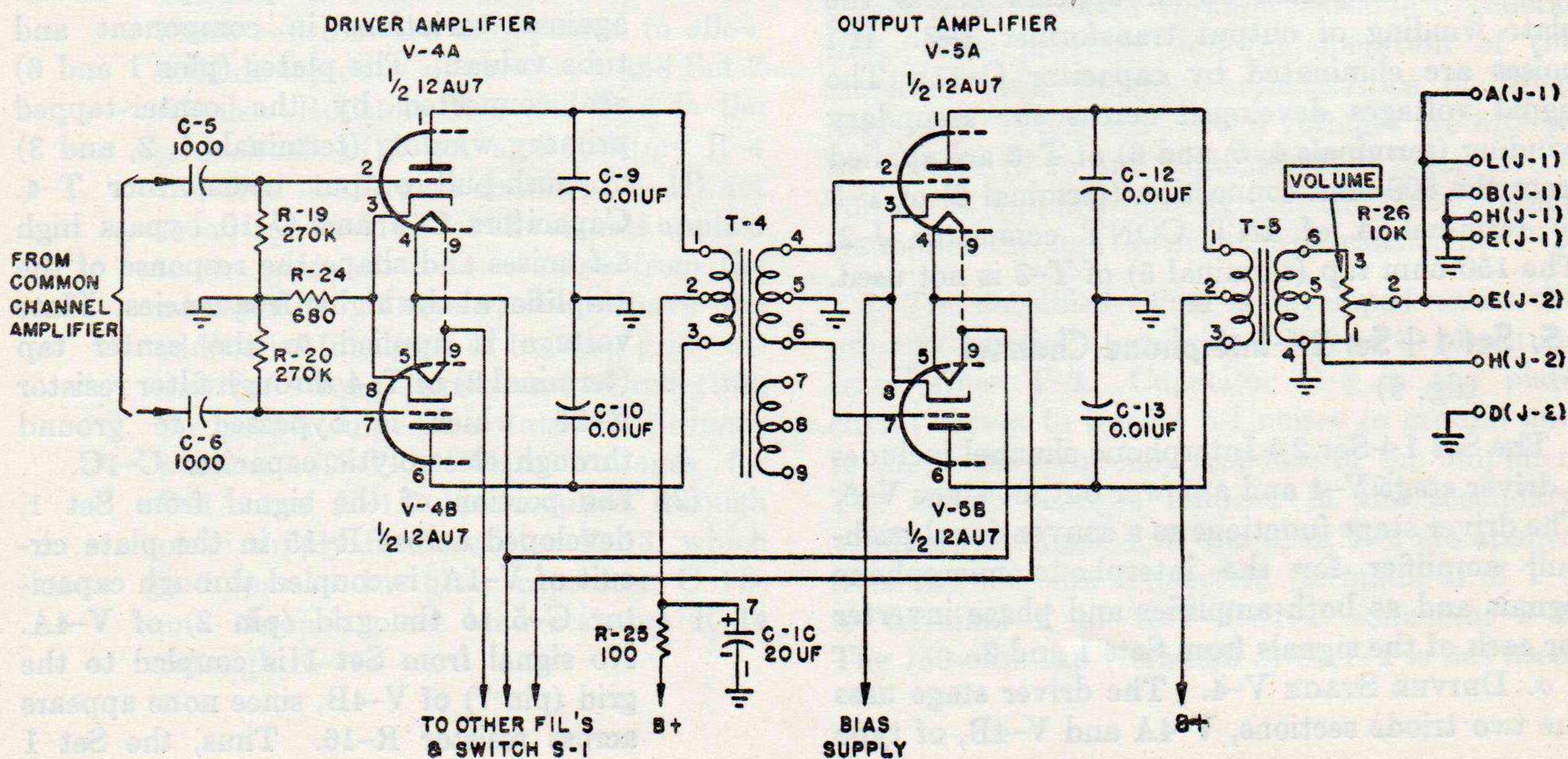


Figure 9. Set 1 + Set 2 + Interphone channel.



amplifier. Plate voltage for the operation of the stage is applied at the center tap (terminal 2) of T-5. The signals developed across the primary winding of T-5 are induced into the secondary winding (terminals 4, 5, and 6). This winding provides a 600-ohm connection (terminal 6) which extends through VOLUME control potentiometer R-26 to terminals A and L of AUDIO connector J-1 and to terminal E of INT CONT connector J-2. A 150-ohm tap (terminal 5) on the secondary winding of T-5 is brought out to terminal H of connector J-2.

## 16. Power Supply Circuits Arranged for 24-Volt Operation

(fig. 10)

*a. BATTERY CIRCUIT.* The 24-volt storage battery is connected between terminals A-B (+) (strapped) and C (-) of POWER IN connector J-6. The battery circuit extends through a 4-ampere fuse, F-1, and through contacts of section 2C of the OFF-INT-RT-70 switch, S-2 (in either the INT or RT-70 position), to terminal 3 of connector J-5 and contacts of the 6V-12V-24V switch, S-1. The branch circuits which are supplied from these points are described in *b* through *d* below.

*b. FILAMENT AND BIAS SUPPLY CIRCUITS.* For 24-volt operation, the series-parallel amplifier filaments are connected across the battery in series with the receiver-transmitter filament-supply and overvoltage protection circuit. The receiver-transmitter filament supply is utilized also as a bias supply for power output tube V-5 in the amplifier.

(1) With switch S-2 in either the INT or RT-70 position, the amplifier filaments are connected through 24-volt contacts of switch S-1 (section 1B) to one side (pin 2) of ballast tube R-32. Ballast tube R-32, resistor R-33, the heater element of thermal relay K-1, and additional contacts of S-1 (section 1A) complete a circuit to the ground side of the line. A normally closed contact of K-1 connects resistor R-34 in parallel with R-33; connects resistor R-35 in parallel with the series-parallel combination of R-33, R-34, and the heater element of K-1; and connects the potential at pin 7 of ballast tube R-32 to the cathode of power output tube V-5 and to section 1A of the OFF-INT-RT-70 switch S-2. The RT-70 contacts of S-2 connect the receiver-

transmitter filaments in parallel with the resistance and thermal relay network through choke L-1 and contact F of jack J-3. Choke L-1 and capacitors C-15 and C-16 form an audio filter for the receiver-transmitter filament circuit. Alternately, INT contacts of switch S-2 may connect resistor R-36 as a dummy load in place of the receiver-transmitter filaments.

(2) The drop across the amplifier filaments (V-1 through V-5) is normally 12 volts. An additional drop of 5.7 volts occurs across ballast tube R-32, leaving 6.4 volts available at pin 7 of K-1 for the filaments of the receiver-transmitter and for bias on power output tube V-5. The ballast tube is essentially a variable resistor the resistance of which (over its normal operating range) depends on the voltage supplied to it. If the battery voltage decreases, the voltage applied across R-32 decreases and the resistance consequently decreases. The net result is an essentially constant current through the circuit and an essentially constant voltage available for the receiver-transmitter filament circuit and the amplifier bias circuit, provided the resistance of the load circuit is constant. If the load varies, R-32 tends to maintain a constant current, so that the load voltage (filament and bias) will vary also.

(3) Thermal relay K-1 and the network associated with it protect the filament circuit against an overvoltage condition such as might occur when a filament in the series-parallel filament circuit of the receiver-transmitter breaks down. As long as the voltage across the heater element does not exceed a certain predetermined value, the shorting contacts remain closed and the circuit arrangement is as described in (1) above. The values of R-33, R-34, and R-35 are selected so that the required voltage is obtained across the relay heater. When the voltage to the receiver-transmitter filaments (at pin 7 of K-1) exceeds 7.5 volts, the voltage across the heater element of K-1 increases and causes the relay to operate. Contacts of K-1 then open, placing resistors R-33 and R-34 in series with the receiver-transmitter fila-



ments. The increased resistance drops the filament voltage to a safe value, but maintains it high enough to allow circuit checking. When the contacts of K-1 open, the resistance in series with the heater element of K-1 is also increased, since R-33 and R-34 are no longer in parallel. This increased resistance protects the thermal relay by reducing the voltage drop across the heater element. The relay remains in an operated condition until power is removed from the amplifier unit.

- (4) When an overvoltage condition occurs, the bias on power output tube V-5 rises simultaneously with the filament voltage of the receiver-transmitter. When the thermal relay operates, the bias is reduced simultaneously with the filament voltage.

c. **PLATE SUPPLY CIRCUIT.** The battery potential is supplied through terminal 3 of J-5 to terminal 3 of X-1 in the vibrator power supply unit. The vibrator unit converts the storage battery voltage to a high-voltage plate and screen supply. The output voltage, approximately 150 volts when S-2 is in the INT position and approximately 130 volts when S-2 is in the RT-70 position, is developed across terminals 8 (+) and 7 (—) of J-5. The voltage is applied through T-5 to the plates of V-5 (fig. 17), through R-13 to the plates of V-1, and through R-25 to the plates of V-4 and the plates and screens of V-2 and V-3. When S-2 is in the RT-70 position the d-c output voltage of the power supply unit is applied also through contacts of S-2 (section 1B) and through voltage-dropping resistors R-37, R-39, and R-41 to terminals J of connectors J-3 and J-4. The 90-volt potential appearing at these terminals is used to supply the plate and screen voltages for Receiver-Transmitter RT-70/GRC, which may be used with the amplifier. Voltage regulator tube V-6, tube type OB2, is connected in series with current limiting resistor R-38 from the junction of R-37 and R-39 to terminal E of J-3. Voltage regulator V-7, also a type OB2 tube, is connected in series with current limiting resistor R-40 from the junction of resistors R-39 and R-41 to terminal E of J-3. These tubes limit the maximum output voltage when terminal E is grounded by external system wiring.

When plug P-1 of Cable Assembly CX-1213/U is plugged into J-3 (RT-70 POWER connector), terminal E of J-3 is connected to terminal E of P-1 in Cable Assembly CX-1213/U. Terminal E of P-1 is connected through the cable to terminal E of P-2 at the other end of Cable Assembly CX-1213/U. Terminal E of P-2 is jumped to terminal D of P-2 which connects (through the cable) to terminal D of P-1 and to terminal D of J-3 which is grounded in the amplifier. The voltage regulator tubes, V-6 and

V-7, therefore draw current only when Cable Assembly CX-1213/U is plugged into J-3 (RT-70 POWER).

The purpose of this arrangement is to prevent the voltage regulator tubes from operating when Receiver-Transmitter RT-70/GRC is not connected to the amplifier. Under such conditions the tubes would be overloaded and their life would be shortened. It is therefore important, when connecting Cable Assembly CX-1213/U between the amplifier and Receiver-Transmitter RT-70/GRC, that plug P-2 of the cable assembly be connected to the POWER receptacle of the receiver-transmitter before plug P-1 is connected to the RT-70 POWER connector (J-3) of the amplifier.

d. **RELAY, MICROPHONE, AND CONTROL VOLTAGE SUPPLIES.** Socket connector X-1 of Power Supply PP-282/GRC provides a strap connection between terminals 3 and 6 of connector J-5 in the power supply compartment of the amplifier. (See the lower left-hand corner of figure 10.) This connection arranges a group of voltage-dropping resistors (R-27 through R-30) to drop the 24 volts from the storage battery to the 6 volts required by relay O-1, the microphone circuit, and external control circuits.

- (1) *Relay circuit.* The strap connection between terminals 3 and 6 of J-5 connects the battery circuit through voltage-dropping resistors R-28 and R-27 to the 6-volt coil of relay O-1 (terminal 4). The relay circuit extends through the relay coil (terminal 1) to terminals F of J-1 and K of J-2. The relay is energized when ground return is connected to either one of these terminals. In a typical installation, ground is connected to these terminals when the interphone microphone push-to-talk button is operated.
- (2) *Microphone circuit.* The strap connection between terminals 3 and 6 of J-5 also connects the battery circuit through R-28 and R-27 to the microphone circuit. The circuit continues through voltage-dropping resistor R-2, choke L-2, and the primary winding of microphone transformer T-1 over the normally open contacts of relay O-1 to terminals C of connectors J-1 and J-2. In a typical installation, the carbon element of the microphone is connected between terminal C of J-1 or J-2 and ground through the microphone push-to-talk switch. When the push-to-talk switch is closed, relay O-1 in the amplifier is energized. Its contacts close, complete the talking circuit, and apply the excitation voltage to the carbon element of the mi-



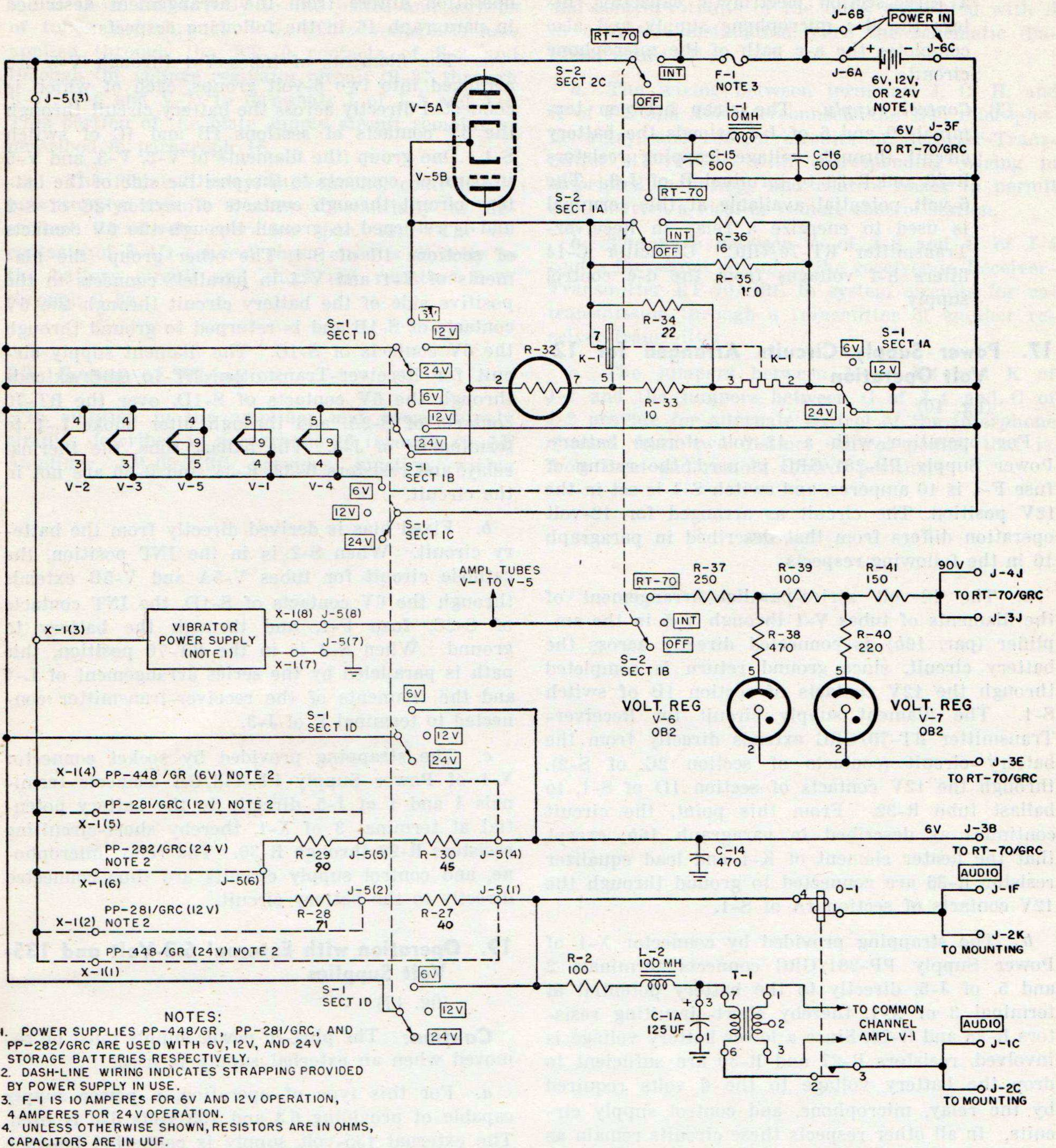


Figure 10. Power supply circuits.



crophone. Capacitor C-1A, one section of a three-section electrolytic capacitor, filters the d-c microphone supply and also completes the a-c path of the microphone circuit.

- (3) *Control supply.* The strap between terminals 3 and 6 of J-5 extends the battery circuit through voltage-dropping resistors R-29 and R-30 to terminal B of J-3. The 6-volt potential available at this terminal is used to energize a relay in Receiver-Transmitter RT-70/GRC. Capacitor C-14 filters h-f voltages from the d-c control supply.

## 17. Power Supply Circuits Arranged for 12-Volt Operation

(fig. 10)

For operation with a 12-volt storage battery, Power Supply PP-281/GRC is used, the rating of fuse F-1 is 10 amperes, and switch S-1 is set in the 12V position. The circuit as arranged for 12-volt operation differs from that described in paragraph 16 in the following respects:

*a.* The 12-volt series-parallel arrangement of the filaments of tubes V-1 through V-5 in the amplifier (par. 16*b*) is connected directly across the battery circuit, since ground return is completed through the 12V contacts of section 1B of switch S-1. The filament supply circuit for Receiver-Transmitter RT-70/GRC extends directly from the battery circuit (contacts of section 2C of S-2), through the 12V contacts of section 1D of S-1, to ballast tube R-32. From this point, the circuit continues as described in paragraph 16*b*, except that the heater element of K-1 and load equalizer resistor R-36 are connected to ground through the 12V contacts of section 1A of S-1.

*b.* The strapping provided by connector X-1 of Power Supply PP-281/GRC connects terminals 2 and 5, of J-5, directly to the battery potential at terminal 3 of X-1, thereby short-circuiting resistors R-28 and R-29. Since a lower battery voltage is involved, resistors R-27 and R-30 are sufficient to drop the battery voltage to the 6 volts required by the relay, microphone, and control supply circuits. In all other respects these circuits remain as described in paragraph 16*d*.

## 18. Power Supply Circuits Arranged for 6-Volt Operation

(fig. 10)

For operation from a 6-volt storage battery, Power Supply PP-448/GR is used, the rating of fuse F-1 is 10 amperes, and switch S-1 is set in

the 6V position. The circuit as arranged for 6-volt operation differs from the arrangement described in paragraph 16 in the following respects:

*a.* The filaments of tubes V-1 through V-5 are arranged into two 6-volt groups, each of which is connected directly across the battery circuit through the 6V contacts of sections 1B and 1C of switch S-1. One group (the filaments of V-2, V-3, and V-5 in parallel) connects to the positive side of the battery circuit through contacts of section 2C of S-2 and is returned to ground through the 6V contacts of sections 1C of S-1. The other group (the filaments of V-1 and V-4 in parallel) connects to the positive side of the battery circuit through the 6V contacts of S-1B and is returned to ground through the 6V contacts of S-1C. The filament supply circuit for Receiver-Transmitter RT-70/GRC extends through the 6V contacts of S-1D, over the RT-70 contacts of S-2A, and through filter choke L-1 to terminal F of J-3. The ballast tube, the thermal relay, and resistors R-33, R-34, and R-36 are not in the circuit.

*b.* Fixed bias is derived directly from the battery circuit. When S-2 is in the INT position, the cathode circuit for tubes V-5A and V-5B extends through the 6V contacts of S-1D, the INT contacts of S-2C, fuse F-1, and through the battery to ground. When S-2 is in the RT-70 position, this path is paralleled by the series arrangement of L-1 and the filaments of the receiver-transmitter connected to terminal F of J-3.

*c.* The strapping provided by socket connector X-1 of Power Supply PP-448/GR connects terminals 4 and 1 of J-5, directly to the battery potential at terminal 3 of X-1, thereby short-circuiting resistors R-27 through R-30. The relay, microphone, and control supply circuits are thus connected directly to the battery circuit.

## 19. Operation with External 6.3-Volt and 135-Volt Supplies

(fig. 17)

**Caution:** The plug-in power supply must be removed when an external supply is used.

*a.* For this type of operation, a power supply capable of providing 6.3 and 135 volts d-c is used. The external 135-volt supply is connected between terminal D (+) and C (—) of J-6. The 6.3 volt supply is connected between terminals A-B (+) and C (—) of J-6. Since the vibrator power supply unit is not in its compartment, the strap connections provided by that unit are not there. It is necessary to set S-1 in the 6V position to establish continuity between the 6.3-volt source and the relay, microphone, and control supply circuits. A 4-ampere fuse is used for F-1.



b. The 135-volt supply is connected from terminal D of J-6 directly to the plates and screens of tubes V-1 through V-5. This voltage is also applied through the RT-70 contacts of S-2 and through the voltage regulator circuit (R-37 through R-41, V-6 and V-7) to terminals J of J-3 and J-4. This portion of the plate supply circuit remains as described in paragraph 16.

c. The filament, relay, microphone, control, and bias supply circuits remain substantially as described for 6-volt operation (par. 18). The 6V contacts of S-1D connect these circuits directly to the battery circuit and short out resistors R-27 through R-30.

## 20. System of Wiring

In addition to the amplifier and power supply circuits described in paragraphs 16 through 19, AF Amplifier AM-65/GRC provides junction wiring

which serves to interconnect the signal, power, and control circuits of the units associated with it in a system installation. See the schematic diagram, figure 17.

a. The wiring between terminals J, C, H, and K of J-3 and J-4 interconnects the B+, microphone, relay, and control circuits of Receiver-Transmitter RT-70/GRC with corresponding wiring in associated mountings and control boxes to permit control from a local or remote control station.

b. The wire between A of J-3 and B of J-4 routes the signal output of the receiver in Receiver-Transmitter RT-70/GRC to system circuits for retransmission through a transmitter of another receiver-transmitter.

c. The jumpers between F of J-1 and K of J-2 and the jumpers between C of J-1 and C of J-2 provide for alternate control of the interphone channel from two distinct control points, that is, from local and remote control positions.



# CHAPTER 3

## FIELD MAINTENANCE INSTRUCTIONS

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

### Section I. PREREPAIR PROCEDURES

#### 21. Tools, Materials, and Test Equipment

Tools, materials, and test equipment needed for performing the preresearch procedures in this section are listed below:

Tool Equipment TE-113.

Tube Puller TL-201.

Cleaning fluid: Solvent, dry-cleaning, (SD); Federal specification P-S-661a.

Tube Tester I-177, or equivalent tube tester capable of checking the tubes in the amplifier.

Electronic Multimeter TS-505/U: d-c volt-ohmmeter.

Test Lead Set CX-1331/U.

#### 22. Removal of Pluck-out Parts

*a.* To remove any of the pluck-out parts except the fuse, the immersionproof cover must be removed. Proceed as follows:

(1) Loosen the four Dzus fasteners located on the right and left edges of the front panel.

