TM 11-5039

TO 16–35 AM 65–5

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

AF AMPLIFIER

AM-65/GRC

DEPARTMENT OF THE ARMY • JANUARY 1951

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For explanation of distribution formula, see SR 310–90–1.

WARNING

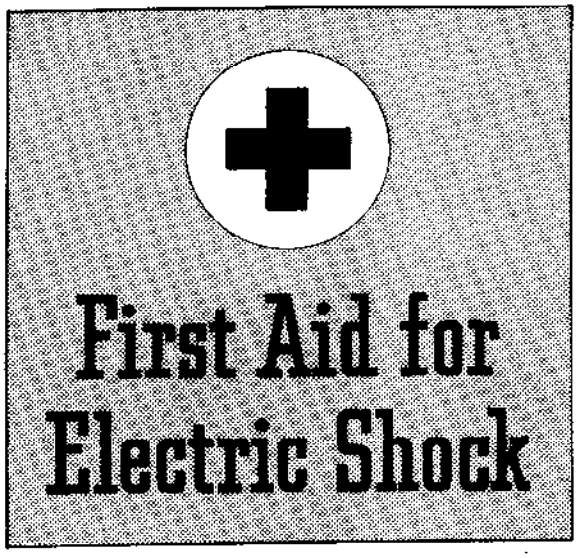
HIGH VOLTAGE

is used in the operation of this equipment.

DEATH ON CONTACT

may result if operating personnel fail to observe safety precautions.

CONTENTS



RESCUE.

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

SYMPTOMS.

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

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

TREATMENT.

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

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

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

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

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

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

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

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

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

f. The resuscitation procedure is as follows:

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

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

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

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

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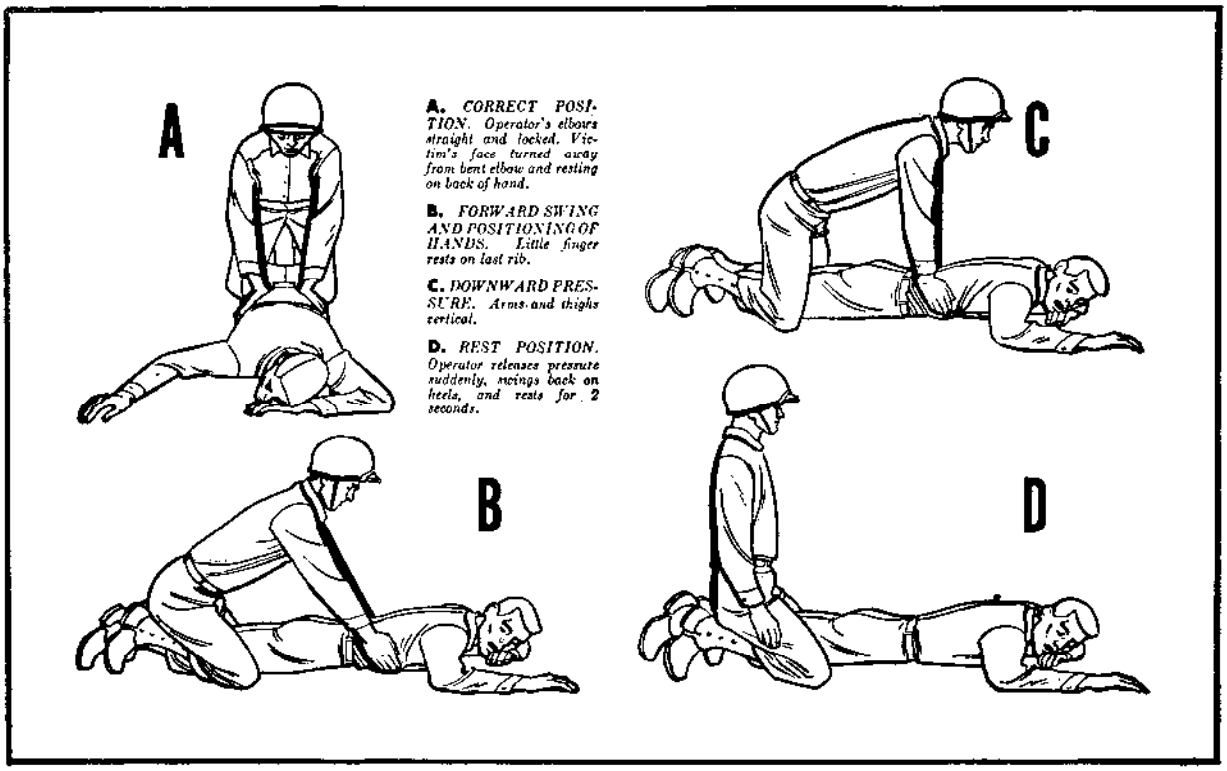

seconds for a complete cycle. Until the operator is thoroughly familiar with the correct cadence of the cycle, he should count the seconds aloud, speaking distinctly and counting evenly in thousands. Example: one thousand and one, one thousand and two, etc.

