TM11-878

WAR DEPARTMENT TECHNICAL MANUAL

RADIO RECEIVER

R-96/SR

WAR DEPARTMENT • *MAY 1945*

TECHNICAL MANUAL

RADIO RECEIVER R-96/SR

CHANGE No. 1

DEPARTMENT OF THE ARMY
WASHINGTON 25, D. C., *24 March 1954*

TM 11-878, 10 May 1945, is changed as follows:

11.1. Antijamming Procedures
(Added)

When the radio receiver is being jammed by unwanted signals, the immediate superior officer must be notified. However, the operator must not cease operating the equipment under any condition. One or more of the following procedures may be used for obtaining the maximum intelligibility from the desired signals during the jamming process.

a. AM Signals Jammed by CW, Pulse, FM, Bagpipe, or Other Noise Signals.

(1) Vary the tuning dial control several degrees on both sides of the desired signal. It may permit better copy of the signal.

(2) Operate the N. L. OFF-ON control knob to the ON position. The strong pulses will be clipped and the desired signal may become intelligible.

(3) Vary the RF GAIN control knob. The undesired signal may be reduced in strength, and provide a degree of desired signal copy. Repeat the procedure in (1) above.

(4) If the undesired signal strength is weaker than that of the desired signal, vary the AF GAIN control in both directions. The level of the desired signal may be raised sufficiently to permit copy.

(5) Operate the AVC ON-OFF switch to the OFF position. Operate the RF GAIN control counterclockwise until the reception clears. With the controls in these positions, the sensitivity of the receiver is greatly increased. Repeat the procedure in (1) above.

(6) If unsatisfactory conditions still exist after trying the above procedures, request a change in frequency and call sign.

(7) If the reception is in voice, request the use of CW signals.

(8) If it is possible, place an object such as a tree, tank, or hill between the source of the jamming signals and the antenna. The strength of the jamming signals may be reduced.

(9) Try to change the direction, length, and height of the antenna.

(10) If the antenna is the whip or dipole type, and is installed horizontally, try changing the position of the antenna gradually, until it is vertical. The strength of the jamming signal may be reduced considerably, and permit copy of the desired signal.

(11) If the jamming process is so thorough that communication is impossible, inform the immediate superior of the condition and continue to operate the equipment.

b. CW Signals Jammed by CW, Pulse, AM, FM, Bagpipe, or Other Sharp Noise Signals.

(1) Vary the BFO OFF-SEND control knob to separate the characteristic tone pitch of the desired signal from that of the undesired signal.

(2) Repeat the procedures in *a* above.

[AG 300.7 (2 Mar 54)]

BY ORDER OF THE SECRETARY OF THE ARMY:

M. B. RIDGWAY,
General, United States Army,
Chief of Staff.

OFFICIAL:
WM. E. BERGIN,
Major General, United States Army,
The Adjutant General.

DISTRIBUTION:
Active Army:
Tech Svc (1); Tech Svc Bd (1); AFF Bd (ea Svc Test Sec) (1); AFF (5); AA Comd (2); OS Maj Comd (5); Base Comd (5); MDW (2); Log Comd (5); A (5); CHQ (2); FT (2); Sch (5) except 11 (25); Gen Dep (2); Dep 11 (20) except Sig Sec, Gen Dep (10); Tng Div (2); POE (2), OS Sup Agencies (1); Lab 11 (5); Mil Dist (1); Field Maint Shops 11 (3); Two (2) copies to each of the following T/O & E's: 11–107; 11–127; 11–128; 11–500A, KA, KB, KC, RA through RR; 11–587; 11–592; 11–597.
NG: Same as Active Army except one copy to each unit.
USAR: None.
For explanation of distribution formula, see SR 310–90–1.

TAGO 4756A
U. S. GOVERNMENT PRINTING OFFICE: 1954

WAR DEPARTMENT TECHNICAL MANUAL

TM 11-878

RADIO RECEIVER

R-96/SR

WAR DEPARTMENT *MAY 1945*

United States Government Printing Office

Washington : 1949

WAR DEPARTMENT,
WASHINGTON, 25, D. C., 10 MAY, 1945.

TM 11-878, Radio Receiver R-96/SR, is published for the information and guidance of all concerned.

[A. G. 300.7 (30 May 44).]

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:
J. A. ULIO,
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The Adjutant General.

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AAF(2); AGF(2); ASF(2); T of Opns(2); Dept(2); Arm & Sv Bd(2); Def Cmd(2); Tech Sv (2); SvC(2); PE(2); Gen Overseas SOS Dep (Sig Sec) (2); Dep 11(2); Gen and Sp Sv Sch(2); USMA(2); WDGS Lib(5); Lab 11(2); A(2). T/O & E: 11-107(3); 11-127(3); 11-237(3); 11-587(3); 11-592(3); 11-597(3).
(For explanation of symbols see FM 21-6)

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

DESTRUCTION NOTICE

WHY —To prevent the enemy from using or salvaging this equipment for his benefit.

WHEN—When ordered by your commander.

HOW —1. Smash—Use sledges, axes, handaxes, pickaxes, hammers, crowbars, heavy tools.

2. Cut—Use axes, handaxes, machetes.

3. Burn—Use gasoline, kerosene, oil, flame throwers, incendiary grenades.

4. Explosives—Use firearms, grenades, TNT.

5. Disposal—Bury in slit trenches, fox holes, other holes. Throw in streams. Scatter.

USE ANYTHING IMMEDIATELY AVAILABLE FOR DESTRUCTION OF THIS EQUIPMENT.

WHAT—1. Smash—All panels, switches, vacuum tubes, instrument panels, nameplates, calibrated dials, controls, relays, meters, gas and oil lines, water cooling systems, keys, phones, microphones, and crystal holders.

2. Cut—All wiring and connecting cables.

3. Burn—Technical manuals, books, circuit labels, and all available records.

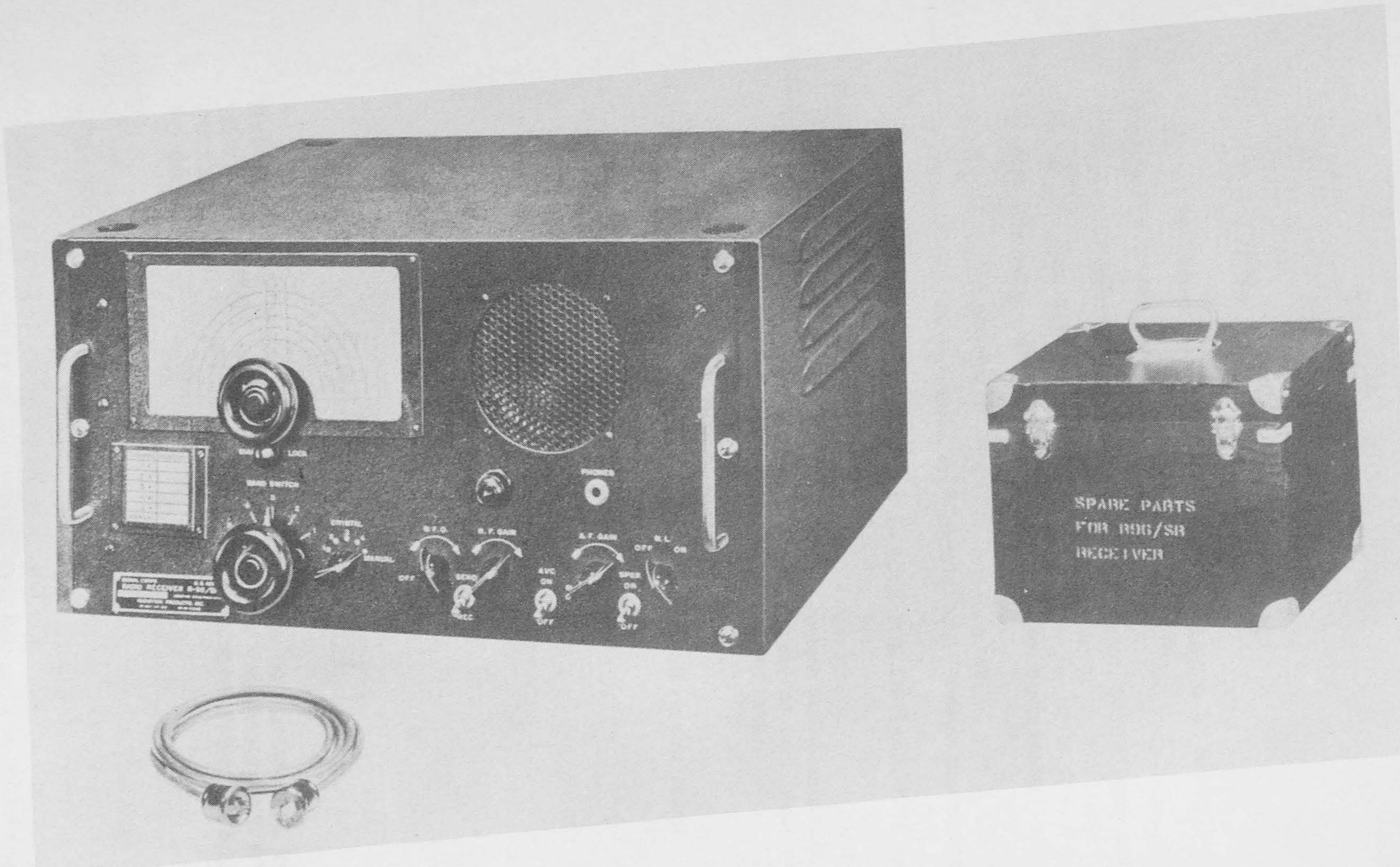
4. Bend—Chassis.