(2) Stand the unit on the front panel and lift off the cover. Take care not to damage any wiring or components while removing the cover or at any time while the panel-and-chassis assembly is being handled without the cover on.

*b.* The fuse is accessible from the front panel (fig. 1). Unscrew the fuse cap at the top of the panel. Removal of the cap also will cause the fuse to come out of its holder, since the cap is also a fuse extractor.

*Note.* A spare fuse is mounted on the rear wall of the chassis assembly (fig. 3). A small compartment adjacent to the fuse holds the circuit label.

*c.* Remove the plug-in power supply unit as follows:

- (1) Loosen the clamp bracket at the rear of the power supply compartment (fig. 11).
- (2) Pull the power supply unit out of the compartment. A handle is provided on the power supply unit for this purpose.
- (3) Check that the voltage marking on the power supply unit and the voltage indicated by the meter on the front panel (fig. 1) agree.

*d.* Remove the tubes as follows:

- (1) Place the unit in its normal operating position, and remove the tube shields.
- (2) Remove tubes V-1 through V-7 from their sockets (fig. 3) with a tube puller. If a tube puller is not available, pull up the tubes with the fingers, using a straight upward pull. Do not rock or jiggle the tube in its socket; the socket prongs may become damaged.

*e.* Ballast tube R-32 and thermal relay K-1 are mounted horizontally in the rear of the chassis (fig. 3). Remove these parts with a straight horizontal pull, following the precaution indicated in *d* above.

*f.* Remove electrolytic capacitor C-1 (fig. 3).

#### 23. Inspecting and Cleaning Pluck-out Parts

*a.* Inspect the electrolytic capacitor for discoloration, corrosion, bulging, or leakage of liquid. If these conditions are observed, substitute a new electrolytic capacitor known to be in good condition.

*b.* Inspect glass envelopes of tubes, thermal relay, and ballast tube. Replace them if the envelope is loose or cracked. Wipe off dirt or dust.



c. Inspect the bases of pluck-out parts for evidences of damage. Clean dirty or corroded pins by rubbing them lightly with fine emery cloth. Dust them with a small, clean brush. Clean the base and shell of the capacitor with a clean lint-free cloth moistened with solvent (SD). Dry in an air draft.

d. Clean the fuse ends and clips with emery cloth. Wipe with a clean cloth. Throw away blown fuses.

## 24. Testing Pluck-out Parts

a. TUBES V-1 THROUGH V-5. Check vacuum tubes V-1 through V-5 with Tube Tester I-177 (or equivalent). If a tube checker is not available, the most reliable test is to substitute the tube in a unit known to be operating properly.

b. THERMAL RELAY K-1. Using Electronic Multimeter TS-505/U as an ohmmeter, check the continuity as follows:

Pins	Meter reading (ohms)
5 and 7.....	0
2 and 3.....	27.7

c. BALLAST TUBE R-32. The ohmmeter connected between pins 2 and 7 of the ballast tube should read about 3 ohms.

d. ELECTROLYTIC CAPACITOR C-1. The triple-section electrolytic capacitor C-1 may be tested by substituting one from an amplifier known to be in good operating condition and observing whether the unit continues to operate unsatisfactorily when the capacitor is installed. The capacitor may be tested also by using an ohmmeter. For testing sections C-1B and C-1C of the capacitor, which have high-voltage ratings, use the high-resistance scale (at least 5 megohms) of the ohmmeter. For testing low-voltage section C-1A, use the 50,000-ohm range of the meter. Test each section of the capacitor separately. Proceed as follows:

- (1) Before making any measurements, discharge the capacitor by shorting the positive and negative terminals. This applies also if a measurement is to be repeated. Note that the negative terminal is common to all three sections of the capacitor.

- (2) Connect the positive lead of the ohmmeter to the positive terminal of the capacitor section under test. Connect the negative lead of the meter to the common negative terminal of the capacitor.

- (3) Observe the meter pointer. The ohmmeter first should indicate a very low value of resistance. The pointer should then creep up slowly in the high-resistance direction on the scale. The final resistance reading should be at least 1 megohm for each of the high-voltage sections, C-1B and C-1C, and about 15,000 ohms for the low-voltage section, C-1A.

- (4) If the final resistance reading is less than 250,000 ohms for C-1B or C-1C or less than 3,000 ohms for C-1A, the capacitor should be replaced.

e. VOLTAGE REGULATOR TUBES V-6 AND V-7. Check the emission of the tubes with a tube checker. Using the ohmmeter, make the measurements indicated below:

Point of measurement	Meter reading (ohms)
Pins 1 to 5.....	0
Pins 2 to 4.....	0
Pins 2 to 7.....	0
Pins 2 to 5.....	infinity

f. FUSE F-1. Using an ohmmeter, check the fuse for continuity. Discard the fuse if the check shows it to be open.

## 25. Disassembly for Inspection and Cleaning

(Fig. 11)

Note. Save screws and washers which will be removed during the disassembly procedure that follows. They will be needed for reassembly of the unit.

a. PANEL.

- (1) Remove the six screws which hold the panel to the chassis assembly. Two screws are located at the top, two on the bottom, and one on each side of the assembly.

- (2) Carefully pull the panel away from the chassis as far as the cable wiring will permit. Take care not to loosen any soldered connections. Do not place undue strain on the cable. Handle switch assemblies only when necessary.



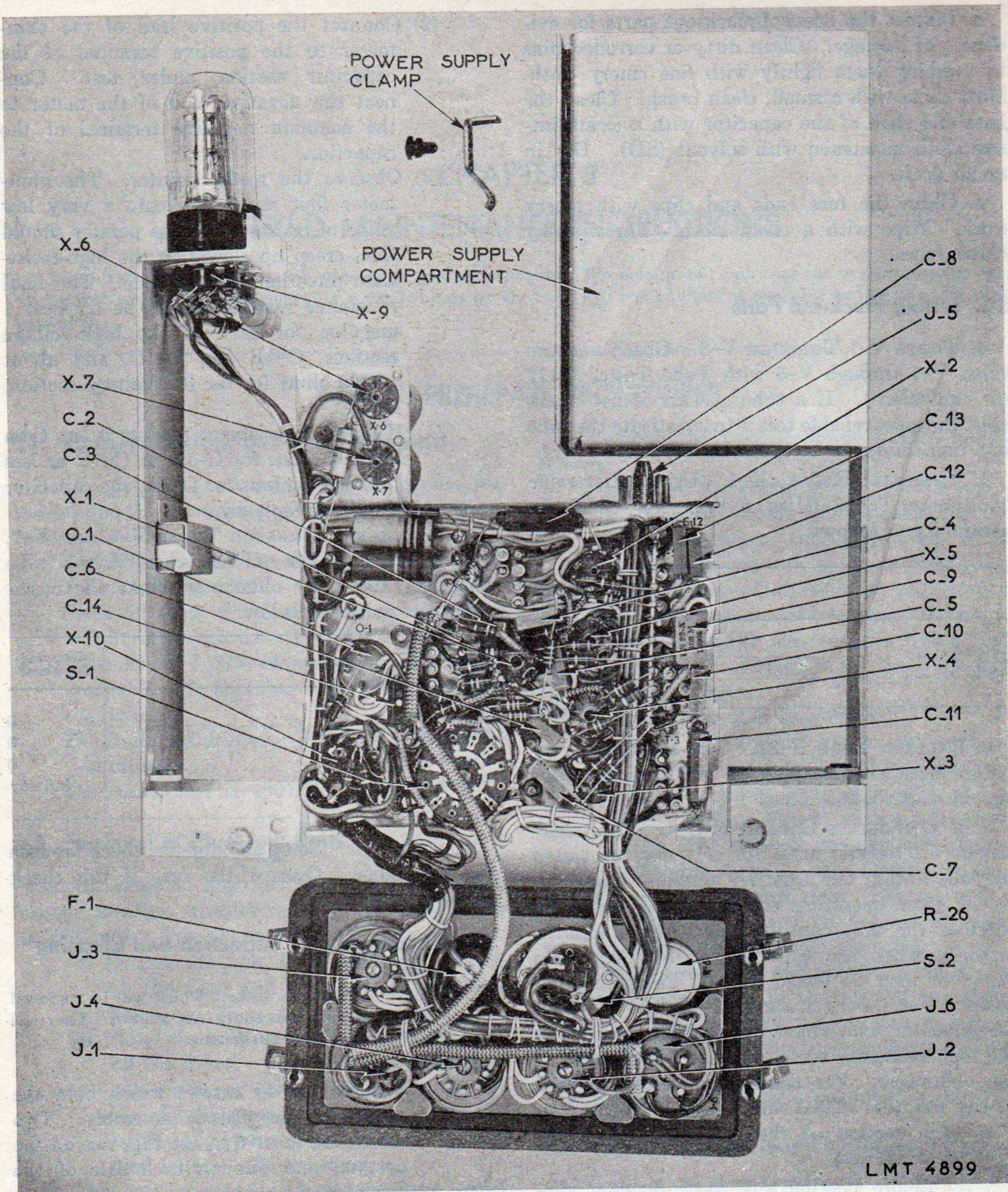


Figure 11. AF Amplifier AM-65/GRC, disassembled view.



**b. SIDE BRACKET.** To gain access to the components located within the small compartment in the rear of the chassis, remove the right side wall as follows:

- (1) Remove the five screws which hold the side wall of the assembly. Two screws are located at one end of the wall, two toward the middle of the wall, and one at the front of the assembly.
- (2) Carefully disengage the side wall from the tabs on the bottom portion of the chassis, being careful not to damage the wiring to sockets X-8 and X-9.

## 26. General Inspection

After the unit has been disassembled (pars. 22 and 25), it is possible to inspect all parts and wiring. Thoroughly inspect the unit for any abnormal conditions. If any are found, the cause of such conditions should be determined and the defects remedied before proceeding with the trouble-shooting and other tests described in paragraphs 29 through 38 and 45 through 49. Repair instructions are given in paragraphs 39 through 41.

**a. CHASSIS.** Examine the chassis for mechanical defects, dirt, and corrosion.

**b. WIRING.** Examine for charred, loose, defective, or broken wiring and insulation. Examine lugs on capacitors, transformers, chokes, switches, and connectors, and on tube and relay sockets.

**c. MOUNTING HARDWARE.** Examine all nuts, bolts, and other mounting hardware on the chassis to make sure that they are not loose. Loose mounting hardware may cause intermittent noises in the amplifier and in the set associated with it.

**d. SOCKETS.** Inspect tube and other sockets for broken or excessively spread or corroded and dirty contacts. Check mounting rivets to determine that sockets are held firmly to the chassis. See that the tube shields hold firmly to their bases.

**e. CONNECTORS.** Examine connectors for corrosion of contacts, breaks or damage to insulation, and defective wiring.

**f. CAPACITORS.** Examine capacitors for signs of discoloration, leaks, bulging, dirt, loose mountings, or loose connections. Melted or oozing wax or other dielectric is a sure sign of damage to the part. Such capacitors must be removed for electrical check and replaced with good ones.

**g. RESISTORS.** Examine bodies of resistors for blistering, discoloration, or other signs of over-

heating. Inspect connecting leads for corrosion, dirt, dust, looseness, and broken or trailing strands in the connecting wires. Discoloration of the resistor may indicate that the component has been operated under overload and overheating, and may be taken as a sign of a defect in another part. (Power resistors may show discoloration as a result of burning of the fungicidal lacquer; hence the discoloration does not always indicate a defective resistor.) Be careful when examining or removing resistors which have pigtail connections. These connections may break at the point of entry into the body of the resistor and render it useless.

**h. TRANSFORMERS.** Leakage of potting compound from transformers is evidence of a short circuit in a winding of that part or of overloading because of associated faulty resistors or capacitors.

**i. FUSE HOLDER.** Check the fuse holder for signs of burning, charring, corrosion, or poor contact with the fuse.

*Note.* A burned-out fuse is usually a sign of failure in another part of the circuit. When a fuse is found to be burned out, the trouble is automatically localized to the filament, relay, or plate supply circuits in the amplifier.

**j. SWITCH.** Operate the switch on the front panel to each of its operating positions to determine that it works easily with no searching for contacts. Examine switch contacts for evidences of corrosion, improper contact, or dirt. Do not place excessive strain on the solder connections of the switch.

## 27. Cleaning

**a.** Dirt or corrosion will interfere with electrical continuity and mechanical efficiency of the parts and the unit by causing circuits to be shorted or insulated, or by causing switches to be jammed. For these reasons, it is important to clean all parts of the chassis and panel carefully and thoroughly.

**b.** No set method can be given for removal of dirt because of the many ways and places in which it can be collected. Cleaning should be done with a lintless cloth, fine (#000) sandpaper, crocus cloth, a soft brush, or, in more difficult cases, with the sharp edge of a screw driver. Dust and grease usually can be removed with a cloth or brush moistened in solvent (SD). *Never use gasoline for cleaning.* Be extremely careful in cleaning spots which are difficult to reach or parts which are delicate in order to avoid damage to wiring or parts. When it is necessary to remove portions



of the moisture-fungiproofing from a part, re-tropicalization is essential (par. 43b).

c. If available, use an air hose to blow out dust and lint from the chassis. Make sure, however, that no oil or water is carried along with the air stream and that the stream is controlled so that damage to small resistors and capacitors does not result.

d. Clean the cases of fixed capacitors, the relay, and other components. Remove all dirt and corrosion. In most cases, a dry cloth will do the job. If deposits of dirt are hard to remove, moisten the cloth with solvent (SD). Dry carefully.

e. Clean small components, such as resistors, with a small brush.

f. Clean dirty or corroded socket and switch contacts carefully. Use crocus cloth to remove corrosion. The wafer of switch S-1 is fragile; handle it with care.

## Section II. FIELD TROUBLE-SHOOTING

**Warning:** Never turn the OFF-INT-RT-70 switch to the RT-70 position when power is applied to the unit, unless suitable loads are connected across the power supply circuit output terminals which feed Receiver-Transmitter RT-70/GRC. Without proper loads, thermal relay K-1 will be severely overloaded.

### 29. Trouble-shooting Procedures

The test procedures for sectionalizing and localizing trouble in the amplifier are outlined in the following steps.

a. **SHORT-CIRCUIT CHECKS.** These checks consist of resistance measurements. They are intended to locate short circuits which might damage the battery or power supply, or cause additional damage to the equipment when power is applied (par. 31). Repair all short circuits before applying power to the unit.

b. **OPERATIONAL CHECKS.** The operational checks (pars. 32 and 34) are made to determine whether or not the amplifier functions properly. The trouble symptoms obtained will point to a faulty condition within a specific circuit section, and in some cases to a specific wire or part. It is recommended that each trouble be cleared as it is found before proceeding with the next operational check. Accordingly, the operational checks are divided into two parts, as follows:

### 28. Reassembly

The arrangement of AF Amplifier AM-65/GRC is such that, even though the unit is disassembled as described in the preceding paragraphs, electrical continuity exists between all parts of the unit. It is suggested that the unit be left unassembled for the test and repairs to be described in the following section. The trouble-shooting procedures given in section II of this chapter and the repair procedures given in section III of this chapter are based on the assumption that the unit is disassembled. Replace pluck-out parts as directed in the procedure for the particular test. When the required results are obtained for the checks of paragraphs 32 and 34, and any necessary repairs have been made, reassemble the unit in accordance with the procedure given in paragraph 41.

- (1) Power supply circuit output voltage measurements (par. 32) are made to determine that the proper voltages are delivered to the amplifier and are made available for connection to Receiver-Transmitter RT-70/GRC. If the correct voltages are present at the output terminals, proceed with the signal transmission measurements (par. 34). Otherwise, localize the trouble within the power supply circuits (par. 33) and remedy the defect before making the signal transmission checks.
- (2) Signal transmission checks (par. 34) through the three channels of the amplifier are made to determine whether the signal paths are in proper operating condition and provide the proper gain.

c. **SIGNAL SUBSTITUTION.** Once the trouble within the signal paths of the amplifier is sectionalized by means of the operational checks to a particular channel, a signal substitution or signal tracing procedure (par. 35) is used to localize the trouble to a particular stage within the channel.

d. **RESISTANCE MEASUREMENTS.** These tests are made to locate faulty or defective components and wiring within the circuit or stage shown to be faulty by the signal tracing procedure (pars. 35 and 37).

e. **VOLTAGE MEASUREMENTS.** Voltage measurements (par. 36) are made to determine whether the



correct d-c voltages are present at significant points of the circuit. They are made for the purpose of disclosing faults not observable during the preceding tests.

f. **ADDITIONAL CHECKS.** The interconnector strapping in the amplifier is important in the application of the unit in a system. Continuity checks (par. 38) are made to determine whether these strap connections are made as required.

### 30. Test Equipment

The following equipment is required for making the trouble-shooting tests described in this section.

a. Any one of the following power supply combinations:

- (1) A 6-volt storage battery and Power Supply PP-448/GR.
- (2) A 12-volt storage battery and Power Supply PP-281/GRC.
- (3) A 24-volt storage battery and Power Supply PP-282/GRC.
- (4) A 6-volt filament supply and a 135-volt plate and screen supply.

b. Electronic Multimeter TS-505/U, d-c volt-ohmmeter.

c. Electronic Multimeter ME-6/U, vacuum-tube voltmeter.

d. Audio Oscillator TS-382A/U.

e. Any one of the following combinations of audio devices:

- (1) Chest Set Group AN/GSA-6 with Headset-Microphone H-63/U.
- (2) Microphone M-29/U and Headset Navy type CW-49507.

f. Dynamic Loudspeaker LS-166/U.

g. Switch, single-pole, single-throw.

h. Capacitor paper dielectric; 2 uf (microfarad), 600 vdcw.

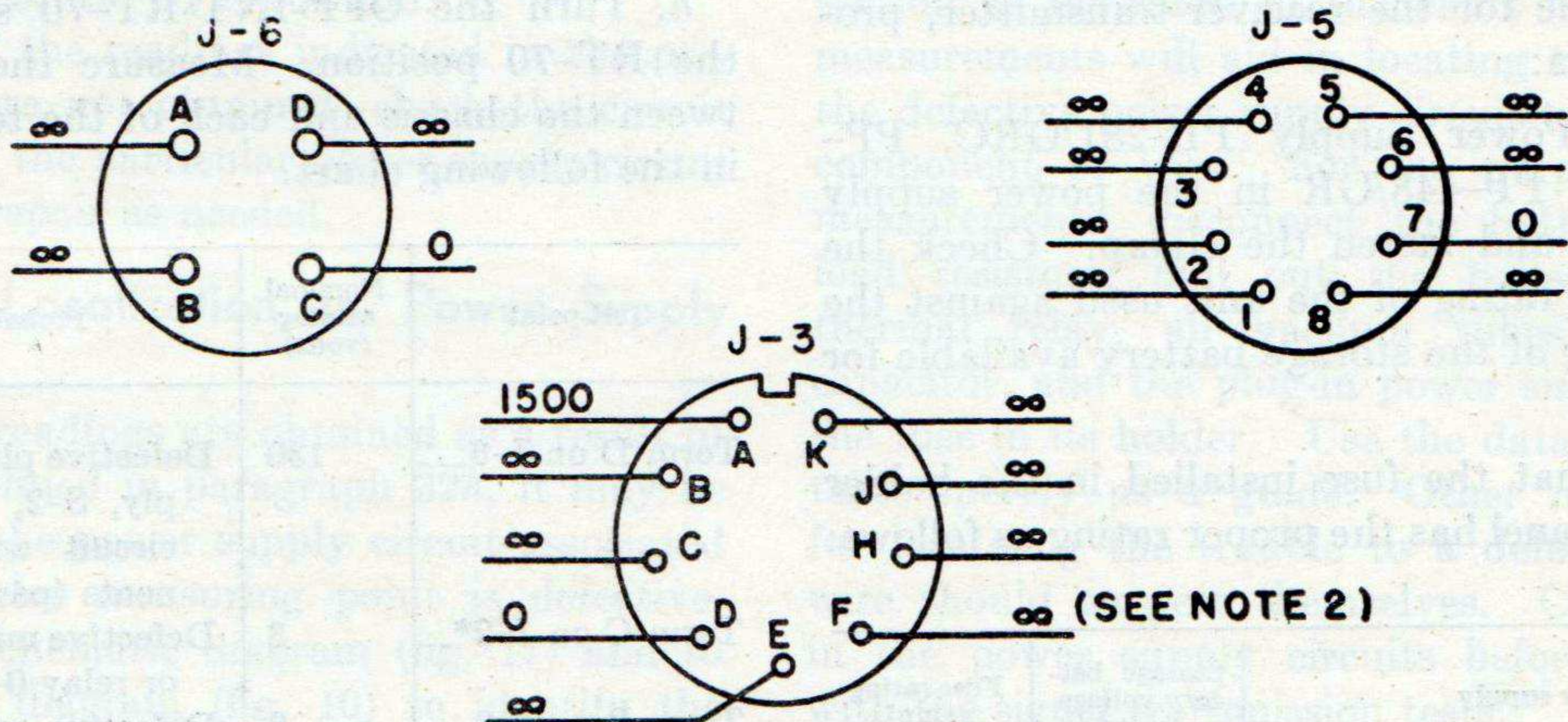
i. Dummy load resistors, as follows:

- (1) One resistor, 150 ohms, 5 watts.
- (2) Two resistors, 600 ohms, 5 watts.
- (3) One resistor, 100 ohms, 5 watts.
- (4) One resistor, 1,200 ohms, 10 watts.
- (5) One resistor, 39 ohms, 5 watts.
- (6) One resistor, 17.5 ohms, 5 watts.

### 31. Short-circuit Checks

(fig. 12)

a. Restore a good fuse in the fuse holder on the panel and replace the fuse cap. Do not reinsert any of the other pluck-out parts. Use Electronic Multimeter TS-505/U, or an equivalent meter, to check the resistance between each of the points on connectors J-3, J-5, and J-6 and chassis. The points of measurement and the required readings are summarized in figure 12. First turn internal



**NOTE 1:** ALL EXTERNAL & INTERNAL PLUG-IN COMPONENTS MUST BE REMOVED.

**NOTE 2:** 150 OHMS WITH S-1 IN EITHER 12V OR 24V POSITION & S-2 IN RT-70 POSITION.

Figure 12. AF Amplifier AM-65/GRC, short-circuit checks on power supply circuits.



switch S-1 to the 24V position, and obtain readings for each of the three positions of S-2. Repeat this procedure for the 12V and 6V positions of S-1. The readings shown in figure 12 should be obtained for all switch positions, except as indicated by the notes on the figure.

b. If a required reading is not obtained, refer to figure 10, functional diagram of the power supply circuits, and to the over-all schematic for the amplifier (fig. 17), to determine which part or parts may be responsible for the trouble. Incorrect readings may be due to a shorted or leaky capacitor (C-14), or to a wire or a lug on one of the parts shorted to the chassis. Check each capacitor in the affected circuit section for leakage or short and replace, if necessary. Check the wires, lugs on components, and contacts on switches, and repair as necessary. Do not apply power to the unit until the trouble has been cleared, and the readings indicated by figure 12 are obtained for all switch positions.