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

RELIEVING OPERATOR.

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

STIMULANTS.

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

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

CAUTIONS.

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

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

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

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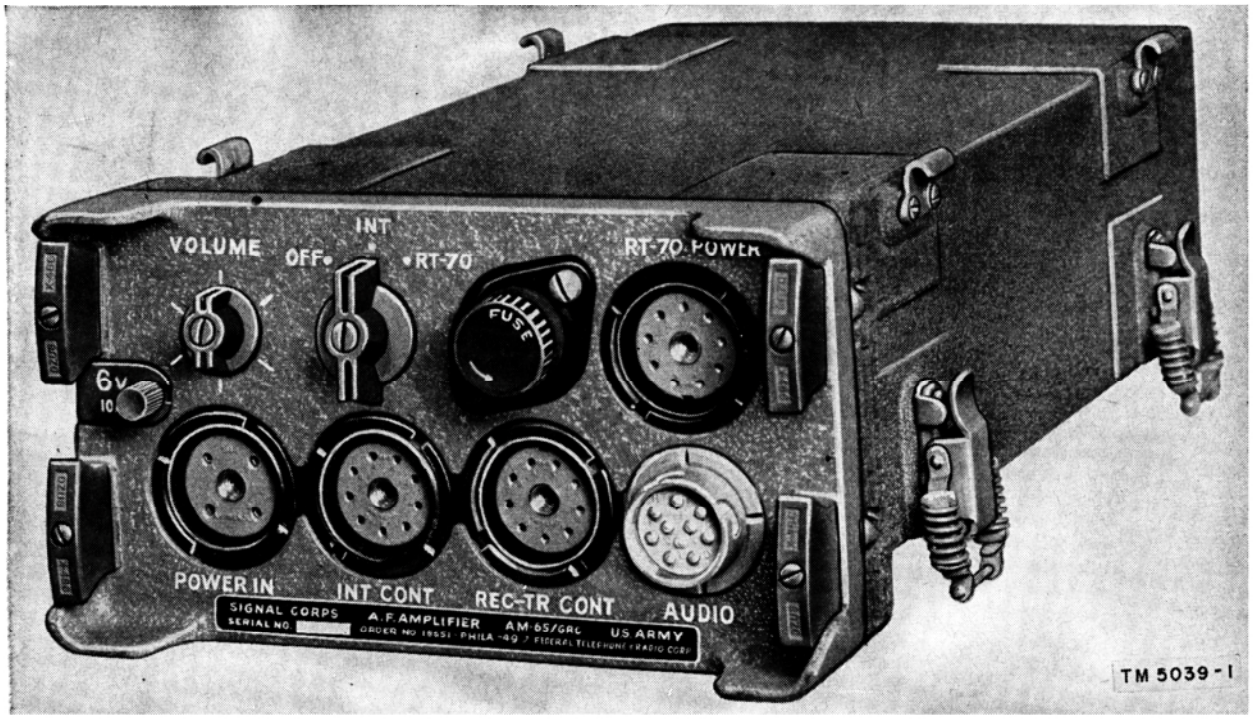

Figure 1. AF Amplifier AM–65/GRC, front view.

CHAPTER 1
INTRODUCTION

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, respectively. 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 connections 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

