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# INSTRUCTION BOOK

FOR

# RECEIVER-TRANSMITTER RT-70/GRC



FEDERAL TELEPHONE & RADIO CORPORATION
CLIFTON, NEW JERSEY
Order No. 18651 – Phila. – 49
29 DECEMBER 1950

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**WARNING**

**HIGH VOLTAGE**

is used in the operation of
this equipment.

**DEATH ON CONTACT**

may result if operating personnel
fail to observe safety precautions.

# First Aid for Electric Shock

## 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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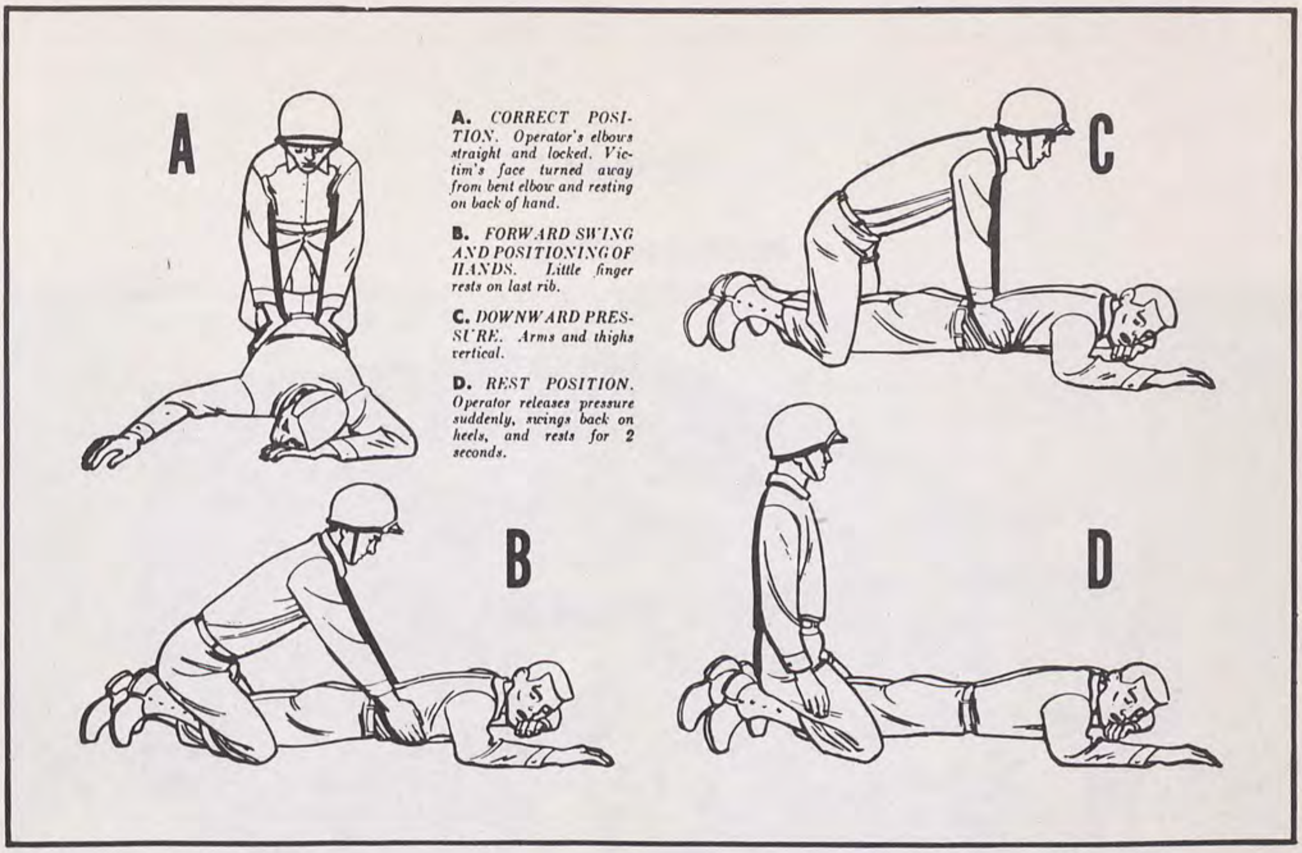


**A.** *CORRECT POSITION. Operator's elbows straight and locked. Victim's face turned away from bent elbow and resting on back of hand.*

**B.** *FORWARD SWING AND POSITIONING OF HANDS. Little finger rests on last rib.*

**C.** *DOWNWARD PRESSURE. Arms and thighs vertical.*

**D.** *REST POSITION. Operator releases pressure suddenly, swings back on heels, and rests for 2 seconds.*

**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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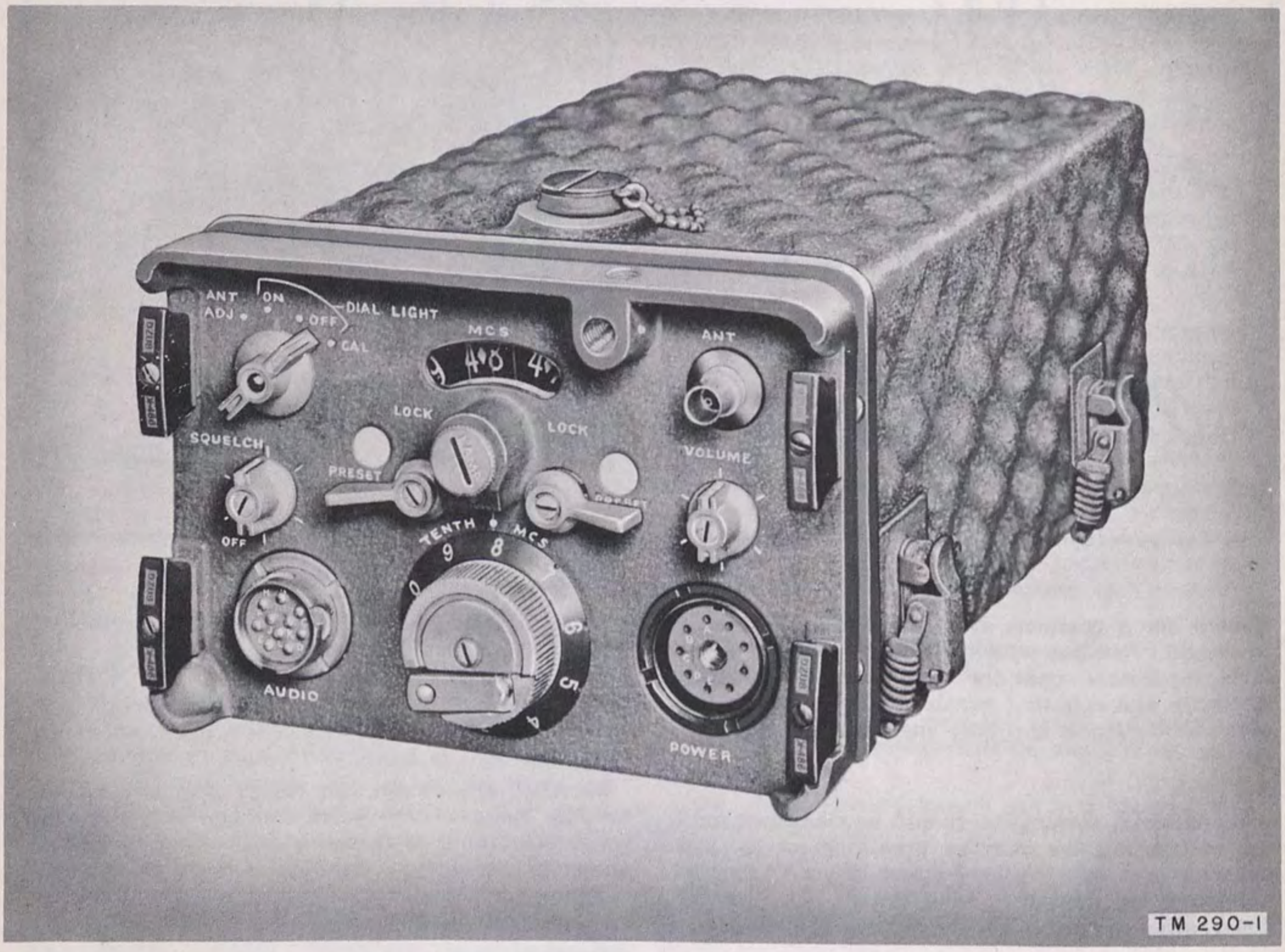



*Figure 1. Receiver-Transmitter RT-70/GRC, over-all view.*

*Note. This instruction book will be replaced by TM 11-290 which, when published, will be listed in SR 310-20-4.*

# CHAPTER 1

# INTRODUCTION

## Section I. GENERAL

### 1. Scope

This instruction book contains a description, detailed theory of operation, and instructions for field maintenance and repair of Receiver-Transmitter RT-70/GRC (fig. 1). In addition, a chapter on the disassembly and repacking of the equipment for shipment or limited storage is included. Two appendixes covering a list of references and an identification table of parts are also provided.

### 2. Forms and Records

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

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

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

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

## Section II. DESCRIPTION AND DATA

### 3. Purpose

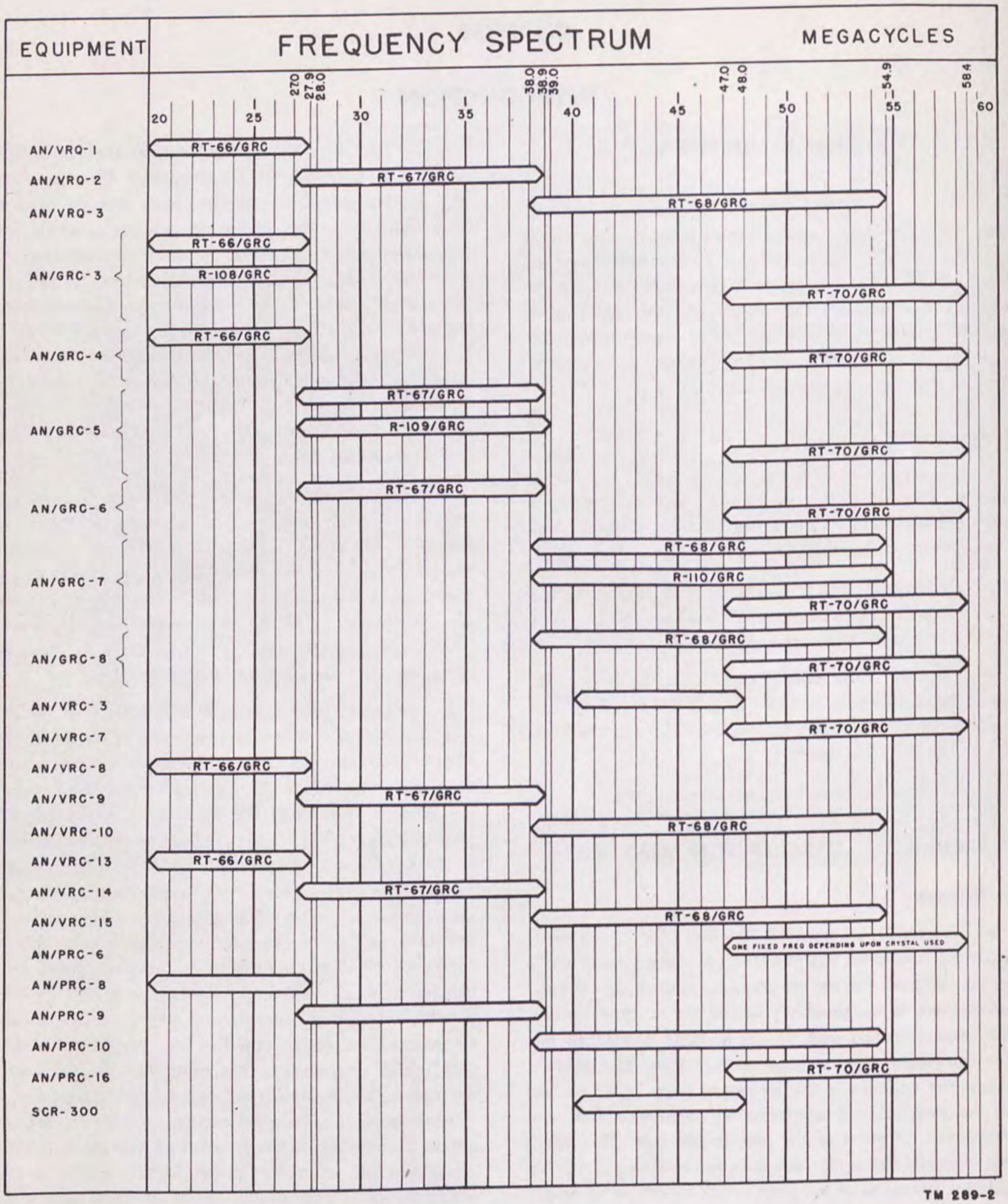
*a.* Receiver-Transmitter RT-70/GRC (fig. 1) is a small, lightweight radio set, less power supply and accessory equipments, designed for use in portable, ground, or vehicular installations. When suitably powered, the set provides two-way communication with similar portable, ground, or mobile equipments over a range up to 1 mile. The receiver-transmitter operates in the frequency range of 47 to 58.4 mc (megacycles) and uses frequency modulation. The communication circuit is of the push-to-talk type. This means that normally the equipment is in the receiving condition, and that operation of the push-to-talk switch on an associated carbon microphone or handset, or of a switch on an associated control box, disables the receiver and turns on the transmitter. Thus, conversation can proceed in one direction at a time only.

*b.* The frequency coverage of Receiver-Transmitter RT-70/GRC is indicated in the frequency spectrum chart (fig. 2). For comparison, the frequency coverage of other radio equipments with which the receiver-transmitter described here may be associated in a working system installation is included in the chart. The chart shows, for example, that a considerable overlap exists between Receiver-Transmitter RT-68/GRC and Receiver-Transmitter RT-70/GRC. The receiver-transmitter provides for continuously variable tuning. Rapid selection of two preset detent channels is provided for.

### 4. System Application

*a.* Receiver-Transmitter RT-70/GRC may be used as a component of a portable field set such as Radio Set AN/PRC-16 (fig. 3), as part of a vehicular installation such as Radio Set AN/VRC-7 (fig. 4), or as part of systems such as Radio Sets AN/GRC-3 through -8. The normal operating range of the receiver-transmitter is about 1 mile. Under favorable conditions of terrain and climate the operating range may be somewhat extended.

*b.* To use Receiver-Transmitter RT-70/GRC in an operating installation, it is necessary to provide a suitable source of power. In addition, control, audio, and output connections, and an antenna with mounting and connecting facilities must be provided. The microphone input and the receiver audio output circuits are brought out to connectors on the front panel. Since these connections may, therefore, be made to any audio equipment having the proper impedance and proper power handling capacity, a high degree of flexibility exists. For example, the audio circuits may be completed *by direct connection to the front panel,* by a handset, or a microphone and headset, as in the case of a portable installation. Alternatively, the audio circuits may be extended through an amplifier (AF Amplifier AM-65/-GRC) and a mounting (Mounting MT-300/GR) to a microphone and headset, a microphone and loudspeaker, or to a telephone line. The power connections are also brought out to a connector on the front panel, making it possible to connect the set to any power source capable of providing 90 volts for the plates and screens of the tubes in the set, and 6.3 volts for the filaments, microphone, and the control relay. The power source may be a set of dry batteries (housed in Case CY-590/GRC), or a vibrator type power supply unit (Power Supply PP-448/GR, PP-281/-




TM 289-2

*Figure 2. Frequency spectrum chart.*

GRC, or PP-282/GRC) housed in AF Amplifier AM-65/-GRC and operating from the vehicular storage battery (6, 12, or 24 volts, respectively). Typical working installations are described briefly in subparagraphs *c* through *e* below.

*c.* Figure 3 shows the manner in which Receiver-Transmitter RT-70/GRC is associated with the other components necessary to complete a portable field installation, such as Radio Set AN/PRC-16. The figure also illustrates the basic principle of operation of Receiver-Transmitter RT-70/GRC, namely the push-to-talk arrangement.

(1) The additional components, necessary to complete Radio Set AN/PRC-16, include a set of dry batteries (90 volts and 7.5 volts), housed in a battery box, Case CY-590/GRC, a microphone with push-to-talk switch (Microphone T-17), a headset (Headset HS-30), an antenna, and a mounting plate (not shown). The battery box houses the dry batteries, and in addition provides a power on-off switch, and the wiring necessary to extend the power control connections from the panel of the battery box to the control facilities. A cable fitted with suitable connectors, Power Cable Assembly CX-1209/U, joins the control and power input circuits of the receiver-transmitter to the wiring and batteries in Case CY-590/GRC.

(2) Reception and transmission are placed under control of the microphone switch, and of a control relay within the receiver-transmitter. With the power on-off switch in the battery box closed, the control relay remains unenergized as long as the microphone switch is open, because the ground return connection for the relay is broken. Under this condition the receiver is operative, since full power is applied to it. Plate and screen power is applied by direct connection, while filament power is applied over a normally closed pair of contacts of the control relay. The transmitter is not fully energized since other, normally open, relay contacts keep the microphone and some of the filament and screen supply circuits open. When the microphone switch is closed, the ground return connection for the relay is completed, the relay becomes energized, its contacts complete the screen, filament, and microphone supply circuits of the transmitter, and at the same time break the filament supply circuits for the receiver. The transmitter thus becomes fully energized and ready for the transmission of a message. The receiver, however, is partially disabled, and no r-f (radio-frequency) signal can enter it. A sidetone circuit, completed by the closure of the relay contacts when the relay is energized, routes a portion of the microphone audio energy to the audio circuits of the receiver (which remain energized under transmit conditions) for monitoring purposes.

*d.* The combination of Receiver-Transmitter RT-70/-GRC, AF Amplifier AM-65/GRC, Control Box C-375/-VRC, Power 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 4 is a functional block diagram of this set. In this arrangement the amplifier provides for monitoring the receiver output of Receiver-Transmitter RT-70/GRC (Set 2), and interphone channel between control stations, monitoring of the interphone channel, 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 output of the receiver in Receiver-Transmitter RT-70/GRC are routed over one path to one of the three amplifier input circuits (Set 2 input). The amplified signals appear at two of the three output circuits (Set 2 + Interphone, and Set 1 + Set 2 + Interphone) of the amplifier. These signals may then be heard at the locally connected headphones, and in the headphones of any one of the control stations (Control Box C-375/VRC) associated with the installation. Speech signals from the locally connected microphone, or from any one of the control stations, may be applied through wiring in the amplifier directly to the input circuits of the transmitter in Receiver-Transmitter RT-70/GRC for transmission over the air. A portion of the microphone signals is routed from the transmitter input circuits, over the sidetone circuit to the receiver audio circuits, from which they are applied, just like any received signal, to the amplifier input circuits, as described above, for distribution to the locally connected headphones and to the headphones of the control stations for monitoring purposes. Alternatively, depending on the setting of a selector switch on the control equipment, the microphone signals from the locally connected microphone or from a control station, may be routed to the interphone input of the amplifier. After amplification, these signals are distributed not only as sidetone to the sending operator's headphones, but also the headphones of any of the control stations, thus providing for communication between the several control stations. The three-position switches, shown connected to the amplifier input and output circuits, are simplified representations 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 three amplifier channels. See note below.

*Note.* The amplifier portion of AF Amplifier AM-65/GRC provides three input and three output circuits. Of the input circuits, one is for connection to the receiver output of one receiver-transmitter (Receiver-Transmitter RT-70/GRC or Set 2), another for connection to the interphone or control station microphones, and the third for connection to the receiver output of another receiver-transmitter (Set 1). Set 1 (either Receiver-Transmitter RT-66/GRC, RT-67/GRC, or RT-68/GRC) is not used in Radio Set AN/VRC-7. Of the three output circuits, one carries the amplified speech signals from Set 2 and from the microphones (Set 2 + Interphone output), the other speech signals from Set 1 and from the microphones, and the third signals from both receivers and from the microphones (Set 1 + Set 2 + Interphone output). A mixing circuit within the amplifier makes this path arrangement possible.

(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 d-c (direct-current) potentials required for operation of both Receiver-Transmitter RT-70/GRC and AF Amplifier AM-65/GRC. The h-v (high-voltage) supply 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 screen and plate potentials for the receiver-transmitter as well as for the amplifier. A l-v (low-voltage) circuit provides the filament potential for the receiver-transmitter and for the amplifier. Another l-v circuit supplies the control and interphone microphone energizing potentials for both units.

(3) *Control circuits.* The control circuit arrangement is similar to that described in subparagraph *c* above, except that the push-to-talk function is extended from the microphone switch, through controls on the control box to the interphone control relay in the amplifier as well as through wiring in the amplifier to the control relay in the receiver-transmitter.

*e.* The combination of Receiver-Transmitter RT-70/GRC and AF Amplifier AM-65/GRC may be used in conjunction with a longer range receiver-transmitter and possibly an auxiliary receiver in any one of the more complex system installations, Radio Sets AN/GRC-3 through -8.

*f.* The major components which are normally associated with Receiver-Transmitter RT-70/GRC are described in separate instruction books. The manner in which Receiver-Transmitter RT-70/GRC is used as part of a complete installation in a communication network is described in the technical manual for the particular radio set.

**5. Technical Characteristics**

*a.* OVER-ALL EQUIPMENT.

Frequency range .......... 47 to 58.4 mc.
Type of signals transmitted
and received .......... Voice, f-m (frequency-modulated).
Type of tuning .......... Continuous.
Number of preset detented channels .......... 2.
Channel spacing .......... 100 kc (kilocycles).
Number of channels .......... 115.
Reliable communication range .......... 1 mile.
Type of operation .......... Push-to-talk.
Type of control .......... Local or remote.
Power supply requirements ...90 volts at 80 ma (milliampere) for plates and screens.

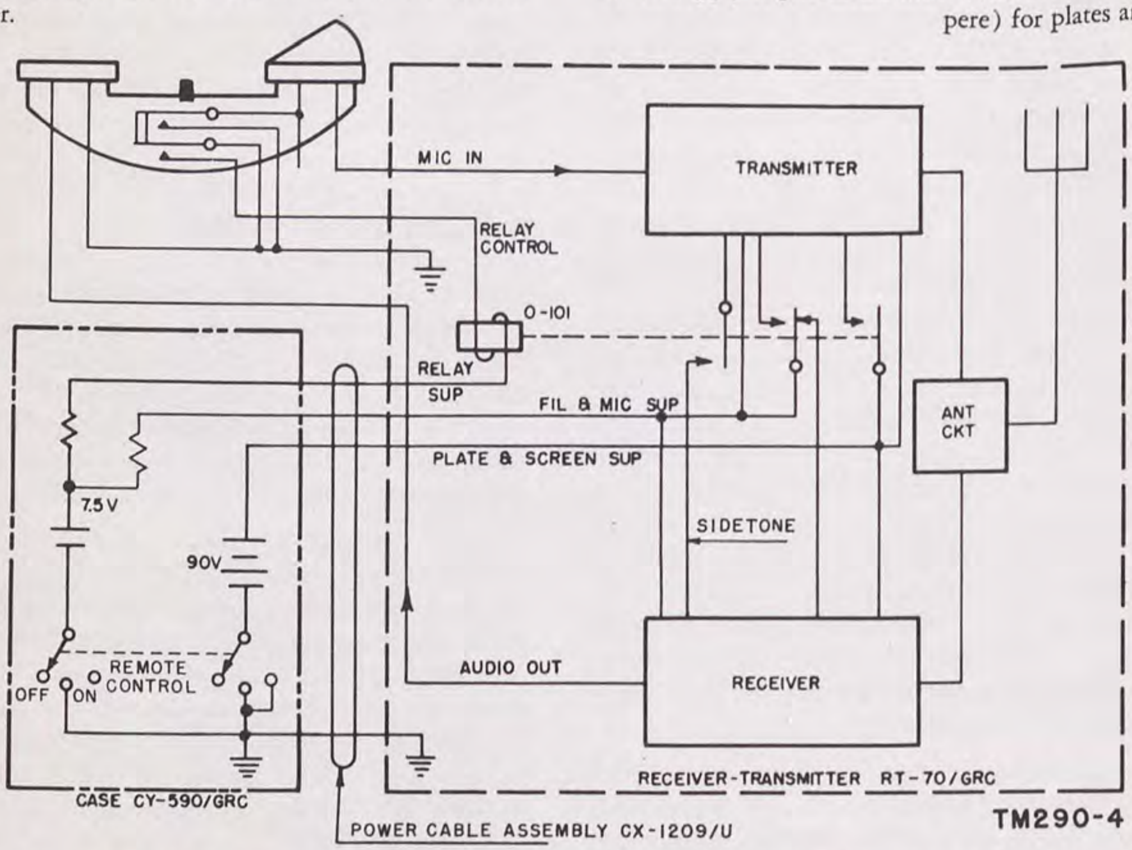



*Figure 3. Application of Receiver-Transmitter RT-70/GRC to Radio Set AN/PRC-16, simplified block diagram.*

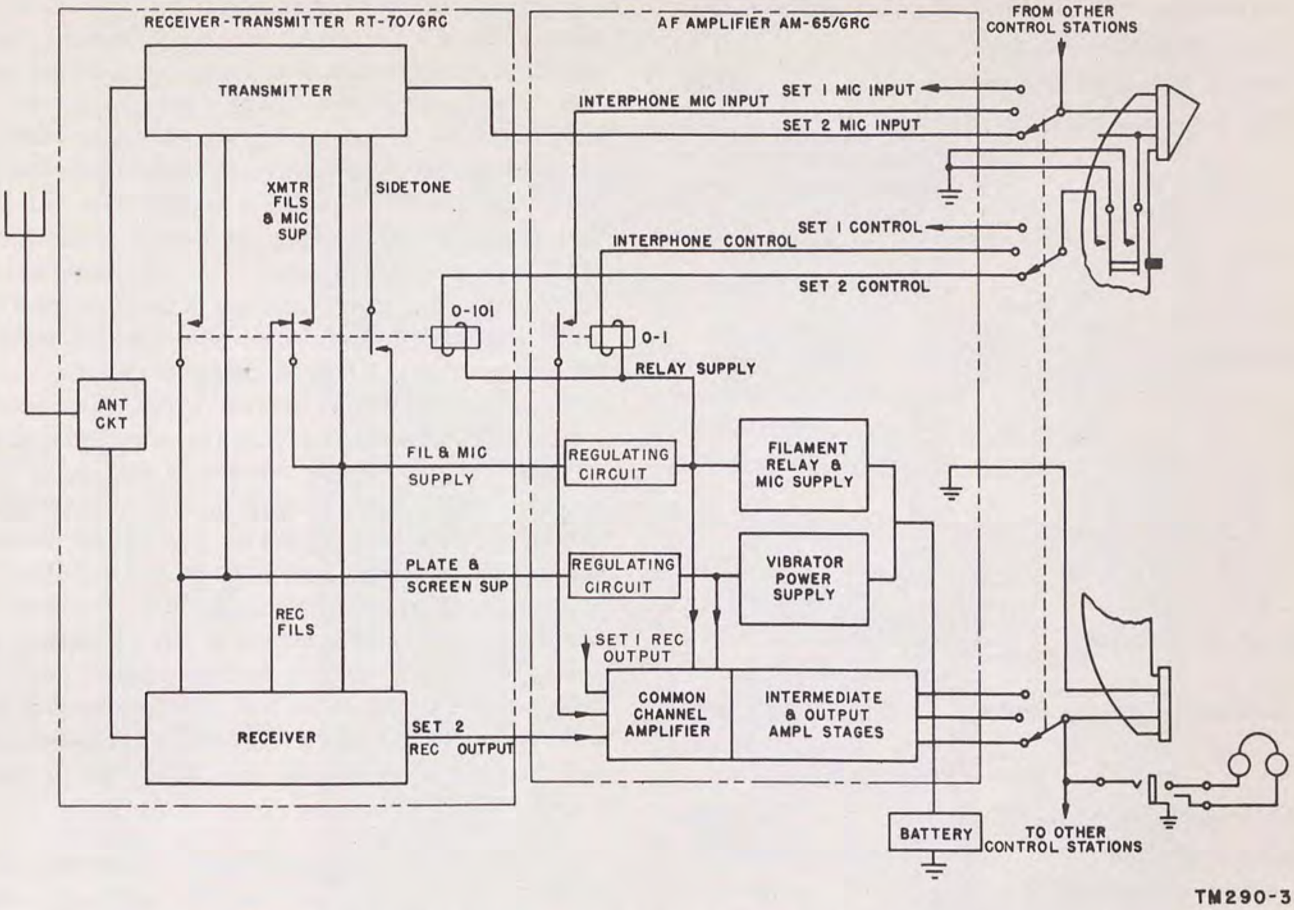



*Figure 4. Application of Receiver-Transmitter RT-70/GRC to Radio Set AN/VRC-7, simplified block diagram.*

6.3 volts at 360 ma for filaments.

6.3 volts at 160 ma for relay (transmit only).

The above voltages obtainable either from dry batteries in Case CY-590/GRC or from vibrator-type Power Supply PP-448/GR, Power Supply PP-281/GRC, or Power Supply PP-282/GRC and 6-, 12-, or 24-volt storage battery, respectively, through AF Amplifier AM-65/GRC.

Antenna requirements ..........Common whip-type antenna 50-ohm impedance.

*b.* Transmitter Circuit.

Power output .................................. 50 mw (milliwatts).

Maximum modulation frequency deviation ...........±20 kc at 1,000 cps (cycles per second) with .25-volt input.

Carrier frequency generation ..........................Continuously variable 32- to 43.4-mc self-excited oscillator and 2d harmonic of crystal controlled mixer oscillator.

Transmitter mixer oscillator frequency .................... 7.5 mc.

Type of operational control ...............................Push-to-talk transmitter normally in stand-by condition.

| Power input requirements: | | *Transmitting* |
|---|---|---|
| Plate and screen ................. | 90 volts | 80 ma. |
| Filament ............................ | 6.3 volts | 360 ma. |
| Relay ................................. | 6.3 volts | 160 ma. |

Transmitter audio input ............... 150 ohms at 1,000 cps.

Transmitter audio input level .................................. .25 volts rms (root mean square) at 1,000 cps.

*c.* Receiver Circuit.

Type of receiver circuit .........Double conversion superheterodyne.

First intermediate frequency ................................... 15 mc.

| | |
|---|---|
| First mixer oscillator tuning range | 32 to 43.4 mc. |
| Second intermediate frequency | 1.4 mc. |
| Second mixer oscillator frequency | 6.8 mc. |
| Type of operational control | Receiver normally in stand-by condition and silenced by squelch action. Turned on by signals having a minimum level determined by setting of SQUELCH control. |
| Sensitivity | 25 db (decibel) signal-to-noise ratio at 1.0 microvolt — 15-kc deviation at 1,000 cps. |
| Bandwidth: | |
| 6 db down | 80 kc. |
| 20 db down | 120 kc. |
| 40 db down | Not over 180 kc |
| Audio power output | 75 mw maximum for ±15-kc deviation at 1,000 cps. |
| Audio power output control | Continuously variable by means of panel-mounted VOLUME control. |
| Audio output impedance | 600 ohms |
| Noise suppression sensitivity (squelch) | ½ microvolt, approximately. |
| Squelch control | Continuously variable, panel-mounted SQUELCH control adjusts squelch sensitivity. OFF position of control disables squelch circuit. |

| Power input requirements: | | *Receive* | *Transmit* |
|---|---|---|---|
| Plate and screen | 90 volts | 80 ma | 80 ma. |
| Filament | 6.3 volts | 360 ma | 390 ma. |
| Relay | 6.3 volts | 0 | 160 ma. |

*d.* CALIBRATION.

| | |
|---|---|
| Calibrate frequencies | At each mc from 47 through 58 mc. |
| Built-in calibrate oscillator (crystal-controlled) | 1 mc. |
| Built-in oscillator (crystal-controlled) | 1.4 mc. |
| Accuracy of calibrate oscillator | .01 percent, approximately. |

## 6. Description of Receiver-Transmitter RT-70/GRC

*a.* Receiver-Transmitter RT-70/GRC is a combination double-conversion type superheterodyne receiver and f-m transmitter with common antenna circuit. It is designed for the reception and transmission of f-m voice signals within the continuously variable tuning range of 47 to 58.4 mc.

*b.* A front view of Receiver-Transmitter RT-70/GRC is shown in figure 1. The unit is a compact, lightweight panel-and-chassis assembly with outer cover. All operating controls, cable connectors, and indicators are mounted on the front panel and are immediately accessible. The panel is recessed to prevent damage to panel-mounted parts due to impact. The panel is finished in a wrinkled olive drab lacquer. Important panel markings are made luminous and a dial light is provided to permit the unit to be operated in the dark. An outer cover is attached to the front panel by means of wing-type spring-loaded Dzus fasteners, making the unit watertight. A hole on the top of the outer cover gives access to the antenna trimmer capacitor. This hole is covered with a watertight cap. Snap catches are provided on the outer cover so that the unit can be mounted on AF Amplifier AM-65/GRC when it is used in a vehicular installation. No carrying handles are provided for portable use since the unit is arranged to fit on Case CY-590/GR which is equipped with carrying facilities. The cover is finished in an olive green lacquer. It may be removed by turning the Dzus fasteners on the front panel ¼ turn and sliding off the cover from the rear. The dimensions of the entire unit are 12⅞ inches x 7¼ inches x 5¼ inches. The weight of the complete unit with outer cover is 16¾ pounds.

*c.* Figures 5 through 8 show Receiver-Transmitter RT-70/GRC removed from the case. The panel-and-chassis assembly consists of three separable parts, namely: a front panel, an r-f chassis, and an i-f (intermediate-frequency) chassis. The r-f chassis mounts the h-f (high-frequency) components of both the transmitting and receiving circuits. The receiver i-f components and the audio components of both the transmitter and receiver are mounted on the i-f chassis. Both chassis are attached to projections at the rear of the front panel by means of screws and are so arranged that all internal tuning adjustment controls, tubes, and other plug-in parts are accessible without further disassembly of the unit. No solder connections are made between the r-f and i-f chassis or between these chassis and the front panel. Multiconnectors establish continuity between the chassis and the panel controls and connectors. A rigid assembly is assured by a back plate, which is fastened to the two chassis by means of heavy captive screws and by two bracing screws, located toward the middle of the r-f chassis, which effectively clamp the r-f chassis to the i-f chassis. By removing the retaining and bracing screws and the back plate, disconnecting the multiconnectors and the two pin connectors joining the r-f and i-f circuits, and loosening the coupling between the dial-drive mechanism on the front panel and the shaft of the tuning capacitor on the r-f chassis, either one or both chassis may be removed for maintenance purposes. An important feature of the assembly is that a complete chassis can be substituted if either the r-f or i-f chassis of the set is defective.

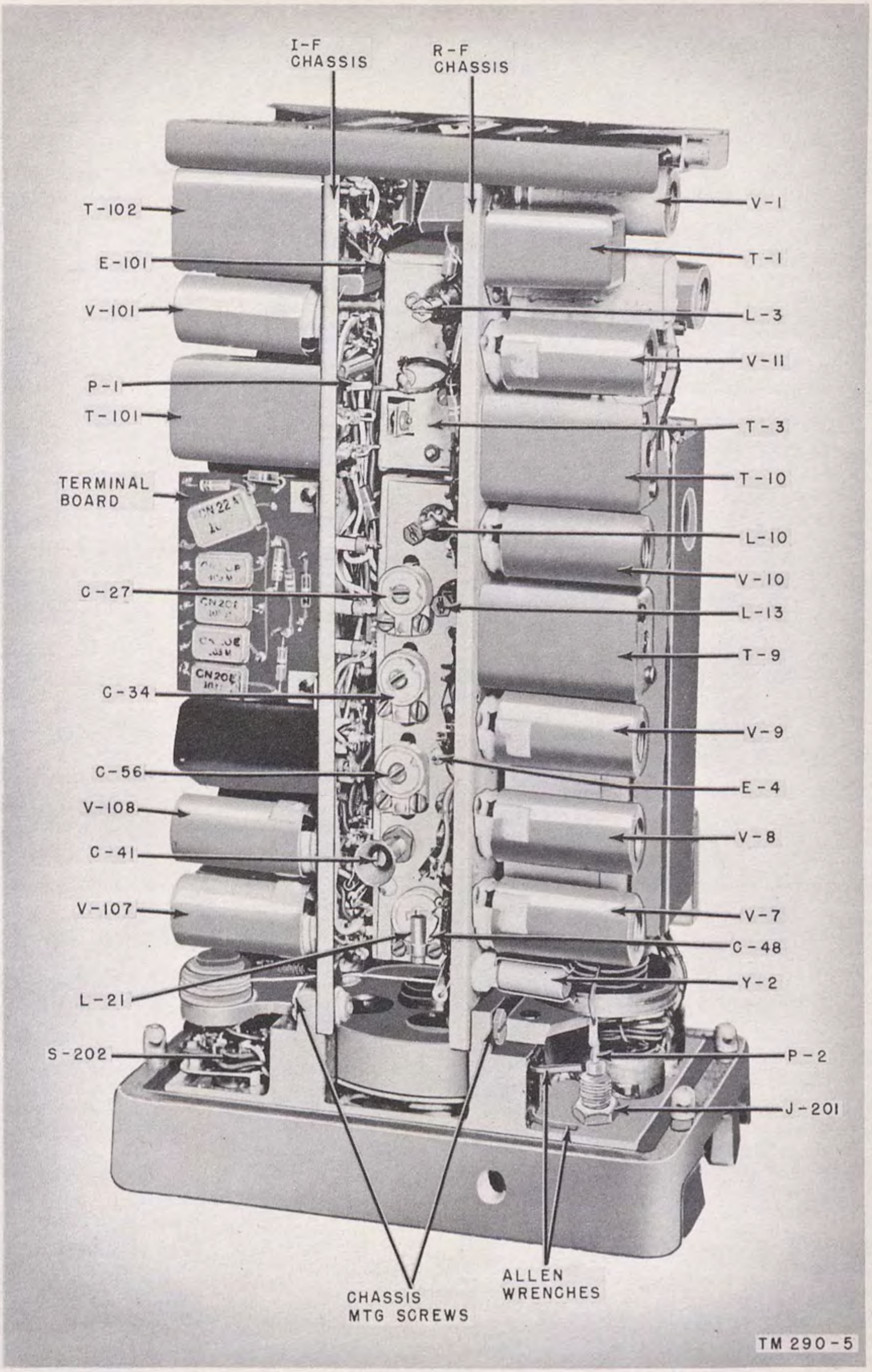



*Figure 5. Receiver-Transmitter RT-70/GRC, case removed, top view of panel-and-chassis assembly.*

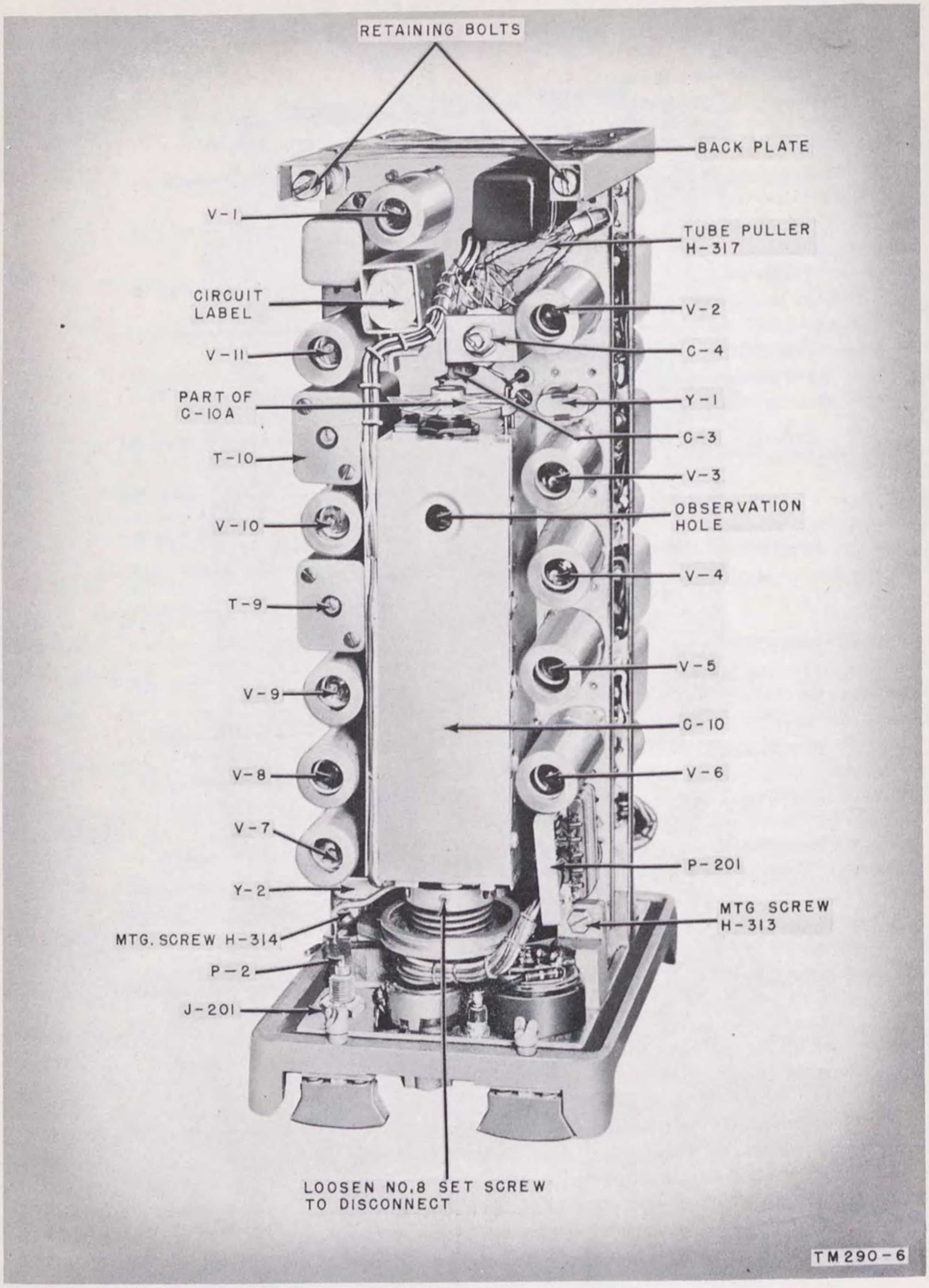



*Figure 6. Receiver-Transmitter RT-70/GRC, case removed, view of r-f chassis (right side of panel-and-chassis assembly).*

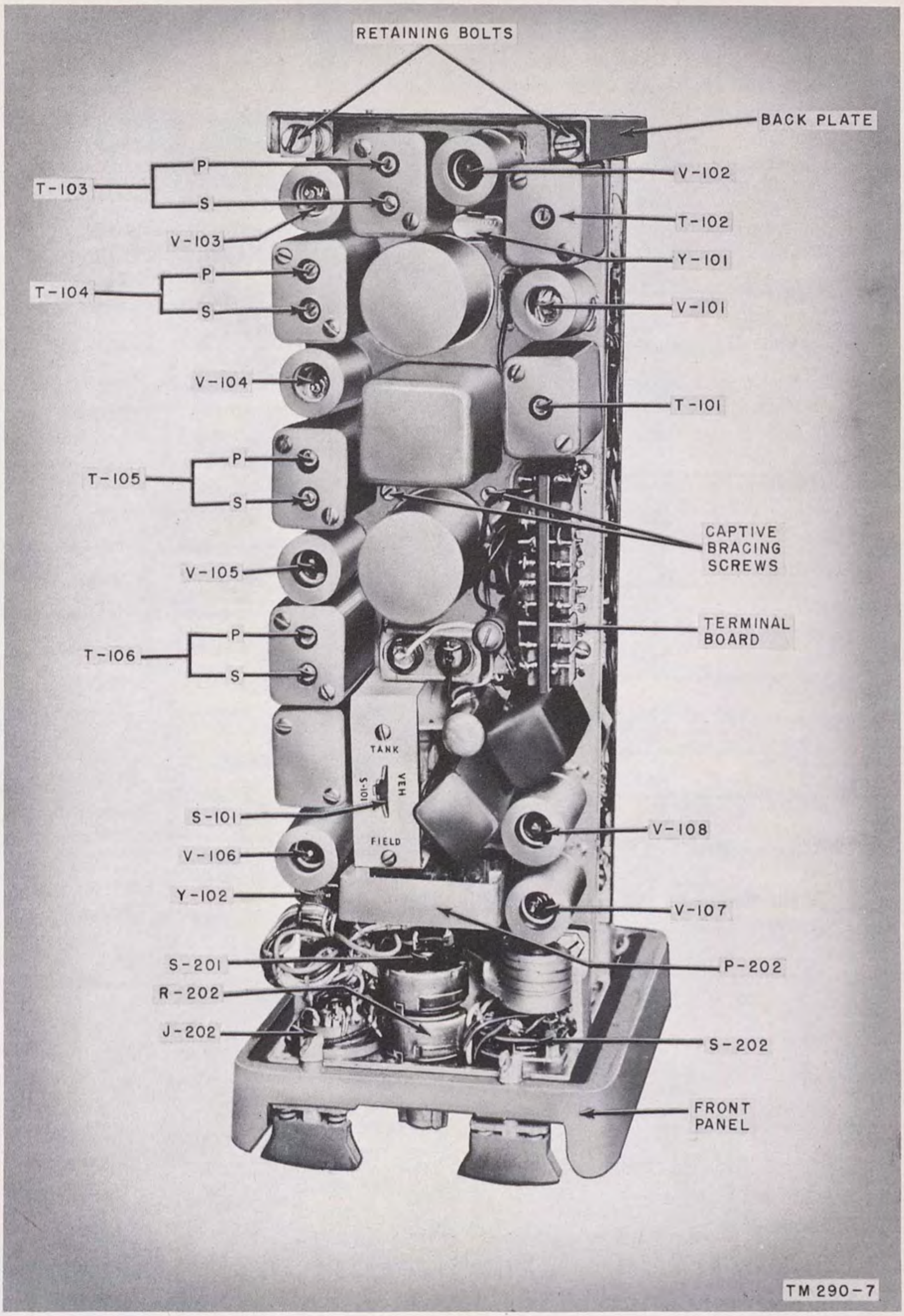



*Figure 7. Receiver-Transmitter RT-70/GRC, case removed; view of i-f chassis (left side of panel-and-chassis assembly).*

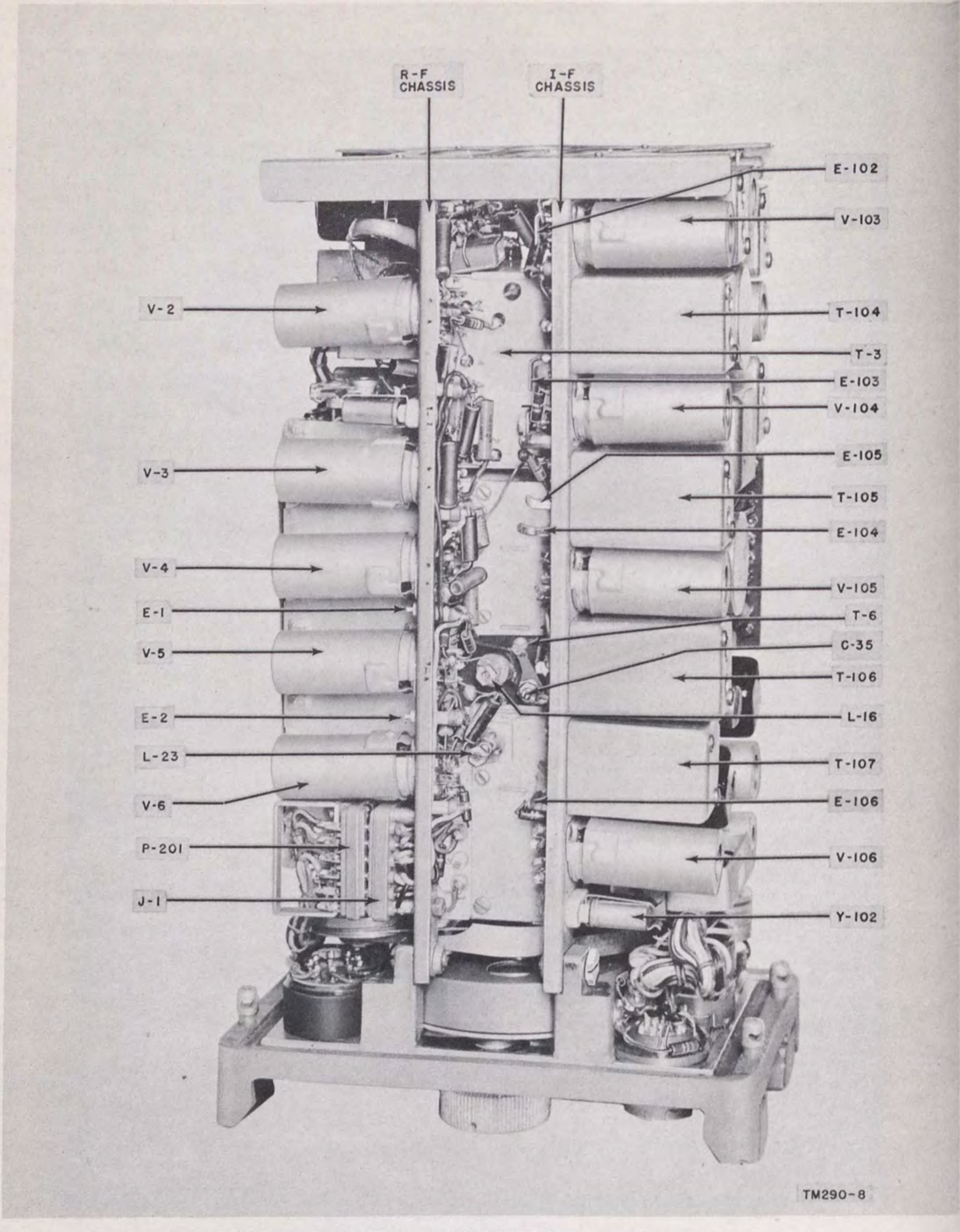



*Figure 8. Receiver-Transmitter RT-70/GRC, case removed, bottom view of panel-and-chassis assembly.*

(1) *Front panel.* The cast-aluminum front panel mounts all operating controls and connectors (fig. 1) and the dial-drive and detent mechanism (fig. 36). The dial-drive assembly, mounted on the rear of the front panel, couples mechanically to the shaft of the r-f tuning gang capacitor (C-10), mounted on the component side of the r-f chassis. A set of Allen wrenches, provided with the equipment, is mounted in a bracket at the rear of the panel (fig. 36).

(2) *R-f chassis* (figs. 6, 39, 40, and 41). The r-f chassis is located on the right side of the panel-and-chassis assembly. It mounts the audio and r-f components of the transmitter and the h-f portion of the receiver, the variable 32- to 43.4-mc oscillator, V-2, and calibrate oscillator V-7, including ganged tuning capacitor (C-10), crystals, and associated parts. The slotted plates, shown mounted at the rear of the gang capacitor (referenced as "Part of C-10A" on figure 6) serve for calibrating the section of gang capacitor C-10A which tunes the variable 32- to 43.4-mc common oscillator, V-2. A tube puller and a circuit label are provided on the r-f chassis. The tuning coils for the r-f circuits are grouped in two compartments, mounted on the wiring side of the r-f chassis. These compartments (fig. 40) are identified as T-3 and T-4 through T-8, respectively. Partitions on the r-f coil compartment cover (fig. 41) separate the larger of the two compartments into a number of sections identified as T-4 through T-8. Tuning adjustment controls for the coils in these compartments are accessible from the top (fig. 5) and bottom (fig. 8) of the panel-and-chassis assembly.

(3) *I-f chassis.* The i-f chassis (figs. 7, 37, and 38) mounts the components of the receiver i-f amplifier, squelch and audio circuits. The receiver-transmitter control relay and TANK-VEH-FIELD switch (S-101) are also mounted on the i-f chassis.

### 7. Controls, Instruments, and Connectors (fig. 9)

All operating controls and external connectors appear on the front panel of the receiver-transmitter. The antenna tuning adjustment capacitor C-41 (fig. 5) is accessible from the top of the outer cover when the cap is removed. The location of panel controls and connectors is shown in figure 9. The following table lists the controls and connectors and indicates the function of each.

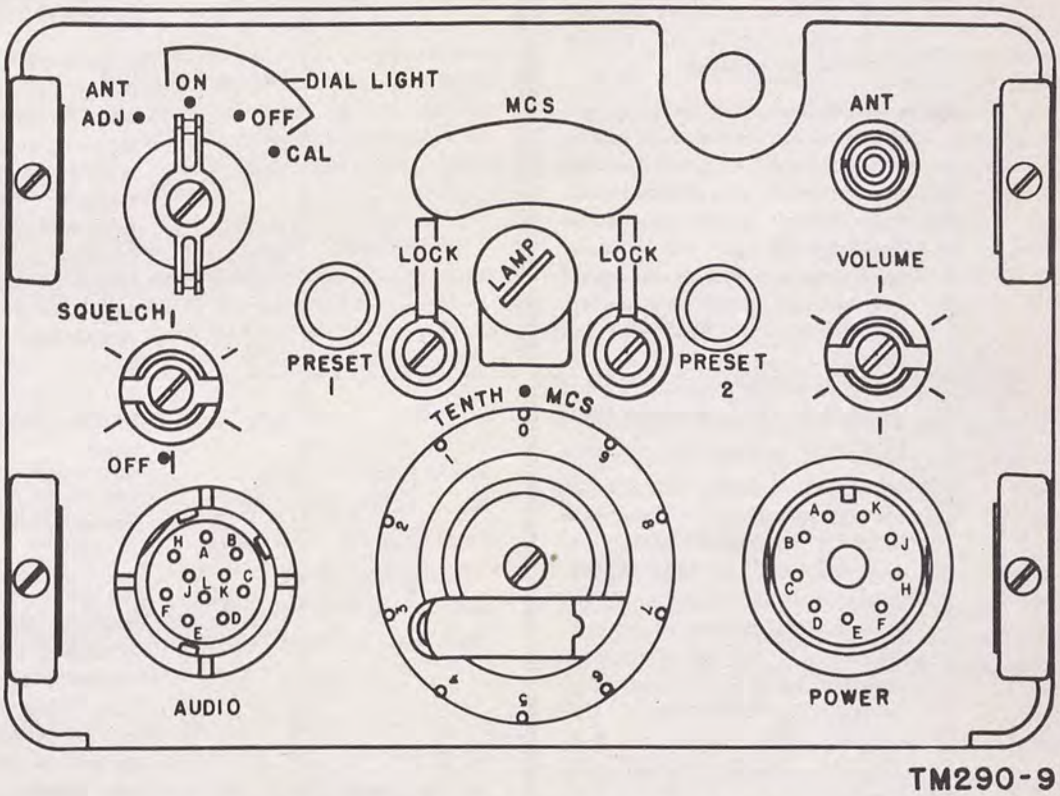



*Figure 9. Receiver-Transmitter RT-70/GRC, panel controls and connectors.*

| Control or connector | Function |
|---|---|
| TENTHS-MCS tuning knob | Calibrated in tenths of an mc. One complete rotation tunes the receiver-transmitter over one mc. Calibration marker above knob constitutes a reference point when the knob is reset to zero adjustment. Zero adjustment is accomplished by holding the knob in fixed position and rotating plate under knob until zero on plate lines up with calibration marker on panel, when the set is tuned to a signal on an integral megacycle. |
| MCS dial | Calibrated in mc from 47 through 58. One complete rotation of tuning knob changes dial setting by one mc. Frequency indication between mc markings obtainable from setting of TENTHS-MCS tuning knob. Tuning frequency of set is sum of nearest lower dial number plus calibration marking on knob. |
| LOCK detent levers | Two levers, one on each side of the dial lamp. Each serves (independently of the other) to actuate a detent mechanism to detent or preset the dial-drive mechanism at any position within the tuning range.<br>The detent mechanism is spring pre-loaded so that the dial drive may be forced to rotate past the detaining point. However, the next time around, the increased pressure required to drive the dial past the particular point serves as indication that desired frequency setting has been reached. A plastic marker (PRESET 1 and PRESET 2) associated with each detent lever permits recording the frequency to which the particular detent has been set. |
| LAMP (E-201) | A pilot light, in holder with screw-on cover immediately above tuning knob illuminates calibration markings of knob and dial. Two lucite windows in holder distribute light to dial and knob. Light turned on when switch (S-202) is in any one of three test positions. Lamp extinguished when switch is in DIAL LIGHT OFF position. (See function of ANT ADJ-DIAL LIGHT (ON-OFF)-CAL switch.) |
| SQUELCH control (R-202 and S-201) | This switch and potentiometer assembly serves to adjust the degree of the receiver squelch or noise quieting. In the maximum counterclockwise direction of rotation of the knob the switch is turned OFF and the squelch (or receiver noise quieting circuit) is disabled, providing no receiver quieting. In the clockwise direction of rotation, increasingly stronger signals are required to disable the squelch and restore the receiver audio amplifier circuits to normal operation. For any setting of the potentiometer, a particular signal-plus-noise-to-noise ratio is determined below which the receiver audio circuits are inoperative and above which signals may be heard. |
| VOLUME (R-204) | This potentiometer serves to adjust the audio output of the receiver. |
| ANT ADJ - DIAL LIGHT (ON-OFF) - CAL (S-202) | This four-position, wafer type switch has the functions tabulated below: |

| *Position* | *Function* |
|---|---|
| ANT ADJ | Turns on calibrate oscillator V-7, provided the receiver-transmitter is in the receiving condition.<br>The calibrate oscillator cannot be turned on when the receiver-transmitter is in the transmitting condition. The calibrator oscillator feeds into the receiver r-f stage, a crystal-controlled source of r-f test signal for alining the receiver-transmitter antenna circuit. Turns on dial illuminating LAMP (E-201) on the front panel. |
| DIAL LIGHT-ON | Turns on the dial illuminating LAMP (E-201). |
| DIAL LIGHT-OFF | Turns off the dial illuminating LAMP. (A load equalizing resistor is substituted for the lamp when the internal TANK-VEH-FIELD switch (S-101) is in the TANK or VEH position.) |
| CAL | Turns on the calibrate oscillator (V-7) and 1.4-mc beat oscillator, (part of V-106), to provide a standard test frequency |

| Control or connector | Function | Control or connector | Function |
|---|---|---|---|
| | *Position* *Function* and a crystal-controlled comparison frequency, respectively, for the purpose of alining the receiver tuned circuits and for checking the calibration of the receiver-transmitter main oscillator (V-2). The two signals combine in the receiver discriminator circuit to produce a zero-voltage or zero beat note as an indication of proper alinement, or a measurable voltage and an audible beat note as an indication of improper receiver calibration and alinement. | | circuits. Adjustment is made by means of a screwdriver. |
| | Turns on the dial illuminating lamp. | Antenna base holder | Two holes, at right angles to each other, permit attaching the antenna Mounting MT-652/GR with Dzus type fasteners in either one of two positions. |
| ANT connector J-201 | This is a small coaxial connector located in the top right-hand corner of panel. Serves to connect the lead from the common receiver and transmitter antenna to the antenna circuit inside the set. | AUDIO connector (J-202) | This 10-pin multiconnector with male compression type contacts provides for connecting headphones, microphone, and microphone push-to-talk button to the receiver output and the transmitter audio input circuits, respectively. A through connection is also provided between a pin on this connector and the POWER connector for an external power control circuit. |
| ANTENNA TUNING ADJUSTMENT (C-41) | This is a trimmer capacitor which is made accessible when the cap at the top of the outer case is removed. It serves to tune the common antenna | POWER connector (J-203) | This 9-pin multiconnector serves to connect external plate, screen, filament, relay, and microphone voltages to the receiver-transmitter. In addition, the microphone input, and the push-to-talk relay control connections from the AUDIO connector are paralleled to terminals on this connector. These latter terminals are used in installations involving indirect microphone circuit connection (that is, when AF Amplifier AM-65/GRC is involved). One side of the through connection for remote power control (see functions of AUDIO connector) appears at a terminal of this connector. |

## 8. TANK-VEH-FIELD Switch S-101 (fig. 7)

In addition to the controls, connectors, and other items mounted on the panel (par. 7), TANK-VEH-FIELD switch S-101 is provided on the i-f chassis inside the unit. This switch is set during initial installation to the position corresponding to the type of service to which the receiver-transmitter is to be put. The switch positions and their functions are summarized below.

*a.* TANK POSITION. The switch is set to the TANK position when the receiver-transmitter is to be used in an installation involving AF Amplifier AM-65/GRC, one or more monitoring positions through the amplifier and Control Box C-375/VRC, and the use of Power Supply PP-281/GRC, PP-282/GRC, or PP-248/GR and a suitable storage battery to supply plate and filament potentials. In such an installation, it is important to keep the drain on the power supply fairly constant. Maximum sidetone level is required to provide enough audio for the headset of the receiving operator and of the monitoring positions. Accordingly, in this position the switch performs the following functions:

(1) It substitutes a dummy load across the filament supply in place of the dial light, when the ANT ADJ-DIAL LIGHT-CAL switch (S-202) is in the DIAL LIGHT OFF position. This arrangement insures a constant drain on the filament supply regardless of whether the pilot light is lit or extinguished.

(2) It places a dummy load across the 90-volt supply circuit when the receiver-transmitter is in the receiving condition and the screen supply circuit is disconnected from certain transmitter tubes. The dummy load is equivalent to the drain on the 90-volt supply by these transmitter screens. A fairly constant drain on the 90-volt supply under both receive and transmit conditions is thus insured.

*b.* VEH POSITION. The switch is set in the VEH position when the receiver-transmitter is to be used in an installation involving AF Amplifier AM-65/GRC and one of the vibrator power supplies, but no monitoring or interphone positions. Accordingly the switch performs the following functions:

(1) It equalizes the filament supply drain, as described in *a* (1) above.

(2) It equalizes the 90-volt supply drain as described in *a* (2) above.

(3) It reduces the level of sidetone fed from the transmitter microphone circuit to the receiver audio circuits, thereby making the sidetone level suitable for reception in the earpiece of the transmitting operator's handset, without causing acoustic feedback through the handset.

*c.* FIELD POSITION. The switch is set in the FIELD position when the receiver-transmitter is to be used in a portable installation, in which the amplifier is not used, power is derived from a set of dry batteries (Case CY-590/GRC), and no monitoring or interphone positions are involved. The use of dry batteries makes drain equalization unnecessary. In this position the switch performs the following functions:

(1) The dummy loads (see subpars. *a* and *b* above) are disconnected, since power economy is a prime consideration.

(2) The level of sidetone is reduced, for the reasons stated in *b* (3) above.

## 9. Additional Equipment Required

The following materials are *not* supplied as part of Receiver-Transmitter RT-70/GRC, but are required for its installation and operation: a microphone and headset, or a handset with push-to-talk button; an antenna with mounting components and hardware; a source of 90-volt plate and screen power; and a source of 6-volt filament and relay power; suitable control boxes, mounting facilities; connecting cables; and a set of spare parts. The number and type of components necessary to complete a working installation differs from one installation to another, depending on the nature of the system in which the receiver-transmitter is used. The materials normally supplied for two typical installations are detailed in subparagraphs *a* and *b* below.

*a.* PORTABLE INSTALLATION (RADIO SET AN/PRC-16). For a portable installation, such as Radio Set AN/PRC-16, the following materials are normally supplied:

(1) Receiver-Transmitter RT-70/GRC.

(2) Carrying case — Case CY-590/GRC, including the required set of dry batteries (90 volts and 7.5 volts).

(3) Equipment mount — Mounting MT-673/UR.

(4) Antenna mounting — Mounting MT-652/GR.

(5) Mast Section AB-22/GR.

(6) Mast Section AB-24/GR.

(7) Power cable assembly — Power Cable Assembly CX-1209/U.

(8) Handset with push-to-talk button — Handset H-33 ( )/PT.

(9) Technical Manual TM 11-282.

*b.* VEHICULAR INSTALLATION (RADIO SET AN/VRC-7). For a vehicular installation, such as Radio Set AN/VRC-7, the following materials are normally supplied:

(1) Receiver-Transmitter RT-70/GRC.

(2) Interphone amplifier with suitable vibrator type power supply — AF Amplifier AM-65/GRC and one of item (3) below.

(3) Vibrator-type power supply. One of Power Supplies PP-448/GR, PP-281/GRC, or PP-282/GRC, depending on whether the vehicular storage battery voltage is 6, 12, or 24 volts, respectively. (The power supply is housed in a compartment of AF Amplifier AM-65/GRC, item (2), above.)

(4) Equipment mount — Mounting MT-300/GR.

(5) Vehicular antenna components, as follows:

(*a*) Mast Base AB-15/GR.

(*b*) Mast Section AB-22/GR.

(*c*) Mast Section AB-24/GR.

(6) Interphone operation control unit — Control Box C-375/GRC.

(7) Remote control equipment — Control Group AN/GRA-6, including Local Control C-434/GRC and Remote Control C-433/GRC (optional).

(8) RF Cable Assembly CG-530/U, (4 ft, 2 in. long).

(9) Special Purpose Cable WM-46/U.

(10) Special Purpose Cable Assembly CX-1213/U.

(11) Connector and bondnut (Appleton Electric Co. No. 61007 and BL-50) or equal.

(12) Adapter UG-273/U.

(13) Adapter UG-306/U.

(14) Bag CW-206/GR.

(15) Case CY-684/GR.

(16) Technical Manual TM 11-285.

*Note.* The above lists are intended for illustrative purposes only. Detailed information on parts and additional equipments supplied for a particular installation is given in the technical manual for the particular system.