### 32. Trouble Sectionalization in Power Supply Circuits

(fig. 13)

To check whether the power supply circuits within AF Amplifier AM-65/GRC are functioning properly, and whether the correct voltages are made available for the receiver-transmitter, proceed as follows:

a. Install Power Supply PP-281/GRC, PP-282/GRC, or PP-448/GR in the power supply compartment and fasten the clamp. Check the input voltage rating of the unit used against the voltage rating of the storage battery available for these tests.

b. Check that the fuse installed in the holder on the front panel has the proper rating as follows:

Power supply	Storage battery voltage (volts)	Fuse rating (amp)
PP-281/GRC	12	10
PP-282/GRC	24	4
PP-448/GR	6	10

c. Set the 6V-12V-24V switch (mounted on the chassis, screw driver control) to the position corresponding to the input voltage used.

d. Insert all pluck-out parts, including tubes V-1 through V-5, voltage regulator tubes V-6 and V-7, ballast tube R-32, thermal relay K-1, and capacitor C-1. Make sure that they are firmly seated in their sockets.

e. Make sure that the OFF-INT-RT-70 switch S-2 is in the OFF position at this time.

f. Connect a set of dummy load resistors between the output terminals and ground (terminal D of J-3). The values of the load resistors and the connection points are listed in the following chart.

Terminal	Connector	Resistance or connection
B	J-3	39 ohms, 5 watts.
E	J-3	Ground.
F	J-3	17.5 ohms, 5 watts.
J	J-3	1,200 ohms, 10 watts.
K	J-2	On-off switch to ground.*
C	J-2	100 ohms, 5 watts.
F	J-2	600 ohms, 5 watts.
H	J-2	150 ohms, 5 watts.
A	J-2	600 ohms, 5 watts.

\*Keep this switch open unless otherwise directed in the test procedure.

g. Connect the (+) terminal on the storage battery to terminals B-A (strapped internally) on connector J-6. Connect the (-) terminal of the battery to terminal C of J-6.

h. Turn the OFF-INT-RT-70 switch S-2 to the RT-70 position. Measure the voltages between the chassis and each of the terminals listed in the following chart.

Test point	Nominal reading (volts)	Probable trouble
Term D on J-6	130	Defective plug-in power supply, S-2, or plate supply circuit wiring or components (par. 33).
Term C on J-2*	3	Defective microphone circuit or relay 0-1 (par. 33).
Term B on J-3	6	Defective relay supply lead (par. 33).
Term F on J-3	**6.3	Relay K-1 operated or defective filament supply circuit for the receiver-transmitter (par. 33).
Term J on J-3	90	Defective 90-volt supply circuit for receiver-transmitter (par. 33).

\*Close external switch connected to K of J-2.

\*\*Slightly less for 6V position of S-1.



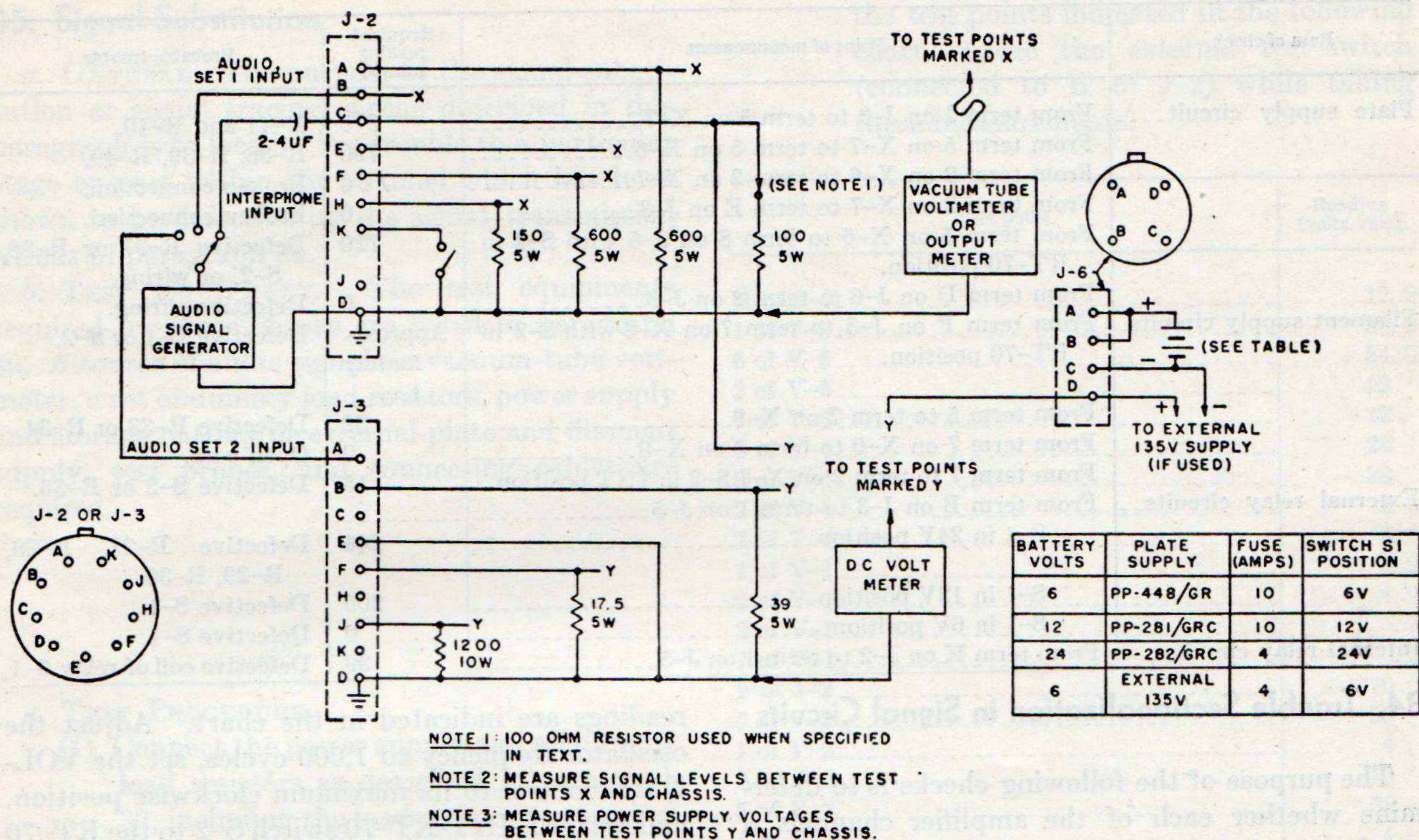


Figure 13. AF Amplifier AM-65/GRC, operational test set-up for voltage and signal transmission checks.

i. The filaments of amplifier tubes V-1 through V-5 are not accessible at any of the connector points. Check whether filament voltage is applied to these tubes by noting whether they are lit.

j. Turn S-2 to the OFF position.

k. If any of the readings indicated in the preceding table are not obtained, check the circuit components in the particular power supply circuit (par. 33) and repair as needed.

### 33. Trouble Localization in Power Supply Circuits

If incorrect readings are obtained as a result of the checks outlined in paragraph 32h, it may be assumed that the power supply circuit associated with a particular measuring point is defective. Refer to the schematic diagram (fig. 17) and to the functional diagram (fig. 10) to identify the

point of measurement with the circuit section involved. Using Electronic Multimeter TS-505/U, or an equivalent ohmmeter, make point-to-point resistance measurements for the defective circuit section as indicated in the chart below. These measurements will aid in locating the trouble in the defective power supply circuit to a particular component or wire. For the purpose of these measurements, disconnect the battery and the load resistors; pull out the ballast tube, the thermal relay, all vacuum tubes, electrolytic capacitor, and the plug-in power supply. Leave the fuse in its holder. Use the data given in the table merely as a guide. Other measurements for localizing the trouble to a defective part of wire should suggest themselves. Clear troubles in the power supply circuits before proceeding with the signal transmission tests.



Item of check	Point of measurement	Required reading (ohms)	Probable trouble
Plate supply circuit	From term J on J-3 to term 5 on X-7	370	R-41 and R-40.
	From term 5 on X-7 to term 5 on X-6	790	R-38, R-39, R-40.
	From term 2 on X-6 to term 2 on X-7	0	Broken connection.
	From term 2 on X-7 to term E on J-3	0	Broken connection.
	From term 5 on X-6 to term 8 on J-5 with S-2 in RT-70 position.	720	Defective R-37 or R-38, S-2, or wiring.
Filament supply circuits	From term D on J-6 to term 8 on J-5	0	Defective wiring.
	From term F on J-3 to term 7 on X-8 with S-2 in RT-70 position.	Approximately 1.	Defective L-1 or S-2.
	From term 5 to term 7 on X-8	32	Defective R-33 or R-34.
External relay circuits	From term 7 on X-9 to term 5 on X-8	0	Open wire.
	From term 7 to term 2 on X-8 S-2 in INT position	15	Defective S-2 or R-36.
	From term B on J-3 to term 1 on J-5		
	S-1 in 24V position	246	Defective R-27, R-28, R-29, R-30.
	S-1 in 12V position	200	Defective S-1.
Internal relay circuit	S-1 in 6V position	0	Defective S-1.
	From term K on J-2 to term 1 on J-5	39	Defective coil of relay 0-1.

### 34. Trouble Sectionalization in Signal Circuits

The purpose of the following checks is to determine whether each of the amplifier channels is continuous for transmission of signal, whether it provides the required gain, and whether the proper paths are taken by the signals applied to each of the input terminals. In the checks summarized in the following chart, it is assumed that the connections made in paragraph 32 are retained. The test circuit arrangement is shown in figure 13. In addition, the oscillator connections, oscillator output levels, points of measurement, and required

readings are indicated in the chart. Adjust the oscillator frequency to 1,000 cycles, set the VOLUME control to its maximum clockwise position, and set OFF-INT-RT-70 switch S-2 to the RT-70 position. Allow a warm-up period of a few minutes. The oscillator output level should be measured across the terminals to which the oscillator is connected. Use a high impedance a-c voltmeter or a vacuum-tube voltmeter (par. 30) to make all measurements. Failure to meet any of the required reading points to the fault or faults indicated in the probable trouble column of the chart for that particular item.

Oscillator		Measuring point	Required reading (volts)	Probable trouble
Connection	Output level (volts)			
C on J-2 (interphone signal). Close external switch connected to K of J-2.	0.25	E on J-2	30	Defective, amplifier V-1, V-4, or V-5.
		H on J-2	15.5	Defective transformer T-5 or wiring from 150-ohm tap on T-5 to terminal H on J-2.
		F on J-2	15	Defective amplifier V-1 or V-2 and associated circuits.
B of J-2 (Set 1 signal)	5	A on J-2	15	Defective amplifier V-1 or V-3 and associated circuits.
		F on J-2	15	Defective input circuit or amplifier V-2 in Set 1 + INT channel.
A of J-3 (Set 2 signal)	3.5	H on J-2	12.5	Defective amplifier V-1, V-4, or V-5 and associated circuits.
		A on J-2	02*	Defective C-1.
	5	A on J-2	15.	Defective input circuit or amplifier V-3 in Set 2 + INT channel.
		H on J-2	12.5	Defective amplifier V-1 or interphone channel circuits.
3.5	F on J-2	02**	Defective C-1.	

\*At least 50 db below signal level at F of J-2.

\*\*At least 50 db below signal level at A of J-2.

Note. All connections and measurements made between terminals indicated and ground.



### 35. Signal Substitution

*a. GENERAL.* The purpose of the signal substitution or signal tracing checks described in this paragraph is to localize the trouble to a particular stage or part within the channel which has been shown to be defective by the signal transmission checks of paragraph 34.

*b. TEST EQUIPMENT.* The test equipments required for these checks are listed in paragraph 30. A source of audio signals, a vacuum-tube voltmeter, a set of dummy load resistors, power supply and storage battery or external plate and filament supply, test probes, and connecting cables are required.

*c. TEST PROCEDURE.*

- (1) Connect the power supply and all dummy load resistors as described in paragraph 32, including the load resistor to terminal C of J-2.
- (2) Connect the ungrounded side of the audio signal generator through a 2-uf capacitor to the channel input terminals specified in *d* below. Connect the ground side of the signal generator to the amplifier chassis or to any one of the grounded terminals on one of the multiconnectors on the panel.
- (3) Connect the vacuum-tube voltmeter between each of the test points shown in the chart and ground.
- (4) Adjust the frequency of the signal generator to 1,000 cycles and adjust its output level so that the voltage, as measured with a vacuum-tube voltmeter across the channel input terminals, is as specified in *d* below.
- (5) Turn the OFF-INT-RT-70 switch to the RT-70 position and allow a warmup period of about 1 minute.
- (6) Using a vacuum-tube voltmeter, measure the signal voltages at the points indicated in *d* below. Follow the order given in the chart.

*d. MEASUREMENT DATA.*

- (1) With the 1,000-cycle signal supplied at a level of 0.14 volt between terminal C of J-2 and ground, measure the levels at

the test points indicated in the following chart. Close the external test switch (connected to K of J-2) while taking these measurements.

Test point	Reading (volts, rms)
H of J-2	12.2
1 of V-5	54.0
6 of V-5	54.0
2 of V-5	12
7 of V-5	12
1 of V-4	28
6 of V-4	28
2 of V-4	2.5
7 of V-4	2.5
1 of V-1	4.9
6 of V-1	4.9
2 of V-1	.5
7 of V-1	.5
F of J-2	10
5 of V-2	58
1 of V-2	4
A of J-2	10
5 of V-3	58
1 of V-3	4

- (2) With the 1,000-cycle signal supplied at a level of 3.3 volts between terminal B of J-2 and ground, measure the levels at the test points indicated in the following chart.

Test point	Reading (volts, rms)
H of J-2	11.5
1 of V-5	49
6 of V-5	49
2 of V-5	11.5
7 of V-5	11.5
1 of V-4	25
6 of V-4	25
2 of V-4	5
7 of V-4	
1 of V-1	9
6 of V-1	
2 of V-1	
7 of V-1	
F of J-2	13.4
5 of V-2	84
1 of V-2	7.6
A of J-2	
5 of V-3	
1 of V-3	



- (3) With the 1,000-cycle signal supplied at a level of 3.3 volts between terminal A of J-3 and ground, measure the levels at the test points indicated in the following chart.

Test point	Reading (volts, rms)
H of J-2	11
1 of V-5	49
6 of V-5	49
2 of V-5	11.5
7 of V-5	11.5
1 of V-4	25
6 of V-4	25
2 of V-4	
7 of V-4	5
1 of V-1	
6 of V-1	9
2 of V-1	
7 of V-1	
F of J-2	
5 of V-2	
1 of V-2	
A of J-2	13.4
5 of V-3	84
1 of V-3	7.6

*e.* ANALYSIS. Compare the readings obtained with the value given in the chart. The tabulated data are nominal values. Nonuniformity in tubes, tolerances of components, etc., may be responsible for reading variations between amplifiers of as much as 10 percent. Interpret the test results with this fact in mind. In general, the fault in the channel lies between the point at which a normal reading is first obtained and the preceding test point. A fault may be indicated by the absence of a reading, or by a drastic reduction or increase in a reading. In the case of the push-pull stages of the Set 1+Set 2+Interphone channel, a fault is indicated if the readings for one-half of the stage do not agree (approximately) with readings taken at corresponding points in the other half of the stage. Again note that such correspondence is nominal only, and depends upon tolerance in tubes and components. Unbalance in a push-pull stage may be due to a defect in one of the components which serve to maintain balance; for example, a leaky bypass capacitor C-9, a partially shorted transformer T-4 winding (1-2), or an aging resistor R-19. Refer to the schematic diagram (fig. 17), to identify the circuit section to which the trouble has been localized. Note also,

that a similar correspondence of readings applies to comparable points in the Set 1+Interphone and Set 2+Interphone channels.

*f.* FURTHER TROUBLE LOCALIZATION CHECKS. When trouble has been localized to a given stage or a portion of a stage, do the following:

- (1) Turn the OFF-INT-RT-70 switch to the OFF position, and pull the tube out of its socket.
- (2) Test the tube by means of a tube checker and, if defective, replace with a good one. If a tube checker is not available, substitute a tube known to be good for the suspected defective tube.
- (3) To isolate trouble in the defective stage measure the voltages and resistances at the tube socket (fig. 14) and other pertinent points (pars. 36 and 37). Note that the information given is merely a guide and should suggest other tests, measurements, and procedures for localizing the trouble to a defective part or wire.
- (4) When a defective part is found, replace it. Repair a defective or broken wire. Isolate and clear the trouble before proceeding with the succeeding step, since each step presupposes the satisfactory completion of all previous steps. Refer to paragraphs 39 through 41 for repair procedures.

### 36. Voltage Measurements

Make the pertinent d-c voltage measurements indicated in figure 14. These measurements serve to locate defects which are not readily determined by the resistance measurements of paragraphs 33 and 37, that is, defective capacitors, partially shorted transformer windings, etc. For these measurements, insert all plug-in parts, and connect the battery and load resistors (par. 32). All voltage measurements shown in figure 14, except filament voltages, are made to ground. Filament voltages are measured between the filament terminals of the socket. Refer to the schematic diagram (fig. 17), to identify the circuit components involved in a particular measurement. Note especially the arrangement of amplifier filament wiring for each position of the 6V-12V-24V switch S-1. Required readings are shown above the guide lines from the socket terminals. Use Electronic Multimeter TS-505/U as a voltmeter. Repair any part found by the voltage measurements to be defective.



**NOTE 1:** VOLTAGE VALUES SHOWN APPLY UNDER THE FOLLOWING CONDITIONS:

(a) EITHER RECEIVER-TRANSMITTER RT-70/GRC OR EQUIVALENT LOAD (RESISTORS AND STRAPPING AS SHOWN IN FIGURE 13) CONNECTED.

(b) FILAMENT VOLTAGES MEASURED BETWEEN PINS 3 AND 4 OF 7-PIN SOCKETS; BETWEEN PINS 9 AND 4-5 OF 9-PIN SOCKETS. ALL OTHER VOLTAGES MEASURED TO GROUND.

**NOTE 2:** S-2 IN RT-70 POSITION.

\* VALUES SHOWN OBTAINED WITH 6V OPERATION. WITH 12V OR 24V OPERATION VALUES ON PINS 3 OR 8 WILL INCREASE TO 6.4 V.

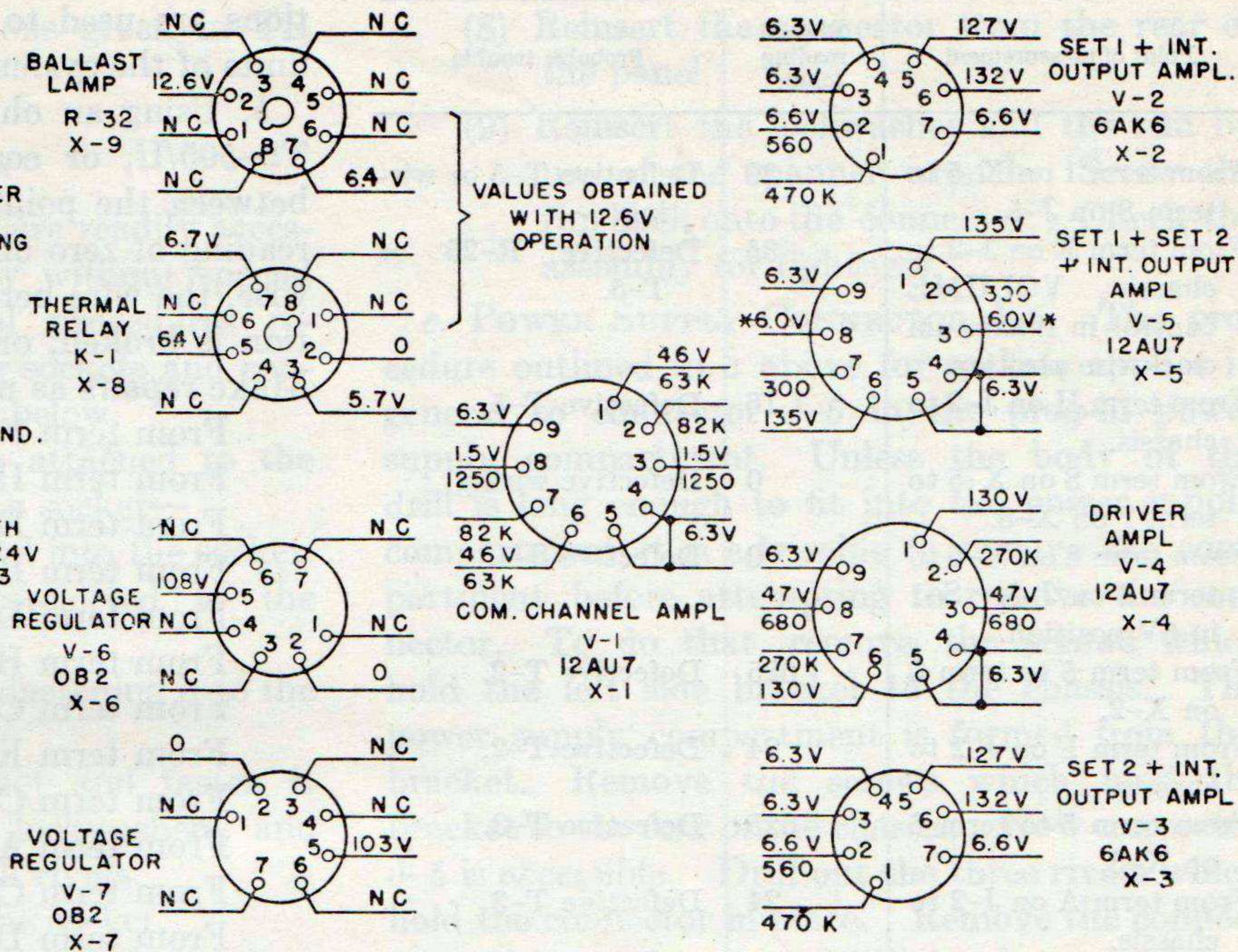


Figure 14. AF Amplifier AM-65/GRC, tube socket voltage and resistance diagram.

### 37. Resistance Measurements

(fig. 14.)