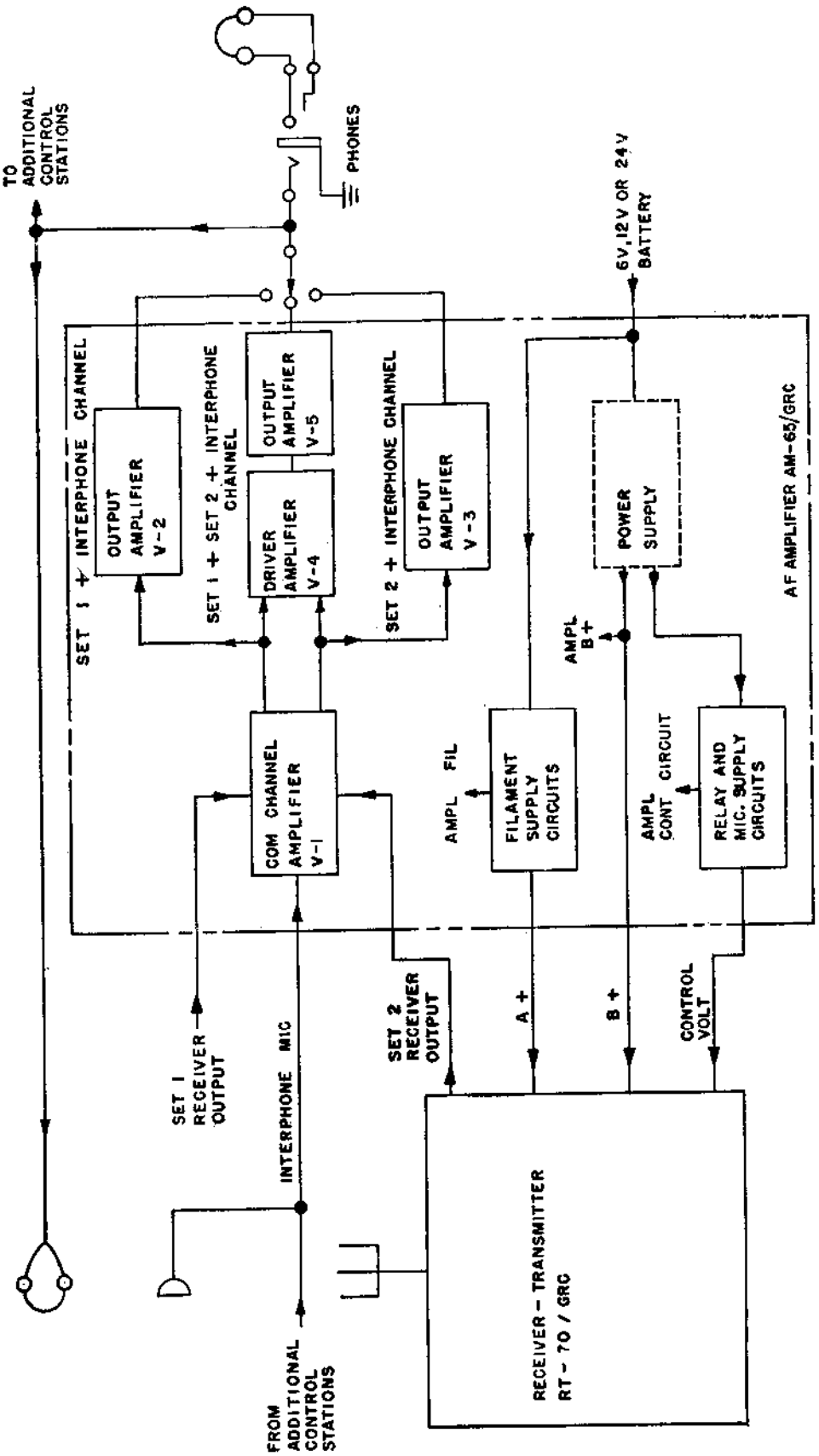

Figure 2. System application.

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)	350	350	1, 800
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.