5. Bury or scatter—All remaining parts.

DESTROY EVERYTHING

SAFETY NOTICE

THIS EQUIPMENT USES VOLTAGES DANGEROUS TO HUMAN LIFE. DON'T ATTEMPT ANY REPAIR OR ADJUSTMENT WITHIN THE EQUIPMENT WHILE THE CURRENT IS ON. DON'T UNDERTAKE REPAIRS UNLESS YOU ARE AUTHORIZED TO DO SO.



Frontispiece. Radio Receiver R-96/SR and spare parts box.

SECTION I

DESCRIPTION

1. GENERAL.

Radio Receiver R-96/SR is intended for use in harbor and sea-going vessels where extreme conditions such as tropical climates and salt sea atmosphere may be prevalent, and where severe vibrations and shock may be encountered. It is designed for operation alone or in combination with a radio transmitter.

a. The receiver is provided with four crystal-controlled channels for operation in a frequency range of 1,700 to 8,700 kc (kilocycles) and a fifth position for manual tuning over the frequency ranges of 135-260 kc, 255-510 kc, 1,485-3,030 kc, 2,970-6,060 kc, and 5,940-12,120 kc.

b. C-w (continuous-wave), m-c-w (modulated-continuous-wave), i-c-w (interrupted-continuous-wave), and voice-modulated signals (phone) may be received with either automatic or manual volume control.

c. Terminals are provided in the receiver to accommodate the necessary interconnecting cables in order that send and receive operations may be secured through the action of the push-to-talk handset, and relays incorporated in the radio transmitter.

d. A line filter in the receiver is used to reduce generator or line noise reaching the receiver through the power source.

2. POWER REQUIREMENTS.

The receiver is designed for operation from 115-volt, 50- to 60-cycle a-c (alternating-current) power sources, or 115-volt, d-c (direct-current) power sources, and requires approximately 0.4 amperes or approximately 45 watts.

3. MAJOR COMPONENTS.

Radio Receiver R-96/SR consists of the following major components:

Quantity	Name	Dimensions (in.)	Weight (lb)
1	Radio Receiver R-96/SR	10 x 20⅞ x 17½	69.5
1	Spare parts box	9 x 11 x 14	18

4. VACUUM TUBE COMPLEMENT.

References should be made to the following table when installing or replacing tubes:

Ref. No.	Function	Tube
V1, V2	R-f amplifier	JAN-6SK7
V3	Mixer	JAN-6SA7
V4	Local oscillator	JAN-6SJ7
V5, V6	I-f amplifier	JAN-6SK7
V7	Beat-frequency oscillator	JAN-6SJ7
V8	Detector, first a-f amplifier	JAN-6SQ7GT
V9	Noise limiter	JAN-6H6GT
V10	Second a-f amplifier	JAN-25L6GT
V11	Rectifier	JAN-25Z6GT

5. ELECTRICAL DESCRIPTION.

The receiver uses a superheterodyne circuit comprised of two stages of r-f (radio-frequency) amplification, a local oscillator, mixer, two stages of i-f (intermediate-frequency) amplification, a beat-frequency oscillator, detector, noise limiter, two stages of a-f (audio-frequency) amplification and a rectifier. Operation on either ac or dc is possible.

a. **R-f Amplifiers.** Two stages of r-f amplification using pentode tubes provide high sensitivity plus a

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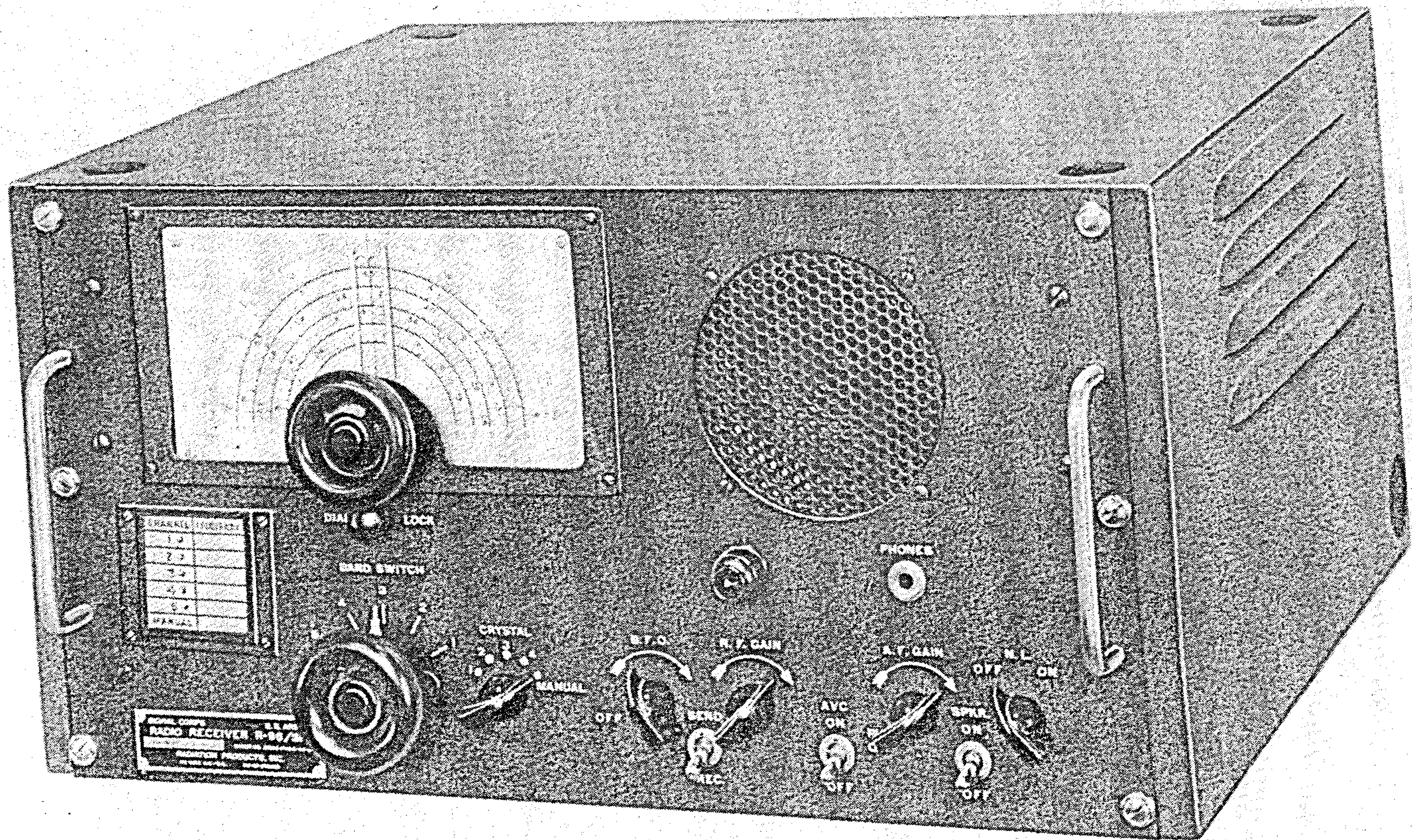