These checks are intended to serve as a guide for locating defective components or wiring in the amplifier stage found to be defective by the signal substitution checks of paragraph 35. For these checks, disconnect the batteries, remove the power supply unit, the ballast tube, thermal relay and all vacuum tubes; leave the fuse in its holder. Use Electronic Multimeter TS-505/U for taking the measurements. Replace any component or repair any wire found to be defective.

a. Make the pertinent measurements indicated in figure 14. These measurements all are made from the socket terminal to ground. The required resistance readings are shown below the guide line from the socket terminal. It is not necessary to make all of the measurements shown in figure 14, but only those that are indicated at the tube socket associated with the stage found to be defective by the signal substitution checks of paragraph 35.

b. Make the pertinent measurements listed in the following table. The data given in the table supplements the data given in figure 14.

Point of measurement	Normal reading (ohms)	Probable trouble
From term C on J-2 to term 7 on T-1.	Infinity	Defective 0-1 contacts.
From term 1 to term 2 on T-1.	800	Defective T-1, R-3, or R-5.
From term 3 to term 2 on T-1.	800	Defective T-1, R-4, or R-6.
From term B on J-2 to chassis.	1, 560	Defective R-7, R-9, or R-11.
From term A on J-3 to chassis.	1, 560	Defective R-8, R-10, or R-12.
From term 1 to term 6 on X-1.	114, 000	Defective R-14, R-15, R-16, or R-17.
From term 1 of X-1 to term 8 on J-5.	62, 600	Defective R-14, R-15, or R-13.
From term 1 to term 6 on X-4.	1, 550	Defective T-4.
From term 6 on X-2 to term 1 on X-4.	800	Defective T-4.
From term 6 on X-3 to term 6 on X-4.	750	Defective T-4.
From term 2 to term 7 on X-5.	650	Defective T-4.
From term 1 to term 6 on X-5.	200	Defective T-5.
From term 2 on T-4 to term 8 on J-5.	100	Defective R-25.



Point of measurement	Normal reading (ohms)	Probable trouble
From term 1 on X-5 to term 8 on J-5.	80	Defective T-5 or wiring.
From term E on J-2 to chassis. VOLUME control in maximum clockwise position.	35	Defective R-26 or T-5.
From term H on J-2 to chassis.	16	Defective T-5.
From term 8 on X-5 to term 7 on X-8.	0	Defective wiring.
From term 8 on X-5 to term 3 on J-5. S-1 in 6V position.	0	Defective S-1.
From term 5 to term 6 on X-2.	625	Defective T-2.
From term F on J-2 to chassis.	24	Defective T-2.
From term 5 to term 6 on X-3.	625	Defective T-3.
From term A on J-2 to chassis.	24	Defective T-3.

### 38. Check of Interunit Strapping Connections

*a.* The continuity checks, outlined below, should be made to determine whether the strapping connections between the multiconnectors in the amplifier are properly made. The strapping connec-

tions are used to tie in the amplifier with other units of the system in which it is used.

*b.* Using an ohmmeter (Electronic Multimeter TS-505/U, or equivalent), check for continuity between the points listed below. In each case a reading of zero ohms should be obtained. Otherwise, the wire between the two terminals in question is broken, or the connector pin is defective. Make repairs as needed.

- From term F of J-1 to term K of J-2.
- From term H of J-1 to term D of J-3.
- From term E of J-1 to term H of J-1.
- From term B of J-1 to term E of J-1.
- From term L of J-1 to term E of J-2.
- From term H of J-3 to term H of J-4.
- From term C of J-3 to term C of J-4.
- From term K of J-3 to term K of J-4.
- From term C of J-6 to term 1 of R-26.
- From term A of J-1 to term L of J-1.
- From term C of J-1 to term C of J-2.
- From term D of J-2 to term 1 of R-26.
- From term D of J-2 to term D of J-4.
- From term A of J-3 to term B of J-4.
- From term J of J-3 to term J of J-4.
- From term D of J-2 to term D of J-3.
- From term 7 of J-5 to ground bus.
- From term D of J-4 to term B of J-1.
- From term C of J-6 to ground bus.
- From ground bus to chassis.

## Section III. REPAIRS

### 39. Replacement of Parts

When replacing parts in AF Amplifier AM-65/GRC, observe the precautions given below.

*a.* TAGGING LEADS. Tagging leads is essential to assure that correct rewiring will be made when a part is replaced. Before unsoldering leads from transformers, tube sockets, panel connectors, or other parts, tie together the leads that are attached to each of these parts. Use small tags or short pieces of adhesive tape to identify all wires in accordance with their numbered connections. Identify every lead that is to be removed.

*b.* PARTS AND SUBSTITUTION. When damaged parts must be replaced, use identical parts. If identical parts are not available and the damaged component is beyond repair, a substitution must be made. The part substituted must have identical electrical properties and must be of equal or higher voltage and current rating.

*c.* LOCATION. Relocation of substituted parts may develop certain difficulties, such as hum or noise, and is not recommended.

*d.* MOUNTING. Mount the new or replaced part in the same mounting as that formerly occupied by the damaged part. Fasten all mountings securely.

*e.* SOLDERING. Before soldering any connection, carefully scrape all parts that will be touched by the solder until all traces of rust, corrosion, paint, or varnish are removed. Dust the scraped parts with a small clean brush. Tin all parts to be soldered. Wrap the wire around the lug to be soldered to obtain mechanical support. Solder the connections with a very little solder and use sufficient heat to make the solder flow evenly around the tinned surfaces.

*f.* RETROPICALIZATION. If the parts being replaced require special treatment, such as retrop-



icalization, follow the instructions given in TB SIG 13 and TB SIG 72.

#### 40. Special Repair Procedures

Most of the parts in this unit are readily accessible and can be replaced easily without special procedure instructions. Special procedures required for repairing or replacing sockets and connectors are given in *a* through *c* below.

*a.* SOCKETS. All sockets are attached to the chassis with rivets. To change a socket—

- (1) Remove the part plugged into the socket.
- (2) Unsolder the wires connected to the socket.
- (3) Drill out the two rivets fastening it to the chassis.
- (4) Substitute a new socket and fasten it with machine screws, lockwashers, and nuts or, if feasible, with rivets.
- (5) Resolder the wires to the socket.
- (6) Clean the unit thoroughly to remove solder drops or metal chips.
- (7) Check the new connections with those shown in the schematic diagram, figure 17.

*b.* PANEL CONNECTORS. To remove panel connectors, it is necessary to use a spanner wrench (or long-nose pliers).

- (1) Insert the teeth on the spanner wrench into the notches in the rim of the connector on the front panel.
- (2) Turn the spanner wrench in the counterclockwise direction until the rim is removed. Remove the lockwasher.
- (3) Remove the connector from the rear of the panel.
- (4) Unsolder all wires.
- (5) In selecting a new connector, make sure that the new part has a rubber gasket.
- (6) Resolder all wires to the new connector. Clean thoroughly to remove solder drops.
- (7) Recheck the new connections with those shown in the schematic diagram (fig. 17).

(8) Reinsert the connector from the rear of the panel.

(9) Reinsert the lockwasher and the rim by use of the spanner wrench. Screw the rim back onto the connector. Check the assembly for tightness.

*c.* POWER SUPPLY CONNECTOR J-5. The procedure outlined in *a* above for sockets applies in general to connector J-5 in the plug-in power supply compartment. Unless the body of the drill is long enough to fit into the power supply compartment, it is advisable to remove the compartment before attempting to remove the connector. To do that, remove the screws which hold the left side bracket to the chassis. The power supply compartment is formed from this bracket. Remove the screws which hold the bracket to the rear of the chassis. Now connector J-5 is accessible. Drill out the three rivets which hold the connector in place. Remove the connector and proceed as described in *a* above to replace the part.

#### 41. Reassembly

After the inspection tests and repairs described in the preceding paragraphs have been made, the unit is ready for reassembly. To reassemble the unit follow the reverse of the procedure described in paragraph 25. Proceed as follows: Reattach the side brackets, if they have been removed. Reassemble the left side bracket first. Line it up so that the slits in the bracket slide over the notches on the side of the chassis. Restore the mounting screws. Follow a similar procedure to reassemble the right side bracket. Reattach the front panel by means of the six mounting screws, taking care to tuck the connecting cable carefully in place and not to damage the wiring. Tighten all mounting screws. Check that all plug-in parts are firmly seated in their sockets. Replace the outer case and tighten the Dzus fasteners.

### Section IV. LUBRICATION AND WEATHERPROOFING

#### 42. Lubrication

AF Amplifier AM-65/GRC described in this manual does not require lubrication; do not apply oil or grease to any part of this unit.

#### 43. Weatherproofing and Rustproofing

*a.* GENERAL. Signal Corps equipment, when operated under severe climatic conditions, such as prevail in tropical, arctic, and desert regions,



requires special treatment and maintenance. Fungus growth, insects, dust, corrosion, salt spray, excessive moisture, and extreme temperatures are harmful to most materials.

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

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

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

*e.* RUSTPROOFING. Rust and corrosion can be prevented by touching up bared surfaces. Clean, where necessary, with fine sandpaper. Never use steel wool.

*Note.* For further information on general preventive maintenance techniques, refer to TB SIG 178.

## 44. Refinishing

*a.* When the finish on the case or on the panel has been badly scarred or damaged, rust and corrosion can be prevented by touching up bared surfaces. Use #00 or #000 sandpaper to clean the surface down to the bare metal; obtain a bright smooth finish. Instructions for refinishing badly marred panels and cases are given in TM 9-2851.

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

*b.* When a touch-up job is necessary, apply paint with a small brush. Remove rust from the case by cleaning corroded metal with solvent (SD). In severe cases, it may be necessary to use solvent (SD) to soften the rust and to use sandpaper to complete the preparation for painting. Paint used will be authorized and consistent with existing regulations.

## Section V. FINAL TESTING

### 45. General

If the unit fails to meet the requirements of paragraphs 32 and 34, repeat the trouble-shooting procedures given in paragraphs 33 and 35 to 37 to locate other faults. Make repairs as found necessary. If the unit operates as required in paragraphs 32 and 34, perform the tests outlined in the following paragraphs before returning the unit to service.

### 46. Speech Transmission Tests

The purpose of the tests described in this paragraph is to determine the volume and quality of speech signals at each of the channel output terminals, when speech signals are applied to the input of the interphone channel. Proceed as follows:

*a.* Connect the load resistors and apply power to the unit as shown in figure 13. Omit the load resistor between terminals C and D of J-2.

*b.* Connect Chest Set Group AN/GSA-6 with Headset-Microphone H-63/U to AUDIO connector J-1.

*c.* Connect a loudspeaker or a headset between terminals E and D of J-2. Set the VOLUME control to its extreme counterclockwise position.

*d.* Operate the push-to-talk button and talk into the microphone. Listen to the loudspeaker or headset and gradually advance the VOLUME control until the desired volume of sound is heard.

*e.* Note the quality of the received speech signals. Clear, distortion-free speech should be heard.

*f.* Shift the loudspeaker or headset connection to terminal F of J-2, and perform the operations indicated in the preceding steps. The requirements stated in *e* above should be met.

*g.* Shift the loudspeaker or headset connection to terminal A of J-2. The results should be approximately the same as those for *e*, above.

### 47. Frequency Response

*a.* To prevent high- and low-frequency noises from being amplified and transmitted through the system, frequencies above 3,500 cycles and below 400 cycles are sharply attenuated. Capacitors C-2, C-3, and C-8 through C-12 contribute to the shaping of the amplifier frequency response characteristic. The following tests are made to determine whether these requirements are met and whether or not these capacitors are defective.



b. The procedure is as follows:

- (1) Connect a variable frequency audio signal generator, in series with a 2- to 4-uf capacitor across the channel input terminals as shown in figure 13 and listed in the chart below. Also connect the load resistors indicated in figure 13.
- (2) Connect a vacuum tube voltmeter or an output meter across the channel output terminals, as indicated in the chart.
- (3) Adjust the frequency of the signal generator to 1,000 cycles and its output level to the voltage shown in the chart for the particular channel input.
- (4) Measure the level at the channel output terminals. Record this 1,000-cycle output level. This value is the reference level.
- (5) Now, change the frequency of the signal generator to 400 cycles, but keep the in-

put level to the amplifier channel at the same value as for 1,000 cycles.

- (6) Measure the level at the channel output terminals, and compare it with the 1,000-cycle value, obtained in (4) above.

*Requirement:* The output level at 400 cycles should be within  $-3$  and  $+2$  db of that at 1,000 cycles.

- (7) Change the frequency of the signal generator to 5,000 cycles, again keeping the input level to the channel at the same value as at 1,000 cycles.
- (8) Measure the channel output level, and compare with the level at 1,000 cycles obtained in step (4) above.

*Requirement:* The output level at 5,000 cycles should be at least 10 db below the 1,000-cycle output level (a voltage ratio of 3.16).

c. The oscillator connections, channel input levels, and the output meter connections are summarized in the following chart. All connections are made between the points shown and chassis.

Oscillator			Output meter	
Channel input	Connection	Signal input level (volts)	Channel output	Connection
Interphone	Term C of J-2 (Close test switch connected to K of J-2).	0.2	Set 1 + Set 2 + Interphone	Term H of J-2.
			Set 1 + Interphone	Term F of J-2.
			Set 2 + Interphone	Term A of J-2.
Set 1 amplifier	Term B of J-2	2.5	Set 1 + Interphone	Term F of J-2.
			Set 1 + Set 2 + Interphone	Term H of J-2.
Set 2 amplifier	Term A of J-3	2.5	Set 2 + Interphone	Term A of J-2.
			Set 1 + Set 2 + Interphone	Term H of J-2.

## 48. Crosstalk

a. The purpose of the checks outlined in this paragraph is to determine whether proper separation is maintained between the Set 1 and Set 2 amplifier channels, that is, whether a signal applied to the input of one of these channels is kept out, as required, from the output of the other channel.

b. A satisfactory qualitative check may be made as follows:

- (1) Connect a signal generator to the input terminals of the Set 1 channel (terminals B and D of J-2). Connect the load resistors indicated in figure 13.
- (2) Connect a headset to the output of that channel (terminals F and D of J-2).

- (3) Adjust the signal generator to apply 1,000-cycle signal at 3.5 volts to the channel input terminals.
- (4) Note the level of the signal at the channel output terminals.
- (5) Transfer the headset connections to the output terminals of the Set 2 amplifier channel (terminals A and D of J-2); any signal heard should be weak.
- (6) Shift the signal generator connections to the Set 2 amplifier channel input terminals (terminals A and D of J-3), adjust the frequency and level as before, and listen for the signal at the output terminals of each of the two channels.



No signal should be heard at the Set 1 channel amplifier output terminals (terminals F and D of J-2).

c. A quantitative check may be made by following the procedure outlined above, but using an output meter or vacuum tube voltmeter in place of the headset. When the signal is applied to the Set 1 amplifier input terminals, the level of the signal at the Set 2 amplifier output terminals should be at least 50 db below the level at the Set 1 amplifier output terminals. This level difference corresponds to a voltage ratio of 316. Similarly, when the signal is applied to the Set 2 amplifier input terminals, the level of the signal at the Set 1 amplifier output terminals should be 50 db below the level at the Set 2 amplifier output terminals, a voltage ratio of 316.

## 49. Noise

The purpose of the test described in this paragraph is to determine whether the amplifier provides noise-free operation. Proceed as follows: Apply power and connect the load resistors as shown in figure 13. With no signal applied to the amplifier input terminals, measure the voltages at each pair of output terminals, namely, between terminals H and D of J-2 (Set 1+Set 2+Interphone), F and D of J-2 (Set 1+Interphone), and A and D of J-2 (Set 2+Interphone). The voltages measured represent noise contributed by the amplifier. The voltage across each pair of output terminals should be less than .5 volt.



## CHAPTER 4

# SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

### 50. Repacking for Shipment or Limited Storage

Wrap and pack securely according to directions given in Packaging Specifications JAN-P-100, or as directed by the Officer in Charge.

### 51. Demolition of Matériel to Prevent Enemy Use

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

*a. Smash.* Smash capacitors, transformers, resistors, sockets, plugs, and other components,

using sledges, axes, handaxes, pickaxes, hammers, crowbars, or heavy tools.

*b. Cut.* Cut wiring, using axes, handaxes, or machetes.

*c. Burn.* Burn technical manuals, records and forms, resistors, capacitors, and transformers, using gasoline, kerosene, oil, flame throwers, or incendiary grenades.

*d. Bend.* Bend chassis, panels, and covers, use  
*e. Explosives.* If explosives are necessary. firearms, grenades, or TNT.

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

*g. Destroy.* Destroy everything.



# 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 catalog pamphlets.

### 1. Army Regulations

AR 380-5 Safeguarding Military Information.

### 2. Supply Publications

SIG 1 Introduction and Index.  
SIG 5 Stock List of All Items.  
SIG 6 Sets of Equipment.  
SIG 7 & 8 Organizational Maintenance Allowances and Field and Base Maintenance Stockage Guide.  
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. Publications on Test Equipment

NAVSHIPS Instruction Book for Electronic Multimeter ME-91269 6A/U.  
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. Military (JAN) Specifications

JAN-D-169 Desiccants (Activated).  
JAN-P-100 Packaging and Packing for Overseas Shipment—General Specifications.  
JAN-P-106A Packaging and Packing for Overseas Shipment—Boxes; Wood, Nailed.  
JAN-P-116 Packaging and Packing for Overseas Shipment—Preservation, Methods of.  
JAN-P-125 Packaging and Packing for Overseas Shipment—Barrier Materials, Waterproof, Flexible.  
JAN-P-131 Packaging and Packing for Overseas Shipment—Barrier Material; Moisture-Vaporproof, Flexible.

### 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, Sup-



	ply 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.
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

a-c	alternating current
a-f	audio frequency
amp	ampere(s)
C	centigrade
db	decibel(s)
d-c	direct current
F	Fahrenheit
h-f	high frequency
ma	milliamperes
r-f	radio frequency
rms	root mean square
uf, uuf	microfarad, micromicrofarad



## APPENDIX II

### IDENTIFICATION TABLE OF PARTS

#### 1. Requisitioning Parts

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 a specific pamphlet in each series of T/O & E, TE, TA, T/BA, SIG 6, SIG 7 & 8, SIG 7-8-10, SIG 10, list of allowances of expendable material,

or another authorized supply basis. The Department of the Army Supply Catalog applicable to the equipment covered in this manual is SIG 7 & 8 AM-65/GRC. 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.

#### 2. Identification Table of Parts for AF Amplifier AM-65/GRC

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	ARMY-NAVY AF AMPLIFIER AM-65/GRC: power output: 1200 mw for Set 1 + Set 2+Int channel, 280 mw for Set 1+Int, and Set 2+Int channels with .25 v interphone input signal; 350 mw at Set 1+Int and Set 2+Int, and 800 mw at Set 1 + Set 2+Int with 5 v signal applied to Set 1 or Set 2 input. -2 db or lower at 250 cyc, +2 to -3db at 400 cyc, 0 db at 1000 cyc, 0 to -5 db at 2500 cyc, -10 db or lower at 5000 cyc; 7 7/8" wd x 4 1/4" h x 12 7/8" d o/a; nom input 6.3, 12.6, or 25.2 v DC vehicular, or 6 and 135 v DC external supply; three input channels, one for 150 ohms low-impedance mic; two 5 v audio channels; output impedance 600 ohms w/150 ohm tap, metal case; has voltage regulating ckt; moisture and fungus resistant; contains compartment to accept vibrator plate power supply; LMT part/dwg GA-2436-14-FR. S. C. spec. MIL-A-13030.	Interphone and monitor amplifier.	2C449-65-FR
C-1A, C-1B, C-1C.	CAPACITOR, fixed: electrolytic; 3 sect; cap between pins 1 and 5 and pins 1 and 7 ea 20 uf, between pins 1 and 3 125 uf, tolerance all sect -10% +150%; 20 uf sect ea 250 vdcw, 125 uf sect 50 vdcw; working temp range -40° C. to +85° C.; 1 1/2" diam x 2 3/32" lg excluding cont and locating pins; HS metal can; four pin type terme; all term insulated from can; mts in std octal socket by means of plug-in base; LMT part/dwg GH-1771-2-FR.	C-1A: Microphone circuit filter. C-1B: Plate circuit decoupling, V-1. C-1C: B+ decouplers, V-2, V-3, and V-4.	3DB125-5-FR
C-14	CAPACITOR, fixed: mica; 470 uuf ±20%; 500 vdcw. LMT part/dwg PL-775568.	Relay supply circuit decoupling	3K2047144-FR
C-8, C-11.	CAPACITOR, fixed: mica; 4700 uuf ±10%; 500 vdcw. LMT part/dwg PL-775569.	C-8: V-2 plate h-f bypass ..... C-11: V-3 plate h-f bypass.	3K4047211-FR
C-4 thru C-7.	CAPACITOR, fixed: paper dielectric; JAN type CN-20A102M; 1000 uuf ±20%; 400 vdcw. LMT part/dwg PL-775744.	C-4: V-2 input coupling ..... C-5: V-4A input coupling. C-6: V-4B input coupling. C-7: V-3 input coupling.	3DA1-215-FR



Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
C-2, C-3.	CAPACITOR, fixed: paper dielectric; JAN type CN-20A302M; 3000 uuf $\pm 20\%$ ; 200 vdcw. LMT part/dwg PL-775744.	C-2: V-1A plate h-f bypass ..... C-3: V1B plate h-f bypass.	3DA3-116-FR
C-9, C-10, C-12, C-13.	CAPACITOR, fixed: paper dielectric; JAN type CN-22A103M; 10,000 uuf $\pm 20\%$ ; 300 vdcw. LMT part/dwg PL-775542.	C-9: V-4A plate h-f bypass ..... C-10: V-4B plate h-f bypass. C-12: V-5A plate h-f bypass. C-13: V-5B plate h-f bypass.	3DA10-447-FR
C-15, C-16.	CAPACITOR, fixed: ceramic dielectric; 500 uuf $\pm 20\%$ ; variable temp coef; 500 vdcw; case 5/8" lg x 5/16" wd across flats of mtg flange; axial wire leads; single hole mtg, bushing 12-28 x 9/32" lg w/hex mtg flange; ceramic insulation; rosin lacquer coated and wax impregnated, feed-thru type capacitor. LMT part/dwg GH-2051-2-1-FR.	Filament supply h-f filters .....	3D9500-226-FR
O-2, O-3.	CLIP: fuse; for holding spare fuse; phosphor bronze, burnished nickel pl; 7/16" lg x 15/32" wd x 3/4" d o/a; ea clip has pair of fuse stop ears used for type 5AG fuses. LMT part/dwg PL-775719.	Spare fuse holder clips .....	3Z1013-FR
	DUST CAP for connector U-79/U w/rubber gasket and beaded chain LMT part/dwg LMT 405265.	Connector protector.	2Z3351-723-FR
L-1	REACTOR: audio reactor; 10 mh min, 360 ma DC; 1.1 ohms $\pm 5\%$ DC resistance; not cased. LMT part/dwg GH-3104-2-FR.	Filament supply h-f filter .....	3C315-156-FR
L-2	REACTOR: audio reactor; 100 mh min, 30 ma DC; 13.5 ohms $\pm 10\%$ DC resistance; not cased. LMT part/dwg GH-3085-2-FR.	Microphone circuit filter .....	3C315-154-FR
J-5	CONNECTOR, receptacle: 8 round male cont; straight. LMT part/dwg GA-1611-2-FR.	Plug-in power supply connection	2Z3028-55-FR
J-1	CONNECTOR, receptacle: U-79/U 10 round button-type cont; straight. LMT part/dwg GH-2079-12-FR.	AUDIO connector .....	2Z7250-79-FR
J-6	CONNECTOR, receptacle: 4 round female cont; straight. LMT part/dwg GH-2081-12-FR.	POWER IN connector .....	2Z3065-126-FR
J-2, J-3, J-4.	CONNECTOR, receptacle: 9 round, female cont; straight. LMT part/dwg GH-2082-12-FR.	J-2: INT CONT connector ..... J-3: RT-70 POWER connector. J-4: REC-TR CONT connector.	2Z3070-64-FR
H-5 thru H-8.	FASTENER, Dzus: panel to case fastener; die cast zinc and steel, olive drab finish; 1 5/8" lg x 1 5/16" wd x 5/16" thk o/a; mts by shaft thru 1/4" diam clearance hole; preloaded spring pressure, unlocked approx 32 lb, locked 45 lb. LMT part/dwg GA-2178-2-FR.	Panel-to-case fasteners .....	6Z3809-27-FR
F-1	FUSE, cartridge: 10 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 1/2" lg x 13/32" diam; term 13/32" diam x 3/8" lg. LMT part/dwg PL-775741-GR-5.	Fuse for use with 6- and 12-volt power supply.	3Z2610.1 FR
F-1	FUSE, cartridge: 4 amp; open 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 1/2" lg x 13/32" diam; term 13/32" diam x 3/8" lg. LMT part/dwg PL-775741-GR-3.	or Fuse for use with 24-volt power supply.	3Z2632-FR
O-21	GASKET: neoprene or Buna N; single hole; rectangular, 6.6" lg x 3.506" wd x .187" thk o/a; hole 6.12" lg x 3.026" wd. LMT part/dwg GR-1443-12-3-FR.	Panel-to-case waterproof seal gasket.	2Z4868.784-FR
E-8	HOLDER, fuse: extractor post type; single 5AG cartridge fuse. LMT part/dwg GA-2365-2-FR.	Fuse holder .....	3Z3282-42.3-FR



Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
H-34 thru H-37.	INSERT, threaded; p/o LMT GA-1716-14-FR case assem; steel cad pl and olive drab iridited; generally rectangular w/two rounded corners; 29/32" lg x 11/32" wd x .1196" thk. LMT part/dwg GB-1171-2-FR.	Retaining inserts (nuts) for strike mounting screws.	2Z5400-52-FR
H-38 thru H-41.	INSERT, threaded: p/o LMT GA-1716-14-FR case assem; steel cad pl and olive drab iridited; generally rectangular w/1 rounded end; 1 5/16" lg x 3/8" wd x .1196 thk. LMT part/dwg GB-1172-2-FR.	Retaining inserts (nuts) for catch mounting screws.	2Z5400-56-FR
E-18, E-21.	INSULATOR, bushing: tubular shape; phenolic 9/16" lg o/a; 5/16" OD x 11/64" ID; mts by means of outer diam and ctr hole. LMT part/dwg GR-4103-2-FR.	Toroid coil mounting insulator.	3G100-266-FR
E-1 thru E-7, E-9, E-10.	INSULATOR, standoff: round post shape; white unglazed ceramic w/metal end caps; .7875" lg o/a; .209" diam. LMT part/dwg GG-1743-2-1-FR.	Stand-off insulators	3G350-113-FR
E-19	KNOB: round; olive drab zinc alloy; for 1/4" diam double flatted shaft; luminous markings. LMT part/dwg GC-1245-2-FR.	Control knob	2Z5822-403-FR
E-20	KNOB: round w/bar, olive drab zinc alloy; for 1/4" diam double flatted shaft; luminous markings. LMT part/dwg GC-1246-2-FR.	Switch knob	2Z5822-402-FR
N-1	LABEL: aluminum; .968" lg x .562" wd x .032" thk o/a; inscribed 6V10A on one side, 12V10A other side; white print on olive drab background. LMT part/dwg GT-2426-2-FR.	Voltage designation label	6D16839-1-FR
N-2	LABEL: aluminum; .968" lg x .562" wd x .032" thk o/a; inscribed 24V4A on one side, 135V 4A other side; white print on olive drab background. LMT part/dwg GT-2438-2-FR.	Voltage designation label	6D16839-FR
N-3	LABEL: white nylon tafetta, 6 5/8" wd x 13 1/4" lg x .004" thk w/1/4" wd tape stitched to one end, extends 17 3/8" beyond label; black print on white background. LMT part/dwg GD-1105-14-FR.	Circuit label	6D16778-3-FR
H-1 thru H-4.	LATCH, fastener: p/o LMT GA-1716-14-FR; case assem; c/o back plate lever, 2 ea outside and inside links, 2 pins and 2 springs; steel zinc pl and olive drab iridited; 2 1/16" lg x 1 7/16" wd x 1/2" d in locked position; two .144" diam mtg holes on back plate; .437" c to c; Sig C dwg SC-D-20648. LMT part/dwg GH-4051-2-FR.	Mounting catches	6Z3810-97-FR
H-9, H-10.	NUT, castellated: steel cad pl and olive drab iridited; finished per dwg; 3/8"-32 NS-2; 1/8" thk; 9/16" OD. LMT part/dwg GB-1106-2-FR.	H-9: Control mounting nut H-10: Switch mounting nut.	6L3006-32S-FR
H-11	NUT, hexag: brass, chamfered corners on bearing surface; 3/8"-32 NS-2. LMT part/dwg GB-2437-2-FR.	Control mounting	6L3506-32-8.2 FR
H-12	NUT, thumb: steel, olive drab enamel; machined bearing surface; 6-32 NC-2; 3/8" thk; 5/16" OD, counterbored 1/4" diam x 1/4" d; fine knurl on outside edge. LMT part/dwg GB-2440-2-FR.	Voltage designation plate retaining nut.	6L3896-32-5-FR



Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
O-12	PLATE, retainer: p/o Army-Navy AF Amplifier AM-65/GRC and Radio Receivers R-108/GRC, R-109/GRC, and R-110/GRC; steel, tin pl; D shaped plate w/hole in ctr; 2" OD x 1" ID x .108" thk o/a. LMT part/dwg GB-1609-2-FR.	Power pack receptacle retainer ring.	2Z7091-342-FR
O-1	RELAY, armature: 1A; 100 ma, 150 v; single wnd 6 v nom; pull-in voltage 4 v DC, max operating 8 v DC, $39 \pm 3$ ohms DC resistance, ins coil; solder lug term on coil and cont; max dimen 1 5/8" lg x 1 7/16" wd x 2 3/8" h o/a; three 6-32 x 5/16" lg mtg studs on 15/16" x 1 3/16" mtg/c; fastacting; HS metal case; term 1 marked w/brown dot, circuit diagram on top of can. LMT part/dwg GH-1670-2-FR.	Microphone control .....	2Z7599A-250-FR
K-1	RELAY, thermal: SPST normally closed; cont rating 2 amp max; silver cont; single wnd heat coil, operates at 6.9 v DC w/1 amp cont load, release at 2 to 3.5 v, heater current 250 ma w/6.9 v applied, ins; coil and cont leads terminate in octal base; 1.275" diam x 2 7/8" lg excluding base cont and locating pin; mts by means of octal base; operates within 10 sec; incl in type T-9 bulb w/std octal base. LMT part/dwg GH-2392-1-FR.	Overvoltage protection .....	2Z7598-129-FR
R-13	RESISTOR, fixed: comp; JAN type RC20BF562K; 5600 ohms $\pm 10\%$ ; 1/2 w. LMT part/dwg PL-774385.	V-1 plate circuit decoupling .....	3RC20BF562K-FR
R-9, R-10.	RESISTOR, fixed: comp; JAN type RC20BF392K; 3900 ohms $\pm 10\%$ ; 1/2 w. LMT part/dwg PL-774385.	R-9: Set 1 input voltage divider R-10: Set 2 input voltage divider	3RC20BF392K-FR
R-14, R-17.	RESISTOR, fixed: comp; JAN type RC20BF183K; 18,000 ohms $\pm 10\%$ ; 1/2 w. LMT part/dwg PL-774385.	R-14: V-1A plate load .....	3RC20BF183K-FR
R-15, R-16.	RESISTOR, fixed: comp; JAN type RC20BF393K; 39,000 ohms $\pm 10\%$ ; 1/2 w. LMT part/dwg PL-774385.	R-15: V-1A plate load. R-16: V-1B plate load.	3RC20BF393K-FR
R-5, R-6.	RESISTOR, fixed: comp; JAN type RC20BF823K; 82,000 ohms $\pm 10\%$ ; 1/2 w. LMT part/dwg PL-774385.	Interphone input voltage dividers.	3RC20BF823K-FR
R-3, R-4.	RESISTOR, fixed: comp; JAN type RC20BF154K; 150,000 ohms $\pm 10\%$ ; 1/2 w. LMT part/dwg PL-774385.	Interphone input voltage dividers.	3RC20BF154K-FR
R-19, R-20.	RESISTOR, fixed: comp; JAN type RC20BF274K; 270,000 ohms $\pm 10\%$ ; 1/2 w. LMT part/dwg PL-774385.	R-19: V-4A grid return. R-20: V-4B grid return.	3RC20BF274K-FR
R-18, R-21.	RESISTOR, fixed: comp; JAN type RC20BF474K; 470,000 ohms $\pm 10\%$ ; 1/2 w. LMT part/dwg PL-774385.	R-18: V-2 grid return. R-21: V-3 grid return.	3RC20BF474K-FR
R-34	RESISTOR, fixed: comp; JAN type RC30BF220K; 22 ohms $\pm 10\%$ ; 1 w. LMT part/dwg PL-775547.	Overvoltage circuit current limiter.	3RC30BF220K-FR
R-33	RESISTOR, fixed: comp; 10 ohms $\pm 10\%$ ; 2 w. LMT part/dwg 775572.	Overvoltage circuit current limiter.	3RC40BF100K-FR
R-2, R-25.	RESISTOR, fixed: comp; JAN type RC20BF101K; 100 ohms $\pm 10\%$ ; 1/2 w. LMT part/dwg PL-774385.	R-2: Microphone current limiting. R-25: B+ decoupling.	3RC20BF101K-FR



Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
R-39	RESISTOR, fixed: comp; 100 ohms $\pm 10\%$ ; 2 w. LMT part/dwg PL-775572.	Set 2 B+ dropping .....	3RC40BF101K-FR
R-41	RESISTOR, fixed: comp; 150 ohms $\pm 10\%$ ; 2 w. LMT part/dwg PL-775572.	Set 2 B+ dropping .....	3RC40BF151K-FR
R-35,	RESISTOR, fixed: comp; JAN type RC20BF151K; 150 ohms $\pm 10\%$ ; 1/2 w. LMT part/dwg PL-774385.	R-35: Relay K-1 shunt .....	3RC20BF151K-FR
R-38	RESISTOR, fixed: comp; JAN type RC30BF471K; 470 ohms $\pm 10\%$ ; 1 w. LMT part/dwg PL-775547.	V-6 current limiting .....	3RC30BF471K-FR
R-40	RESISTOR, fixed: comp; JAN type RC20BF221K; 220 ohms $\pm 10\%$ ; 1/2 w. LMT part/dwg PL-774385.	R-40: V-7 current limiting.	3RC20BF221K-FR
R-22, R-23.	RESISTOR, fixed: comp; JAN type RC20BF561K; 560 ohms $\pm 10\%$ ; 1/2 w. LMT part/dwg PL-774385.	R-22 : V-2 cathode bias .....	3RC20BF561K-FR
		R-23: V-3 cathode bias.	
R-24	RESISTOR, fixed: comp; JAN type RC20BF681K; 680 ohms $\pm 10\%$ ; 1/2 w. LMT part/dwg PL-774385.	V-4A and V-4B cathode phase inverter load.	3RC20BF681K-FR
R-7, R-8.	RESISTOR, fixed: comp; JAN type RC20BF152K; 1500 ohms $\pm 10\%$ ; 1/2 w. LMT part/dwg PL-774385.	R-7: V-1A cathode bias .....	3RC20BF152K-FR
		R-8: V-1B cathode bias.	
R-11, R-12.	RESISTOR, fixed: comp; JAN type RC20BF222K; 2200 ohms $\pm 10\%$ ; 1/2 w. LMT part/dwg PL-774385.	R-11: Set 1 input load .....	3RC20BF222K-FR
		R-12: Set 2 input load.	
R-36	RESISTOR, fixed: WW; JAN type RW30G160; 16 ohms $\pm 5\%$ ; 8 w. LMT part/dwg PL-775576.	Dummy load to replace Set 2 filaments.	3RW13503-FR
R-27	RESISTOR, fixed; WW; JAN type RW30G400; 40 ohms $\pm 5\%$ ; 8 w. LMT part/dwg PL-775576.	Relay and microphone supply voltage dropping.	3RW15904-FR
R-30	RESISTOR, fixed: WW; JAN type RW30G450; 45 ohms $\pm 5\%$ ; 8 w. LMT part/dwg PL-775576.	Relay supply voltage dropping....	3RW16203-FR
R-28	RESISTOR, fixed: WW; JAN type RW30G710; 71 ohms $\pm 5\%$ ; 8 w. LMT part/dwg PL-775576.	Relay and microphone supply voltage dropping.	3RW17413-FR
R-29	RESISTOR, fixed: WW; JAN type RW30G900; 90 ohms $\pm 5\%$ ; 8 w. LMT part/dwg PL-775576.	Relay supply voltage dropping....	3RW18002-FR
R-37	RESISTOR, fixed: WW; JAN type RW30G251; 250 ohms $\pm 5\%$ ; 8 w. LMT part/dwg PL-775576.	Set 2 B+ dropping .....	3RW20705-FR
R-32	RESISTOR, thermal: current thru lamp greater than .58 amp w/4.3 v measured across lamp and less than .625 amp w/9.7 v measured across lamp; designed for DC; T-9 bulb, 2 7/8" lg o/a; intermediate octal base. LMT part/dwg GH-2677-2-FR.	Current regulator .....	3Z6925-3.19-FR
R-26	RESISTOR, variable: comp; 10,000 ohms $\pm 20\%$ ; 2 w; 70° C max continuous operating temp; 3 solder lugs; metal case, 1 1/16" diam x 2 1/32" d, encl; double flatted metal shaft 1/4" diam x 23/32" lg w/axially tapped 6-32 hole 1/4" d in end; AB type B taper, 100% resistance at 0% rotation, 88% at 10%, 65% at 20%, 44% at 30%, 23% at 40%; 10% at 50%, 5% at 60%, 2% at 70%, 1% at 80%; ins cont arm, w/o off position; normal torque; 9/32" lg x 3/8"-32 bushing, nonturn device on 17/32" rad at 9 o'clock; tropicalized and salt water resistant, wp seal in bushing and mtg collar. LMT part/dwg GH-1811-2-FR.	VOLUME control .....	3Z7410-179-FR



Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
H-13	SCREW, captive: slot drive; cheese head, finished per dwg; steel, normal hardness, cad pl and olive drab iridite; w/olive drab enamel head; 6-32 NC-2; 7/16" lg; thd portion 19/64" lg; head .235" diam x 3/32" thk, slot 3/64" wd x 3/64" d. LMT part/dwg GB-2427-2-FR.	Voltage designation plate mounting screw.	6L4776-32.86-FR
E-12, E-13.	SHIELD, tube: JAN type TS102U02; cad pl brass; round w/hole in top; bayonet push on mtg; .81" ID x 1 3/4" lg; pressure coil spring inside. LMT part/dwg PL-775574.	Tube shields	2Z8304.276-FR
E-11, E-14, E-15.	SHIELD, tube: JAN type TSFOT105; copper or brass, nickel pl; round w/hole in top, bayonet push on mtd; .95" ID x 1 15/16" lg; pressure coil spring inside. LMT part/dwg PL-775579.	do	2Z8304.275-FR
E-16, E-17.	SHIELD, tube JAN type TSFOT103; copper or brass, nickel pl; round w/hole in top; bayonet push on mtd; .81" ID x 2 1/4" lg; pressure coil spring inside. LMT part/dwg PL-775575.	do	2Z8304.277-FR
X-2, X-3, X-6, X-7.	SOCKET, tube: 7 cont miniature; JAN type TS 102PO1 S010M; one piece saddle mtg; two 1/8" diam mtg holes on 7/8" mtg/c; round plastic body, w/metal shell, 1 1/8" lg x .8" wd x 25/32" d excluding term; beryllium copper silver pl cont; marked S010M; w/metal shock shield and ctr shield .18" OD. LMT part/dwg PL-775581.	X-2: V-2 tube socket X3: V-3 tube socket. X-6: V-6 tube socket. X-7: V-7 tube socket.	2Z8677.94-FR
X-1, X-4, X-5.	SOCKET, tube: 9 cont miniature; JAN type TSE9 T101; one piece saddle mtg; two 1/8" diam mtg holes on 1 1/8" mtg/c; round plastic body w/metal shell, 1 3/8" lg x .94" wd x 25/32" d excluding term; beryllium copper, silver pl cont; marked w/type number and mfr code; w/metal shock shield and ctr shield .18" OD. LMT part/dwg PL-775583.	X-1: V-1 tube socket X-4: V-4 tube socket. X-5: V-5 tube socket.	2Z8679.30-FR
X-8, X-9, X-10.	SOCKET, tube: octal; one piece molded in mtg plate; two 5/32" diam mtg holes on 1 1/2" mtg/c; round plastic body 1.11" diam x .49" h excluding term; beryllium copper silver pl cont. LMT part/dwg GH-2039-2-FR.	X-8: K-1 relay socket X-9: R-32 ballast tube socket. X-10: C-1 capacitor socket.	2Z8678.338-FR
O-17 thru O-20.	SPRING: flat type; fastener catch spring; 23 ga spring steel, cad pl and olive drab iridite; 1 1/16" lg x 13/16" wd x 3/8" h o/a; two 1/8" diam mtg holes on .437" mtg/c. LMT part/dwg PL-775648.	Fastener catch springs	2Z8877.380-FR
O-13 thru O-16.	SPRING: loop type; strike for Dzus fastener; .08" diam olive drab iridited music wire; 1 3/8" lg x 5/32" wd x .08" thk o/a; two end turned perpendicular at 90 deg angle to straight portion on 1/16" rad. LMT part/dwg GB-2414-2-FR.	Fastener strikes	6Z8377-10-FR
H-14 thru H-17.	STRIKE, fastener: steel, cad pl and olive drab iridite; 7/8" lg x 9/16" wd x 11/32" h o/a; two .169" diam mtg holes, .531" c to c; one edge shaped into hook on 1/16" inside rad x 19/32" wd to provide catch action. LMT part/dwg GB-3035-FR.	Mounting fastener strikes	6Z8569-4-FR



Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
S-1	SWITCH, rotary: 4 pole, 3 position; single sect; silver pl brass cont; plastic wafer; max dimen 1 19/32" lg x 1 1/4" wd x 3/4" d; nonshorting cont; locking action; solder lug term; single hole mtg; bushing 3/8"-32 x 1/4 lg, shaft 1/4" diam x 3/8" lg from mtg surface, w/screwdriver slot, flush mtg; has nonturn device on 17/32" rad. LMT part/dwg GH-1602-2-FR.	6V-12V-24V switch .....	3Z9825-36.3-FR
S-2	SWITCH, rotary: 3 pole, 3 position; double sect, 1 wafer and 1 vol control type switch, rated 12 amp at 8 v; silver cont, plastic body; max dimen 1 19/32" lg x 1 1/4" wd x 1 7/16" d; nonshorting cont; locking action; solder lug term; single hole mtg, bushing 3/8"-32 x 5/16" lg, shaft 1/4" diam x 11/16" lg from mtg surface, has double flats and 6-32 axially tapped hole in end 1/4" d, flush mtg; has nonturn device on 17/32" rad, wp seal in bushing and mtg fl. LMT part/dwg GH-1601-2-FR.	OFF-INT-RT-70 switch .....	3Z9825-36.2-FR
T-1	TRANSFORMER, AF: input type; pri 1 30 ohms impedance, pri 2 190 ohms impedance, secd 19,000 ohms impedance CT, 500 v RMS test; HS steel case; turns ratio pri 1 to secd 1 : 22.8, pri 2 to secd 1 : 10; freq response 250 to 2500 cyc, +2 to -2 db; 7 solder type stud term on bottom of case; two .128" diam mtg holes on 1 1/8" mtg/c; part number marked on top of case. LMT part/dwg GH-1205-2-FR.	Microphone transformer .....	2Z9631.393-FR
T-2, T-3.	TRANSFORMER, AF: plate coupling type, pri 19,000 ohms impedance CT, .005 amp DC, secd 600 ohms impedance CT, 500 v RMS test; HS steel case; turns ratio of pri to secd 5.54 : 1; freq response 250 to 2500 cyc, +2 to -2 db; six solder type stud term on bottom of case; two 6-32 x 15/64" lg mtg studs on diagonally opposite corners on 13/16" x 13/16" mtg/c; part number marked on top of case. LMT part/dwg GH-1202-2-FR.	T-2: Set 1+Interphone channel output transformer. T-3: Set 2+Interphone channel output transformer.	2Z9632.585-FR
T-4	TRANSFORMER, AF: plate coupling type; pri 22,000 ohms impedance CT, .006 amp DC, secd 1 600 ohms impedance CT, secd 2 5200 ohms impedance CT; .500 v RMS test; HS steel case; 160 mw output turns ratio pri to secd 1 6.28:1, pri to secd 2 2.03:1; freq response +2 to -2 db between 250 and 2500 cyc; 9 solder type stud term on bottom of case; two .128" diam mtg holes on 1 1/8" mtg/c; part number marked on top of case. LMT part/dwg GH-1203-2-FR.	V-4, V-5 interstage transformer	2Z9632.562-FR
T-5	TRANSFORMER, AF: plate coupling type; pri 7600 ohms impedance CT, .001 amp DC, secd 600 ohms impedance CT; 500 v RMS test; HS metal case; output 2 w min at 1000 cps across 600 ohms; turns ratio of pri to secd 3.46 : 1; freq response 250 to 2500 cyc, -1 to +3 db; 6 solder type stud term on bottom of case; two 6-32 x 15/64" lg mtg studs on diagonally opposite corners on 13/16" x 13/16" mtg/c; part number marked on top of case. LMT part/dwg GH-1655-2-FR.	Set 1+Set 2+Interphone channel output transformer.	2Z9632.590-FR
V-6, V-7.	TUBE, electron: type OB2; voltage regulator.	Voltage regulators .....	2JOB2-FR