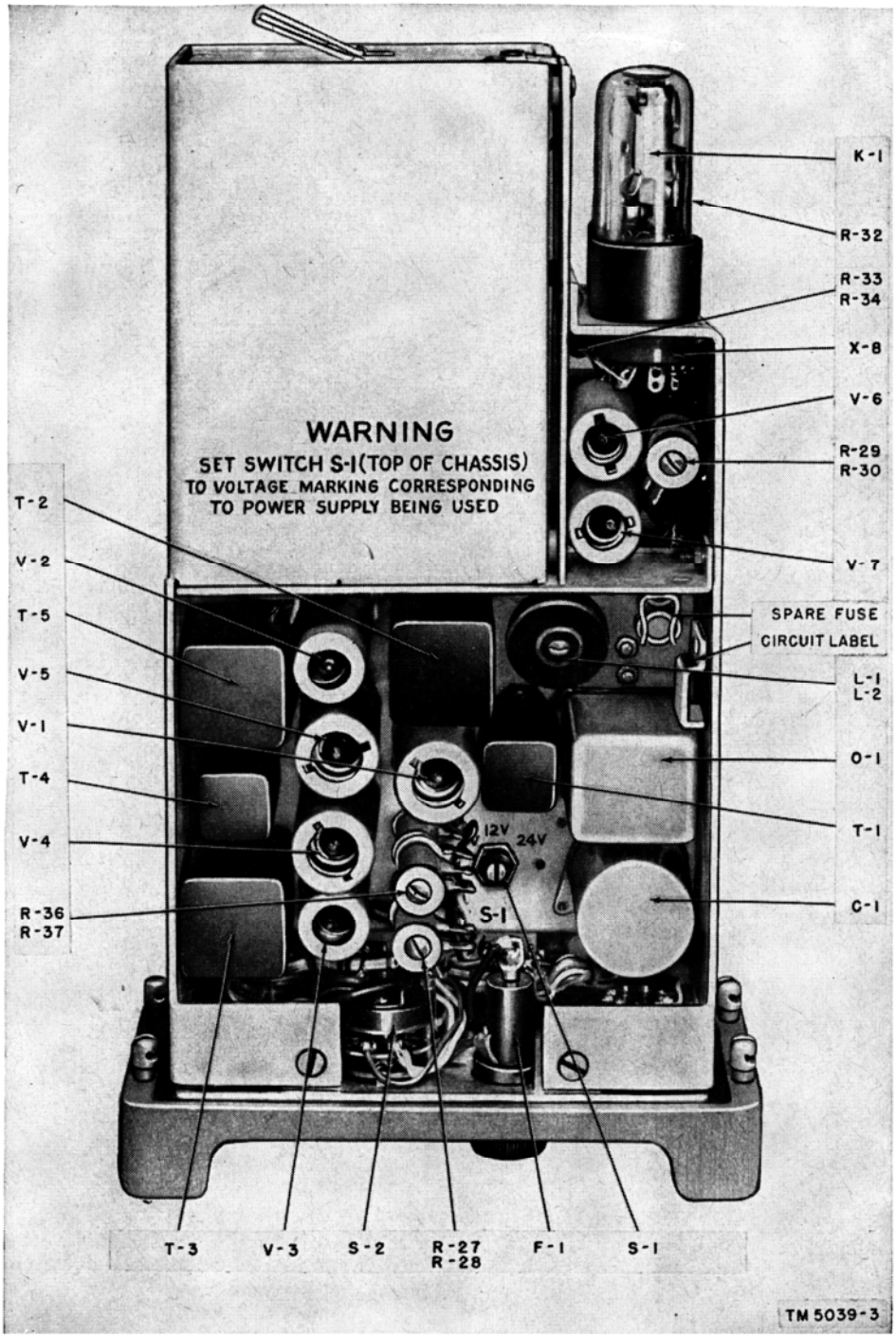

Figure 3. AF Amplifier AM–65/GRC, top view of chassis.