## 10. Running Spare Parts and Tools

*a.* RUNNING SPARE PARTS. The following running spare parts are supplied with each Receiver-Transmitter RT-70/GRC.

1 GH-1992-2 Lamp Incandescent or Mazda 331.
1 Type 3B4 Tube.
6 Type 3Q4 Tubes.
2 3A5 Tubes.
2 1L4 Tubes.
10 1U4 Tubes.
2 1R5 Tubes.
1 1S5 Tube.
1 1AE4 Tube.

*b.* TOOLS. The following tools are supplied with each Receiver-Transmitter RT-70/GRC.

(1) Allen wrench #6 and #10 (fig. 5).

(2) Tube puller (fig. 6).

# CHAPTER 2

# THEORY OF RECEIVER-TRANSMITTER RT-70/GRC

## 11. Block Diagram (fig. 10)

*a.* GENERAL. The signal path of the receiver-transmitter is shown in the functional block diagram, figure 10. A complete schematic diagram of the equipment is shown in figure 47. The block diagram shows that the equipment consists of a separate transmitter circuit and a separate receiver circuit. The two circuits are associated with each other through a common antenna circuit, a common 32- to 42.3-mc oscillator, V-2, and a common tuning control. Normally, the receiver is operative while the transmitter is in a stand-by or inoperative condition. When the microphone button is closed, that is, when the operator desires to talk, the receiver is effectively turned off and the transmitter is turned on. This function is accomplished by a relay control circuit also indicated on the block diagram. The frequency range of the transmitter and of the receiver is from 47 to 58.4 mc. This range corresponds to 115 channels of 100 kc each.

*b.* TRANSMITTER SIGNAL PATH. The function of the transmitter is to convert speech signals from an external microphone, amplifier, telephone line, or other a-f (audio-frequency) source into f-m, r-f signals. This is accomplished by causing the a-f signals to shift the frequency of a locally generated carrier frequency which is then transmitted over the air. Voice signals from the external microphone, amplifier, or telephone line are amplified by microphone amplifier stage V-1 to the proper value for modulation (pars. 17 and 18). Audio voltages are applied to the modulator to vary the frequency generated by variable oscillator V-2 (par. 19) in accordance with the amplitude and frequency of the audio signal. The outputs of the 32- to 43.4-mc oscillator V-2 and the 15-mc transmitter oscillator V-3 (par. 21) are combined in mixer stage V-4 (par. 22). The desired sum frequency at the output of the transmitter mixer is selected by a tuned circuit and is applied to the transmitter driver stage V-5 (par. 23). The signal is amplified again and is applied to the transmitter power amplifier stage V-6 (par. 24). The amplified output is then routed through a tuned antenna circuit to the antenna (par. 25). No antenna switching is provided since the receiver is inoperative when the transmitter is energized and, conversely, the transmitter is disabled when the receiver is operative.

*c.* RECEIVER CIRCUITS. The function of the receiver is to accept f-m carrier signals and to convert them by a double conversion process and by means of an f-m discriminator into the originally transmitted audio signals. The audio signals then are applied to an external headset, an earpiece of a handset, an audio amplifier, a telephone line, or some other suitable a-f receiving device. Carrier signals from the antenna are applied through the common antenna circuit to the first r-f amplifier stage V-8 (par. 26), the output of which is tuned by a section of the variable gang capacitor. The amplified output of this stage and the output of the common variable oscillator V-2 (subpar. *b* above) is applied to the mixer stage V-9 (par. 27) which produces sum and difference frequencies. The difference frequency is selected by the tuning circuit of the mixer and is routed as a band of frequencies centered about 15 mc to a three-stage i-f amplifier (V-10, V-11, and V-101) (par. 28). The 15-mc output of V-101, in conjunction with the output of the 13.6-mc oscillator (part of V-102), is combined in the receiver second mixer portion of V-102 (par. 29) to produce a second i.f. centered about 1.4 mc. This signal is amplified again in a three-stage amplifier-limiter (V-103, V-104, and V-105) (par. 30). The first stage (V-103) is a conventional 1.4-mc i-f amplifier. The second and third stages (V-104 and V-105) have the additional function of limiting (or eliminating) any amplitude variations of the signal. Such amplitude variations represent noise and are, therefore, undesirable. In addition, the proper functioning of the discriminator (T-107), which follows the second limiter (V-105), requires that the level of the applied signal be fairly uniform for variations in the level of the incoming signal. The output of the second limiter stage is applied to the discriminator circuit (T-107) which functions to demodulate the audio signal from the incoming carrier signal (par. 31). The discriminator converts variations from the center frequency of the incoming signal into audio signals. These audio signals appearing at the output of the discriminator are amplified in the two-stage audio amplifier V-106 and V-108 (pars. 32 and 33) and are applied to the receiver output terminals of the panel-mounted AUDIO and POWER connectors. The panel-mounted VOLUME control is located between the output of the first and the input of the second audio amplifier stages.

*d.* SIDETONE. A portion of the audio signal applied to the transmitter is routed over a special path, called a sidetone path, to the receiver audio circuits where it is amplified and becomes audible in the earpiece of the handset or in the headset of the operator (par. 36). This sidetone signal is useful for two reasons: one, it permits monitoring the transmission; two, it imparts a natural effect in the earpiece of the handset. Without sidetone, the circuit would seem dead.

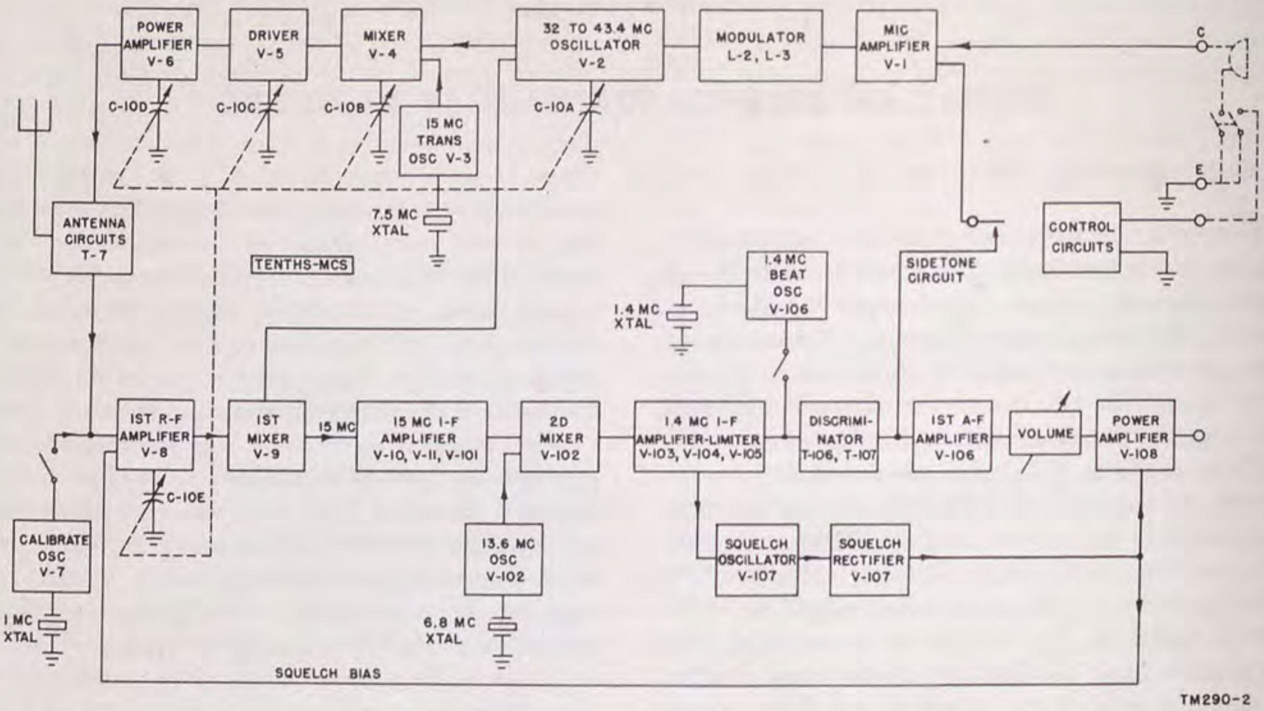



*Figure 10. Receiver-Transmitter RT-70/GRC, funtional block diagram.*

## 12. Transmitter Carrier Frequency and Receiver I-f Generation

As shown in figure 10, three oscillators serve to produce the transmitting carrier frequency and the two receiver intermediate frequencies. These are the 32- to 43.4-mc oscillator (V-2), the 15-mc transmitter oscillator (V-3), and the fixed second i-f 13.6-mc oscillator (part of V-102).

*a.* 32- TO 43.4-MC OSCILLATOR V-2. The variable self-excited common oscillator, V-2, is tunable over its frequency range of 32 to 43.4 mc by means of the A section of ganged tuning capacitor C-10. The frequency generated by this oscillator is always 15 mc below the receiver-transmitter operating frequency. This means that for any setting of the tuning capacitor the variable oscillator frequency is 15 mc below the ultimate, desired transmitting frequency, and also 15 mc below the frequency to which the receiver is tuned. The output of the variable oscillator is fed over two paths. One path applies the oscillator output of the receiver first mixer V-9, where during reception of a signal the first i.f. of 15 mc is produced. The other path applies the output of the oscillator to the transmitter mixer, V-4. There the variable oscillator frequency combines with the output of the 15-mc transmitter oscillator, V-3, to produce a sum frequency which is the desired transmitter carrier frequency. During transmission the output of the variable oscillator is fm by the voice signals entering the transmitter circuits from the microphone or other audio device.

*b.* 15-MC TRANSMITTER OSCILLATOR V-3. The fixed-frequency crystal-controlled oscillator, V-3, produces a frequency of 7.5 mc. The second harmonic of this frequency, namely 15 mc, is selected and applied to the transmitter mixer, V-4, together with the output of the variable common oscillator V-2. The resultant sum frequency is the desired transmission frequency.

*c.* 13.6-MC OSCILLATOR V-102. A portion of tube V-102 is used in a fixed-frequency crystal-controlled oscillator circuit producing a frequency of 6.8 mc. The second harmonic of this frequency (13.6 mc) is selected and fed to the receiver second mixer, another portion of V-102, where by beating with the first i.f. (15 mc), a lower i.f. (1.4 mc) is produced.

## 13. Receiver-transmitter Common Circuit Elements

In addition to the common 32- to 43.4-mc variable oscillator, V-2, discussed in paragraph 12, the elements described below are also common to the receiver and to the transmitter.

*a.* TUNING ELEMENTS. The receiver and transmitter are always tuned to the same operating frequency. Selection of the desired operating frequency is accomplished by the continuously variable tuning control on the front panel. Varying this control varies the ganged tuning capacitor C-10, the five sections of which are associated with the tuned receiver-transmitter r-f stages as tabulated below. The table also shows the trimmer capacitors associated with each variable tuned circuit.

*b.* ANTENNA CIRCUIT. Since the transmitting and receiving frequency is always the same, and since only the

### Receiver-Transmitter RT-70/GRC R-f Circuits

| Stage or circuit | Capacitor | Section capacity range | Trimmer |
|---|---|---|---|
| 32- to 43.4-mc oscillator V-2 | C-10A | 14 to 77 uuf | C-4 (3-15 uuf (micromicro-farad) ) and tracking plates* |
| Transmitter mixer V-4 | C-10B | 11 to 36 uuf | C-27 (3-12) |
| Transmitter driver V-5 | C-10C | 11 to 36 | C-34 (3-12) |
| Transmitter power amplifier V-6 and antenna circuit | C-10D | 11 to 36 | C 41 (3-15) |
| Transmitter neutralizer circuit | — | — | C-35 (.3-3.0) |
| Receiver r-f stage V-8 | C-10E | 11 to 36 | C-56 (3-12) |
| Calibrate oscillator V-7 | — | — | C-48 (3-12) |

*The slotted tracking adjustment plates (fig. 6), mounted at the rear of the gang capacitor, serve to straighten out the oscillator tuning capacity versus dial rotation curve (i.e. calibration). Adjustment is made by bending the segment corresponding to the particular mc setting of the dial. For adjustment details see paragraph 72e.

transmitter or the receiver is on at any one time, a common antenna circuit is used. Section C-10D of the gang capacitor and trimmer capacitor C-41 tune the antenna circuit to resonance at the operating frequency.

*c.* CONTROL CIRCUITS. In effect, the receive-transmit control circuit applies full power to either the transmitter when relay O-101 in the control circuit is energized or to the receiver when the control relay is de-energized (par. 35). Relay O-101 is energized when ground return to the relay is made, and is de-energized when ground return is broken. Application or removal of ground return may be accomplished either by the push-to-talk of a microphone directly or by that button through a sequence of other external relays, depending on the arrangement of the system in which the receiver-transmitter is used.

### 14. Modulation

The 32- to 43.4-mc oscillator frequency is modulated by varying the inductance of the small coil, L-2B, connected in series with the oscillator tuning coil, L-3. The inductance of this small modulating coil is changed by varying the permeability of the iron-dust core upon which it is wound. To accomplish this, the coil is placed in the magnetic field of the larger a-f coil, L-2A, which is energized by the microphone amplifier when the operator talks into the carbon microphone connected to the receiver-transmitter. The iron dust core is also magnetically biased by a permanent magnet to provide a proper center operating point. Modulation is represented by a shift of about ±15 kc in the frequency generated by variable oscillator V-2, and ultimately by a shift in the over-all carrier frequency.

### 15. Squelch Circuit

It is characteristic of very sensitive receivers that in the absence of a received signal a rushing noise is heard in the receiver phones or loudspeaker. The noise is the result of thermal agitation in the vacuum tubes and receiver components and of external electrical disturbances. A *squelch* circuit is, therefore, used to suppress this annoying noise during no-signal intervals. In Receiver-Transmitter RT-70/GRC, the squelch circuit consists of a carrier switched 30-kc (approximately) oscillator followed electrically by a diode rectifier. Actually, the oscillator and diode rectifier are in the same envelope of multipurpose tube V-107. When the receiver is in a squelched condition and no signal is being received, the squelch circuit is operative and biases the audio amplifier and the r-f amplifier. When a signal is received which has the proper signal strength, the squelch is disabled and the r-f and audio amplifiers are restored to normal operation. Squelch action is adjustable by means of the panel-mounted SQUELCH control, R-202. The OFF position of this control operates switch S-201 and disables the squelch for test purposes or for reception of weak or fading signals. The squelch circuit is described in greater detail in paragraph 34.

### 16. Calibrating and Test Circuit

A calibrating circuit associated with the receiver includes a crystal (1 mc) controlled oscillator V-7, the output of which is very rich in harmonics, and a 1.4-mc oscillator derived from a portion of the first audio amplifier tube V-106 and the ANT ADJ — DIAL LIGHT (ON-OFF) — CAL test switch S-202.

*a.* CALIBRATE OSCILLATOR. A signal for use in calibrating the receiver at frequency settings of the dial which are multiples of one mc is generated by crystal oscillator V-7 (par. 37). This oscillator is permanently associated with the input of the first r-f amplifier tube V-8 of the receiver. When the test switch is in either the ANT ADJ or in the CAL position, the oscillator is turned on and generates a frequency of one mc. The harmonics of this signal are selected by the tuned circuits of the receiver, the particular harmonic selected depending on the frequency to which the receiver is tuned.

*b.* BEAT OSCILLATOR. When the test switch is in the CAL position, the first audio amplifier stage, V-106, functions as a combined 1.4-mc crystal oscillator and an audio amplifier (par. 38). The output of this oscillator is connected at a point ahead of the discriminator rectifiers. Since the frequency generated by this oscillator is the same as that to which the 1.4-mc i-f amplifier is tuned, a zero beat is obtained at the output of the discriminator when a 1.4-mc signal enters the discriminator. An audio beat note is obtained when the incoming signal to the r-f stage is not a multiple of one mc, thereby causing the signal at the discriminator input to be different than 1.4 mc. This a-f beat enables the operator to make precise frequency adjustments.

*c.* USE. If either the 13.6-mc oscillator or the 32- to 43.4-mc oscillator is off frequency, the signal entering the discriminator circuit will not be 1.4 mc, and, therefore, an audible beat note will be heard. However, as long as the oscillators are all on frequency, a zero-beat note will be obtained. The calibrate oscillator alone can be used to check the tuning of the antenna circuit since proper alinement will cause quieting of the noise in the receiver. The combination of the beat oscillator and the calibrate oscillator may be used to check the following (par. 39):

(1) The calibrate oscillator (V-7).

(2) The receiver 13.6-mc oscillator (part of V-102).

(3) The tuning of the common 32- to 43.4-mc oscillator (V-2).

(4) The tuning of the over-all receiver.

### 17. Microphone Input Circuit (fig. 11)

*a.* Two parallel input connections for the audio signal and carbon button of the microphone, or another source of audio modulation to be transmitted, are provided. One input connection is at terminals C and E (ground) of AUDIO connector J-202, and the other at terminals C and D (ground) of POWER connector J-203. The microphone circuit of Receiver-Transmitter RT-70/GRC extends over terminals 2 of chassis connectors P-201 and J-1 to the 150-ohm primary winding (terminals 6-7) of microphone transformer T-1. The ground return path for the audio signals is completed over terminals 4 of J-1 and P-201 and terminals 4 of P-202 and J-101, through section B of dual capacitor C-157.

*b.* D-c voltage for energizing the carbon button of the microphone is applied from an external 6-volt d-c source (filament supply) to terminals F and D (ground) of J-203. The 6-volt microphone supply circuit extends from terminal F of J-203, through terminals 13 of P-202 and J-101, through the normally open contacts 2-3 of control relay O-101, over terminals 15 of J-101, P-202, P-201, and J-1, and through voltage-dropping resistor R-1 to terminal 7 of primary winding of T-1. The microphone supply voltage is filtered by capacitors C-157B and C-157A.

*c.* Contacts 2-3 of relay O-101 close and apply microphone energizing voltage when the microphone push-to-talk button is closed or when through some other external circuit arrangement ground return for the coil of relay O-101 is completed (par. 35).

*d.* The signal voltage developed across winding 6-7 of T-1 is induced into secondary winding 1-2-3 of that transformer for application to the microphone amplifier (par. 18). The portion of the signal developed across winding 1-2 of T-1 is routed over the sidetone circuit to the receiver audio amplifier stages. The sidetone circuit is described in paragraph 36.

### 18. Transmitter Microphone Amplifier V-1 (fig. 11)

The transmitter microphone amplifier uses a tube type 3Q4 pentode, V-1, in a conventional Class A audio amplifier circuit. The purpose of this stage is to raise the level of the speech signals to the proper value for modulating the transmitter.

*a.* PRE-EMPHASIS CIRCUIT. The high-impedance secondary winding 1-2-3 of microphone transformer T-1 is connected to the grid of V-1 through a shaping circuit comprising capacitor C-1 and resistors R-2 and R-3. The shaping circuit accentuates the higher audio frequencies to provide pre-emphasis during transmission. This arrangement is used to increase the carrier frequency deviation per audio input volt for the higher audio frequencies, so that at the receiving end the signal-plus-noise-to-noise ratio will be effectively increased.

*b.* PLATE LOAD IMPEDANCE. The plate load impedance of V-1 consists of primary winding 1-2-3 of output transformer T-2 shunted by capacitor C-2. The parallel resonant plate load tends to shape the frequency response of the amplifier and to peak it at about 2,000 cycles.

*c.* PLATE AND SCREEN SUPPLY CIRCUITS. The plate (pins 2 and 6 tied internally) and the screen grid (pin 4) of tube V-1 obtain their operating potentials from the external 90-volt supply. The plate supply circuit extends

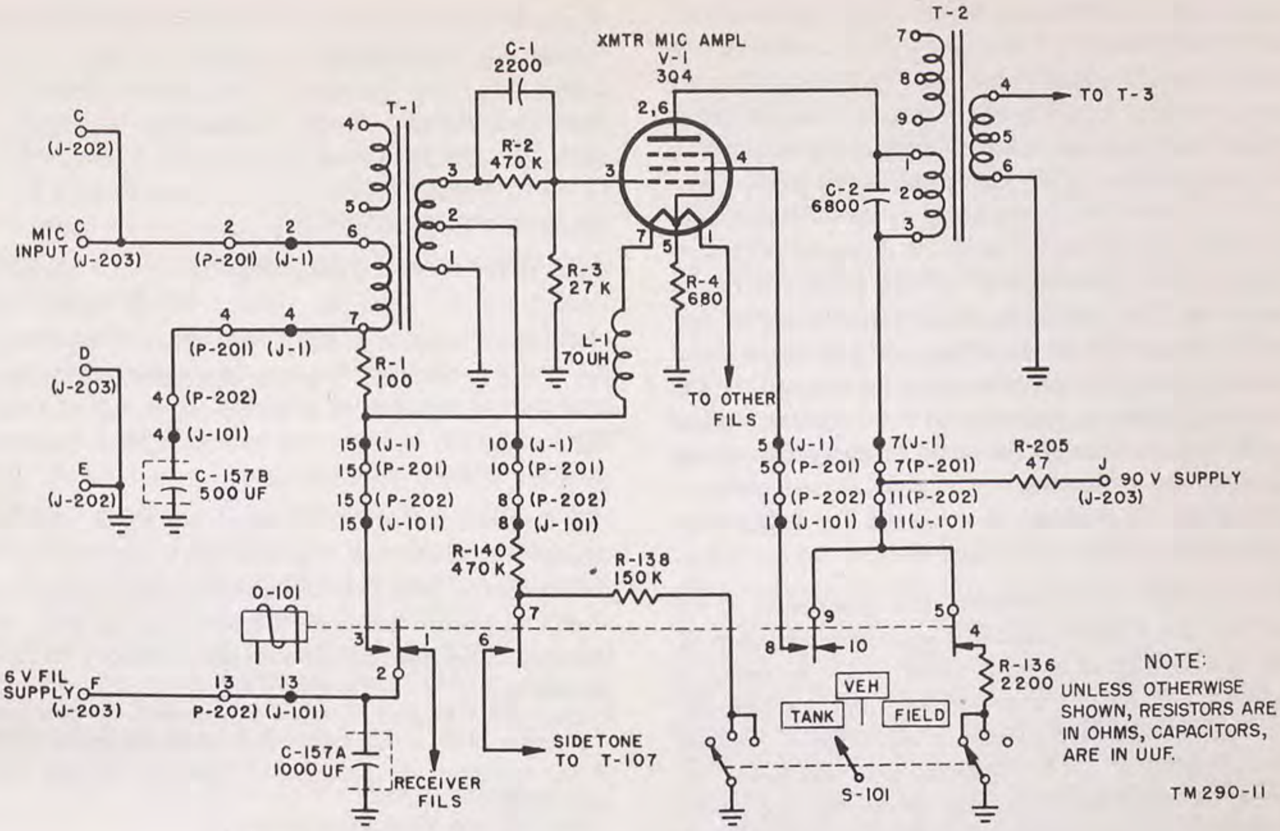



*Figure 11. Microphone and microphone amplifier circuits, functional circuit diagram.*

from pin J of J-203, through decoupling resistor R-205, through pins 7 of chassis connector P-201 and J-1, and through winding of 1-2-3 of T-2. The screen supply circuit extends from pin J of J-203 through R-205, pins 11 of P-202 and J-101, over the normally open contacts 8-9 of relay O-101, pins 1 of J-101 and P-202, and over pins 5 of P-201 and J-1. When O-101 is energized, contacts 8-9 close and complete the above circuit. When relay O-101 is not energized, the screen circuit is open, and the normally closed contact pair 5-4 places current compensating resistor R-136 across the 90-volt supply. Ground return for this resistor is provided when switch S-101 is in either the TANK or VEH position. For a detailed description of the plate and screen supply circuits, see paragraph 40. For a detailed description of the control circuits, see paragraph 35.

*d.* Bias. Bias for the tube is provided by the voltage drop across the filament of V-6.

*e.* Filament Circuits. Filament voltage for V-1 is obtained from the 6-volt filament supply connected to terminal F of J-203. The filament supply circuit extends from pin F of J-203, through pins 13 of connectors P-202 and J-101, over the normally open contacts 2-3 of relay O-101, and through isolating choke L-1 to pin 7 of V-1. The other side of the filament connects to the filaments of other transmitter tubes. Filament voltage is applied when relay O-101 becomes energized and closes contacts 2 and 3. When the transmitter is in stand-by condition, these relay contacts are open and no filament voltage is applied to V-1. The filament circuits of the receiver-transmitter are described in paragraph 41. For control circuit details see paragraph 35.

## 19. Common 32- to 43.4-mc Oscillator V-2 (fig. 12)

The self-excited 32- to 43.4-mc oscillator uses a tube type 3A5 twin-triode, V-2, in a Colpitts circuit. To obtain maximum transconductance the two triode sections of the tube are connected in parallel by joining the two plates, pins 2 and 6, and the two grids, pins 3 and 5.

*a.* Tuned Circuit. The oscillator is tuned to resonance by the parallel resonant circuit composed of series inductors L-3 and L-2B and by C-10A, a section of the receiver-transmitter main tuning capacitor. The parallel group of capacitors C-5, C-6, C-7, and C-9, connected in series with the variable capacitor section, provides the series padding necessary for tracking of the oscillator with the other tuned circuits of the transmitter and the receiver. These capacitors also provide temperature compensation at the l-f (low-frequency) end of the oscillator tuning range. Alinement of the oscillator at the low end of its frequency range is accomplished by varying the inductance by means of the powdered iron-dust core of coil L-3. The h-f end is alined by means of variable trimmer capacitor C-4, connected across C-10A. Exact calibration of the oscillator with the TENTHS-MCS dial is accomplished by bending the segments of the slotted plates (par. 72*e*) mounted at the rear of the gang capacitor (fig. 6). For a particular setting of the tuning capacitor, selected during operation by means of the tuning knob on the front panel, the frequency generated by the oscillator is determined by the total instantaneous inductance of coils L-3 and L-2B. As explained in paragraph 20, since the inductance of L-2B is made to vary in proportion to the amplitude and frequency of the a-f output of the microphone amplifier, the total inductance of the resonant circuit also varies at the a-f rate, and the frequency generated by the oscillator varies from nominal or center value, accordingly. The center frequency is set during alinement by adjustment of C-4 and L-3 and always is equal to the dial frequency minus 15 mc. The tuning range of the oscillator is between 32 and 43.4 mc.

*b.* COLPITTS ARRANGEMENT. The arrangement of the oscillator into a Colpitts circuit is apparent from figure 12. The grid is coupled to the resonant circuit by means of capacitor C-8. Regenerative feedback from the plate-filament circuit necessary to sustain oscillation is provided through capacitor C-14. Capacitors C-11 and C-14 constitute the conventional Colpitts voltage-dividing circuit. Capacitor C-16 is a plate supply bypass. Its high value effectively places the plate at ground potential for rf. C-12 and C-13 serve to place all portions of the filament at the same r-f potential.

*c.* OSCILLATOR OUTPUT CONNECTIONS. A portion of the oscillator output, taken across capacitor C-10A, is routed through the coupling circuit consisting of coil L-4 and capacitor C-53 to the input of the receiver first mixer stage, V-9. Another portion of the oscillator output is taken from the junction of C-12 and C-13 and is routed through coupling capacitor C-15 to the grid (pin 3) of the transmitter mixer tube V-4.

*d.* PLATE SUPPLY. Plate voltage for V-2 is shunt-fed through coil L-7 from the external 90-volt supply. The plate voltage connection for the oscillator is independent of the control circuit, since V-2 must be operative during both receiving and transmitting periods. C-16 is a plate supply bypass capacitor. Its high value places the plate at ground potential for radio frequencies.

*e.* FILAMENT CIRCUIT. Filament current is supplied through the inductor L-5. Capacitors C-13 and C-12 bypass the filament for radio frequencies and also serve to maintain a uniform voltage across the filaments, i.e., to make the filaments an equipotential surface (like a cathode) for radio frequencies.

*f.* GRID BIAS. Grid resistor R-5 limits the grid current of the oscillator and provides self-bias for the operation of the tube.

*g.* MECHANICAL ARRANGEMENT. In order to obtain maximum stability of the oscillator under high humidity conditions, as many of the circuit elements as possible have been inclosed in a box identified as T-3. The alinement controls for C-4 and L-3 are accessible through the cover.

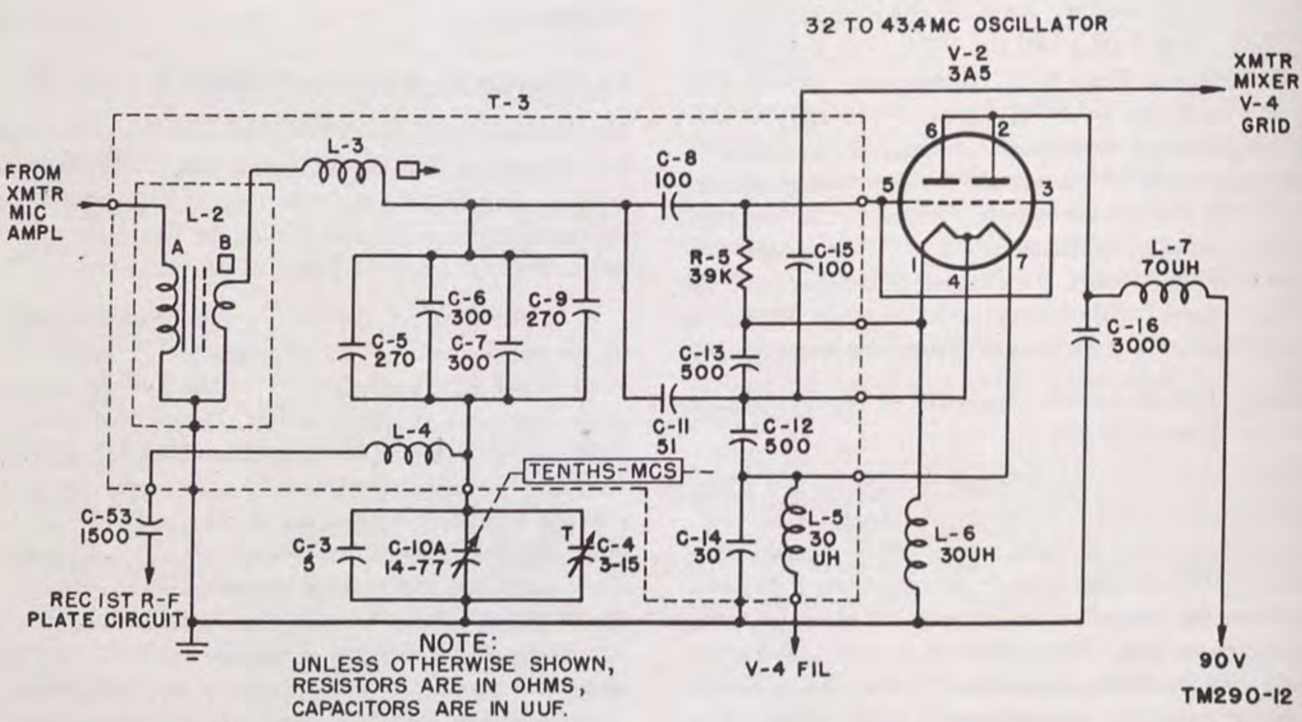



*Figure 12. Reactance modulator and 32- to 43.4-mc oscillator circuits, functional diagram.*

## 20. Modulation (fig. 12)

*a.* In general, fm consists in causing the center or carrier frequency of the master oscillator of the transmitter to be shifted in frequency in accordance with the audio signals to be transmitted. The amplitude variations of the audio signals become changes in the frequency of the carrier, while the frequency of the audio signals becomes the rate with which the frequency of the carrier changes from its center value.

*b.* In Receiver-Transmitter RT-70/GRC this function is performed by modulator coil L-2. This coil consists of two sections. One section of coil L-2B is placed in series with the main tuning coil, L-3, of the 32- to 43.4-mc oscillator V-2. The other section of the coil, L-2A, is placed across the secondary winding of the microphone amplifier output transformer T-2. The inductance of L-2A is made to vary at the rate of the audio signals appearing across the secondary winding of T-2 and consequently across L-2B. The instantaneous inductance of L-2B adds to that of L-3 and the total inductance determines the frequency which the oscillator will generate for a given setting of tuning capacitor C-10A.

*c.* To accomplish the result described in subparagraph *b* above, advantage is taken of the principle that the inductance of the coil is determined by the permeability of its iron-dust core. By varying the flux density in the iron core, the permeability of that core, and thereby the inductance of the coil can be changed. Coil L-2B has a small iron-dust toroidal core on which are wound two turns of relatively heavy wire. This coil is placed in the air gap of the laminated iron core of the larger coil L-2A. A permanent magnet placed in the magnetic structure of L-2A sets up a *fixed magnetic bias* for determining the flux density in and the permeability of the toroidal core (and thus the inductance) of L-2B when no audio currents flow in coil L-2A. This operating point sets the initial inductance of L-2B so that, together with the inductance of L-3, the oscillator is tuned to the center frequency (dial number minus 15) selected by the setting of C-10A. At this point, the permeability will vary in accordance with the added flux density caused by the audio signal current as the audio flux adds to or subtracts from the flux in the iron-dust core due to the permanent magnet.

*d.* When a-f current flows through the winding of L-2A, the electromagnetic field set up by this current in the laminated iron core adds to or subtracts from the flux provided by the permanent magnet. This causes corresponding changes in the flux density in the toroidal core and causes its permeability to shift up or down along the permeability curve. The magnitude of such changes is proportional to the magnitude of the audio current in L-2A. The rate with which flux density in the toroidal core changes is proportional to the frequency of the audio signal. The change in permeability of the toroidal core translates itself into a change in the inductance of L-2B. The net effect is that the tuning of the oscillator and consequently the generated frequency changes in accordance with the instantaneous amplitude of the audio signal across L-2A and the rate of change of the carrier frequency is proportional to the frequency of the audio signal.

## 21. Fixed 15-mc Transmitter Oscillator V-3 (fig. 13)

*a.* R-F CIRCUITS. Fixed 15-mc transmitter oscillator V-3 uses a tube type 1L4 pentode, in a 7.5-mc crystal-controlled electron-coupled oscillator. A 7.5-mc crystal connected between the control grid (pin 6) and ground establishes the oscillating frequency. The screen grid of the tube (pin 3) is effectively placed at r-f ground potential by capacitor C-17. Oscillatory feedback between the grid and plate is established by electron coupling through the internal electrode capacitance of the tube. Capacitors C-18 and C-19 act as a voltage divider to establish the proper grid drive for the tube. The grid current is returned to filament by grid leak resistor R-7. The plate circuit (pin 2) of the stage is tuned to resonance at 15 mc, the second harmonic of the oscillator frequency, by the tuned circuit consisting of fixed capacitor C-20 and coil L-10. The inductance of coil L-10 is adjustable by means of a powdered iron core so as to set the oscillator output at a maximum during alinement. The plate and screen components of the crystal oscillator are assembled in a can identified as T-4.

*b.* D-C CIRCUITS. Plate voltage is applied through filter coil L-11, which is bypassed to ground for rf by capacitor C-21. Screen voltage is applied through decoupling resistor R-6 which is bypassed by capacitor C-17. Filament voltage is applied through the filter coils L-8 and L-9. R-8 reduces filament current to proper value.

*c.* OUTPUT CIRCUITS. The second harmonic frequency voltage developed across the tuned plate circuit is applied through coupling capacitor C-22 to the screen grid (pin 4) of the transmitter mixer stage V-4.

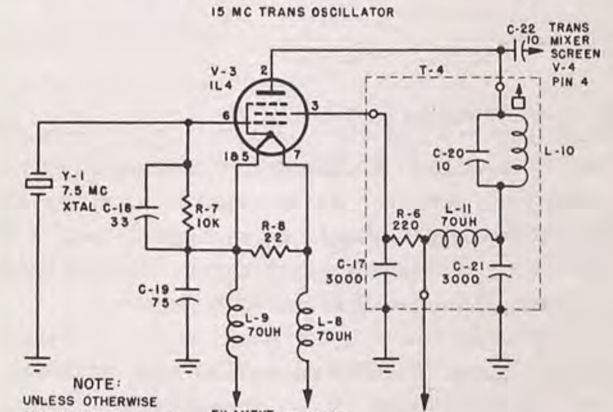



*Figure 13. 15-mc transmitter oscillator, functional diagram.*

## 22. Transmitter Mixer Circuit V-4 (fig. 14)

*a.* R-F CIRCUITS. The transmitter mixer stage uses a tube type 3Q4 pentode, V-4. The output of the variable 32- to 43.4-mc oscillator, V-2, is coupled through capacitor C-15 to the control grid (pin 3) of V-4. Simultaneously, the 15-mc output of crystal oscillator V-3 is coupled through capacitor C-22 to the screen grid (pin 4) of the mixer tube. The tube combines the two signals to produce sum and difference frequencies. The sum frequencies are the desired transmission frequencies and correspond to the frequency setting of the dial on the front panel. These frequencies are selected by the parallel-resonant plate circuit consisting of L-12, the B section of tuning capacitor C-10, and trimmer capacitor C-27. Capacitor C-26 is an isolation capacitor to keep d-c voltage off C-27. For tracking at the l-f end, the inductance of L-13 is adjustable by means of the powdered iron slug of the coil. Adjustment of tracking at the high end of the band is accomplished by means of trimmer capacitor C-27. The tuning range of the circuit is between 47 and 58.4 mc.

*b.* D-C CIRCUITS. Plate voltage is applied through the filter circuit consisting of filter coil L-14 and bypass capacitors C-29 and C-28. Screen voltage is applied through voltage-dropping resistor R-9. Filament voltage is applied through coil L-12. Resistors R-11 and R-12 limit the current flow through the filaments to the proper value. Capacitor C-23 is a filament bypass capacitor. Capacitors C-24 and C-25 place filament section 1-4 at r-f ground potential, thus effectively establishing the filament as an equipotential surface (cathode). The control grid is returned to the filament by grid resistor R-10.

*c.* OUTPUT CIRCUIT. The sum frequency selected by the tuned plate circuit is coupled to the transmitter driver stage V-5 through capacitor C-30. The plate circuit components including tuning coil L-13, trimmer capacitor C-27, and components of the plate supply filter are mounted in a can identified as T-5. The adjustment controls for L-13 and C-27 are available through the side walls of this can.

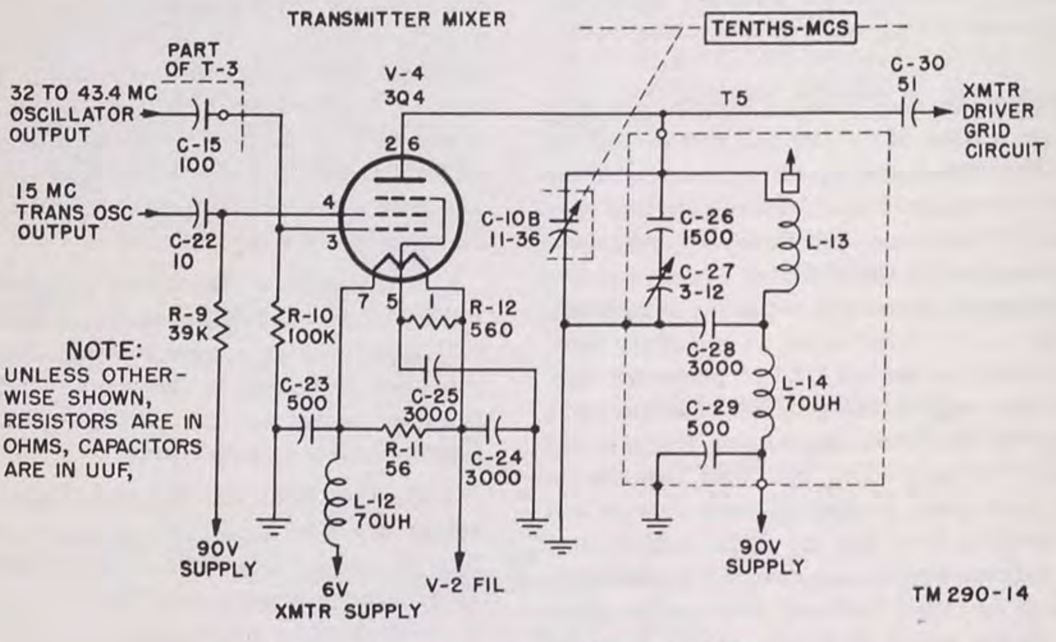



*Figure 14. Transmitter mixer circuit, functional diagram.*

## 23. Transmitter Driver V-5 (fig. 15)

*a.* R-F CIRCUITS. The transmitter driver stage uses a tube type 3Q4 pentode, V-5. The output of the mixer stage is coupled through capacitor C-30 to the grid (pin 3) of V-5. The tube is self-biased by grid current flowing through the series grid resistors R-13 and R-14. Resistor R-14 provides means for measuring the grid drive. The measuring point (E-1) is a stand-off insulator wired in at the junction of R-13 and R-14. The voltage across R-14 may be measured from test point E-1 to chassis. The plate circuit of V-5 is tuned to the dial frequency by the resonant circuit composed of coil L-16A and the C section of tuning capacitor C-10. Tracking may be adjusted by means of the variable powdered iron core of coil L-16A and also by means of trimmer capacitor C-34 connected across the tuning capacitor section. C-33 is an isolation capacitor to keep d-c voltage from C-34. The output of the transmitter driver is coupled to the transmitter power amplifier stage through capacitor C-37.

*b.* D-C CIRCUITS. Plate and screen voltages are supplied from the 90-volt source through resistors R-16 and R-15, respectively. These are bypassed for rf by capacitors C-36 and C-32, respectively. The filament circuits are bypassed to ground by capacitor C-31.

*c.* NEUTRALIZING CIRCUIT. The series arrangement of coil L-16B and variable capacitor C-35, connected between the grid (pin 3) of V-5 and the junction of L-16B and R-16, is a neutralizing or negative voltage feedback circuit serving to balance out the grid-to-plate capacitance of the tube and thus to cancel out any tendency of the tube to break into oscillations. This arrangement serves to provide for stable operation of this relatively high power stage. Coil L-16B is closely coupled to the tuning inductance L-16A, being interwound with it on a common form.

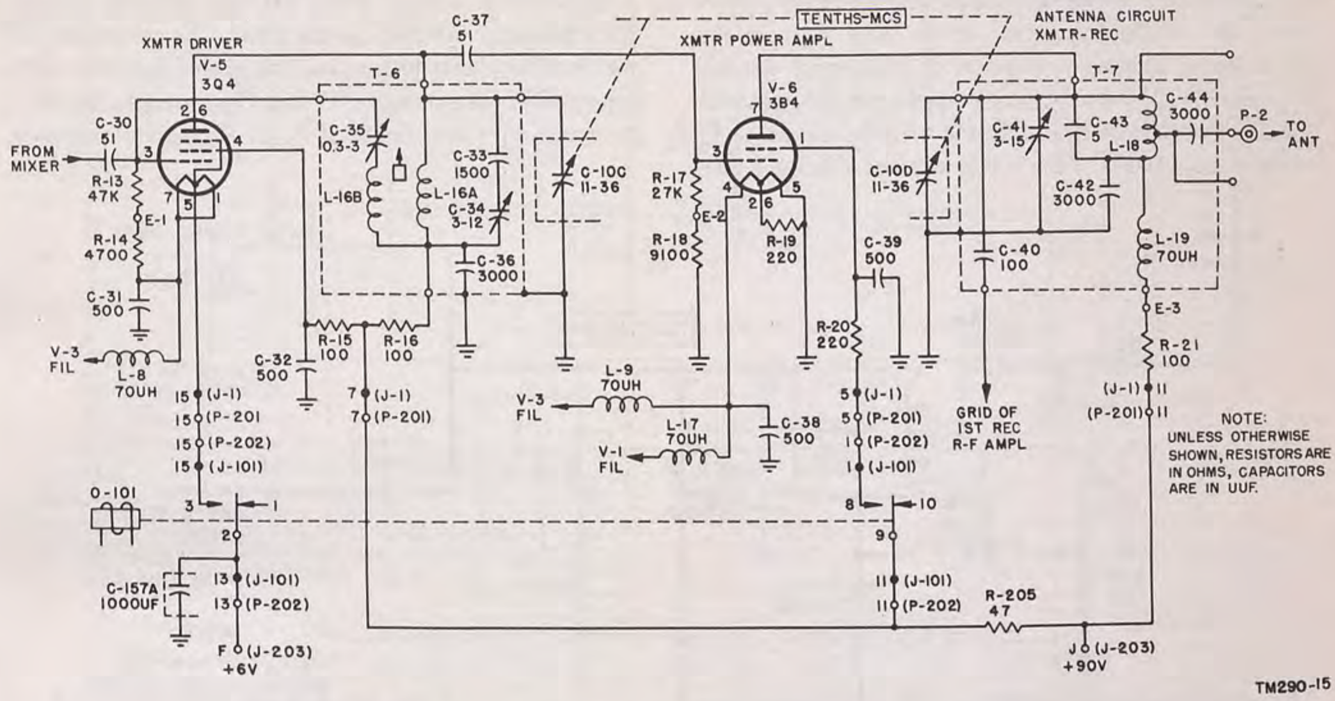



*Figure 15. Transmitter driver and power amplifier circuits, functional diagram.*

### 24. Transmitter Power Amplifier V-6 (fig. 15)

*a.* R-F CIRCUITS. The output stage or power amplifier of the transmitter uses a tube type 3B4, V-6. Grid drive is obtained from the output of the driver stage through coupling capacitor C-37. The grid circuit is returned to ground through grid leak resistors R-17 in series with measuring resistor R-18. The current flowing through these resistors furnishes bias for the operation of the tube. Resistor R-18 provides a means for measuring the grid drive voltage. Measurement is made from stand-off insulator E-2, at the junction of R-17 and R-18, to chassis. The plate (pin 7) of V-6 is connected directly to the tuned antenna circuit which acts as the plate load impedance. This circuit is tuned to a frequency within the range of 47 to 58.4 mc depending on the dial setting. The circuit includes adjustable tuning coil L-18, capacitor C-43, the D section of the tuning capacitor C-10, and trimmer capacitor C-41.

*b.* D-C CIRCUITS. Plate voltage is fed to the amplifier tube through filter coil L-19 and antenna tuning coil L-18 from the 90-volt supply. Capacitor C-42 bypasses the plate supply for rf. Screen voltage is fed from the 90-volt supply through decoupling resistor R-205 and normally open contacts 8-9 of relay O-1 and through decoupling resistor R-20, which is bypassed by capacitor C-39. The filament supply circuit includes filter coil L-17 and rf bypass capacitor C-38. Resistor R-19 limits the current flow in the filaments of the tube to the proper value.

*c.* MEASUREMENTS. Resistor R-21 in series with the plate supply coil L-19 provides a means for measuring the plate current for the power amplifier stage. Measurement is made between test point E-3 and chassis. This is terminal 12 of connector J-1 and P-201. Measuring point E-2 at the junction of R-17 and R-18 provides means of determining grid drive for V-6.

### 25. Antenna Circuit (fig. 16)

The antenna circuit is common to both the transmitter and receiver. It includes tuning coil L-18, capacitor C-43, trimmer capacitor C-41, and the D section of tuning capacitor C-10. The antenna proper is brought to the transmitter and receiver circuits through a plug-in connection into coaxial ANT connector (J-201) on the front panel of the set. A wire terminated in a female pin connector (P-2) provides the path from the ANT connector on the rear of the panel through coupling capacitor C-44 to the antenna circuit (T-7) on the r-f chassis. The impedance of the antenna is matched to the antenna circuit by bringing the connecting wire to a tap on tuning inductance L-18. The antenna circuit is used as the tuned-plate load for transmitter power amplifier V-6, and is also coupled to the grid of the receiver first r-f amplifier V-8, through coupling capacitor C-40. Since the filaments of the transmitter and receiver tubes are alternately turned on and off by control relay O-101, there is no interference from the transmitter into the receiver, even though the two are connected to the same point in the circuit. For a detailed description of the control circuits, see paragraph 35. For alinement purposes, the inductance of L-18 is adjustable by spreading the turns by means of an insulated tool. Access to the coil is obtained through a hole on the r-f coil compartment located on the wiring side of the r-f chassis. Trimmer capacitor C-41 is used for tuning adjustment at the high end of the band. It is adjusted for minimum noise in the receiver. Since the operating frequencies of the transmitter and of the receiver are always the same, once the antenna circuit has been adjusted for one, the adjustment will hold for the other. The components of the antenna circuit proper and the power amplifier plate supply filter components L-19 and C-42 are mounted in a compartment (identified as T-7) of the r-f coil assembly.

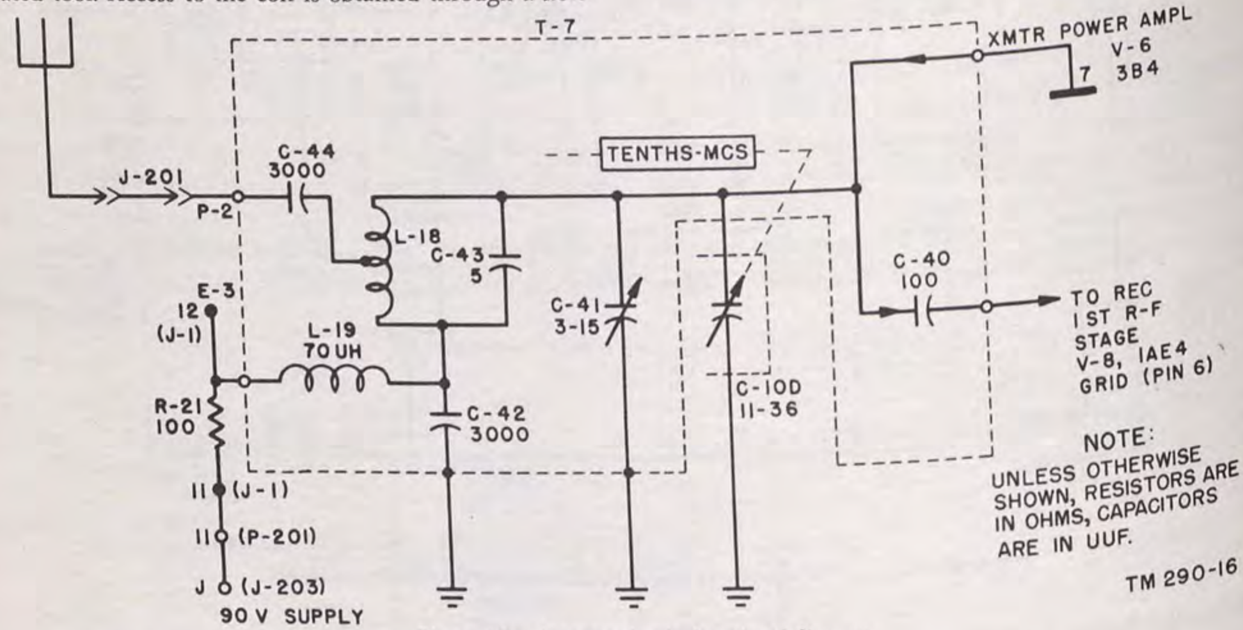



*Figure 16. Antenna circuit, functional diagram.*

## 26. Receiver First R-f Amplifier V-8 (fig. 17)

*a.* The receiver r-f stage, V-8, uses a type 1AE4 pentode tube. This tube is particularly suitable because of the high signal-to-noise ratio obtainable with it. Capacitor C-40 couples the antenna circuit to the grid (pin 6) of V-8. The output of calibrate oscillator V-7 also is coupled to pin 6 of V-8, through capacitor C-47. Normally, however, the calibrate oscillator is disabled by the test switch, S-202, on the front panel. The calibrate oscillator is described in paragraph 37.

*b.* The grid current of V-8 includes grid leak resistor R-24, which is returned to ground through resistor R-34, part of the squelch diode load voltage divider. The tube is operated at the combination of bias voltages developed across these resistors, as follows. During stand-by, or no-signal conditions of the receiver, a bias voltage developed by the diode portion of V-107 is applied across diode load resistor R-131. This voltage, applied across R-34 by voltage divider action of R-132, R-142, and R-34, places bias on V-8, thus reducing its gain. When a signal above the threshhold determined by the squelch setting enters the receiver antenna circuit the squelch circuit is made inoperative, the output of the squelch diode (V-107) is cut off, and the bias voltage across R-34 is removed. Thus, V-8 is restored to normal operation at zero bias. Grid current flow for very strong signals is limited by R-24 and R-34. For details of squelch circuit operation, see paragraph 34.

*c.* The plate circuit (pin 2) includes the parallel resonant circuit composed of L-23, the E section of the ganged tuning capacitor C-10, trimmer capacitor C-56, and capacitor C-55. Trimmer capacitor C-56 and the powdered iron core of L-23 are used to adjust the alinement of the stage at the high and low ends of the band, respectively. L-23 i returned to ground for rf through bypass capacitor C-57.

*d.* Plate voltage is supplied through voltage-droppin resistor R-25, which is bypassed by capacitor C-57. Scree (pin 3) voltage is filtered by capacitor C-52. These voltag are obtained from the 90-volt supply through decouplin resistor R-205 and are not controlled by the relay contac Filament voltage is obtained over normally closed conta 1 and 2 of relay O-101, as described in paragraph 41.

*e.* The output of V-8 is coupled through capacitor C- to the grid (pin 6) of the receiver first mixer tube, V

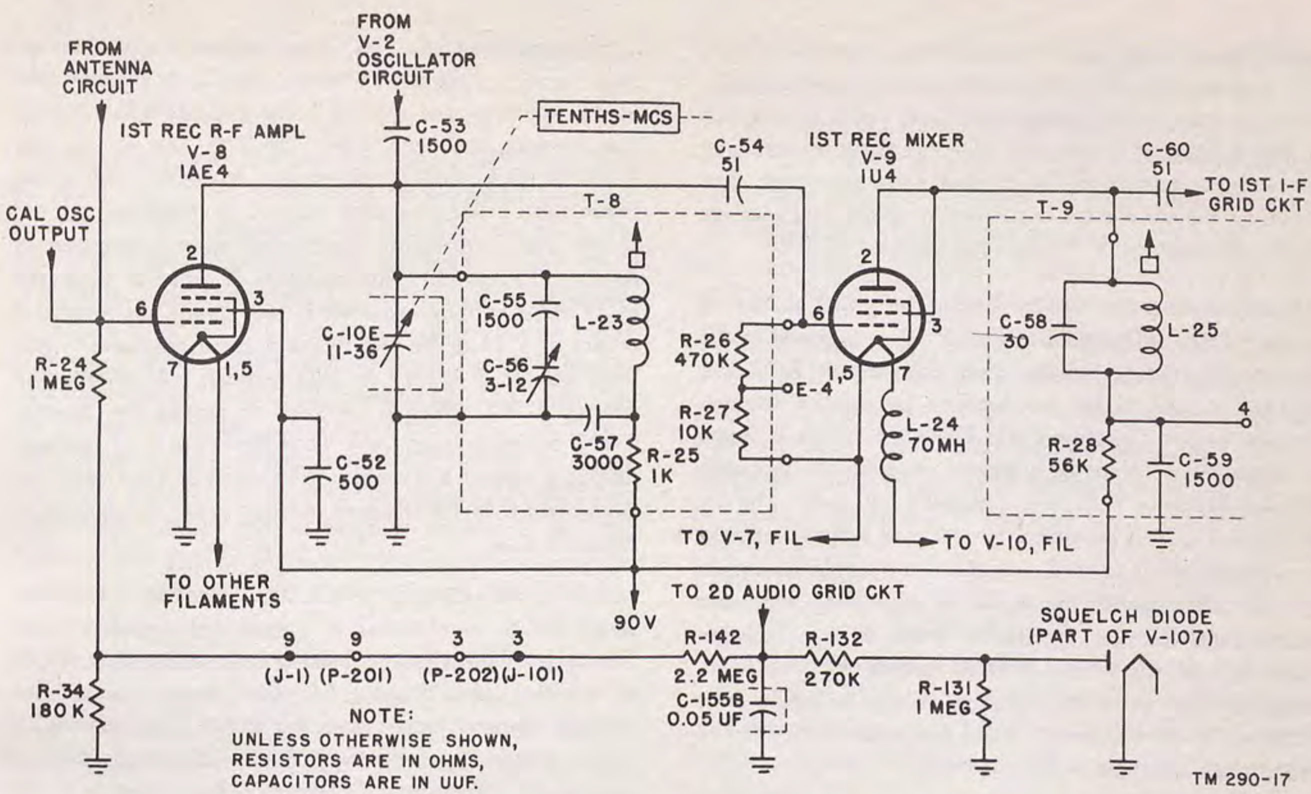



*Figure 17. Receiver first r-f amplifier and mixer circuits, functional diagram.*

### 27. Receiver First Mixer V-9 (fig. 17)

*a.* The first mixer stage uses a type 1U4 pentode tube, V-9. The tube is operated as triode, with the plate (pin 2) and the screen grid (pin 3) connected together. The signal voltage from the first receiver r-f amplifier and the heterodyne frequency voltage from the variable 32- to 43.4-mc oscillator, V-2, are both injected to the grid (pin 6) of the tube through coupling capacitor C-54. The signal voltage is taken from the plate of V-8. The oscillator output, taken at the junction of variable capacitor C-10A and padder capacitors C-5, C-6, C-7, and C-9, is routed through the series arrangement of inductor L-4 and capacitor C-53.

*b.* The grid (pin 6) is returned to filament through grid leak resistor R-26. Measuring resistor R-27, in series with R-26, provides means for measuring the voltages applied to the grid. Measurement is made between test point E-4 and chassis. Capacitor C-51 in the filament circuit provides r-f ground return for the grid circuit.

*c.* The incoming signal and the frequency generated by the variable oscillator are mixed in V-9 to produce sum and difference frequencies, as well as harmonics of these frequencies. The tuned plate circuit is adjusted to resonance at the difference frequency, namely the incoming signal frequency minus the variable oscillator frequency. Since the variable oscillator frequency is always 15 mc lower than the frequency to which the receiver is tuned, the difference frequencies selected by the tuned circuit is in a band centered about 15 mc. This is the first i.f. of the receiver. All other frequencies produced in the mixer stage are effectively rejected by the high Q of the tuned circuit. The output of the mixer stage is coupled to the grid circuit of the first i-f amplifier stage V-10 through capacitor C-60.

*d.* The plate circuit is tuned to resonance at 15 mc by the parallel resonant circuit composed of fixed capacitor C-58 and tuning coil L-25. The inductance of L-25 and the alinement of the stage is adjustable by means of the powdered iron slug of the coil.

*e.* Plate voltage is supplied through voltage-dropping resistor R-28, which is bypassed to ground by capacitor C-59. The filament circuit includes isolating choke coils L-24, L-22, and bypass capacitor C-51. The filament voltage of this tube, as well as for other tubes of the receiver, is applied through contacts of the control relay and is disconnected when the set is in the transmitting condition. The control circuit is described in paragraph 35.

### 28. 15-mc I-f Amplifiers (fig. 18)

*a.* GENERAL. The 15-mc output of the receiver first mixer is coupled through capacitor C-60 to the grid of the first stage of a three-stage i-f amplifier, V-10, V-11, and V-101. The first two stages are located on the r-f chassis. The plate circuit components of the second stage, V-10, and the entire third stage, V-101, are located on the i-f chassis. Wire, fitted with a pin-plug (P-1), establishes the connection between the two chassis. Each stage uses a type 1U4 pentode tube. The plate circuit of each is permeability tuned, by means of a powdered iron slug in the tuning coil, to pass a band of frequencies centered about 15 mc. The bandwidth is determined by the total Q of the circuit. The output of the third stage is coupled to the second receiver mixer and oscillator V-102 through capacitor C-108.

*b.* I-F AMPLIFIER STAGE V-10. The grid (pin 6) of the first 15-mc i-f amplifier stage, V-10, is returned to the filament by current limiting grid leak resistor R-29 and returned to ground for intermediate frequencies through filament bypass capacitor C-61. The plate circuit is tuned to resonance at 15 mc by a single tuned circuit composed of fixed capacitor C-62 and adjustable coil L-27. The inductance of L-27 is adjustable by means of a powdered iron core. Coupling capacitor C-64 applies the amplified output of V-10 to the grid of the second i-f stage V-11. Plate and screen potentials are applied to V-10 through voltage-dropping and filter resistor R-30, which is bypassed to ground by capacitor C-63. Filament voltage is applied over the normally closed contacts 1 and 2 of control relay O-101 and through isolating choke coil L-26.

*c.* I-F AMPLIFIER STAGE V-11. The second i-f amplifier stage, V-11, is very similar in circuit arrangement to the first stage, V-10, described in subparagraph *b* above. The grid is returned to filament through grid leak resistor R-31 in series with measuring resistor R-32. Ground return for intermediate frequency is established through filament bypass capacitor C-46. The voltage measured across this resistor (between pin 1 of T-10 and chassis) is an indication of the signal voltage applied to the grid of V-11. Connection between the plate, pin 2, of V-11 and tuning unit T-101 is made through the plug-in connection (P-1) between the r-f and i-f chassis referred to in subparagraph *a* above. The permeability tuned plate circuit composed of capacitor C-101 and inductor L-101 is tuned to resonance at 15 mc. Coupling capacitor C-103 applies the amplified output of V-11 to the grid of the third i-f amplifier V-101. Plate voltage is applied to V-11 through voltage-dropping resistor R-101, which is bypassed to ground by capacitor C-102. Screen voltage for V-11 is applied through voltage-dropping resistor R-33 which is bypassed by capacitor C-65. Choke coil L-28, the filament isolating choke, is bypassed by capacitor C-46.

*d.* I-F AMPLIFIER STAGE V-101. The third i-f amplifier stage, V-101, is identical in circuit arrangement to the first stage, V-10. Current limiting resistor R-102 in T-101 returns the grid to filament. I-f ground return is established through filament bypass capacitor C-128. The tuned plate circuit composed of capacitor C-105 and inductor L-103 is tuned to resonance at 15 mc. Coupling capacitor C-108 applies the amplified output of V-101 to the grid of the second receiver mixer and oscillator stage V-102. Plate and screen potentials are applied to V-101 through voltage-dropping resistor R-103, which is bypassed to ground by capacitor C-106. Filament voltage supplied through isolating choke L-102 is bypassed by capacitors C-130 and C-128.

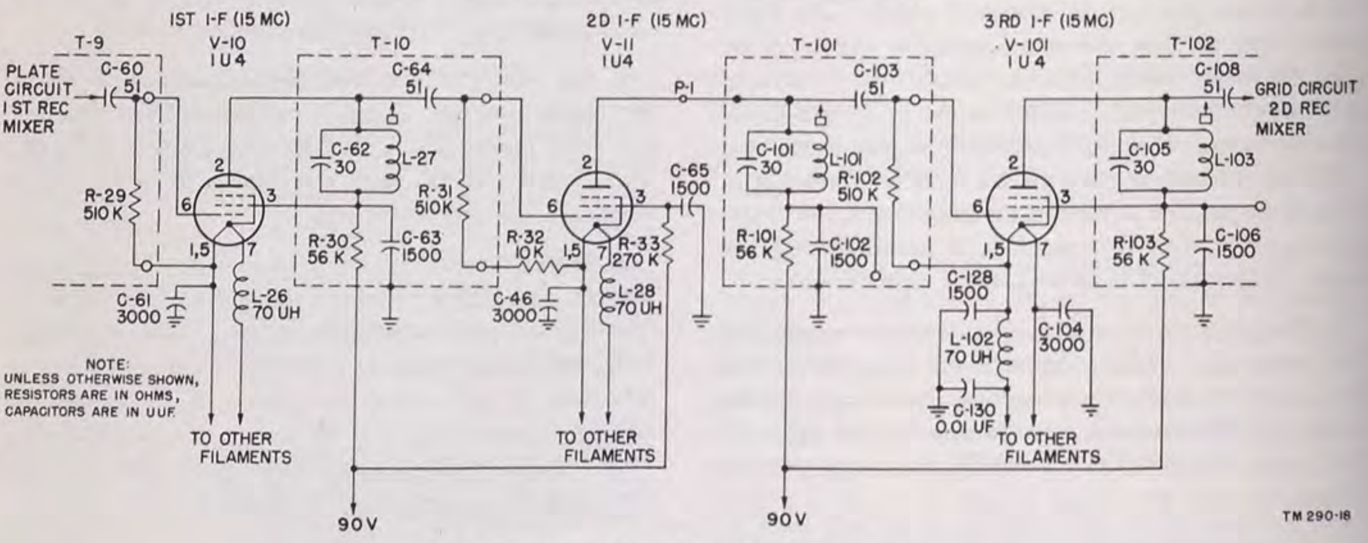



*Figure 18. 15-mc i-f amplifiers, functional diagram.*

## 29. Receiver Second Mixer and Oscillator (fig. 19)

*a.* Tube V-102, a type 1R5 pentagrid converter, serves the dual purpose of crystal oscillator and receiver second mixer. The frequency generated by the oscillator is such that in beating with the 15-mc i-f band, a lower i-f band centered about 1.4 mc is produced.

*b.* The fixed crystal oscillator is a conventional Pierce type circuit, using the first grid (pin 4) as the oscillator grid and the screen grid (pin 3) as the oscillator plate. The quartz crystal, Y-101, is connected between these two electrodes. Oscillatory feedback is established through capacitors C-109 and C-111. Resistor R-105 is the ground return for the oscillator grid. The oscillator generates a fundamental frequency of 6.8 mc, and a number of harmonics of that frequency.