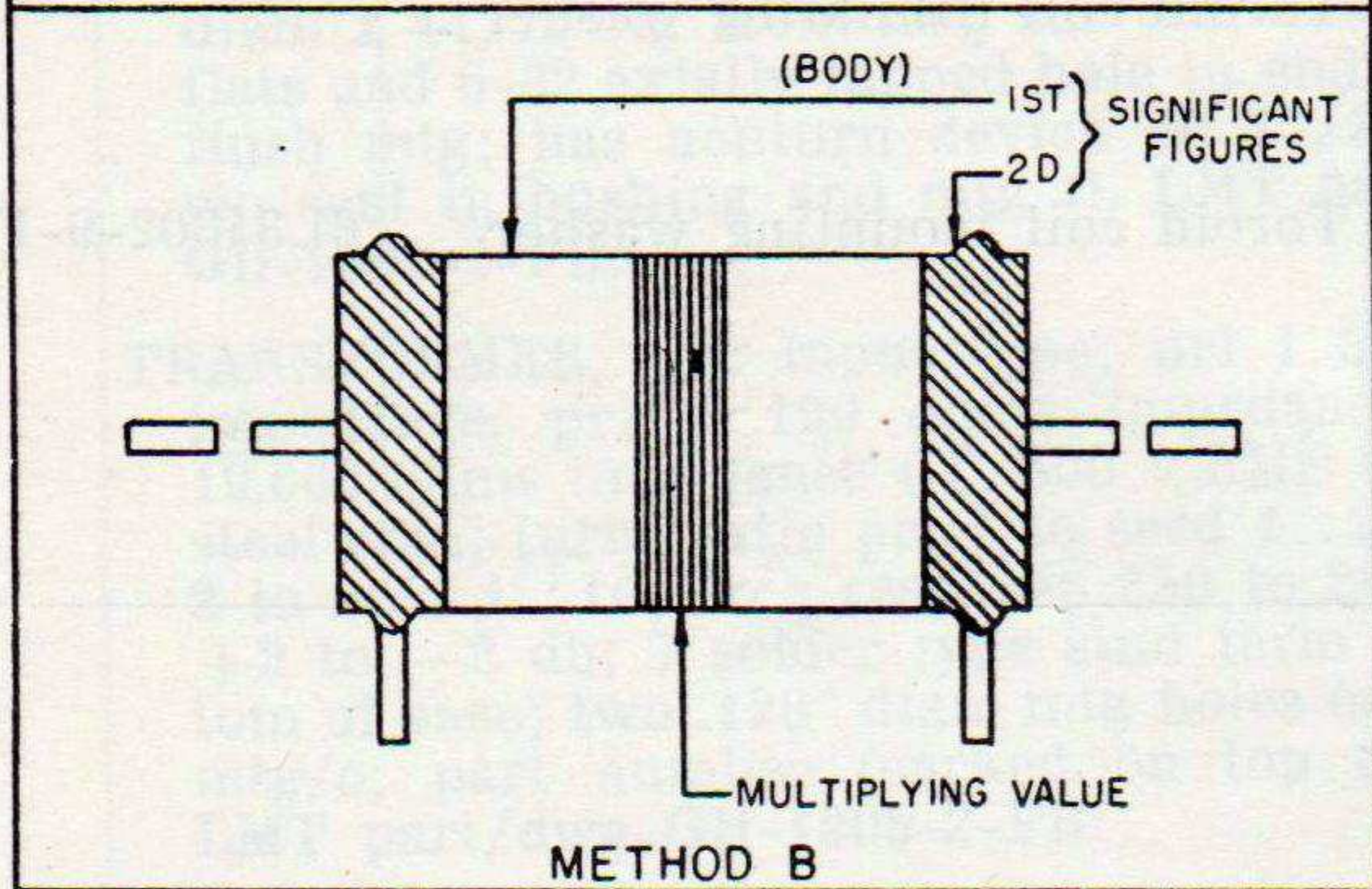
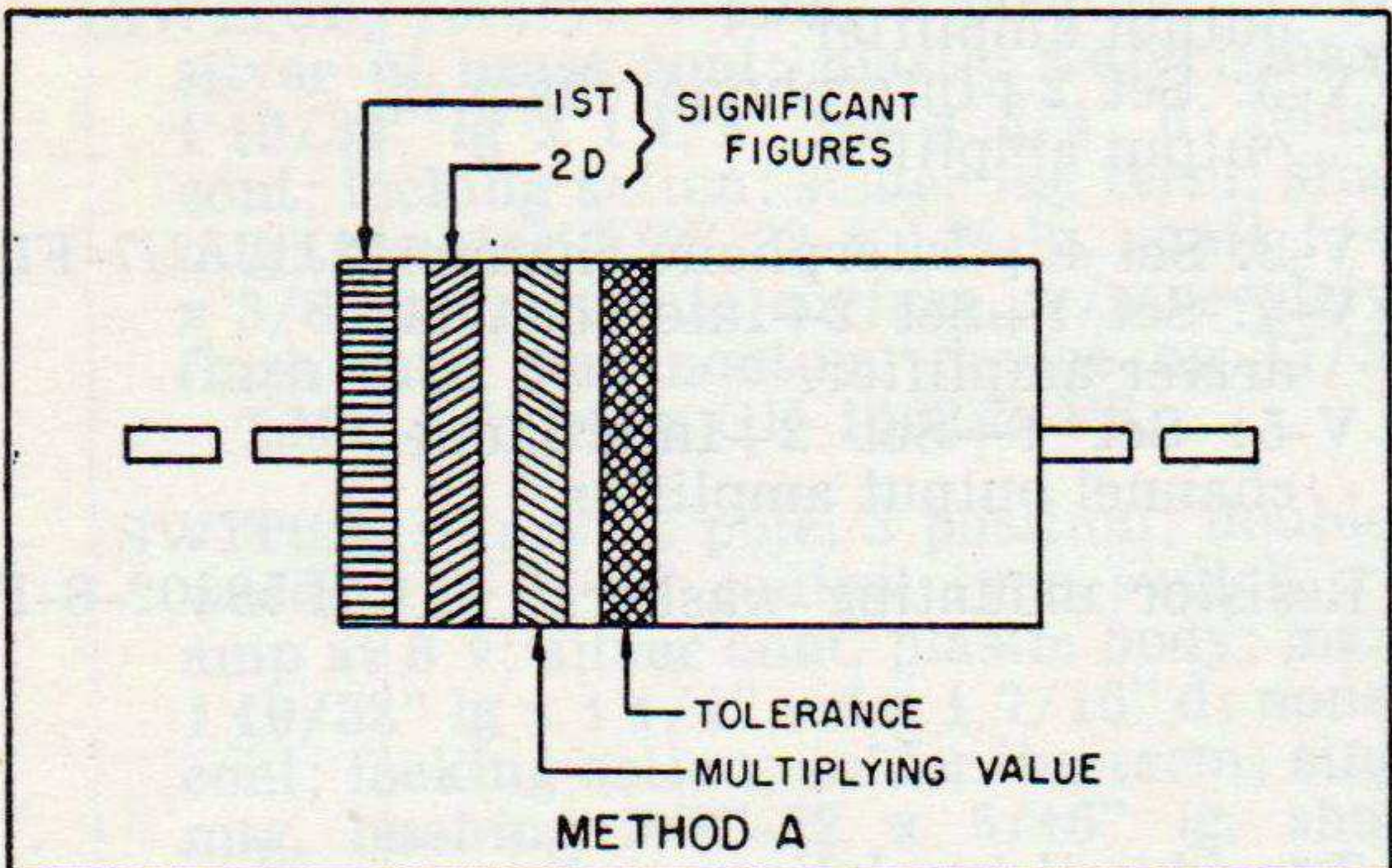


Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
V-2, V-3.	TUBE, electron: type 6AK6; power amplr pentode	V-2: Set 1 + Interphone channel output amplifier. V-3: Set 2 + Interphone channel output amplifier.	2J6AK6-FR
V-1, V-4, V-5.	TUBE, electron: type 12AU7; twin triode.	V-2: Set 1 + Interphone channel V-4: Set 1 + Set 2 + Interchannel driver amplifier. V-5: Set 1 + Set 2 + Interphone channel output amplifier.	2J12AU7-FR
H-22 thru H-33.	WASHER, cup: steel cad pl and olive drab iridited; round cup shaped, 1/2" OD x .140" ID x 3/32" thk o/a; material .0209" thk. LMT part/dwg GB-2378-2-FR.	Resistor mounting washers .....	6L58402-8-FR
H-18, H-19, H-42.	WASHER, flat: phenolic; round, 1" OD x 3/16" ID x 1/16" thk. LMT part/dwg GR. 4102-FR.	Toroid coil insulating washer .....	
H-20	WASHER, flat: brass, round 7/8" OD x .169 ID x .045 thk. LMT part/dwg GB-2340-2-FR.	Toroid coil mounting washer .....	6L34002-9-FR



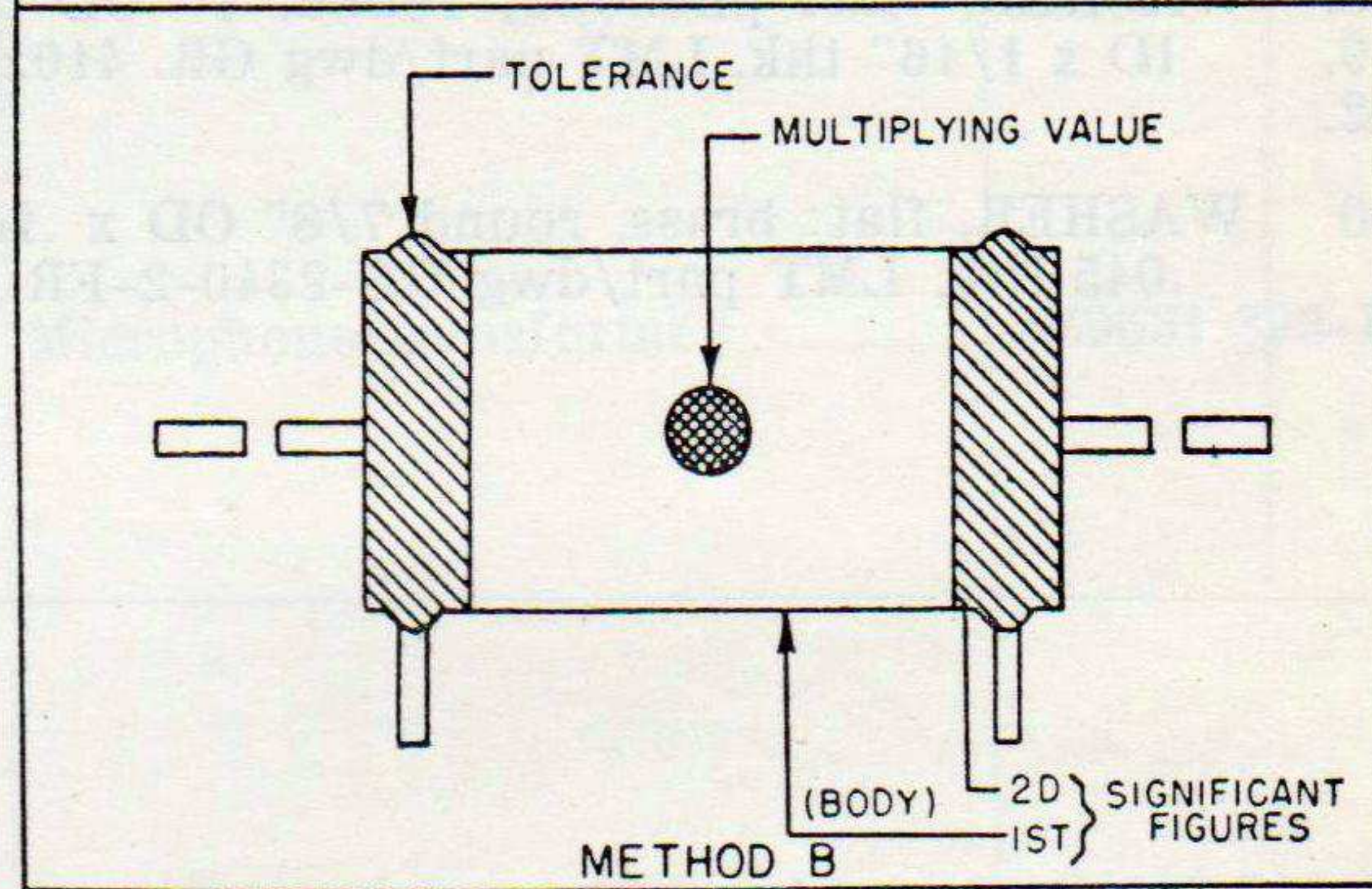
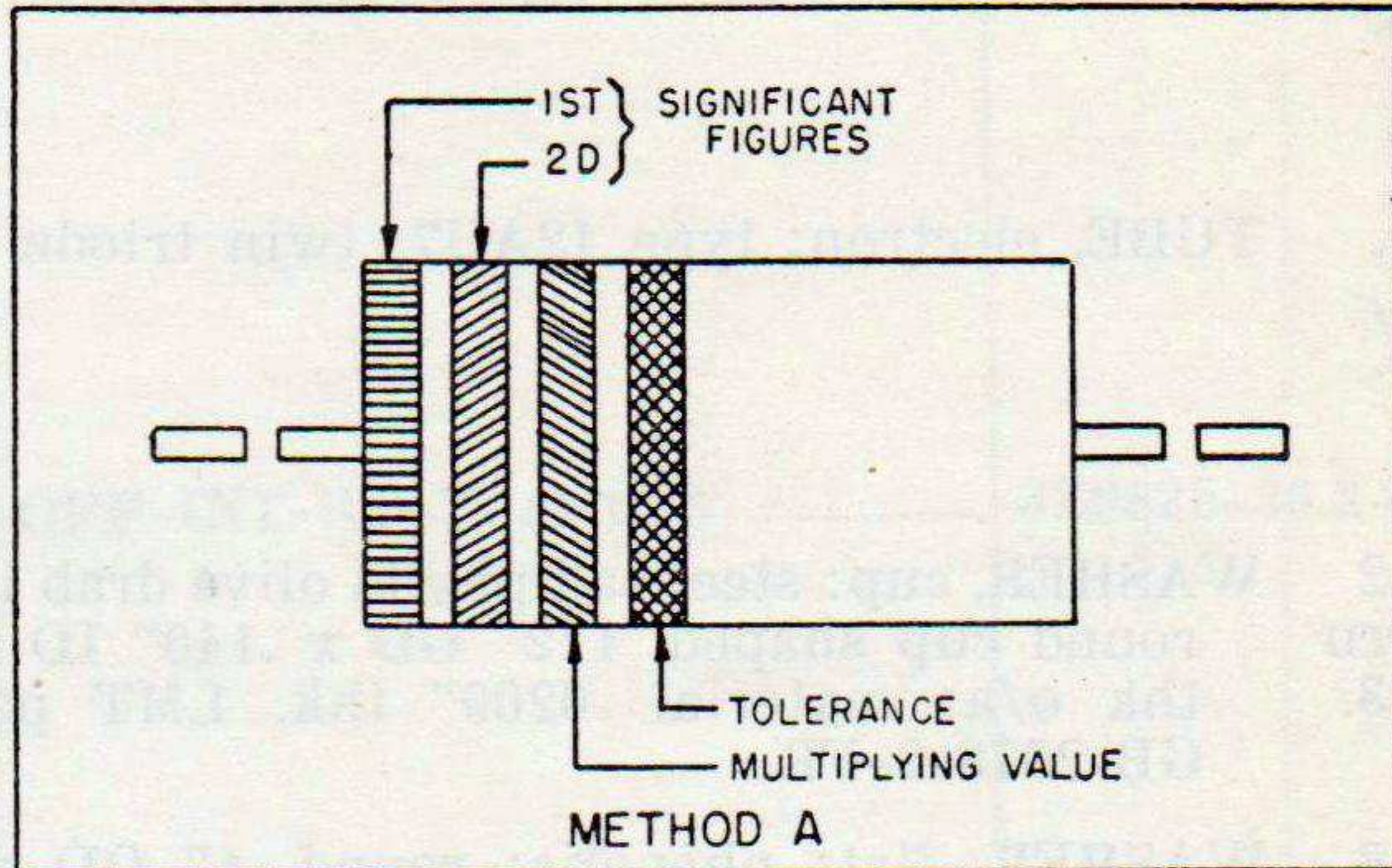
# RESISTOR COLOR CODES

## 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

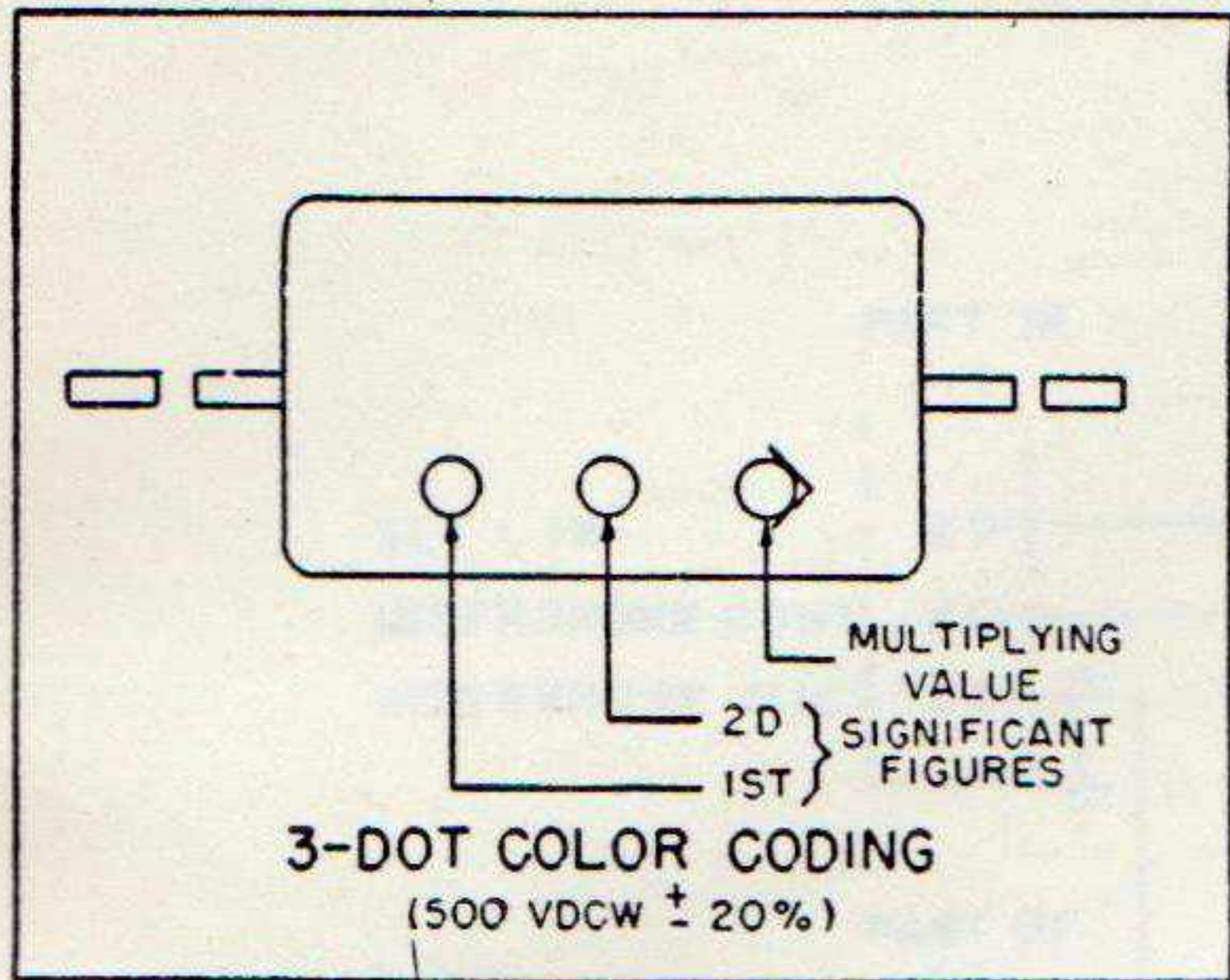
NOTES
* INSULATED FIXED COMPOSITION RESISTORS WITH AXIAL LEADS ARE DESIGNATED BY A NATURAL TAN BACKGROUND COLOR. NON-INSULATED FIXED COMPOSITION RESISTORS WITH AXIAL LEADS ARE DESIGNATED BY A BLACK BACKGROUND.
† RESISTORS WITH AXIAL LEADS ARE INSULATED. RESISTORS WITH RADIAL LEADS ARE NON-INSULATED.
RMA: RADIO MANUFACTURERS ASSOCIATION
JAN: JOINT ARMY-NAVY
THESE COLOR CODES GIVE ALL RESISTANCE VALUES IN OHMS.

Figure 15. Resistor color codes.