Figure 1. Radio Receiver R-96/SR.

favorable signal-to-noise ratio. Individual r-f coils are used for the various tuning ranges of the receiver.

b. Local Oscillator. The local oscillator uses a cathode-coupled feedback oscillator circuit for operation with the manual tuning ranges. A special switching arrangement makes possible the use of the same tube as a Pierce crystal oscillator for use on any one of the four fixed frequencies. A crystal is provided for each of these four frequencies.

NOTE: Crystal units of the Signal Corps Type DC-11-A or equal are used. The crystals are not supplied as components of Radio Receiver R-96/SR, but are issued in accordance with frequency assignments for the individual installation.

c. Mixer. A multigrid tube is used as an electronic mixer for combining the outputs of the local oscillator and the r-f amplifiers. This stage also has individual coils in its signal input circuit to cover the tuning ranges of the receiver.

d. I-f Amplifiers. Two stages of i-f amplification are used. Pentode tubes are used.

e. Beat-frequency Oscillator. A pentode tube connected as a triode and used in a Hartley circuit is employed and provides the necessary beat frequency when reception of c-w signals is desired.

f. Detector and Noise Limiter. The detector stage uses the diode section of a twin diode-triode tube. The rectified output of this detector is fed directly to the first a-f amplifier for operation without the use of a noise limiter. When the noise limiter is switched in, the output of the detector is caused to pass through one section of a twin diode rectifier tube before reaching the first a-f amplifier. The other section of the noise limiter is normally inoperative in the circuit but becomes conducting and blocks the a-f input signals whenever a noise impulse or other high-amplitude signal is received, providing these latter signals or impulses exceed the average amplitude of the normal signals. A separate a-v-c (automatic-volume-control) circuit is also included.

g. A-f Amplifiers. Two stages of a-f amplification allow reception with either a speaker or a headset. The first a-f amplifier employs the triode section of the twin-diode triode tube and the second a-f amplifier uses a beam power amplifier tube.

h. Rectifier. A half-wave rectifier tube is used and is so connected in the circuit that operation may be obtained by the use of either a-c or d-c power supply.

6. CONTROLS.

The following controls can be found on the receiver front panel (fig. 1):

a. BAND SWITCH (SW1) selects the proper set of coils for tuning over the following ranges:

Band	Tuning range
1	135 kc to 260 kc
2	255 kc to 510 kc
3	1.48 mc to 3.03 mc
4	2.97 mc to 6.06 mc
5	5.94 mc to 12.12 mc

b. CRYSTAL-MANUAL switch (SW2) selects any one of the four crystal-controlled channels, or the MANUAL tuning position. *The crystal-controlled frequencies are not pretuned.* Set the calibrated dial to the frequency and the BAND SWITCH to the band required.

c. AVC ON-OFF switch (SW3) may be used for both phone and cw.

d. SEND-REC. switch (SW4) removes plate voltage *only* and allows tube filaments to remain hot. This switch must be on the SEND position when used with transmitter control relay.

e. B.F.O. control (R20 and SW5) turns the bfo (beat-frequency oscillator) on and off and regulates the amount of bfo injection for best reception.

f. N.L. switch (noise limiter) is turned ON or OFF by this rotary switch (SW7).

g. A.F. GAIN control (R30 and SW8) adjusts the audio volume to speaker and headphones and in the extreme counterclockwise position turns off both plate voltage and filament voltage.

h. R.F. GAIN control (R10) adjusts the maximum receiver sensitivity on avc and the operating sensitivity (regardless of signal) when the AVC is OFF.

i. SPKR. ON-OFF switch (SW9) turns ON or OFF the speaker.

j. PHONES jack is self-explanatory.

k. The tuning control selects the desired frequency within the band being used.

l. The DIAL LOCK is provided to lock the dial in place once it has been set. This will prevent the setting from being changed by any vibrations of the equipment.

7. PACKAGING.

a. **General.** Radio Receiver R-96/SR is shipped in one wooden case, and contains the receiver and the spare parts box. The spare parts box contains the following:

Quantity	Item
2	Technical Manuals TM 11-878.
1 set	Spare tubes.
2	Headsets P-20.
1	Insulator, each type.
1	R-f choke, each type.
10	Fuse, each type.

Quantity	Item
4	Dial lamp, each type.
1	Resistor, each type.
1	Toggle switch, each type.
1	Capacitor, each type.
1	A-c power cord with plugs.

b. Packing Boxes. The following is typical packing data for Radio Receiver R-96/SR:

Box No.	Contents	Dimensions (in.)	Weight (lb)	Volume
1	1 Radio Receiver R-96/SR and spare parts box	36½ x 15½ x 23½	160.5	13295.13 cu in.

SECTION II

INSTALLATION AND OPERATION

8. UNPACKING AND INSPECTION.

Open the box containing the radio receiver, being careful not to scratch or break the receiver cabinet or controls. Do not break in the boards with a handaxe or crowbar; pry the board ends off. Do not use the panels of the box as a support for the prying tool. After the box has been opened, do the following:

a. Carefully clean the exterior of the cabinet to remove the packing excelsior.

b. Remove the front panel screws and take the chassis out of the cabinet.

c. Carefully inspect the interior of the chassis for damage such as warped chassis, etc.

9. TESTING.

a. Tubes. If a tube checker is available, test all tubes. After checking tubes, install them as indicated in figure 2. Near each tube is stenciled the tube circuit