*c.* The mixer circuit includes the signal grid (pin 6) and the plate (pin 2) of V-102. The 15-mc signal from the output of V-101 is applied to the grid (pin 6) while the crystal oscillator output is, in effect, injected into the mixer circuit at the screen grid (pin 3). Since the oscillator output is 6.8 mc and harmonics of that frequency, the resultant beat frequencies include difference components between the signal frequencies and each of the oscillator output frequencies. The difference frequencies produced by mixing the 15-mc signal with the second harmonic output of the oscillator (13.6 mc) are selected by the double-tuned plate circuit of V-102. The band of frequencies thus selected is centered about 1.4 mc. The double-tuned plate circuit includes the parallel arrangement of primary coil L-105, fixed capacitor C-112, and damping resistor R-106. Resistor R-106 loads the tuned circuit in order to broaden the frequency response sufficiently to include the entire i-f band. The 1.4-mc signal voltage developed across the tuned plate circuit is coupled to the input of the fourth i-f stage by induction between primary coil L-105 and secondary coil L-106. The latter coil is the inductive portion of the tuned grid circuit of the fourth i-f amplifier stage, V-103. The tuned secondary circuit includes coil L-106 and fixed capacitor C-113. The primary and secondary coils of this tuned circuit and the tuned circuit of the following i-f amplifier stages are overcoupled. The resultant i-f characteristic therefore has a double peak and a dip between the peaks. The purpose of this arrangement is to provide a broad over-all i-f response characteristic. The primary and secondary coils L-105 and L-106 are slug-tuned by means of powdered iron cores. Coupling capacitor C-114 applies the signal voltage developed across the tuned secondary circuit to the grid of the fourth i-f amplifier stage. The grid (pin 6) of the mixer circuit is returned to filament by resistor R-104 and for i.f. to ground by capacitor C-107.

*d.* Plate voltage for V-102 is supplied through voltage-dropping resistor R-108 which is bypassed by capacitor C-110. Screen voltage is supplied through R-108 and choke coil L-107, which also acts as the load for the crystal oscillator. Filament voltage is applied through isolating choke L-104. Capacitors C-107 and C-104 serve as filament bypass capacitors.

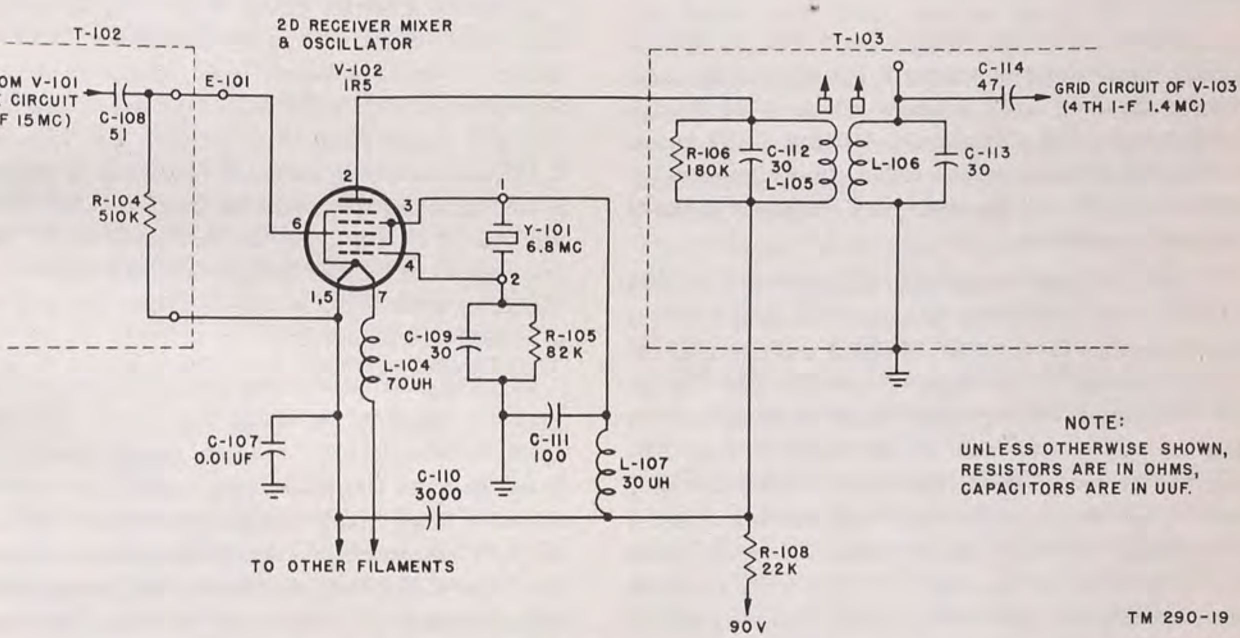



*Figure 19. Second receiver mixer and oscillator, functional diagram.*

### 30. 1.4-mc Amplifier and Limiters (fig. 20)

*a.* FOURTH I-F AMPLIFIER V-103. The 1.4-mc i-f band is selected from the output of the receiver second mixer V-102, by the double-tuned circuit in tuning unit T-103 (par. 29), and coupled through capacitor C-114 to the grid (pin 6) of the fourth i-f amplifier stage V-103.

(1) Coupling capacitor C-114 has the additional function of blocking any d-c current which may be flowing in the filament-to-grid circuit of V-103 from the tuned secondary coil L-106 of T-103. The d-c return path for the grid is established through grid leak resistor R-109 in series with measuring resistor R-107, which is bypassed for signal frequencies by capacitor C-115. The grid leak resistor has the additional function of limiting grid current flow for very strong signals.

(2) Test point E-102, provided at the junction of R-109 and the grid (pin 6) of V-103, permits measurement of the a-c signal voltage and of the d-c bias voltage applied to the tube. A-c measurements from this point to ground give indication of the driving voltage provided by the signal, since C-115 effectively returns the grid to ground for signal frequencies. Measurement across R-107 (between pins 4 and 3 of T-103) gives indication of the d-c bias voltage.

(3) The double-tuned plate circuit of V-103 (tuned plate of V-103 and tuned grid of V-104) is identical in circuit arrangement and component values to tuning unit T-103 (par. 29) for V-102. The circuit is tuned to resonance at 1.4 mc. The primary circuit includes coil L-109, fixed tuning capacitor C-118, and damping resistor R-110. The secondary circuit includes coil L-110 and fixed tuning capacitor C-119. As in the case of T-103, double tuning provides a high degree of i-f selectivity while maintaining the desired bandwidth. The bandwidth is determined by overcoupling between the primary and secondary coils. In addition, the resistive load provided by R-110 flattens out the frequency response of the tuned circuit. The 80-kc band centered about 1.4 mc selected by the tuned circuit is coupled to the input of the first limiter stage V-104 through capacitor C-120.

(4) Plate and screen voltages for V-103 are applied through voltage-dropping resistor R-111, which is bypassed by filter capacitor C-117. Filament voltage is fed through isolating coil L-108. Capacitors C-116 and C-107 bypass the filament circuit to ground. C-116 effectively places the junction of R-107 and filament (pin 1) at ground potential for signal frequencies.

*b.* First Limiter V-104. The output of the fourth i-f amplifier stage, selected by the tuned circuits of T-104, is coupled through capacitor C-120 to the grid circuit of the first limiter stage V-104, a type 1U4 pentode tube. The circuit arrangement and the values of the components in the stage are identical to those of the fourth i-f stage. The stage has the dual function, however, of not only providing further amplification to the signal band centered about 1.4 mc, but also to provide limiting action for strong signals so as to eliminate any amplitude variations which may have been superimposed upon strong signals. Limiting action of this and the following stage is described in subparagraph *d* below.

(1) The series arrangement of grid leak resistor R-113 and measuring resistor R-112 provides the d-c return path for the grid to the filament of the tube. The grid return path to ground for signal frequencies is established through bypass capacitor C-121, which also bypasses measuring resistor R-112 to ground for signal voltages. The measuring point (E-103) is provided at the junction of R-113 and the grid (pin 6) of the tube.

(2) A portion of the d-c voltage appearing in the grid circuit of V-104 as a result of grid circuit rectification of signal or noise voltages is coupled through R-130 to the grid circuit of squelch oscillator tube V-107. The action of the squelch circuit is described in paragraph 34. C-147 places one end of R-130 at ground potential to r-f voltages.

(3) A double-tuned circuit tunes the plate of V-104 and the grid of V-105 to resonance at 1.4 mc. The primary tuned circuit includes coil L-112, fixed tuning capacitor C-124, and damping resistor R-114. The secondary tuned circuit (grid) includes coil L-113 and fixed tuning capacitor C-125.

(4) Plate and screen potentials are applied through voltage-dropping resistor R-115, which is bypassed by capacitor C-123. Filament voltage is supplied through isolating choke L-111. The filament is bypassed to ground by capacitors C-122 and C-116.

(5) The amplified and limited output of this stage is selected by tuning unit T-105 and is coupled by capacitor C-126 in that unit to the grid circuit of the second limiter stage V-105. The bandwidth thus selected is again centered about 1.4 mc. The limiting action provided by this and the following stage is described in subparagraph *d* below.

*c.* Second Limiter Stage V-105. (1) Second limiter stage V-105 uses a tube type 1L4 pentode. This tube is selected to obtain sufficient signal voltage to operate the discriminator circuit which follows the second limiter stage. The grid circuit return path includes grid leak resistor R-119, and measuring resistor R-116, which is bypassed to ground for signal frequencies by capacitor C-127. For measurement of r-f grid drive, the junction of R-119 and the grid (pin 6) of V-105 is brought to measuring point E-104. Measuring point E-105 is used to measure d-c grid voltage as an indication of grid drive.

(2) The plate circuit components of the second limiter stage are assembled in tuning unit T-106. The primary circuit includes coil L-115 and fixed tuning capacitor C-134. It will be noted that no damping resistor is provided. The secondary tuned circuit includes two balanced coils L-116 and L-117 shunted by the series arrangement of capacitors C-135 and C-136. Both the primary and the secondary circuits are tuned to resonance at 1.4 mc and the coupling between them is such that a band of frequencies centered about 1.4 mc is selected. The secondary circuit is a portion of the discriminator circuit described in paragraph 31.

(3) Plate and screen voltage for the second limiter tube is supplied through decoupling resistor R-120 which is bypassed by capacitor C-132. The filament circuit includes isolating coil L-114. Capacitor C-122 bypasses the filament circuit for signal frequencies.

(4) Signal voltages developed across the primary tuned circuit are applied over two paths to the secondary tuned circuit, namely the discriminator. One path is established

by inductive coupling between the primary coil L-115 and the secondary coils L-116 and L-117. The other path is a direct connection from the plate (pin 2) of V-105 to the center tap between capacitors C-135 and C-136. The purpose of this arrangement is described in paragraph 31.

*d.* LIMITING ACTION. The first and second limiter stages have the dual functions of amplifying the 1.4-mc band of frequencies and of eliminating or limiting any amplitude variations. These may have been superimposed upon the signal in its travel from the distant transmitter through the air and through the preceding stages of the receiver to the limiter stages.

(1) Proper operation of the discriminator circuit requires that the applied signal be free of amplitude variations due to bursts of noise and static and due to other causes, and that for wide variations in the strength of incoming signals the average signal voltage applied to the discriminator input circuit remain fairly constant. The circuit parameters of the 1.4-mc i-f amplifier and limiter stages are so arranged as to make both these functions possible.

(2) When the signal voltage appearing across the grid circuit of any one of the three stages described above (V-103, V-104, and V-105) exceeds a certain value, an increase in grid current causes limiting action or cutting off of signal peaks for one half-cycle of the signal voltage, while plate current saturation causes similar limiting action for the other half-cycle of the signal voltage. In this manner, limiting of amplitude variations is accomplished in both the grid and the plate circuits. When the average signal level is higher than that necessary to produce the required voltage across the discriminator input, the grid current is increased to the point where grid current rectification occurs. The d-c grid current then flows through the associated grid leak resistor and develops a voltage across it which is negative at the grid (pin 6) of the tube. The negative voltage tends to bias the tube toward cut-off, thereby reducing the gain of the stage accordingly.

(3) While inherently all three stages, namely the fourth i-f amplifier V-103 and the first and second limiters V-104 and V-105, are capable of providing the action described above, the gain layout of the receiver is such that the signal voltage levels across the grid circuit of the fourth i-f amplifier stage are normally not high enough to start limiting action there. Limiting action normally is confined to the first and second limiter stages, and their designation as such is derived from this fact.

(4) When the receiver is in stand-by condition and no signal is being received, the noise voltages in the antenna and the internal noises in the r-f stage (inherent in any high gain circuit) are amplified by the several receiver stages. The amplification is sufficient to produce a voltage across the input of the second limiter, V-105, to cause limiting action and grid current rectification to take place. Grid current rectification causes a reduction in the gain of that stage. Thus, normally, under no-signal conditions, that stage operates at reduced gain.

(5) When a signal, having the strength equivalent to the threshold of sensitivity of the receiver, enters the antenna circuit, the voltage across the input to the first limiter, V-104, is raised to the point where the noise voltages (which are normally superimposed upon the incoming signal as am.) are cut off by plate current saturation and by an increase in the grid current flow in the first limiter stage. This limiting action then is supplemented by the limiting action of the second limiter stage. When very strong signals are received, the signal voltage across the first limiter stage is increased to the point where grid current rectification and reduction in the gain of that stage takes place. The reduced output of this stage prevents the second limiter stage from biasing itself to cut-off.

(6) The following is a summary of the limiting action described above. The first and second limiter stages function to eliminate any amplitude variations in incoming signal. Such amplitude variations represent noise and are, therefore, undesirable. It is necessary for the proper functioning of the discriminator circuit that the signal applied to it be approximately uniform in level regardless of the strength of the incoming signal. The gain of the receiver is sufficient to raise the level of the random noise to a value necessary to overload tube V-105, the second limiter stage. Grid current flowing through resistor R-119 in the grid circuit of that tube biases the tube toward the cut-off region and thus reduces the gain of the stage. Thus the receiver operates at reduced gain due to the limiting action which takes place in tube V-105. When a signal is received, tube V-104 tends to overload and, therefore, limits its output in a similar fashion. This limiting in output of V-104 is translated in terms of a fixed negative bias on the grid of V-105. This tends to hold the gain of V-105 and thus prevents the output of that tube from falling off excessively due to overloading on strong signals. Therefore, for weak signals the gain of V-105 and V-104 is increased. For strong signals the gains of those stages are reduced. The net result is that the output voltage of V-105 is kept fairly constant. The above also explains why the grid circuit of V-104 is chosen as the source of control voltages for the squelch oscillator.

### 31. Discriminator (figs. 21 and 22)

*a.* DISCRIMINATING FUNCTION. The discriminator circuit shown in figure 21 is a conventional Foster-Seely discriminator in which the d-c path is slightly modified. The discriminator circuit functions to convert the frequency variations of the incoming signal into audio frequencies for application to the a-f amplifier stages. Frequency variations of the signal from the 1.4-mc center frequency at the

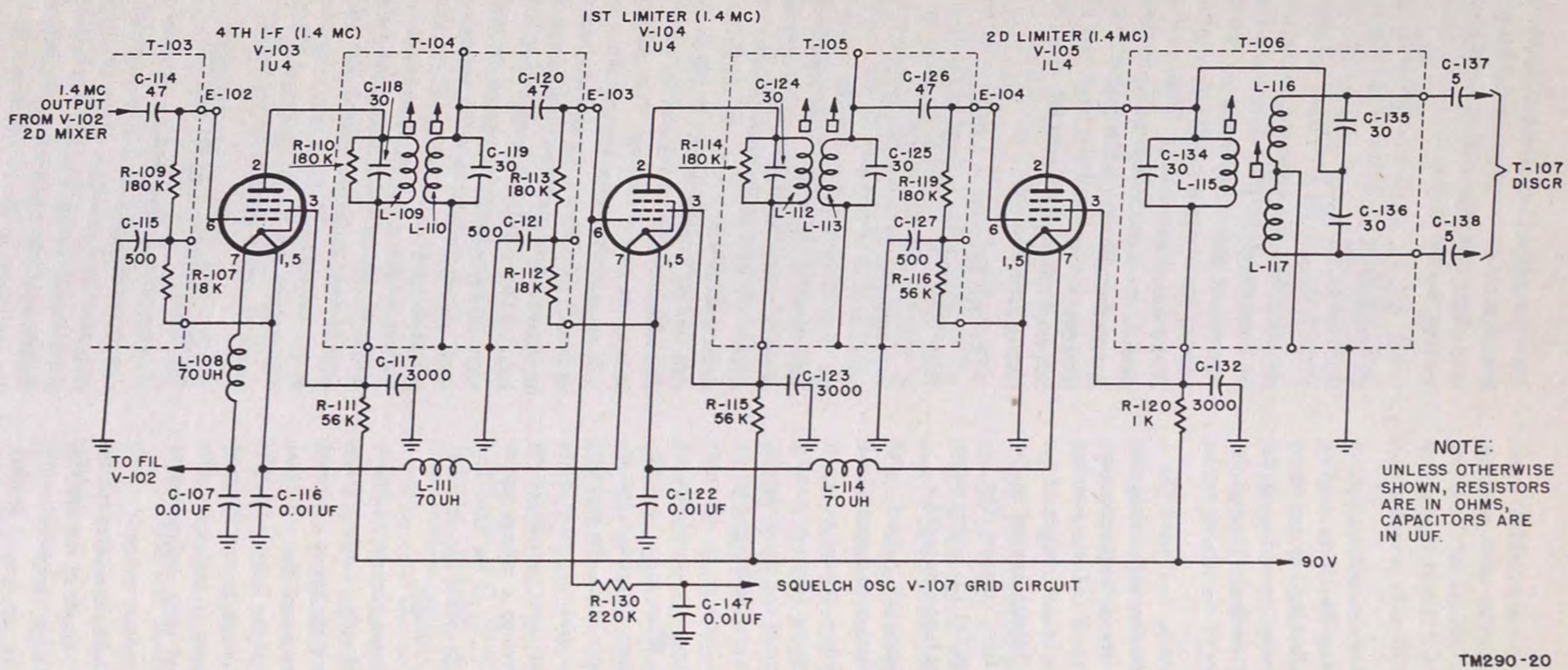



*Figure 20. 1.4-mc i-f amplifier and limiters circuits, functional diagram.*

input to the discriminator are translated into amplitude variations of the signal at the output of the discriminator. The rate with which the frequency varies from the 1.4-mc center frequency is translated into the rate at which the amplitude of the voltage at the ouput of the discriminator changes. Since the rate with which the signal frequency changes from 1.4 mc is the a-f rate, the rate of changes in the amplitude of the discriminator output voltage is the af.

*b.* CIRCUIT ARRANGEMENT. The discriminator circuit includes the secondary tuned circuit in tuning unit T-106, capacitors C-137 and C-138, and the discriminator rectifier circuit. The tuned portion of the discriminator circuit in T-106 consists of two balanced coils L-116 and L-117, shunted by two balanced capacitors C-135 and C-136. The inductance of each of the coils is equal to the inductance of the primary coil L-115. Each of the two capacitors C-135 and C-136 is equal in capacitance to the capacity of C-134 in the primary circuit. The combined values of C-135 and C-136 tune the total inductance provided by L-116 and L-117 to resonance at 1.4 mc. Capacitors C-135 and C-136 have the additional functions of blocking d-c current from flowing through the discriminator coils and of maintaining the discriminator balance for signal frequencies. In a Foster-Seely discriminator circuit conventionally drawn the plate is shown connected to the center tap of the discriminator coil. Here, however, the connection is made to the center tap of the capacitors, which electrically constitutes the same point as the center tap of the coil. The rectifier circuit consists of rectifiers CR-101 and CR-102, each a type 1N34 (or 1N34A) germanium crystal diode, rectifier load resistors R-122 and R-123, and discriminator load impedances C-143 and L-119. Coil L-119 is a d-c return path for the rectifier circuit. Its high impedance at intermediate frequencies prevents h-f current from flowing through it. It represents an effective short-circuit for dc and af. This is a departure from the conventional method of showing the Foster-Seely circuit. Capacitors C-137 and C-138 block dc from the tuned circuit.

*c.* DISCRIMINATOR OPERATION. The output of the second limiter stage, V-105, is connected to the discriminator circuit over two paths. One path is by direct connection from the plate (pin 2) of V-105 to the electrical center of the discriminator at the junction of capacitors C-135 and C-136. The other path is established by inductive coupling from the primary tuned circuit (coil L-115) to the secondary tuned circuit (L-116 and L-117).

(1) The voltages applied to the two rectifiers by direct connection through C-135 and C-136 from the plate of V-105 are equal to each other and are at all times in phase with each other and with the plate voltage of V-105. At resonance, namely when a 1.4-mc signal enters, the primary and secondary circuits are essentially resistive impedances and no reactive component is imparted to the signal voltage by the coils and capacitors. Since L-116 and L-117 are arranged in a series-aiding connection, the voltage induced in them from L-115 is positive at one end and negative at the other. The total voltage across L-116 and L-117 is equal to twice that across L-115. The voltages OB and OC (fig. 22) applied by induction to the rectifiers are 180° out of phase with each other, and each is 90° out of phase with the voltage at the plate of V-105 and with the component of voltage OA applied by direct connection to the rectifiers. At resonance (fig. 22A) the resultant voltages OD and OE appearing across rectifier load resistors R-122 and R-123 are equal in magnitude and opposite in polarity. The net voltage across C-143 at the output of the discriminator is equal to zero. This fact is measured between test point E-106 and chassis.

(2) When the signal frequency deviates from the resonant frequency the tuned circuits are no longer resistive and impart a reactive component to the voltages applied to the rectifiers by induction. The component of voltage OA applied to the rectifiers by direct connection remains unchanged with respect to the voltage appearing at the plate of V-105. The 90° phase relationship between the two components of voltage OB and OC for each rectifier and OA no longer holds. The amount of change in phase at the two rectifiers is the same but opposite in sense. The resultant voltages OD and OE applied across the rectifiers are no longer equal and opposite in polarity. A net voltage (other than zero) is, therefore, developed across load capacitor C-143. For frequencies below resonance (fig. 22C) the tuned circuits show an inductive reactance, and the inductively coupled component of voltage is shifted in phase in the leading direction. The larger resultant voltage OD is then applied to CR-101, the output voltage across R-122 is larger than that across R-123, and the net output voltage of the discriminator is positive at the junction of R-122 and C-143. For frequencies above resonance (fig. 22B) the tuned circuits show a capacitive reactance, the inductively coupled voltage is shifted in phase in the lagging direction, and the larger resultant voltage OE is applied across CR-102. The rectified voltage across R-123 is larger than that across R-122, and the net voltage at the output of the discriminator is positive at the junction of R-123 and C-143. A typical response characteristic curve of the discriminator is shown in figure 22D.

(3) Since for a modulated signal the frequency shift above and below the resonant frequency occurs at the a-f rate, the changes in voltage across the rectifier load resistors R-122 and R-123 occur at the a-f rate. The resulting alternating voltage developed across load capacitor C-143 and delivered to the following stage through isolating resistor R-124 and coupling capacitor C-141 represents the audio frequencies originally transmitted from the distant transmitter.

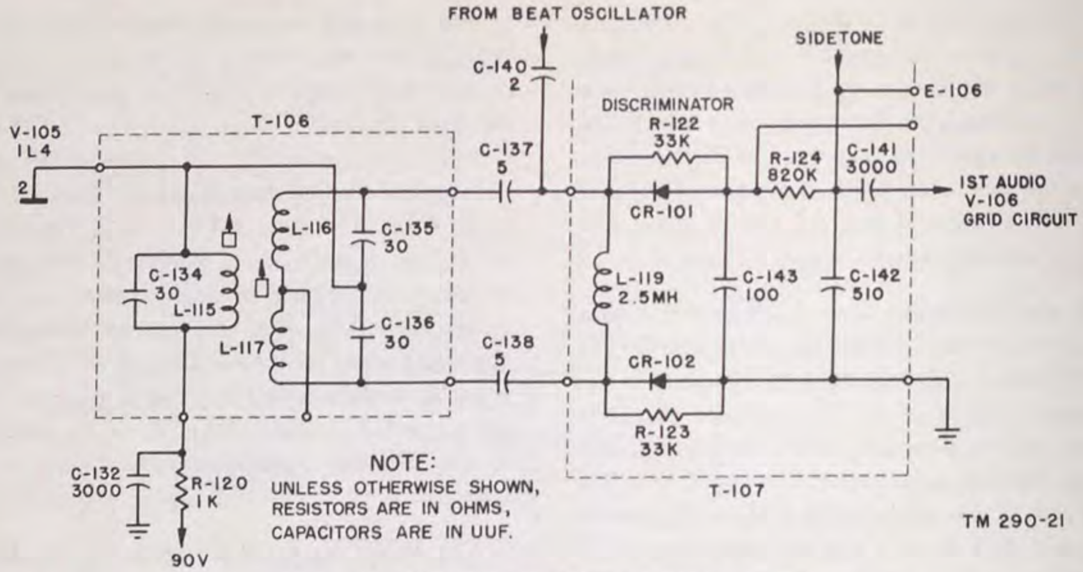



*Figure 21. Discriminator circuit, functional diagram.*

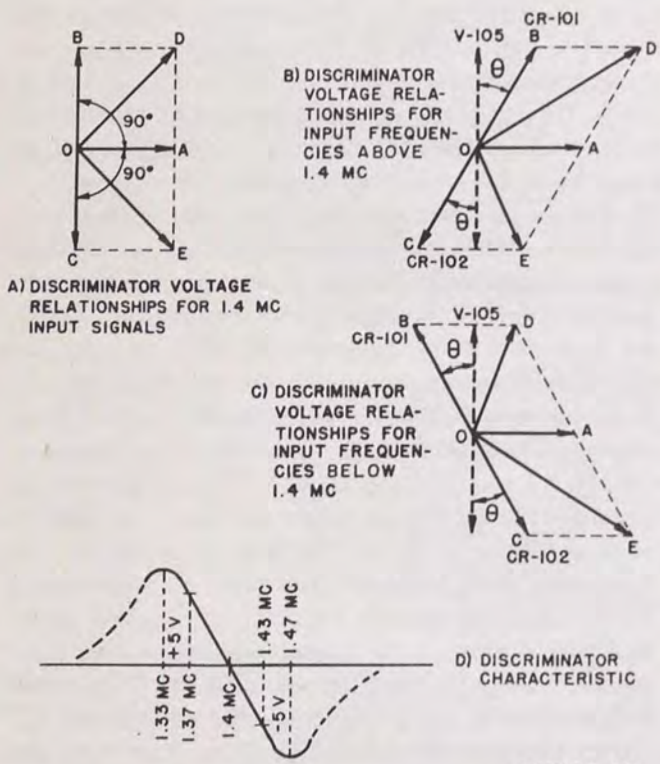



*Figure 22. Discriminator theory, vector diagrams.*

*d.* DISCRIMINATOR CHARACTERISTICS. An important point to be noted about the discriminator is that for proper operation the circuit must be balanced for both signal voltages and for d-c currents. Signal balance is maintained by adjusting the coils in the tuned circuits to be exactly equal to each other. Similarly, the tuning capacitors are equal to each other. D-c balance is obtained by keeping the two load resistors R-122 and R-123 equal in value and in addition by making sure that the forward and backward resistances of one rectifier are equal at all times to the corresponding resistances of the other rectifier. For a properly adjusted and operating discriminator circuit, the voltage (or current) measured at test point E-106 (or terminal 7 of T-107) when a 1.4-mc signal of 2 volts is applied to the input of V-105, is zero ±.5 volt. For a signal which is either 30 kc above or 30 kc below the 1.4-mc center frequency, the voltage measured at test point E-106 (pin 7 of T-107) should be ±5 volts minimum, depending on whether the higher or lower frequency is involved. The two voltages thus measured should be nearly equal to each other. Failure to obtain the 0 ±5 reading indicates improper tuning of the discriminator. If the two voltages for the two frequencies (30 kc above and below 1.4 mc) are not equal, or nearly equal, then the discriminator is off balance. Normally when a fixed component of the discriminator, for example the balanced capacitors C-135 and C-136 or resistors R-122 and R-123, is defective, balance in the discriminator is lost. Unbalance which is not caused by a defective component may be restored by adjusting the powdered iron cores of L-116 and L-117. If the bandwidth is incorrect, i.e., the ±15-volt minimum reading is not correct, then adjustment of coil L-115 by means of the powdered iron core is necessary. Of course, this assumes that the preceding stages are properly alined and the oscillators are on frequency.

*e.* DISCRIMINATOR OUTPUT CIRCUIT. The output of the discriminator is coupled through isolating resistor R-124 and coupling capacitor C-141 to the grid (pin 4) of the first a-f amplifier V-106. During transmission, signals from the sidetone circuit are also applied through C-141 to the grid of V-106. The sidetone circuit is described in paragraph 36.

*f.* BEAT OSCILLATOR INPUT. When the beat oscillator (part of V-106) is turned on by means of test switch S-202, its output is applied through coupling capacitor C-140 to the input of the discriminator rectifier circuit, at the junction of C-137 and CR-101. This 1.4-mc signal is then rectified in the discriminator rectifier circuits. The resultant voltage appearing at the output of the discriminator is then used as a comparison voltage to aid in the alinement of the receiver-tuned circuits. For a detailed description of the beat oscillator and of the use of that oscillator in receiver alinement and testing, see paragraphs 38 and 39.

*g.* DISCRIMINATOR MEASURING CIRCUIT. Test point E-106 is a terminal in the discriminator output circuit at the junction of R-124 and C-142. Measurement of discriminator output is made between test point E-106 and chassis. Capacitor C-142, in conjunction with coupling capacitor C-141 and grid leak resistor R-121, serves as a h-f de-emphasis network for the purpose of reducing the noise voltages at the input of the audio amplifier and shaping the a-f response characteristic at its high end.

### 32. First Audio Amplifier V-106 (fig. 23)

*a.* The signal output of the discriminator is routed through the de-emphasis network, consisting of grid leak resistor R-121, capacitor C-142, coupling capacitor C-141, and resistor R-124, to the grid (pin 4) of the first audio amplifier stage, V-106. The de-emphasis network is in effect a low-pass filter functioning to counteract the pre-emphasis imparted to the higher audio frequencies by the transmitter. The network limits the band of audio frequencies applied to the first audio amplifier thereby removing the noise voltages that appear at the high end of the a-f range.

*b.* Tube V-106, a type 1R5 pentagrid converter, serves the dual functions of first audio amplifier and beat oscillator. The control grid (pin 4) and the screen grid (pin 3) serve as the control grid and plate, respectively, for the first audio amplifier stage. (The other tube elements, pins 6, 3, and 2, serve as the control grid, screen grid and plate of the beat oscillator, respectively.) The beat oscillator is described in paragraph 38.

*c.* The amplified audio output is developed across load resistor R-129 and is coupled through capacitor C-145 and through pins 2 of chassis connectors J-101 and P-202 to the VOLUME control, R-204. This control is located on the front panel of the set and serves to adjust the output level of the receiver. The movable arm of the VOLUME control is connected through pins 6 of chassis-connector P-202 and J-101 to the grid circuit of the second audio amplifier stage, V-108.

*d.* B+ potential is applied to pin 3 of V-106 from the 90-volt supply through resistor R-129. The filament circuit includes isolating choke L-118 and filter capacitors C-144 and C-155A.

### 33. Second Audio Amplifier V-108 (fig. 23)

*a.* Tube V-108, a type 3Q4 pentode, serves as the receiver second audio or power amplifier stage. The output of the first a-f amplifier V-106 is applied to the grid (pin 3) of V-108 through coupling capacitor C-145, VOLUME control R-204, and the low-pass filter network consisting of shunt capacitor C-153 and the series elements of C-154 and R-141. The network serves to reduce h-f noises at the input of the amplifier and to de-emphasize the higher audio frequencies as compensation for the pre-emphasis imparted to them by the distant transmitter. R-141 also reduces the a-f voltage appearing at the grid of V-108 to prevent overdriving this tube.

*b.* The grid circuit includes the series arrangement of resistors R-133, R-132, and R-131. Ground return for audio signals is established through R-133 and bypass capacitor C-155B. Resistors R-132 and R-131 establish the d-c grid return to ground. Resistor R-131 serves also as the load resistor for the squelch diode in V-107, and functions as a load across which squelch bias for both the second audio amplifier V-108 and for the r-f amplifier V-8 is developed. Two bias voltages are provided to determine the operation of V-108. One is the self-bias provided by the voltage drop across filament circuits. This voltage sets the operating point for the amplifier during reception. The other voltage is the bias voltage developed across R-131 by the squelch circuit when the receiver is in stand-by. When the receiver is in stand-by and the squelch circuit is operative the sum of the voltages across R-131 and the filaments drives V-108 to cut-off. The bias voltage provided by the squelch is bypassed by C-155B. When the squelch is turned off, either by means of the squelch switch or by an incoming on-frequency signal, the bias voltage across R-131 is removed and the tube is restored to operation as a Class A amplifier. For a detailed description of the squelch circuit, refer to paragraph 34.

*c.* The amplified output of V-108 is coupled through the plate load transformer T-108 to the audio output connection, terminal A of POWER connector J-203, and to the phone connection, terminal A of AUDIO connector J-202. Both connectors are located on the front panel.

*d.* Plate and screen voltage for V-108 is not supplied internally, but as follows. The plate and screen circuits are extended through decoupling resistor R-135 and terminals 9 of chassis connectors J-101 and P-202 to terminal H of J-203. The 90-volt supply is applied from the external source to pin J of J-203, plate and screen voltages are applied to V-108. The connection may be a jumper strap, or the contacts of an external relay, or the coil of an external relay, or the contacts of a switch. The exact nature of the connection depends on the arrangement of the particular system in which the receiver-transmitter is used. It should be remembered, particularly in connection with trouble shooting and maintenance of Receiver-Transmitter RT-70/-GRC, that no plate or screen voltages exist at the tube pins unless the connection between H and J of J-203 is made. It should also be noted that if the coil of a relay is connected between these terminals, the relay will be energized when V-108 draws plate current and will be de-energized when V-108 plate current is cut off. Thus, when the receiver is in the stand-by condition, and the squelch circuit cuts off the audio amplifier plate current, the relay connected will be de-energized. When an incoming signal cuts off the squelch circuit and V-108 plate current begins to flow, the external relay becomes energized. This arrangement is used when the receiver-transmitter is to be used in a retransmission system in which it is necessary that the incoming audio signal itself takes over the push-to-talk function of turning on the transmitter.

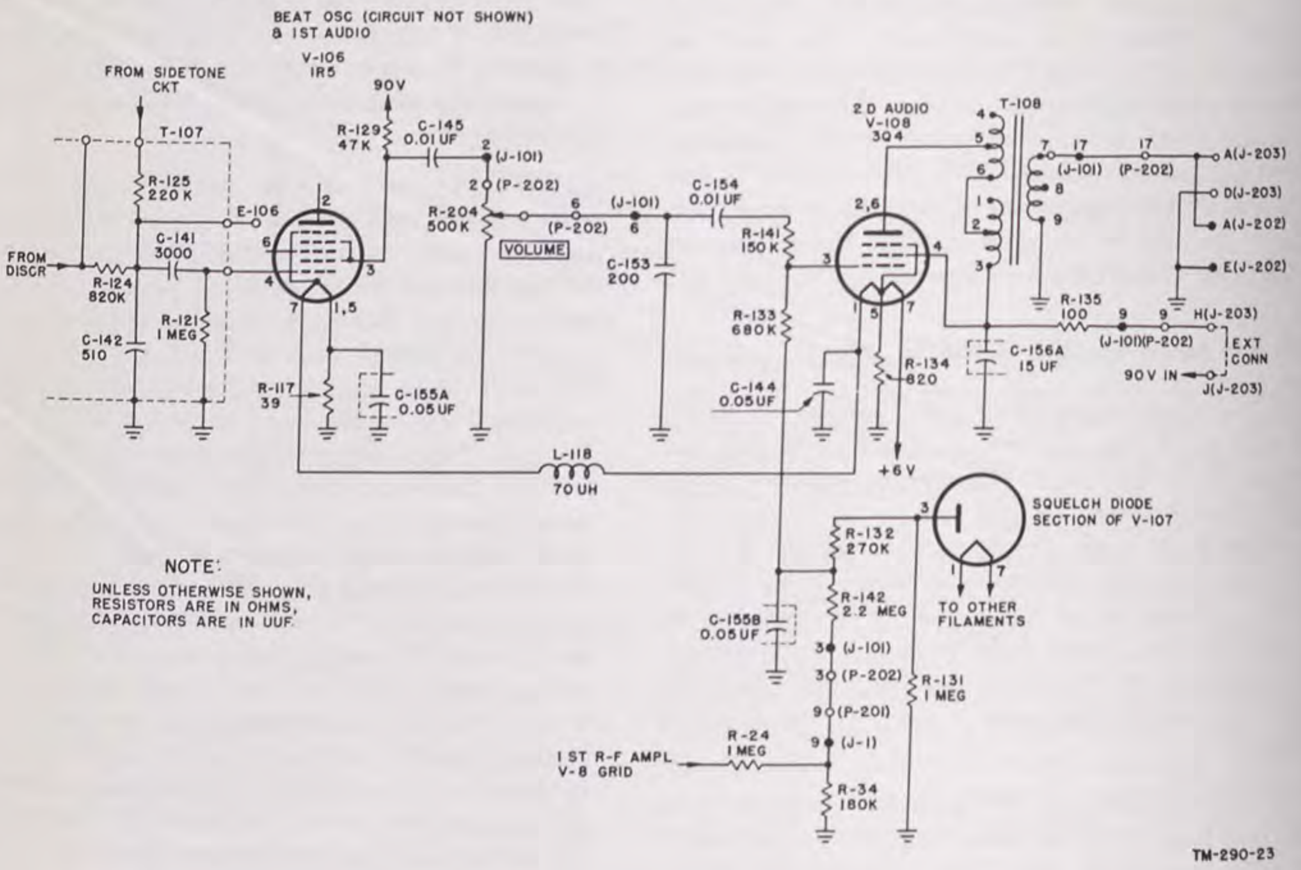



*Figure 23. Audio amplifier circuits, functional diagram.*

## 34. Squelch Circuit V-107 (fig. 24)

*a.* The carrier-operated squelch circuit uses a tube type 1S5, V-107. The tube combines a pentode and a diode in one envelope. The pentode is arranged to form a tuned-plate, tuned-grid oscillator. The diode rectifies the oscillator output. The purpose of this circuit is to keep the second audio amplifier and the receiver r-f amplifier biased during no-signal conditions of the receiver, and to turn on the audio amplifier and the r-f amplifier when a signal enters the receiver. Details of operation of the squelch circuit are described in the following subparagraphs.

*b.* The oscillator circuit includes the grid winding (terminals 3 and 4) and the plate winding (terminals 1 and 2) of transformer T-109. No capacitor is shown connected across either of the two windings since the tuning is accomplished by the interelectrode capacitance of the tube and the stray capacity in the wiring. The oscillator generates a frequency in the region of 30 kc. Regenerative feedback to sustain oscillations is established partially through coupling between the plate and grid windings of T-109 and partially through electron coupling within the tube and the capacity in the wiring. The grid circuit of the oscillator extends through resistor R-130, which is bypassed by capacitor C-147, to the grid of the first limiter tube, V-104. The grid circuit of V-107 is returned to filament through resistor R-126. Resistors R-113 and R-112 in the grid circuit of V-104 are in effect also in the grid circuit of V-107. Thus, any voltage developed across these resistors is applied not only to V-104 but as bias to the grid of V-107. The squelch oscillator bias is a combination of self bias developed by V-107 and the first limiter grid voltages. When no signal is present in the receiver, noise voltages developed across R-113 and R-112 add to the self-bias across R-126. The combined bias voltages applied to the grid of V-107 are low enough to sustain oscillation. When a signal enters, the voltage across R-113 and R-112 is increased so that the oscillator is driven to cut-off and oscillations cease.

*c.* The output of the oscillator is coupled through capacitor C-151 to the plate (pin 3) of the diode section of V-107. When the oscillator is operative, its output is rectified by the diode circuit. The rectified voltage is developed across diode load resistor R-131.

*d.* Diode load resistor R-131 is, in effect, shunted by a voltage divider network, consisting of the series arrangement of R-132, R-142, and R-34. This voltage divider is tapped at one point (junction of R-132 and R-142) for connection through grid resistor R-133 to the grid of the second audio amplifier stage, V-108. Another tap on the voltage divider (junction of R-142 and R-34) is connected through r-f amplifier grid resistor R-24 to the grid of V-8. The squelch bias voltage applied to the grid of V-108 is, therefore, that portion of the diode output voltage which is dropped across the series arrangement of R-142 and R-34. Similarly, the squelch bias voltage applied to the grid of V-8 is that portion of the diode output voltage which is dropped across R-34. It should be noted that the squelch bias voltages applied to the grids of V-108 and V-8 are nearly pure dc, since any h-f ripple voltages are filtered out by capacitor C-155B. Another point to be noted is that the magnitude of the voltage developed across diode load resistor R-131 and therefore the magnitudes of the squelch bias voltages applied to V-108 and V-8 are proportional to the amplitude of squelch oscillator output. The manner in which the amplitude of the oscillator output is controlled is discussed in subparagraph *f* below.

*e.* Plate voltage for the oscillator section of V-107 is applied from the 90-volt source through voltage-dropping resistor R-139 and through the primary winding (terminals 1 and 2) of T-109. Sections B and C of triple electrolytic capacitor C-156 act as r-f bypass and plate supply filter capacitors. Screen voltage is obtained from the 90-volt source through SQUELCH potentiometer R-202 and switch S-201. The screen supply circuit is bypassed by capacitor C-150. This potentiometer and S-201 are mechanically assembled so that when the SQUELCH potentiometer is in the extreme counterclockwise (OFF) position, the switch is open and disconnects screen voltage from V-107, thereby disabling the squelch circuit. R-201 in series with R-202 functions to drop the screen voltage to the required value. The level of the signal generated by V-107 is determined by two factors. One is the setting of R-202. When this potentiometer is in its maximum clockwise position, the full 90 volts is applied to the screen. The output level of the oscillator is then high and the squelch bias voltage developed across R-131 is relatively large. As R-202 is rotated in the counterclockwise direction, the applied screen voltage, the level of the generated oscillator output and the diode output voltage across R-131 are reduced accordingly. The other factor affecting the output level of the oscillator is the bias voltage applied to its grid circuit. The greater the bias (in the negative direction) the lower the amplitude of the oscillator output and vice versa. The magnitude of the bias voltage is a function of the gain layout of the receiver under the particular condition of operation. When the r-f amplifier V-8 is biased by the squelch circuit, the gain imparted to noise voltages is reduced. When the r-f amplifier is fully operative, (under signal conditions or squelch off) the gain of the signal voltage appearing at the input of the first limiter, i.e. the magnitude of the bias voltage applied to the squelch oscillator, is determined by the full gain of the receiver. Therefore the setting of the SQUELCH potentiometer, the input sensitivity of the receiver, the gain layout of the receiver and the oscillator output level are interrelated. Obviously the lower the bias voltage developed across R-131, the lower the level of the signal required to disable the squelch circuit.

*f.* Under no-signal conditions when the oscillator is operative, the squelch bias voltage applied to V-108 and V-8 in the manner described in the preceding paragraphs is sufficient to drive V-108 to cut-off and reduce the gain of V-8. When an on-signal frequency enters the receiver, it reaches the grid circuit of the first limiter V-104 and biases the squelch oscillator V-107 to cut-off, thereby stopping the oscillation. The rectified voltage disappears from across R-131 and bias is removed from V-108 and V-8. These tubes are returned to normal operation as Class A amplifiers. For any setting of the SQUELCH potentiometer a certain minimum level of the signal is required to produce a bias voltage at the input of the first limiter large enough to cut off the squelch oscillator. When the SQUELCH switch is in the OFF position, the oscillator is automatically disabled and the r-f amplifier V-8 and the audio amplifier V-108 is operated at full gain.

### 35. Control Circuits (fig. 25)

*a.* General. The push-to-talk function of Receiver-Transmitter RT-70/GRC is performed by a single relay O-101. This relay is mounted on the r-f chassis. One side of the coil extends to terminal B of J-203 which is the 6.3-volt relay supply connected to the power supply. The other side connects to terminal F of J-202 and to terminal K of J-203. These are the ground return connections for the relay circuits. System wiring in external components (AF Amplifier AM-65/GRC, mounting, control boxes, etc.) associates the grounded contacts of the microphone push-to-talk switch, of a control relay, or of a control switch, with one of these terminals. Normally these ground return connections are opened and the relays are not energized, maintaining the receiver-transmitter in receiving condition. When the microphone push-to-talk switch, the control relay or the control switch is operated, ground return is applied, current flows through the relay coil and the relay becomes energized. The

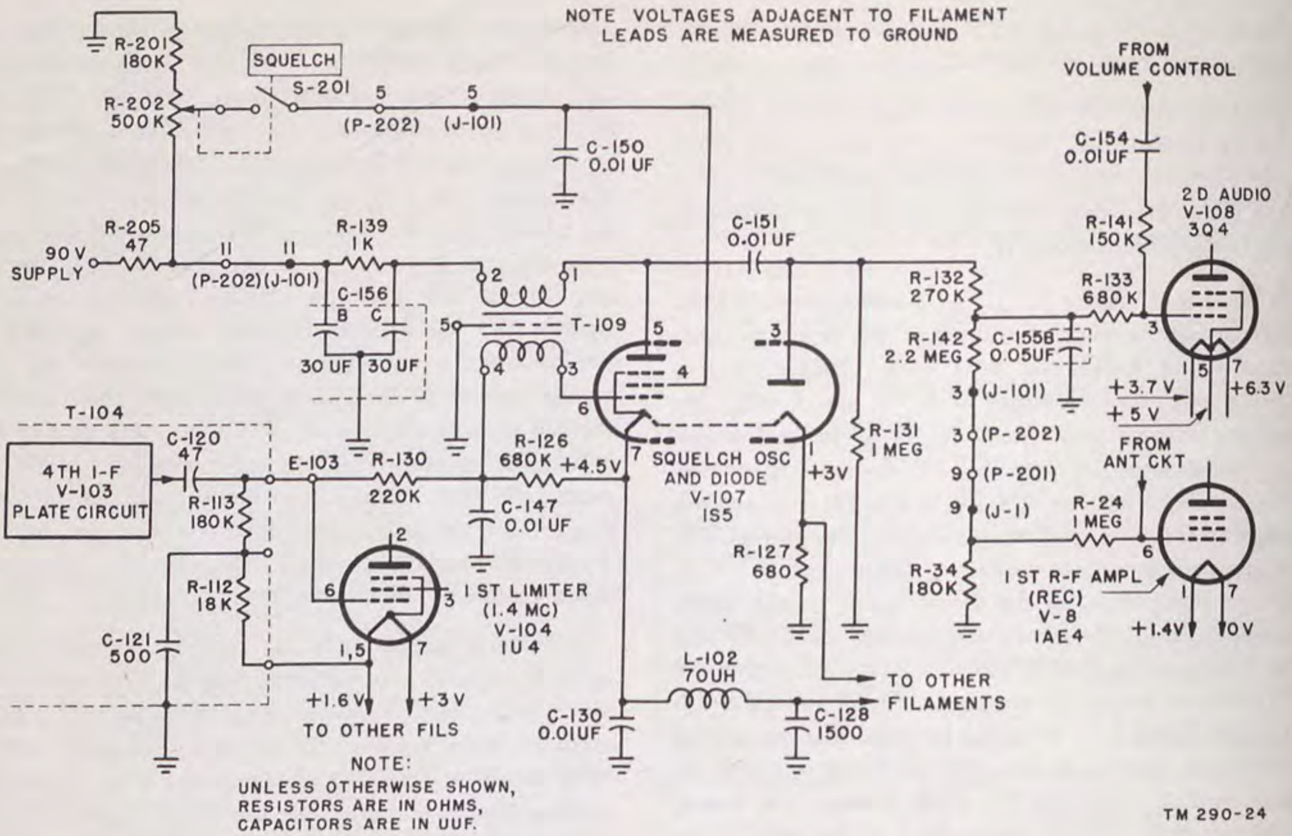



*Figure 24. Squelch circuits, functional diagram.*

resultant transfer of the relay contacts performs the functions outlined in subparagraph *c* below.

*b.* Relay O-101 Unenergized. When relay O-101 is unenergized, its contacts establish the following circuit conditions:

(1) Contacts 1 and 2 are closed, connecting the 6-volt supply (terminal F of J-203) to the filaments of receiver tubes V-8 through V-11, V-101 through V-105, and V-107 and calibrate oscillator tube V-7.

(2) Contacts 2 and 3 are open, with the result that energizing voltage for the filaments of transmitter tubes V-1, V-3, V-5, and V-6 and for the microphone is disconnected.

(3) Contacts 4 and 5 are closed and place a load resistor R-136 across the 90-volt supply when switch S-101 is either in the TANK or VEH position. The switch is placed in these positions when the vibrator power supply unit (Power Supply PP-281/GRC and a 12-volt storage battery, PP-282/GRC and a 24-volt storage battery, or PP-448/GR and a 6-volt storage battery) is used to supply power through AF Amplifier AM-65/GRC. Under these conditions the load circuit is placed across the 90-volt supply to equalize the drain on the supply during the receiving and transmitting conditions. When switch S-101 is in the FIELD position (when the receiver-transmitter is operated from dry batteries) the equalizing load is not necessary and is therefore disconnected.

(4) Contacts 6 and 7 are open, breaking the sidetone circuit.

(5) Contacts 8 and 9 are open, breaking the 90-volt supply to the screens of transmitter tubes V-1 and V-6.

*c.* Relay O-101 Energized. When relay O-101 is energized, as described in subparagraph *a* above, its contacts rearrange the circuit as follows:

(1) Contacts 1 and 2 open, breaking the filament supply to receiver tubes V-8 through V-11, V-101 through V-105, to the calibrate oscillator tube V-7 and the squelch oscillator V-107.

(2) Contacts 2 and 3 close, completing the filament supply circuits to transmitter tubes V-1, V-3, V-5, and V-6, and the microphone supply circuit to the primary winding of microphone transformer T-1.

(3) Contacts 4 and 5 open, disconnecting the compensating load resistor R-136 from across the 90-volt supply.

(4) Contacts 6 and 7 close, completing the sidetone circuit. The sidetone circuit extends from terminal 2 (tap on secondary winding) of T-1, through pins 10 of chassis connectors J-1 and P-201, pins 8 of chassis connectors P-202 and J-101, resistor R-140, over contacts 6 and 7 of the re-

lay, through R-125 and coupling capacitor C-141 to the grid (pin 4) of first a-f amplifier V-106. When switch S-101 is in either the VEH or FIELD position, the level of sidetone routed from the microphone circuit to the receiver audio amplifier is reduced by voltage division through R-138.

(5) Contacts 8 and 9 of the relay close and connect the 90-volt supply source to the screens of transmitter tubes V-1 and V-6.

*d.* SUMMARY. A review of the detailed analysis of subparagraphs *b* and *c* above shows that:

(1) When the relay is unenergized, the receiver is fully operative. The transmitter and sidetone are not operative as some of the filament and screen voltages on the transmitting tubes are removed.

(2) When the relay is energized, the transmitter is fully energized, the sidetone circuit is completed and microphone energizing potential is made available. The receiver, however, is not energized, since the filaments of the h-f circuits (r-f and i-f) are disconnected from the supply circuits.

(3) It should be noted that the squelch oscillator is disabled since the filament supply for V-107 is broken in the energized position of the relay. The 32- to 43.4-mc variable oscillator is fully energized at all times, since it serves both the receiver and the transmitter.

(4) Special purpose circuits, such as the calibrate, beat, and squelch oscillators, have their own power supply arrangements. For detailed description see paragraphs 34, 37, 38, and 39.

(5) The second audio amplifier plate supply circuit is completed externally (par. 40).

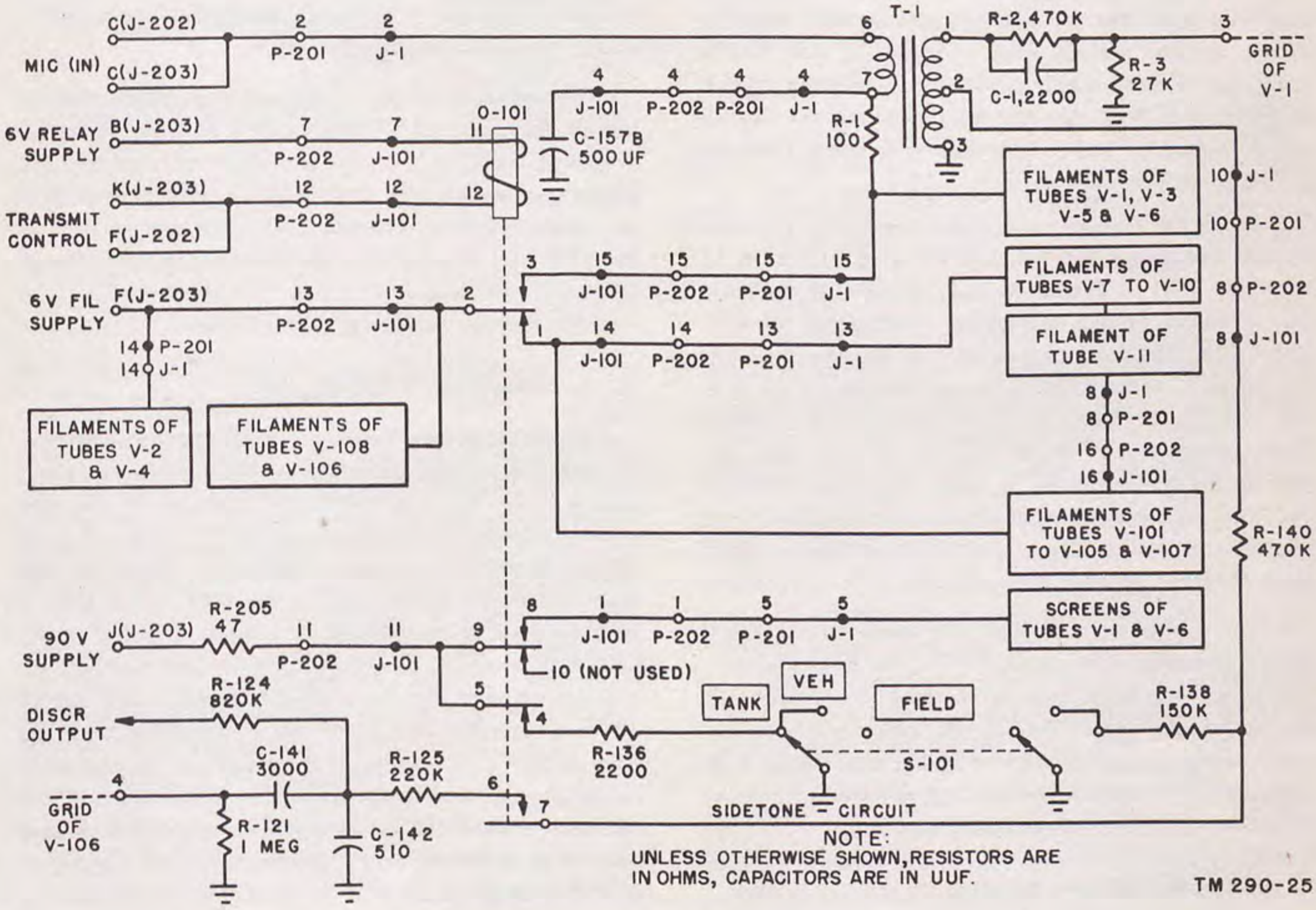



*Figure 25. Control circuits, functional diagram.*

## 36. Sidetone Circuit

*a.* A portion of the speech signals applied to the microphone circuit for transmission through the transmitter is diverted over a separate path to the input of the receiver first audio amplifier, is amplified there and in the receiver second audio amplifier, and appears at the receiver output terminals. The path over which these signals are routed is called the sidetone circuit, and the audio signals routed are called sidetone signals, or sidetone. In ordinary commercial telephony sidetone is returned to the earpiece of a handset to insure a natural effect to the user, since without sidetone a hollow, resounding effect would be evident in the earpiece. In a typical system installation in which Receiver-Transmitter RT-70/GRC is used, this purpose is accomplished. In addition, the sidetone signals appearing at the receiver output terminals are routed by system wiring to control positions for monitoring by other personnel.

*b.* The sidetone voltage developed across a portion of the secondary winding (winding 1-2) of microphone input transformer T-1 (fig. 11) is routed over terminals 10 of chassis connectors J-1 and P-201, over terminals 8 of chassis connectors P-202 and J-101, through voltage-dropping resistor R-140, over contacts 7 and 6 (when closed) of relay O-101, through voltage-dropping resistor R-125 (fig. 23), and coupling capacitor C-141, to the grid (pin 4) of V-106, the receiver first audio amplifier stage. The signal is amplified in this stage and in the second audio amplifier stage and is applied to the receiver audio output terminals. It should be noted that the audio circuits are fully operative during transmit periods, since operation of relay O-101 opens the filament supply circuit for V-107, the squelch oscillator tube. With this tube nonconducting, the squelch circuit is disabled and squelch bias is removed from the grid of V-108 (par. 34).

*c.* When the receiver-transmitter is used in a vehicular or field installation, and switch S-101 (fig. 11) is set in either the VEH or FIELD position, the level of the sidetone is reduced by shunting resistor R-138 across the sidetone circuit. This shunt extends from the junction of R-140 and contact 7 of relay O-101, through R-138 and the contacts of S-101 to ground. R-138 and R-140 form a voltage divider, which reduces the level of the sidetone signal applied to the grid of V-106 by about 70 percent. This arrangement is necessary to prevent acoustic feedback when a handset or loudspeaker is used. Full sidetone is usable when using headphones.

*d.* The level of sidetone appearing at the grid of V-106 may be measured at test point E-106 (fig. 23). The sidetone circuit provides means for checking the operation of the microphone circuit and of the audio amplifier circuits since the absence of sidetone during transmission is an indication of a fault, while presence of sidetone is a positive indication of signal continuity in those circuits.

### 37. Calibrate Oscillator V-7 (fig. 26)

*a.* A tube type 1U4 pentode, V-7, is used as a triode connected crystal oscillator. The grid (pin 6) circuit of the oscillator includes the parallel arrangement of a 1-mc crystal, Y-2, fixed trimmer capacitor C-45, and grid leak resistor R-22. The plate (pin 2) and screen (pin 3) are tied together, providing triode operation of the tube. The plate circuit includes the tuned circuit L-21 and trimmer capacitor C-48. The plate circuit extends through the tuned circuit mentioned above, and through voltage-dropping resistor R-23, which is bypassed by capacitor C-49 to positions 1 and 4 of ANT ADJ-DIAL LIGHT (ON-OFF)-CAL switch S-202 on the front panel. When the switch is in either one of these two positions, the 90-volt supply is connected to the plate circuit of calibrate oscillator V-7 and this circuit becomes operative. The oscillator generates a fundamental frequency of 1 mc and many harmonics. In the other two positions (DIAL LIGHT ON-OFF) of the switch, the plate voltage is disconnected from the tube and the oscillator is inoperative.

*b.* The output of the oscillator is connected on a permanent basis to the input of receiver first r-f amplifier V-8 through coupling capacitor C-47. The harmonic of the oscillator selected by the tuned circuits of the receiver depends on the frequency to which the receiver-transmitter is tuned by means of the dial on the front panel. For example, if the receiver-transmitter is tuned to 47 mc, the 47th harmonic of the output of V-7 is selected by the receiver and is routed through the receiver circuits.

*c.* The oscillator output is used in conjunction with the beat oscillator, part of V-106 (par. 38), to calibrate the 32- to 43.4-mc oscillator V-2 when the test switch is in the CAL position, or without the beat oscillator for adjustment of the antenna trimmer capacitor C-41 when the switch is in the ANT ADJ position. Filament voltage is applied through isolating choke coils L-20 and L-22. Capacitors C-68 and C-50 are filament supply bypass capacitors.

### 38. Beat Oscillator V-106 (fig. 26)

*a.* A portion of tube V-106, a type 1R5 pentagrid converter, is used as a crystal-controlled oscillator generating a frequency of 1.4 mc. The screen grid (pin 6) of the tube is used as the oscillator control grid, while pins 3 and 2 are used as the screen and plate respectively. The other tube elements, namely pins 4 and 3, are used as the control grid and plate of the receiver first audio amplifier as described in paragraph 32. While there is some electrical interaction between the output of the amplifier and that of the beat oscillator, this interaction is negligible from the point of view of the operation of the circuits. The output of the oscillator is used in conjunction with the output of the calibrate oscillator (pars. 37 and 39) to produce a beat note, as an indication of the proper tuning of the 32- to 43.4-mc oscillator, V-2.

*b.* The oscillator *grid* circuit includes grid resistor R-118 and capacitor C-131. The grid circuit is returned for dc to the filament (pin 1) of V-106. This point is placed at r-f ground potential by bypass capacitor C-155A. The 1.4-mc crystal is connected between the plate and the grid. The plate circuit extends through load resistor R-128 and through the CAL contacts (position B4) of switch S-202 to the 90-volt plate supply. Thus the beat oscillator has plate voltage applied to it only when S-202 is in the CAL position. Otherwise, the oscillator is not operative. Oscillatory feedback is established from the plate to the *grid* of the oscillator through the capacitors C-133 and C-131 and through the 1.4-mc quartz crystal, Y-102. The amount of feedback is determined by the ratio of C-133 and C-131. The output of the oscillator is applied through coupling capacitor C-140 to the input of the discriminator rectifier circuit at terminal 4 of T-107 (at the junction of capacitor C-137 and discriminator rectifier CR-101).

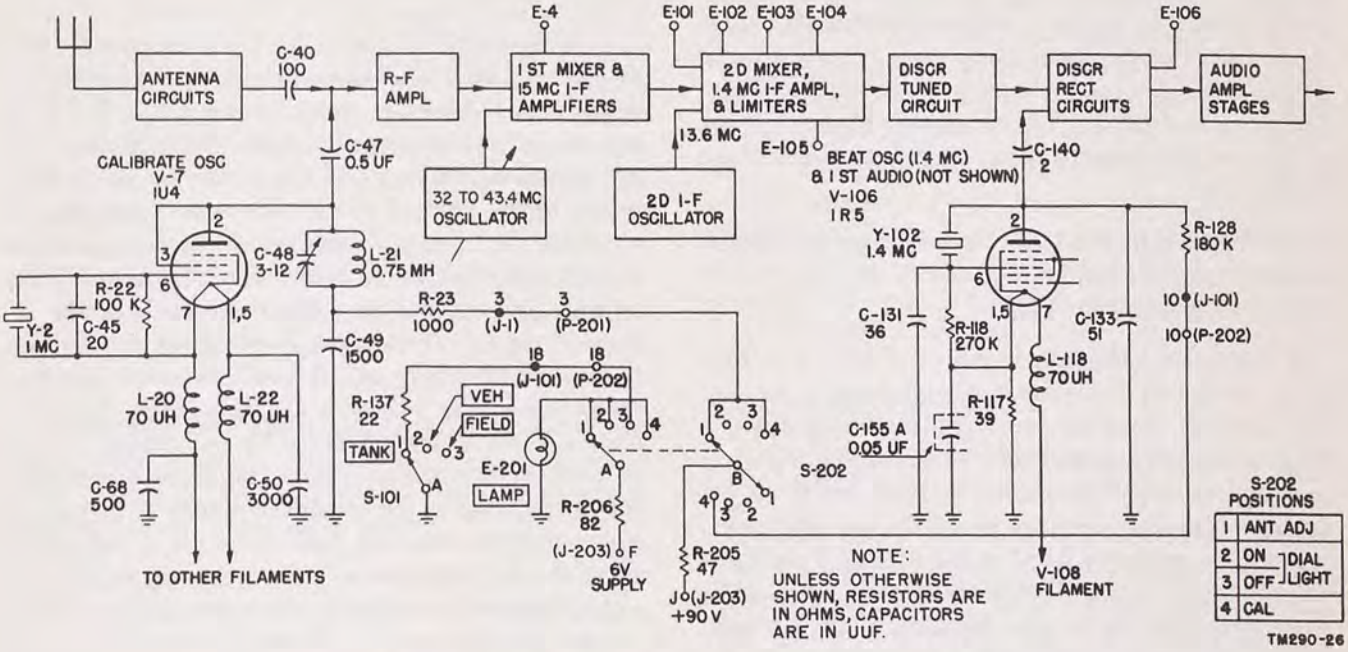



*Figure 26. Calibrate and beat oscillator circuits, functional diagram.*

## 39. Tests and Adjustments with Calibrate and Beat Oscillators

*a.* When switch S-202 is in the CAL position and control relay O-101 is not energized, the beat and calibrate oscillators are both energized since plate voltages are applied to them. When the receiver-transmitter circuits are tuned by means of the TENTHS-MCS control on the front panel to a frequency which is a multiple of 1 mc, and if the calibration of the tuning dial is correct, the r-f circuits of the receiver pick out the proper harmonic of 1 mc generated by the calibrate oscillator. For example, if the receiver is tuned to 47 mc, the 47th harmonic of the output of the calibrate oscillator V-7 is selected.

(1) This signal is amplified in the first r-f amplifier stage, and is applied, together with the output of the variable 32- to 43.4-mc oscillator, V-2, to the input of the first mixer stage.