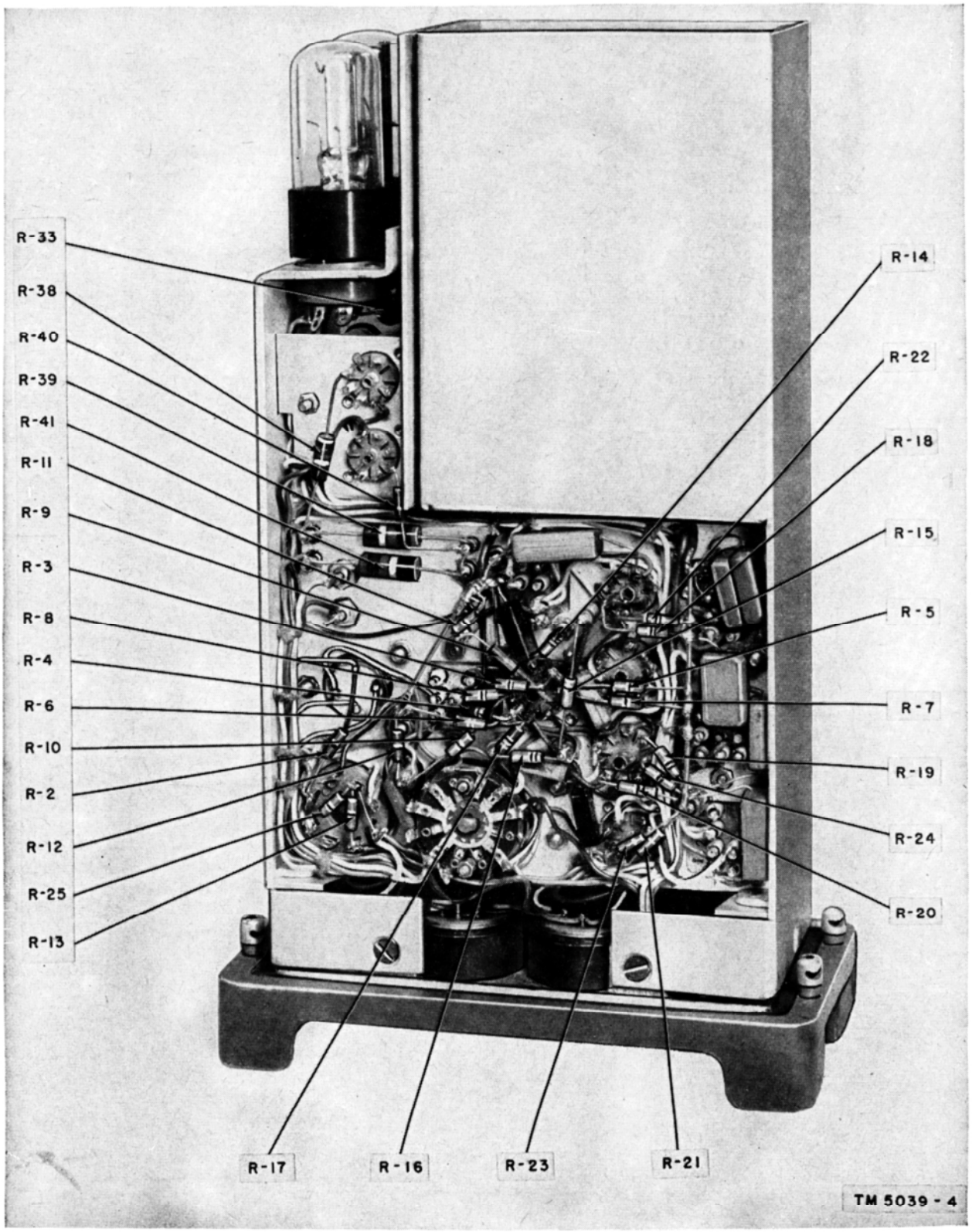

Figure 4. AF Amplifier AM–65/GRC, bottom view of chassis.

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 minitoring.
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. *Caution:* 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. 6 V 10 A 12 V 10 A 24 V 4 A	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.

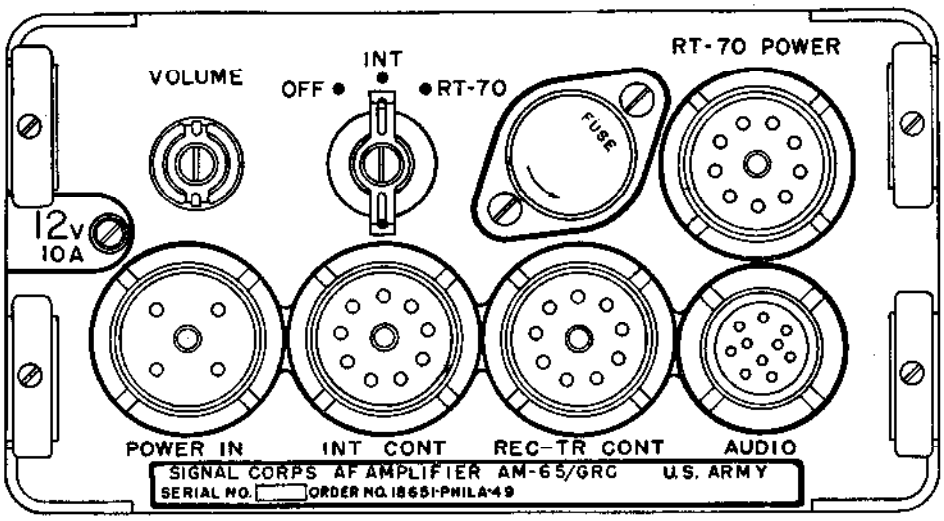

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Figure 5. AF Amplifier AM–65/GRC, panel controls and connectors.

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. ***Note.*** **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—

1 fuse, cartridge, 4 amperes (F–1) (table 1, fig. 17).
1 fuse, 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).
3 tubes type 12AU7, electron (V–1, V–4, V–5).
2 tubes type 0B2, electron (V–6, V–7).