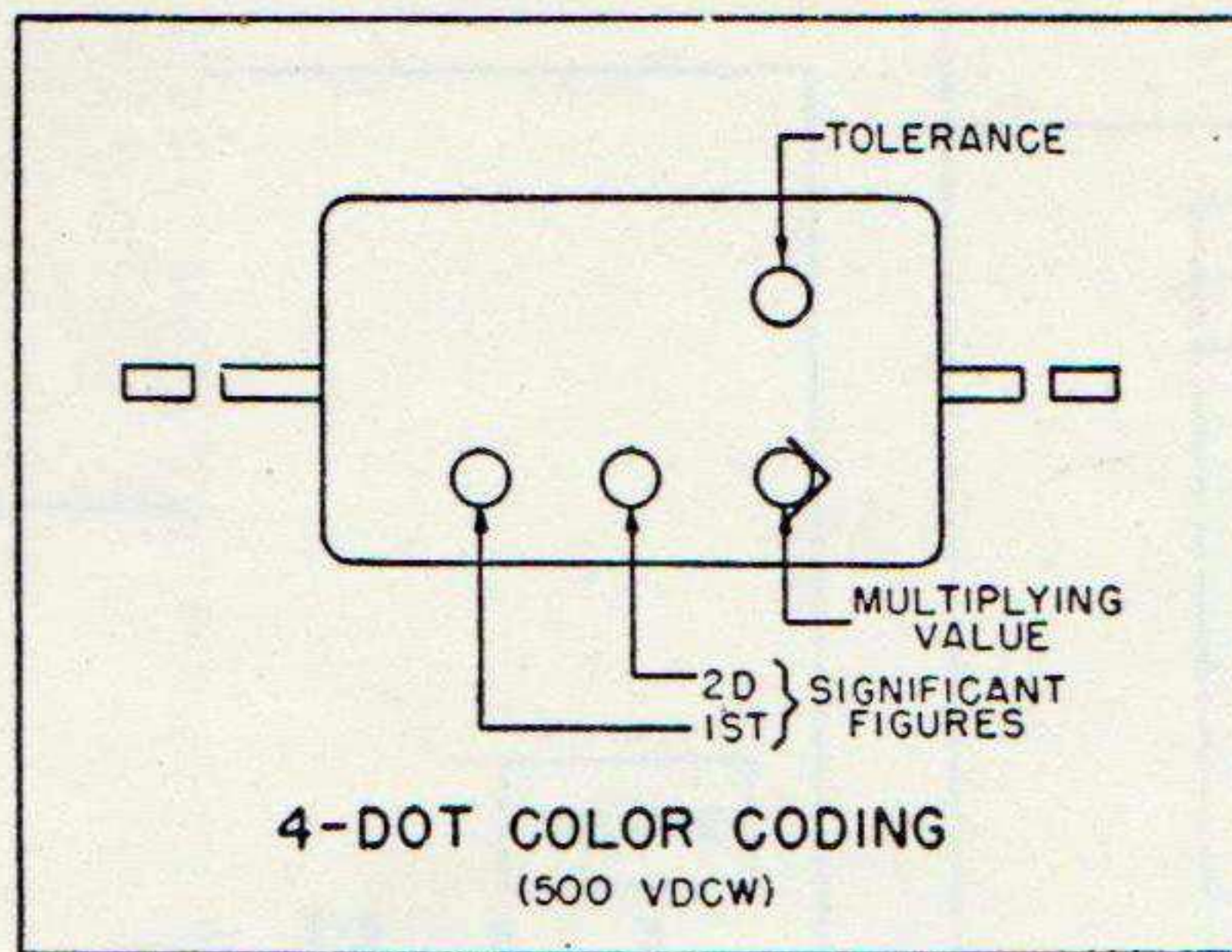


## CAPACITOR COLOR CODES

### RMA 3-4-5-&6-DOT COLOR CODES FOR MICA-DIELECTRIC CAPACITORS



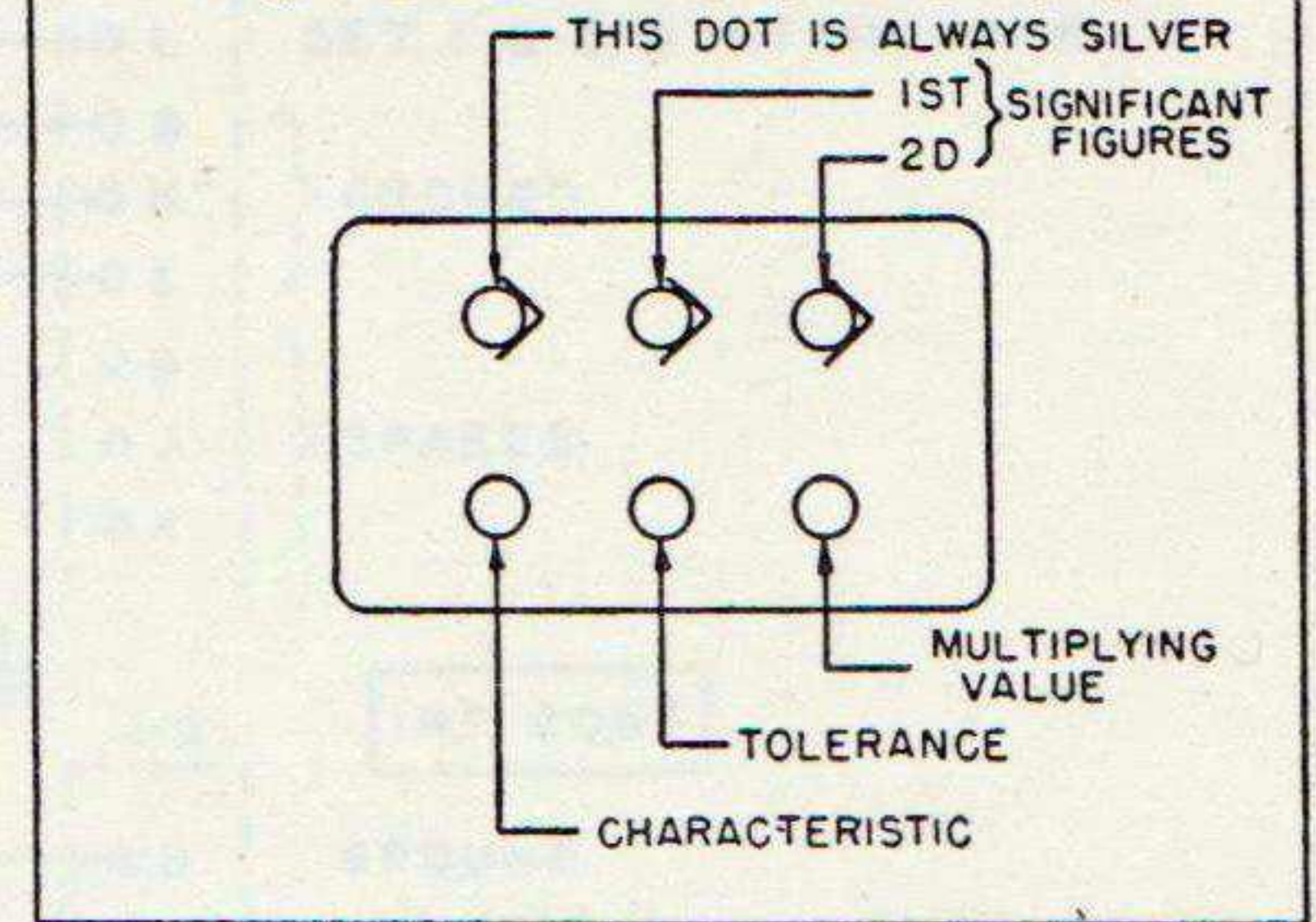
A



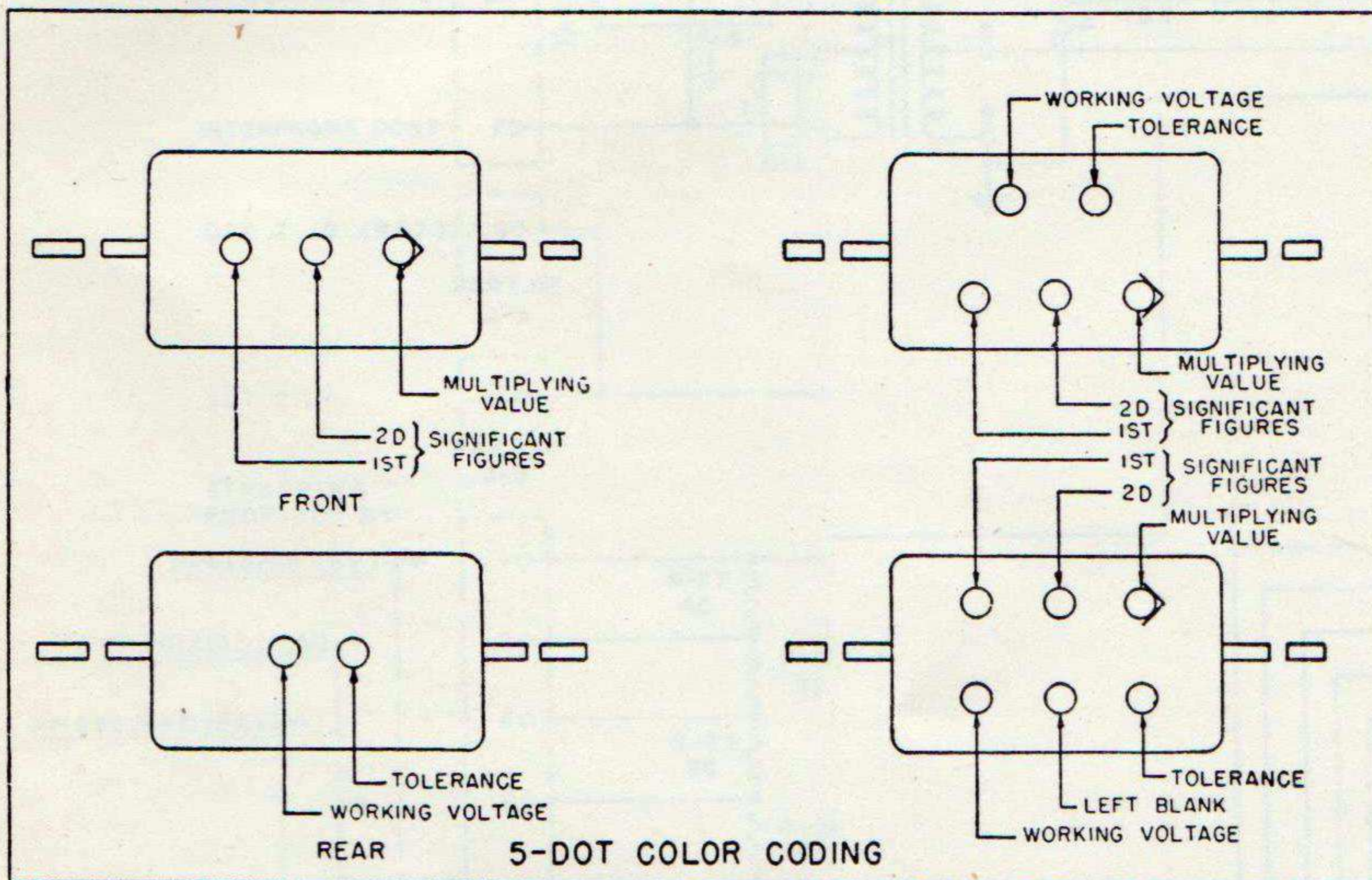
B

### JAN 6-DOT COLOR CODES FOR:

#### PAPER-DIELECTRIC CAPACITORS \*

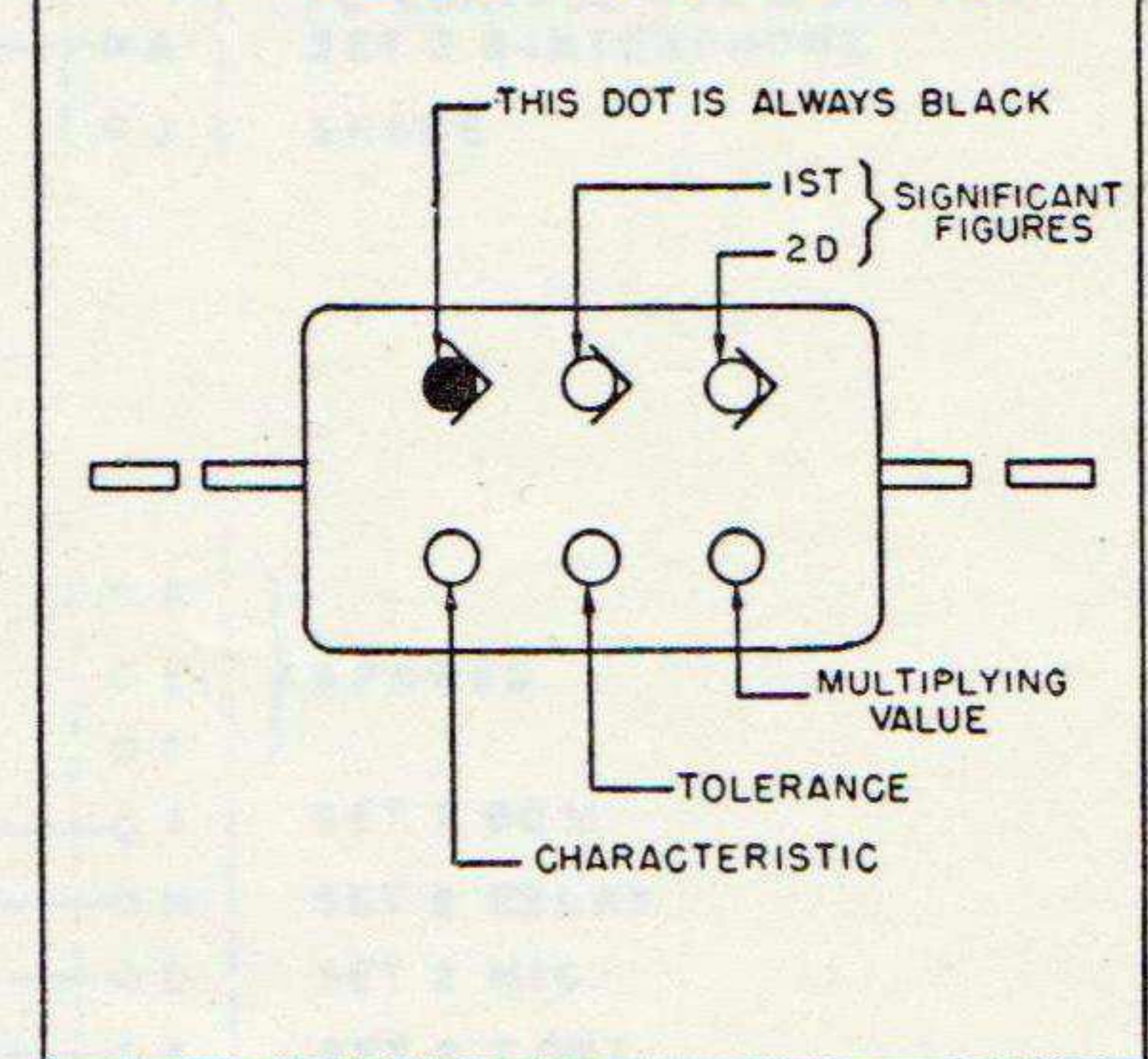


F

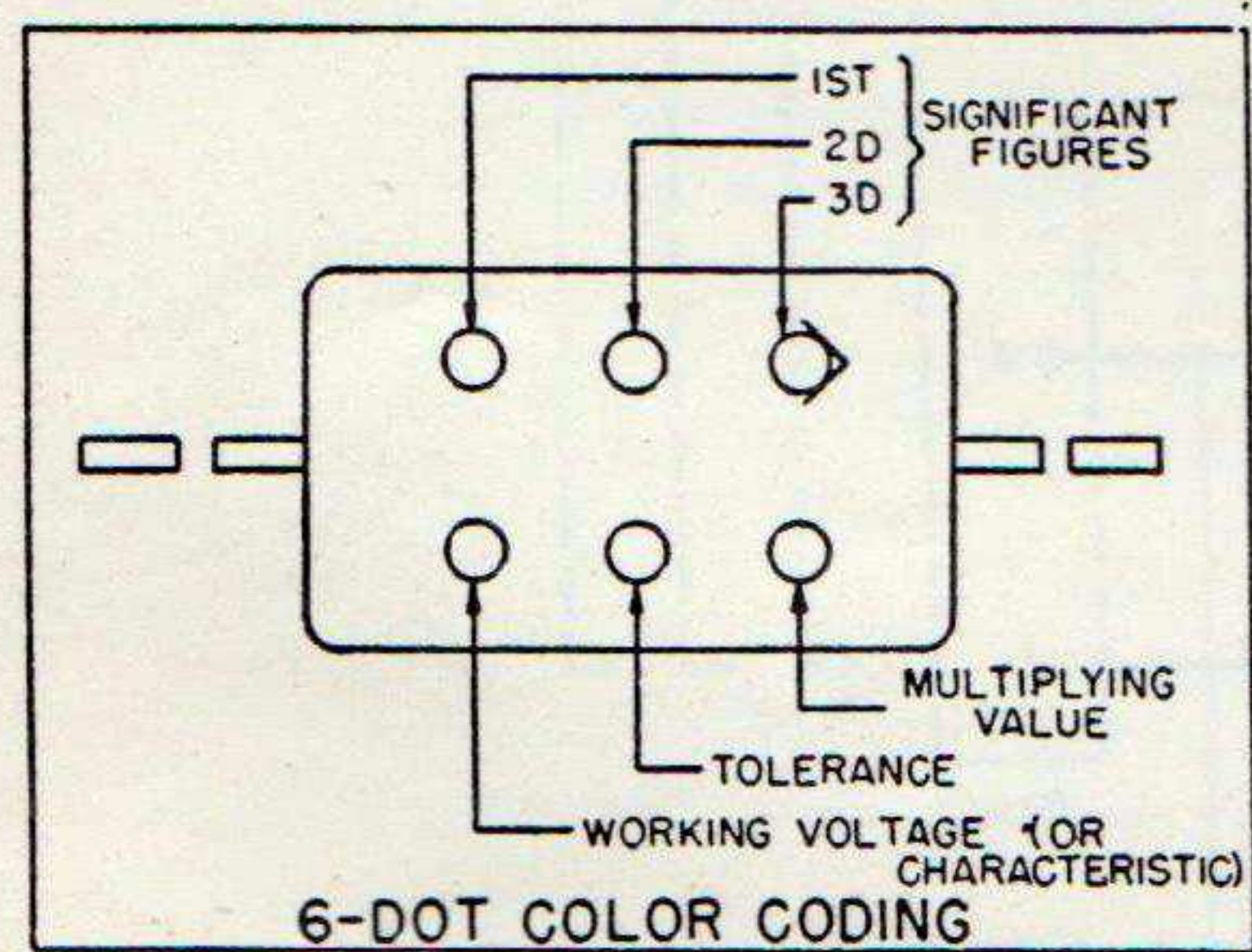


C

#### MICA-DIELECTRIC CAPACITORS †

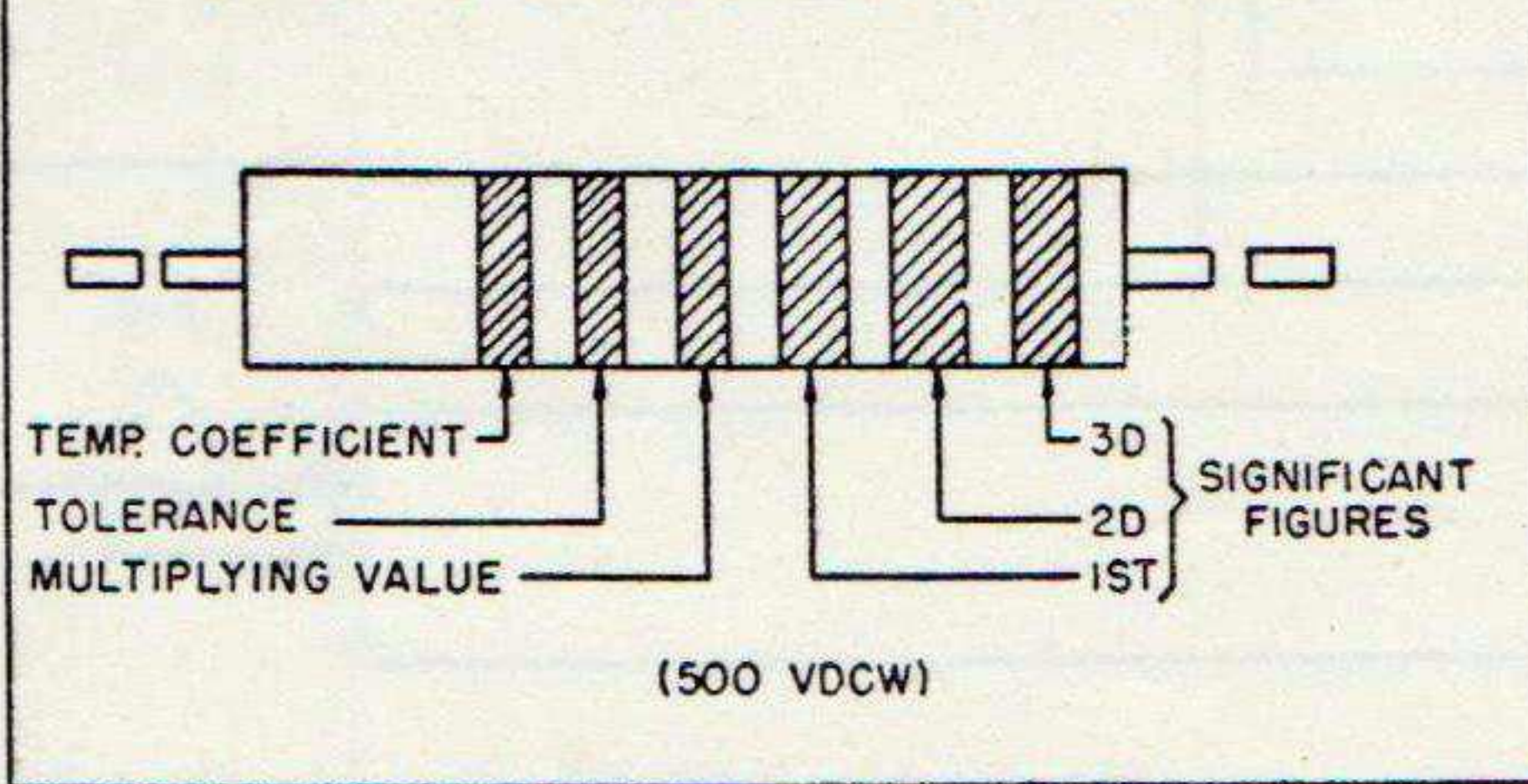


G



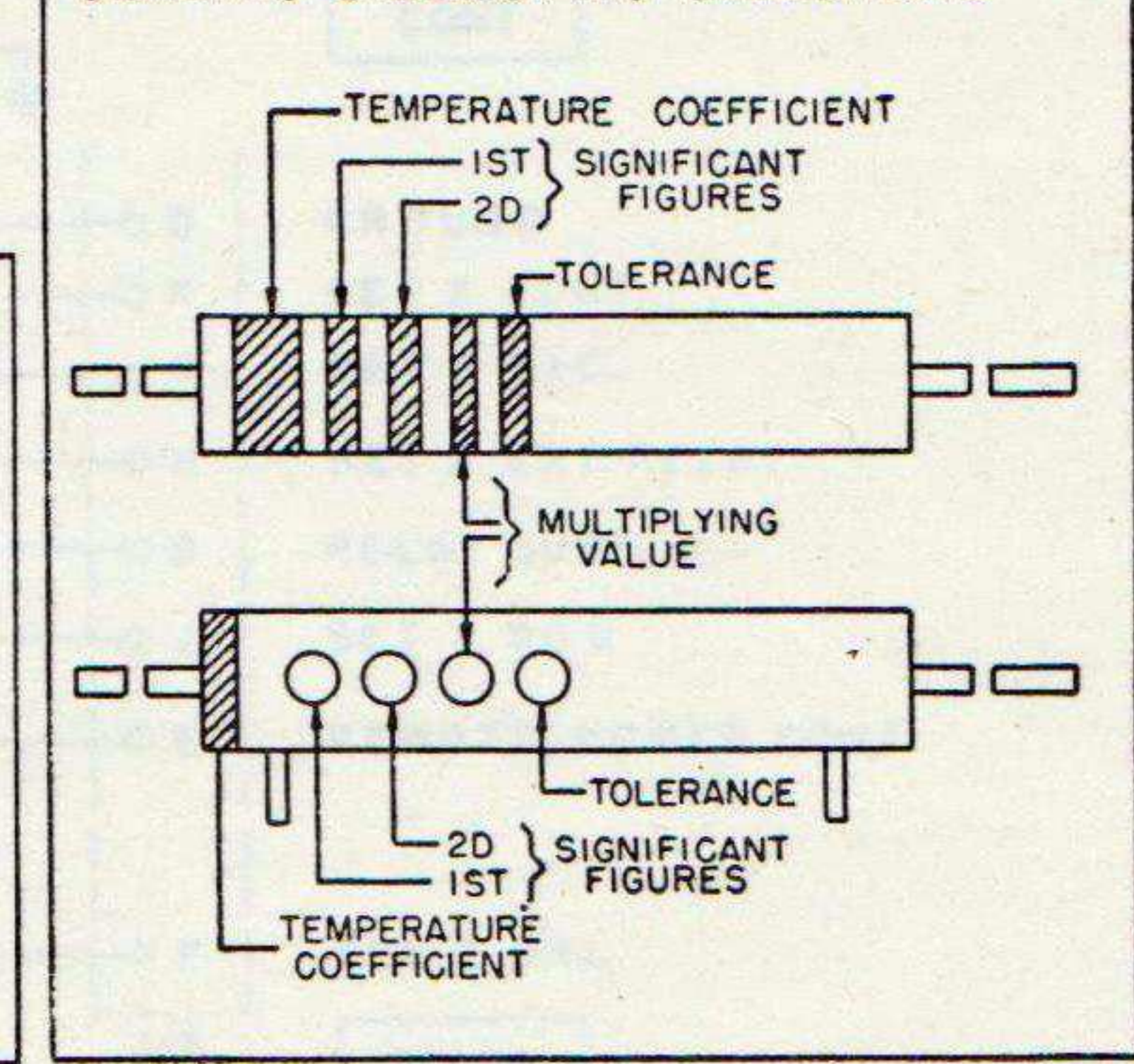
D

#### RMA COLOR CODE FOR TUBULAR CERAMIC-DIELECTRIC CAPACITORS



E

#### CERAMIC-DIELECTRIC CAPACITORS \*\*



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		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.