(2) If, as required, the frequency generated by V-2 is 15 mc below the frequency setting of the dial, the frequency at the output of the first mixer stage is 15 mc. If oscillator V-2 is not 15 mc below the dial reading, the output of the first mixer stage is not 15 mc but some other frequency, depending on the amount by which the variable oscillator is off frequency. In the case exemplified here, the frequency generated by V-2 should be 32 mc. Assuming this to be the case, the 32-mc signal from V-2 and the 47-mc signal from the calibrate oscillator V-7 beat in the first mixer stage to produce the first intermediate frequency of 15 mc.

(3) The 15-mc signal is then amplified and is, in turn, applied together with the 13.6-mc output of the second mixer oscillator V-102 to the input of the 2nd mixer stage. The resultant beat frequency is amplified in the 1.4-mc i-f amplifier-limiter circuit and appears as a voltage across the input to the discriminator rectifier circuits. When the above beat frequency is 1.4 mc the resultant voltages across the discriminator output is close to zero volts.

(4) The 1.4-mc signal voltage and the 1.4-mc output of the beat oscillator V-106 are applied together to the discriminator rectifier circuit (fig. 21). The signal voltage is applied in normal manner through capacitors C-137 and C-138. The beat oscillator is in effect connected between the junction of CR-101 and L-119 on one side and ground (junction of CR-102 and C-143) on the other side. For the purpose under consideration the rectifier circuit serves as a nonlinear mixing device causing sum and difference frequencies to be produced.

(5) By mixing the incoming i-f signal frequency and the frequency generated by the beat oscillator the sum fre-

quency is rejected by the receiver audio circuits. The difference frequency is in the a-f range and is consequently picked up by the receiver audio amplifier circuits for application to the headset or test meter. If the incoming signal is 15 mc above that of V-2, and if the frequency generated by V-102 is correct, the resultant d-c voltage due to the difference frequency measured at E-106 is close to zero. If any of these circuit adjustments are not correct and consequently the test signal voltage at the discriminator input is not 1.4 mc, a voltage other than required voltage is measured at E-106. The deviation from 0 volt is the measure of the deviation of the test signal frequency from 1.4 mc at the input of the discriminator.

(6) It should be noted that the signal from the calibrate oscillator opens the squelch and turns on the audio circuits just like any other received signal.

*b*. The above discussion is explained by a numerical analysis as follows. Assume that the zero setting of the tuning dial is off. Then for a setting of the tuning dial at a marking which is a multiple of 1 mc, say 47 mc, the actual frequency to which the receiver is tuned is off by the amount of the dial calibration inaccuracy, say 5,000 cycles. It should be noted that the Q of the r-f and i-f circuits is not sufficiently sharp to discriminate between signals 5,000 cycles away from the nominal frequency. Therefore, even though the tuning is off by 5,000 cycles the 47-mc test signal from the calibrate oscillator is still being picked up and routed through the receiver, although possibly with some attenuation. The 47th harmonic picked up by the tuned circuits of the first r-f amplifier now beats with the frequency generated by V-2, which is not 32 mc but 32 ±.005 mc. The resultant first i.f. is not 15 mc but 15 ±.005 mc. This frequency in beating with the second intermediate oscillator frequency of 13.6 mc produces a second i.f. of 1.4 ±.005 mc and 1.4 mc, as required. Similarly, at the output of the tuned circuit of the discriminator the 1.4 ±.005-mc signal frequency beats with the 1.4-mc output of the beat oscillator to produce a sum frequency of 2.8 ± .005 mc which is rejected by the audio amplifier circuits. The difference frequency, namely 1.4 ± .005 −1.4 mc is 5,000 cycles. This af is amplified in the audio amplifier circuits and appears as a beat note in the headphones connected to the audio connector pins. If measurement is made at the discriminator test point E-106 (terminal 7 of T-107) the excursion of the meter pointer will be due practically entirely to this difference frequency or beat note. Furthermore, since the discriminator translates a change from 1.4 mc into a-f amplitude, the magnitude of the voltage at E-106 above or below 0 ± .5 volts is a measure of the amount by which V-2 is detuned.

*c*. In some tests it is desirable to set the tuning dial to the desired frequency and to adjust the tuned circuits to produce a zero-beat note at the audio amplifier output. An incoming *on-frequency* signal will produce noise quieting in the receiver output at frequencies near the exact frequency required to produce a zero-beat note. It should be noted that since a harmonic of 1 mc is available from the calibrate oscillator over the entire tuning range of the receiver, a zero-beat note is obtainable for any setting of the tuning dial which is a multiple or nearly multiple of 1 mc.

*d*. With switch S-202 in the ANT ADJ position the beat oscillator V-106 is disabled, since plate voltage is disconnected from it. However, the calibrate oscillator V-7 is on and may be used to make adjustments of the antenna trimmer capacitor. The theory of this adjustment is described briefly below. Antenna circuit adjustment is necessary to match the circuit in the receiver-transmitter to the actual antenna with which the set is to be used. The output of the calibrate oscillator and the r-f noise appearing at the antenna of the set (or an external test signal) may be used for making the adjustment. It should be noted that once the adjustment has been made for the receiver, the adjustment will automatically hold for the transmitter, because both the receiver and transmitter are tuned to the same frequency. Noise at the antenna is usually of a random nature as far as frequency goes. Therefore, it may be assumed that h-f noise signals within the tuning range of the receiver-transmitter are present at the antenna input. When the tuning dial is turned to a mc setting, the antenna tuning circuit picks out these noise signals at the antenna which are in this region and routes them to the receiver. Simultaneously, the tuned r-f circuit of the receiver, which may be assumed to be properly calibrated, selects the proper harmonic of the 1-mc output of the calibrate oscillator. The noise signal and the signal from the calibrate oscillator are amplified in the r-f amplifier and are applied to the input of the first mixer stage. The signals are amplified at 15 and 1.4 mc and applied to the discriminator which converts the random variations of the noise into an audio signal. When the antenna adjusting trimmer C-41 is correctly tuned, the increased strength of the signal from the 1-mc oscillator reaching the limiter tubes will cause the limiters to saturate a little more and the noise output of the set will be reduced.

*e*. In a manner similar to that described in subparagraph *b* the calibrate and beat oscillators may be used to check the calibration of variable receiver-transmitter oscillator V-2. Adjustment of that oscillator may be made by means of trimmer capacitor C-4.

*f*. The output of the calibrate oscillator may also be used for checking the tuning adjustments of the individual stages of the receiver. This procedure involves measuring the output voltages of the individual stages at the "E" test points. For determining whether or not the proper level appears at the several test points, it should be noted that misalinement of an individual stage will show up as a reduction in the output voltage of that stage, and of all the succeeding stages. In a similar manner the center tuning and balance adjustment of the discriminator circuit may be checked by means of the calibrate oscillator.

### 40. Plate and Screen Supply Circuits (fig. 27)

*a.* The 90-volt supply circuit extends from terminal J of panel connector J-203, and is routed over several paths to the plates and screens of the tubes in the receiver-transmitter. One path extends through terminals 11 of P-201 and J-1 to the plate of power amplifier tube V-6. Another path extends through voltage-dropping resistor R-205, and branches out through terminals 7 of P-201 and J-1 to the r-f chassis circuits, and through terminals 11 of P-202 and J-101 to the i-f chassis circuits. Auxiliary paths extend to the screen of squelch oscillator tube V-107, the plate circuit of beat oscillator portion of V-106 and the plate and screen circuits of calibrate oscillator V-7.

*b.* Except for the items listed below all plates and screens are energized directly from the 90-volt source, and are not under control of relay O-101 or of the panel-mounted switches. The exceptions are as follows:

(1) The screen voltages for transmitter tubes V-6 and V-1 are applied only when relay O-101 is energized and closes contacts 8 and 9.

(2) The plate and screen voltages of V-7 are applied only when switch S-202 is in either the ANT ADJ or the CAL position.

(3) The plate voltage of beat oscillator portion of V-106 is applied only when switch S-202 is in the CAL position. The screen voltage for that tube is applied directly from the 90-volt source, since the screen serves as the plate of the first audio amplifier.

(4) The screen voltage for squelch oscillator tube V-107 is applied through SQUELCH potentiometer R-202 and over the contacts of switch S-201. Switch S-201, the squelch on-off switch, is mechanically associated with R-202. Thus when R-202 is in its extreme counterclockwise position, S-201 is open and screen voltage is not supplied to V-107.

(5) The plate and screen voltages for second audio amplifier tube V-108 are not applied through an internal connection to the 90-volt supply lead. Instead, an external connection (system wiring) is required between terminals H and J of J-203, to complete the supply circuit to the plate and screen of V-108. The manner in which this connection is made depends on the particular system arrangement.

*c.* When the receiver-transmitter is in the receiving condition, a load extending over the normally closed contacts 4 and 5 of O-101, through R-136, and the TANK or VEH contact of S-201 to ground, is placed across the 90-volt supply circuit. During transmission, when relay O-101 is energized, contacts 4 and 5 of relay O-101 open and disconnect the load. The purpose of the load connection is to insure that the drain on the 90-volt supply is the same under both conditions of operation of the set. Equalization of current drain is important only when a vibrator power supply is used to supply the plate and screen voltages. This condition prevails when the receiver-transmitter is used in conjunction with AF Amplifier AM-65/GRC and one of the power supply combinations Power Supply PP-281/GRC and a 12-volt storage battery, PP-282/GRC and a 24-volt storage battery, or PP-448/GR and a 6-volt storage battery in either a tank or in some other vehicle. When the receiver-transmitter is powered from dry batteries, equalization of power supply load is unimportant, whereas saving of battery drain is a major consideration. Under such conditions the load circuit is disconnected by contacts of switch S-101 in the FIELD position.

### 41. Filament Circuits (fig. 28)

*a.* The filaments of the tubes in the receiver-transmitter are arranged in three main groups, as follows:

(1) One group includes all filaments which are energized by direct connection to the filament supply lead, terminal F of J-203. 32- to 43.4-mc oscillator tube, V-2, and transmitter mixer tube V-4 on the r-f chassis, and audio amplifier tubes V-106 and V-108 on the i-f chassis belong in this group.

(2) A second group of filaments includes those tubes which are energized over the normally closed contacts of relay O-101. Calibrate oscillator tube V-7, receiver tubes V-8 through V-11 on the r-f chassis, receiver tubes V-101 through V-105, and squelch oscillator tube V-107 on the i-f chassis belong in this group. The calibrate oscillator, the squelch circuit, and all the receiver tubes except the audio amplifier tubes are turned off during transmission.

(3) A third group of filaments includes those tubes which are energized when normally open contacts of 2 and 3 of relay O-101 close when relay O-101 is energized to transmit. Transmitter tubes V-1, V-3, V-5, and V-6 belong in this group. Thus, all transmitter tubes, except the 32- to 43.4-mc oscillator and the transmitter mixer, are de-energized during reception.

*b.* The filaments in each group are arranged in several 6-volt, series-parallel strings, as shown in figure 28. Isolating chokes and filter capacitors are used throughout to prevent a-c currents in one stage from entering tubes in the same or associated strings via the filament circuits. Voltage-dropping resistor R-117 is inserted, in series with the string of filaments which includes V-106 and V-108, to bring the total voltage rating of the string to 6.3 volts. Current limiting resistors (R-11, R-12, R-8, R-34, R-127, R-4, and R-19) are shunted across individual filaments and groups of fila-

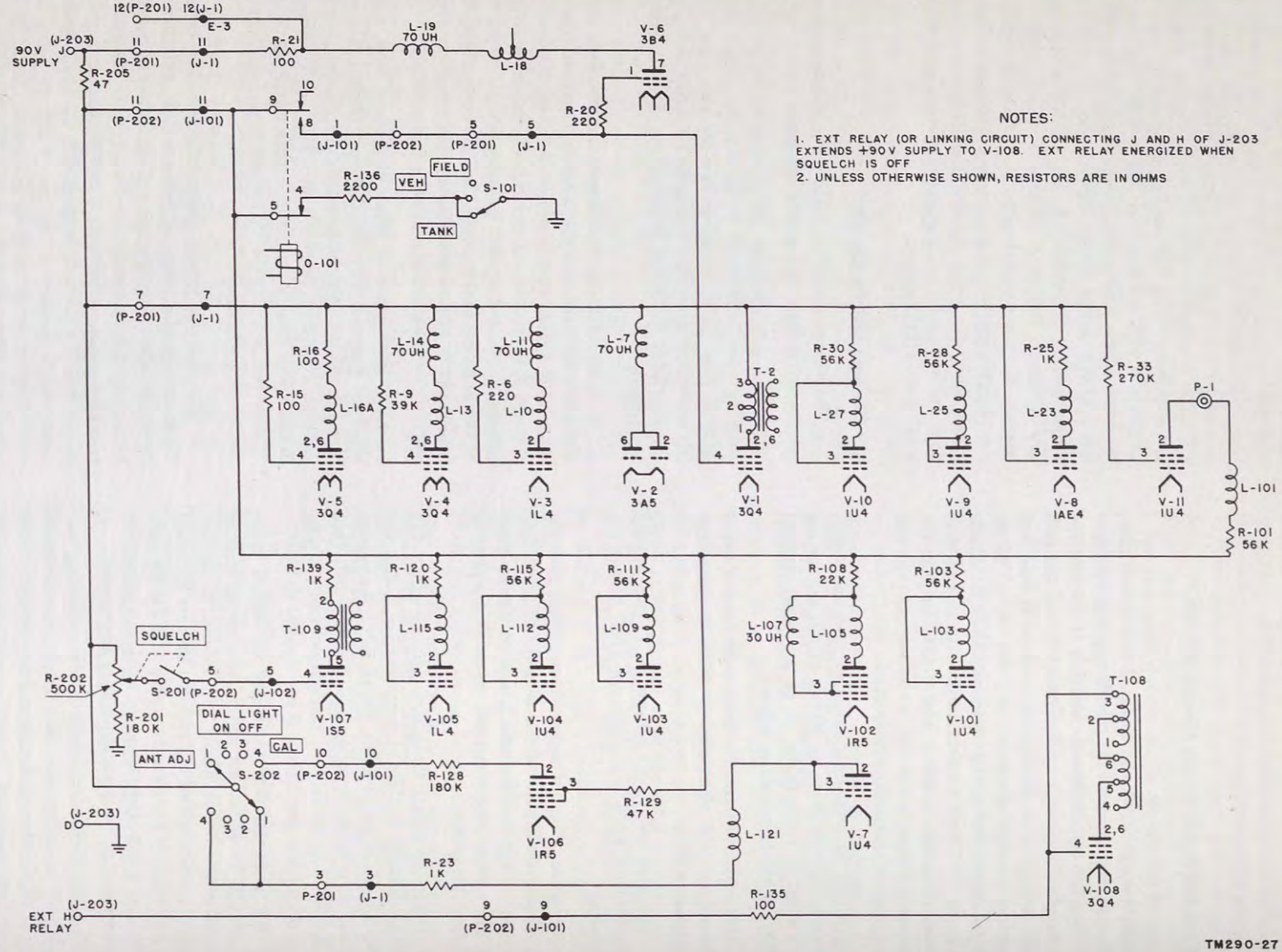
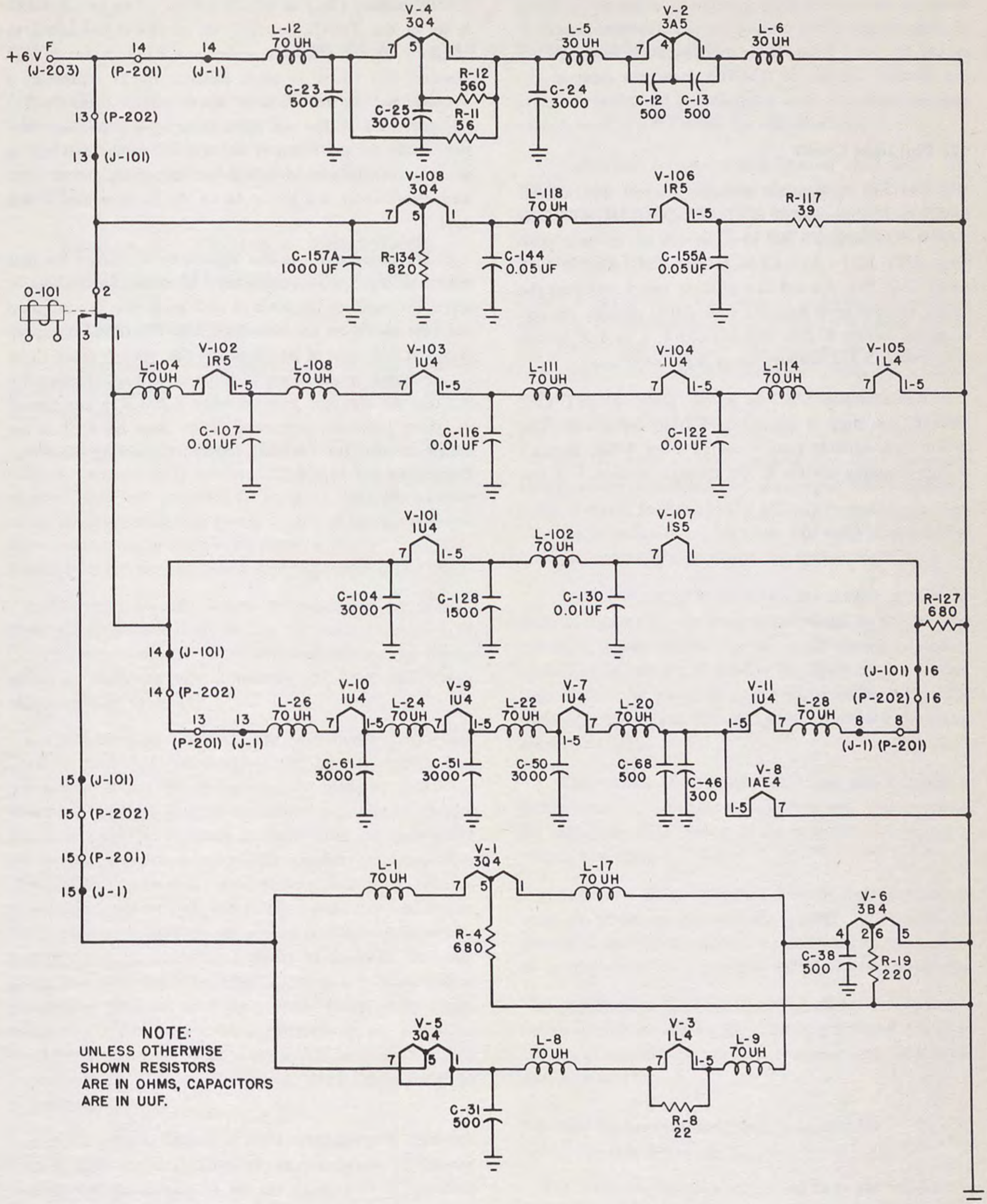



*Figure 27. Plate and screen supply circuits, functional diagram.*




TM290-32

*Figure 28. Filament circuits, functional diagram.*

ments which draw less current than other filaments in the string or those which require shunting to prevent addition of plate currents from causing the total filament current to exceed the rated value. These shunt resistors serve to limit the filament current of relatively low-drain tubes to the required value.

**42. Dial Light Circuit**

*a.* The dial light circuit is shunted across the filament supply lead by contacts of ANT ADJ-DIAL LIGHT (ON-OFF)—CAL switch S-202 in either one of the three positions, ANT ADJ (A1), DIAL LIGHT ON (A2), or CAL (A4) (fig. 26). For any one of these switch positions the circuit extends from terminal F of J-203, through voltage-dropping resistor R-206, over contacts 1, 2, or 4 of section A of switch S-202, through lamp E-201 to ground.

*b.* When switch S-202 is in the DIAL LIGHT OFF position, the lamp is disconnected from the circuit. The circuit then extends from terminal F of J-203, through voltage-dropping resistor R-206, through contacts 3 of section A of S-202, through dummy load resistor R-137 to the TANK contact (A1) of switch S-101. When switch S-101 is set in the TANK position this circuit is continued to ground. When S-101 is in either the VEH or the FIELD position, this circuit is open. Resistor R-137 represents a dummy load on the filament supply circuit equivalent to that presented by the dial light, insuring a practically constant drain on the filament supply. When the receiver is used in installations in which current drain, rather than load equalization, is a prime factor the dummy load is not used.

*c.* The purpose of the dial light is to illuminate the dial whenever the receiver transmitter is to be tuned. Also, it serves the auxiliary purposes of indicating that the calibrate and beat oscillators are turned on, and the filament supply circuit at the point of its entry into the receiver-transmitter is continuous. In operation within a system installation, the fact that the dial light goes on when S-202 is in any one of the three positions mentioned above may be used as an indication that the filament supply is reaching Receiver-Transmitter RT-70/GRC.

# 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 tools and test equipment available, and by the skill of the repairman.

## Section I. TROUBLE SHOOTING AT FIELD MAINTENANCE LEVEL

### 43. Trouble-shooting Procedures

The test procedures for sectionalizing and localizing trouble in Receiver-Transmitter RT-70/GRC are outlined in the following steps:

*a.* SHORT-CIRCUIT CHECKS. These checks consist of resistance measurements at the terminals of the panel connectors. They are intended to bring to light the circuits which might damage the power supply or cause additional damage to the equipment when power is applied (par. 45). Repair all short circuits before applying power to the unit.

*b.* CURRENT DRAIN CHECK. By measuring the over-all plate and filament current drains, the general condition of the receiver-transmitter is determined. This also checks points to defective tube filaments and plate and screen supply circuits (par. 49).

*c.* OPERATIONAL CHECKS. The operational checks outlined in chart form in paragraph 51 for the receiver and paragraph 53 for the transmitter are made to determine whether or not the receiver-transmitter performs its various functions properly. Facilities available from the front panel are utilized for this purpose. The trouble symptoms thus obtained will point to a fault condition within the receiver or within the transmitter, and in some cases may sectionalize the trouble to smaller circuit groups or stages. It is recommended that the operational checks be made in the order given, and that each trouble be cleared as it is found before proceeding with the next operational check. Accordingly every time a fault condition is encountered, the additional checks recommended in the chart should be made. Detailed instructions for using the operational check charts are given in paragraph 50.

*d.* ADDITIONAL TROUBLE SECTIONALIZATION CHECKS. Two trouble sectionalization charts, paragraph 52 for the receiver and paragraph 54 for the transmitter, supplement the operational checks. When trouble is encountered as a result of an operational check, refer to the indicated chart and perform the additional checks called for there. These checks will narrow down the trouble possibilities to a related group of stages, and in some cases to an individual stage or part. A brief description of the charts follows.

(1) *Receiver trouble sectionalization chart.* After the trouble has been traced by operational checks to the receiver circuit, the tests indicated in the receiver trouble sectionalization chart (par. 52) will reduce the trouble to one of the following circuit sections:

(*a*) audio circuits, (*b*) 1.4-mc i-f amplifier-limiter stages including the discriminator, (*c*) 15-mc i-f amplifier including receiver first mixer and (*d*) receiver r-f amplifier circuits. In addition, troubles in the squelch, calibrate oscillator, and beat oscillator circuits can be narrowed down by means of these circuit checks.

(2) *Transmitter trouble sectionalization chart.* The transmitter trouble sectionalization chart (par. 54) indicates a series of checks for functionally grouped transmitter circuits. The checks indicated in this chart will make it possible to limit the trouble to a particular transmitter stage.

*e.* SIGNAL SUBSTITUTION. Once the trouble within the receiver-transmitter has been sectionalized to a particular circuit, a signal substitution or signal tracing procedure (par. 55) is utilized to localize the trouble to a specific stage within the group of stages found to be faulty. The stage gain chart (par. 55) will assist in making the signal substitution tests.

*f.* RESISTANCE MEASUREMENTS. These tests are made to locate faulty or defective components and wiring within the circuit or stage shown to be defective by the signal tracing procedure.

*g.* VOLTAGE MEASUREMENTS. Voltage measurements are made to determine whether the correct d-c voltages are present at significant points. They are made for the purpose of locating faults not observable during the preceding tests.

*h.* ADDITIONAL CHECKS. Faults of a quantitative nature, not easily discoverable by the preceding tests, are traced by a group of over-all equipment performance tests listed under additional checks.

### 44. Test Equipment and Tools Required for Trouble Shooting

The following test equipment and tools are required for making the trouble-shooting tests described in this section. Arbitrary references are assigned to signal generators and meters listed below to facilitate identifying instruments called for in trouble-shooting procedures.

*a.* Any one of the following power supply combinations:

(1) A 6-volt storage battery, Power Supply PP-448/GR and AF Amplifier AM-65/GRC, or

(2) A 12-volt storage battery, Power Supply PP-281/-GRC and AF Amplifier AM-65/GRC, or

(3) A 24-volt storage battery, Power Supply PP-282/-GRC and AF Amplifier AM-65/GRC, or

(4) A set of batteries including a 90-volt plate supply battery and a 6.3-volt filament and relay supply battery. These batteries are used in Case CY-590/GRC.

*b.* Audio devices, as follows:

(1) HANDSET H-33/PT, or

(2) MICROPHONE T-17 with cord and plug, and HEADSET HS-30, or

(3) Chest Set Group AN/GSA-6 with Headset Microphone Assembly H-63/U.

*c.* Test instruments as follows:

(1) Electronic Multimeter TS-505/U: d-c voltohmmeter (M-1).

(2) Electronic Multimeter ME-6/U: a-c voltmeter (M-2).

(3) Multimeter TS-352/U, or equal (M-3).

(4) Output Meter TS-585/U, or equal (M-4).

(5) Frequency Meter TS-174/U (20 to 250 mc), or equal (M-5).

*d.* Tube Tester I-177, or equivalent.

*e.* Signal generators as follows:

(1) Signal generator TS-588/U: or Signal generator: type AN/URN-25 (G-1).

(2) Signal generator: type URM-27 (20 to 100 mc fm) (G-2).

(3) Audio Oscillator TS-382/U; or equal (G-3).

(4) RF Signal Generator SG-20/U (G-4).

*f.* Miscellaneous electrical components as follows:

(1) Shunting unit: consisting of .0062-uf capacitor (microfarad) JAN type CM 35C622J in series with resistor, 2,700 ohms, ½ watt; complete with test clips.

(2) Capacitor: mica dielectric; .0062 uf.

(3) Switch, DPST (double-pole, single-throw) JAN type ST 10K.

(4) Alligator type clips (2 required).

*g.* Antenna components as follows:

Dummy antenna, consisting of a 50-ohm, 1-watt, non-inductive type resistor assembly in series with r-f ammeter (Weston Model No. 425). See figures 30, 31, and 32, and instructions in paragraph 48 for the construction of an equivalent dummy antenna.

*h.* Clips and connectors as follows:

Battery clips and leads.

Test Lead Set CX 1331/U.

Cables and connectors, as required for the particular test set-up used (pars. 46 through 48 and figs. 29 through 32).

*i.* Tools as follows:

(1) Tool Equipment TE-113.

(2) Allen wrenches No. 313 and No. 468 (supplied).

(3) Tube Puller TL-201 (supplied).

## 45. Checking Key Circuits for Shorts

*a.* The checks outlined in this paragraph are to make sure that when power is connected to the receiver-transmitter, a short circuit in the equipment will not cause damage to the parts or to the power supply. Many types of trouble, such as shorted capacitors, faulty relay contacts, etc. may be discovered by means of these tests. Use Multimeter TS-352/U, or equal (M-3), to check the resistance between each of the points on connectors J-202 and J-203 and chassis.

The points of measurements and the required readings are summarized in table I. For these measurements power should be disconnected from the equipment and all front panel connections removed. All tubes, crystal, and other pluck-out parts are assumed to be in their proper sockets. For measurements at connector points F of J-202 and J of J-203, set switches S-202 and S-101 (internal) as shown in table II. For measurements at all other connector points the settings of these switches are immaterial.

**TABLE I**
**PANEL CONNECTORS RESISTANCE MEASUREMENTS**

| Test point | Required reading (ohms) | |
|---|---|---|
| A | Connector J-202<br>23 | Connector J-203<br>23 |
| B | 0 | infinity |
| C | 120 | 120 |
| D | — | 0 |
| E | 0 | infinity |
| F | infinity | see Table II |
| H | 0 | electrolytic capacitor charge |
| J | infinity | see Table II |
| K | — | infinity |
| L | — | — |

**TABLE II**
**RESISTANCE MEASUREMENTS DETERMINED BY SWITCH SETTINGS**

| Test condition | | Test point | |
|---|---|---|---|
| S-202 | S-101 | F of J-203 | J of J-203 |
| ANT ADJ | TANK | 8 | 2200 |
| | VEH | 8 | 2200 |
| | FIELD | 8 | Electrolytic capacitor charge |
| DIAL LIGHT ON | TANK | 8 | 2200 |
| | VEH | 8 | 2200 |
| | FIELD | 0 | Electrolytic capacitor charge |
| DIAL LIGHT OFF | TANK | 8 | 2200 |
| | FIELD | 8 | 2200 |
| | VEH | 0 | Electrolytic capacitor charge |
| CAL | TANK | 8 | 2200 |
| | VEH | 8 | 2200 |
| | FIELD | 8 | Electrolytic capacitor charge |

*b*. If a required reading is not obtained, refer to figure 47, the schematic diagram to determine the part or parts which may be responsible for the trouble. Incorrect readings may be due to shorted or leaky bypass capacitors, defective relay contacts, resistors, or a wire or a lug 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 of switches. Repair as necessary. Do not apply power until the trouble has been cleared, and all the readings indicated in the table are obtained.

*c*. The following notes should serve as a guide in interpreting the results of the short-circuit checks. These notes do not cover all checks, but only a few typical cases.

(1) The resistance measurement from H of J-203 to ground should show a capacitor charge. The rate of charge depends upon the time constant provided by C-156A and R-135, and upon the resistance of the meter used for making the measurement. If a high resistance meter is used, the meter will show a slow charge and the meter pointer will gradually creep up to some finite reading. However, if immediately upon application of the test probes the meter indicates a low steady reading, capacitor C-156A is leaky or shorted, and a breakdown may occur when full power is applied to the equipment.

(2) The reading beween terminal C of J-202 (or J-203) and chassis involves winding 6-7 of T-1, resistor R-1, the transmitter filament circuits (including the isolating choke coils), the filaments of the tubes (fig. 28) and the bypass capacitors in the filament circuits. In effect the filament circuits involved here are paralleled by capacitor C-157B. The reading obtained depends not only on the condition of C-157B but also upon the particular portion of the filament circuit. Thus if C-157B is shorted, the reading will show simply the resistance of T-1, winding 6-7. Variations from the correct reading will be obtained depending upon the location of the fault. In any case, if a very low resistance reading (close to the resistance value of winding 6-7 of T-1) is obtained, do not apply power until the fault is traced and remedied.

(3) Readings at terminals F and J of J-203 depend upon the settings of switches S-202 and S-101. Examine the circuit arrangement resulting from the particular settings of these switches before interpreting readings deviating from those shown in table II.

### 46. Test Set-up for Operational and Trouble-shooting Checks (fig. 29)

This paragraph describes the procedures for preparing and connecting the test installation required for making the operational, trouble-shooting, and final tests discussed throughout this chapter. The procedures for preparing special items, namely, connecting cables and dummy antenna load, are described in paragraphs 47 and 48, respectively. The procedures for making the test set-up connections to the panel connectors are summarized in figure 29. Internal connections for meters, test signal generators, shunting units, etc. are to be made as called for in individual test procedures. Figure 29 shows two basic arrangements for connecting power and audio devices to the receiver-transmitter under test. In one arrangement power for operating the set may be obtained from dry batteries installed in Case CY-590/GRC. In the other arrangement power is obtained from a storage battery through a vibrator type power supply unit (Power Supply PP-448/GR, or PP-281/GRC, or PP-282/-GRC) installed in AF Amplifier AM-65/GRC. The connection of the audio devices or corresponding meters and test signal generator depends on whether or not a plug to mate with the 9-pin AUDIO connector on the receiver-transmitter panel is available. The test connections are described in the following subparagraphs for the two cases.

*a.* CASE CY-590/GRC. If dry batteries and Case CY-590/GRC are to be used to provide power to the equipment, proceed as follows:

(1) *Power connections.* (a) Make sure that 9-volt and 7.5-volt batteries are installed in the case.

(*b*) Make sure that the ON-OFF-REMOTE switch in the case is, at this time, in the OFF position. This switch will be used as a power on-off switch for the test set-up.

(*c*) Check that the plugs on the battery cable within the case are properly connected to the battery sockets.

(*d*) Connect Power Cable Assembly CX-1209/U (complete with connectors) between the POWER connector (J-203) on the receiver-transmitter panel and the 14-PIN connector, J-1, on Case CY-590/GRC.

(2) *Audio devices.* The audio devices (microphone and earphone or audio signal generator and test meter) may be connected either to the AUDIO connector on the receiver-transmitter panel or as shown in figure 29 to the 9-pin connector, J-2, on Case CY-590/GRC.

(*a*) If a 10-pin male compression type connector to mate with the receiver-transmitter AUDIO connector is available for the cable, connect the audio devices to the cable as described in paragraph 47*a* and connect the assembly to the AUDIO connector on the receiver-transmitter panel.

(*b*) If the above connector is not available for the cable, connect the audio device to the cable as described in paragraph 47*b* and connect the assembly to the 9-pin connector, J-2, on Case CY-590/GRC.

(3) *Dummy antenna load.* Prepare the dummy antenna load as described in paragraph 48 and plug into the ANT connector on the front panel of the receiver-transmitter. The dummy antenna load consists of an r-f meter, resistors to form a total of 50 ohms, 1 watt, and a coaxial cable with suitable connector to engage the panel-mounted ANT connector.

*b.* VIBRATOR TYPE POWER SUPPLY. If power is to be derived from the storage battery through a vibrator power supply unit, proceed as follows:

(1) *Power connections.* (*a*) Check that the voltage of the storage battery, the voltage rating of the power supply unit, and the rating of the fuse installed in the fuse holder within AF Amplifier AM-65/GRC all agree. Refer to the table on figure 29.

(*b*) Make sure that the 6V-12V-24V switch within the amplifier unit is set to the position corresponding to the voltage of the storage battery used.

(*c*) Make sure that the OFF-INT-RT-70 switch on the panel of the amplifier unit is in the OFF position at this time. This switch will be used as the power on-off switch for the receiver-transmitter. For this purpose the switch position marked RT-70 is, in effect, the ON position for power applied to the receiver-transmitter. The INT position applies power to the amplifier unit only.

***Caution:*** Never turn the OFF-INT-RT-70 switch to the RT-70 position unless the receiver-transmitter is connected to the amplifier.

(*d*) Install the vibrator power supply unit in AF Amplifier AM-65/GRC.

(*e*) Connect the positive (+) terminal of the storage battery to terminal A of the POWER IN connector on the front panel of the amplifier unit. Connect the negative (—) terminal of the battery to terminal C (ground) of that connector. If a battery cable fitted with battery clips or lugs at one end and a 4-pin male connector to mate with the POWER IN connector on the amplifier at the other end is not available, the cable may be made up as described in paragraph 47*c*.

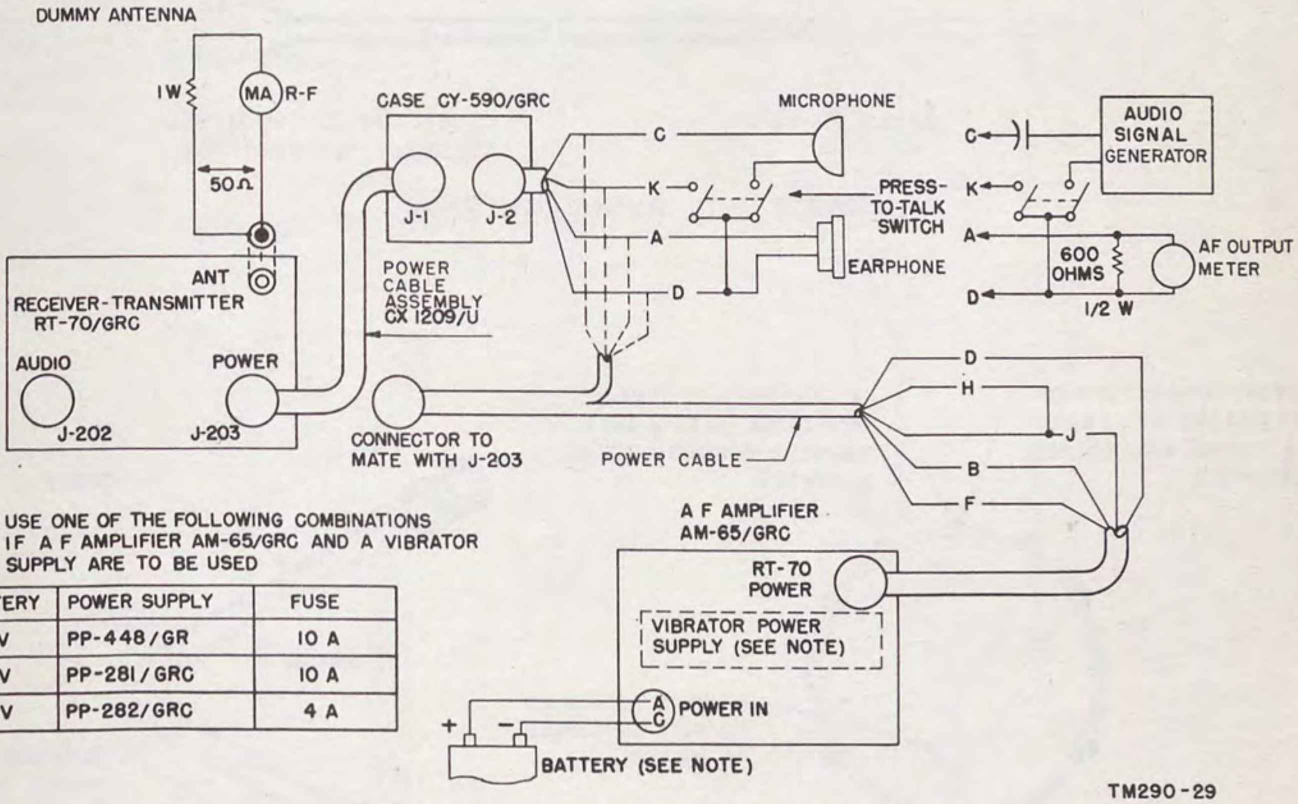
(*f*) Prepare a power cable as described in paragraph 47*d* (power leads shown in figure 29, with a 9-pin connector —male plug-in type terminals— at each end) and connect it between the POWER connector on the receiver-transmitter and the RT-70 POWER connector on the amplifier unit.

(2) *Audio connections.* The audio devices (microphone and earphone or audio signal generator and meter) may be connected either to the AUDIO connector on the front panel of the receiver-transmitter directly, or to the audio terminals of the POWER connector on the receiver-transmitter panel, depending upon whether or not the 10-pin compression type male connector is available.

(*a*) If a 10-pin connector (with male compression type terminals) is available, arrange the cable as described in subparagraph 47*a* and attach the assembly to the AUDIO connector on the receiver-transmitter.

(*b*) If such a connector is not available, the paralleling audio connections brought to the POWER connector within the receiver-transmitter will have to be utilized to make the audio connections. In this case the leads from the audio devices will be connected to the audio terminals of the 9-pin male plug-in type connector on the power cable from the amplifier and the combination plugged into the receiver-transmitter POWER connector. Details for forming that cable are described in subparagraph 47*d*.

(3) *Antenna connections.* Prepare the dummy antenna as described in paragraph 48 and connect to the ANT connector on the front panel of the receiver-transmitter.




NOTE: USE ONE OF THE FOLLOWING COMBINATIONS IF A F AMPLIFIER AM-65/GRC AND A VIBRATOR SUPPLY ARE TO BE USED

| BATTERY | POWER SUPPLY | FUSE |
|---|---|---|
| 6 V | PP-448/GR | 10 A |
| 12 V | PP-281/GRC | 10 A |
| 24 V | PP-282/GRC | 4 A |

*Figure 29. Test set-up for operational and trouble-shooting checks.*

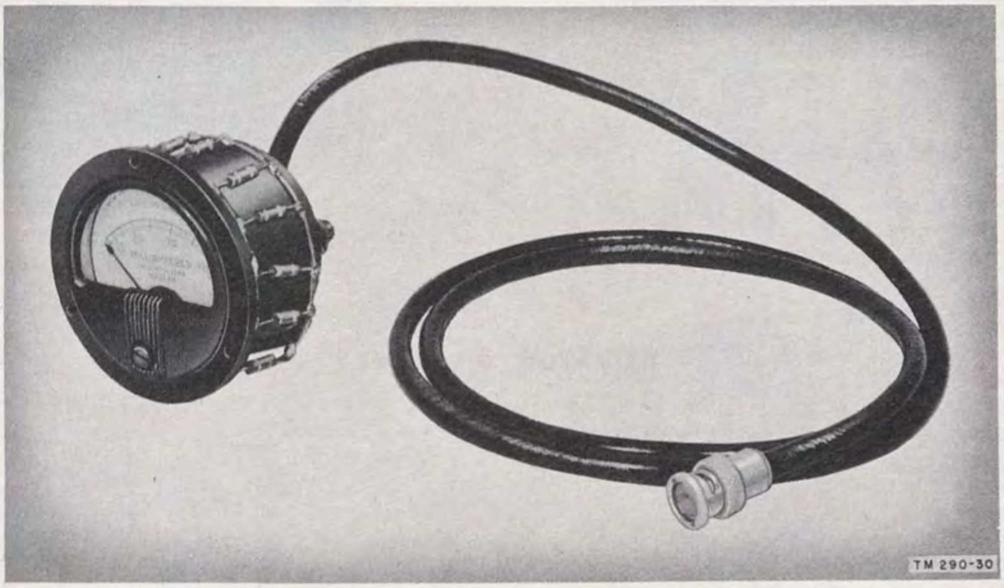



*Figure 30. Dummy antenna load.*

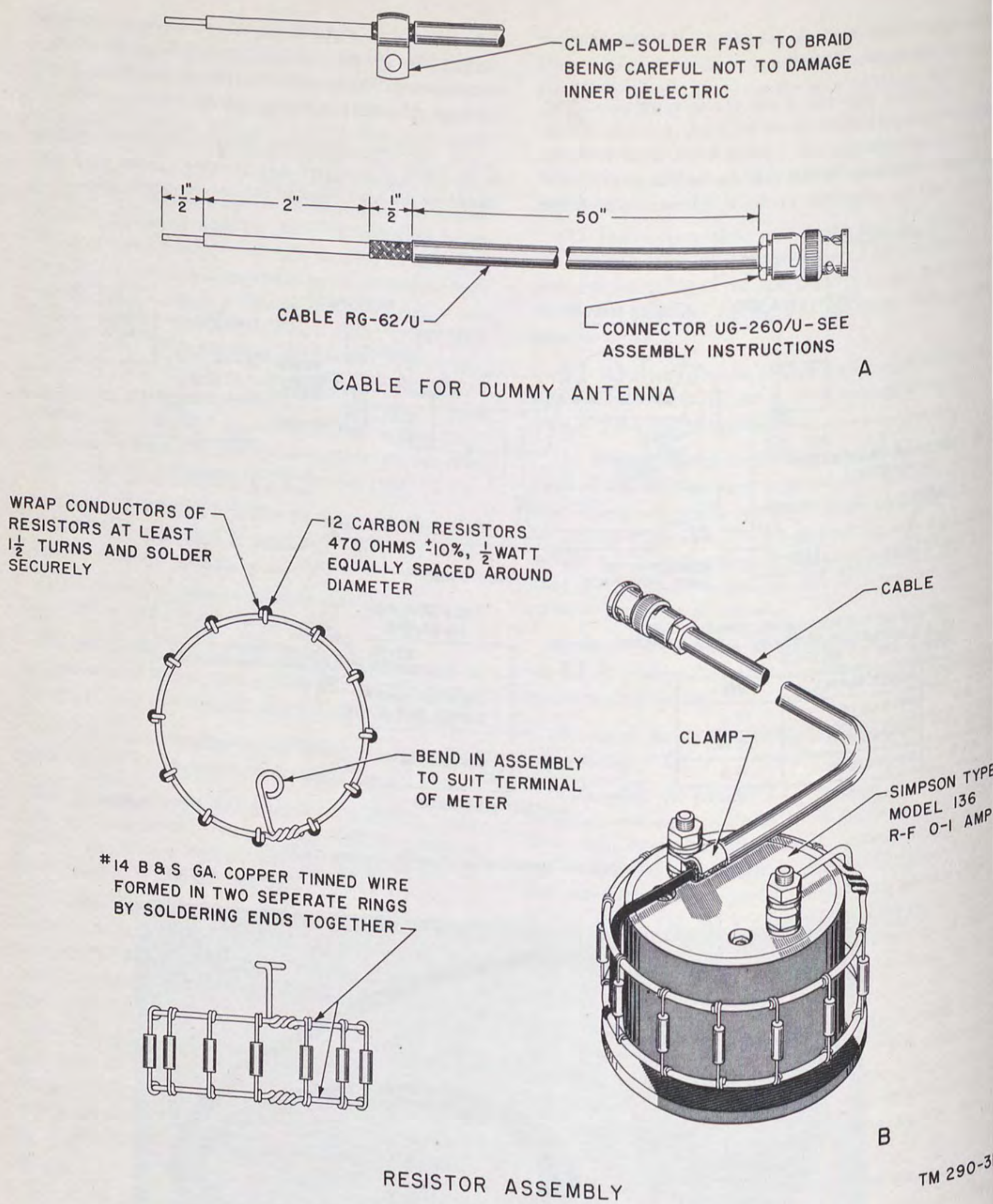



*Figure 31. Construction of dummy antenna.*

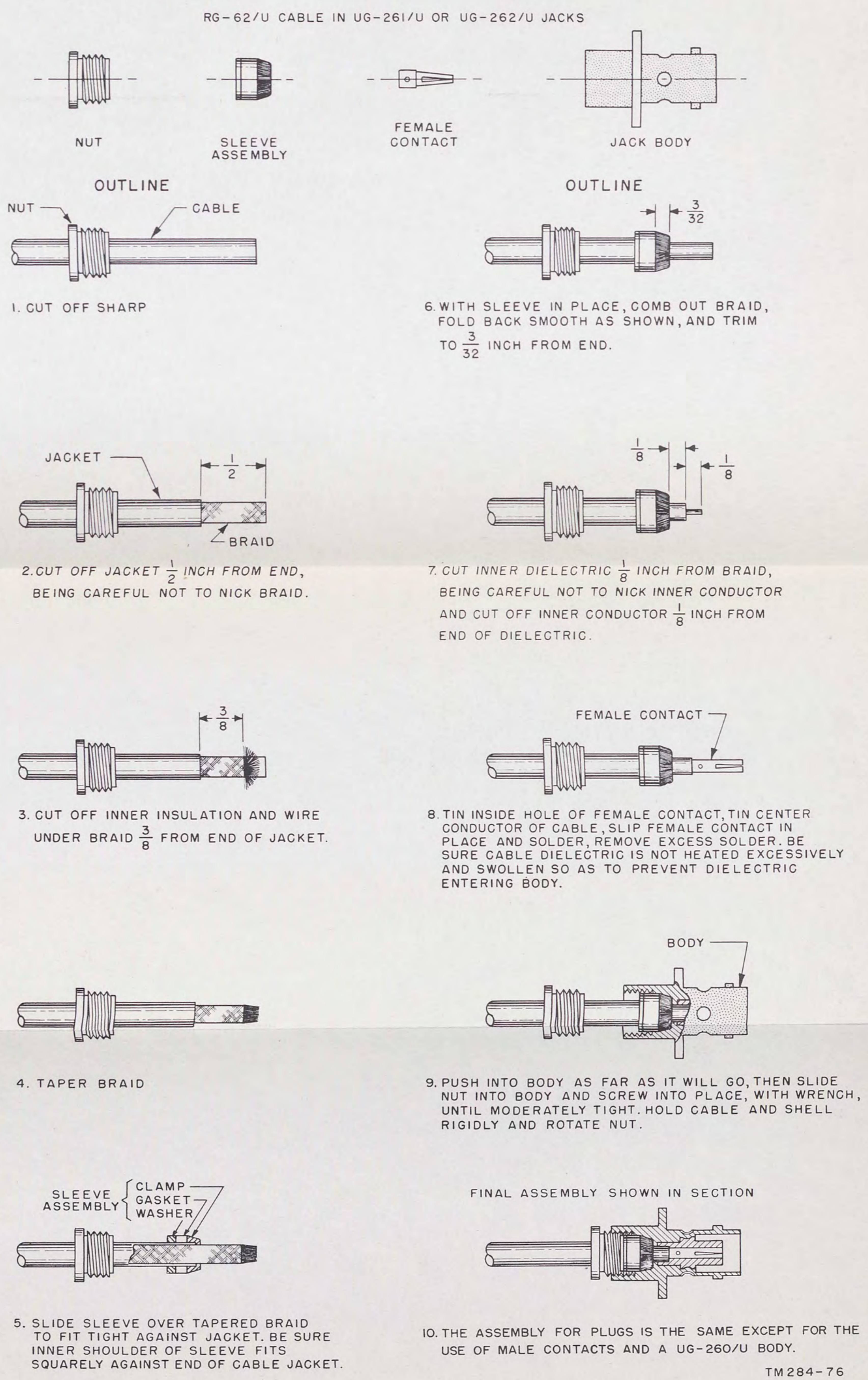



*Figure 32. Assembly instructions for connectors, Plug UG-260/U and Jack UG-261/U to cables.*

## 47. Preparation of Test Cables

*a.* CABLE FOR ATTACHMENT TO AUDIO CONNECTOR ON RECEIVER-TRANSMITTER. Use a 10-pin audio connector (male compression type terminal). Cut lead lengths so that the resultant cable will permit turning the unit under test to any desired position. Since both the headset and microphone and the test signal generator or the a-f output meter are called for in the test, it may be desirable to prepare either two separate cables or to insert switches in the cable leads to permit interchanging the meter and generator for headphones and microphone, respectively, as called for in the particular test. Make the following connections:

(1) Connect the carbon element of the microphone in series with one set of contacts of the microphone push-to-talk switch (or the a-f signal generator in series with one section of a DPST switch) between terminals C and E (ground) of the cable connector.

(2) Connect the other set of contacts of the microphone push-to-talk switch (or second section of DPST switch) between terminals F and B (ground) of the cable connector.

(3) Connect the headphones (or the a-f output meter, M-5, shunted by a 600-ohm, ½-watt resistor) between terminals A and H (ground) of the cable connector.

*b.* AUDIO CABLE FOR ATTACHMENT TO CASE CY-590/-GRC CONNECTOR J-2. If connection is to be made through connector J-2 on Case CY-590/GRC, a 9-pin connector (male plug-in type terminal), suitable for attachment to the J-2 connector on the case, is required. Make the following connections:

(1) Connect the carbon element of the microphone in series with one set of push-to-talk contacts (or the a-f signal generator through one set of DPST switch contacts) between terminals C and D (ground) of the cable connector.

(2) Connect the other set of the push-to-talk contacts of the microphone (or DPST switch) between terminals K and D of the cable connector.

(3) Connect the headphone (or a-f output meter M-5 shunted by 600 ohms) between terminals A and D of the cable connector.

*c.* BATTERY CABLE. The cable for connection between the storage battery and the POWER IN connector on AF Amplifier AM-65/GRC, if used for providing power to the receiver-transmitter, requires the use of a 4-pin connector (male plug-in type terminal) suitable for attachment to the POWER IN connector on the amplifier panel. In addition, a set of battery clips is required to permit connection of the cable to the battery.

(1) If a formed battery cable is not available, cut two lengths of #12 gage heavily insulated wire. Trim the insulation and solder one lead to a clip at one end and to terminal A of the cable connector at the other.

(2) Solder one end of the other lead to a spring clip and the other end to terminal C (ground) of the connector. Make sure that the ends of the cable are properly insulated to prevent short circuits.

*d.* POWER CABLE. The cable described here is used for connection between the RT-70 POWER connector on AF Amplifier AM-65/GRC and the POWER connector on the receiver-transmitter panel. Two 9-pin connectors (male plug-in type terminal) are required.

(1) Connect #16 gage leads between terminal J of the two connectors.

(2) Connect a #16 gage lead between terminal B of the two connectors.

(3) Connect a #12 gage lead between terminal F of the two connectors.

(4) Connect a #12 gage lead between terminal D (ground) of the two connectors.

(5) Connect a strap between terminals J and H of the connector which will attach to the POWER connector on the receiver-transmitter panel. (This strap completes the 90-volt circuit to the receiver second audio amplifier stage. In a system installation this strap is provided in the mounting or in CASE CY-590/GRC.)

*e.* AUDIO CABLE FOR CONNECTION TO RECEIVER-TRANSMITTER POWER CONNECTOR. If connection of the audio circuits cannot be made as described in subparagraph *a* above, then connect the audio devices to the connector on the power cable (subpar. *d*, above) which will attach to the POWER connector on the receiver-transmitter panel.

(1) Connect the microphone (or a-f signal generator) in series with one set of push-to-talk contacts between terminals C and D (ground) of the POWER connector.

(2) Connect the other set of push-to-talk contacts between terminals K and D of the POWER CONNECTOR.

(3) Connect the headphones (or audio output meter M-3 shunted by a 600-ohm resistor) between terminals A and D of POWER connector.

## 48. Preparation of Dummy Antenna Load

The dummy antenna load consists of an r-f meter, a parallel resistor (totaling 50 ohms, 1 watt), and a short coaxial cable with connector suitable for attachment to ANT connector on the front panel of the receiver-transmitter. Figure 30 shows the completed dummy antenna load assembly. Figure 31 shows the details for the preparation of the dummy antenna load and the connecting cable, respectively. Prepare the dummy antenna load as shown in this figure. Figure 32 shows the details for putting the connector on the connecting cable.

### 49. Over-all Plate and Filament Current Drain Check

*a.* TEST PROCEDURE. The purpose of this check is to determine the over-all drain on the plate and filament supplies by the receiver-transmitter. A reduction in over-all drain from the values given below shows that a defect in the filament or plate circuits of the receiver-transmitter exists. It is a rough check on tubes. Proceed as follows:

(1) Insert a milliammeter with a range of 100 ma dc in the 90-volt supply lead to the receiver-transmitter.

(2) Insert an ammeter with a range of 1 ampere dc in the 6.3-volt filament supply lead.

(3) Turn on power and allow a warm-up period of a few seconds.

(4) Obtain the measurements indicated in subparagraph *b* for each of the switch settings of switches S-202 and S-201. For measurements of receiver current drain do not press the microphone switch (relay O-101 unenergized). For readings of transmitter current drain, energize relay O-101 by either closing the microphone switch or grounding terminal K of J-203 or terminal F of J-202. If the required readings are not obtained, perform the operational checks (pars. 51 through 54).

*b.* RECEIVER-TRANSMITTER CURRENT DRAIN CHECK CHART.

| Supply lead | Setting of S-202 | Current readings — Microphone switch open (Receiver on) — S-101 in position TANK | VEH | FIELD | Current readings — Microphone switch closed (Transmitter on) — S-101 in position TANK | VEH | FIELD |
|---|---|---|---|---|---|---|---|
| 90-volt plate and screen supply lead | ANT ADJ | 77 | 77 | 38 | 79 | 79 | 79 |
| | DIAL LIGHT ON | 77 | 77 | 38 | 79 | 79 | 79 |
| | DIAL LIGHT OFF | 77 | 77 | 38 | 79 | 79 | 79 |
| | CAL | 77 | 77 | 38 | 79 | 79 | 79 |
| 6.3-volt filament supply lead | ANT ADJ | 390 | 390 | 390 | 415 | 415 | 415 |
| | DIAL LIGHT ON | 385 | 385 | 385 | 410 | 410 | 410 |
| | DIAL LIGHT OFF | 385 | 385 | 323 | 410 | 410 | 350 |
| | CAL | 395 | 395 | 390 | 415 | 415 | 415 |

### 50. Purpose and Use of Operational Check Chart

*a.* PURPOSE. The operational checks in paragraphs 51 and 53 serve as a first step in sectionalizing trouble in the receiver-transmitter. Panel-mounted controls and facilities are used to operate the equipment under as close to normal conditions as possible at the test bench. Facilities such as the thermal noise normally present in an fm receiver, the internal calibrate and beat oscillators, and sidetone are utilized for this purpose. The trouble symptoms determined by these checks, when properly interpreted (chapter 2), will point to specific circuits as being defective and to additional checks necessary to further localize the trouble to a particular stage.

*b.* USE. The tests given in the charts show a certain specific sequence. Each test assumes that the preceding tests have been made and the troubles thus discovered have been eliminated. Accordingly, start with item 1 and proceed in the indicated order. The chart includes several columns as follows:

(1) *Item of check.* This column assigns the numerical sequence to the particular check to facilitate further reference to it, and describes briefly the purpose of each check.

(2) *Test condition or operation.* This column lists the switches and controls to be operated and the conditions to be met. To facilitate identification, meters and signal generators, where called for, are identified with references corresponding to those given in paragraph 44.

(3) *Normal indication.* This column shows what to expect after the test conditions have been met. If these indications are not met as specified, a trouble condition exists. For example, step 1 gives a check of receiver operation based on the presence of noise in the r-f and i-f circuits. Absence of noise shows that the receiver is defective at some point. Audibility of the noise does not prove conclusively that the entire receiver is functioning properly. The r-f stage may be defective and yet noise may be heard in the earpiece. The volume of noise is a function of the total gain of the stages, a defect in the r-f and mixer stages of the receiver will show up as a reduction in the volume of noise heard. Proper interpretation of the volume will give a more precise meaning to the normal indication for steps 2 and 3.

(4) *Possible causes of trouble.* This column indicates the circuit sections to be suspected as being defective if the normal indication is not obtained. In cases where several types of trouble symptoms are possible the circuit sections involved in each type of trouble symptom are listed.

(5) *Further checks.* This column lists the sectionalization or localization checks to be made if the normal indication is not obtained. Where further operational checks are called for, perform that check. Note the resultant indication and, if abnormal, follow through as indicated in the *Further checks* column for that operational check.

*c.* ADDITIONAL TROUBLE SECTIONALIZATION DATA. The operational check charts are supplemented by sectionalization charts (pars. 52 and 54) which serve to further limit the trouble to a particular stage within the circuit section determined as being defective by the operational checks. The sectionalization charts for the receiver and transmitter include a column marked *Test condition* or *operation.* This column is similar to the one in the operational check chart but since quantitative measurements are made throughout, meters and signal generators are listed. To facilitate identification, these items are assigned references corresponding to those appearing in paragraphs 51 and 53. It should be noted, however, that the nature of the normal indication should serve as a guide in selection of meter ranges and signal generators.

## 51. Receiver Operation Checks

| Item of check | Test conditions and operation | Normal indication | Possible causes of trouble | Further checks and remarks |
|---|---|---|---|---|
| Preliminary. | Check that all tubes and crystals are firmly seated in their sockets. Turn S-202 to DIAL LIGHT OFF.<br>Turn S-101 to VEH if AF Amplifier AM-65/GRC and a vibrator power supply are used, or to FIELD if dry batteries are used to supply power.<br>Set up Receiver-Transmitter RT-70/GRC as outlined in paragraph 46.<br>Turn SQUELCH control to extreme clockwise position. Turn VOLUME control to extreme clockwise position.<br>Turn on power: If Case CY-590/GRC is used, turn the OFF-ON-REMOTE switch in that unit to the ON position.<br>If AF Amplifier AM-65/GRC is used in the test setup, turn the OFF-INT-RT-70 switch on that unit to RT-70 to turn on power. | | | |
| (1)<br>Dial light. | Turn S-202 to DIAL | Dial light goes on. | (a) Defective lamp.<br>(b) No power.<br>(c) Defective dial light circuit. | (a) Check lamp.<br>(b) Check power source.<br>(c) Check dial light circuit by point-to-point resistance measurements. |
| (2)<br>Over-all receiver operation. | Turn SQUELCH control to extreme counterclockwise position. Listen in headphones. | Rushing noise (assuming no incoming signal) is heard in earphone. | Defective stage in receiver circuit. | Check that chassis connectors and coaxial cable connector P-1 are properly connected.<br>Proceed with measurements given in trouble sectionalization. chart (par. 52). |

| | | | | |
|---|---|---|---|---|
| (3) Volume adjustment. | Turn VOLUME control in counterclockwise direction until volume of noise is reduced to suitable listening level. | Volume of rushing noise decreases gradually as control is rotated. | Defective volume control R-204, or associated circuit components. | Check R-204 |
| (4) Squelch action. | Turn SQUELCH control in clockwise direction until noise disappears. | Rushing noise disappears abruptly. | Defective squelch (V-107) circuit. | Check V-107 in a tube checker or substitute a new tube. Check squelch circuit (par. 52, item 14). |
| (5) Dial operation. | Lift cranking handle out of its recess on tuning knob and crank to tune from one end of dial to the other and back. Detent levers not set. | Dial rotates smoothly, without scraping, slippage, or bumps. | Broken or defective dial drive cable. | Repair drive cable as described in paragraph 64*g*. |
| (6) Calibrate oscillator operation. | Turn SQUELCH control to extreme counterclockwise direction (off). Turn S-202 at ANT ADJ position. Turn dial until *normal indication* is obtained. | Rushing noise disappears, or is considerably reduced at some setting of the dial at or near a mc point. | (a) Defective calibrate oscillator (V-7) circuit. | (a) Check V-7. Check circuit components by point-to-point voltage and resistance measurements (pars. 56 and 57). |
| | | | (b) Low receiver gain. | (b) Make measurements on receiver r-f and i-f circuits, as described in paragraphs 52 and 55. |
| | | | (c) Variable oscillator V-2 not oscillating or badly misalined. | (c) Touch grid of V-2. Noise should be reduced. If not, V-2 circuit is defective. |
| (7) Beat oscillator. | Turn S-202 to CAL position. | Rushing noise disappears as beat note is heard at some setting of the dial near a mc position. | Defective beat oscillator. | Check V-106. Check beat oscillator circuit as described in paragraphs 52, item (6), and paragraph 71*b*. Make appropriate receiver measurements (pars. 52, 55, 56, and 57). |
| (8) Vernier dial calibration. | Rotate tuning knob so that beat note is heard at any convenient mc point on the dial. | Zero on vernier knob plate lines up with calibration marker on panel. | Vernier knob requires rezeroing. | Back off knob retaining screw a few turns. Rotate vernier plate until 0 lines up with marker on panel. Hold knob in place while doing this. |

| Item of check | Test conditions and operation | Normal indication | Possible causes of trouble | Further checks and remarks |
|---|---|---|---|---|
| | | | | This procedure calibrates the channels up to 1 mc above and 1 mc below the calibration point, and will be referred to whenever calibration of a test signal is called for in subsequent checks. |
| (9) Calibration check. | Rotate dial through its entire tuning range, starting with 58 mc. | At or close to each mc setting of the dial, rushing noise disappears. Beat note is heard. | (a) Variable oscillator not oscillating. | (a) Check grid voltage of V-2 (par. 54, item 1.) |
| | Listen in headphones for noise and adjust tuning knob until zero beat is obtained at each mc point (Note 1 below). | | (b) Variable oscillator V-2 is off frequency, if beat notes occur at points more than 25 kc from mc points. | (b) Check variable oscillator frequency (par. 72*e*(1). If the calibration error (Note 2 below) exceeds 25 kc at 58- and/or 47-mc setting of dial, incorrect alinement of the oscillator is indicated. Realine oscillator (par. 72*e*). |
| (10) Receiver gain. | Rotate dial through its entire tuning range. | Volume of noise is about the same in intensity for all mc settings of the dial. | If level of noise drops off considerably as one end of dial is approached, the gain at that end of the band is too low. | Check stage gain (par. 55). |

*Note 1.* The pitch of sound in the headphones will be higher as the knob is rotated in either direction away from a "zero beat" position. This fact should be noted to make sure that what is presumed to be zero beat is not in reality silence due to absence of a signal or a note too high in pitch to be audible.

*Note 2.* The term calibration error is taken to mean the amount by which the vernier plate zero is away from the calibration marker on the panel, when the zero beat is obtained.