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

CHAPTER 2
THEORY OF AF AMPLIFIER AM-65/GRC

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

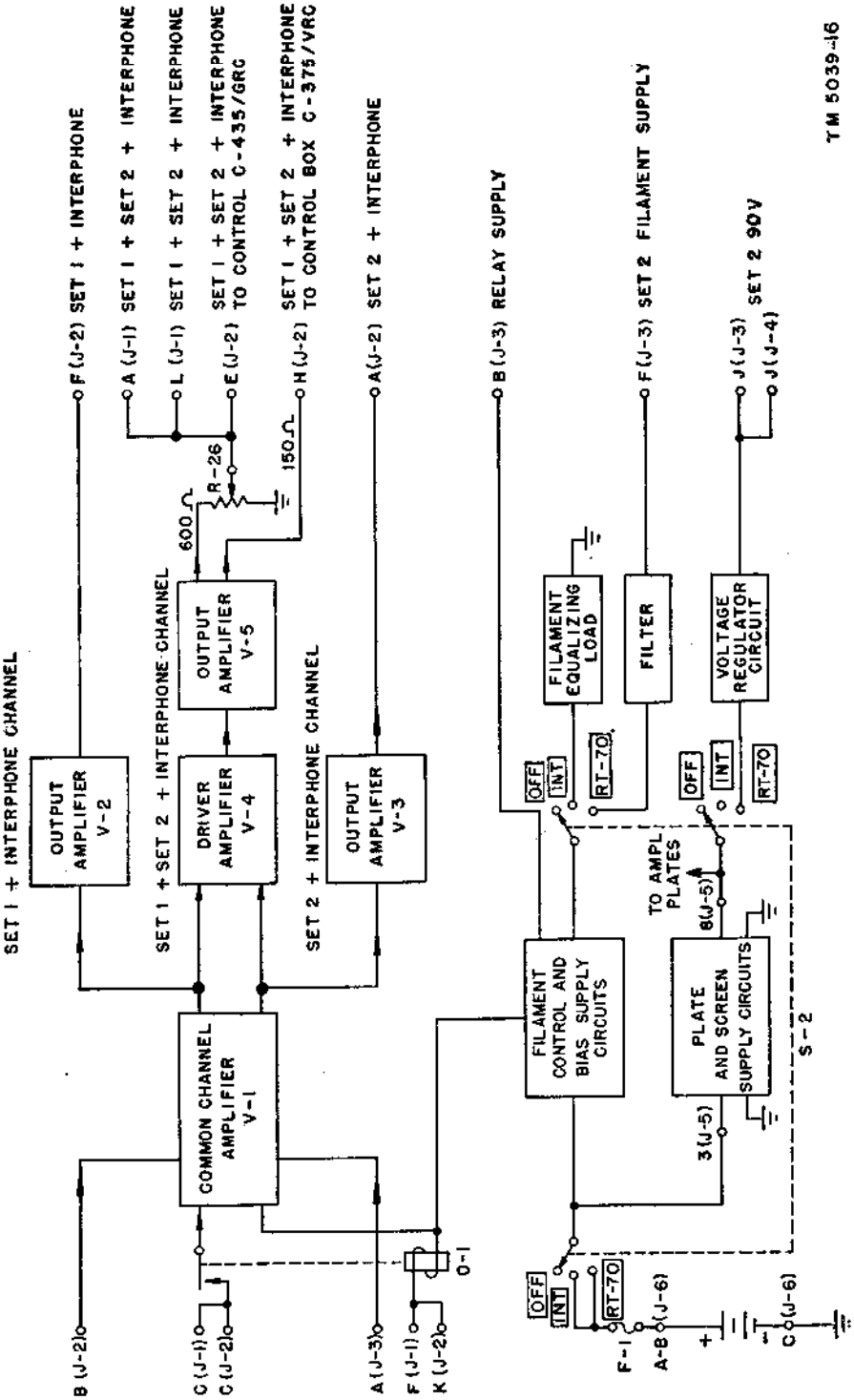

Figure 6. AF Amplifier AM-65/GRC, block diagram.

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.

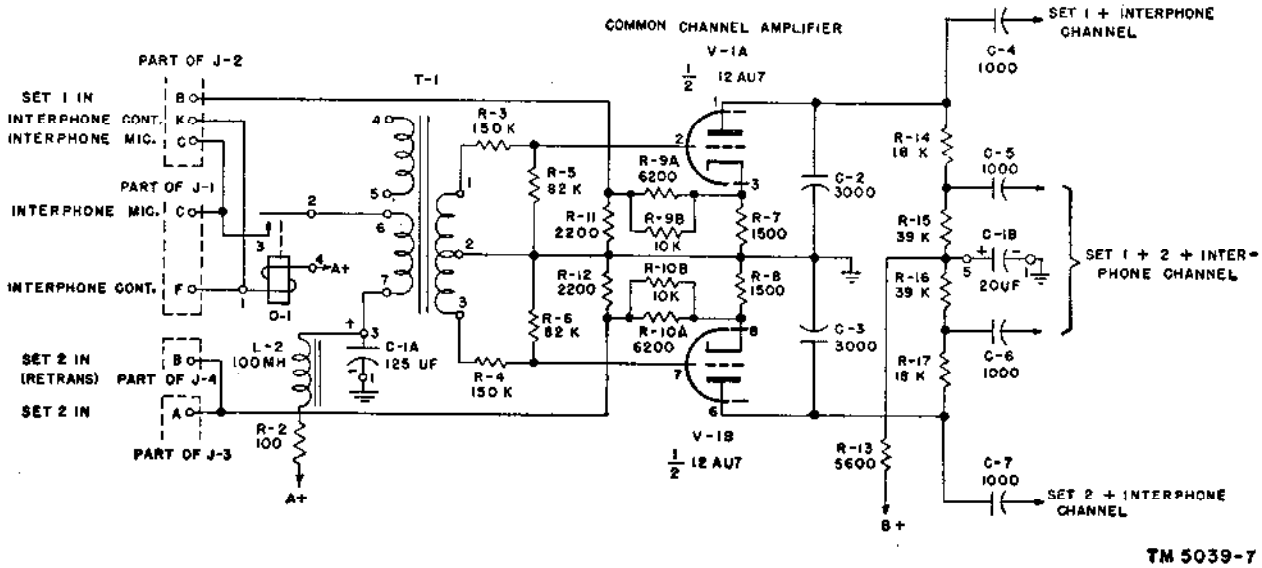

Figure 7. Signal input and common channel amplifier circuits.