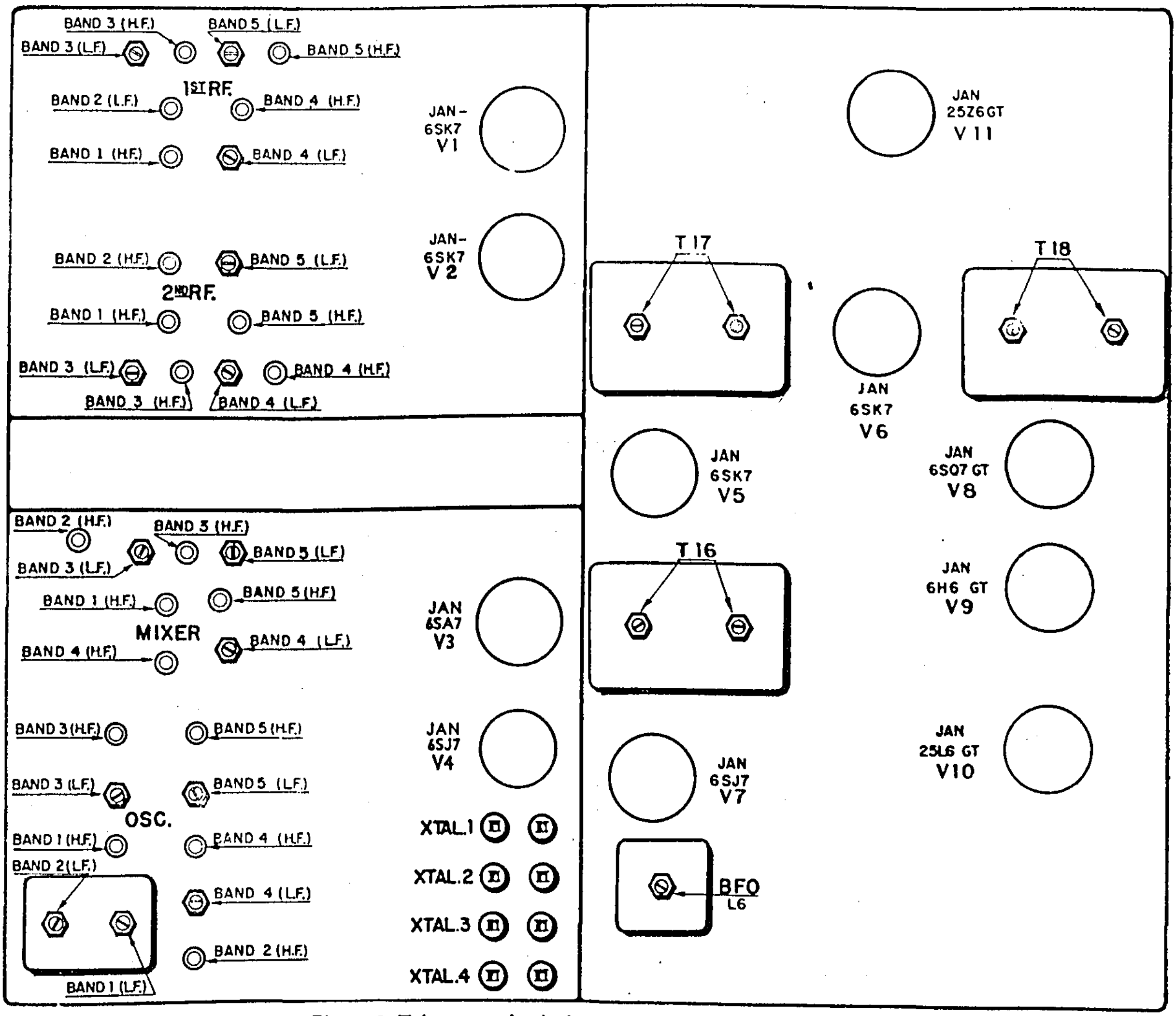


Figure 2. Trimmer and tube layout chart, top view of chassis. TL 18740

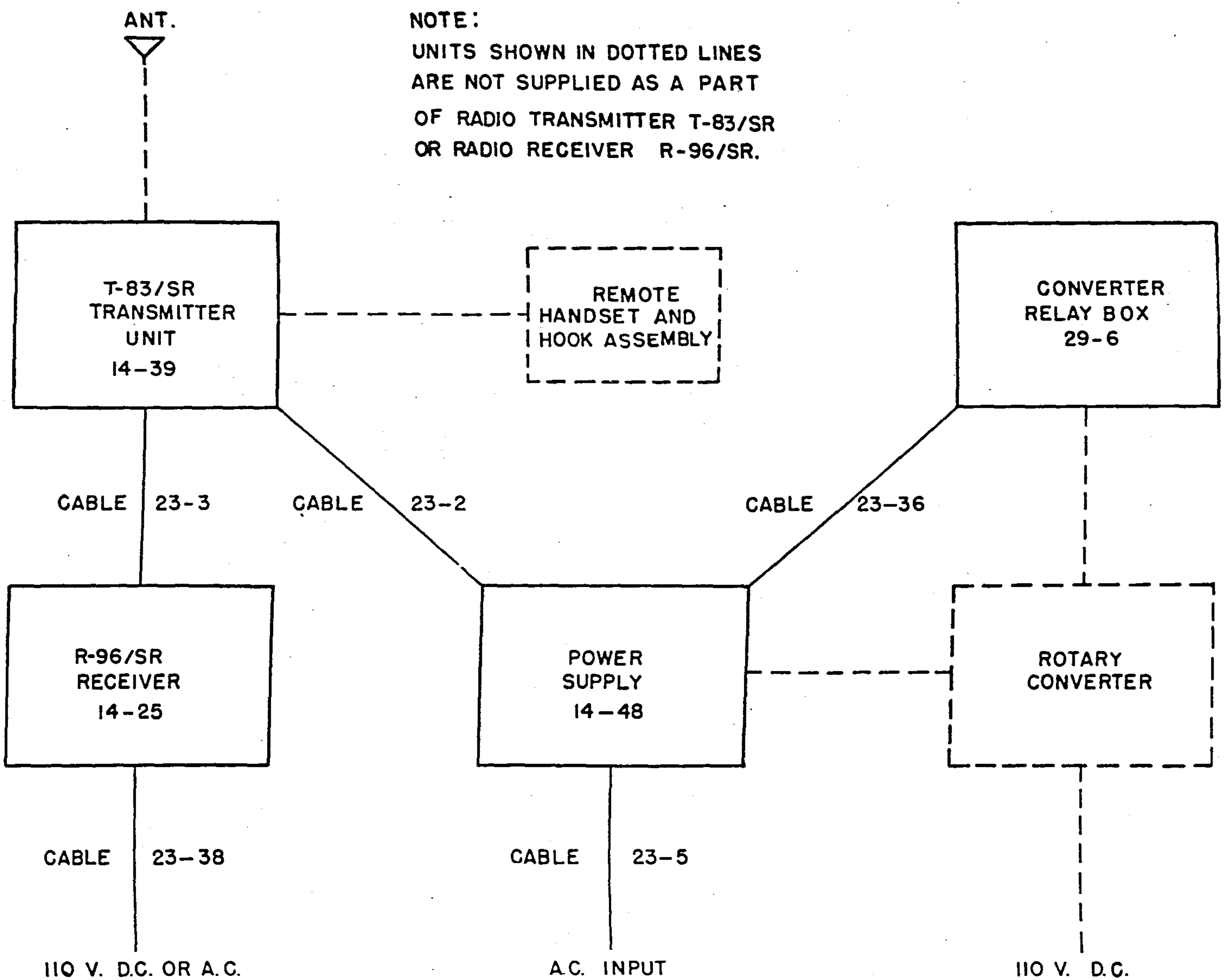
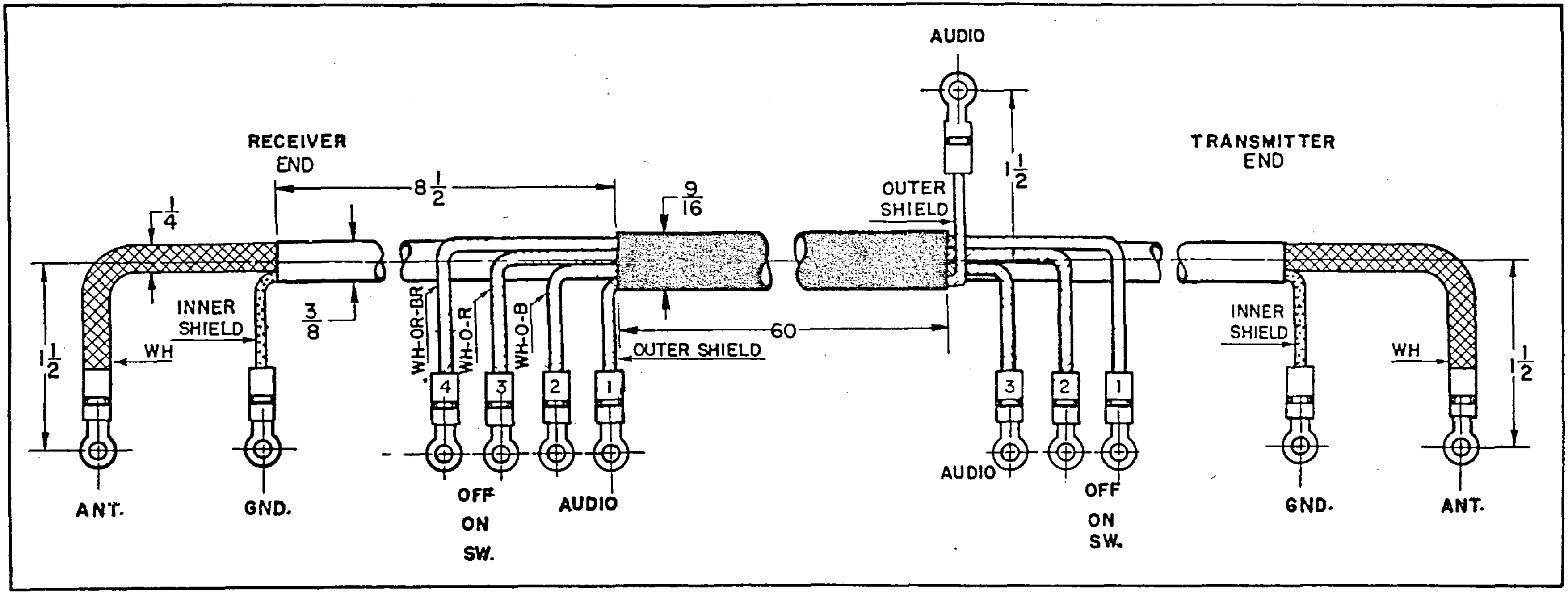