## 52. Receiver Trouble Sectionalization Checks

| Item of check | Test conditions and operation | Normal indication | Possible causes of trouble | Further checks and remarks |
|---|---|---|---|---|
| Preliminary. | S-202 in DIAL LIGHT OFF position.<br><br>SQUELCH control in OFF position.<br><br>VOLUME control in extreme clockwise position. | | | |
| (1) Audio amplifier circuit gain. | Connect audio signal (G-3) between test point E-106 and chassis.<br><br>Adjust frequency to 1,000 cycles and level to .45 volts.<br><br>Connect meter (M-4) between terminals A of J-202 or J-203 and chassis. | A-f output meter (M-4) reads 80 mw. | Defective audio amplifier stage V-106 or V-108. | Make individual stage gain measurements (par. 55).<br><br>Check tube of stage (V-106 or V-108) shown to give low or no output.<br><br>Make point-to-point resistance measurements of stage shown to be defective (par. 56). |
| (2) Determine equivalent limiter meter reading. | Connect 1.4-mc test signal generator (G-1) through a .01-uf capacitor between E-103 and chassis.<br><br>Connect meter (M-1) between E-104 and chassis.<br><br>Tune receiver to a point between mc positions of the dial (to keep calibrate oscillator signal out of circuit).<br><br>Adjust test signal frequency to zero beat with beat oscillator (1.4-mc). Adjust test signal level to .15 volts. | Meter (M-1) should read about —1.4 volts. | | Record the reading thus obtained. This reading will be referred to as REFERENCE A. In subsequent measurements the test signal level will be adjusted to obtain this reference reading. The test signal level required to obtain this reading will be taken as a measure of the gain of the circuit or stage being measured. |
| (3) 1.4-mc i-f amplifier limiter stages over-all gain measurement. | Connect limiter meter (M-1) to E-104 and chassis.<br><br>Connect 1.4-mc test (G-1) signal (unmodulated) through .01-uf capacitor between E-101 and chassis. | 2,600 microvolts (approx). | (a) Defective i-f amplifier stage (V-102 through V-104). | (a) Check gains of individual stages V-102 through V-104 par. 55).<br><br>Check tube of stage showing low or no output. |

## 52. Receiver Trouble Sectionalization Checks (contd)

| Item of check | Test conditions and operation | Normal indication | Possible causes of trouble | Further checks and remarks |
|---|---|---|---|---|
| | Zero-beat the test signal with the beat oscillator. | | | Make point-to-point voltage and resistance measurements (pars. 57 and 56) of stage with low or no output. |
| | Adjust the 1.4-mc test signal level to obtain REFERENCE A (step 2). | | | Check alinement of 1.4-mc i-f circuits if above procedures fail to reveal causes of trouble. |
| | Measure the test signal level when reference reading is obtained. | | (b) Excessive gain reading may indicate regeneration. | (b) Check filament bypass capacitors. |
| (4) Receiver 2nd mixer stage. | Connect 15-mc test signal generator (G-1) (unmodulated) through .003-uf capacitor between E-101 and chassis. | 5,200 microvolts (approx). | (a) Defective 2nd mixer stage. | (a) Check V-102.<br>Make point-to-point voltage and resistance measurements on V-102 circuits (pars. 57 and 56). |
| | Connect limiter meter (M-1) to E-104. | | | |
| | Zero-beat test signal with test oscillator. | | (b) Defective 2nd mixer oscillator (part of V-102). | (b) See item (5) below. |
| | Adjust level to obtain REFERENCE A on limiter meter. | | | |
| | Measure test signal level when reference reading is obtained. | | | |
| (5) 2nd mixer oscillator. | Disconnect test signal generator. | (approx) —2.65 volts. | (a) Defective Y-101 crystal. | (a) Try replacing with another crystal. |
| | Use M-1 to make the following measurements. | | (b) Defective V-102. | (b) Check tube V-102. |
| | Between pin 4 of V-102 and chassis. | | (c) Defective circuit component. | (c) Make point-to-point voltage and resistance measurements (pars. 57 and 56). |
| (6) Beat oscillator check. | *Set S-202 to CAL. Disconnect test signal from equipment.* | | | |

| | | | | |
|---|---|---|---|---|
| | Using M-1 measure voltages at the following points: | | | |
| | (a) Pin 2 of V-106. | (a) +45 volts. | | |
| | (b) Pin 6 of V-106. | (b) −2.55 volts. | Defective crystal Y-102. | Try replacing crystal. |
| | | | Defective V-106. | Check tube V-106. |
| | | | Defective circuit component. | Make point-to-point resistance and voltage measurements on oscillator circuit components associated with V-106 (pars. 57 and 56). |
| (7) Discriminator. | 1.4-mc test signal (G-1) at .15-volt rms applied between E-103 and chassis. | O±.5 volt. | | |
| (a) Alinement | Connect M-1 between E-106 and ground. | | (a) Defective V-105. | (a) Check V-105. |
| | | | (b) Defective circuit components of V-105. | (b) Check resistances in V-105 circuits (par. 56). |
| | | | (c) Misalined discriminator circuit. | (c) Check alinement of discriminator circuit (T-106) par. 72*c*). |
| (b) Balance | (a) Change test signal frequency to 1.43 mc. | (a) +4 volts, min. | Defective CR-101 or CR-102, or coils L-32 or L-33. | The two readings should be of opposite polarity and numerically equal to each other, within .2 volt. If this requirement is not met, realine T-106. If this cannot be accomplished, check circuit components. |
| | (b) Change test signal frequency to 1.37 mc. | (b) −4 volts, min. | | |
| (8) 15-mc i-f amplifier circuits, gain measurement. | Connect limiter meter M-1 to test point E-104. Connect signal generator G-1 through a .003-uf capacitor, between pin 6 of V-10 and chassis. | 12 microvolts (approx). | (a) Defective i-f amplifier stage V-10, V-11 or V-101. | (a) Check gains of individual stages V-10, V-11, and V-101 (par. 55). |
| | | | | Check alinement of 15-mc i-f amplifier circuits (par. 72*d*.) |
| | | | | Check tube of stage showing low or no output. |

## 52. Receiver Trouble Sectionalization Checks (contd)

| Item of check | Test conditions and operation | Normal indication | Possible causes of trouble | Further checks and remarks |
|---|---|---|---|---|
| | Adjust the test signal frequency for zero beat with beat oscillator (step 2). | | | Make point-to-point voltage and resistance measurements of stage with low or no output (pars. 57 and 56). |
| | Adjust test signal level to obtain REFERENCE A. | | (b) Excessive gain readings may indicate regeneration. | (b) Check filament bypass capacitor. |
| | Measure test signal level. | | | |
| (9)<br>REFERENCE B indication for 15-mc i-f and r-f circuit measurements. | Raise test signal level until second limiter grid meter (M-1) reads -11 volts dc. Determine test signal level. Measure test signal level. | 150 microvolts (approx). | Same as in step 8 above. | Same as in item 8 above.<br>*Note.* This step serves to establish a new limiter grid reference level sufficiently above the noise level to make accurate readings possible. Hereafter, this reading will be called REFERENCE B. |
| (10)<br>Gain of receiver first mixer V-9. | Shift generator connection to grid (pin 6) of V-9. Adjust signal generator level to obtain REFERENCE B reading (-11 volts) on limiter meter. | 24 microvolts (approx). | (a) Improper alinement. | (a) Check alinement of T-9 (par. 72*d*). |
| | | | (b) Defective V-9. | (b) Check V-9. |
| | | | (c) Defective circuit components of mixer stage. | (c) Check circuit components by point-to-point resistance and voltage measurements (pars. 57 and 56). |
| | Measure test signal level. | | | |
| (11)<br>Gain of receiver r-f stage V-8. | Connect r-f signal generator (G-2) through a 500-uuf capacitor between pin 6 of V-8 and chassis. | | Improper alinement. | Check alinement of T-8 (par. 72*f*). |
| | | | Defective V-8. | Check tube V-8. |
| | (a) Adjust frequency to 58 mc. Tune in with receiver dial. Adjust level to obtain REFERENCE B readings on limiter meter. | (a) 7 microvolts (approx). | Defective circuit component for stage. | Make point-to-point resistance and voltage measurements (pars. 57 and 56). |
| | Determine signal generator output level required to obtain REFERENCE B. | | Output of variable oscillator V-2 too low. | Check grid voltage of V-2 (par. 54, step (1)). |
| | | | | Check alinement of V-2 stage (par. 72*e*). |

| | | | | |
|---|---|---|---|---|
| | (b) Adjust test frequency to 47 mc, and tune in on receiver. Adjust signal input level to obtain REFERENCE B reading on limiter meter. Determine test signal input level required to obtain that reading. | (b) 15 microvolts (approx). | | |
| (12) Receiver r-f circuits. | Connect r-f signal generator (G-2) to ANT connector. Make leads as short as possible. | | | |
| (a) Antenna trimmer (C-41) adjustment. | Adjust test frequency to 58 mc, and tune in with dial.<br>Adjust test signal level to give REFERENCE B limiter meter reading.<br>Tune receiver for maximum deflection of limiter meter (M-1).<br>Adjust trimmer capacitor C-41 for max deflection of M-1. Readjust signal level to obtain REFERENCE B reading on limiter meter. Determine test signal input level. | 8 microvolts (approx). | Defective antenna circuit. | Check antenna circuit components for defects (par. 56). |
| (b) Antenna inductance adjustment. | (b) Change test signal frequency to 47 mc. Tune in with dial. Do not adjust C-41. Adjust test signal level to obtain REFERENCE B reading on limiter meter.<br>Determine test signal level. | 1.6 microvolts (approx). | Inductance of L-18 incorrect. | Adjust the inductance of L-18. This is done by detaching the i-f chassis to gain access to r-f coil box, and spreading or squeezing the turns of L-18, as required. Coil L-18 is accessible through slot in r-f coil compartment. For adjustment details, see paragraph 72*g*. |

## 52. Receiver Trouble Sectionalization Checks (contd)

| Item of check | Test conditions and operation | Normal indication | Possible causes of trouble | Further checks and remarks |
|---|---|---|---|---|
| (13) Discriminator checks. | Apply an r-f 1.0-microvolt signal modulated at 1 kc with ±15-kc deviation to ANT connector (use G-2). Set VOLUME control to max clockwise position. Set SQUELCH control to max counterclockwise position.<br>Turn S-202 to DIAL LIGHT ON (or OFF). Adjust test signal frequency to suitable frequency (58 mc). Tune in with dial knob. Using output meter M-4, measure power output level across A and B of J-202. Use a 600-ohm load. | Meter should read 80 milliwatts (approx). | (a) Improper alinement of dicriminator.<br>(b) Reduced discriminator output.<br>(c) Low output of V-105. | (a) Check alinement (par. 72*c*).<br>(b) Check stage gains (par. 55).<br>(c) Check V-105, and associated circuit components. |
| (14) Squelch circuits operation. | (a) VOLUME control in max clockwise position. SQUELCH control in OFF position. Apply test signal at 58 mc with 1-kc modulation at ±15-kc deviation (G-2) and at a level of 1 microvolt to ANT connector. Tune in signal with dial. Reduce test signal level to zero. Gradually advance SQUELCH control in clockwise direction. Increase G-2 output until some noise reappears. Check G-2 output level. | (a) Noise disappears abruptly at some setting of SQUELCH control. Signal generator output required should be less than 1 microvolt. | (a) Defective squelch circuit. | (a) Check squelch tube V-107 and squelch circuit voltages (par. 57*b*(4)). |
| | (b) Connect meter M-1 in series with 800 ohms to H and J of J-203. | (b) Meter should read 0 ma when rushing noise has disappeared. | | |
| | (c) Same as in (a) above. Gradually advance test signal input level until tone is heard in headphones. Measure signal input level when tone is heard. | (c) Rushing noise should stop. Tone should be heard when test signal input level is about 0.4 microvolts. | (c) Defective squelch circuit. | (c) Check squelch tube V-107. Check squelch circuit voltage using (M-1), a high impedance vacuum tube voltmeter (par. 57*b*). |

| | | | | |
|---|---|---|---|---|
| | Measure voltage with meter (M-1) between H and J of J-203. | Meter M-1 reads approx. 4 volts. | | |
| | (d) Rotate squelch control to extreme clockwise position. Raise test signal level until tone is heard. Measure test signal level. | (d) Tone is heard when test signal level is between 3 and 15 microvolts. | (d) Poor receiver sensitivity. | (d) Make over-all receiver sensitivity check, step 15. Follow up with receiver stage-by-stage gain checks and receiver alinement if sensitivity is poor (pars. 55 and 72). |
| | Measure voltage between H and J (across 800 ohms). | Meter (M-1) reads approximately 4 volts. | | |
| (15)<br>Receiver sensitivity. | Reduce the audio output level by means of the VOLUME control until the (M-4) power output meter reads 70 MW. | Th. signal plus noise-to-noise ratio should be at least 30 db. | (a) Improper alinement.<br>(b) Low gain in r-f or i-f amplifier stages. | (a) Realine receiver circuits (par. 72).<br>(b) Make stage gain checks (par. 55). |
| | Remove modulation from test signal and measure audio output level as above. Compute the ratio of the audio output level obtained for a modulated signal to that obtained with the unmodulated test signal. | | | |
| (16)<br>Calibrate oscillator V-7. | Connect a high impedance vacuum-tube voltmeter (M-1) between pin 6 (grid) of V-7 and chassis. Turn S-202 to the CAL position. | Meter reads approximately —18 volts dc. | (a) Defective Y-2.<br>(b) Defective V-7.<br>(c) Check circuit. | (a) Check by substituting another crystal.<br>(b) Check tube.<br>(c) Check circuit components, particularly contacts of S-202. See point-to-point measurements, paragraph 56. |
| | Adjust trimmer capacitor C-48 to obtain a peak reading on the meter. Decrease capacity of trimmer until meter reads 70% of peak reading obtained above. | | | |

## 53. Transmitter Operation Checks

| Item of check | Test conditions and operation | Normal indication | Possible causes of trouble | Further checks and remarks |
|---|---|---|---|---|
| (1)<br>Relay circuit. | Operate microphone switch. Listen for relay click. | Relay click should be heard. | Defective relay O-101. | Make sidetone check (item 3). |
| (2)<br>Transmitter power output. | Set S-202 in DIAL LIGHT OFF (or ON) position.<br><br>Make sure that the dummy antenna load (resistor in series with r-f meter is connected to the ANT connector).<br><br>Tune dial to 58-mc position.<br><br>Operate microphone switch and observe r-f meter reading. | Meter reading should be about 100 ma or 500 mw. | (a) Misalined transmitter circuits. | (a) Check alinement, item 5. |
| | | | (b) Defective transmit oscillator V-3. | (b) Check oscillator V-3. See transmitter trouble sectionalization chart, paragraph 54. |
| | | | (c) Defective variable 32- to 43.4-mc oscillator V-2. | (c) Check V-2 and oscillator circuit operation, step (1) of transmitter trouble sectionalization chart (par. 54). If correct normal indication is obtained, variable oscillator is operative. |
| | | | (d) Defective transmitter mixer, driver or power amplifier circuits (V-4, V-5, V-6). | (d) Make voltage measurements at test points E-1 through E-3. See transmitter trouble sectionalization chart, paragraph 54. |
| | | | (e) Defective relay circuits. | (e) Measure the voltages at the screens of V-1 (pin 4) and V-6 (pin 1), and the filament voltages of V-1 and V-3 through V-6, when the microphone switch is operated. A no-voltage indication at the screens shows that contacts 8 and 9 of relay O-101 are not closed. A no-voltage indication at the tube filaments shows that contacts 2 and 3 of the relay are not closed. Check the relay coil and the relay circuits. Replace the relay if contacts are shown to be defective or the coil is open. |

| | | | | |
|---|---|---|---|---|
| (3) Sidetone. | Same as above. Set S-101 in TANK position. Talk into microphone. Listen with headphones. | Speech should be heard. | (a) Sidetone circuit not established due to defective relay O-101 contacts.<br>(b) Defective sidetone circuit components or wiring.<br>(c) Defective audio amplifiers (V-106 or V-108). | (a) Check relay O-101, and associated circuit components.<br>(b) Check sidetone circuit components.<br>(c) See receiver trouble sectionalization chart, paragraph 52, item (1). |
| (4) Sidetone level reduction by S-101. | Set S-101 in VEH or FIELD position. Repeat operations of step (3). | Volume of sidetone board should be considerably reduced. | Defective S-101 or R-138. | Check the contacts of S-101 and circuit components and wiring associated with sidetone circuits (fig. 47). |
| (5) Over-all transmitter tuning. | Same as in step 2, except rotate dial through its entire range, and observe r-f meter reading. | The meter reading should not drop more than 10 ma from the reading obtained in step (2). | If the power output of the transmitter varies by more than 10 ma, misalinement of the transmitter r-f circuits is indicated. | Realine as described (par. 73). |
| (6) Check of transmitter modulation using test receiver. | Use as f-m receiver within the tuning range of the receiver-transmitter under test as a test device.<br>Operate the microphone push-to-talk button and talk into the microphone.<br>Tune in signal on test receiver.<br>Note the quality of the speech in the test receiver. | Intelligible speech of good quality should be heard. | (a) Defective microphone amplifier circuit.<br>(b) Defective microphone amplifier circuit. | (a) Check modulator circuit components.<br>(b) Check gain of microphone amplifier (par. 54, step (6). Check V-1 and associated circuit components. |

## 54. Transmitter Trouble Sectionalization Chart

| Item of check | Test conditions and operation | Normal indication | Possible causes of trouble and further checks |
|---|---|---|---|
| (1)<br>32- to 43.4-mc oscillator V-2 operation. | Measure voltage between terminal 3 of V-2 and chassis using meter M-1. | | If the voltage is zero, oscillator is not oscillating. Check tube V-2. Check circuit components by point-to-point voltage and resistance measurements. If voltage is low, oscillator is weak. Check V-2. |
| | (a) At 58 mc. | (a) −3.5-volt dc at 58 mc. | |
| | (b) At 47 mc. | (b) −2 volts at 47 mc (approx). | |
| (2)<br>15-mc trans. oscillator V-3 operation. | Operate the microphone switch and measure the grid voltage at pin 8 of V-3 (M-1). | −2.8 volt dc (approx). | A zero voltage reading shows that V-3 is not oscillating. Check V-3; make point-to-point voltage and resistance measurements at the tube socket. Try substituting a crystal known to be good for crystal Y-1. |
| (3)<br>Grid drive for transmitter driver V-5. | Connect meter (M-1) between test point E-1 and pin 7 of V-5. For each dial position operate microphone switch and obtain meter reading. | | Absence of grid drive shows a defect in transmitter mixer V-4. Check V-4; make point-to-point voltage and resistance measurements at the tube socket; check alinement (pars. 57, 56, and 73).<br><br>Low grid drive indicates low gain in V-4 or misalinement. |
| | (a) Operate dial to 58-mc position. | (a) −4.5 volts (approx). | |
| | (b) Operate dial to 47-mc position. | (b) −4.5 volts (approx). | |
| (4)<br>Grid drive for transmitter power amplifier V-6. | Connect meter (M-1) between test point E-2 and chassis, and proceed as in step (3) above. | −5.5 volts dc (approx) at all frequencies. | Absence of grid drive shows a defective stage V-5.<br><br>Check tube V-5; make point-to-point measurements of voltage and resistance to locate a defective component in the circuits of V-5.<br><br>Check alinement (par. 73).<br><br>An excessively high meter reading may indicate that an oscillatory (spurious) condition exists, and that adjustment of neutralization is necessary. Check this by shorting pin 5 on V-2 to ground. If voltage at E-2 goes to zero, neutralization is approximately correct, otherwise check and adjust neutralization as described in *paragraph 74.* |

| | | | |
|---|---|---|---|
| (5) Plate current of transmitter power amplifier V-6. | Connect meter (M-1) between E-3 and pin 11 of J-1. | +1.7-volts dc (approx). | A no-voltage indication, when the microphone switch is operated, shows a break in the plate supply circuit, or zero plate current in V-6 for other reasons. Turn off power and make continuity measurements to trace the break.<br><br>A low reading when the microphone switch is closed shows that there is insufficient grid drive on V-6, or that antenna trimmer capacitor C-41 is not adjusted properly (pars. 73 and 72*g*).<br><br>Check tube V-6; make point-to-point resistance measurements to discover defective components, (par. 56). Make point-to-point voltage measurements (par. 57). |
| (6) Microphone amplifier V-1. | Apply 1,000-cps signal as above. Operate microphone switch. Using meter (M-2) measure the signal level:<br>(a) across winding 4-6 of T-2.<br>(b) across winding 3-1 of T-1. | <br>(a) 7.0 volts rms (approx).<br>(b) 5.5 volts rms (approx). | Check V-1. Check circuit components (pars. 57 and 56). |
| (7) Sidetone level. | Connect meter M-4 and a 600-ohm load between A of J-203 and chassis.<br>Apply 1,000-cycle test signal as in step 6.<br>Operate microphone switch, set VOLUME control to extreme clockwise position, and measure signal level as follows:<br>(a) Between test point E-106 and chassis, using meter, M-2. Switch S-101 set in the VEH or FIELD positions.<br>(b) Same as in (a). Switch S-101 in TANK position.<br>(c) Between A of J-203 and chassis using M-4. Switch S-101 in VEH or FIELD position.<br>(d) Same as in (c). Switch S-101 in TANK position. | (a) 0.3 volt rms (approx).<br>(b) 0.7 volt rms (approx).<br>(c) 15 mw.<br>(d) 70 mw. | Check sidetone circuit components.<br><br>Check gain of audio amplifiers V-106 and V-108 (par. 52, item 1).<br><br>Defective switch S-101, R-138, R-140, or T-1.<br><br>Check these components and associated wiring. |

## 55. Signal Substitution

*a.* GENERAL. The purpose of the signal substitution or signal tracing checks described in this paragraph is to localize trouble to a particular stage or part within the circuit group of the receiver-transmitter, which has been shown to be defective by the trouble sectionalization charts of paragraphs 51 through 54. The data thus obtained serve also to determine whether alinement for a particular stage or stages is needed.

*b.* TEST EQUIPMENT. The test equipment required for the signal tracing checks is listed in paragraph 44.

*c.* TEST CONNECTIONS. The dummy antenna load, the cabling, and the power source should be connected as described in paragraph 46 and shown in figure 29. The connections for the test meters and the signal source are to be made as indicated in the stage gain charts included in this paragraph for the particular circuit under test.

*d.* SIGNAL TRACING IN RECEIVER. In general, the procedure of signal tracing described here consists of the following. Connect the meter to the final output circuit of the circuit group under test. Connect the signal generator successively to each of the input circuits preceding that output connection. For each connection of the signal generator, determine the level of the test signal required to obtain the reference reading on the meter. By comparing the values thus obtained with the data given in the stage gain chart, determine whether or not a particular stage provides the required gain. Failure to provide the required gain may be due to either a faulty component or tube within the stage, or to improper alinement. The signal generator and meter connections, the required test signal frequency and the required test signal levels, and the reference readings are given stage-by-stage in the stage gain chart, subparagraph *f* below.

(1) For signal tracing purposes the receiver is sectionalized into four major groups, as follows: audio amplifier stages, 1.4-mc i-f stages (including limiter and discriminator stages), 15-mc i-f stages (including 13.6-mc oscillator and 2nd mixer), the r-f stages (including variable 32- to 43.4-mc oscillator and 1st mixer).

(2) For measurements on the audio circuits the reference reading is the nominal audio power output of the receiver. The reference reading on the limiter meter is the reference level for measurements on all i-f and r-f circuits. See items (2) and (9) of paragraph 52.

*e.* SWITCH AND CONTROL SETTINGS. The following switch and control settings apply for all measurements on the receiver circuits:

| Switch or control | Setting |
|---|---|
| SQUELCH | OFF |
| VOLUME | Max clockwise |
| ANT ADJ — DIAL LIGHT (ON-OFF) — CAL | DIAL LIGHT-ON |
| Microphone push-to-talk button | Unoperated |
| Dial | To correspond to test frequency used (see Stage-by-stage gain chart). |

*f.* STAGE GAIN CHART. (1) *I-f circuits.* Perform the following steps in conjunction with the stage-by-stage gain chart.

(*a*) Connect test signal generator (G-1) between the grid of the indicated stage and chassis.

(*b*) Connect a vacuum-tube voltmeter (M-1) between test point E-104 and chassis.

(*c*) In all cases the meter should read the reference reading determined as in item (2), paragraph 52.

(2) *R-f circuits.* Perform the following steps in conjunction with the stage-by-stage gain chart.

(*a*) Connect the test signal generator (G-2) between the grid of the indicated stage or circuit and chassis.

(*b*) Connect a vacuum-tube voltmeter (M-1) between E-104 and chassis.

(*c*) In all cases the meter should read the reference reading determined as in step (9), paragraph 52.

**Stage-by-stage gain chart**

| Signal generator at grid of | Approximate input (uv) | Signal generator frequency (mc) | 2d limiter grid to ground voltage (volts dc) |
|---|---|---|---|
| V-105 | 2,000,000 | 1.4 | —1.4 |
| V-104 | 150,000[a] | 1.4 | —1.4 |
| V-103 | 12,000 | 1.4 | —1.4 |
| V-102 | 2,600 | 1.4 | —1.4 |
| V-102 | 5,200 | 15.0 | —1.4 |
| V-101 | 560 | 15.0 | —1.4 |
| V-11 | 76 | 15.0 | —1.4 |
| V-10 | 12 | 15.0 | —1.4 |
| V-10 | 150 | 15.0 | —11[a] |
| V-9 | 24 | 15.0 | —11 |
| V-8 | 15 | 47.0 | —11 |
| V-8 | 7 | 58.0 | —11 |
| ANT jack | 1.6 | 47.0 | —11 |
| ANT jack | .8 | 58.0 | —11 |

[a]Figures thus indicated are adjustment data and are exactly as indicated. All other figures are approximate.

(3) *Audio circuits.* Apply an r-f signal to the ANT connector at any convenient frequency within the tuning range of the receiver-transmitter. Tune in the test signal with dial. Adjust the signal level to 1 microvolt. Apply 1,000-cps modulation at 15-kc deviation. Connect a 600-ohm load between pin A of J-202 and chassis. Set VOLUME control to extreme clockwise position and SQUELCH control to extreme counterclockwise position. Use meter M-4 to make the measurements between the indicated test points and chassis.

| Point of measurement | Nominal reading (rms volts) |
|---|---|
| Pin A of J-202 | 6.9 volts (50 mw) |
| Pin 2 of V-108 | 38 |
| Pin 3 of V-108 | 1.9 |
| Pin 3 of V-106 | 3.2 |
| Pin 4 of V-106 | .45 |

*g.* ANALYSIS. Compare the signal generator output levels required to give the reference readings with the levels given in the chart. The tabulated data are nominal values. Nonuniformity in tubes, tolerances of components, etc., may be responsible for reading variations between sets as much as 20 percent. Interpret the test results with this fact in mind. In general, the fault in the circuit group lies between the point at which the abnormal 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. Large nonuniformity in the readings over the frequency range may be due to improper alinement of the r-f circuits. Refer to the schematic diagram (fig. 47), to identify the stage to which the trouble has been localized. An excessively high signal generator output level required to provide the reference reading may be due to a defective tube or circuit component or to misalinement of the stage.

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

(1) Turn the power supply off, and pull the tube out of its socket.

(2) Test the tube by means of a tube checker. If the tube is defective, replace it with a good one. If a tube checker is not available, substitute a tube known to be good for the suspected one.

(3) Turn on the power and measure the test socket voltages. Refer to paragraph 57 and to figures 33 and 34. Replace any defective components found by this procedure.

(4) Attempt to realine the receiver circuits, particularly if the measurements show consistently low gains or after a tuned stage has been extensively repaired.

(5) If alinement fails to improve the condition, investigate the possibility of mechanical defects, such as loose coupling to a capacitor shaft, broken tuning slugs, or defective trimmer capacitors.

(6) Measure the resistances at the tube socket of the defective stage. Refer to paragraph 56 and to figures 33 and 34 for the points of measurement and the required reading. Note that the information given is merely a guide and should suggest other tests, measurements, and procedures for localizing the trouble to defective parts or wiring. Replace any component found to be defective.

### 56. Resistance Measurements (figs. 33 and 34)

These checks are intended to serve as a guide for locating defective components or wiring in the stage or stages found to be defective by the signal substitution checks of paragraph 55. For these checks disconnect power from the receiver-transmitter. Use 20,000-ohm/-volt meter (M-3) as an ohmmeter. Replace any component or repair any wiring found to be defective.

*a.* Make the pertinent measurements indicated in figures 33 and 34. These measurements are all made from the socket terminal to ground. Carefully read the notes on the figure. These notes define the test conditions under which the indicated readings have been obtained. If, for some reason, a departure from the indicated test conditions is desired, the test results must be reinterpreted accordingly. This may be done by reference to the schematic diagram (fig. 47) and to the applicable functional diagrams in chapter 2. The required resistance readings are shown below the guide line from the socket terminal. It is not necessary to make all measurements shown in figures 33 and 34, but only those indicated at the tube sockets associated with the stage or circuit found to be defective by the signal substitution checks of paragraph 55 and the other trouble sectionalization checks.

*b.* If the resistance measurements made in accordance with subparagraph *a* above fail to reveal the cause of the trouble, make detailed measurements on individual components. Refer to parts list for coil data and to the schematic diagram (fig. 47) for circuit details.

### 57. D-C Voltage Measurements

*a.* MEASUREMENTS WITH 20,000-OHM/VOLT METER. Make the pertinent d-c voltage measurements indicated in figures 33 and 34. These measurements serve to locate defects which are not readily determined by the resistance measurements of paragraph 56, that is, defective capacitors, partially shorted transformer and coil windings, etc. For these measurements make sure that all tubes and crystals are seated firmly in their sockets, and apply power to the unit. All voltage measurements shown in the figures are made to ground. Refer to the schematic diagram (fig. 47) to identify the circuit components involved in a particular measurement. Note especially those circuits which are turned off or on by the operation of the microphone push-to-talk button, or by the grounding of terminal K of J-203.

Refer to paragraph 35. The required readings are shown above the guide lines from the socket terminals. In some cases two values of voltage are shown. Those within the parenthesis ( ) are voltages obtained when the push-to-talk button is operated. Those not in parenthesis are obtained when the button is unoperated, or when terminal K of J-203 or terminal F of J-202 is not grounded. Note that that values shown have been obtained with a 20,000-ohm/-volt meter. If a meter with another internal resistance is used, the values must be interpreted accordingly. Repair any part found to be defective as a result of the voltage measurements. The readings given should serve as a guide to other measurements for localizing the trouble to a particular component in the defective circuit. The values given are nominal values and some differences from unit to unit are to be expected.

*b.* MEASUREMENTS WITH VACUUM-TUBE VOLTMETER. The data given in the following table supplement the measurements indicated in figures 33 and 34. They also supplement (and in some cases repeat) the data given in the trouble sectionalization charts (pars. 52 and 54). Readings are obtained with a high-impedance vacuum-tube voltmeter, Electronic Multimeter TS-505/U (M-1). The points listed are such that the readings obtained with a low-impedance voltmeter lose significance because of the shunting effect of the meter. Except where otherwise stated, all measurements are made between the test point indicated in the table and chassis.

(1) *Measurements at receiver test points.* For the measurements listed below, use Electronic Multimeter TS-505/U. Turn the SQUELCH control to the extreme counter-clockwise (OFF) position. Measure between the indicated test point and chassis. The d-c voltage readings are obtained under a no-signal condition of the receiver and will vary approximately 20 percent and will vary also with setting of antenna trimmer capacitor C-41.

| *Point of measurement* | *Circuit or stage* | *Nominal voltage reading (d-c volts)* |
|---|---|---|
| E-105 | 2d limiter grid (V-105) | —2.5 |
| E-104 | 2d limiter grid (V-105) | —8.5 |
| E-103 | 1st limiter grid (V-104) | .8 |

(2) *Measurements at receiver oscillator grids.* For the following measurements, use Electronic Multimeter TS-505/U. Turn the SQUELCH control to the extreme counter-clockwise (OFF) position. Measure between the points indicated and chassis. The d-c voltage readings are obtained under a no-signal condition of the receiver. Set test switch as indicated. These measurements check whether oscillations are being sustained. Failure to get a reading points to a defective crystal or other component part.

| *Point of measurement* | *Circuit or stage* | *Test switch S-202 setting* | *Nominal reading (d-c volts)* |
|---|---|---|---|
| V-7, pin 6 | Calibrate oscillator | ANT ADJ | —20 |
| V-7, pin 6 | Calibrate oscillator | CAL | —20 |
| V-102, pin 4 | 2d receiver mixer oscillator | — | —3.0 |
| V-106, pin 6 | Beat oscillator | CAL | —4.0 |
| V-2, pin 5 | 32- 43.4-mc oscillator | — | —2.0 to —3.5 |

(3) *Measurement of discriminator output voltages.* The following measurements are a summary of the measurements made in paragraph 52, item (7).

(*a*) Connect Electronic Multimeter TS-505/U between test point E-106 and chassis.

(*b*) Connect 1.4-mc generator (G-1) through a .003-uf capacitor between pin 6 of V-104 and chassis.

(*c*) Adjust the generator to each of the frequencies indicated below, and to an output level of 150,000 microvolts (.15 volt) rms for each frequency.

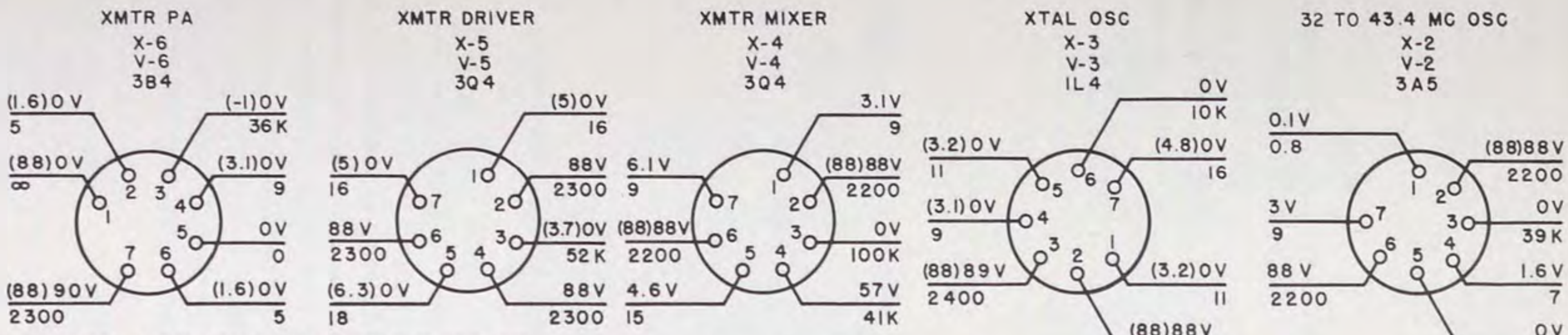
(*d*) The following readings should be obtained for a properly balanced discriminator.

| *Frequency (kc)* | *Normal reading (d-c volts)* |
|---|---|
| 1470 | +9 (peak) |
| 1330 | —9 (peak) |
| 1430 | +4 |
| 1370 | —4 |

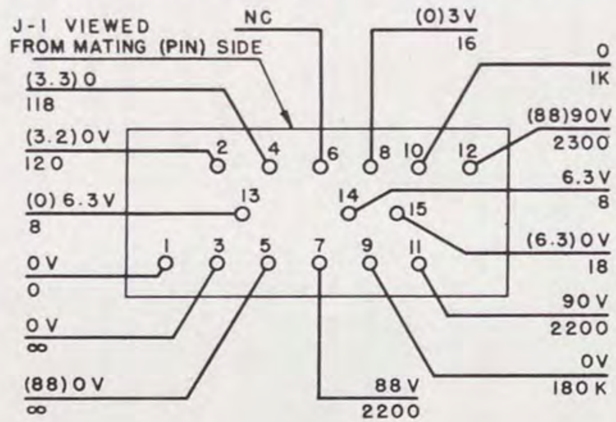
(4) *Measurements of squelch circuit voltages.* The following measurements supplement the checks of paragraph 52, item (14). Use Electronic Multimeter TS-505/U to make the indicated voltage measurements. Turn the SQUELCH control to the extreme clockwise position. Measurements are made between indicated points and chassis.

| *Point of measurement* | *Nominal reading (d-c volts)* |
|---|---|
| Pin 3 of V-107 | —70 |
| Pin 3 of V-108 | —60 |
| Pin 6 of V-8 | —2.6 |

(5) *Measurement of transmitter oscillator grid voltages.* Use meter M-1 to make the following measurements:




ALL TUBE SOCKETS SHOWN FROM WIRING SIDE OF CHASSIS.



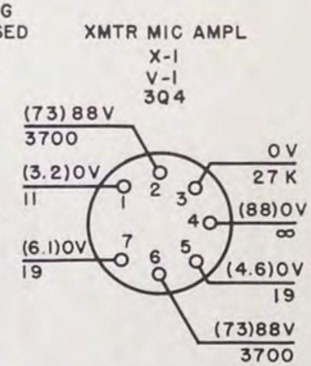

TABLE

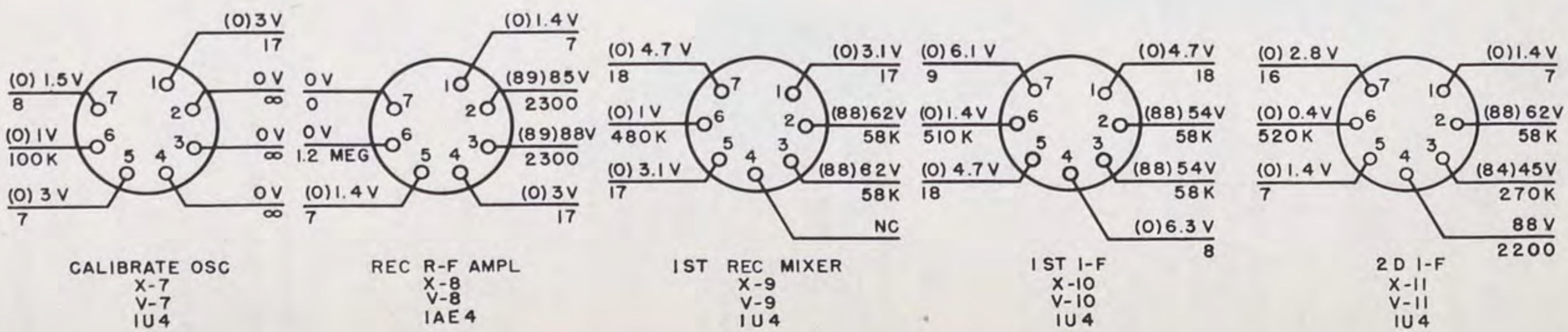
| V-7 PIN | |
|---|---|
| 2 | 87 V |
| 3 | 87 V |
| 4 | 88 V |
| 5 | 3 V |
| 6 | 1 V |
| 7 | 1.5 V |

(SEE NOTE 3)

TEST CONDITIONS:

1. S-101 IN TANK POSITION
2. S-202 IN DIAL LIGHT OFF POSITION
3. VOLTAGE READINGS FOR V-7 OBTAINED WITH S-202 IN CAL OR ANT ADJ POSITION ARE LISTED IN TABLE
4. SQUELCH CONTROL IN EXTREME COUNTERCLOCKWISE POSITION
5. VOLUME CONTROL IN EXTREME CLOCKWISE POSITION
6. WHERE TWO VOLTAGES ARE SHOWN, THE VOLTAGE READING IN PARENTHESIS IS OBTAINED WITH MICROPHONE SWITCH CLOSED (I.E., TERMINAL K OF J-203 GROUNDED)
7. ALL READINGS OBTAINED WITH 20,000 OHMS PER VOLT METER
8. NUMBERS ABOVE REFERENCE LINES ARE VOLTAGE READINGS, OBTAINED WITH NO SIGNAL
9. NUMBERS BELOW REFERENCE LINES ARE RESISTANCE READINGS, OBTAINED WITH ALL TUBES INSTALLED AND ALL EXTERNAL PLUGS DISCONNECTED
10. ALL MEASUREMENTS MADE BETWEEN POINTS INDICATED AND CHASSIS
11. NC INDICATES NO CONNECTION




TM290-33

*Figure 33. Resistance and voltage data, r-f chassis.*

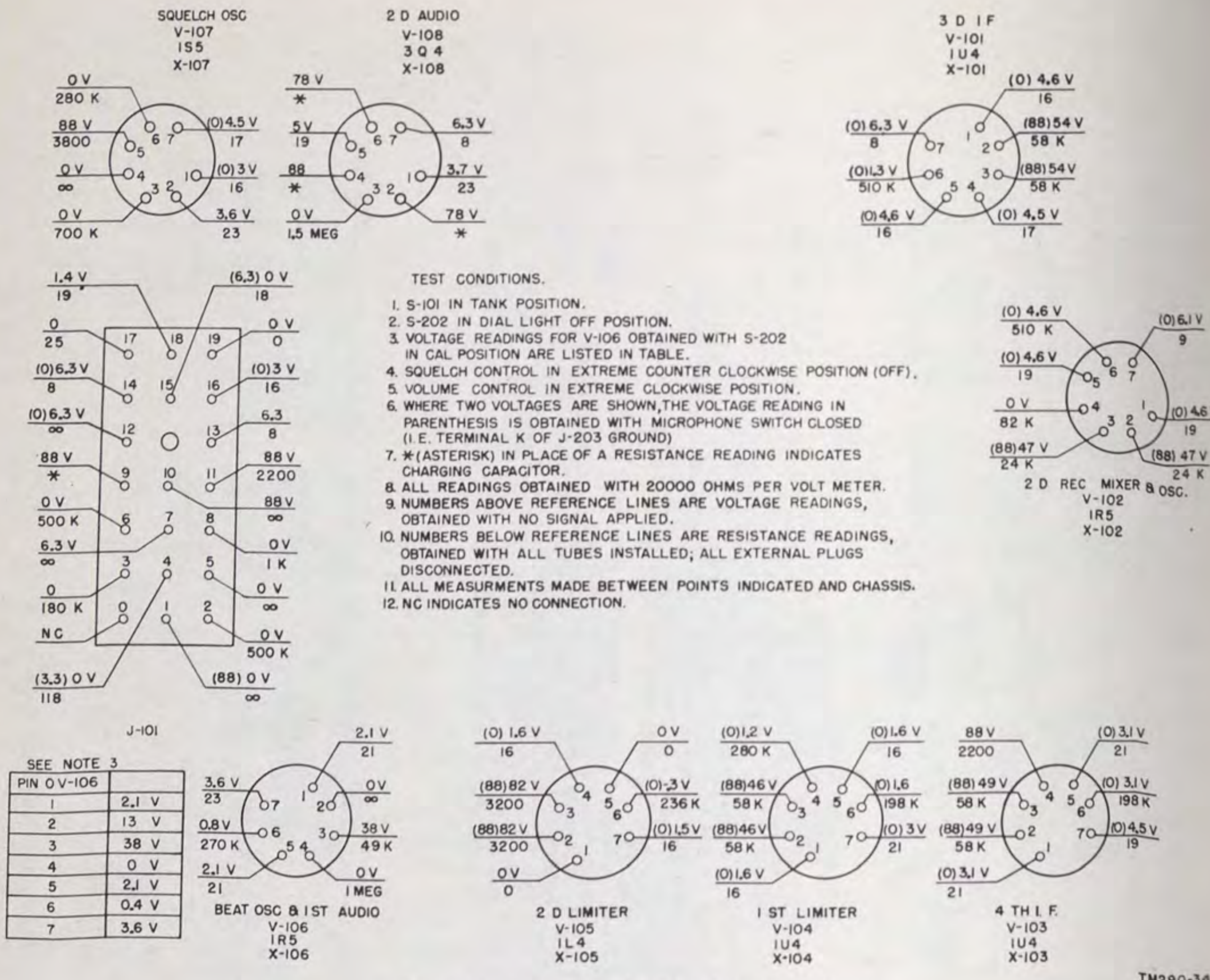



*Figure 34. Resistance and voltage data, i-f chassis.*

| Point of measurement | Test conditions | Nominal reading (d-c volts) |
|---|---|---|
| Pin 5 of V-2 | Dial set to 58 mc | —3.5 |
| Pin 5 of V-2 | Dial set to 47 mc | —2.0 |
| Pin 6 of V-3 | Operate microphone switch | —4.0 |

(6) *Measurements at transmitter test points.* Use Electronic Multimeter TS-505/U to make the following measurements. For these measurements the dial may be set in any convenient midscale position. Operate microphone to place transmitter on.

| Point of measurement | Nominal reading (d-c volts) |
|---|---|
| Between E-1 and pin 7 of V-5 | — .4 volt |
| Between E-2 and chassis | —5.5 volts |
| Between E-3 and pin 11 of J-1 | +1.7 volts |

## 58. Check of Interunit Strapping Connections

The continuity checks outlined below should be made to determine whether the strapping connections between panel-mounted multiconnectors in the receiver-transmitter are made properly. The strapping connections serve to interconnect the receiver-transmitter with other units of the system in which it is used. Using an ohmmeter, check for continuity between the points listed in the following table. In each case a reading of zero ohms should be obtained. Otherwise the wire connecting the two terminals in question is broken or the connector pin is defective. Repair as necessary.

| | |
|---|---|
| From term A of J-202 to term A of J-203 | From term C of J-202 to term C of J-203 |
| From term J of J-202 to term E of J-203 | From term F of J-202 to term K of J-203 |
| From term B, E, and H of J-302 to chassis | From term D of J-203 to chassis |

## Section II. REPAIRS

### 59. Repair Procedures

This section describes the procedure for disassembling the major subassemblies of Receiver-Transmitter RT-70/GRC, removal and replacement of components, and subassemblies found to be defective by the trouble-shooting procedures of the preceding section and by the inspection procedure described below.

### 60. Disassembly for Inspection, Cleaning, and Repair (figs. 35 through 41)

*a.* OUTER CASE. To remove the outer case proceed as follows: Loosen the four Dzus fasteners distributed around the edges of the front panel. Slide the panel-and-chassis assembly out of the case. 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. The component side of the r-f and i-f chassis can be inspected and cleaned without taking the assembly apart. However, to gain access to the r-f coils, to components mounted on the back of the panel, or to components mounted between the two chassis, it is necessary to remove either the i-f chassis or the r-f chassis. It is preferable to remove the i-f chassis first, in accordance with the procedure outlined in the following subparagraphs. Under certain conditions, especially if parts are to be replaced on the panel or on the r-f chassis, it is desirable to remove the r-f chassis next. A disassembled view of the unit is shown in figure 35.

***Caution:*** Be very careful during the disassembly procedure; the assembly is somewhat intricate and the parts are delicate. Careless handling may cause damage to parts. Side pressure on the coupling between the dial drive assembly and the shaft of the gang capacitor may cause damage to the gang capacitor or the coupling.

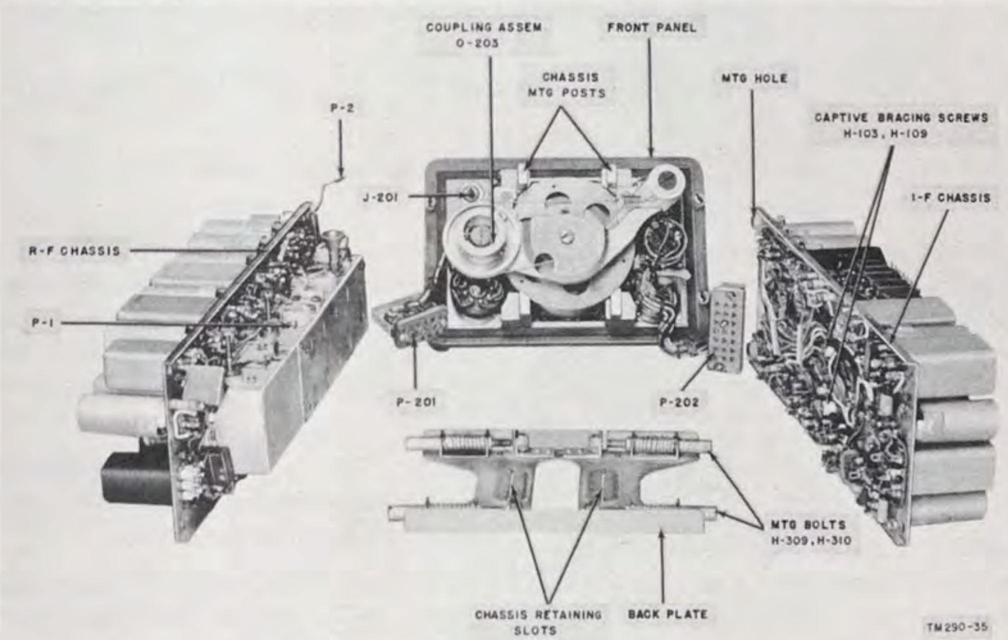



*Figure 35. Receiver-Transmitter RT-70/GRC, disassembled view.*

*b.* REMOVAL OF I-F CHASSIS. To disengage the i-f chassis from the rest of the equipment, proceed as follows. Component and wiring side views of the i-f chassis are shown in figures 37 and 38, respectively.

(1) Place the unit on a solid support in its correct operating position.

(2) Withdraw multiconnector P-202 from J-101 (fig. 7) on the i-f chassis. These connectors are located on the chassis near the panel.

(3) Disengage the pin connector P-1 (fig. 5) joining the plate of V-11 on the r-f chassis to pin 2 of T-101 on the i-f chassis. This lead is located on the top rear of the panel-and-chassis assembly.

(4) Remove the back plate as follows: loosen the two large retaining bolts (fig. 7) which hold the back plate to the i-f chassis. These bolts are located in the rear corners of the chassis.

(5) In the manner similar to that described above, remove the two retaining bolts which hold the back plate to the r-f chassis (fig. 6). These bolts are located in the rear corner of the r-f chassis.

(6) Remove the back plate.

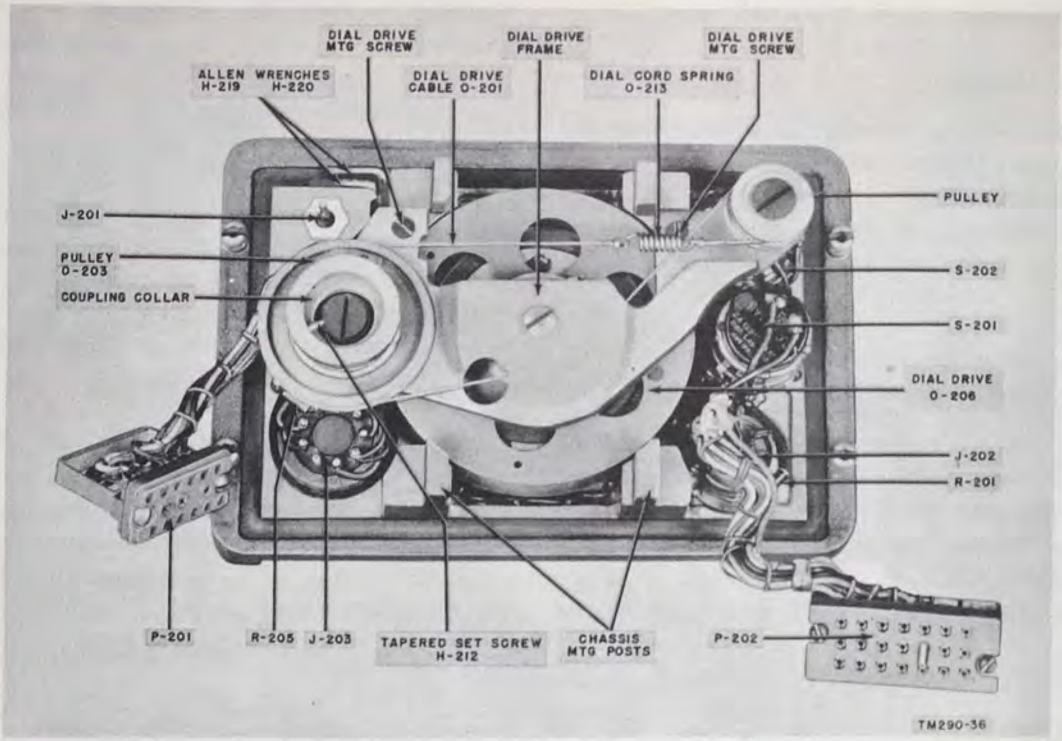



*Figure 36. Receiver-Transmitter RT-70/GRC, rear view of panel.*

(7) Remove the two captive bracing screws located on the i-f chassis (fig. 7) just in front of relay O-101. These screws engage threaded holes on the r-f coil compartment (mounted on the wiring side of the r-f chassis) and assure a secure and rigid panel-and-chassis assembly.

(8) Remove the two chassis mounting screws (fig. 5) which hold the i-f chassis to the projections from the rear of the panel.

(9) Very carefully lift the i-f chassis away from the rest of the assembly, taking care not to bend the chassis out of shape or to damage any of the components mounted on either the r-f or i-f chassis.

*Note.* For most purposes it will not be necessary to disassemble the unit further. Disengage the r-f chassis from the panel only as need arises.

*c.* Removal of R-F Chassis. Component and wiring side views of the r-f chassis are shown in figures 39, 40, and 41. To disengage:

(1) Withdraw multiconnector P-201 from J-1. This connector is located on the r-f chassis near the panel (fig. 6).

(2) Disengage pin connector P-2 (fig. 6) from the pin on the ANT connector J-201 at the rear of the panel.

(3) Using a No. 564 Allen wrench (located in a bracket on the back of the front panel) (fig. 5) release the No. 8 set screw associated with the GREEN dot on the coupling between the large pulley on the dial drive mechanism and the gang capacitor. The set screw becomes accessible by turning the tuning dial to the 47 MCS position and is the set screw which is flush with the rim of the coupling (fig. 6).

*Note.* Two recessed set screws associated with the red dots are not to be touched. These set screws hold the coupling to the dial drive mechanism.

(4) Remove the two chassis mounting machine screws (fig. 5) which hold the projections from the rear of the panel to the r-f chassis.

(5) Carefully lift the r-f chassis from the panel. Be careful not to cause damage to couplings, gang capacitor shaft, or to components.

### 61. General Inspection of Chassis

If the unit has been disassembled as described in the preceding paragraph, it is possible to inspect all parts and wiring. Inspect the unit thoroughly for any abnormal conditions. If any are found, the cause of such conditions should be determined and the defects remedied. Repair instructions for defective components, located by the inspection described below or by the trouble-shooting procedure described in the preceding paragraphs, are given in paragraphs 63 and 64.

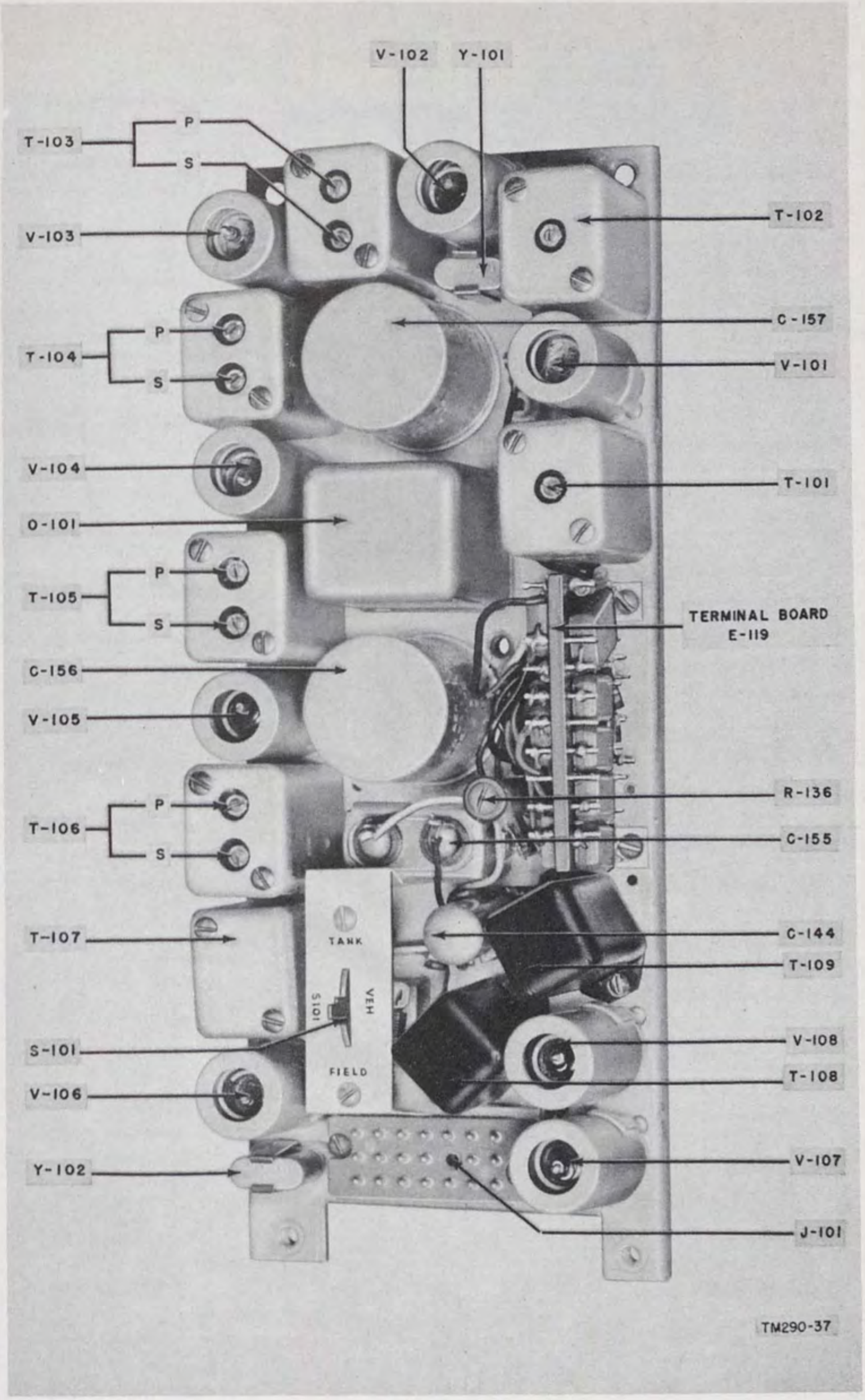



*Figure 37. Receiver-Transmitter RT-70/GRC, component side of i-f chassis.*

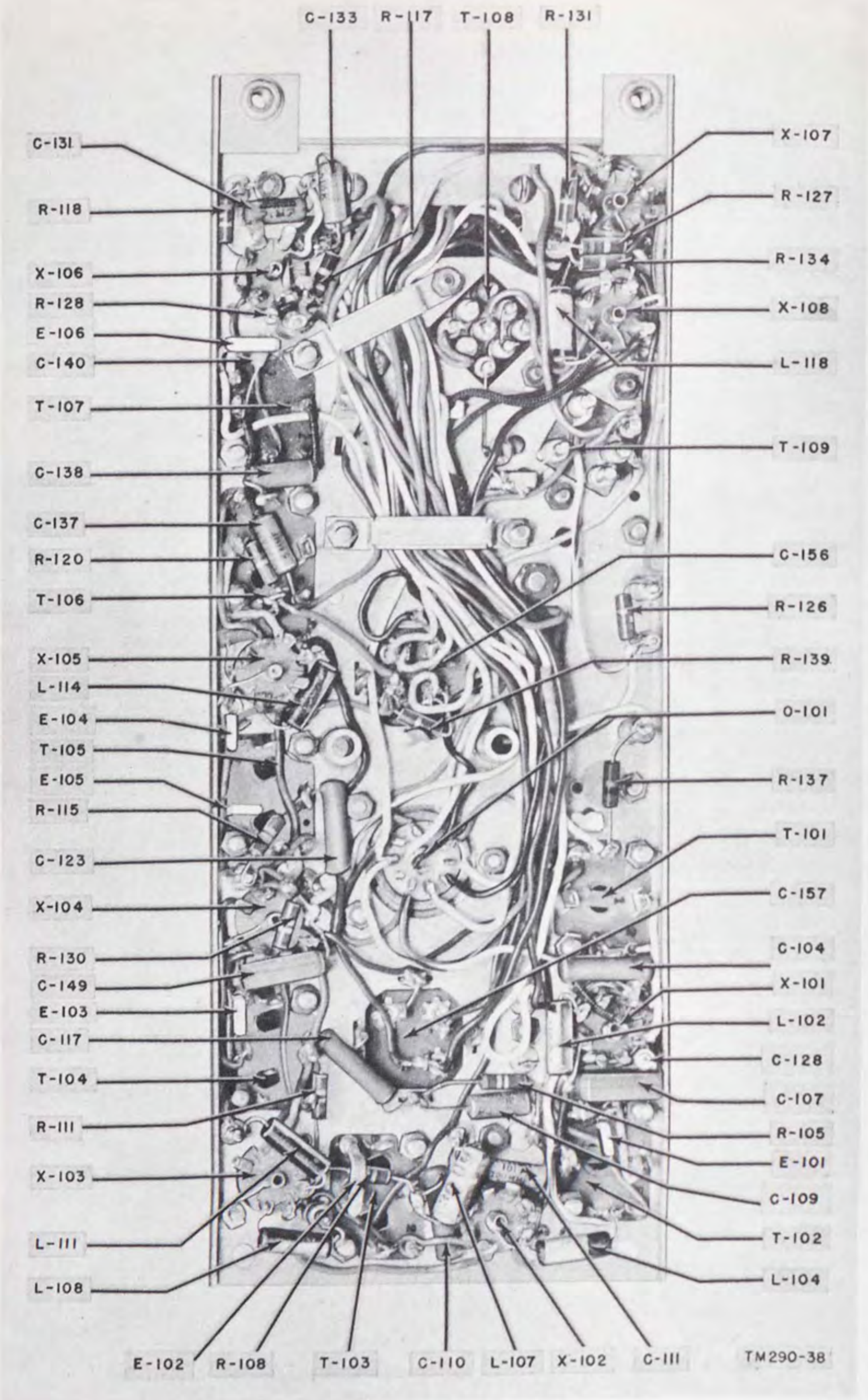



*Figure 38. Receiver-Transmitter RT-70/GRC, wiring side of i-f chassis.*

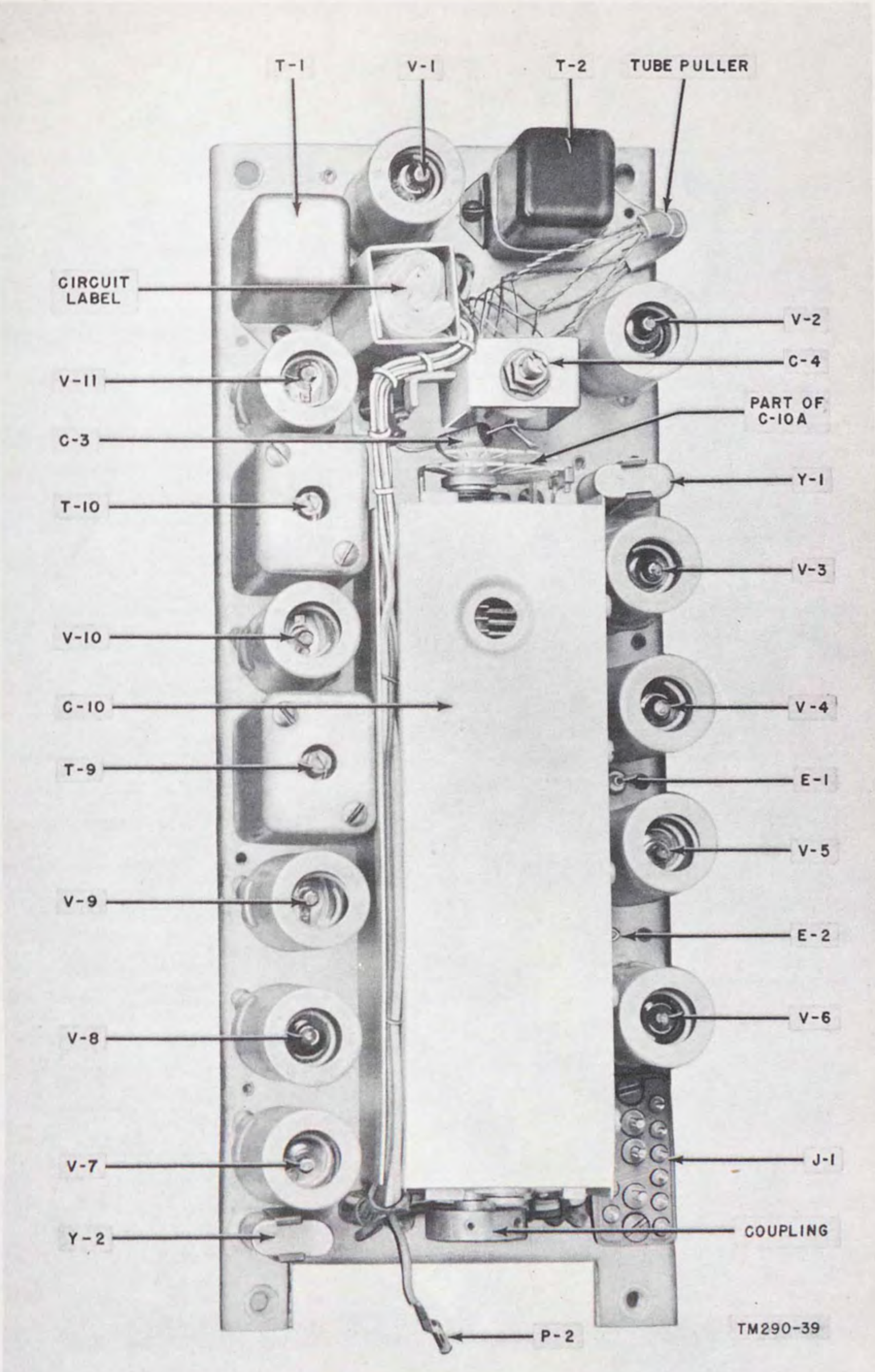



*Figure 39. Receiver-Transmitter RT-70/GRC, component side of r-f chassis.*

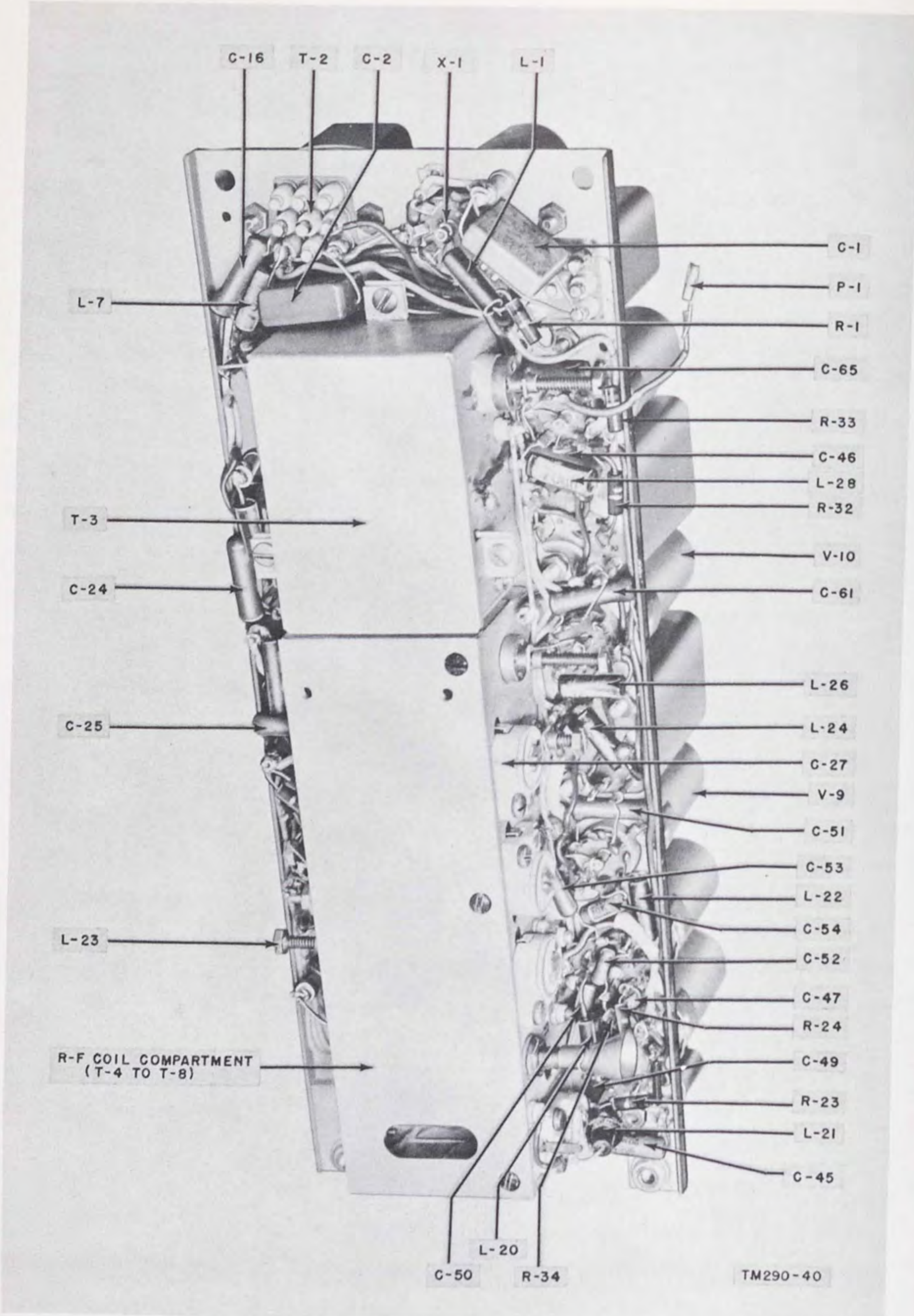



*Figure 40. Receiver-Transmitter RT-70/GRC, wiring side of r-f chassis.*

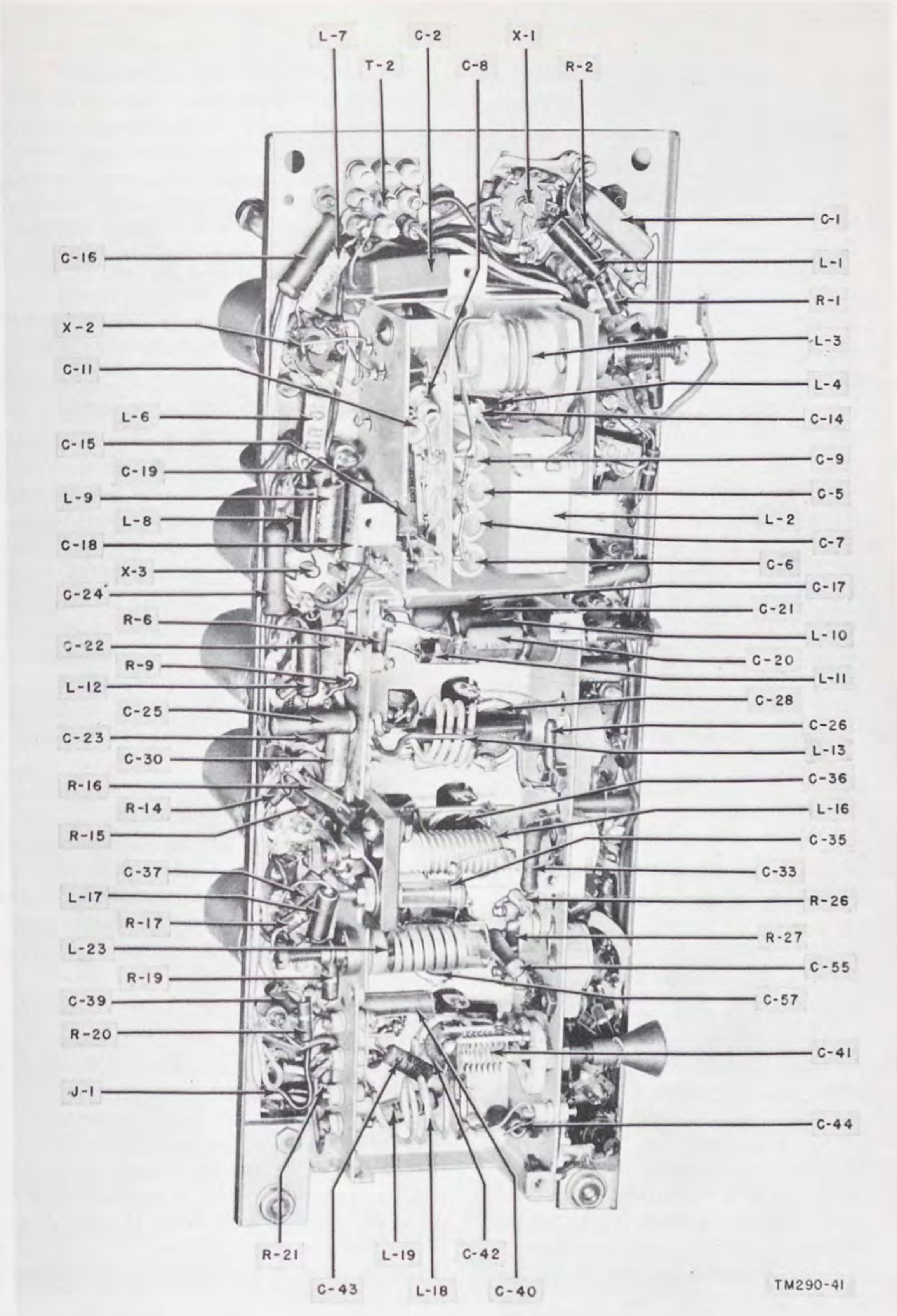



*Figure 41. Receiver-Transmitter RT-70/GRC, wiring side of r-f chassis, with coil compartment covers removed.*

*a.* Inspect all parts for rust, corrosion, breakage, or other damage.