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 (A and B) 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 (A and B) 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.

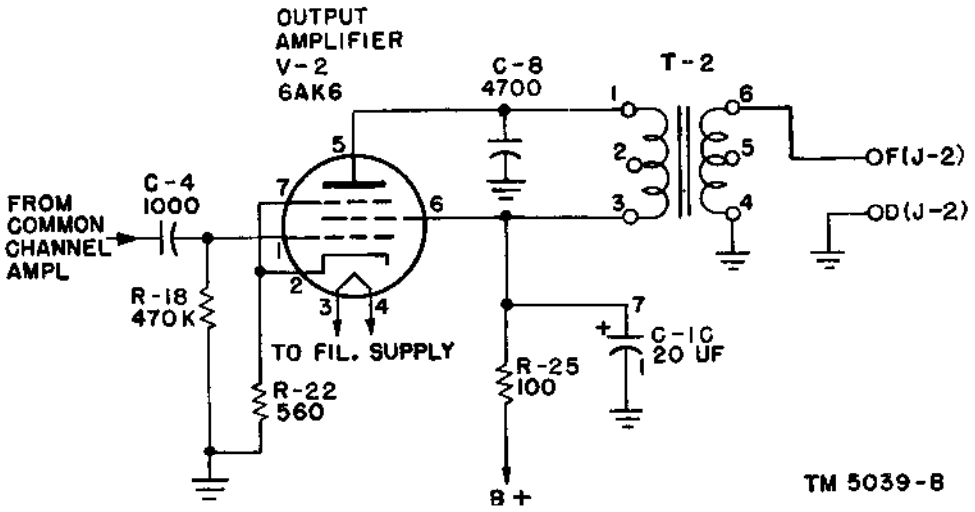

Figure 8. Set 1+Interphone channel circuits.

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

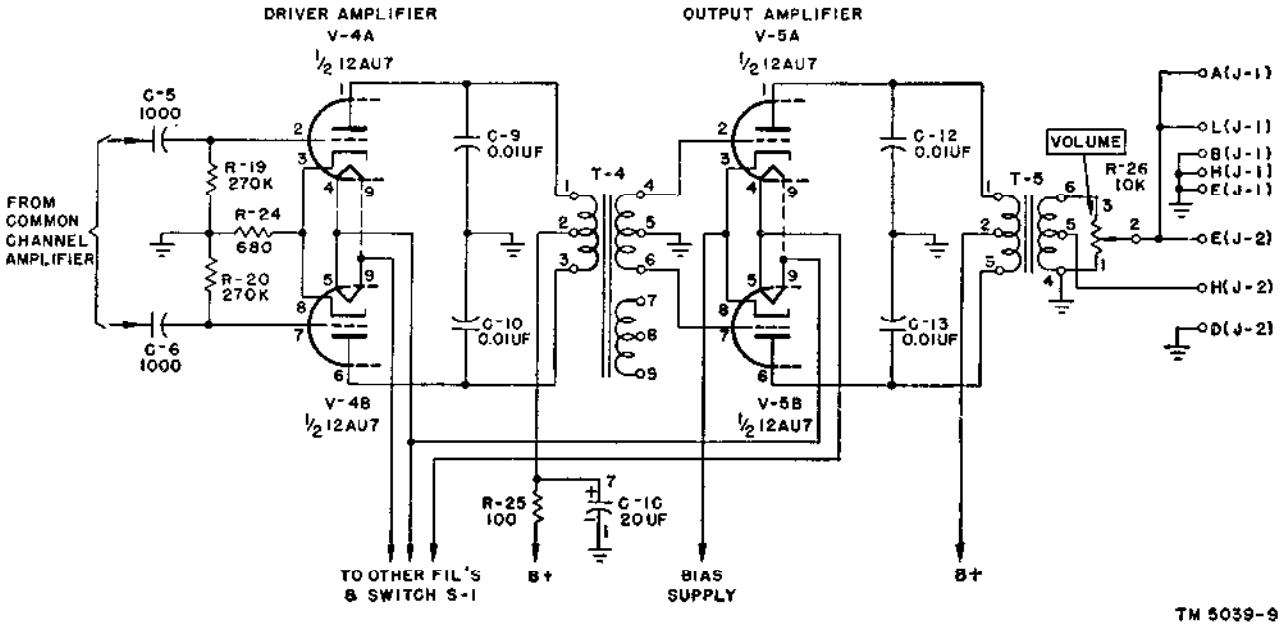

Figure 9. Set 1+Set 2+Interphone channel.