Figure 3. Interconnection diagram Radio Receiver R-96/SR and Radio Transmitter T-83/SR. TL 11456-S



TL 18726

B = BLACK
BR = BROWN
OR = ORANGE
R = RED
WH = WHITE

Figure 4. Interconnection cording (supplied with Radio Transmitter T-83/SR).

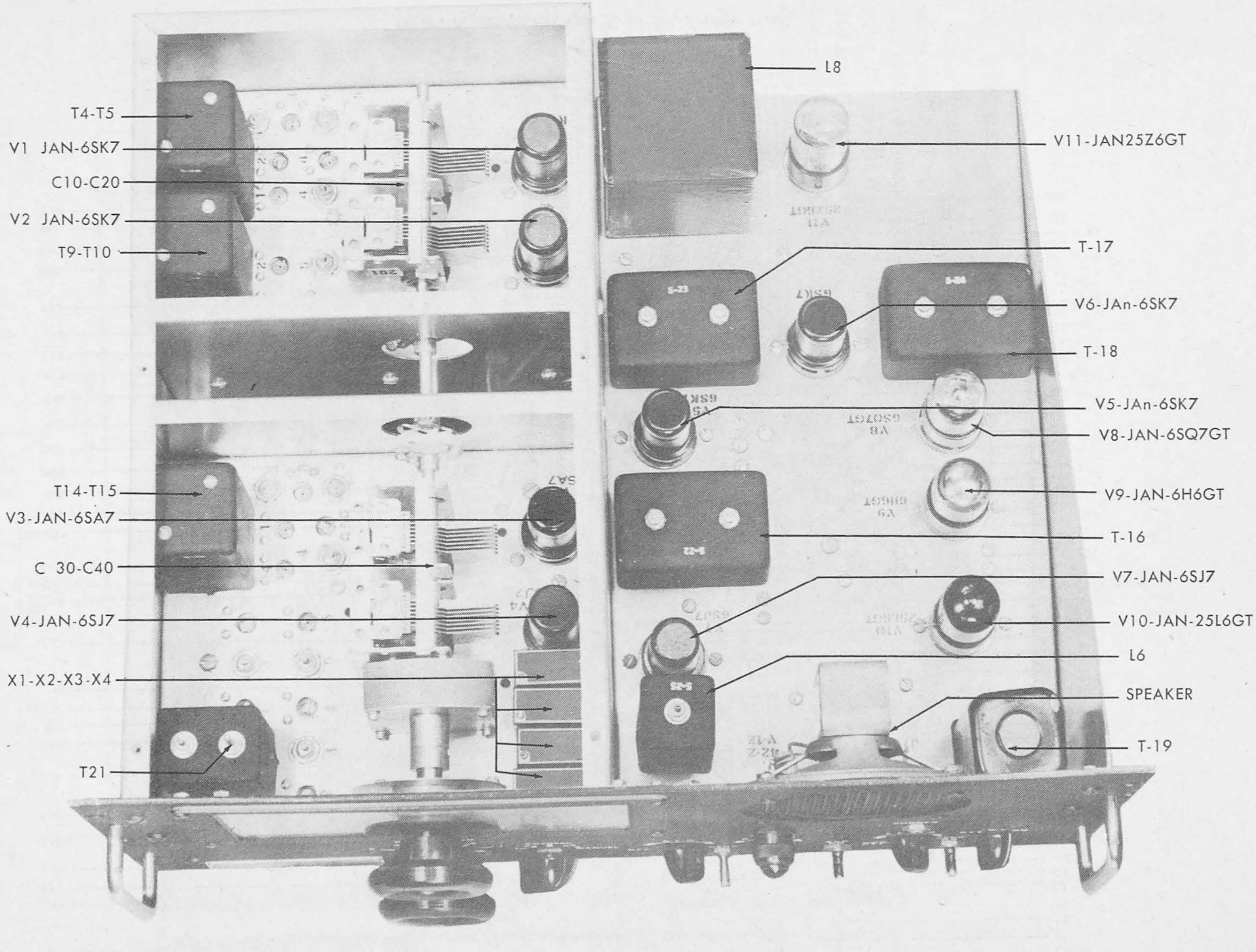


Figure 5. Radio Receiver R-96/SR, top view.

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diagram numbers and the tube type number. Be sure that all tubes are securely in position.

b. **Cables.** Carefully inspect the power cable for worn insulation, broken leads, bent or broken plugs, and dampness. Connect the power cable to a suitable source of voltage and test according to data given in the table of point-to-point voltages and resistances, (par. 50).

10. INSTALLATION.

a. **General.** Radio Receiver R-96/SR should be installed in a location where it will be protected from the weather and salt water spray and, if possible, within convenient reach of the operating position. Choose a location that will allow reasonably short leads to power supply, antenna, and ground connections. If the receiver is to use the same antenna as a transmitter and to use the transmitter relay system for push-to-talk operation of the receiver, locate the receiver as close as possible to the transmitter. If the receiver is to operate with its own antenna and not in conjunction with a transmitter, locate the receiver as far away from any transmitter as is possible.

b. **Radio Receiver R-96/SR.** This receiver is intended for mounting on top of an operating desk or shelf. Bulkhead mounting facilities for the receiver when used with a transmitter in a stacked position, are also provided. The receiver cabinet is constructed to bear the weight of Radio Transmitter T-83/SR. Provision has been made for fastening the transmitter to the receiver and the receiver to bulkhead mounting brackets. Necessary bolts, nuts, and lockwashers are included in the transmitter running spare parts box. No shock mounting is required.

c. **Wiring.** All wiring to the receiver should be with shielded cable. The shield braid must be well grounded at both ends and every few feet where possible. When using the receiver with a transmitter, connections should be made between the receiver and transmitter as shown in figure 3. Figure 4 shows the interconnections and cording.

11. OPERATION.

a. Before operating the receiver, check to see that:

(1) The line input voltage is between 103.5 and 126.5 volts.

(2) On a d-c line, that the positive line will be connected to the plates of rectifier tube V11.

(3) The tubes have been inserted securely in their proper sockets.

(4) All cables connecting the receiver and transmitter (if a combination installation is used) are on the correct terminals.