*b.* Inspect wiring for loose connections, frayed or burned insulation, and mounting hardware for mechanical defects. Examine the chassis for dirt and corrosion.

*c.* Examine lugs on capacitors, transformers, chokes, switches, connectors, and tube sockets for loose connections or breaks. Examine all switches, 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 set which are very difficult to locate except by visual inspection.

*d.* Inspect all sockets for broken, excessively spread, or corroded and dirty contacts. Check mounting hardware and mounting rivets to determine that sockets are held firmly to the chassis. Check that tube shields are held firmly in their bases when installed and that springs are seated properly within the tube shield.

*e.* Examine connectors for loose mounting hardware, dirty or corroded contacts, or improper contact tension. Where applicable, adjust and try the action of the connector after adjustment. Make sure that solder connections and wiring to the connectors are not broken, frayed, or loose. Make sure that handles are screwed firmly in, since the loose handle may short-circuit connector lugs.

*f.* Examine fixed capacitors for signs of discoloration, leaks, bulging, dirt, loose mounting hardware, or loose connections. Melted or oozing wax or other dielectric is a sign of damage to the part. Such capacitors should be tested electrically and replaced with good ones if found to be defective.

*g.* Examine resistors for blistering, discoloration, or other signs of overheating. Inspect connecting leads for corrosion, dirt, dust, looseness, and broken or trailing strands of wire. Discoloration of a resistor usually indicates that the component has been operated under overload. Overheating is a sign of a defect in another part.

*h.* Inspect the variable capacitor on the r-f chassis for accumulation of dirt, dust, or lint. Examine the plates for signs of damage, misalinement, or binding that would cause them to touch other plates during turning. Check for loose terminals, mounting hardware, and connections. Make sure that the two slotted plates on the rear shaft of the capacitor are mounted firmly, and that in the extreme counterclockwise position of the capacitor shaft the last segment on the plates lines up with the index mounted on projections from the capacitor. This index represents the fixed plate of the notched oscillator tracking plates (fig. 39).

*Note.* Unless trouble with the capacitor is definitely suspected, it is not advisable to remove the capacitor cover. When doing so be careful not to damage or bind the capacitor plates.

*i.* Remove the covers of tuning assemblies mounted on the wiring side of the r-f chassis (fig. 40) by removing the retaining screws at the top and side of the cans. Examine the components inside the cans (fig. 41) to make sure that they are not damaged, that the wiring between the components and to the terminal lugs (on the side walls of the assembly) is not broken, frayed, or loose. Check the tuning slugs (on the side walls of the assembly) to make sure that they are not loose or broken and that the spring clips are installed. These spring clips insure that the tuning slugs remain firm after adjustment.

***Caution:*** Do not turn adjusting slugs since they will throw the set out of alinement.

*j.* Examine spring clips and crystal sockets to make sure that the crystal is held firmly to the socket.

*k.* Operate switches on the panel (fig. 1) and on the i-f chassis (fig. 37) to each one of their operating positions to determine that they work easily with no searching for contacts. Where switch contacts are accessible, examine for evidences of corrosion, improper contact, or dirt. Proper switch contact may best be determined by continuity measures.

*l.* Check that all metal shield cans of tuning assemblies on the r-f and i-f chassis are firmly mounted to the assembly posts. Loose shield cans may contribute to noise and poor operation of the equipment. Mounting hardware and rivets associated with containers should be tightened, if necessary.

## 62. Cleaning

*a.* Dirt or corrosion will interfere with electrical continuity and mechanical efficiency of the parts and of 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 it collects. Cleaning should be done with a lintless cloth, fine sandpaper (#000), crocus cloth, or a soft brush. Dust and grease can usually be removed with a cloth or brush moistened with solvent (SD). Never use gasoline for cleaning. Extra care must be exercised in cleaning delicate parts or parts which are difficult to reach, in order to avoid damage to wiring or parts. Where it is necessary to remove portions of moisture-fungusproofing in order to clean a part properly, refinishing is essential. Refinishing information is given in paragraph 68.

*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 parts, such as resistors and capacitors, does not result. To determine that the air stream does not carry oil or water, place a clean white sheet of paper in its path and observe any evidences of streaking or moisture.

*d.* When handling the chassis during cleaning, or at any other time, be careful not to break wiring or small parts with fingers. Lift the chassis by the metal sides and keep fingers off the insides where small wires and components are located.

*e.* Clean cases of fixed capacitors and other components to 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.

*f.* Clean small components, such as resistors, with a small brush. Clean dirty or corroded socket, connector, and switch contacts with crocus cloth to remove corrosion; then clean with solvent (SD). Handle wafer switches with care. The wafers are fragile.

*g.* Before cleaning moving parts, such as variable capacitors, or parts which accumulate dirt easily and are difficult to reach, clean the chassis in general. Check for and blow out dust or dirt. If available use an air hose. Be careful not to break or damage wiring or components during the process of cleaning the chassis.

*h.* Remove all dust and lint between variable capacitor plates, in the capacitor container, and at the point where the plates are held to the capacitor shaft, by blowing out with an air hose. Be careful not to bend, distort, or otherwise damage the plates. Clean mounting bushings, mounting hardware, trimmer capacitors, and couplings associated with the variable air capacitor.

### 63. Replacement of Parts

When replacing parts in Receiver-Transmitter RT-70/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. With a small tag or short pieces of adhesive tape, identify all wires in accordance with their numbered conditions. Identify every lead that is to be removed. Refer to the schematic diagram, figure 47.

*b.* PARTS AND SUBSTITUTION. When damaged parts must be replaced, identical parts should be used. 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 regeneration hum, noise, or crosstalk and is not recommended.

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

*e.* RETROPICALIZATION. If the parts being replaced require a special treatment, such as retropicalization, follow the instructions given in TB SIG 13 and TB SIG 72.

### 64. Special Repair Procedures

Most of the parts in the receiver-transmitter are readily accessible and can be replaced without special procedure instructions. Most of the small components, namely, resistors, small capacitors and small choke coils, are wired point-to-point directly to the lugs of sockets and terminals of tuning units. In replacing these parts, care must be exercised not to damage adjacent components. Special procedures for repairing or replacing sockets, connectors, and some of the more complicated subassemblies are given in the following subparagraphs. Since the unit is very compact and many of the components are sandwiched in between the i-f and r-f chassis, it will be necessary to disassemble the unit as described in paragraph 60 before the mechanical repair and replacement procedures described below can be followed. In many cases disassembly of the unit before the part is replaced will prevent damage to other parts. It is a matter of judgment to decide when it is necessary to disassemble the unit and when it is possible to do the replacement without disassembly.

*a.* SOCKETS. All tube sockets are attached to the chassis with rivets. To replace a socket proceed as follows:

(1) Disassemble the particular chassis from the rest of the unit to prevent possible damage by the tools used in removing the part.

(2) Remove the tube shield and the tube plugged into the socket.

(3) Unsolder the wires connected to the socket.

(4) Drill out the two rivets fastening the socket to the chassis.

(5) Substitute a new socket and fasten it with machine screws, lockwashers, and nuts, or with rivets. Make sure that the socket is keyed the same way as the socket which was removed.

(6) Resolder the wires and components to the socket.

(7) Clean the chassis thoroughly to remove solder drops or metal chips.

(8) Check the new connections with those shown on the schematic diagram (fig. 47).

*b.* STAND-OFF INSULATORS. The stand-off insulators have rivet type bars. To remove, unsolder the leads attached to the insulator and drill out the rivet. Substitute a new insulator and spread the unit type base with a nail punch or suitable tool.

*c.* PANEL CONNECTORS. A spanner wrench or long-nosed pliers is necessary. The procedure is as follows:

(1) Disengage the panel from the rest of the assembly to gain access to the rear of the panel (fig. 36). Insert the teeth of the spanner wrench into the notches in the nut of the connector on the front panel. Turn the spanner wrench in the counterclockwise direction until the nut is removed. Remove the lockwasher.

(2) Unsolder all wires.

(3) Remove the connector from the rear of the panel.

(4) In selecting a new connector make sure that the new part has a rubber gasket.

(5) Resolder all wires to the new connector.

(6) Clean thoroughly to remove solder drops.

(7) Recheck the new connections with those shown in the schematic diagram (fig. 47).

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

(9) Reinsert the lockwasher and the nut by use of the spanner wrench.

(10) Screw the nut on the connector. Check the assembly for tightness.

(11) Reassemble the panel to the rest of the unit.

*d.* REPLACEMENT OF R-F COILS. The r-f coils of both the transmitter and the receiver are located in compartments of an assembly mounted on the wiring side of the r-f chassis (fig. 41). The location of parts, terminals, and tuning controls in the r-f coil compartment is detailed in figure 42.

(1) Disassemble the r-f chassis from the rest of the panel-and-chassis assembly as described in paragraph 60. Place the r-f chassis with the wiring side up.

(2) Remove the six (three on top and three on the side) machine screws which hold the cover of the coil compartment in place. Remove the cover. The partitions separating the r-f coils from each other are part of the cover.

(3) To replace any one of the r-f coils proceed as follows:

(*a*) Unsolder the leads connected to the coil. In doing this be careful not to damage the delicate coil windings.

(*b*) Unscrew the large nut located on the outer side of the compartment frame. In doing this be sure not to lose the small spring clip which grips the tuning slug to the nut. This clip insures that the tuning slug holds its adjustment.

(*c*) Remove the coil.

(*d*) Insert the replacement coil.

(*e*) Resolder all connections and restore the nut and tuning slug assembly. Make sure that the spring clip is in place, otherwise the tuning slug will get loose and come out of adjustment.

(*f*) Carefully clean away all solder drops.

(4) Replace the cover and mounting screws.

*e.* REPLACEMENT OF VARIABLE GANG CAPACITOR C-10. The variable gang capacitor C-10 is mounted on the component side of the r-f chassis. To replace the capacitor it is necessary to remove the r-f chassis from the rest of the assembly and to proceed as follows:

(1) Turn the unit, wiring side up, and remove the r-f coil compartment cover, as described in the preceding subparagraph.

(2) Unsolder all the leads from the capacitor lugs projecting through holes in the chassis plate into the r-f coil compartment.

(3) Remove the two screws at the front end of the capacitor and the one screw at the rear of the capacitor, which hold C-10 to the chassis.

(4) Lift the capacitor off the chassis.

**Caution:** Do not remove the coupling or the slotted plates from capacitor shaft. If these plates are broken, replace the capacitor.

(*a*) Place the repaired or new capacitor on the r-f chassis so that the holes in the mounting brackets at the front and at the rear of the capacitor line up with the corresponding holes on the chassis plate.

(*b*) Insert and tighten the three mounting screws.

(*c*) In placing the capacitor on the chassis make sure that the capacitor lugs clear the holes on the chassis plate.

(*d*) Reconnect all solder connections to the capacitor lugs, making sure that the proper connections are made.

*f.* REPLACEMENT OF COMPONENTS IN SHIELD CANS. The tuning units on the r-f and i-f chassis are mounted by means of two studs, which are part of the tuning unit assembly, and two nuts. To replace the unit as a whole, unsolder the leads and remove the two nuts on the wiring side of the chassis. To gain access to components within the can remove the two screws at the top of the can which hold the cover to the assembly. Lift off the cover.

*g.* REPLACEMENT OF DIAL DRIVE CABLE. To replace the dial drive cable, it is necessary to disengage the panel by removing the i-f and r-f chassis as described in paragraph 60. The cable replacement procedure is illustrated in figure 43. The steps indicated in figure 43 are keyed to the procedure outlined below. The procedure assumes that a cable, fitted with terminal lugs at each end, is available. (Since a special crimping tool is required to attach the lugs to the cable it is not advisable to attempt preparation of the cable unless such a tool is available.) First remove the pulley holder from the dial drive assembly. To do this, remove

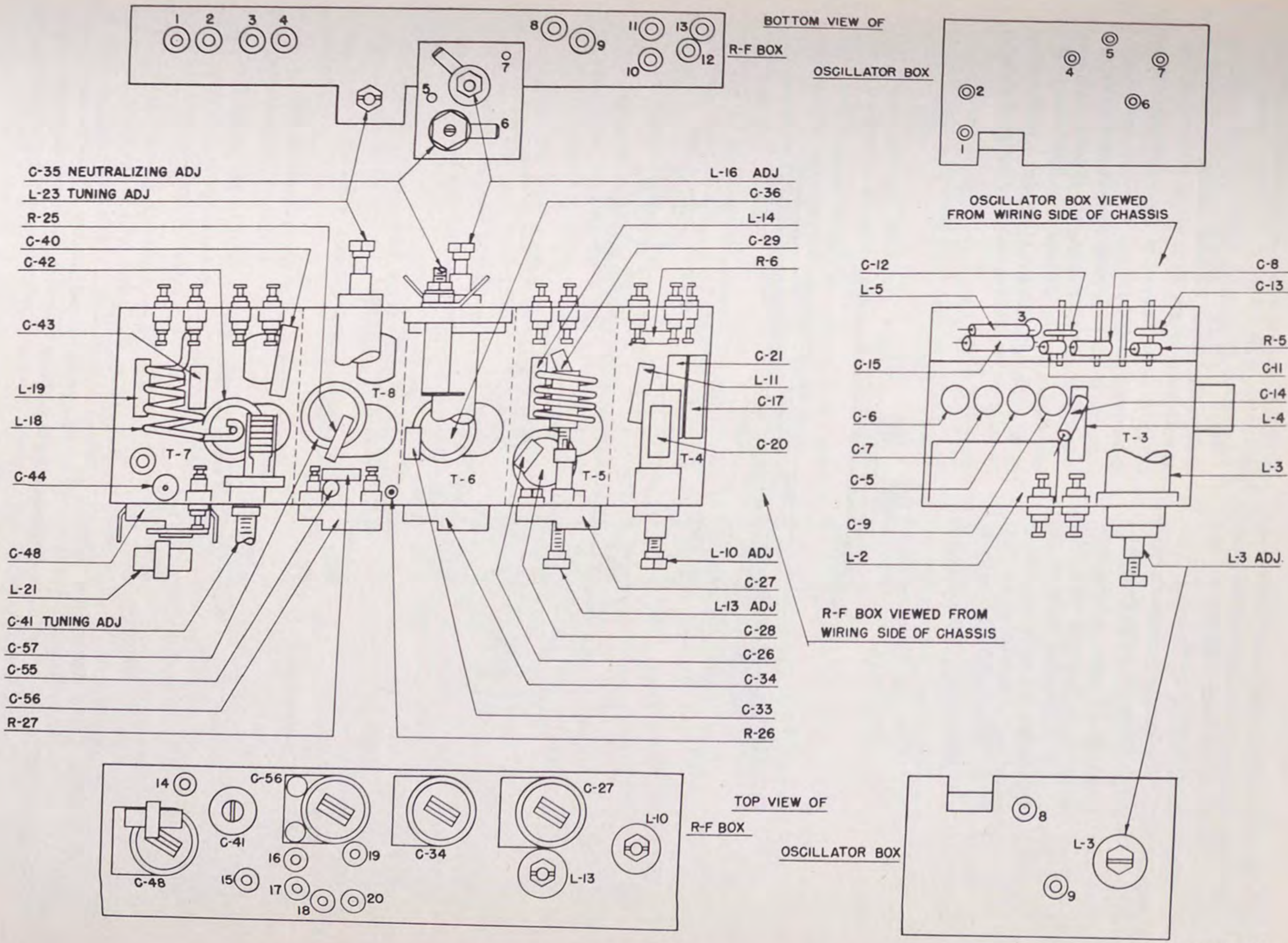



*Figure 42. RF coil compartment, component location diagram.*

the large screw which mounts the pulley holder to the drum assembly. This screw is located at the center of the drum (step 5 below). Now proceed as follows: Remove the two screws which mount the holder to the panel.

Step 1. Rotate the dial (with knob on front panel) to its lowest frequency setting until it comes to rest at the stop.

Step 2. Measure and mark off 15 inches of cable from the end of one terminal lug. (The length of cable from that lug to the 15-inch mark is identified below as the long cable section, and the terminal lug as the long end of the cable. The other terminal lug is identified as the short end of the cable.) Fasten the cable assembly to the drum so that the long end of the cable faces the large pulley and the 15-inch mark on the cable coincides with the centerline (C) of the clamp.

Step 3. Wrap the short end of the cable (end facing small pulley) around the drum assembly, as shown in the cable diagram of figure 43.

Step 4. Insert long end of the cable through the hole in the pulley holder.

Step 5. Reattach the pulley holder to the drum assembly.

Step 6. Rotate the coupling (large pulley) until screw hole marked with green paint is pointed outward and is on the horizontal centerline of the dial drive. Now clamp the cable to the coupling and wrap around as shown in the cabling diagram.

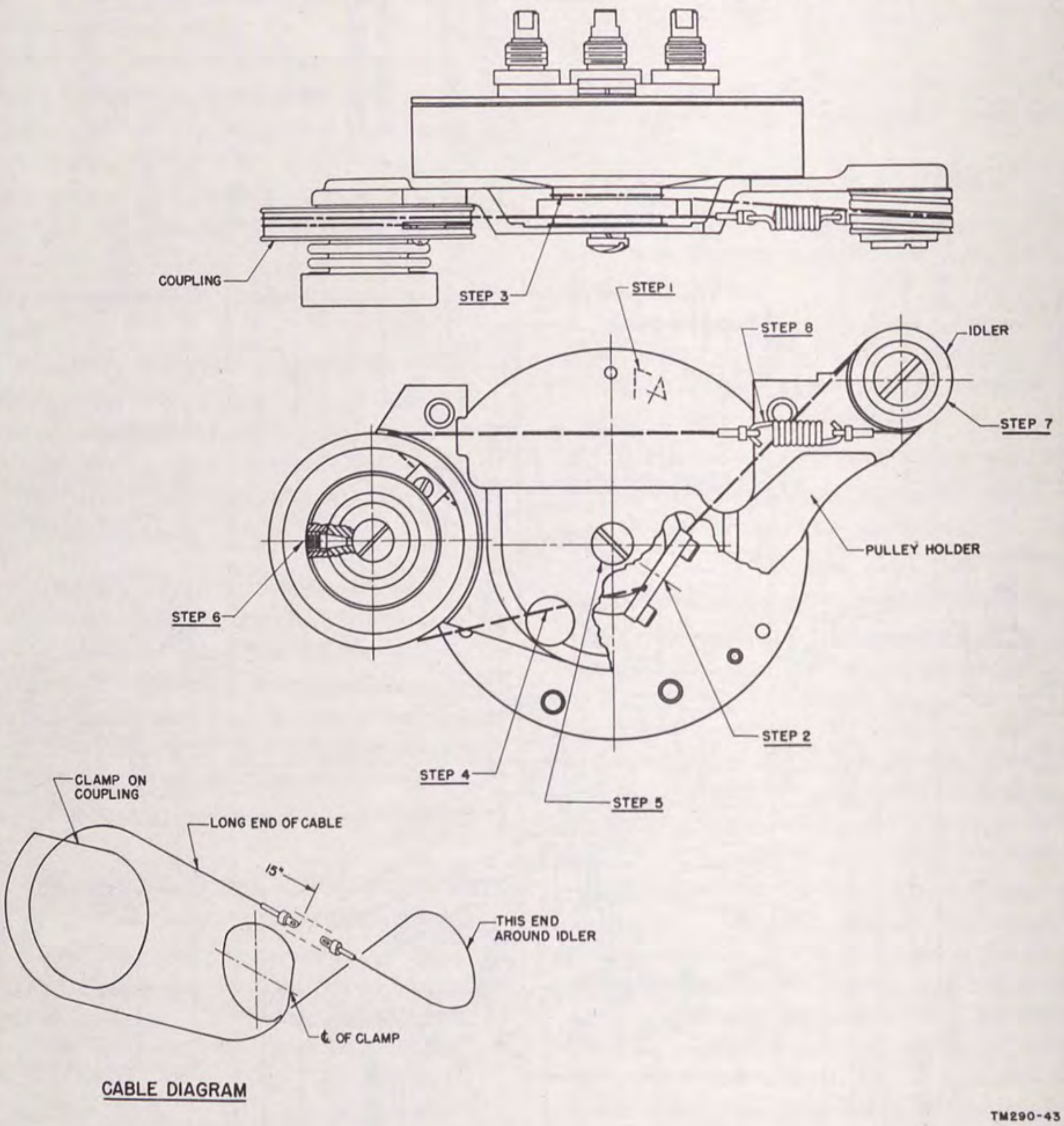



*Figure 43. Replacement of dial drive cable.*

Step 7. Set the idler pulley (small) in the approximate position shown in figure 43. Wrap the cable around the idler pulley as shown in the cable diagram and in the profile drawing of the assembly (top portion of fig. 43).

Step 8. Attach the spring to the two terminal lugs at the ends of the cable.

Step 9. Check the assembly by rotating the dial toward the high-frequency end, and then back. Make sure that there is no scraping, binding, or slipping and that the dial tunes properly over the entire range.

*h.* DIAL DRIVE MECHANISM. To replace the dial drive assembly proceed as follows:

(1) Remove the screw which holds the knob to the dial drive shaft on the front panel. Remove the knob and the vernier plate.

(2) Remove the screw which holds each of the detent levers to the detent shafts. Remove the levers.

(3) Using a spanner wrench or a pair of long-nosed pliers remove the nuts which hold the shafts to the panel.

(4) Remove the two screws holding the pulley holder to the front panel..

(5) Lift the dial drive mechanism off the rear of the panel, being careful not to loosen the rubber O ring behind the panel.

(6) To replace, reverse the above procedure.

*i.* REPLACEMENT OF DIAL LAMP. To replace the dial lamp, unscrew the dial lamp cover. This will give access to the dial lamp, which is held in a spring-type socket.

*j.* SWITCHES. The panel-mounted switch S-202 may be removed as follows:

(1) Disconnect the panel from the rest of the assembly.

(2) Remove the dial drive mechanism as described above.

(3) Unsolder all wires from the switch, making sure to tag the leads, to enable proper replacement.

(4) Remove the switch knob by removing the knob retaining screw.

(5) Remove the castellated nut, using a spanner wrench or long-nosed pliers.

(6) The switch can now be removed from the rear of the panel. In working the switch away from the panel, make sure not to damage the switch.

(7) When replacing the switch, make sure that the key on the switch fits into the keying hole on the panel. Be careful in handling the switch, since the wafer is fragile. Examine contacts to make sure that they are made properly and that the switch turns freely to its four positions. Note that the two end positions on the switch are spring return and check whether the switch is returned from each of its end positions to the adjacent inner position.

(8) Restore the mounting nut and the knob.

(9) Resolder all connections and check against the schematic diagram (fig. 47). Clean away all solder drops.

(10) Replace the pulley holder.

*k.* TERMINAL BOARD. The terminal board on the i-f chassis (fig. 37) mounts resistors and capacitors. Figure 44 shows the location of components on that terminal board. Components mounted on that side of the board facing toward the outside of the panel-and-chassis assembly can be replaced without removal of the board. To gain access to components mounted on the side of the board facing toward the chassis, remove the two mounting screws which hold the brackets to the chassis and tilt the terminal board back. After the defective component has been replaced, remount the board.

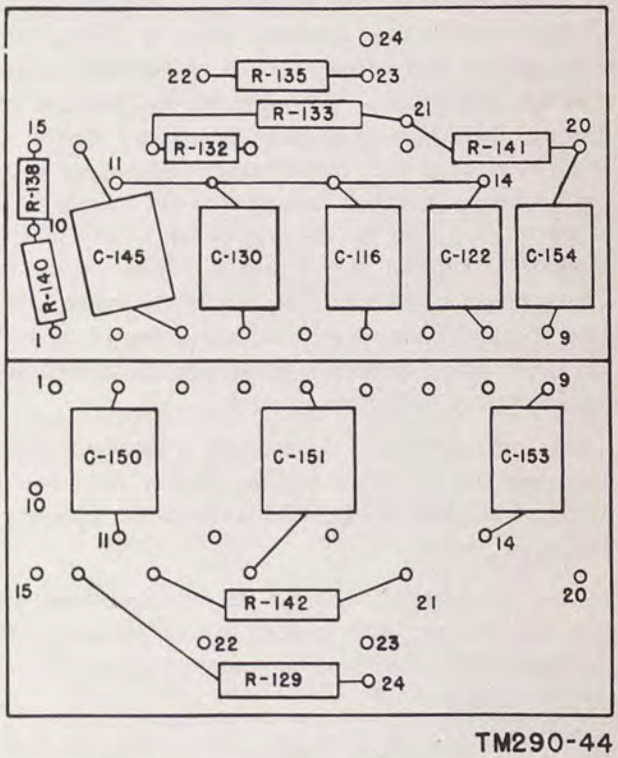



*Figure 44. Terminal board component location diagram.*

*l.* TUBES. A tube puller is provided to permit removal of tubes from their sockets. This tube puller is mounted at the rear of the r-f chassis (fig. 39). To remove a tube, remove the tube shield and then, using a tube puller, remove the tube from its socket. Press the puller well over the tube and pull in a direction perpendicular to the chassis. Avoid jiggling or rocking the tube in its socket to prevent damage to the prongs. Label any tube as soon as it is removed so that it can be replaced in its proper socket. Tube reference symbols are stamped on the chassis alongside the tube socket.

*m.* CIRCUIT LABEL. A circuit label, rolled up in a compartment on the rear of the r-f chassis, is provided to permit identification of electrical parts and circuit components to be repaired or replaced. Make sure to replace the circuit label in its compartment after the repair of the equipment has been completed.

## 65. Reassembling the Equipment

In general, the procedure for reassembling the equipment follows the reverse of the procedure for disassembling the unit (par. 60). The recommended order is to attach the r-f chassis to the front panel first. After that is done, attach the i-f chassis to the panel. Next, reattach the back plate, restore the bracing screws, and reattach all connectors. This procedure is outlined in the following subparagraphs.

*a.* R-F CHASSIS. (1) Set the dial to its lowest frequency setting.

(2) Place the front panel face down. Visually line-up the r-f chassis over the front panel and drop it in place so that the projections on the chassis fall to the right of the projections from the rear left of the front panel and the capacitor shaft fits into the coupling collar. It will be necessary to rotate the capacitor shaft until the tapered hole in the coupling on the capacitor shaft lines up with the threaded hole on the coupling collar on the large pulley. It may also be necessary to shift the chassis back and forth slightly to achieve proper alinement. (Note that when proper alinement of the two holes is achieved, the setting of the dial will correspond to the setting of the capacitor plates.) Insert and tighten the tapered set screw.

(3) Insert and tighten the two large screws holding the front panel and r-f chassis together. Slightly shift the r-f panel back and forth as required to obtain proper alinement. Tighten the screws.

*b.* I-F CHASSIS. (1) Line up the i-f chassis over the front panel and drop it in place so that the projections on the chassis fall to the left of the projections from the rear right of the front panel.

(2) Insert and tighten the two screws holding the front panel and i-f chassis together. Slightly shift the i-f panel back and forth as required to obtain proper alinement of the mounting holes.

*c.* BACK PLATE. (1) Attach the back plate to the rear of the chassis assembly so that the edges of the chassis fit into the slots of the back plate and the large captive bolts in the corners of the back plate line up with the mounting holes on the chassis.

(2) Tighten the bolts.

*d.* CONNECTORS. Reattach the connectors, as follows:

(1) Reattach multiconnector P-202 on the cable from the panel to connector J-101 on the i-f chassis.

(2) Reattach multiconnector P-201 on the cable from the panel to connector J-1 on the r-f chassis.

(3) Reconnect pin connector P-2 from the r-f chassis to the ANT connector J-201 on the panel.

(4) Reconnect pin connector P-1 from the plate of V-11 on the r-f chassis to pin 2 of T-101 on the i-f chassis.

*e.* PLUG-IN COMPONENTS. (1) Make sure that all tubes are installed and that they are seated firmly in their sockets. Check that all tube shields are installed.

(2) Make sure that all crystals are installed and seated firmly in their sockets. Check tightness of crystal retaining springs. Crystals Y-1 and Y-2 are located at the center and front, respectively, of the r-f chassis. Crystals Y-101 and Y-102 are located at the rear and front, respectively, of the i-f chassis.

# Section III.
# LUBRICATION AND WEATHERPROOFING

## 66. Lubrication

Receiver-Transmitter RT-70/GRC described in this manual does not require lubrication in the field. Certain parts are selflubricated. Included in this category are the dial-drive mechanism and the O-ring seals on the shafts of panel-mounted components.

## 67. 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 temperature 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 fully 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 fully 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 fully 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 or emery cloth.

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

## 68. Refinishing

*a.* When the finish on the case or 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 IV. ALINEMENT PROCEDURES

## 69. Test Equipment Required for Alinement

The test equipment required for alinement of the receiver-transmitter is the same as that listed in paragraph 44.

## 70. Initial Procedures

*a.* INITIAL SWITCH AND CONTROL SETTINGS. Unless otherwise specified, the controls should be set as follows:

| Control | Position |
|---|---|
| SQUELCH | Extreme counterclockwise (OFF) |
| VOLUME | Extreme clockwise (maximum gain) |
| ANT ADJ- DIAL LIGHT ON OFF CAL | DIAL LIGHT OFF (or ON) |
| TANK-VEH-FIELD | VEH or FIELD, depending on whether a vibrator power supply and AF Amplifier AM-65/GRC or Case CY-590/GR and dry batteries are used to supply power to the unit under test. |

*b.* TEST CONNECTIONS. Unless otherwise called for under the alinement procedures, the test connections are the same as described in paragraph 46.

## 71. Checks and Adjustments of Calibrate and Beat Oscillators

*a.* ADJUSTMENT OF CALIBRATE OSCILLATOR (V-7).

(1) Connect a vacuum-tube voltmeter (M-1) between the grid (pin 6) of tube V-7 and the chassis.

(2) Set the test switch in the CAL position.

(3) Adjust the plate circuit trimmer capacitor C-48 (fig. 5) for a maximum d-c voltage.

*Requirement:* The maximum deflection of the meter should be approximately —25 volts dc (peak).

(4) Reduce the capacity of the trimmer until the voltmeter reads 17 of the maximum reading obtained in step (3). For example, if the reading in step (3) is 20 volts dc the new reading should be 20 x .7 = 14.0 volts dc.

(5) Turn the test switch to the ANT ADJ position and recheck as above.

(6) Disconnect the vacuum-tube voltmeter and return the test switch to one of the DIAL LIGHT positions.

(7) If trouble with the calibrate oscillator is indicated, refer to paragraphs 51 and 52.

*b.* CHECK OF 1.4-MC BEAT OSCILLATOR (PART OF V-106). (1) Connect a vacuum-tube voltmeter (M-1) between the grid (pin 6) of V-106 and chassis.

(2) Turn the test switch to the CAL position and observe whether the following requirement is met.

*Requirement:* The meter should read approximately —4.0 volts.

(3) If the above requirement is not met, and trouble with the beat oscillator is indicated, refer to paragraphs 51 and 52.

## 72. Receiver Alinement

*a.* TEST SIGNAL CALIBRATION (REFERENCE LEVEL A). (1) Connect the 1.4-mc test signal generator (G-1) in series with a .01-uf capacitor between test point E-103 (fig. 38) and chassis.

(2) Connect meter (M-1) between test point E-104 (fig. 38) and chassis. Hereafter this meter will be referred to as the LIMITER METER.

(3) Adjust the test signal frequency for zero-beat with the 1.4-mc beat oscillator. To do that:

(*a*) Turn the test switch on the front panel to the CAL position. This is a spring-return position.

(*b*) Adjust the test signal frequency to 1.4 mc until a zero-beat note is heard in the headset.

(*c*) Return the test switch to the DIAL LIGHT position.

(4) Adjust the test signal level to .15 volt and observe the LIMITER METER reading. The meter reading obtained under these conditions will, hereafter, be referred to as REFERENCE A. In subsequent checks the test signal generator output level will be adjusted to obtain this reading of the meter.

*Requirement:* The LIMITER METER should read approximately —1.4 volts dc.

(5) If the above requirement is not met V-104 and V-105 should be checked and replaced if found defective. If necessary, make point-to-point resistance and voltage measurements, to locate a defective component. After repairing the fault, and obtaining the required reading, proceed with the tests and adjustments described in the following subparagraphs. If the requirement is still not met, T-105 may be misalined. Check as indicated in subparagraph *b* below.

*b.* ALINEMENT OF 1.4-MC I-F AMPLIFIER STAGES. For the following adjustments leave the test equipment connected as in subparagraph *a* above.

(1) Adjust the signal generator frequency to 1.4 mc.

(2) Connect the shunting unit (that is, the series arrangement of a 6,000-uuf capacitor and a 2,700-ohm, ½-watt resistor) between the plate (pin 2) of 1st limiter tube V-104 and chassis.

(3) Adjust the test signal level to obtain REFERENCE A reading on the LIMITER METER.

(4) Tune the slug marked S (secondary coil L-113) in tuning unit T-105 (fig. 37) until the LIMITER METER shows a peak reading.

(5) Shift the connection of the shunting unit to test point E-104 (fig. 38) and adjust the test signal level to obtain REFERENCE A.

(6) Tune the slug marked P (primary coil L-112) on tuning unit T-105 (fig. 37) until the LIMITER METER shows a peak reading.

(7) Shift the signal generator connection to test point E-102 (fig. 38).

(8) Shift the shunting unit connection to pin 2 of X-103 (fig. 38) which is the plate of V-103.

(9) Adjust the frequency to 1.4 and the test signal level to REFERENCE A reading of the LIMITER METER.

(10) Tune slug marked S (secondary coil L-110) on tuning unit T-104 (fig. 37) until the LIMITER METER shows a peak reading.

(11) Shift the shunting unit connection to test point E-103 (fig. 38) and adjust the test signal level to obtain REFERENCE A.

(12) Adjust the slug marked P (primary coil L-109) on tuning unit T-104 (fig. 37), until the LIMITER METER shows a peak reading.

(13) Shift the signal generator connection to test point E-101 (fig. 38).

(14) Adjust the test signal frequency to 1.4 mc and the level to obtain the REFERENCE A reading of the LIMITER METER.

(15) Shift the shunting unit connection to pin 2 of X-102 (fig. 38) which is the plate of V-102.

(16) Adjust the slug marked S (secondary coil L-106) on tuning unit T-103 (fig. 37) until the LIMITER METER shows a peak reading.

(17) Shift the shunting unit connection to test point E-102 (fig. 38) and adjust the test signal level to obtain REFERENCE A.

(18) Adjust the slug marked P (primary coil L-105) on tuning unit T-103 (fig. 37), until the LIMITER METER shows a peak reading.

(19) Remove the shunting unit connections.

(20) Adjust the test signal level to obtain the REFERENCE A reading of the LIMITER METER, and note the level required to obtain that reading.

*Requirement:* For a properly alined 1.4-mc i-f amplifier-limiter the test signal level should be approximately 2,600 uv.

*c.* DISCRIMINATOR ALINEMENT. (1) Connect the test signal generator and the LIMITER METER as described in subparagraph *a* above.

(2) Connect the DISCRIMINATOR METER (M-1) between test point E-106 (fig. 38) and chassis.

(3) Adjust the signal generator frequency to 1.4 mc and the level to obtain REFERENCE A reading of the LIMITER METER, as described in subparagraph *a* above.

(4) Adjust tuning slug S (secondary coils L-116 and L-117) if necessary, on the discriminator tuning unit T-106 (fig. 37) until the DISCRIMINATOR METER (connected to test point E-106) reads zero.

(5) Raise the frequency of the test signal above 1.4 mc until a peak reading is obtained on the DISCRIMINATOR METER. Note the frequency and the meter reading at this point.

(6) Lower the frequency of the test signal below 1.4 mc until a peak reading is again obtained. Note the frequency and the meter reading at this point.

*Requirement:* The two absolute peak readings should not differ by more than 1.0 volt dc. The two peak readings should be of opposite polarity (one should be + and the other −). Each of the two peak readings should be approximately 9 volts dc. The difference in frequency between the two peaks should be approximately 140 kc (kilocycles).

(7) Omit step (7) and proceed with step 8 if the above requirements are met. If the above requirements are not met, proceed as follows:

(*a*) Readjust the test signal frequency to the resonant peak at which the lower of the two voltage readings are obtained in steps 5 and 6.

(*b*) Adjust the tuning slug marked P (primary coil L-115) of T-106 (fig. 37) until the meter reading is increased by about one-half of the difference between the two original resonant peak voltage readings.

(*c*) Check the readings of the discriminator meter at both peaks, as before, and observe whether the peaks are now within 1 volt of each other.

(*d*) If the peak readings are still not within 1 volt of each other, repeat steps (*a*), (*b*) and (*c*) above. This procedure may have to be repeated several times before the requirements are met.

(8) Check step (4) above, and observe whether the DISCRIMINATOR METER stills reads zero. If it does, the alinement of the discriminator is completed. Otherwise, proceed as follows:

(a) Readjust the S slug of T-106 (fig. 37) for a zero reading of the DISCRIMINATOR METER.

(*b*) Repeat steps 5 and 6, and, if necessary, steps 7 and 8.

*d.* ALINEMENT OF 15 MC I-F AMPLIFIER STAGES. (1) Connect a 15-mc test signal generator (G-1) between test point E-101 (fig. 38) and chassis.

(2) Connect the LIMITER METER (M-1) between test point E-104 (fig. 38) and chassis.

(3) Adjust the test signal frequency to 15 mc and for zero-beat with the beat oscillator (panel switch in CAL position).

(4) Adjust the test signal level to obtain REFERENCE A reading on the LIMITER METER, as described in subparagraph *a*.

(5) Shift the test signal generator connection to pin 6 of X-101 (fig. 38) which is the grid of the 3rd i-f amplifier stage V-101.

(6) Adjust the test signal level to obtain the REFERENCE A reading on the LIMITER METER.

(7) Adjust the tuning slug of coil L-103 in T-102 (fig. 37) until the LIMITER METER shows a peak reading.

(8) Shift the test signal generator connection to the grid (pin 6) of 2nd i-f amplifier stage V-11 (on the r-f chassis figure 40).

(9) Adjust the level of the test signal to obtain REFERENCE A reading on the LIMITER METER.

(10) Adjust the slug of coil L-101 in T-101 (fig. 37) until the LIMITER METER shows a peak reading.

(11) Shift the test signal generator to the grid (pin 6) of 1st i-f amplifier stage V-10 (fig. 40).

(12) Adjust the test signal level to obtain the REFERENCE A reading on the limiter meter.

(13) Tune the slug of coil L-27 in T-10 (fig. 39) until the LIMITER METER shows a peak reading.

(14) Adjust the test signal level to obtain the REFERENCE A LIMITER METER reading, and note the signal level required to obtain that reading.

*Requirement:* The test signal generator output level required to produce the REFERENCE A reading should be approximately 12 uv if the 15-mc and 1.4-mc i-f amplifier circuits have been properly alined.

(15) Leaving the signal generator connected as in step (11), above, raise the test signal level to obtain a reading of −11 volts dc on the LIMITER METER. By definition this reading will be referred to as REFERENCE B reading of the LIMITER METER.

*Requirement:* The test signal level required to obtain REFERENCE B reading of the LIMITER METER should be approximately 150 uv (microvolts).

(16) Shift the signal generator connection to the grid (pin 6) of the receiver first mixer stage V-9 (fig. 40).

(17) Adjust the tuning slug of coil L-25 in T-9 (fig. 39) to obtain a peak reading on the LIMITER METER.

(18) Readjust the signal generator output level to obtain REFERENCE B reading, and determine the signal generator output level.

*Requirement:* The signal generator output level should be approximately 24 uv.

*e.* ALINEMENT OF 32 TO 43.4 MC OSCILLATOR. Each alinement step outlined in this paragraph must be performed very carefully and accurately.

(1) *Preliminary mechanical adjustments.* (*a*) Rotate the dial to the highest frequency setting until it comes to the stop.

(*b*) Hold main tuning knob and adjust the vernier plate until the 9 lines up with the dot calibration marker on the panel.

(*c*) Rotate the dial counterclockwise until the vernier plate reads (0) and shift the plastic index for the main dial until the hairline lines up with the 58 mark on the dial. This will offset the hairline approximately 7 degrees to the left of the vertical (center of the dial window).

(2) *Preliminary electrical adjustments.* For the following adjustments an r-f signal generator (G-2) capable of being set to 58 mc, with an accuracy of .4 mc or better, is required. This generator will be used to ascertain that the harmonic frequency of the 1 mc calibrate oscillator V-7 selected corresponds to the number shown by the dial. Proceed as follows:

(*a*) Turn the VOLUME control to the extreme clockwise position (full audio gain), and the SQUELCH control to the extreme counterclockwise position (OFF).

(*b*) Connect the r-f signal generator to the ANT connector on the front panel.

(*c*) Disable the calibrate oscillator V-7 by removing crystal Y-2 (fig. 39) from its socket.

(*d*) Turn the test switch on the receiver-transmitter panel to the CAL position. Note that this is a spring-return position.

(*e*) Tune the signal generator to 58 mc and adjust the output to 10 uv. Observe whether the following requirement is met.

*Requirement:* A zero-beat note should be heard in the headphones connected to the receiver audio output terminals.

(*f*) If the above requirement is not met, adjust oscillator V-2 trimmer capacitor C-4 (fig. 6) until the requirement is met.

(3) *Calibration of 58 mc point on the dial.* The following adjustments are to insure that the dial is tuned accurately to 58 mc (58th harmonic frequency of the calibrate oscillator V-7), *which may not result from the preceding steps if the calibration of the signal generator is not exact.*

(*a*) Restore crystal Y-2 into its socket. Make sure that it is firmly seated.

(*b*) Disconnect the signal generator.

(*c*) Turn the test switch on the receiver-transmitter panel to the CAL position, and note whether the following requirement is met.

*Requirement:* A zero-beat note should be heard.

(*d*) If the above requirement is not met, proceed as follows:

*1.* Turn the dial to the right of zero and then to the left of zero on the vernier plate, until the zero-beat note is tuned in in each case. Note that the beat note will be found on each side of zero. However, the desired (58 mc) beat note is the one which occurs at the vernier plate setting nearest the zero.

*2.* Tune for the zero-beat note which occurs for the vernier plate setting nearest to zero which is the 58-mc beat note.

*3.* Adjust C-4 (fig. 6) slightly, and turn the tuning knob slightly to bring in the zero-beat note again. Note whether the beat note now occurs closer to zero or further away from zero.

*4.* If the beat note is now further away from zero, reverse the direction of turning C-4. If the beat note is closer to zero the correct direction or rotation of C-4 has been selected. Continue the adjustment of C-4 and turn the dial until the zero-beat note occurs when the vernier zero lines up with the calibration marker on the panel. When this occurs, the variable oscillator will have been accurately calibrated against the 58-mc setting of the dial.

(4) *Calibration of 47-mc point on the dial.* (*a*) Rotate the dial in the direction of the l-f end of its tuning range, keeping the test switch in the CAL position.

(*b*) Count off eleven beat notes, starting with 57 as beat note number 1. The 11th beat note corresponds to the 47th harmonic of the 1-mc calibrate oscillator, and represents a frequency of 47 mc.

(*c*) Observe whether the following requirement is met.

*Requirement:* If the dial calibration is correct, the hairline on the dial will coincide with the 47 marker, and the zero on the vernier plate will coincide with the calibration marker on the panel. A tolerance of ±5 kc is permitted.

(*d*) If the above requirement is met, proceed directly to step (5) below. If the requirement is not met proceed with the following adjustments and, if necessary, with substep (*e*) below, before continuing with step (5) below.

*1.* Adjust the tuning slug of coil L-3 (fig. 5) in tuning unit T-3, in or out, about ¼ of a turn.

*2.* Retune the knob to again obtain the zero-beat note.

*3.* Observe whether the zero-beat note occurs at a point on the vernier plate, closer to or further away from the required position and continue to adjust the tuning slug accordingly until the requirement is met (following step (4) (*c*)).

(*e*) If the 11th beat note cannot be reached (see substep (*b*)) or if the adjustments of substep (*d*) fail to produce the results specified in the requirement following (*c*), the coupling between the dial drive and the gang capacitor has probably been disturbed and the capacitor cannot cover the entire tuning range of the set. Readjustment is then necessary. The procedure for doing this is as follows:

*1.* Look through the hole on top of the gang capacitor C-10 (fig. 39). Rotate the dial to the extreme l-f end of its range, until the stop is reached.

*2.* Observe whether the rotor plates are meshed with the stator plates as described in the following requirement:

*Requirement*: The edges of the rotor plates should be 1/32 inch in the reduced capacity (open) direction from the edges of the stator plates.

*3.* If this requirement is not met, loosen the two outer set screws on the coupling collar. These Allen setscrews hold the brass coupling to the gang capacitor shaft. The screws are identified by RED dots.

*4.* Carefully rotate C-10 until the requirement stated above is met. Be careful not to touch the adjustment of the front dial while the setscrews are loose. Note that the capacitor may be rotated by means of the shaft end at the rear of the capacitor. Tighten the setscrews.

*5.* Repeat steps *3.* and *4.* above, to check whether the variable gang capacitor now covers the entire tuning range of the receiver-transmitter. The procedures of steps *3.* and *4.* above may have to be repeated several times before all requirements in these steps are met.

(5) *Recheck of dial calibration at 58-mc point.* After the requirements of steps *3.* and *4.* are met, the dial will will be in the 47-mc position. Recheck the dial calibration at the 58-mc position as follows:

(*a*) Rotate the dial back toward the h-f end, holding the test switch in the CAL position. Count off 11 beat notes, starting with that at 48 as beat note number 1.

(*b*) Observe the dial and vernier plate settings when the 11th beat note has been reached.

*Requirement*: When the 11th beat note has been reached, the main dial hairline should be at 58, and the zero on the vernier plate should be within $\pm 5$ kc of the calibration marker on the panel.

(*c*) If the above requirement is met, proceed with step (6) below. Otherwise, repeat steps *3.*, *4.* and *5.* above, until the dial calibration requirements at the l-f end of the dial (47 mc) and at the h-f end of the dial (58 mc) are both met.

(6) *Dial calibration at intermediate integral mc points.* After the low and high ends of the dial have been calibrated as described in steps *3.* and *4.* above, and the calibration at the high end rechecked as described in step (5) above, it is necessary to determine whether the calibration of the dial at intermediate points follows a straight-line curve. The dial calibration follows a straight-line curve, if the zero-beat note for each integral megacycle point on the dial is obtained when the vernier plate zero is within ¼ of a division (25 kc) of the calibration marker on the panel. Adjustment of the calibration is accomplished by bending the segments of the segmented plates mounted on the rear end of the gang capacitor shaft. The procedure is as follows:

(*a*) Hold the test switch in the CAL position, and turn the dial to each successive position at which a zero-beat note is heard, starting with position 57, and continuing toward the l-f end of the dial.

(*b*) For each zero-beat note observe the position of the dial with respect to the hairline, and of the vernier plate zero with respect to the panel marker.

*Requirement*: Each zero-beat note should occur when the hairline coincides with the correct (see note below) mc mark on the main dial. The zero on the vernier plate should be not more than ¼ of a division (25 kc) away from the calibration marker on the panel.

*Note.* To determine whether a particular beat note occurs at the correct mc position of the dial (for example, whether the 52nd harmonic or 52 mc is actually selected when the dial is at or near 52) assign a sequence number to each beat note in the order of its occurrence. Start with the first beat note heard after turning away from 58. Assign number 1 to that beat note. Assign number 2 to the next beat note, etc. Subtract the sequence number from 58. This will give the correct dial position number. For example the 6th beat note occurring after turning away from 58 corresponds to the 52nd harmonic of the beat oscillator (58-6) and should therefore occur when the dial hairline is at or near 52.

(*c*) If the above requirements are met, proceed with step (7), below. Otherwise, make the adjustments described below, before proceeding with step (7).

*1.* Rotate the dial to the highest frequency zero-beat note at which the dial calibration requirement following (*b*), above, is not met.

*2.* Bend slightly and carefully that segment of the outer slotted plate (calibration adjustment plate mounted on the rear end of the capacitor shaft (fig. 6) which corresponds to the particular setting of the dial. To identify the segment which corresponds to the particular setting of the dial, look for the segment which meshes with the small triangular fixed section mounted on projections from the gang capacitor wall.

**Caution:** Be very careful not to break off the segment by applying excessive pressure. Bend the segment a little at a time. Check the results of the bending before continuing to bend the segment further.

*3.* Bending the segment will cause the zero-beat note to shift to another position on the vernier plate. Turn the tuning knob until the zero-beat note reappears, and observe whether the zero on the vernier plate is now closer to or further away from the calibration marker on the panel. If the zero beat is closer to the zero position of the vernier plate, the segment was bent in the correct direction. Otherwise, repeat by bending the segment in the opposite direction.

*4.* Continue to bend the segment and adjust the tuning knob until the zero-beat note occurs when the zero on the vernier plate is within 1/4 of a division (25 kc) of the calibration marker on the panel, for the particular integral mc setting of the dial.

*Note.* Bending one segment of the slotted calibration plates may affect the adjacent integral mc frequency setting of the dial. Therefore, upon completion of the adjustment at any one mc position of the dial, recheck the settings involving the adjacent segments as in steps (6) (*a*) and (6) (*b*) above. If necessary, adjust as in step (6) (*c*).

*5.* Repeat step (6) (*c*), above, for each integral mc setting of the dial at which the calibration requirement following (6) (*b*), above, is not met. Work in the order of descending mc settings of the dial.

***Caution:*** Do not bend segments which mesh at 58 and 47 mc.

(*d*) After completing the adjustments at all mc segments, at which the calibration requirement has not been met, recheck the entire dial as described in (6) (*a*) and (6) (*b*) above, and if necessary, repeat the adjustments of (6) (*c*) until the calibration requirements are met for all integral settings of the dial.

(7) To make sure that the oscillator is now properly alined, and the dial calibration adjustments properly made, go through the checks starting with step (1) of this subparagraph, and observe whether the requirements at the high, low and intermediate mc points of the dial are now met.

*Note.* For proper operation of the equipment it is necessary that the oscillator be properly alined and the dial be properly calibrated. For this reason the above procedure stresses repeated checking until all requirements are met.

*f.* Receiver R-F Amplifier and Antenna Circuit Alinement. After the oscillator has been properly alined as described in subparagraph *e*, above, proceed with the alinement of the receiver r-f amplifier, as outlined in the following steps. Note that once the antenna circuit has been alined for the receiver, it will not be necessary to realine it for the transmitter. However, when the unit being tested is installed in the vehicle or field installation, and is equipped with the antenna with which it is to operate, readjustment of the antenna trimmer capacitor (C-41) will be necessary.

(1) Connect an r-f signal generator (G-2) to the ANT connector on the front panel. Remove the dummy antenna load to make the generator connection possible.

(2) Connect the LIMITER METER (M-1) between test point E-104 (fig. 38) and chassis.

(3) Adjust the signal generator frequency to 58 mc and tune it in with the receiver dial. The signal will have been tuned in properly when the LIMITER METER shows a peak reading.

(4) Adjust the test signal level to obtain the REFERENCE B (–11 volts dc) reading on the LIMITER METER.

(5) Adjust trimmer capacitor C-56 (fig. 5) for a peak reading on the LIMITER METER.

(6) Adjust the test frequency to 47 mc and tune in with dial until the LIMITER METER shows a peak reading.

(7) Adjust the test signal level to obtain REFERENCE B reading on the LIMITER METER.

(8) Adjust the tuning slug of coil L-23 (fig. 8) in tuning unit T-8 (in the r-f coil compartment) for a peak reading on the LIMITER METER.

(9) Repeat the adjustment of capacitor C-56 (steps 3 through 5 above) and of the coil L-23 (steps 6 through 8 above) until no further improvement in the peaking is obtainable at either the h-f or l-f end of the dial.

*g.* Antenna Circuit Alinement. For the following adjustments retain the test connections of the preceding subparagraph. Note that once the antenna circuit has been alined for the receiver, it will not be necessary to realine it for the transmitter. However, when the unit being tested is restored to the vehicle or to the portable installation, and is equipped with the antenna with which it is to operate, readjustment of the trimmer capacitor (C-41), accessible from top of outer case when cap is removed, will be necessary.

(1) Adjust the test signal frequency to 58.0 mc and tune in with receiver-transmitter dial until the LIMITER METER shows a peak reading. Adjust the test signal level to obtain the REFERENCE B reading on the LIMITER METER.

(2) Adjust trimmer capacitor C-41 until the LIMITER METER shows a peak reading. Note that C-41 has the funnel-shaped adjustment control. When the panel-and-chassis assembly is installed in the case, this control is accessible through the hole at the top of the case after the cap has been removed. See figures 1 and 6.

(3) Adjust the test signal frequency to 47.0 mc and tune in with receiver-transmitter dial until the LIMITER METER shows a peak reading. Adjust the test signal level to obtain REFERENCE B reading on the LIMITER METER.

(4) To check whether the antenna coil L-18 needs adjustment, vary trimmer capacitor C-41 slightly away from its setting arrived at in step (2). Vary it in the clockwise

and in the counterclockwise direction. Observe the LIMITER METER when doing this. If the LIMITER METER reading shows a tendency to decrease, the coil does not need adjustment. Simply restore the trimmer capacitor to its original adjustment. If the LIMITER METER reading shows a tendency to increase as the capacitor control is varied, the coil needs adjustment.

(*a*) Using a non-metallic tool spread or compress the turns of coil L-18 until a peak reading is obtained in the LIMITER METER. Coil L-18 (fig. 41) is located in the r-f coil compartment, and is part of T-7. Access to the coil turns is obtainable through a slot at the front end of the r-f coil compartment (fig. 40). To gain access to the slot, it is necessary to disengage the i-f chassis from the rest of the panel-and-chassis assembly.

(*b*) Repeat steps (1) through (4), above, until no further improvement in peaking is obtainable.

*Note.* In actual operation, any mistracking at any point on the dial due to the coil may be taken care of by adjusting the trimmer capacitor (C-41) to obtain a peak reading on the LIMITER METER, for that dial setting.

### 73. Transmitter Alinement

*a.* In the transmitter alinement procedure outlined below, it is assumed that the common 32- to 43.4-mc variable oscillator has been checked and alined as described in paragraph 72*e*. It is also assumed that the 15-mc transmitter oscillator V-3 is operative. See grid voltage check of paragraph 54, step 2.

*b.* The alinement procedure is as follows: (1) Connect the dummy antenna load to the ANT connector (J-201) on the front panel.

(2) Connect the microphone with push-to-talk switch. See paragraph 46.

(3) Connect a vacuum tube voltmeter (M-1) to test point E-1 (fig. 39). Connect the ground side of the meter to pin 7 of transmitter driver tube V-5. Test point E-1 is wired into the grid circuit of V-5, at the junction of resistors R-13 and R-14.

(4) Rotate the dial to the 58.0-mc position.

(5) Operate the microphone push-to-talk switch to energize the transmitter.

(6) Adjust trimmer capacitor C-27 (fig. 5) to obtain a peak reading on the meter.

(7) Rotate the dial to the 47.0-mc position.

(8) Operate the microphone push-to-talk switch.

(9) Adjust the tuning slug of coil L-10 (fig. 5) to obtain a peak reading on the meter. Coil L-10 is located in the r-f coil compartment and is part of T-4.

(10) Adjust the tuning slug of coil L-13 (fig. 5) to obtain a peak reading on the meter. Coil L-13 is located in the r-f coil compartment, and is part of T-5.

(11) Repeat the adjustment of L-10 and L-13 until no further improvement in the peaking is possible.

(12) Repeat steps (4) through (11) until no further improvement in the peaking is possible. At the peak the voltmeter should read approximately .2 volt dc.

(13) Reconnect the meter between test point E-2 (fig. 39) and chassis. Test point E-2 is wired into the grid circuit of the transmitter power amplifier stage V-6, at the junction of R-17 and R-18.

(14) Rotate the dial to the 58.0-mc position.

(15) Operate the microphone switch, and adjust trimmer capacitor C-34 (fig. 5) to obtain a peak reading on the meter.

(16) Readjust trimmer capacitor C-27 (fig. 5) to obtain a peak reading on the meter.

(17) Readjust trimmer capacitor C-34 to obtain a peak reading on the meter.

(18) Repeat steps (16) and (17) until no further improvement in the peaking is possible.

(19) Rotate the dial to the 47.0-mc position.

(20) Operate the microphone switch and adjust the tuning slug of coil L-16A (fig. 8) to obtain a peak reading on the meter. Coil L-16A is one winding of an interwound coil located in the r-f coil compartment, and is part of T-6.

(21) Readjust the tuning slugs of coils L-13 and L-16A, in that order, to improve the peak reading of the meter for the l-f end of the dial, and until no further improvement in the peaking is possible.

(22) Return the dial to the 58.0-mc position, and recheck the adjustment of C-27 and C-34 to make sure that no further improvement in peaking at the h-f end of the dial is possible.

(23) Return the dial to the 47.0-mc position and recheck the adjustments of coils L-13, and L-16A to make sure that no further improvement in the peaking at the l-f end of the dial is possible.

(24) Disconnect the meter. The alinement of the transmitter is now complete.

*Note.* The antenna circuit has been alined in connection with the alinement of the receiver r-f circuits, paragraph 72*g*. An alternative method of adjustment of trimmer capacitor C-41 for the 58-mc setting of the dial and of L-18 (knifing) for l-f end of the dial is to follow the procedure outlined in paragraph 72*f* but to observe the peaking adjustment on the r-f meter in the dummy antenna load. Note that once the antenna circuit has been alined for either the transmitter or the receiver, further alinement for the other circuit is not necessary. However, when the unit under test is installed in the vehicle or other installation, a readjustment of antenna capacitor C-41 will be necessary to match the antenna circuit to the antenna actually to be used in the installation. In this case it is necessary to tune C-41 for maximum noise quieting in the receiver, with the test switch in the ANT ADJ position, and the SQUELCH control turned OFF.

(25) Check that the plate current of power amplifier tube V-6 is of the correct value as follows:

(*a*) Connect a vacuum tube voltmeter (M-1) between terminals 1 and 3 on the sidewall of T-7 (fig. 42). These terminals are accessible from the bottom of the panel-and-chassis assembly, and are stamped with numbers 1 and 3, respectively.

(*b*) Operate the microphone push-to-talk switch, and observe the meter reading.

*Requirement*: The meter should read approximately 1.7 volts, to indicate that approximately 17 ma (milliamperes) of plate current is being drawn by V-6.

### 74. Neutralization Adjustment

It is not necessary to adjust neutralizing capacitor C-35 during normal alinement of the transmitter circuits. These adjustments should not be attempted unless it is certain that neutralization is required, and then only by experienced maintenance personnel. Neutralization is adjusted at the factory, and the neutralization controls sealed with red glyptal. Unless major repairs have been made on the transmitter circuits, neutralization should not be required.