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 6.7 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 the external ground connection is broken, the tubes draw no current. The arrangement serves to prevent the tubes from drawing excessive current if the receiver-transmitter (load) is disconnected with switch S–2 in the RT–70 position.

d. Relay, Microphone, and Control Voltage Supplies. Socket connector X–1 or 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 or 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 microphone. 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.

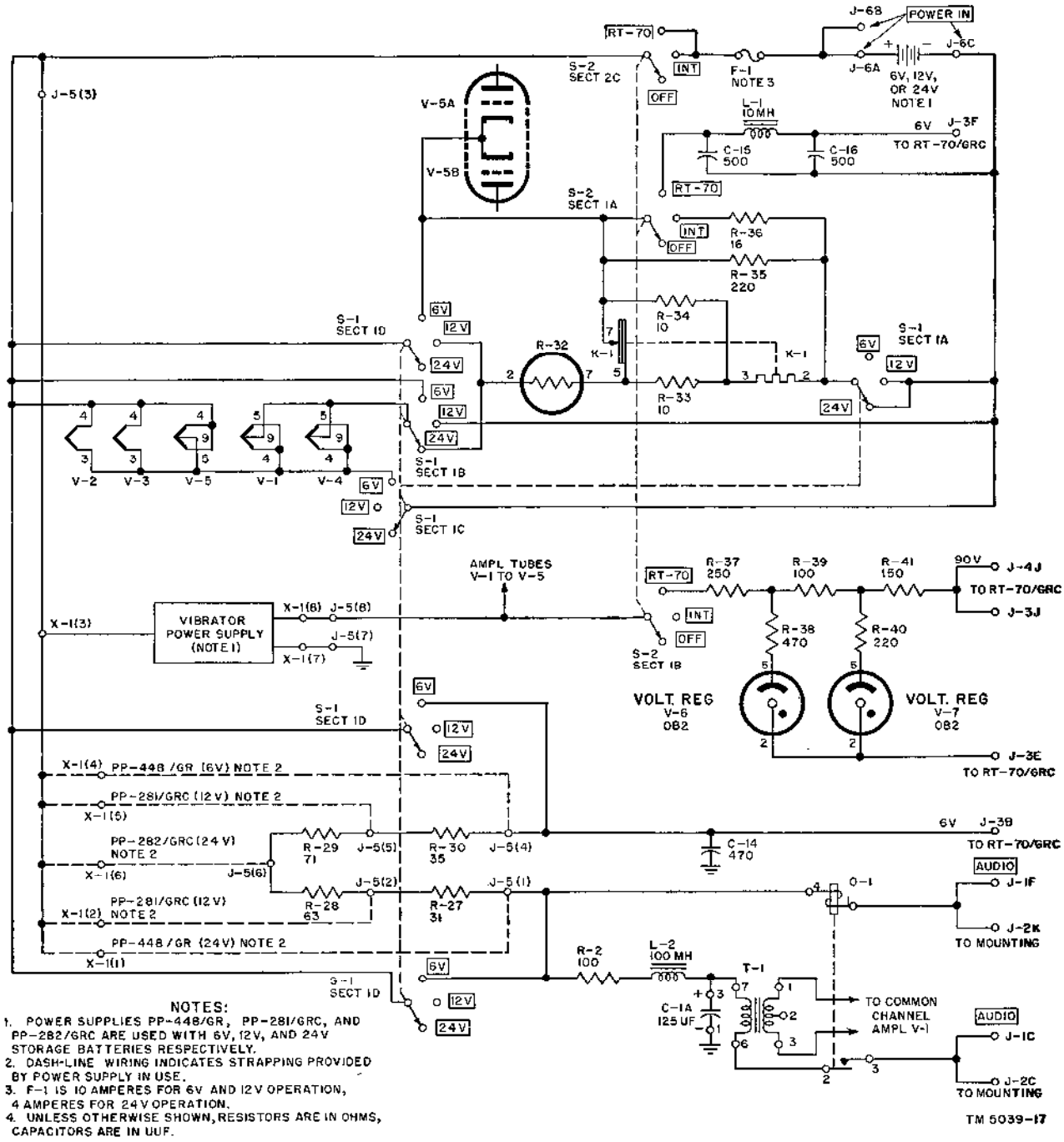

Figure 10. Power supply circuits.

(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 16b, 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 terminals 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 prerepair 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 market 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.