(5) The antenna and ground connections have been properly made.

b. Throw A.F. GAIN switch (SW8) to the right and allow about 30 seconds for the tubes to heat. Throw SEND-REC. switch to REC.

c. Select the frequency to be used. If the frequency chosen is one covered by one of the crystals, select the correct crystal with CRYSTAL-MANUAL switch (SW2). Using the BAND SWITCH select the correct wave band covering the frequency chosen.

d. Rotate the tuning control to the frequency chosen. If loudspeaker is to be used, turn the SPKR. switch to ON position. Increase R.F. GAIN and A.F. GAIN controls for desired signal output.

e. If noise is excessive, turn the N.L. (noise limiter) switch (SW7) to the ON position. Operate the AVC switch as required. If signals fade considerably, turn the AVC switch to ON.

f. For receiving c-w signals, turn the B.F.O. control clockwise to the desired signal.

g. To shut off the equipment, turn the A.F. GAIN control fully counterclockwise to PWR. OFF position.

SECTION III

FUNCTIONING OF PARTS

12. GENERAL.

Radio Receiver R-96/SR is a superheterodyne receiver capable of receiving amplitude-modulated signals, either continuous wave or interrupted continuous wave. The receiver covers a frequency range of 135 to 510 kc and 1,485 to 12,120 kc. Provision is also made for crystal-controlled reception for four frequencies in the range of 1,700 to 8,700 kc.

13. BLOCK DIAGRAM OF RECEIVER.

The signal is fed from the antenna to the first r-f amplifier V1 where it is amplified and fed to the second r-f amplifier V2 for further amplification (fig. 7). The signal is then fed to the mixer stage input V3. The h-f (high-frequency) mixer oscillator V4 generates a signal 550 kc higher in frequency than the received signal and feeds this signal into the mixer stage input. The mixer stage, therefore, has input signals from the r-f amplifier and from the h-f oscillator. Because the i-f stages are resonant at 550 kc, the difference frequency (550 kc) will be amplified by the two i-f stages V5 and V6. The amplified i-f signal is then fed to the detector stage V8a where it is demodulated and fed through the noise limiter V9 to the audio amplifiers V8b and V10. The noise limiter grounds the audio voltage when noise impulses are received, keeping noise out of the audio system. The amplified audio signals are fed to the loudspeaker and headset. A small portion of the signal from the i-f amplifier being fed to the detector stage is rectified and fed back as negative a-v-c voltage to the two r-f amplifier stages, mixer stage, and first i-f amplifier stage. A beat-frequency oscillator V7 generates a signal which is fed to the second i-f stage and beats against the amplified i-f signal to produce an audio beat note. This note is used for receiving c-w signals. The power supply for the receiver using rectifier V11 supplies voltage from either 115-volt, d-c source or 115-volt, a-c 50- to 60-cycle source.

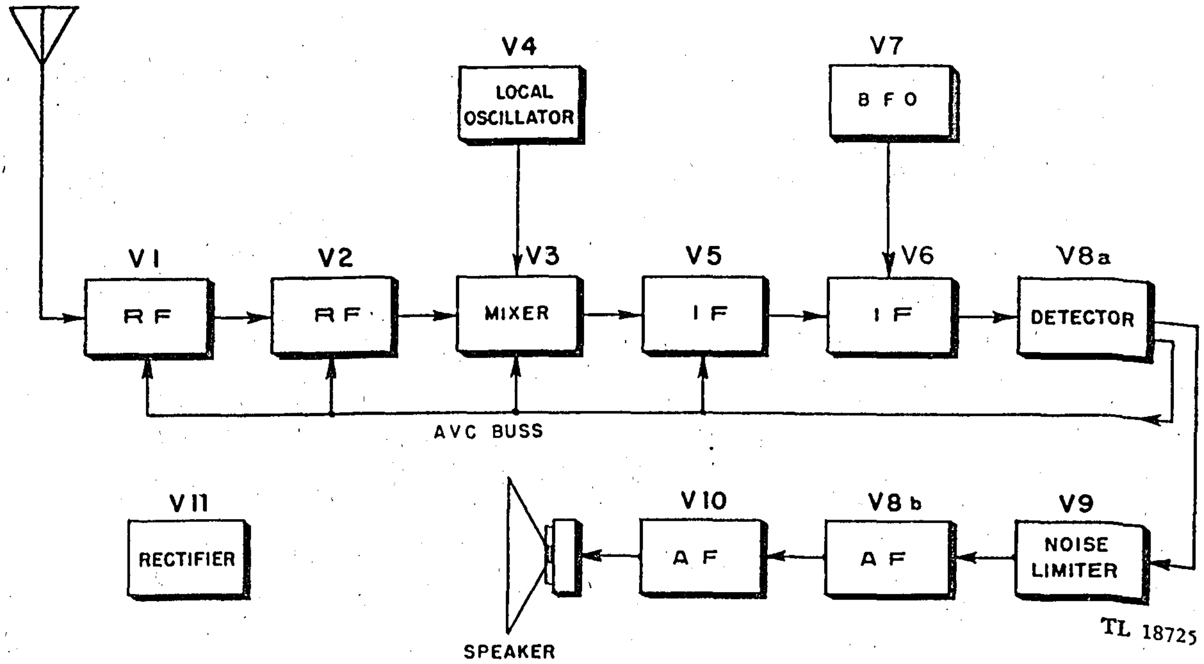


Figure 7. Radio Receiver R-96/SR, block diagram.

14. FIRST R-F AMPLIFIER.

a. The two r-f amplifier stages, the mixer stage, and the mixer oscillator operate on five wave bands. A ganged wave-band switch SW1 switches from one wave band to another. The first r-f amplifier stage is shown in figure 8. For convenience, only one of the five bands are shown on this diagram. The remaining four bands operate in a similar manner.