*a*. NEUTRALIZATION CHECK. If the adjustments of C-27 and C-34, as outlined in paragraph 73, steps 1 through 24, seem to be interdependent (adjustment of C-34 affects tuning of C-27), then the transmitter is not neutralized correctly. It is then necessary to proceed as in subparagraph *b*, below.

*b*. NEUTRALIZATION ADJUSTMENT. (1) Remove the plate and screen voltages from the transmitter driver tube V-5 by disconnecting one end of R-16 and of R-15 (fig. 41). Disconnect one end of R-20 (fig. 41). One end of each resistor terminates on a stand-off insulator and is easily removed by unsoldering. Turn off power while doing this.

(2) Connect a vacuum tube voltmeter (M-1) between test point E-2 (fig. 39) and chassis.

(3) Turn the dial to the 58.0-mc position.

(4) Turn on power, and operate the microphone push-to-talk switch.

(5) Adjust trimmer capacitor C-34 (fig. 5), in the plate circuit of V-5, and trimmer capacitor C-27 (fig. 5) in the plate circuit of V-4 for a maximum deflection of the meter.

(6) Adjust neutralizing capacitor C-35 (fig. 8) for a minimum deflection of the meter. This capacitor is located inside the r-f coil compartment.

(7) The adjustments of C-34, C-27 and C-35 may have to be repeated several times to obtain the desired results.

(8) Turn off power and reconnect R-15, R-16, and R-20.

(9) Turn on power, and retune C-27 and C-34 for a maximum deflection of the meter pointer.

(10) Repeat the check of subparagraph *a* above.

### 75. Identification of Test Points

*a*. The test points on the r-f chassis, E-1 through E-4, are feed-through insulators, mounted on the sides of the r-f coil compartment, and accessible from the top or bottom of the panel-and-chassis assembly. Their locations are shown in figure 42.

*b*. The test points on the i-f chassis (fig. 38), E-101 through E-106, are solder lug terminals, distributed around the edge of the chassis. For identification purposes a color code has been assigned to the insulation (spaghetti) covering the major portion of each test point. The color code data are included in the following chart.

| Test point | Insulation color | Circuit association |
|---|---|---|
| E-101 | white | grid circuit V-102 |
| E-102 | black | grid circuit V-103 |
| E-103 | blue | grid circuit V-104 |
| E-104 | red | grid circuit V-105 |
| E-105 | green | grid circuit V-105 |
| E-106 | yellow | discriminator T-107 |

## Section V. FINAL TESTS

After the receiver-transmitter has been repaired and alined, as described in the preceding sections of this chapter, the unit should be fit for return to service. To make sure that this is the case, repeat the operational and sectionalization checks outlined in paragraphs 51 through 54. Other faults may thus come to light. Make the necessary repairs. If the unit operates as required in paragraphs 51 through 54, perform the tests outlined in the following paragraphs. These tests are *double-check* to make sure that the most important functional requirements of the unit are met, and that it is therefore safe to return the unit to service.

### 76. Over-all Receiver Sensitivity

Connect the test equipment as indicated in section I of this chapter, with the following exceptions:

*a.* Connect an r-f signal generator (G-2) to the ANT connector on the front panel.

*b.* Connect an a-c voltmeter (M-2), shunted by a 600-ohm, ½-watt resistor, to the audio output terminals.

*c.* Set the controls on the front panel as follows:

| | |
|---|---|
| (1) SQUELCH | to the OFF position. |
| (2) ANT ADJ — DIAL LIGHT ON OFF — CAL switch | to the DIAL LIGHT OFF position. |
| (3) TANK-VEH-FIELD switch (internal) | to the VEH or FIELD position depending on whether AF Amplifier AM-65/GRC and a vibrator power supply, or Case CY-590/GR and dry batteries are used to supply power. |
| (4) VOLUME control | to extreme clockwise position. |

*d.* Adjust the frequency of the TENTHS-MCS dial and of the signal generator to 47.0 mc.

*e.* Adjust the signal generator output level to 1.0 uv.

*f.* Apply fm to the signal generator. The modulation frequency should be 1,000 cycles at ±15 kc deviation.

*g.* Adjust the VOLUME control on the front panel until the voltmeter (M-2) reads 2.45 volts rms (root mean square). (This voltage reading is equivalent to 10 mw (milliwatts).)

*h.* Now remove the modulation from the signal generator frequency.

*i.* Note the voltmeter reading.

*Requirement*: The voltmeter reading should not be greater than .078 volt (or 30 db below 2.45 volts).

*j.* Repeat steps *d* through *i* for each of the r-f frequencies 52.0 mc and 58 mc. The same requirement should be met at each frequency.

### 77. Over-all Selectivity

*a.* MEASUREMENTS. (1) Connect the r-f signal generator (G-2) to the ANT connector.

(2) Connect the limiter meter (M-1) between test point E-104 (grid of V-105) and chassis.

(3) Tune the receiver dial to 58 and line up the zero on the vernier plate exactly with the dot (calibration marker) on the panel.

(4) Tune in the r-f signal generator frequency exactly to the frequency setting of the receiver. This is done by varying the signal generator frequency at or near 58 mc until the LIMITER METER shows a peak reading.

(5) Adjust the signal generator output level to produce the REFERENCE B (−11 volts) reading on the LIMITER METER. Note the signal generator output level at the REFERENCE B reading.

(6) Now increase the signal generator output level by 6 db (that is, double the output voltage).

(7) Tune the receiver to a frequency above 58 mc, until the reading obtained in step (5) is again obtained. Note the change in frequency for which this occurs, by reading the point of the vernier plate which now lines up with the calibration (dot) marker on the panel. For example: If the dot on the panel lines up with a point on the vernier plate which is one-half (.5) of a division from zero, the change in frequency is 50 kc (since 1 division corresponds to 100 kc). If the dot on the panel is to the right of zero, the frequency has been increased by 50 kc (58.05 mc). If the dot is to the left of zero (between 9 and zero) the frequency has been decreased by 50 kc (57.95 mc).

(8) Tune the receiver to a frequency below 58.0 mc until the reading obtained in step (6) (REFERENCE B) is again obtained. Note the change in frequency from center frequency (see example above) for which this reading occurs, by again noting the point on the vernier plate which lines up with the calibration marker on the panel.

(9) Compute the sum of the two CHANGES in frequency obtained in steps 7 and 8. This is the overall receiver bandwidth at points which are 6 db below the center frequency. The bandwidth should be about 85 kc.

(10) Compute the difference between the two CHANGES in frequency noted in steps 7 and 8. This difference, a measure of symmetry, should be not greater than 15 kc.

*b.* ANALYSIS. Incorrect bandwidth is indicative of improper alinement of the receiver. An unsymmetrical selectivity curve (second requirement) indicates a defective component in the tuned circuit, or improper alinement of the double tuned stages of the 1.4-mc i-f amplifier, or regeneration in any of the i-f or r-f circuits. Accordingly, if the measurements made in the preceding subparagraphs show that either one of these defects may exist, recheck the alinement of the receiver stages, as described in paragraph 72. If alinement fails to clear the trouble, look for a defective resistor, by-pass capacitor, or tuning coil. The bandwidth check in subparagraph *c* below need not be performed if the requirements of subparagraph *a* are met. If these requirements are not met, this check will help to sectionalize the difficulty to the 15-mc i.f., 1.4-mc i.f. or to the r-f stages.

*c*. OVER-ALL I-F SELECTIVITY (15.0 mc). (1) Connect the signal generator (G-1) through a .003-uf capacitor between the grid (pin 6) of the receiver 1st mixer V-9 and chassis.

(2) Adjust the signal generator to 15.0 mc by zero-beating with the beat oscillator. Adjust the test signal level to obtain the REFERENCE B reading (–11 volts dc) of the LIMITER METER. Note the level of the signal generator output required to do so.

(3) Raise the signal generator output level by 6 db — that is, double the voltage level of step (2).

(4) Raise the frequency of the signal generator above 15.0 mc until the REFERENCE B reading of the LIMITER METER is again obtained. Note the change in signal generator frequency for which REFERENCE B is again obtained.

(5) Lower the frequency below 15.0 mc and note the change in frequency for which the REFERENCE B reading is again obtained.

(6) Compute the sum of the two changes in frequencies obtained in steps (4) and (5). This sum (a measure of bandwidth) should be 85 ±10 kc.

(7) Compute the difference between the two changes in frequencies of steps (4) and (5). This difference (a measure of symmetry) should not exceed 15.0 kc.

(8) If the above requirements of steps (6) and (7) are not met, check as indicated in subparagraph *b* above.

### 78. Dial Calibration Check

Check the calibration of the dial at each of the integral mc positions, as described in paragraph 72*e*, and note whether the following requirement is met.

*Requirement*: A beat note should be heard at each mc point of the dial. When the beat note is heard, the zero on the vernier plate should be not more than ¼ (25 kc) of a division away from the calibration marker (dot) on the panel.

### 79. Over-all Receiver Frequency Response

*a*. Connect an f-m signal generator (G-2) to the ANT connector. Tune the receiver being tested and the signal generator to 52.0 mc.

*b*. Adjust the test signal level to 10.0 uv.

*c*. Modulate the test signal with a 1,000-cycle audio tone at ±15-kc deviation.

*d*. Connect an a-f output meter (M-4) to the audio output connections on the front panel.

*e*. Connect the discriminator meter (M-1) between test point E-106 and chassis.

*f*. Adjust the frequency of the signal generator to obtain a zero deflection on the discriminator meter (M-1).

*g*. Adjust the VOLUME control to obtain 10-mw reading on the output meter.

*h*. Leaving the setting of the VOLUME control constant, adjust the modulating frequency of the signal generator to 400, 1,000, 2,000, and 5,000 cycles, successively, maintaining a deviation of ±15 kc for each frequency.

*i*. For each modulating frequency observe the reading of the output meter.

*Requirement*: The approximate readings at the audio frequencies applied as modulation to the r-f signal are tabulated below.

| *Audio modulation frequency (cps)* | *A-f output meter reading (db)* |
|---|---|
| 400 | 0 |
| 1,000 | 0 (reference, 10 mw) |
| 2,000 | –3 |
| 5,000 | –12 |

*j*. Apply 1,000-cycle modulation to the test signal and turn the VOLUME control to the maximum clockwise position. Observe the reading of the output meter.

*Requirement*: The output meter should read at least 60 mw.

### 80. Check of Modulator Operation

*a*. AUDIO SIGNAL TRANSMISSION CHECKS. These checks involve the use of another Receiver-Transmitter RT-70/-GRC, known to be in good operating condition. This receiver-transmitter will be referred to as a test receiver.

(1) Connect an audio signal generator (G-3) to the microphone input terminal of the receiver-transmitter being tested, as illustrated in figure 29. Connect a dummy antenna load to the ANT connector. Connect an output meter (M-4) to the audio output terminals of the test receiver. Connect meter M-1 to the output of the discriminator test point E-106 of the test receiver.

(2) Operate the microphone switch on the unit being tested, and transmit unmodulated carrier. Measure the transmitter power output across the dummy load.

*Requirement*: The r-f meter in the dummy load should read 500 mw.

(3) Tune in the unmodulated carrier from the unit being tested on the receiver being used as a test instrument. Adjust the transmitter frequency to obtain a zero reading on the test receiver discriminator meter (M-1).

(4) Now adjust the audio signal generator to deliver a 1,000-cycle signal at a level of .25 volt to the microphone terminals of the unit being tested.

(5) Measure the audio output level at the output terminals of the test receiver, setting its volume control for maximum output. Assuming that another Receiver-Transmitter RT-70/GRC is being used, the output level should be at least 60 mw. (If another receiver is being used, the output level should be the normal output level for that receiver.)

(6) Adjust the volume control of the test receiver to obtain an output reading of 10 mw.

(7) Now change the modulating frequency to 400 cycles and then to 2,000 cycles. In each case the input level should be .25 volt. For each modulating frequency read the output meter connected to the test receiver.

*Requirement*: The approximate readings at each test frequency should be as tabulated below.

| *Audio frequency (cps)* | *Output meter reading (db)* |
|---|---|
| 400 | –10 |
| 1,000 | 0 (reference, 10 mw) |
| 2,000 | +1.5 |

*Note.* The above figures assume that another Receiver-Transmitter RT-70/GRC is being used for the test, and that that unit has been tested and established as being in good operating condition. If this assumption is not true, only qualitative checks can be made, or the requirements re-interpreted to correspond to the test receiver characteristics.

*b*. SPEECH TRANSMISSION CHECK. Replace the a-f output meter with a pair of headphones, and the audio signal generator (subpar. *a*) with a microphone. Operate the microphone push-to-talk switch, and talk into the transmitter being tested. Listen in the headphones of the test receiver.

*Requirement*: Good quality, clearly understandable speech should be heard, with adequate audio volume.

*Note.* To prevent overloading, the test receiver should be located at some distance from the unit being tested.

# CHAPTER 4

# SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

## 81. Repacking for Shipment or Limited Storage

Wrap and pack securely according to directions given in Packaging Specifications JAN-P-100, or Signal Corps Instructions No. 712-478, revised 15 October 1948, or as directed by Officer-in-Charge.

## 82. Demolition of Materiel 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 manual, records and forms, resistors, capacitors and transformers, using gasoline, kerosene, oil, flame throwers, or incendiary grenades.

*d.* BEND. Bend chassis, panels, and covers.

*e.* EXPLOSIVES. If explosives are necessary, use 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 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 Depot 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. Technical Manual on Test Equipment

| | |
|---|---|
| TM 11-2627 | Tube Tester I-177. |

## 4. Painting and Preserving

| | |
|---|---|
| TB SIG 13 | Moistureproofing and Fungiproofing Signal Corps Equipment. |
| TM 9-2851 | Painting Instructions for Field Use. |

## 5. Demolition

| | |
|---|---|
| FM 5-25 | Explosives and Demolitions. |

## 6. Other Publications

| | |
|---|---|
| FM 24-18 | Field Radio Techniques. |
| SR 310-20-3 | Index of Training Publications. (Field Manuals, Training Circulars, Army Training Programs, Mobilization Training Programs, Firing Tables and Charts, Graphic Training Aids, Joint Army-Navy-Air Force Publications, and Combined Communications Board Publications. |
| SR 310-20-4 | Index of Technical Manuals, Technical Regulations, Technical Bulletins, Supply Bulletins, Lubrication Orders, Modification Work Orders, Tables of Organization and Equipment, Reduction Tables, Tables of Allowances, Tables of Organization, Tables of Equipment and Tables of Basic Allowances. |
| TB SIG 66 | Winter Maintenance of Signal Equipment. |
| TB SIG 72 | Tropical Maintenance of Ground Signal Equipment. |
| 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 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. |
| FM 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. |

## 7. Abbreviations

ac .......... alternating current
af .......... audio frequency
amp .......... ampere(s)
C .......... centrigrade
db .......... decibel(s)
dc .......... direct current
F .......... Fahrenheit
hf .......... high frequency
ma .......... milliampere
rf .......... radio frequency
rms .......... root mean square
uf, uuf .......... microfarad, micromicrofarad

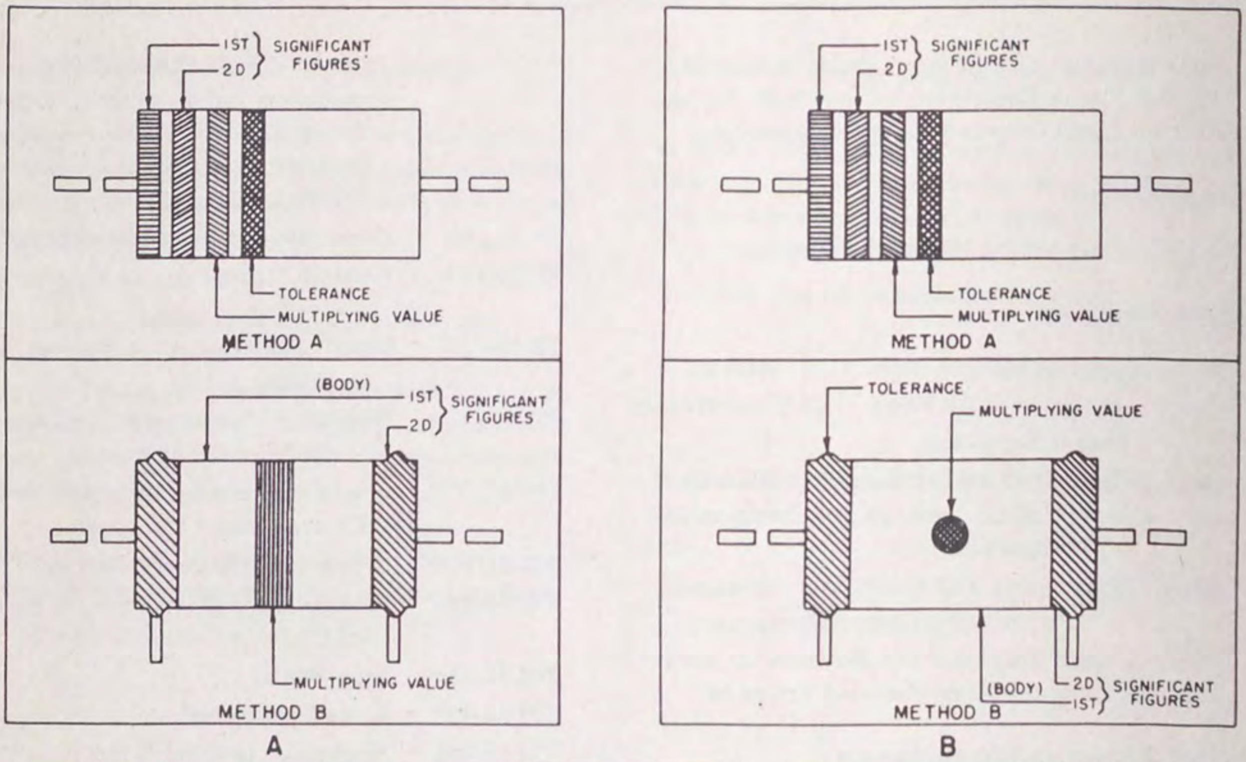
## 8. Glossary

For explanation of terms used in this manual, refer to TM 11-455.

## RESISTOR COLOR CODES

RMA COLOR CODE FOR FIXED COMPOSITION RESISTORS*

JAN COLOR CODE FOR FIXED COMPOSITION RESISTORS†




| COLOR | SIGNIFICANT FIGURE | MULTIPLYING VALUE | TOLERANCE (%) |
|---|---|---|---|
| BLACK | 0 | 1 | ± – |
| BROWN | 1 | 10 | ± 1 |
| RED | 2 | 100 | ± 2 |
| ORANGE | 3 | 1,000 | ± 3 |
| YELLOW | 4 | 10,000 | ± 4 |
| GREEN | 5 | 100,000 | ± 5 |
| BLUE | 6 | 1,000,000 | ± 6 |
| VIOLET | 7 | 10,000,000 | ± 7 |
| GRAY | 8 | 100,000,000 | ± 8 |
| WHITE | 9 | 1,000,000,000 | ± 9 |
| GOLD | – | 0.1 | ± 5 |
| SILVER | – | 0.01 | ± 10 |
| NO COLOR | – | – | ± 20 |

### NOTES

* INSULATED FIXED COMPOSITION RESISTORS WITH AXIAL LEADS ARE DESIGNATED BY A NATURAL TAN BACKGROUND COLOR. NON-INSULATED FIXED COMPOSITION RESISTORS WITH AXIAL LEADS ARE DESIGNATED BY A BLACK BACKGROUND.

† RESISTORS WITH AXIAL LEADS ARE INSULATED. RESISTORS WITH RADIAL LEADS ARE NON-INSULATED.

RMA RADIO MANUFACTURERS ASSOCIATION

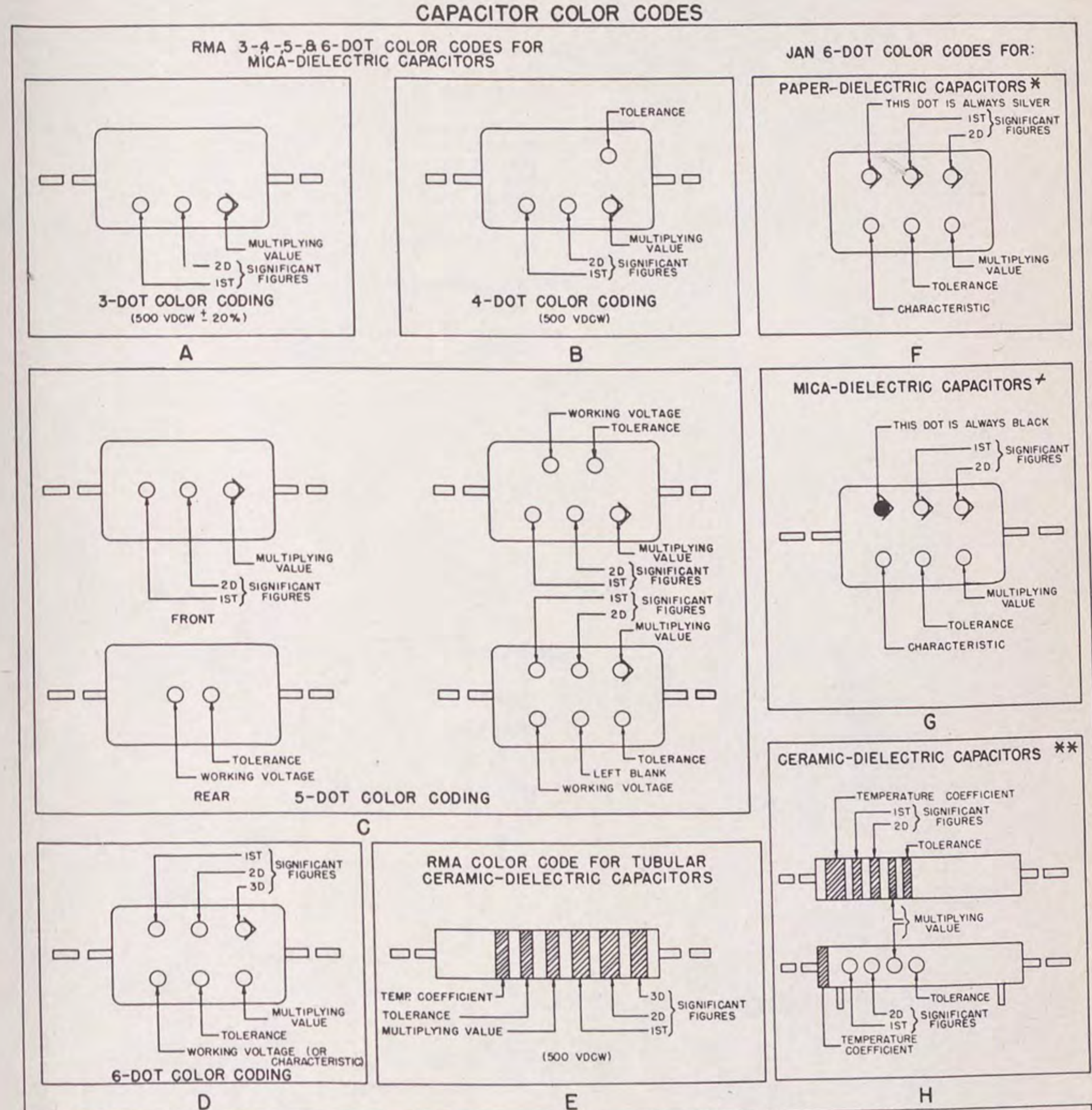
JAN JOINT ARMY-NAVY

THESE COLOR CODES GIVE ALL RESISTANCE VALUES IN OHMS

TL 32454S

*Figure 45. Resistor color code.*

## CAPACITOR COLOR CODES




| 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.

TL 32453S

*Figure 46. Capacitor color code.*

NOTES

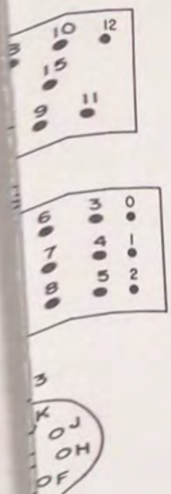
1: SWITCH S-101 VIEWED FROM DETENT SPRING SIDE IN EXTREME CLOCKWISE POSITION. S-202 VIEWED FROM KNOB END IN EXTREME COUNTER CLOCKWISE POSITION. ROTOR SECTIONS ARE DESIGNATED BY LETTERS A,B,C,ETC., AND CONTACTS ARE DESIGNATED BY A LETTER AND A NUMBER. THE LETTER INDICATES THE ROTOR SECTION THRU WHICH THE CONTACTS COMPLETE A CIRCUIT. THE NUMBER INDICATES THE SWITCH POSITION IN WHICH THE CONTACT IS IN A COMPLETED CIRCUIT.

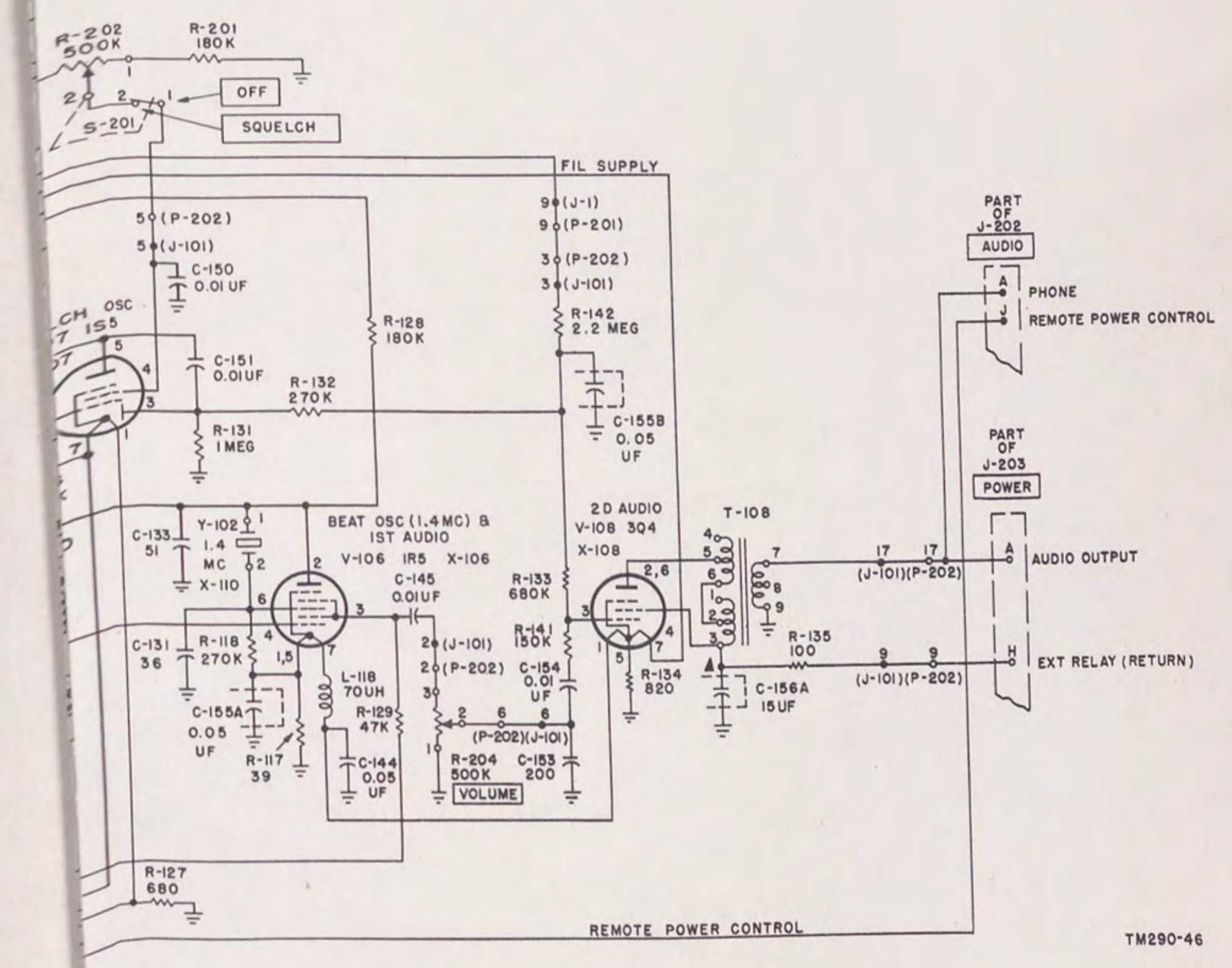
2: UNLESS OTHERWISE SHOWN, RESISTORS ARE IN OHMS. CAPACITORS ARE IN UUF.

3: UNLESS OTHERWISE SHOWN, RESISTORS ARE $\frac{1}{2}$ WATT.

4: E-1 TO E-4, E-101 TO E-106 ARE TEST POINTS.

5: FRONT PANEL IS GROUNDED TO R-F CHASSIS THRU PIN 1 ON P-201 & J-1, & TO I-F CHASSIS THRU PIN 19 ON P-202 & J-101.






TM290-46

*Figure 47. Receiver-Transmitter RT-70/GRC, schematic diagram.*

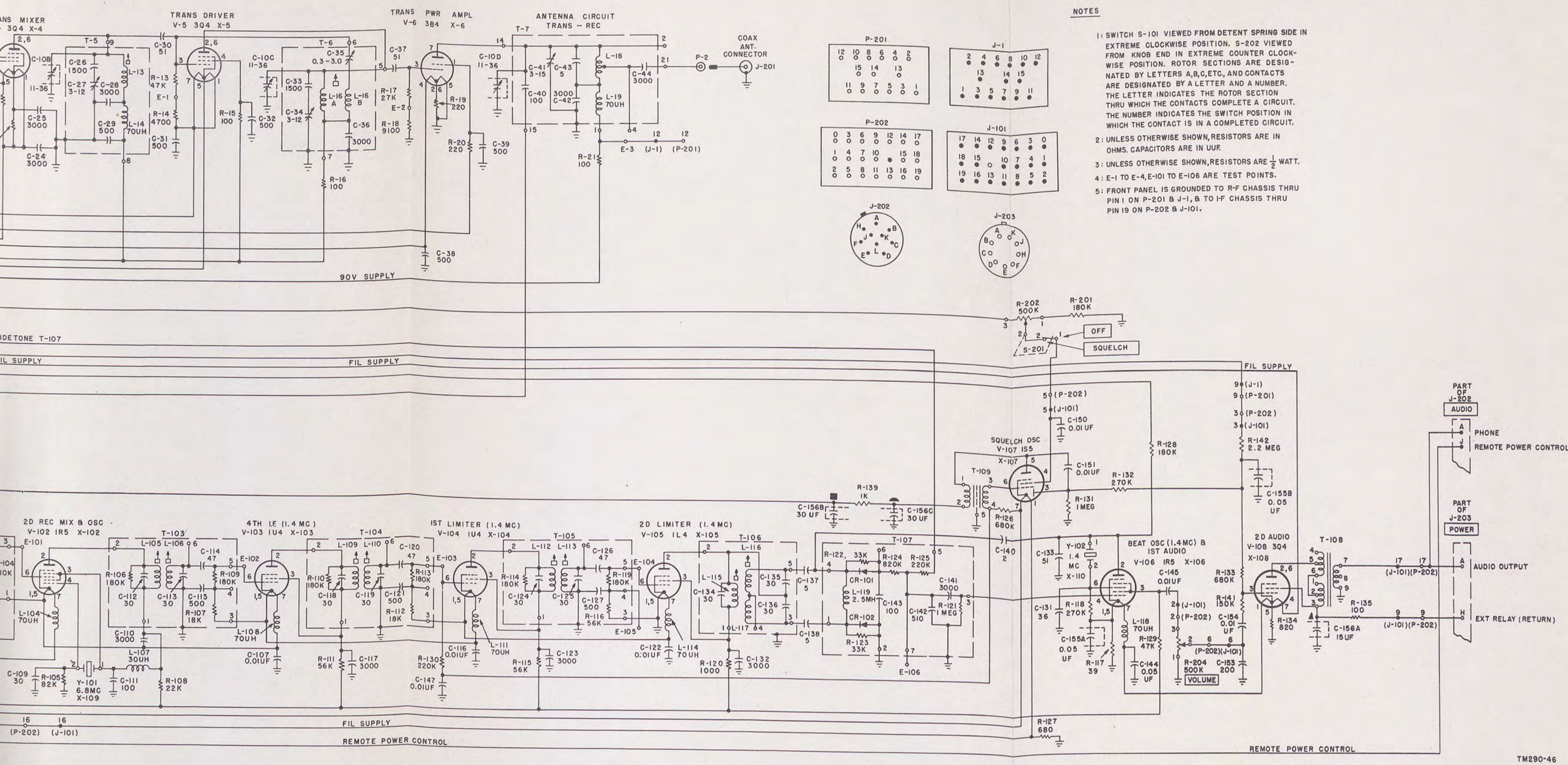
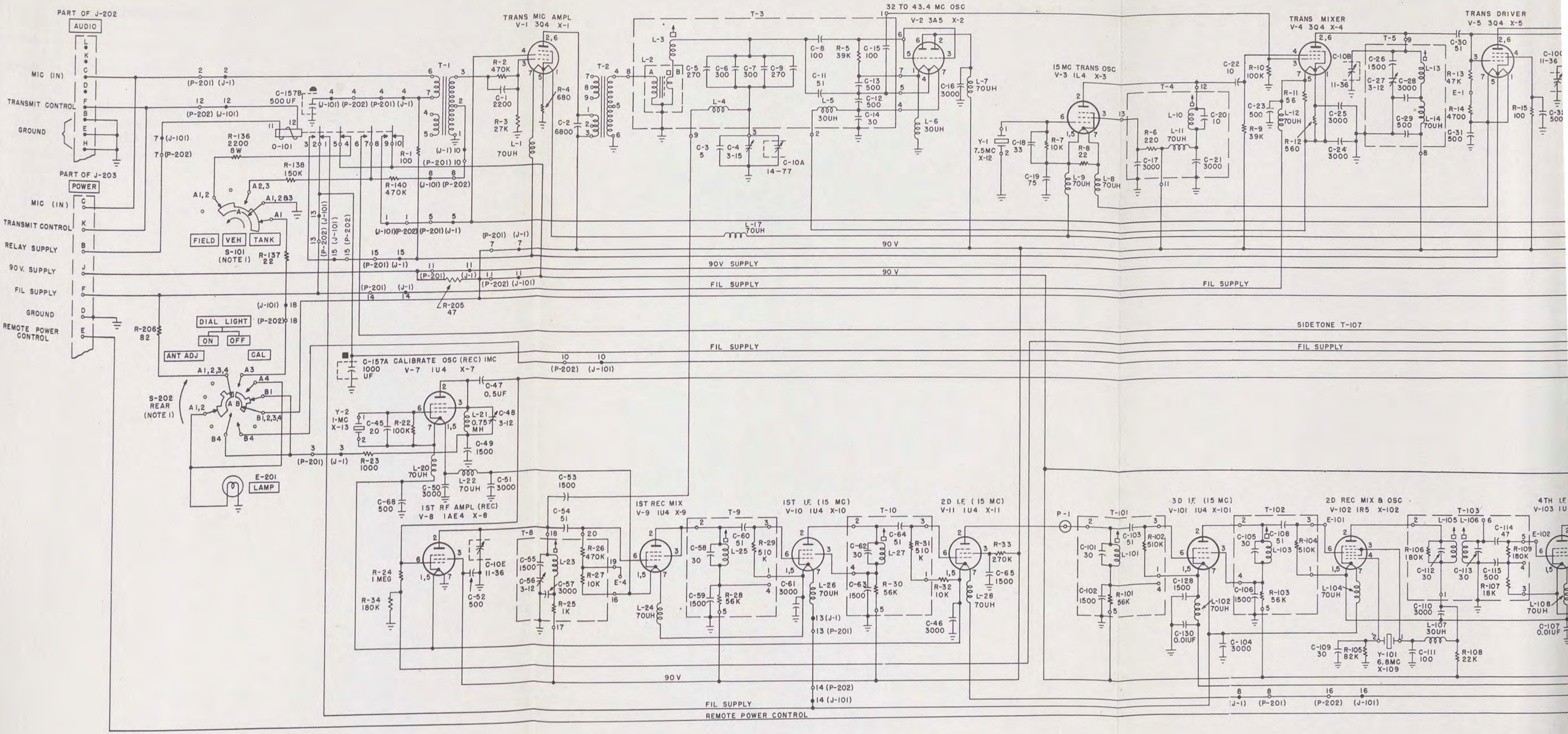



*Figure 47. Receiver-Transmitter RT-70/GRC, schematic diagram.*


PART OF J-202
AUDIO
MIC (IN)
TRANSMIT CONTROL
GROUND
PART OF J-203
POWER
MIC (IN)
TRANSMIT CONTROL
RELAY SUPPLY
90V. SUPPLY
FIL SUPPLY
GROUND
REMOTE POWER CONTROL
FIELD
VEH
TANK
S-101 (NOTE I)
DIAL LIGHT
ON
OFF
ANT ADJ
CAL
S-202 REAR (NOTE I)
E-201 LAMP
TRANS MIC AMPL V-1 3Q4 X-1
32 TO 43.4 MC OSC V-2 3A5 X-2
15 MC TRANS OSC V-3 IL4 X-3
TRANS MIXER V-4 3Q4 X-4
TRANS DRIVER V-5 3Q4 X-5
C-157A CALIBRATE OSC (REC) IMC V-7 1U4 X-7
1ST RF AMPL (REC) V-8 IAE4 X-8
1ST REC MIX V-9 1U4 X-9
1ST I.F. (15 MC) V-10 1U4 X-10
2D I.F. (15 MC) V-11 1U4 X-11
3D I.F. (15 MC) V-101 1U4 X-101
2D REC MIX & OSC V-102 IR5 X-102
90V SUPPLY
90 V
FIL SUPPLY
SIDETONE T-107
REMOTE POWER CONTROL

# 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 T/O&E, TA, T/BA, 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-RT-70/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 Receiver-Transmitter RT-70/GRC

| Ref symbol | Name of part and description | Function of part | Signal Corps stock No. |
|---|---|---|---|
| | ARMY-NAVY RECEIVER-TRANSMITTER RT-70/GRC; vehicular, ground, portable; FM; xmtr output approx 400 mw; freq range of both rec and xmtr 47-58.4 mc in 1 band; nom input 6 v and 90 v DC; w/operating spare tubes, crystals, and dial lamp; mtd in metal case 7⅞" wd x 5¼" h x 12⅞" d o/a, mts on Army-Navy AF Amplifier AM-65/GRC or Case CY-590()/GRC by means of 4 mtg studs on bottom and fastens by means of 4 catches, 2 on ea side at bottom edge of case; immersion and fungus resistant, self-luminous dial and control knob markings; p/o Army-Navy Radio Sets AN/GRC-3 thru AN/GRC-8, AN/VRC-7, and AN/PRC-16; Fed Tele & Radio part/dwg #GA-2197-14; US Army spec #71-3323. | | 2C5130-70 |
| E-119 | BOARD, terminal: 24 tinned copper wire solder type term; term irregularly spaced on board; type LST-E-4 natural phenolic board; 2-11/16" lg x 2" wd x ⅝" thk o/a; two .154" diam mtg holes 1 in ea mtg bracket on 2.312" mtg/c; 2 angle bracket mtg feet located on lower edge, terms 1, 9, 10, 11, 14, 15, 20, 21, 22, 23, and 24 are marked; Fed Tele & Rad part/dwg #GA-1995-2. | Terminal board. | 3Z770-24.29 |
| A-101 | BRACKET: "U" shape; cad pl brass; 1-5/16" lg x 49/64" wd x 1-1/16" h excluding mtg studs; two #6-32 x ⅜" lg thd spade type mtg studs on 1-9/16" mtg/c; oval hole in top of bracket 1-3/16" lg x .537" wd, similar to CPO6SA1 bracket per spec JAN-C-25 except for mtg stud lg; Fed Tele & Rad part/dwg #GB-2134-2. | Capacitor mounting bracket. | 2Z1239.268 |
| O-201 | CABLE ASSEMBLY, mechanical: SS; .030" diam; 7 strands, 3-0.005" diam wires per strand; 23¼" lg o/a; lug ea end .3585" lg x ⅛" diam flatted on end w/.067" diam hole; terminating lugs swedged to cable; p/o Fed Tele & Rad GA-1914-14 dial drive; Fed Tele & Rad part/dwg #GA-1357-2. | Dial drive cable. | 3E7350-3-4 |
| O-301 | CAP: c/o 1 Fed Tele & Rad #GA-2257-2 chain, 1 #GB-1033-2 screw; and 1 #GB-1035-2 ring; round cap; cap portion .937" diam x .578" h, attached; chain 3" lg; mts in single hole by means of ½"-20 NF-2 x ¼" lg mtg thd on cap, has retaining chain attached by means of ring; Fed Tele & Rad part/-dwg #GA-1166-2. | Cap for antenna trimmer adjustment access hole in case. | 2Z1607-101 |
| C-47 | CAPACITOR, fixed: ceramic dielectric; JAN type CC21LKOR5C; .5 uuf ±.25 uuf; 500 vdcw; spec JAN-C-20A. | V-7, calibrate oscillator coupling. | 3D9000.5-5 |
| C-140 | CAPACITOR, fixed: ceramic dielectric; JAN type CC21LKO20C; 2 uuf ±.25 uuf; 500 vdcw; spec JAN-C-20A. | V-106 beat oscillator coupling. | 3D9002-53 |
| C-3,<br>C-43,<br>C-137, | CAPACITOR, fixed: ceramic dielectric; JAN type CC21LH050D; 5 uuf ±.5 uuf; 500 vdcw; spec JAN-C-20A. | C-3; V-2, 32- to 43.5-mc oscillator tuning.<br>C-43: Antenna circuit tuning.<br>C-137: Discriminator coupling to CR-101. | 3D9005-117 |

| Ref symbol | Name of part and description | Function of part | Signal Corps stock No. |
|---|---|---|---|
| C-138 | | C-138: Discriminator coupling to CR-102. | |
| C-22 | CAPACITOR, fixed: ceramic dielectric; JAN type CC21LH100F; 10 uuf ±1 uuf; 500 vdcw; spec JAN-C-20A. | V-3 crystal oscillator coupling. | 3D9010-176 |
| C-20 | CAPACITOR, fixed: ceramic dielectric; JAN type CC21TJ100F; 10 uuf ±1 uuf; 500 vdcw; spec JAN-C-20A. | V-3 plate load tuning | 3D9010-177 |
| C-45 | CAPACITOR, fixed: ceramic dielectric; JAN type CC21LH200K; 20 uuf ±10%; 500 vdcw; spec JAN-C-20A. | V-7, calibrate oscillator tuning. | 3D9020-61 |
| C-14 | CAPACITOR, fixed: ceramic dielectric; JAN type CC30RH300J; 30 uuf ±5%; 500 vdcw; spec JAN-C-20A. | V-2, r-f bypass. | 3D9030-66 |
| C-134, C-135, C-136 | CAPACITOR, fixed: ceramic dielectric; JAN type CC20SH300K; 30 uuf ±10%; 500 vdcw; spec JAN-C-20A; part of T-106. | Discriminator tuning. | 3D9030-61 |
| C-109, C-112, C-113, C-118, C-119, C-124, C-125 | CAPACITOR, fixed: ceramic dielectric; JAN type CC21TH300K; 30 uuf ±10%; 500 vdcw; spec JAN-C-20A. | C-109: V-2, 32- to 43.5-mc oscillator feedback.<br>C-112 and C-113: I-f transformer tuning, part of T-103.<br>C-118 and C-119: I-f transformer tuning, part of T-104.<br>C-124 and C-125: I-f transformer tuning, part of T-105. | 3D9030-46 |
| C-58, C-62, C-101, C-105 | CAPACITOR, fixed: ceramic dielectric; JAN type CC30LH300K; 30 uuf ±10%; 500 vdcw; spec JAN-C-20A. | C-58: I-f transformer tuning, part of T-9.<br>C-62: I-f transformer tuning.<br>C-101: I-f transformer tuning, part of T-101.<br>C-105: I-f transformer tuning, part of T-102. | 3D9030-67 |
| C-18 | CAPACITOR, fixed: ceramic dielectric; JAN type CC21TH330K; 33 uuf ±10%; 500 vdcw; spec JAN-C-20A. | V-3, 15-mc oscillator feedback. | 3D9033-37 |
| C-131 | CAPACITOR, fixed: ceramic dielectric; JAN type CC21UK360K; 36 uuf ±10%; 500 vdcw; spec JAN-C-20A. | V-106, beat oscillator feedback. | 3D9036-13 |
| C-114, C-120, C-126 | CAPACITOR, fixed: ceramic dielectric; JAN type CC30HH470K; 47 uuf ±10%; 500 vdcw; spec JAN-C-20A. | C-114: I-f coupling, part of T-103.<br>C-120: I-f coupling, part of T-104.<br>C-126: I-f coupling, part of T-105. | 3D9047-55 |
| C-11 | CAPACITOR, fixed: ceramic dielectric; JAN type CC30RH510J; 51 uuf ±5%; 500 vdcw; spec JAN-C-20A. | V-2, 32- to 43.4-mc oscillator feedback. | 3D9051-61 |
| C-30, C-37, C-54, C-133, C-60, | CAPACITOR, fixed: ceramic dielectric; JAN type CC21UK510K; 51 uuf ±10%; 500 vdcw; spec JAN-C-20A. | C-30: V-4, transmitter mixer coupling.<br>C-37: V-5, transmitter driver plate coupling.<br>C-54: V-9, first receiver mixer | 3D9051-8 |

| Ref symbol | Name of part and description | Function of part | Signal Corps stock No. |
|---|---|---|---|
| C-64,<br>C-103,<br>C-108 | | grid coupling.<br>C-133: V-106, beat oscillator feedback.<br><br>I-f coupling, part of T-9.<br>I-f coupling, part of T-10.<br>I-f coupling, part of T-101.<br>I-f coupling, part of T-102. | |
| C-19 | CAPACITOR, fixed: ceramic dielectric; JAN type C26TH750K; 75 uuf ±10%; 500 vdcw; spec JAN C-20A. | V-3, r-f bypass. | 3D9075-50 |
| C-15,<br>C-40,<br>C-111 | CAPACITOR, fixed: ceramic dielectric; JAN type CC26UK101K; 100 uuf ±10%; 500 vdcw; spec JAN-C-20A. | C-15: V-4, transmitter mixer grid coupling.<br>C-40: T-7, receiver antenna coupling.<br>C-111: V-102, second receiver oscillator feedback. | 3D9100-251 |
| C-8 | CAPACITOR, fixed: ceramic dielectric; JAN type CC32LH101J; 100 uuf ±5%; 500 vdcw; spec JAN-C-20A. | V-2, 32- to 43.5-mc oscillator grid coupling. | 3D9100-293 |
| C-5<br>C-9 | CAPACITOR, fixed: ceramic dielectric; 270 uuf ±10%; neg temp coef 220 (to 1 ±15%) uuf/-uf/°C; 500 vdcw; 1.165" lg x .36" diam max; 2 radial wire leads; uninsulated; Fed Tele & Rad part/dwg #GN-2531-12-4. | C-5: V-2, 32- to 43.4-mc oscillator padder.<br>C-9: V-2, 32- to 43.4-mc oscillator padder. | 3D9270-20 |
| C-6,<br>C-7 | CAPACITOR, fixed: ceramic dielectric; 300 uuf ±10%; neg temp coef 220 (to 1 ±15%) uuf/-uf/°C; 500 vdcw; 1.11" lg x .36" diam; 2 radial wire leads; uninsulated; Fed Tele & Rad part/dwg #GN-2531-12-5. | V-2, 32- 43.4-mc oscillator padders. | 3D9300-68 |
| C-23,<br>C-29,<br>C-31<br>C-32,<br>C-38,<br>C-39,<br>C-52,<br>C-68,<br>C-115,<br>C-121,<br>C-127 | CAPACITOR, fixed: ceramic dielectric; 500 uuf ±20%; var temp coef; 500 vdcw; .460" lg x .240" diam; radial wire leads; dipped phenolic insulation; Erie type #337 Hi-K Ceramicon; Fed Tele & Rad part/dwg #GH-2094-2-2. | C-23: V-4 filament decoupling.<br>C-29: V-4 plate decoupling.<br>C-31: V-5 filament decoupling.<br>C-32: V-5 screen decoupling.<br>C-38: V-6 filament decoupling.<br>C-39: V-6 screen decoupling.<br>C-52: V-8 screen decoupling.<br>C-68: V-8 filament decoupling.<br>C-115: Grid circuit decoupling, part of T-103.<br>C-121: Grid circuit decoupling, part of T-104.<br>C-127: Grid circuit decoupling, part of T-105. | 3D9500-237 |
| C-59,<br>C-63,<br>C-102,<br>C-106 | CAPACITOR, fixed: ceramic dielectric; 1500 uuf +50% −0%; var temp coef; 150 vdcw; 19/32" diam x .175" thk; max o/a; 2 radial wire leads; dipped Durez coating; Fed Tele & Rad part/dwg #GH-2432-2. | C-59: Plate circuit decoupling, part of T-9.<br>C-63: Plate circuit decoupling, part of T-10.<br>C-102: Plate circuit decoupling, part of T-101.<br>C-106: Plate circuit decoupling, part of T-102. | 3DA1.500-54 |

## 2. Identification Table of Parts for Receiver-Transmitter RT-70/GRC (contd)

| Ref symbol | Name of part and description | Function of part | Signal Corps stock No. |
|---|---|---|---|
| C-26, C-33, C-49, C-53, C-55, C-65, C-128 | CAPACITOR, fixed: ceramic dielectric; 1500 uuf ±20%; var temp coef; 500 vdcw; .71" lg x .24" diam; radial wire leads; dipped phenolic insulation; Erie type #337 Hi-K Ceramicon; Fed Tele & Rad part/dwg #GH-2094-2-3. | C-26: Padder capacitor for T-5.<br>C-33: Padder capacitor for T-6.<br>C-49: V-7 plate decoupling.<br>C-53: V-8, first r-f mixer coupling.<br>C-55: Padder capacitor in plate circuit of V-8.<br>C-65: V-11 screen decoupling.<br>C-128: V-101 filament decoupling. | 3DA1.500-50 |
| C-16, C-17, C-21, C-24, C-25, C-44, C-46, C-50, C-51, C-61, C-104, C-110, C-117, C-123, C-132, C-141 | CAPACITOR, fixed: ceramic dielectric; 3000 uuf ±20%; var temp coef; 500 vdcw; .937" lg x .312" diam; radial wire leads; dipped phenolic insulation; Erie type #337 Hi K Ceramicon; Fed Tele & Rad part/dwg #GH-2094-2-5. | C-16: V-2, plate decoupling.<br>C-17: V-3, screen decoupling.<br>C-21: V-3, plate decoupling.<br>C-24 and C-25: V-4 filament decoupling.<br>C-44: Antenna coupling.<br>C-46: V-11 filament decoupling.<br>C-50: V-7 filament decoupling.<br>C-51: V-8 filament decoupling.<br>C-61: V-10 filament decoupling.<br>C-104: V-101 filament decoupling.<br>C-110: V-112 plate decoupling.<br>C-117: V-103 screen decoupling.<br>C-123: V-104 screen decoupling.<br>C-132: V-105 screen decoupling.<br>C-141: V-106 audio coupling. | 3DA3-142 |
| C-157 | CAPACITOR, fixed: electrolytic; 2 sect; capacity between square coded and plain term 1000 uf, between semicircle coded and plain term 500 uf tolerance both sect −10% +150%; 10 vdcw ea sect; working temp range −20 to +85°C; 1-15/32" diam x 2" lg excluding mtg tabs and term; HS metal can; 3 solder lug term on bottom; all term insulated from can; 4 mtg tabs on bottom, .190" wd x .032" thk x 9/32" lg, 90 deg apart on .508" rad; marked w/date of mtg, term coding, capacity and working Aerovox #GH-1190-2; Fed Tele & Rad part/dwg #GH-1190-2. | C-157A: V-108 filament decoupling (1000 uf).<br>C-157B: J-101 microphone decoupling (500 uf). | 3DB1000-25 |
| C-156 | CAPACITOR, fixed: electrolytic; 3 sect; capacity between semicircle coded and plain term and square coded and plain term ea 30 uf and between triangle coded and plain term 15 uf, tolerance all sect −10% +150%; 150 vdcw ea sect; working temp range −20 to +85°C; 1-15/32" diam x 2" lg excluding mtg tabs and term; HS metal can; 4 solder lug term on bottom; all term insulated from can; 4 mtg tabs on bottom .190" wd x .032" thk x 9/32" lg, 90 deg aprt on .508" rad; marked w/date of mfg, term coding, capacity and working v, Aerovox #GH-1191-2; Fed Tele & Rad part/dwg #GH-1191-2. | C-156A: V-108 plate decoupling (15 uf).<br>C-156B: V-107 B+ decoupling (30 uf).<br>C-156C: V-107 plate decoupling (30 uf). | 3DB30-63 |
| C-143 | CAPACITOR, fixed: mica; JAN type CM20B101J; 100 uuf ±5%; 500 vdcw; spec JAN-C-5. | CR-101 and CR-102 rf bypass. | 3K2010122 |
| C-153 | CAPACITOR, fixed: mica; JAN type CM20B201J; 200 uuf ±5%; 500 vdcw; spec JAN-C-5. | V-108, audio de-emphasis. | 3K2020122 |

## 2. Identification Table of Parts for Receiver-Transmitter RT-70/GRC (contd)

| Ref symbol | Name of part and description | Function of part | Signal Corps stock No. |
|---|---|---|---|
| C-12, C-13 | CAPACITOR, fixed: mica; 500 uuf ±10%; 500 vdcw; temp coef letter E; .463" diam x 1/16" thk excluding term; button type metal case; 3 mtg tab and 1 eyelet term; mts by means of 3 mtg tabs on bottom which also act as term; capacity color code on upper outside edge; Erie type #370CH or equal; Fed Tele & Rad part/dwg #GH-2138-2. | V-2 filament bypass. | 3D9500-241 |
| C-142 | CAPACITOR, fixed: mica; JAN type CM20B511J; 510 uuf ±5%; 500 vdcw; spec JAN-C-5. | V-106 audio de-emphasis. | 3K2051122 |
| C-1 | CAPACITOR, fixed: mica; JAN type CM30B222K; 2200 uuf ±10%; 500 vdcw; spec JAN C-5. | V-1 audio pre-emphasis. | 3K3022221 |
| C-28, C-36, C-42, C-57 | CAPACITOR, fixed: mica; 3000 uuf ±10%; 500 vdcw; temp coef letter E; .651" diam x .102" thk excluding term; 3 mtg tab solder lug term on bottom outer edge and 1 post type solder term in ctr of bottom; lugs are 3/32" wd x .007" thk x 5/32" h spaced 90 deg apart on ¼" rad; stud .062" diam x 3/16" lg; mts by means of term tabs; capacity color coded around outer upper edge; Erie type #4700; Fed Tele & Rad part/dwg #GH-2139-2. | C-28: V-4, plate decoupling.<br>C-36: V-5 plate decoupling.<br>C-42: V-6 plate decoupling.<br>C-57: V-8 plate decoupling. | 3DA3-143 |
| C-2 | CAPACITOR, fixed: mica; JAN type CM35B682K; 6800 uuf ±10%; 500 vdcw; spec JAN-C-5. | V-1 plate coil tuning. | 3K3568221 |
| C-107, C-116, C-122, C-130, C-147, C-154 | CAPACITOR, fixed: paper dielectric; JAN type CN20E103M; 10,000 uuf ±20%; 120 vdcw; spec JAN C-91. | C-107: V-103 filament decoupling.<br>C-116: V-104 filament decoupling.<br>C-122: V-105 filament decoupling.<br>C-130: V-101 filament decoupling.<br>C-147: V-107 squelch decoupling.<br>C-154: V-108 audio coupling. | 3DA10-380 |
| C-145, C-150, C-151 | CAPACITOR, fixed: paper dielectric; JAN type CN22A103M; 10,000 uuf ±20%; 300 vdcw; spec JAN-C-91. | C-145: V-106, audio coupling.<br>C-150: V-107 screen decoupling.<br>C-151: V-107 noise amplifier coupling. | 3DA10-447 |
| C-144 | CAPACITOR, fixed: paper dielectric; 50,000 uuf +40% −15%; 600 vdcw; HS metal case; ⅝" diam x 1⅜" lg excluding term and mtg bkt; oil impregnated; term are 1 axial wire lead, and mtg bracket; internally grounded; U shaped single hole mtg bracket mtd axially on 1 end, hole #6-32 NC-2 thd; JAN type CP25A2EF503X capacitor w/ special mtg bracket attached; Fed Tele & Rad part/dwg #GH-2366-2. | V-106 and V-108 filament decoupling. | 3DA50-444 |
| C-155 | CAPACITOR, fixed: paper dielectric; JAN type CP-61B6EE503X; 2 sect; ea 50,000 uuf +40% −15%; 400 vdcw; spec JAN-C-25. | C-155A: V-106 filament decoupling (50,000 uuf).<br>C-155B: V-108 audio decoupling (50,000 uuf). | 3DA50-445 |

| Ref symbol | Name of part and description | Function of part | Signal Corps stock No. |
|---|---|---|---|
| C-35 | CAPACITOR, variable: air dielectric; neutralizing; concentric type; 0.3 to 3 uuf; 1500 v AC peak; 1" lg x 5/16" diam excluding adj screw and term; term are single pigtail lead and mtg stud; one #-12-24 x 7/32" lg mtg stud; glass insulating adj scdr slot; mtg stud 7/32" lg flatted on 1 side to fit .183" wd x .223" lg "D" hole; Corning Glass code #690082 or equal; Fed Tele & Rad part/dwg #GH-1989-2-1. | V-5 neutralizing adjustment. | 3D9003V-21 |
| C-41 | CAPACITOR, variable; air dielectric; plate meshing type, single sect; 2.6 to 13.3 uuf; SLC characteristic; 800 v RMS test; 1-9/32" lg x ⅝" wd x ¾" h o/a excluding shaft, shaft .188" diam x ½" lg, bushing ¼"-32 x ⅜" lg; scdr adj; 15 SLC silver pl brass plates; 180 deg clockwise rotation; ceramic insulation; solder lug term; single hole mtg by ¼" diam mtg bushing; tropicalized, supplied w/hex mtg nut; Fed Tele & Rad part/dwg #GH-2090-2. | Antenna tuning. | 3D9013VE3 |
| C-4 | CAPACITOR, variable; air dielectric; plate meshing type, single sect; 2.6 to 13.3 uuf; SLC characteristic; 800 v RMS test; 1-9/32" lg x ⅝" wd x ¾" h o/a excluding shaft, shaft .188" diam x ¼" lg, locking type bushing ¼"-32 x ⅜" lg; scdr adj; 15 SLC silver pl brass plates; 180 deg clockwise rotation; ceramic insulation; solder lug term; single hole mtg by ¼" diam mtg bushing; tropicalized, supplied w/hex mtg nut and hex locking nut; Fed Tele & Rad part/dwg #GH-2091-2. | V-2 oscillator tuning. | 3D9013VE3-1 |
| C-10 | CAPACITOR, variable: air dielectric; plate meshing type, 5 sect; sect 1, 2, 3, 4 capacity 1/uuf to 35.48 uuf sect 5 capacity 14 uuf to 76.96 uuf; SLF; 1000 v RMS test; 6.449" lg excluding shaft x 1¾" wd x 2-1/16" h excluding term; shaft 13/32" lg x ⅜" diam; no trimmer adj; sects 1, 2, 3, 4, ea 7 cad pl steel plates sect 5, 23 cad pl steel plates; 180 deg counterclockwise rotation; ceramic insulation; lug term; three #4-40 NC-2 thd mtg holes, 2 on 1 side of bottom on 4⅜" ctr, third on other side of bottom 1.093" from ctr line of other 2 holes and 1-29/32" back from front hole; special calibration sect mtd on rear of shaft outside of frame; RCC part #CN-800231; Fed Tele & Rad part/dwg #GH-1022-14. | C-10A: V-2 oscillator tuning.<br>C-10B: V-4, transmitter mixer tuning.<br>C-10C: V-5, transmitter driver tuning.<br>C-10D: Transmitter power amplifier tuning.<br>C-10E: V-8, first r-f amplifier (receiver). | 3D9076VE96 |
| C-27,<br>C-34,<br>C-48,<br>C-56 | CAPACITOR, variable: ceramic; rotary type, single sect; 3 uuf to 12 uuf; 500 vdcw; zero uuf/uf/°C; 55/64" lg x 21/32" wd x ⅜" h excluding term; 2 solder lug term; two .120" diam mtg holes on .445" mtg/c; scdr slot adj; ceramic base; Erie type #NP-OTS2A or equal; Fed Tele & Rad part/ dwg #GH-1990-2. | C-27: V-4, transmitter mixer tuning.<br>C-34: V-5, transmitter driver tuning.<br>C-48: V-7, calibrate oscillator tuning.<br>C-56: V-8, first r-f amplifier tuning (receiver). | 3D9012V-24 |
| H-301,<br>H-302,<br>H-303,<br>H-304 | CATCH, fastener: p/o Fed Tele & Rad #GA-1718-14 case assem; c/o 1 back plate, 1 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 ½" d in locked position; two .144" diam mtg holes on back plate, .437" c to c; Sig C dwg #SC-D-2064B. | Mounting catches. | 6Z3810-97 |

| Ref symbol | Name of part and description | Function of part | Signal Corps stock No. |
|---|---|---|---|
| H-101 | CLAMP: cable clamp; steel; electro tin pl; 1-13/16" lg x ¼" wd x .2195" h o/a, two .159" diam mtg holes on 1.562" mtg/c; rectangular clamping space 1" lg x 3/16" h; p/o Fed Tele & Rad #GA-1852-14 IF assem; Fed Tele & Rad part/dwg #GB-2210-2-1. | Wiring cable clamp. | 2Z2646.65 |
| H-102 | CLAMP: cable clamp; steel; electro tin pl; 1⅜" lg x ¼" wd x .2195" h o/a; two .159" diam mtg holes on 1.375" mtg/c; rectangular clamping space 13/16" lg x 3/16" h; p/o Fed Tele & Rad #GA-1852-14 IF assem; Fed Tele & Rad part/dwg #GB-2210-2-2. | Wiring cable clamp. | 2Z2646.66 |
| O-202 | CLIP: spring temper phosphor bronze; ¾" lg x ⅜" wd x .11" thk; 2 sides and lower edge turned over 1/16" on 1/16" rad, top edge straight, single .154" diam mtg hole, mts against metal plate and provides holding action when wrench is slipped between clip and plate, hold 2 wrenches; p/o Fed Tele & Rad #GA-1850-14 front panel assem; Fed Tele & Rad part/dwg #GB-2679-2. | Holding clip, set screw wrenches. | 2Z2712.174 |
| O-1, O-2, O-102, O-103 | CLIP: crystal holding clip; nickel pl spring temper phosphor bronze; 1⅛" lg x ⅝" wd x 7/32" thk o/a; clip opening 7/32" U shaped, front lips bent at 45 deg angle to facilitate application; mtg hole in base of U .128" diam; Fed Tele & Rad part/dwg #GB-1702-2. | Crystal holding clips. | 2Z2712.175 |
| L-18 | COIL, RF: antenna; single wnd, single layer wnd; unshielded; 4 turns #14 B & S ga (.064") soft copper wire; 1" lg x .909" wd x 1" h o/a; air core; mts by term which are looped ends of coil; silver pl; Fed Tele & Rad part/dwg #GA-2209-2. | Antenna tuning. | 3C1084K-113 |
| L-21 | COIL, RF: choke single pie universal wnd; unshielded; .75 mh at 1000 cps, 12.5 ohms DC resistance; approx 5/16" diam x ½" lg excluding leads; powdered iron core; 2 axial wire leads; impregnated for tropical use; Muter part #C-7308; Fed Tele & Rad part/dwg #GN-1693-2. | V-7, calibrate oscillator tuning choke. | 3C345-7 |
| L-119 | COIL, RF: choke; 2 pies, universal wnd; unshielded; 2.5 mh at 1000 cps, 28 ohms DC resistance; approx ⅜" diam x 17/32" lg excluding leads; powdered iron core; 2 axial wire leads; impregnated for tropical use; Muter part #C-7309; Fed Tele & Rad part/dwg #GN-1694-2. | Discriminator load (CR-101 and CR-102). | 3C345-8 |
| L-4 | COIL, RF: choke; single wnd, single layer close wnd; unshielded; 35 turns #30 AWG enameled wire; ⅝" lg x .2" diam excluding leads; phenolic core; 2 axial wire leads; phenolic resin coated and wax impregnated; Muter part #C-7304; Fed Tele & Rad part/dwg #GN-1311-2. | V-2, oscillator decoupling | 3C345-9 |
| L-1, L-7, L-8, L-9, | COIL, RF: choke; single layer choke wnd; unshielded; 63 uh at 1000 cyc, 1.9 ohms DC resistances; 95 turns #35 AWG wire; ⅝" lg x 5/16" diam; powdered iron core; two 1½" lg axial wire leads; | L-1: V-1 filament decoupling. L-7: V-2 plate decoupling. L-8, L-9, and L-11: V-3 plate decoupling. | 3C345-5 |