Figure 16. Capacitor color codes.



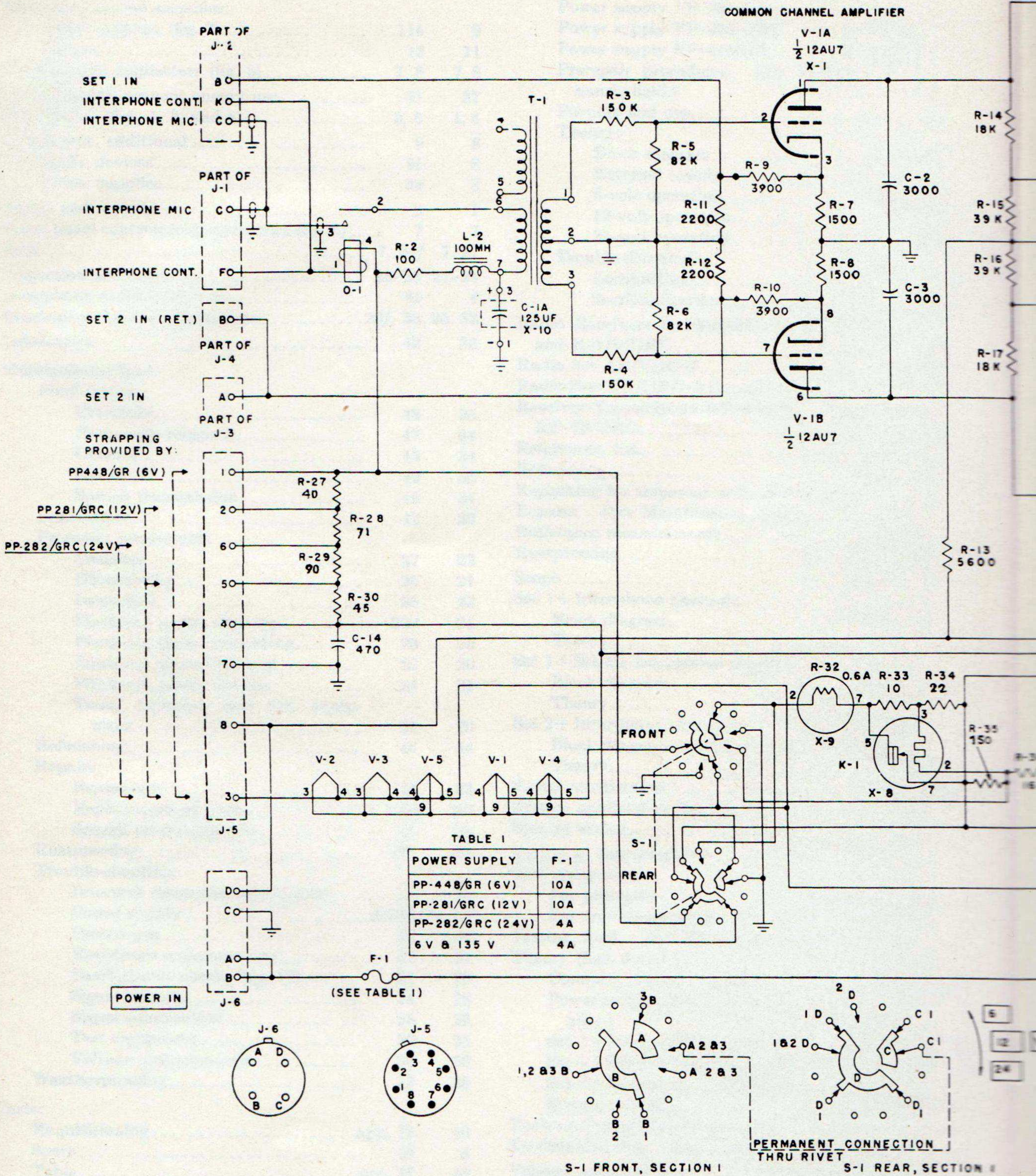


Figure 17. AF Amplifier



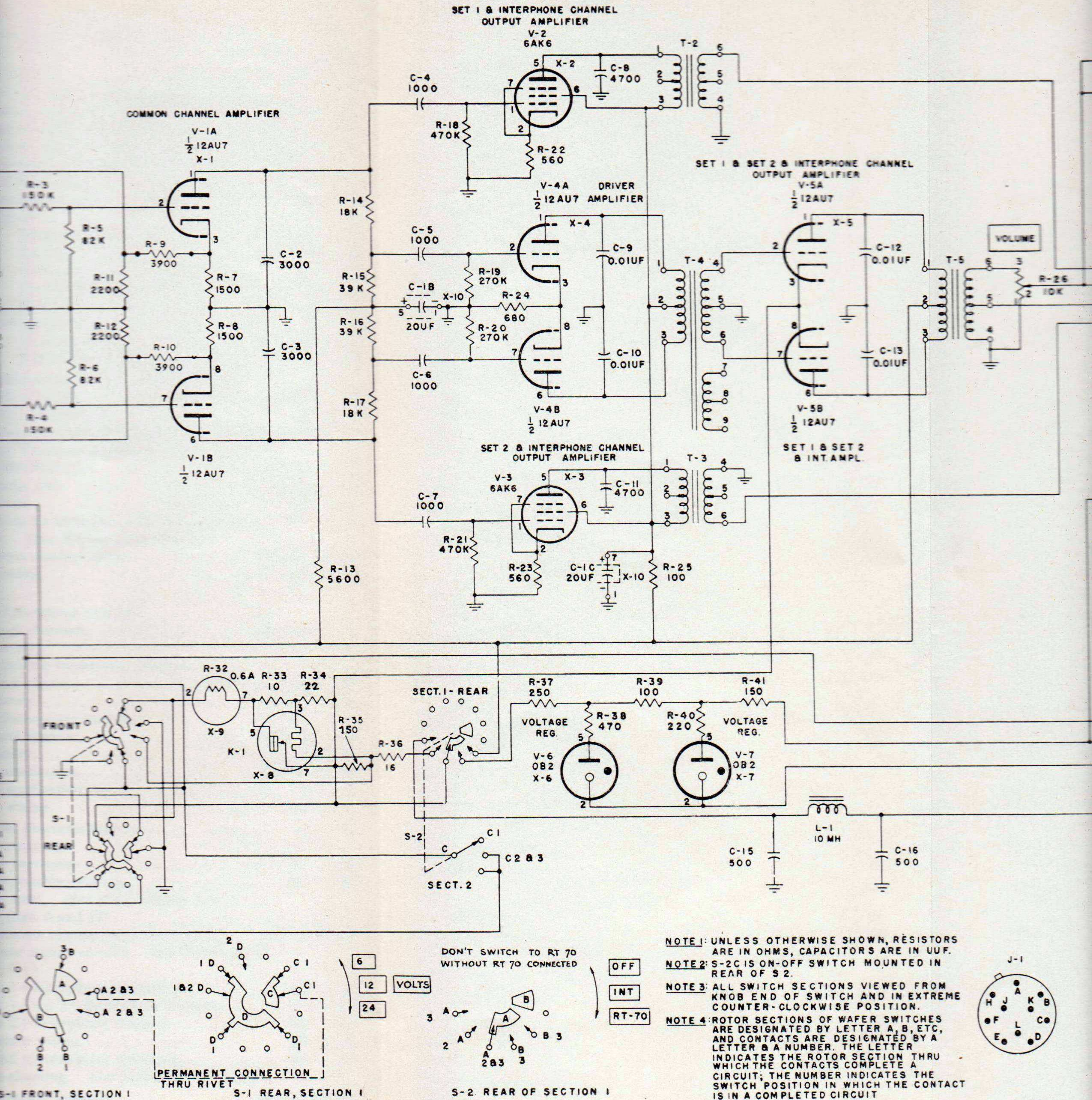
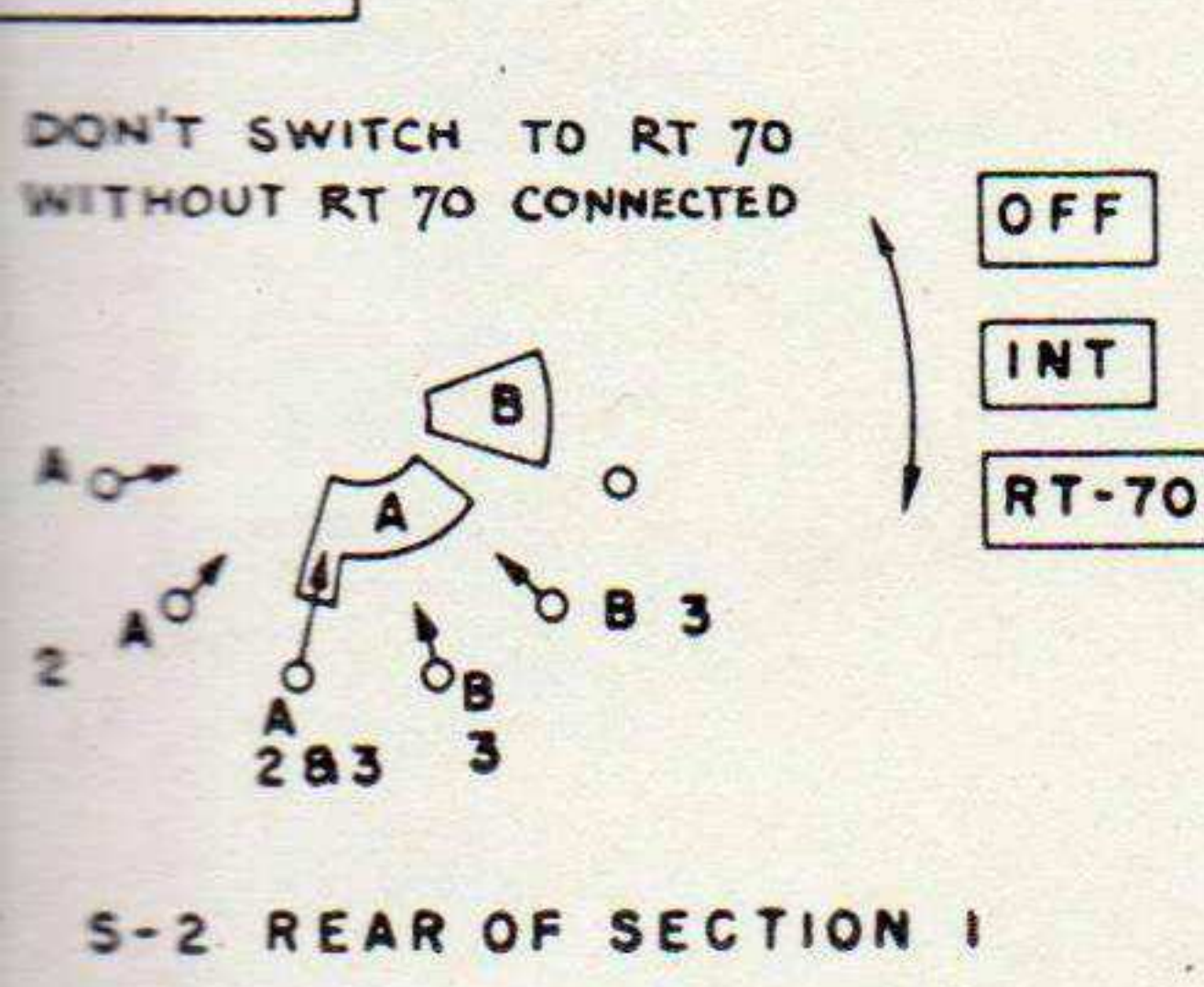
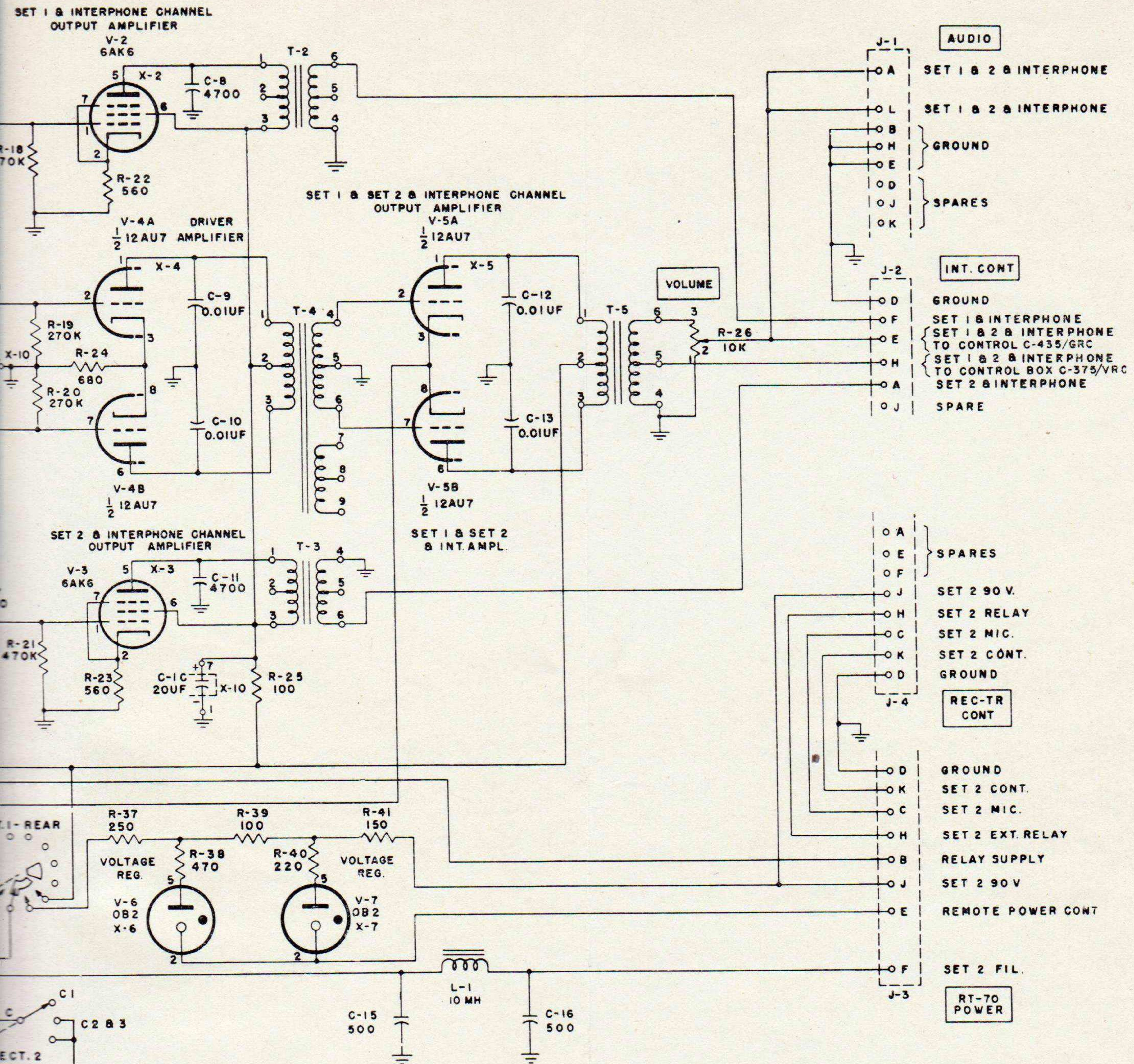


Figure 17. AF Amplifier AM-65/GRC, schematic diagram.



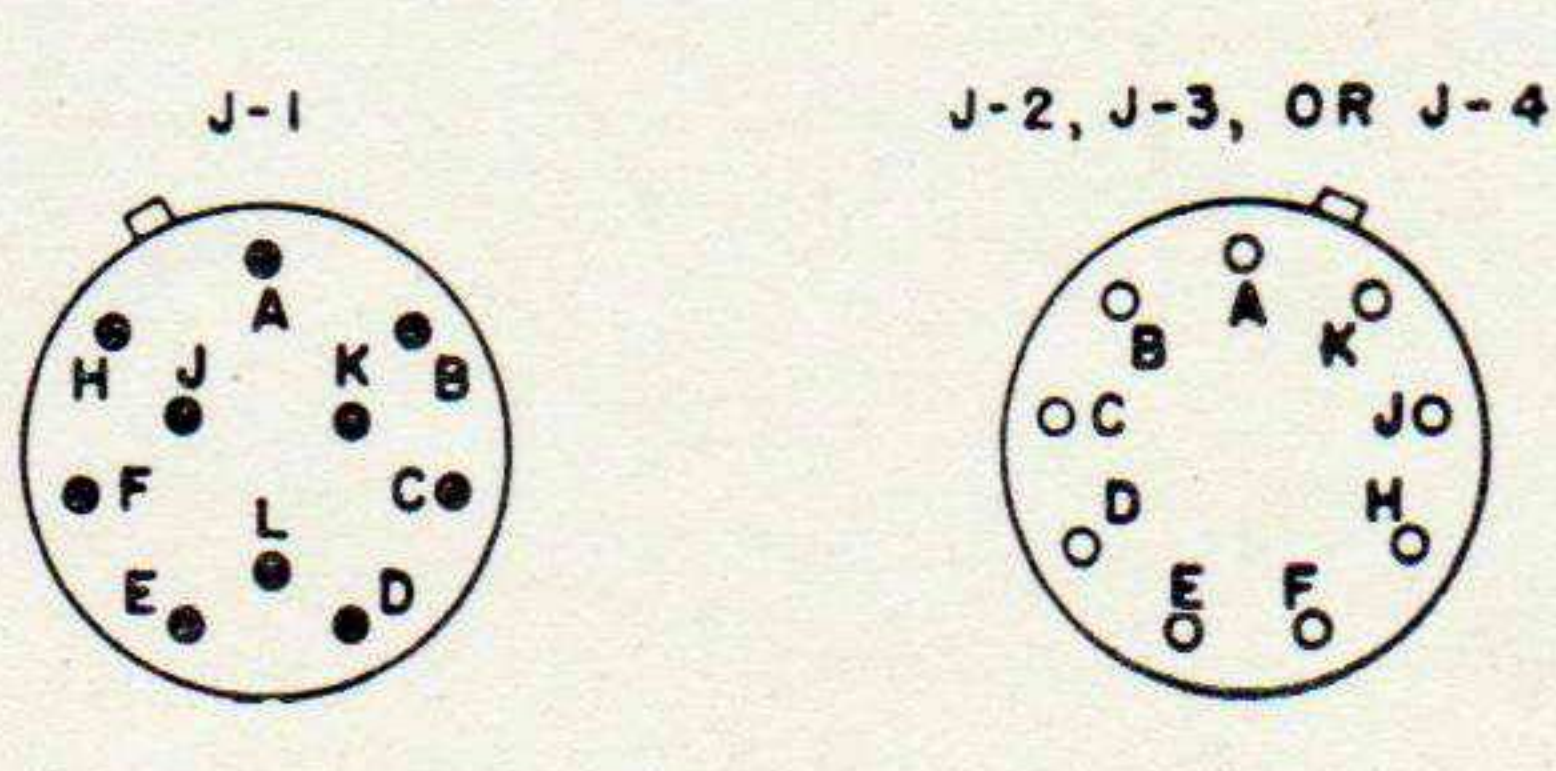


**NOTE 1:** UNLESS OTHERWISE SHOWN, RESISTORS ARE IN OHMS, CAPACITORS ARE IN UUF.

**NOTE 2:** S-2C IS ON-OFF SWITCH MOUNTED IN REAR OF S 2.

**NOTE 3:** ALL SWITCH SECTIONS VIEWED FROM KNOB END OF SWITCH AND IN EXTREME COUNTER-CLOCKWISE POSITION.

**NOTE 4:** ROTOR SECTIONS OF WAFER SWITCHES ARE DESIGNATED BY LETTER A, B, ETC, AND CONTACTS ARE DESIGNATED BY A LETTER & 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



AM-65/GRC, schematic diagram.



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