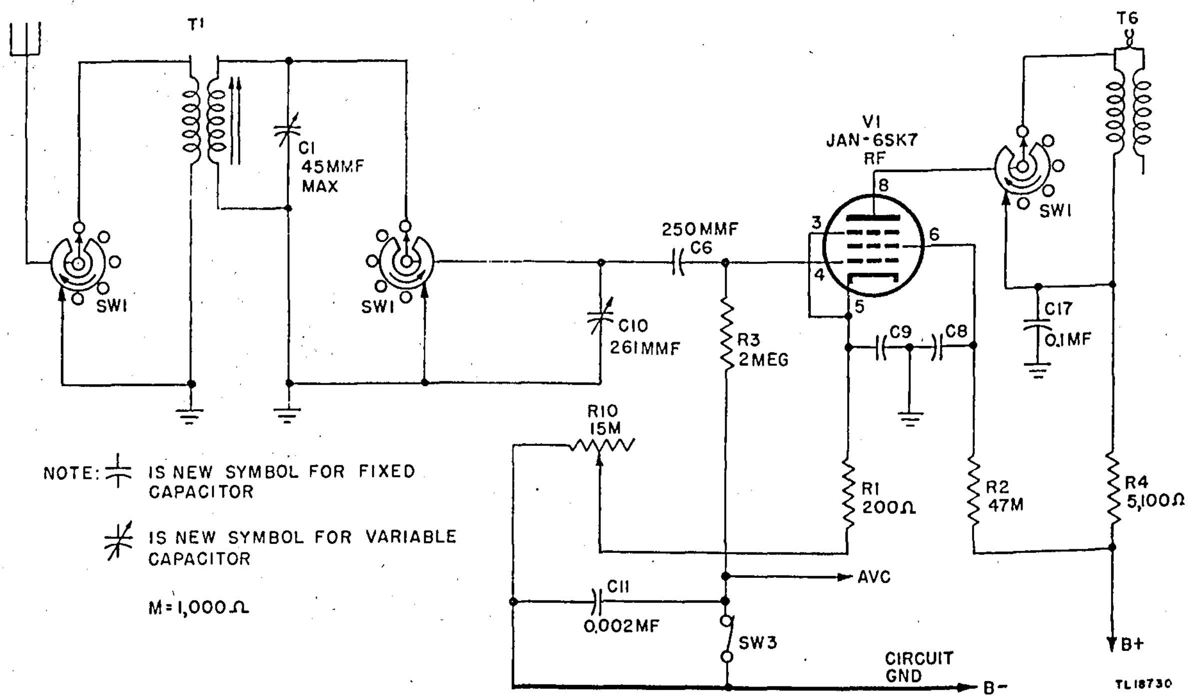
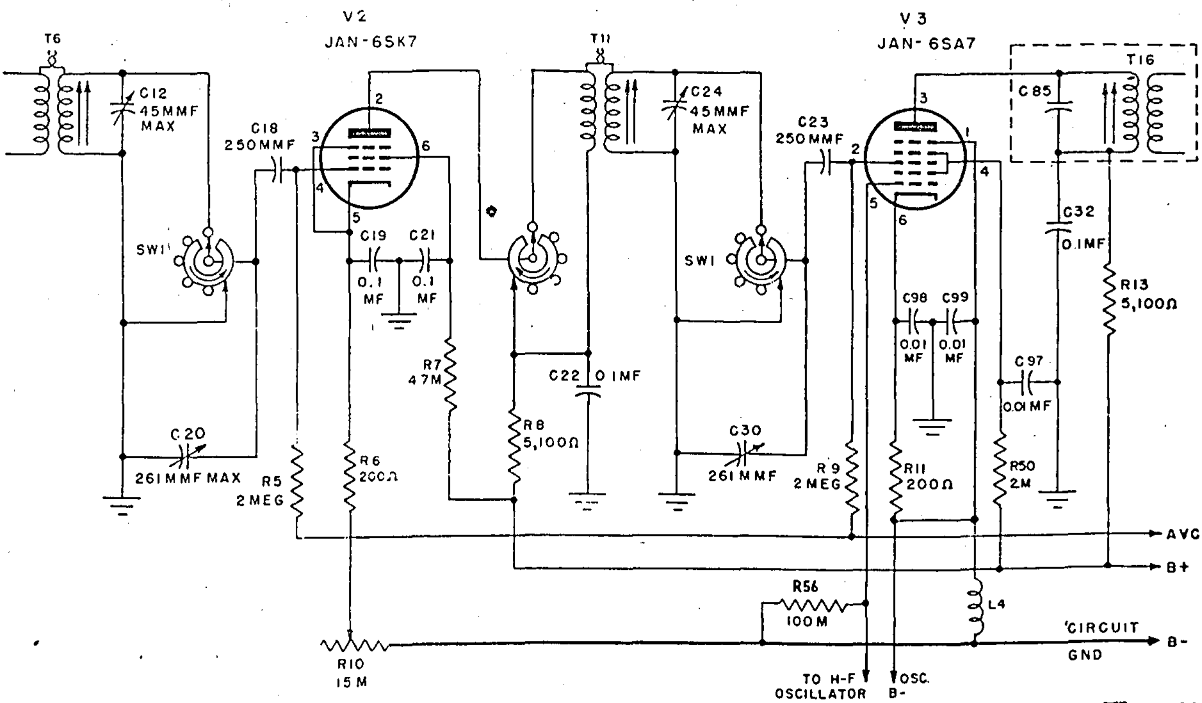


Figure 8. R-f amplifier, functional diagram.

b. Figure 8 shows r-f transformer T1 (the coil for band 5) switched into the circuit. The secondary of the r-f transformer is tuned by capacitor C10 which is ganged with the tuning capacitors of the remaining r-f and oscillator transformers. Capacitor C1 is a r-f trimmer. A moveable metal-core inductor assists in aligning the low frequency end of the band. A-v-c voltage is applied through decoupling resistor R3 to the grid of the r-f amplifier. Capacitor C6 prevents grounding of the a-v-c line. A-v-c switch SW3 grounds the a-v-c line in the OFF position. Capacitor C11 is an a-v-c filter. The r-f gain control resistor R10 is a variable resistor in the cathode circuits of the two r-f and first i-f stages, controlling the amplification of these stages. Resistor R1 is the normal cathode bias resistor and is bypassed by capacitor C9. The screen voltage is reduced to its proper value by resistor R2 which is bypassed by capacitor C8. The untuned plate circuit is decoupled from the power circuits by resistor R4 and capacitor C17.

15. SECOND R-F AMPLIFIER AND MIXER STAGES.

Figure 9 is a functional diagram of the second r-f amplifier and mixer stages. As in the case of the first r-f amplifier diagram, the wave band switch SW1 is shown in the band 5 position. The remaining four bands function in a similar manner. The second r-f amplifier is inductively coupled through transformer T11 to the signal grid of the pentagrid mixer V3. The signal grid input circuit of the mixer is also similar to the grid input circuits of the r-f stages. Local oscillations are applied from the h-f oscillator through capacitor C59, developing across resistor R56, and consequently, on the number one or injector grid of the mixer. The cathode bias combination is resistor R11 and bypass capacitor C98. Capacitor C97 bypasses the screen circuit. Screen potential is taken directly off the B plus supply line. The output circuit (primary of i-f transformer T16) is tuned to the difference frequency signal (550 kc) which is transformer coupled to the first i-f amplifier. Resistor R13 and capacitor C32 are the plate circuit decoupling combination.



TL 18729

IS NEW SYMBOL FOR FIXED CAPACITOR

IS NEW SYMBOL FOR VARIABLE CAPACITOR

M = 1,000 Ω

Figure 9. Second r-f amplifier and mixer stages, functional diagram.

16. HIGH-FREQUENCY MIXER OSCILLATOR.

a. The h-f oscillator V4 operates either as a variable oscillator or as a crystal oscillator. The variable oscillator operates on all five bands and the crystal oscillator operates on four crystal frequencies. Operation is changed from one method of operation to the other by the CRYSTAL MANUAL switch SW2. Figure 10 is a functional diagram of the complete h-f oscillator showing the function of the switch SW2.