## 2. Identification Table of Parts for Receiver-Transmitter RT-70/GRC (contd)

| Ref symbol | Name of part and description | Function of part | Signal Corps stock No. |
|---|---|---|---|
| L-11, L-12, L-14, L-17, L-19, L-20, L-22, L-24, L-26, L-28, L-102, L-104, L-108, L-111, L-114, L-118 | marked 70 uh; phenolic coated; wax impregnated and phenolic covered; Muter part #C-7307; Fed Tele & Rad part/dwg #GN-1312-12. | L-12 and L-14: V-4 plate decoupling. L-17 and L-19: V-6 plate decoupling. L-20: V-8 plate decoupling. L-22: V-7 plate decoupling. L-24: V-9 plate decoupling. L-26: V-10 plate decoupling. L-28: V-11 plate decoupling. L-102: V-101 plate decoupling. L-104: V-102 plate decoupling. L-108: V-103 plate decoupling. L-111: V-104 plate decoupling. L-114: V-105 plate decoupling. L-118: V-106 plate decoupling. | |
| L-5, L-6, L-107 | COIL, RF: choke; single layer close wnd; unshielded; 27.9 uh at 1000 cyc; 1.13 ohms DC resistance; 65 turns #33 AWG wire; ⅝" lg x 5/16" diam; phenolic form w/powdered iron core; two 1½" lg axial wire leads; marked 30 uh; phenolic resin coated and wax impregnated; Muter part #C-7305-1; Fed Tele & Rad part/dwg #GN-1314-2-GRI. | L-5 and L-6: V-2 filament decoupling. L-107: Oscillator plate load. | 3C345-3 |
| L-10 | COIL, RF: single wnd, single layer close wnd; unshielded; 27 turns #26 AWG wire; 1.1" lg x 9/16" diam o/a; phenolic form mtd on electro tin pl brass insert; air core; coil form ½" max diam x 1-1/16" lg o/a; single "D" hole mtg, insert tapped 5/16"-32 NEF-2 thd x 3/16" d; 2 solder lug term on side of coil form; Fed Tele & Rad part/dwg #GA-2066-2. | V-3 crystal oscillator coil. | 3C1084K-114 |
| L-16 | COIL, RF: 2 wnd, single layer wnd; unshielded; 1 wnd 5¼ turns #18 AWG tinned copper wire, other wnd 5⅝ turns #18 AWG tinned copper wire; 1-21/32" lg o/a x 1½" wd x 1-1/16" h o/a; ceramic form mtd on phenolic plate, air core; coil form 1-15/32" lg x .65" max diam phenolic plate 1½" lg x 1-1/16" wd x 5/32" thk; two .128" diam mtg holes in phenolic plate on .687" mtg/c; 2 solder type term on mtg plate, 1 on coil form; phenolic plate has "D" shaped hole for mtg trimmer capacitor not supplied as part of coil; Fed Tele & Rad part/dwg #GA-2633-2. | L-16A: V-5 driver tank coil. L-16B: Neutralizing coil. | 3C1084K-115 |
| L-13 | COIL, RF: mixer plate loading coil; single wnd, single layer wnd; unshielded; approx 4 turns #14 AWG silver pl copper wire; .628" diam x 1-5/16" lg o/a; air wnd, air core; mts by means of ends of coil which are bent into hook type term; 2 solder type term 1 on either end of coil; Fed Tele & Rad part/dwg #GB-2690-2. | V-4 mixer tuning. | 3C1084K-116 |
| L-3 | COIL, RF: oscillator plate tuning coil; single wnd, single layer wnd; unshielded; 2½ turns #16 AWG silver pl copper wire; ⅞" lg x 1⅛" wd x ¾" d o/a; ceramic form, air core; coil form ⅞" lg x .625" diam w/saddle type mtg bkt on front end | V-2 grid tuning coil. | 3C1084K-117 |

## 2. Identification Table of Parts for Receiver-Transmitter RT-70/GRC (contd)

| Ref symbol | Name of part and description | Function of part | Signal Corps stock No. |
|---|---|---|---|
| | 1⅛" lg x ¾" wd x ⅛" thk; two .119" diam mtg holes in bkt on .876" mtg/c; 1 solder lug term on side of form other term pigtail end of coil extending 1½" from end of coil form; Fed Tele & Rad part/dwg #GA-2374-2. | | |
| L-23 | COIL, RF: receiver RF plate tuning coil; single wnd, single layer wnd; unshielded; 4¾ turns electro tin pl copper ribbon pl onto glass coil form; 13/16" lg x 9/16" diam o/a excluding pigtail term; glass form w/electro tin pl brass mtg insert air core; coil form 1-3/16" lg x 9/16" diam; single hole mtg, insert tapped 5/16"-32 NEF-2 x 3/16" d; 2 pigtail leads extend radially from side of coil form; Fed Tele & Rad part/dwg #GH-2379-2. | V-8, r-f amplifier plate tuning. | 3C1084K-118 |
| P-1, P-2 | CONNECTOR, plug: single round female cont; straight; .687" lg x .105" wd x .105" h; 4 finger spring type round phosphor bronze body, silver pl; mts on wire by solder lug term extending from Cinch type #120J6709 or equal; Fed Tele & Rad part/dwg #GB-2158-2. | P-1: I-f connector.<br>P-2: Antenna connector. | 2Z3062-237 |
| P-201 | CONNECTOR, plug: 15 round female cont; straight; 1½" lg x ¾" wd x .415" h excluding term; rectangular phenolic body; two .15" mtg holes on 1.188" mtg/c; cont marked from 1 to 15; Amphenol dwg #26-150; Fed Tele & Rad part/dwg #GH-2126-12. | Panel to r-f chassis plug. | 2Z3076-31 |
| P-202 | CONNECTOR, plug: 20 round female cont; straight; 2-1/32" lg x 13/16" wd x 1-3/64" h o/a; rectangular phenolic body; two .128" diam mtg holes on diagonally opposite corners of body on .218" x 1.780" mtg/c; 20 solder lug term extending 5/16" from bottom of body marked from 0 to 19, .125" diam x 5/16" lg locating pin for mating receptacle; Amphenol dwg #26-812 or equal; Fed Tele & Rad part/dwg #GH-2246-2. | Panel to i-f chassis plug. | 2Z3081-8 |
| J-201 | CONNECTOR, receptacle: single round female cont; straight; 1-9/32" lg x 9/16" diam o/a; cylindrical brass body; silver pl; polyethylene insert; mts thru hole in panel, body has ⅜"-32 NEF -2 thd 11/32" lg; "O" ring wp seal in panel bushing, supplied w/lockwasher and nut; Amphenol dwg #31-102; Fed Tele & Rad part/dwg #GH-2118-2. | Antenna connector. | 2Z3062-233 |
| J-203 | CONNECTOR, receptacle: 9 round female cont; straight; 1-15/32" diam x 1⅛" max lg o/a; cont rated 10 amp at 800 v ac; cylindrical brass body, electro tin pl finish, locking; molded phenolic insert; single hole mtg, 1¼" -18 NEF-2 x ⅜" lg mtg bushing; "O" ring wp seal in mtg flange, supplied w/spanner type mtg nut and lockwasher, immersion and salt spray resistant, 2 index flats on mtg bushing, ¼" -20 double thd tapped metal insert in ctr of phenolic insert provides locking action w/mating plug, locating key in shell and groove in insert; Amphenol dwg #164-3; Fed Tele & Rad part/dwg #GH-2082-12. | Power connector. | 2Z3070-49 |

| Ref symbol | Name of part and description | Function of part | Signal Corps stock No. |
|---|---|---|---|
| J-202 | CONNECTOR, receptacle: 10 round button type cont; straight; 1.286" max diam x 1.197" max d o/a; cylindrical stainless steel body, sand blast finish, locking; molded phenolic insert; single hole mtg, 1" -32 NS -2 x 5/16" lg thd mtg bushing; "O" ring wp seal on mtg flange, supplied w/spanner type mtg nut, immersion and salt spray resistant, index flats on mtg portion; Amphenol dwg #164-7 or Cannonelec dwg #17651-1; Fed Tele & Rad part/dwg #GH-2079-12. | Audio connector. | 2Z3030-27 |
| J-1 | CONNECTOR, receptacle: 15 round male cont; straight; 1½" lg x ¾" wd x 13/64" h excluding term and cont; rectangular phenolic body; two .150" diam mtg holes on 1.188" mtg/c; cont marked from 1 to 15; Amphenol dwg #26-151; Fed Tele & Rad part/dwg #GH-2127-12. | Panel to r-f chassis receptacle. | 2Z3035-31 |
| J-101 | CONNECTOR, receptacle: 20 round male cont; straight; 1-31/32" lg x ¾" wd x ¾" h o/a; rectangular molded phenolic body; two .128" diam mtg holes on diagonally opposite corners of body on .218" x 1.718" mtg/c; cont marked from 0 to 19, locating hole for mating plug; Amphenol dwg #26-813 or equal; Fed Tele & Rad part/dwg #GH-2291-2. | Panel to i-f chassis receptacle. | 2Z3040-11 |
| O-3, O-4, O-5, O-6 | CORE, adjustable tuning: c/o 1 Fed Tele & Rad #GH-1746-2 tuning core, 1 #GB-1468-2 stud, and 1 #GB-2709-2 nut; 1¾" lg x 7/16" diam o/a; single hole mtg by means of 5/16" -32 NEF-2 x ⅛" lg thd on stud portion; slotted hexagon head adj nut on end of core stud; Fed Tele & Rad part/-dwg #GA-1987-2. | Adjustable tuning cores. | 2Z3262-51 |
| O-7 | CORE, adjustable tuning: c/o 1 Fed Tele & Rad #GH-1745-2 tuning core, 1 #GB-1775-2 stud, and 1 #GB-2709-2 nut; 1-7/16" lg x ½" diam o/a; single hole mtg by means of 7/16" -32 NS-2 x ⅛" lg thd on stud portion; slotted hexagon head adj nut on end of core stud; Fed Tele & Rad part/-dwg #GA-1988-2-GrI. | Adjustable tuning core. | 2Z3262-52 |
| O-203 | COUPLING ASSEMBLY, flexible: p/o Fed Tele & Rad #GA-1914-14 dial drive; c/o 1 Fed Tele & Rad #GA-1259-12 coupling sub-assembly, and 1 Torrington #GB-47 needle bearing; round shape; 1-15/16" max diam x approx ⅞" lg; pulley portion .4325" diam shaft mtg hole; collar portion ⅞" diam shaft hole; bellows type flexible portion between pulley and collar; Fed Tele & Rad part/-dwg #GA-1260-12. | Dial drive to variable capacitor coupling. | 2Z3274-4 |
| Y-2 | CRYSTAL UNIT, quartz: Army-Navy crystal Unit CR-18/U; single crystal plate in Army-Navy Crystal Holder HC-6/U; nom freq 1000.000 kc; Sig C spec 71-3314. | Calibrate oscillator. | 2X209-1000 |
| Y-102 | CRYSTAL UNIT, quartz: Army-Navy Crystal Unit CR-18/U; single crystal plate in Army-Navy Crystal Holder HC-6/U; nom freq 1400.000 kc; Sig C spec 71-3314. | Beat oscillator. | 2X209-1400 |

## 2. Identification Table of Parts for Receiver-Transmitter RT-70/GRC (contd)

| Ref symbol | Name of part and description | Function of part | Signal Corps stock No. |
|---|---|---|---|
| Y-101 | CRYSTAL UNIT, quartz: Army-Navy Crystal Unit CR-18/U; single crystal plate in Army-Navy Crystal Holder HC-6/U; nom freq 6800.000 kc; Sig C spec 71-3314. | Receiver oscillator. | 2X209-6800 |
| Y-1 | CRYSTAL UNIT, quartz: Army-Navy Crystal Unit CR-18/U; single crystal plate in Army-Navy Crystal Holder HC-6/U; nom freq 7500.000 kc; Sig C spec 71-3314. | Transmitter oscillator. | 2X209-7500 |
| CR-101, CR-102 | CRYSTAL UNIT, rectifying: plastic case; .83 ma max inverse current at −50 v, 5 ma min forward current at +1 v, shunt capacity 1.0 uuf; .5" lg x .24" diam o/a; 2 axial wire leads; marked IN-43; RMA type #1N-43; WECo catalog #1N-43. | Discriminator diodes. OR ALTERNATE | 2Z1N43 |
| | OR ALTERNATE | | |
| CR-101, CR-102 | CRYSTAL UNIT, rectifying: .8 ma max inverse current at −50 v, 5 ma min forward current at +1 v, shunt capacity 1.0 uuf; 7/8" lg x 1/4" diam; 2 axial wire leads; Sylvania Prod catalog #1N-34A. | Discriminator diodes. | 2J1N34A |
| O-204, O-205 | DISK, marker: p/o Fed Tele & Rad #GA-1850-14 front panel assem; solid white lamicoid; circular plate shaped; .437" diam x 3/64" thk; chamfered around upper edge; Fed Tele & Rad part/dwg #GG-1080-2. | Marking disk detent frequency indication. | 2Z3807-27 |
| O-206 | DRIVE, dial: 1 Fed Tele & Rad #GB-1094-2 floating gear, 1 #GB-1095-2 pinion, 1 #GC-1184-14 drum, 1 #GC-1234-14 pulley holder, 1 #GA-1260-12 coupling assem, 1 #GB-1262-2 dial, 1 #GA-1357-2 cable assem, 2 #GP-1744-2 index cams, 1 ea #GB-1777-12 and #GB-1778-12 shafts, 1 #GA-1780-2 gear assem, 1 #GA-1791-2 pinion holder assem, 1 #GA-1794-2 hub assem, 1 #GA-2072-2 indicator assem, and misc clamps, collars; springs, washers, and std hardware; round shape w/2 offset arms, 1 arm has coupling assem other has idler pulley; approx 6-5/16" wd x 3½ h x 2-11/16" d o/a; two .169" diam csk mtg holes, 3.063 c to c; luminoil; white markings on dial, diamond shape calibrations and numerals from 47 to 58 incl; Fed Tele & Rad part/dwg #GA-1914-14. | Dail drive. | 273876.127 |
| H-201, H-202, H-203, H-204 | FASTENER, Dzus: die cast zinc and steel, olive drab finish; 1⅝" lg x 1-5/16" wd x 5/16" thk o/a; mts by shaft thru ¼" diam clearance hole; preloaded spring pressure unlocked approx 32 lb, locked 45 lb; Dzus dwg #X-486; Fed Tele & Rad part/dwg #GA-2178-2. | Panel to case fasteners. | 6Z3809-27 |
| O-207 | GASKET: neoprene or Buna N; single hole; rectangular; 6.6" lg x 4.413" wd x .187" thk o/a; hole 6.12" lg x 3.933" wd; durometer hardness 35-40; p/o Fed Tele & Rad #GA-1850-14 front panel assem; Fed Tele & Rad part/dwg #GR-1443-12-2. | Panel to case waterproof gasket. | 2Z4867.688 |
| O-208 | GASKET: rubber or rubber substitute; single hole; circular; 1¼" OD x 1⅛" ID x .093" thk o/a; durometer hardness 35-40; p/o Fed Tele & Rad #GA-1850-14 front panel assem; Fed Tele & Rad part/dwg #GR-1073-2. | Dial window gasket. | 2Z4867.689 |

## 2. Identification Table of Parts for Receiver-Transmitter RT-70/GRC (contd)

| Ref symbol | Name of part and description | Function of part | Signal Corps stock No. |
|---|---|---|---|
| O-209 | GASKET: Buna N; single hole; circular w/circular cross section; ⅜" OD x ¼" ID x 1/16" thk; p/o Fed Tele & Rad #GA-1850-14 front panel assem; Linear Inc part #1820-6; Fed Tele & Rad part/dwg #GS-1948-1-4. | Pilot light lens waterproof gasket. | 2Z4868.767 |
| O-210 | GASKET: Buna N; single hole; circular w/circular cross section, 9/16" OD x ⅜" ID x 3/32" thk; p/o Fed Tele & Rad #GA-1850-14 front panel assem; Linear Inc part #1820-8; Fed Tele & Rad part/dwg #GS-1948-1-7. | Pilot light retaining screw waterproof gasket. | 6654006-19 |
| O-302 | GASKET: Buna N; single hole; circular w/circular cross section; ¾" OD x 9/16" ID x 3/32" thk; p/o Fed Tele & Rad #GA-1718-14 case assem; Linear Inc part #1820-11. | Cap waterproof gasket. | 2Z4867.690 |
| H-205 | INSERT, insulator: p/o Fed Tele & Rad #GA-1850-14 front panel assem; polystyrene; circular w/beveled sides; .428" max OD x .378" max ID x .109" thk, sides taper at 30 deg angle from top to bottom; mts in tapered hole in lamp cap screw; Fed Tele & Rad part/dwg #GP-2696-2. | Lamp cap screw insulating insert. | 2Z5400-54 |
| H-305, H-306, H-307, H-308 | INSERT, threaded: p/o Fed Tele & Rad #GA-1718-14 case assem; steel, cad pl and olive drab iridited; generally rectangular w/1 rounded end; 1-5/16" lg x ⅜" wd x .1196" thk; two #6-32 NC-2 tapped holes on .437" ctr; Fed Tele & Rad part/dwg #GB-1172-2. | Catch mounting screws retaining inserts (nut). | 2Z5400-53 |
| E-22 thru E-41 | INSULATOR, feedthru: cylindrical shape; white grade L-4 steatite, unglazed; 19/32" lg o/a; .187" o/a diam; mts in .168" diam hole; c/o 1 Fed Tele & Rad #GB-1587-2-1 term, 2 #GG-1589-2 ceramic bushings, 1 #GR-1588-2 silicone rubber grommet, and 1 #BG-1590-2-1 eyelet, supplied unassembled; Fed Tele & Rad part/dwg #GA-1584-2. | Wiring terminal insulators. | 3G290-19 |
| E-42, E-43 | INSULATOR, feedthru: cylindrical shape; white grade L-4 steatite, unglazed; 11/16" lg o/a; .187" o/a diam; mts in .168" diam hole; c/o 1 Fed Tele & Rad #GB-2512-2 term, 2 #GG-1589-2 ceramic bushings, 1 #GR-1588-2 silicone rubber grommet, and 1 #GB-1590-2-1 eyelet; supplied unassembled; Fed Tele & Rad part/dwg #GA-2529-2. | Wiring terminal insulators. | 3G290-28 |
| E-44 | INSULATOR, plate: generally rectangular w/ends rounded; type LTS-E-5 natural phenolic; 1⅛" lg o/a; ¾" wd, 9/16" diam hole in ctr, two .128" diam mtg holes on ⅞" mtg/c, material 1/32" thk; p/o Fed Tele & Rad #GA-1855-12 osc assem; Fed Tele & Rad part/dwg #GP-1847-2. | Oscillator coil mounting insulator. | 3G320-199 |
| E-202 | INSULATOR, standoff: round post shape; natural or black grade LTS-E-4 phenolic, w/electro tin pl brass term lug and cad pl and clear iridited hex brass mtg base and stud; 13/16" lg o/a; 600 v RMS breakdown; 5/16" diam o/a; single #6-32 NC-2 x ¼" lg mtg stud; p/o Fed Tele & Rad #GA-1850-14 panel assem; Cambridge Therm type #X-1518-B; Fed Tele & Rad part/dwg #GN-2198-2. | Wiring terminal insulator. | 3G350-119 |

## 2. Identification Table of Parts for Receiver-Transmitter RT-70/GRC (contd)

| Ref symbol | Name of part and description | Function of part | Signal Corps stock No. |
|---|---|---|---|
| E-45 thru E-55, E-119 thru E-121, E-123 thru E-126 | INSULATOR, standoff: round post shape; white unglazed ceramic w/metal end caps; .7875" lg; .209" diam; ceramic, silicone treated, rivet type mtg stud on 1 end .094" diam x .1" lg, solder type stud term other cap; Fed Tele & Rad part/dwg #GG-1743-2-1. | Wiring terminal insulators. | 3G350-113 |
| E-203, E-204 | KNOB: lever type; olive drab zinc alloy; for ¼" diam double flatted shaft; single #6-32 screw thru hole in face of knob, screws into axially tapped hole in end of shaft; 1-7/32" lg x ⅝ wd x ½" h o/a; shaft hole .141" d from bottom surface; Fed Tele & Rad part/dwg #GC-1164-2. | Detent locking knobs. | 2Z5821-158 |
| E-205, E-206 | KNOB: round; olive drab zinc alloy; for ¼" diam double flatted shaft; single #6-32 screw thru hole in face of knob screws into axially tapped hole in end of shaft; 2 white luminous lines; 23/32" max diam at bottom tapers to 21/32" max diam top, 15/32" h o/a; shaft hole .359" d from bottom surface; luminous marking; Fed Tele & Rad part/dwg #GC-1245-2. | E-205: Squelch control knob.<br>E-206: Volume control knob. | 2Z5822-403 |
| E-207 | KNOB: round w/bar; olive drab zinc alloy; for ¼" diam double flatted shaft; single #6-32 screw thru hole in face of knob screws into axially tapped hole in end of shaft; 2 white luminous lines on bar portion; 1-3/16" lg x ⅞" wd x 15/32" h o/a; shaft hole .359" d from bottom surface; Fed Tele & Rad part/dwg #GC-1246-2. | Antenna dial light switch knob. | 2Z5822-402 |
| E-208 | KNOB: round w/folding spinner arm and knob; olive drab zinc alloy; for ¼" diam double flatted shaft; single #6-32 screw thru hole in face of knob screws into axially tapped hole in end of shaft; circular white luminous line on face of knob; 1-17/32" diam x 19/32" h o/a; shaft hole .328" d from bottom surface; luminous marking, knurled edge; Fed Tele & Rad part/dwg #GA-2219-2. | Tuning control knob. | 2Z5822-473 |
| N-1 | LABEL: circuit label; white nylon tafetta, 120 x 88 mesh; 5-9/16" wd x 30½" lg x .004" thk w/¼" wd nylon tape stitched to 1 end extending 18-7/16" beyond label; black printing on white background; edges heat treated to prevent fraying; individually packed; Fed Tele & Rad part/dwg #GD-1654-26; Sig C dwg #SC-D-40613-A. | Circuit label. | 2Z5872-9 |
| E-201 | LAMP, incandescent: 1.35 v .06 amp; bulb T-1-¾ clear; ⅝" lg; single cont midget flanged base; C-6 tungsten filament; burn any position; GE type #331; Fed Tele & Rad part/dwg #GH-1992-2. | Dial illumination. | 2Z5877-21 |
| H-206 thru H-211 | NUT, castellated: steel, cad pl and olive drab iridite; finished per dwg #⅜-32 NS-2; ⅛" thk; 9/16" OD; 4 slots 3/32" wd x 3/64" d spaced 90 deg apart; p/o Fed Tele & Rad #GA-1850-14 panel assem; Fed Tele & Rad part/dwg #GB-1106-2. | H-206: Squelch control mounting nut.<br>H-207: Antenna dial lamp switch mounting nut.<br>H-208: Volume control mounting nut.<br>H-209 and H-210: Detent lock mounting nuts.<br>H-211: Dial drive mounting nut. | 6L3006-32CS |

| Ref symbol | Name of part and description | Function of part | Signal Corps stock No. |
|---|---|---|---|
| H-1 | NUT, hexagon: steel, cad pl and olive drab iridite unfinished bearing surface; #12-24 NC-2; 5/32" thk; 5/16" across flats; chamfered corners on top surface; p/o Fed Tele & Rad #GA-1854-14 RF box assem; Fed Tele & Rad part/dwg #GB-1905-2. | Trimmer capacitor mounting nut. | 6L3612-24C |
| A-201 | PLATE, clamp: p/o Fed Tele & Rad #GA-1850-14 front panel assem; aluminum, alcoted; right angle triangle shape; 1⅜" lg x ⅞" wd x ⅛" thk; single csk mtg hole .154" diam; chamfer on longest edge; Fed Tele & Rad part/dwg #GB-2182-2. | Cable holding plate. | 2Z7091-347 |
| A-202 | PLATE, clamp: p/o Fed Tele & Rad #GA-1850-14 front panel assem; aluminum, alcoted; rectangular w/1 concave corner; 1¾" lg x 15/16" wd x ⅛" thk; single csk mtg hole .154" diam; chamfer on concave edge; Fed Tele & Rad part/dwg #GB-2183-2. | Cable holding plate. | 2Z7091-348 |
| O-211 | PLATE, retainer: p/o Fed Tele & Rad #GA-1850-14 panel assem; steel, cad pl olive drab iridite, stained black; rectangular shape; 1.812" lg x 1" wd x .0598" thk; 5 csk mtg holes for #4 FM machine screw, 4 on 1.562" x .687" mtg/c, fifth ctr under kidney shaped opening; Fed Tele & Rad part/dwg #GB-1078-2. | Dial window retainer plate. | 2Z7091-349 |
| T-109 | REACTOR: audio; dual; term 1 and 2, 255 mh, term 3 and 4, 285 mh; term 1 and 2, 270 ohms, term 3 and 4, 280 ohms DC resistance; 500 v RMS test; HS metal case; 1⅜" lg x ⅞" wd x 2½" h o/a; two .128" diam mtg holes on 1⅛" mtg/c; 5 solder type stud term on bottom of case; electrostatic shield between sect; Fed Tele & Rad part/dwg #GH-1226-2. | Squelch oscillator tuning and feedback coil. | 3C315-153 |
| L-2 | REACTOR: audio; dual, AF and RF sect; AF sect 200 mh inductance, RF sect c/o 2 turns #20 AWG wire; AF sect 120 ohms DC resistance; metal case, AF sect 1800 turns #38 AWG wire, RF sect 2 turns #20 AWG wire; 1.057" lg x .733" wd x 1¼" h o/a; two #2-56 x ¼" lg thd mtg studs on diagonally opposite corners of back side of case on .906" x .672" mtg/c; 2 pigtail term out top of case; tropicalized, has internal polarizing magnet; Fed Tele & Rad part/dwg #GA-1444-2. | Modulator coil, part of T-3. | 3C315-158 |
| O-101 | RELAY, armature: 1A1B2C; cont rating term 1-2, 330 ma at 6v, term 2-3, 410 ma at 6v, term 4-5, 8-9, 9-10, ea 5 ma at 50v, term 6-7, 15 ma at 90 v DC; single wnd, coil v, 6v nominal, pull in v, 4 v DC, max operating v, 8v DC, 39 ±3 ohms DC resistance, insulated coil; coil and cont leads term in solder lug term on base of can; 1⅝" lg x 1-7/16" wd x 2-5/16" h max o/a; three #6-32 NC-2 x ¼" lg thd mtg studs on 1-3/16" x 5/16" mtg/c; fast acting; HS metal case, marked w/dwg No. and circuit diagram, brown dot identifies cont #1; Adv Elec part #A8771-1Y, or Dunca type #181ABA100; Fed Tele & Rad part/dwg #GH-1362-2. | Receives transmit relay. | 2Z7599A-256 |

| Ref symbol | Name of part and description | Function of part | Signal Corps stock No. |
|---|---|---|---|
| R-8, R-137 | RESISTOR, fixed: composition; JAN type RC20BF-220K; 22 ohms ±10%; ½ w; spec JAN-R-11 | V-3 filament voltage adjustment dummy load. | 3RC20BF220K |
| R-117 | RESISTOR, fixed: composition; JAN type RC20BF-390K; 39 ohms ±10%; ½ w; spec JAN-R-11. | V-106 filament voltage adjustment. | 3RC20BF390K |
| R-205 | RESISTOR, fixed: composition; JAN type RC20BF-470K; 47 ohms ±10%; ½ w; spec JAN-R-11. | V-107, plate decoupling. | 3RC20BF470K |
| R-11 | RESISTOR, fixed: composition; JAN type RC20BF-560K; 56 ohms ±10%; ½ w; spec JAN-R-11. | V-4 filament voltage adjustment. | 3RC20BF560K |
| R-206 | RESISTOR, fixed: composition; JAN type RC20BF-820J; 82 ohms ±5%; ½ w; spec JAN-R-11. | Pilot lamp voltage adjustment. | 3RC20BF820J |
| R-1, R-15, R-16, R-21, R-135 | RESISTOR, fixed: composition; JAN type RC20BF-101K; 100 ohms ±10%; ½ w; spec JAN-R-11. | R-1: V-1, microphone decoupling.<br>R-15: V-5, screen decoupling.<br>R-16: V-5, plate decoupling.<br>R-21: V-6, plate decoupling.<br>R-135: V-108, plate decoupling. | 3RC20BF101K |
| R-6, R-19, R-20 | RESISTOR, fixed: composition; JAN type RC20BF-221K; 220 ohms ±10%; ½ w; spec JAN-R-11. | R-6: V-3 screen decoupling.<br>R-19: V-6 filament voltage adjustment.<br>R-20: V-6 screen decoupling. | 3RC20BF221K |
| R-12 | RESISTOR, fixed: composition; JAN type RC20BF-561K; 560 ohms ±10%; ½ w; spec JAN-R-11. | V-4 filament voltage adjustment. | 3RC20BF561K |
| R-4, R-127 | RESISTOR, fixed: composition; JAN type RC20BF-681K; 680 ohms ±10%; ½ w; spec JAN-R-11. | R-4: V-1 filament voltage adjustment.<br>R-127: V-109 filament voltage adjustment. | 3RC20BF681K |
| R-134 | RESISTOR, fixed: composition; JAN type RC20BF-821K; 820 ohms ±10%; ½ w; spec JAN-R-11. | V-108 filament voltage adjustment. | 3RC20BF821K |
| R-23, R-25, R-120, R-139 | RESISTOR, fixed: composition; JAN type RC20BF-102K; 1000 ohms ±10%; ½ w; spec JAN-R-11. | R-23: V-7 screen decoupling.<br>R-25: V-8 plate decoupling.<br>R-120: V-105 plate and screen decoupling.<br>R-139: V-107 plate decoupling. | 3RC20BF102K |
| R-14 | RESISTOR, fixed: composition; JAN type RC20BF-472K; 4700 ohms ±10%; ½ w; spec JAN-R-11. | V-5 grid resistor. | 3RC20BF472K |
| R-18 | RESISTOR, fixed: composition; JAN type RC20BF-912J; 9,100 ohms ±5%; ½ w; spec JAN-R-11. | V-6 grid resistor. | 3RC20BF912J |
| R-27, R-32, R-7 | RESISTOR, fixed: composition; JAN type RC20BF-103K; 10,000 ohms ±10%; ½ w; spec JAN-R-11. | R-27: V-9 grid resistor.<br>R-32: V-11 grid resistor.<br>R-7: V-3 grid resistor. | 3RC20BF103K |
| R-107, R-112 | RESISTOR, fixed: composition; JAN type RC20BF-183K; 18,000 ohms ±10%; ½ w; spec JAN-R-11. | R-107: V-103 grid circuit decoupling, part of T-103.<br>R-112: V-104 grid circuit decoupling, part of T-104. | 3RC20BF183K |
| R-108 | RESISTOR, fixed: composition; JAN type RC20BF-223J; 22,000 ohms ±5%; ½ w; spec JAN-R-11. | V-102 plate decoupling. | 3RC20BF223J |
| R-17, R-3 | RESISTOR, fixed: composition; JAN type RC20BF-273K; 27,000 ohms ±10%; ½ w; spec JAN-R-11. | R-17: V-6 grid resistor.<br>R-3: V-1 audio pre-emphasis. | 3RC20BF273K |

| Ref symbol | Name of part and description | Function of part | Signal Corps stock No. |
|---|---|---|---|
| R-122, R-123 | RESISTOR, fixed: composition; JAN type RC20BF-333K; 33,000 ohms ±10%; ½ w; spec JAN-R-11. | R-122: CR-101 diode stabilization.<br>R-123: CR-102 diode stabilization. | 3RC20BF333K |
| R-5 R-9 | RESISTOR, fixed: composition; JAN type RC20BF-393K; 39,000 ohms ±10%; ½ w; spec JAN-R-11. | R-5: V-2 grid resistor.<br>R-9: V-3 oscillator plate load. | 3RC20BF393K |
| R-13, R-129 | RESISTOR, fixed: composition; JAN type RC20BF-473K; 47,000 ohms ±10%; ½ w; spec JAN-R-11. | R-13: V-5 grid resistor.<br>R-129: V-106 plate load of first audio. | 3RC20BF473K |
| R-111 R-115, R-28, R-30, R-101, R-103, R-116 | RESISTOR, fixed: composition; JAN type RC20BF-563K; 56,000 ohms ±10%; ½ w; spec JAN-R-11. | R-111: V-103 plate and screen decoupling.<br>R-115: V-104 plate and screen decoupling.<br>R-28: V-9 plate circuit decoupling, part of T-9.<br>R-30: V-10 plate circuit decoupling, part of T-10.<br>R-101: V-11 plate circuit decoupling, part of T-101.<br>R-103: V-101 plate circuit decoupling, part of T-102.<br>R-116: V-105 grid circuit decoupling, part of T-105. | 3RC20BF563K |
| R-105 | RESISTOR, fixed: composition; JAN type RC20BF-823K; 82,000 ohms ±10%; ½ w; spec JAN-R-11. | V-102 oscillator grid resistor. | 3RC20BF823K |
| R-10, R-22 | RESISTOR, fixed: composition; JAN type RC20BF-104K; 100,000 ohms ±10%; ½ w; spec JAN-R-11. | R-10: V-4 grid resistor.<br>R-22: V-1 grid resistor. | 3RC20BF104K |
| R-138, R-141 | RESISTOR, fixed: composition; JAN type RC20BF-154K; 150,000 ohms ±10%; ½ w; spec JAN-R-11. | R-138: Sidetone level adjustment.<br>R-141: V-108 audio level adjustment. | 3RC20BF154K |
| R-128, R-201, R-34, R-106, R-109, R-110, R-113, R-114, R-119 | RESISTOR, fixed: composition; JAN type RC20BF-184K; 180,000 ohms ±10%; ½ w; spec JAN-R-11. | R-128: V-106 plate load.<br>R-201: Squelch range adjustment.<br>R-34: V-8 grid resistor.<br>R-106: damping resistor, part of T-103.<br>R-109: grid resistor, part of T-103.<br>R-110: damping resistor, part of T-104.<br>R-113: grid resistor, part of T-104.<br>R-114: damping resistor, part of T-105.<br>R-119: grid resistor, part of T-105. | 3RC20BF184K |
| R-125, R-130 | RESISTOR, fixed: composition; JAN type RC20BF-224J; 220,000 ohms ±5%; ½ w; spec JAN-R-11. | R-125: sidetone level adjustment.<br>R-130: V-106 first audio decoupling. | 3RC20BF224J |
| R-33, R-118, R-132 | RESISTOR, fixed: composition; JAN type RC20BF-274K; 270,000 ohms ±10%; ½ w; spec JAN-R-11. | R-33: V-11 screen voltage dropping.<br>R-118: V-106 grid resistor.<br>R-132: V-107 squelch coupling. | 3RC20BF274K |

## 2. Identification Table of Parts for Receiver-Transmitter RT-70/GRC (contd)

| Ref symbol | Name of part and description | Function of part | Signal Corps stock No. |
|---|---|---|---|
| R-2, R-26, R-140 | RESISTOR, fixed: composition; JAN type RC20BF-474K; 470,000 ohms ±10%; ½ w; spec JAN-R-11. | R-2: V-1 audio de-emphasis.<br>R-26: V-9 grid resistor.<br>R-140: sidetone level adjustment. | 3RC20BF474K |
| R-29, R-31, R-102, R-104 | RESISTOR, fixed: composition; JAN type RC20BF-514J; 510,000 ±5%; ½ w; spec JAN-R-11. | R-29: V-10 grid resistor, part of T-9.<br>R-31: V-11 grid resistor, part of T-10.<br>R-102: V-101 grid resistor, part of T-101.<br>R-104: V-102 grid resistor, part of T-102. | 3RC20BF514J |
| R-126, R-133 | RESISTOR, fixed: composition; JAN type RC20BF-684K; 680,000 ohms ±10%; ½ w; spec JAN-R-11. | R-126: V-107 grid resistor.<br>R-133: V-108 grid resistor. | 3RC20BF684K |
| R-124 | RESISTOR, fixed: composition; JAN type RC20BF-824K; 820,000 ohms ±10%; ½ w; spec JAN-R-11. | CR-101 audio de-emphasis. | 3RC20BF824K |
| R-24, R-121, R-131 | RESISTOR, fixed: composition; JAN type RC20BF-105K; 1 meg ±10%; ½ w; spec JAN-R-11. | R-24: V-8 grid resistor.<br>R-121: V-106 grid resistor.<br>R-131: V-107 diode load. | 3RC20BF105K |
| R-142 | RESISTOR, fixed: composition; JAN type RC20BF-225K; 2.2 meg ±10%; ½ w; spec JAN-R-11. | V-108 grid resistor. | 3RC20BF225K |
| R-136 | RESISTOR, fixed: WW; JAN type RW29G222; 2200 ohms ±5%; 8 w; spec JAN-R-26A. | Load compensating resistor. | 3RW26415 |
| R-204 | RESISTOR, variable: comp; 500,000 ohms ±20%; 2 w; 70° C max continuous oper temp; 3 solder lugs; metal case 1-1/16" diam x 21/32" d, enclosed; double flatted metal shaft ¼" diam x 23/32" lg w/axially tapped #6-32 hole ¼" d in end; AB type A taper 1% resistance at 30% rotation, 5% at 40%, 10% at 50%, 20% at 60%, 40% at 70%, 65% at 80%, 92% at 90%; insulated cont arm; w/o off position; normal torque; 9/32" lg x ⅜"-32 bushing, non turn device on 17/32" rad at 9 o'clock; tropicalized and salt water resistant, has wp seal in bushing and mtg collar; AB type #JW, modified; Fed Tele & Rad part/dwg #GH-1627-2. | Volume control. | 3Z7498-50.142 |
| R-202 | RESISTOR, variable: comp; 2 sect, ea sect 500,000 ohms ±20%; ea sect 2 w, 70 deg max continuous oper temp; 3 solder lugs ea sect; metal case 1-1/16" diam x 1⅜" lg, enclosed; round metal shaft w/double flats on end, shaft ¼" diam x 23/32" lg w/axially tapped #6-32 hole ¼" d in end; front sect AB type S taper, 4% resistance at 20% rotation, 15% at 30%, 33% at 40%, 50% at 50%, 70% at 60%, 90% at 70%, 98% at 90%, rear sect, extreme counterclockwise position 1% of total resistance, 455,000 ohms ±20% at 50% rotation, 10,000 ohms at extreme clockwise position; insulated cont arms, w/o off position; normal torque; 9/32" lg x ⅜"-32 bushing, non turn device on 17/32" rad at 9 o'clock; SPST switch, normally open, operates at start of rotation, 2 amp, 125 v, 2 solder lug term; tropicalized | Squelch control. | 3Z7498-50.143 |

| Ref symbol | Name of part and description | Function of part | Signal Corps stock No. |
|---|---|---|---|
| | and salt water resistant, has wp seal in bushing and mtg collar; AB type #JJSW, modified; Fed Tele & Rad part/dwg #GH-1649-2. | | |
| N-201 | SCALE: dial scale; round disc, zinc alloy die casting, 2-1/16" OD x .155" thk, ctr hole .693" diam; marked from 0 to 9 in 5/32" h alternate gothic #3 numerals spaced 36 deg apart on beveled edge, has concave cuts in outer edge, 1 over ea numeral; mts on dial drive shaft by means of ctr hole; white luminous numerals on olive drab background; p/o Fed Tele & Rad #GA-1850-14 front panel assem; Fed Tele & Rad part/dwg #GC-1018-2. | Dial scale. | 2Z8076-157 |
| H-309, H-310, H-311, H-312 | SCREW, captive: slot drive; cheese head, finished .312" diam ±.005", 1/32" x 45 deg chamfer, head 1-15/16" lg; cad pl and green iridited steel; #10-32 NF-2; 2½" lg; thd portion ⅜" lg; head .312" diam x 1-15/16" lg; slotted groove around head portion .043" wd x .031" d 1-1/16" from bottom edge of head, cone pointed end; p/o Fed Tele & Rad #GA-1486-12 and #GA-1698-12 back plate assem; Fed Tele & Rad part/dwg #GB-1493-2. | Back plate chassis mounting screws. | 6L4770-40.86F |
| H-103, H-104 | SCREW, captive: slot drive; straight side binding head, finished .281" diam x .064" thk, slot .046" wd x .046" d, head rounded on ¼" rad, tolerance ±.005"; brass, nickel pl; #6-32 NC-2; ⅝" lg; thd portion ¼" lg; head .281" diam x .064" thk; unthreaded portion .094" diam x ⅜" lg; end pointed at 45 deg angle; head finished in green lacquer; p/o Fed Tele & Rad #GA-1854-14 IF assem; Fed Tele & Rad part/dwg #GB-1591-2. | I-f chassis mounting screws. | 6L4766-10.81F |
| H-313, H-314, H-315, H-316 | SCREWS, machine: slot drive; hex head unfinished; steel, cad pl and green iridited; #10-32 NF-2; ¾" lg; thd entire length; slot in head .047" wd x .062" d; Fed Tele & Rad part/dwg #GB-2439-2-1. | Chassis to panel mounting screws. | 6L20910-12.81C |
| H-105 | SCREW, machine: slot drive; RH unfinished; steel, cad pl and olive drab iridited; normal hardness; #8-32 NC-2; 2⅛" lg; slot in head .045" wd x .066" d; p/o Fed Tele & Rad #GA-1852-14 IF assem; Fed Tele & Rad part/dwg #GB-2211-2. | Resistor mounting screw. | 6L20908-34.1C |
| H-212 | SCREW, set: Allen drive: headless; steel, olive drab iridited, special hardness; #8-32 NC-2; ⅜" lg o/a; elongated hanger point; thd for ⅛" of length, point tapers from .130" to .062" diam in .187" lg; p/o Fed Tele & Rad #GA-1914-14 dial drive; Fed Tele & Rad part/dwg #GB-1338-2. | Dial drive coupling setscrew. | 6L18508-6Y |
| H-213 | SCREW, thumb: knurled head; brass, head top and knurl painted olive drab; 9/16" -25 NEF-2; .250" lg; thd ⅛" lg; recessed end; head 11/16" diam x 1/16" thk; shoulder .39" diam x ⅛" lg; coined slot in head .062" wd x ⅜" lg; marked "lamp" on head; Fed Tele & Rad part/dwg #GA-2695-2. | Pilot lamp retaining screw. | 6L17509-4.8K |

## 2. Identification Table of Parts for Receiver-Transmitter RT-70/GRC (contd)

| Ref symbol | Name of part and description | Function of part | Signal Corps stock No. |
|---|---|---|---|
| E-11 thru E-21, E-111 thru E-118 | SHIELD, tube: JAN type SOS 6; cad pl brass; round w/hole in top; bayonet push on mtg; .81" ID x 1¾" lg; pressure coil spring inside; spec JAN-S-28. | Tube shields. | 2Z8304.154 |
| O-8, O-9 | SLEEVE, spacer: p/o Fed Tele & Rad #GA-1853-14 RF chassis assem; seamless steel tubing, electro tin pl; tubular; ¼" OD x .152" ID x ⅜" lg o/a; mts by means of ID; Fed Tele & Rad part/dwg #GB-1742-2-1. | Chassis connector mounting spacers. | 2Z8552-72 |
| O-104, O-105 | SLEEVE, spacer: p/o Fed Tele & Rad #GA-1852-14 IF assem; seamless steel tubing, electro tin pl; tubular; ¼" OD x .120" ID x ¼" lg o/a; mts by means of ID; Fed Tele & Rad part/dwg #GB-1742-2-2. | Transformer mounting spacers. | 2Z8552-73 |
| X-12 X-13, X-109, X-110 | SOCKET, crystal: ceramic body; tropicalized; 2 round female silver pl phosphor bronze cont; rectangular w/round ends; 55/64" lg x ⅜" wd x 43/64" h o/a; cont on .486" ctr; one ⅛" diam mtg hole centered between cont; Fed Tele & Rad part/dwg #GH-1991-2. | Crystal sockets. | 2Z8672.80 |
| X-1, X-2, X-7 thru X-11, X-101 thru X-108 | SOCKET, tube: 7 cont miniature; JAN type SO10M; 1 piece saddle mtg; two ⅛" diam mtg holes on ⅞" mtg/c; round plastic body w/metal shell 1⅛" lg x .8" wd x 25/32" d excluding term; beryllium copper silver pl cont; marked SO10M; w/metal shock shield and ctr shield .18" OD; spec JAN-S-28. | Tube sockets. | 2Z8677.94 |
| X-3, X-4, X-5, X-6 | SOCKET, tube: 7 cont miniature; JAN type SO10C; 1 piece saddle mtg; two ⅛" diam mtg holes on ⅞" mtg/c; round ceramic body w/metal shell 1⅛" lg x .8" wd x 25/32" d excluding term; beryllium copper silver pl cont; marked SO10C; w/metal shock shield and ctr shield .18" OD; spec JAN-S-28. | Tube sockets. | 2Z8677.99 |
| O-303, O-304, O-305, O-306 | SPRING: loop type; strike for Dzus fastener; .08" diam olive drab iridited music wire; 1⅜" lg x 5/32" wd x .08" thk o/a; 2 ends turned perpendicular at 90 deg angle to straight portion on 1/16" rad; Dzus dwg #X-487, Fed Tele & Rad part/dwg #GB-2414-2. | Panel to case fastener strikes. | 6Z8377-10 |
| O-10, O-11, O-12, O-13, O-14 | SPRING: loop type; .033" diam cad pl and olive drab iridited music wire; 25/64" lg x ¼" wd x .037" thk o/a; irregular shape snap on type spring, snaps on stud and screw assem and exerts pressure on screw thd, Fed Tele & Rad part/dwg #GB-2007-2. | Adjustable tuning core tension springs. | 2Z8877.358 |
| O-307, O-308, O-309, O-310 | SPRING: flat type; #23 ga spring steel, cad pl and olive drab iridited; 1-7/16" lg x 13/16" wd x ⅜" h o/a; two ⅛" diam mtg holes on .437" mtg/c; Corbin Cabinet catalog #15822. | Fastener catch retaining springs. | 2Z8877.380 |

## 2. Identification Table of Parts for Receiver-Transmitter RT-70/GRC (contd)

| Ref symbol | Name of part and description | Function of part | Signal Corps stock No. |
|---|---|---|---|
| O-311, O-312, O-313, O-314 | SPRING: helical compression type; provide spring tension on mtg screw; .025" cad pl olive drab iridited music wire; 1⅛" lg x .381" OD o/a; 10 turns; squared ends ground; heat treated to remove hydrogen embrittlement; p/o Fed Tele & Rad #GA-1698-12 and #GA-1486-12 back plate assem; Fed Tele & Rad part/dwg #GB-1492-2. | Back plate mounting screw release springs. | 2Z8877.356 |
| O-212 | SPRING: helical compression type; pilot lamp base cont; .02" diam silver pl spring temper phosphor bronze wire; 1⅝" lg x .291" OD o/a; 7 turns; 1 end squared, other end straight wire extending 1" beyond coil portion; p/o Fed Tele & Rad #GA-1850-14 front panel assem; Fed Tele & Rad part/-dwg #GB-1658-2. | Pilot lamp contact spring. | 2Z8877.396 |
| O-213 | SPRING: helical extension type; for dial drive cable tension; .045" diam type #316 spring temper stainless steel wire; .70" lg x .215" OD o/a; 7½" turns; hook term bent on .04" rad, located on .61" mtg/c; p/o Fed Tele & Rad GA-1914-14 dial drive; Fed Tele & Rad part/dwg #GB-1339-2. | Dial drive cable tension spring. | 2Z8877.397 |
| S-101 | SWITCH, lever: 3 pole 3 position, locking; cont rated at 5 amp; phenolic wafers mtd on metal bkt; body 1⅜" lg x 7/16" wd x 1⅞" h excluding term; .437" lg metal handle; solder lug term; two #6-32 NC-2 tapped mtg holes on 1⅝" mtg/c; tropicalized; Centralab part #N12221; Fed Tele & Rad part/dwg #GH-2572-2. | Power and sidetone adjuster. | 3Z9580-2.7 |
| S-202 | SWITCH, rotary: 3 pole 4 position; single sect; spring silver cont, coin silver rotor; plastic wafer; 1-9/16" lg x 1¼" wd x 23/32" d; locking in positions 2 and 3, spring loaded to return from position 1 to position 2, and from position 4 to position 3; solder lug term; single hole mtg, bushing ⅜"-32 x 5/16" lg, shaft ¼" diam x ⅜" lg has double flat on end ¼" d and tapped axially w/#6-32 NC-2 x ¼" thd; tropicalized, dwg No. marked on switch, has wp "O" ring seals in bushing and on mtg shoulder; Griasby-Allison spec #2685-4M-1; Fed Tele & Rad part/dwg #GH-1342-2. | Antenna adjust — calibrate switch. | 3Z9825-36.4 |
| E-209 | TERMINAL, lug: straight type w/2 bent up soldering ears; brass, hot tin dipped; 27/64" lg x 7/32" wd x 3/32" h o/a; .146" diam mtg hole between ears, ears bent up at 45 deg angle; solder connects to wire; wrap around type w/1/32" rad slots in either side of ears; #GA-1850-14 front panel assem; similar to Shakeproof part #2558-06-00; Fed Tele & Rad part/dwg #GB-2248-2-2. | Grounding terminal. | 3Z12073-41.3 |
| E-210 | TERMINAL, lug: straight type; phosphor bronze hot tin dipped; 3/32" diam wire hole; ⅝" lg x 5/16" wd x .018" thk; solder connects to wire; Shakeproof type int toothed mtg hole for #6 screw; similar to Shakeproof part #2106-06-00; Fed Tele & Rad part/dwg #GB-2717-2. | Grounding terminal. | 3Z12073-41.4 |

## 2. Identification Table of Parts for Receiver-Transmitter RT-70/GRC (contd)

| Ref symbol | Name of part and description | Function of part | Signal Corps stock No. |
|---|---|---|---|
| E-56 | TERMINAL, lug: ring type; brass, hot tin dipped; 53/64" lg x 7/16" wd x .025" thk; solder connects to wire by 3/32" diam wire hole; .328" diam mtg hole; Cinch #4422; Fed Tele & Rad part/dwg #GB-2375-2. | Adjustable tuning core terminal. | 3Z12073-37.1 |
| E-57 | TERMINAL, lug: ring type; brass, hot tin dipped; 51/64" lg x ⅜" wd x .02" thk; solder connects to wire by 3/32" diam wire hole; ¼" diam mtg hole; Cinch part #1467-A; Fed Tele and Rad part/dwg #GB-2390-2. | Trimmer capacitor terminal. | 3Z12073-37.2 |
| E-58 thru E-71 | TERMINAL, lug; right angle ring type; brass hot tin dipped; 11/32" lg x ¼" wd x ⅜" h o/a; solder connects to wire by 5/64" diam wire hole; .120" diam mtg hole; similar to Shakeproof #2585-04-01; Fed Tele & Rad part/dwg #GB-2249-2. | Grounding terminals. | 3Z12073-41.5 |
| E-127 thru E-135 | TERMINAL, lug: straight type w/2 bent wp soldering ears; brass, hot tin dipped; 27/64" lg x 7/32" wd x 3/32" h o/a; .12" diam mtg hole between ears, ears bent up 45 deg angle; solder connects to wire; wrap around type w/1/32" rad slots in either side of ears; similar to Shakeproof part #2558-04-00; Fed Tele & Rad part/dwg #GB-2248-2-1. | Grounding terminals. | 3Z12073-57 |
| 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; silicon steel core; 1⅜" lg x ⅞" wd x 2-1/16" h o/a; turns ratio pri #1 to secd 1:22.8, pri #2 to secd 1:10; freq response 250 to 2500 cycs, +2 to –2db; 7 solder type stud term on bottom of case; two .128" diam mtg holes on 1⅛" mtg/c; part number marked on top of case; Fed Tele & Rad part/dwg #GH-1205-2; spec JAN-T-27. | Transmitter microphone input. | 2Z9631.393 |
| T-2, T-108 | 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, silicon steel core; 1⅜" lg x ⅞" wd x 2-1/16" h o/a; 160 mw output; turns ratio pri to secd #1 6.28:1, pri to secd #2 2.03:1; freq response +2 to –2db between 250 and 2500 cyc; 9 solder type stud term on bottom of case; two .128" diam mtg holes on 1⅛" mtg/c; part number marked on top of case; Fed Tele & Rad part/dwg #GH-1203-2; spec JAN-T-27. | T-2: Transmitter microphone amplifier output.<br>T-108: Audio output. | 2Z9632.562 |
| T-103, T-104 | TRANSFORMER IF: 1.4 mc; interstage; shielded; 1-7/32" lg x 31/32" wd x 2-17/32" h o/a; powdered iron core; pri and secd tuned; adj iron core tuning; two #6-32 x 9/32" lg mtg studs on diagonally opposite corners of base on .859" x .609" mtg/c; 6 solder type term; tropicalized, part No. stamped on case; Muter part #C-7318; Fed Tele & Rad part/dwg #GH-2342-12-1. | T-103: Second receiver mixer plate tuning.<br>T-104: Fourth i-f plate tuning. | 2Z9642.126 |

## 2. Identification Table of Parts for Receiver-Transmitter RT-70/GRC (contd)

| Ref symbol | Name of part and description | Function of part | Signal Corps stock No. |
|---|---|---|---|
| T-105 | TRANSFORMER IF: 1.4 mc; output; shielded; 1-7/32" lg x 31/32" wd x 2-17/32" h o/a; powdered iron core; pri and secd tuned; adj iron core tuning; two #6-32 x 9/32" lg mtg studs on diagonally opposite corners of base on .859" x .609" mtg/c; 6 solder type term; tropicalized, part No. stamped on case; Muter part #C-7319; Fed Tele & Rad part/dwg #GH-2342-12-2. | First limiter plate tuning. | 2Z9642.131 |
| T-106 | TRANSFORMER, IF: 1.4 mc; discriminator; shielded; 1-7/32" lg x 31/32" wd x 2-17/32" h o/a; powdered iron core; pri and secd tuned; adj iron core tuning; two #6-32 x 9/32" lg mtg studs on diagonally opposite corners of base on .859" x .609" mtg;c; 6 solder type term, 1 of which is a dummy; tropicalized, part No. marked on can; Muter part #C-7321; Fed Tele & Rad part/dwg #GH-2345-12. | Discriminator tuning unit. | 2Z9643.354 |
| T-9,<br>T-10,<br>T-101,<br>T-102 | TRANSFORMER IF: 15 mc; interstage; shielded; 1-7/32" lg x 31/32" wd x 2-17/32" h o/a; powdered iron core; single tuned; adj iron core tuning; two #6-32 x 9/32" lg mtg studs on diagonally opposite corners of base on .859" x .609" mtg/c; 6 solder type term, 1 of which is dummy; tropicalized, part No. marked on can; Muter part #C-7317; Fed Tele & Rad part/dwg #GH-2353-12. | T-9: First receiver mixer plate tuning.<br>T-10: First i-f plate tuning.<br>T-101: Second i-f plate tuning.<br>T-102: Third i-f plate tuning. | 2Z9643.365 |
| V-8 | TUBE, electron: type 1AE4; pentode; per Fed Tele & Rad spec/dwg #GH-1123-2. | Receiver first r-f amplifier. | 2J1AE4 |
| V-3,<br>V-105 | TUBE, electron: JAN-1L4; pentode. | V-3: 15-mc transmitter oscillator.<br>V-105: Receiver second limiter. | 2J1L4 |
| V-102,<br>V-106 | TUBE, electron: JAN-1R5; pentagrid converter. | V-102: Receiver second mixer and oscillator.<br>V-106: Receiver first audio. | 2J1R5 |
| V-107 | TUBE, electron: JAN-1S5; diode, pentode. | Receiver noise amplifier — squelch. | 2J1S5 |
| V-7,<br>V-9,<br>V-10,<br>V-11,<br>V-101,<br>V-103,<br>V-104 | TUBE, electron: JAN-1U4; pentode. | V-7: Receiver calibrate oscillator.<br>V-9: Receiver first mixer.<br>V-10: Receiver first i-f amplifier.<br>V-11: Receiver second i-f amplifier.<br>V-101: Receiver third i-f amplifier.<br>V-103: Receiver fourth i-f amplifier.<br>V-104: Receiver first limiter. | 2J1U4 |
| V-2 | TUBE, electron: JAN-3A5; twin triode. | 32- to 43.4-mc oscillator. | 2J3A5 |
| V-6 | TUBE, electron: JAN-3B4; pentode. | Transmitter power amplifier. | 2J3B4 |
| V-1,<br>V-4,<br>V-5,<br>V-108 | TUBE, electron: JAN-3Q4; power amplr, pentode. | V-1: Transmitter microphone amplifier.<br>V-4: Transmitter mixer.<br>V-5: Transmitter driver.<br>V-108: Receiver second audio. | 2J3Q4 |

## 2. Identification Table of Parts for Receiver-Transmitter RT-70/GRC (contd)

| Ref symbol | Name of part and description | Function of part | Signal Corps stock No. |
|---|---|---|---|
| H-214, H-215, H-216 | WASHER, flat: Buna N; .56" OD x .428" ID x .066" thk; p/o Fed Tele & Rad #GA-1850-14 front panel assem; Fed Tele & Rad part/dwg #GR-2119-2. | H-214: Dial drive bushing waterproof washer. H-215 and H-216: Detent bushing waterproof washers. | 6L58027-14 |
| H-2 thru H-13, H-106, H-107 | WASHER, flat: LTS-E-5 natural phenolic; 15/64" OD x .116" ID x .025" thk; p/o Fed Tele & Rad #GA-1854-14 RF box assem; #GA-1855-12 osc assem, #GA-1853-14 RF chassis assem, and #GA-1852-14 IF assem; Fed Tele & Rad part/dwg #GP-2383-2. | H-2 thru H-9: Trimmer capacitor mountings. H-10 and H-11: Oscillator coil mounting washers. H-12 thru H-107: Crystal socket mounting washers. | 6L50522-53 |
| H-108, H-109 | WASHER, flat: LTS-E-4 natural phenolic; 7/16" OD x .185" ID x 1/32" thk; Fed Tele & Rad #GA-1852-14-IF assem; Fed Tele & Rad part/dwg #GP-2212-2. | Resistor mounting insulating washers. | 6L50523-44 |
| H-17 | WASHER, spring: beryllium copper, cad pl and heat treated; round 1-1/16" OD x .078" thk, ctr hold for double flatted shaft .252" diam, .189" across flats; 4 radial slots in outer edge ea .032" wd x ⅛" d spaced 90 deg apart; p/o Fed Tele & Rad #GA-1850-14 front panel assem; Fed Tele & Rad part/dwg #GB-1014-2. | Spring washer between tuning knob and dial scale. | 6L73474-3C |
| H-18 | WINDOW: lucite; kidney shape; approx 1⅝" lg x 11/16" wd x 7/32" thk o/a; mts in kidney shaped hole in panel; faces are polished and free from scratches and burns, has flange around edge 1/16" wd; Fed Tele & Rad part/dwg #GP-1076-2. | Dial window. | 2ZA1352-183 |
| H-317 | PULLER tube: basket type; steel wire w/flattened copper tubing finger grip, galv; approx 2½" lg, basket portion approx ⅝" OD, finger grip portion approx ⅝" OD, finger grip portion 1" wd x ¼" thk; for removing miniature tubes; Kellems type #11-16; Fed Tele & Rad part/dwg #GB-3037-2. | Tube puller. | 6R7443-4 |
| H-219 | WRENCH: set screw key; 5/64" across flats; short arm 45/64" lg, long arm 1-31/32" lg; steel, parkerized; "L" shaped hexagon bar; for Allen #8 setscrew, #4 socket head cap screw and #6 flat head cap screw; Allen mfg code #564. | Set screw wrench. | 6R57400 |
| H-220 | WRENCH: set screw key; 1/16" across flats; short arm 21/32" lg, long arm 1-27/32" lg; steel, parkerized; "L" shaped hexagon bar; for Allen #5 and #6 setscrews, and #4 flat head cap screw; Allen Mfg code #116. | Set screw wrench. | 6R57400-6 |

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Issued: September 6, 1951

SUPPLEMENT TO ADDENDA SUPPLEMENT TO ADDENDA

INSTRUCTION BOOK

FOR

RECEIVER-TRANSMITTER RT-70/GRC

Issued 29 December 1950

and ADDENDA

Issued April 28, 1951

S.C. Order No. 18651-Phila-49

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The information given below, describes changes in the design of Receiver-Transmitter RT-70/GRC, made since the ADDENDA, issued April 28, 1951, to the Instruction Book for Receiver-Transmitter RT-70/GRC, have been printed. This information together with the change information in the ADDENDA modify those portions of the instruction book, referenced by page, paragraph and illustration numbers affected by the design changes in the equipment.

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1. Page 18. Par. 18a. Line 4. Change: "...and resistors R-2 and R-3" to read: "...and grid resistor R-3".

2. Page 18. Par. 18. Delete subparagraph 18b, and substitute the following:

   b. PLATE LOAD IMPEDANCE. The amplified output of V-1 is developed across primary winding 1-2-3 of output transformer T-2. Corresponding signal voltages induced in the secondary winding 4-5-6 are applied to the transmitter modulator circuit in T-3 (par. 20). A portion of the signal voltage developed across the secondary winding of T-2 is returned through feedback resistor R-2 (connected between terminal 4 of T-2 and the grid of V-1) to the grid of V-1. The negative feedback voltage serves to flatten out the frequency response of the amplifier and to stabilize its operation. A damping resistor R-35, shunted across the secondary winding of T-2 further flattens out the amplifier output.

3. Page 19. Figure 11. Make the following changes:

   a. Disconnect resistor R-2 from its junction with terminal 3 of T-1 and C-1, and connect it to terminal 4 of T-2. Change the value of R-2 from 470K to 270K.
   b. Delete C-2, 6800 μμf.
   c. Connect a resistor between terminals 4 and 6 of T-2. Mark this resistor R-35, 3300.







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d. Change the value of R-3 from 27K to 82K.
e. Change the value of R-140 from 470K to 220K.

4. Page 36. Figure 24. Change as follows:

a. Change the value of R-142 from 2.2 MEG to 510K.
b. Change the value of R-34 from 180K to 100K.
c. Disconnect R-126 from pin 7 of V-107 and connect it to pin 1 of V-107.

5. Page 37. Figure 25. Change the value of R-140 from 470K to 220K, (and the value of R-3 from 27K to 82K. Delete R-2).

6. Page 42. Figure 27. Change the value of R-111 from 56K to 5600 ohms

7. Page 73. Figure 33. Below the lead from pin 3 of V-1 change the resistance reading from 270K to 82K.

8. Page 74. Figure 34. Change resistance readings (below guide lines) and voltage readings (above guide lines) as follows:

a. Pin 3 of J-101, resistance: from 180K to 100K
b. Pin 8 of J-101, resistance: from 1K to infinity
c. Pin 10 of J-101, voltage: from 88V to 0V

9. Page 80. Figure 40. Make the following changes:

a. Delete C-2, arrow, and reference label.
b. Show resistor R-35 connected between terminals 4 and 6 of T-2. These terminals are the end terminals in the second row of terminals of T-2.
c. Show resistor R-2 connected between terminal 4 of T-2 (right-hand terminal in second row of terminals of T-2 from top) and the tie post (top right of chassis) to which C-1 is also shown connected.

10. Page 81. Figure 41. Make the following changes:

a. Delete C-2, arrow and reference label.
b. Show R-35 between terminals 4 and 6 of T-2.
c. R-2 and C-1 are shown connected together to two tie posts. Disconnect R-2 from the tie post just below the arrow to L-1, and connect that lead from R-2 to terminal 4 (right-hand terminal in middle row) of T-2. Change the location of R-2 accordingly.

11. Overall schematic diagram, Page 105. Figure 47. Make the following changes:

a. Disconnect R-2 from its junction with C-1 and pin 3 of T-1. Connect that end of R-2 to terminal 4 of T-2.
b. Change the value of R-2 from 470K to 270K.
c. Delete C-2, 6800 μμf.
d. Connect R-35, 3300 ohms between terminals 4 and 6 of T-2.
e. Change the value of R-3 from 27K to 82K.
f. Change the value of R-140 from 470K to 220K.

12. Identification Table of Parts. Make the following changes:

a. Page 112. Delete C-2, 6800 μμf capacitor, in all columns.
b. Page 122. Add R-35, 3300 ohms, in the appropriate columns, as indicated below:

| Reference symbol | Name of part and description | Function of part | Signal Corps stock No. |
| --- | --- | --- | --- |
| R-35 | RESISTOR, fixed: composition; JAN type RC20BF332K; 3300 ohms ±10%; 1/2 w; spec JAN-R-11 | T-2 damping | 3RC20BF332K |

c. Page 122. Delete R-3, 27000 ohms from last item on page, in the "Ref symbol" and "Function of part" columns

d. Page 123. Add R-3, 82000 ohms in the appropriate columns of the 5th item on the page, as indicated below:

| Reference symbol | Function of part |
| --- | --- |
| R-3 | R-3: V-1 grid resistor |

e. Page 123. To next-to-last item on page add R-140, 220,000 ohms, in the columns indicated below:

| Reference symbol | Function of part |
| --- | --- |
| R-140 | R-140: sidetone level adjustment |

f. Page 123. To last item on page add R-2, 270,000 ohms, in the columns indicated below:

| Reference symbol | Function of part |
| --- | --- |
| R-2 | R-2: V-1 feedback |

g. Page 124. Delete R-2, 470,000 ohms, in the "Ref symbol" and "Function of part" columns.

h. Page 124. Delete R-140, 470,000 ohms in the "Ref symbol" and "Function of part" columns.

13. Correct the ADDENDA sheets as follows:

a. Page 3. Item 22. Correct last line of (3) by changing "V-1" to "V-8".

b. Page 7. Item 64. Correct (d) to read: "Disconnect R-126 from pin 7 of V-107 and connect the free end of pin 1 of V-107."