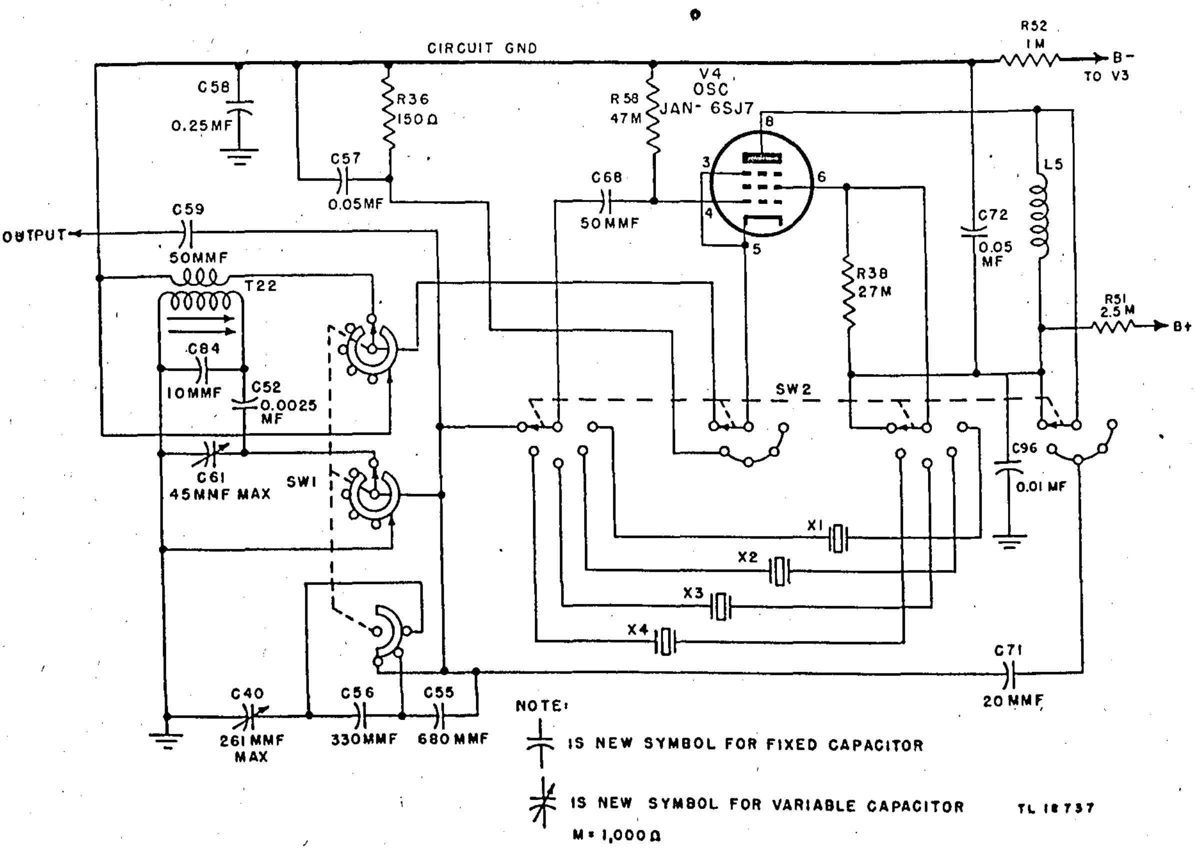


Figure 10. H-f oscillator, functional diagram.

b. Figure 11 shows a simplified functional diagram of the h-f oscillator operating as a variable oscillator on band five. For simplicity, wave band switch SW1 and manual crystal switch SW2 have been omitted from the diagram. The oscillator tube V4 is connected as a triode in a self-excited oscillator using a cathode feed-back coil. The tuned circuit consists of tuning capacitor C40, trimmer capacitor C61, fixed padder capacitor C84, tracking capacitor C52, and an inductor with a movable metal core. Blocking capacitor C68 prevents shorting of the d-c grid bias which is developed across resistor R58 by the flow of oscillator grid current. Capacitor C72 is the oscillator plate return; capacitor C58 ties together the r-f and the circuit grounds.

c. Figure 12 shows a simplified functional diagram of the h-f oscillator operating as a crystal oscillator. For simplicity, wave band switch SW1 and manual crystal switch SW2 have been omitted. Coil T22 (band 5) is shown in the circuit and one of the four crystals is shown. In this circuit, oscillator tube V4 is operating as an electron coupled Pierce oscillator, using the screen as the anode. With this connection the oscillator turned circuit (subpar. b above) is switched to the plate circuit. The plate voltage is applied through r-f choke L5 and is blocked from the tuned circuit by capacitor C71. Capacitor C72 bypasses the plate and screen circuits. Screen potential is reduced to the proper value by resistor R38. Cathode bias is developed across resistor R36 which is bypassed by capacitor C57. The oscillator grid resistor is R58.

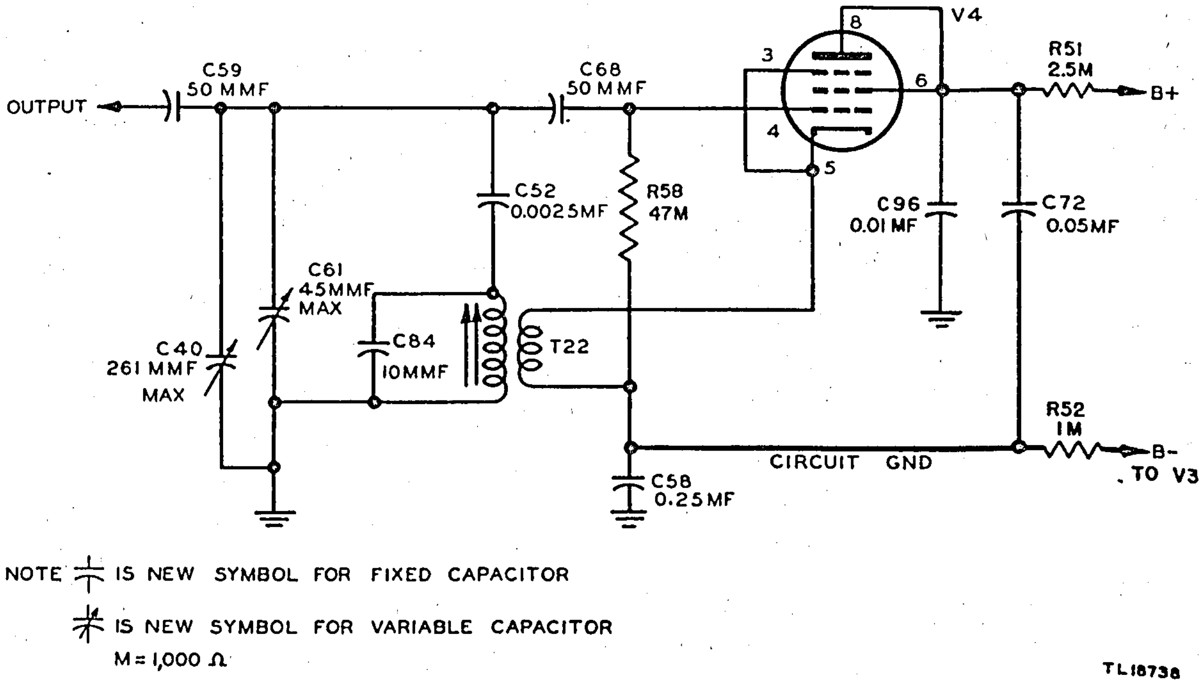


Figure 11. Variable oscillator, simplified diagram.

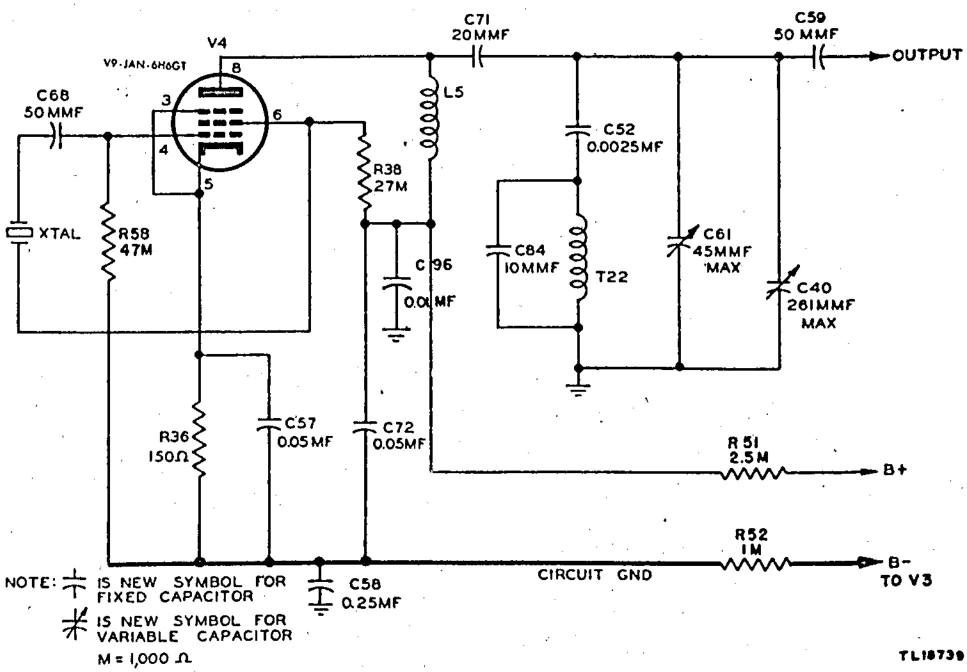


Figure 12. Crystal oscillator, simplified diagram.

17. I-F AMPLIFIER.

a. Two stages of r-f amplification increase the amplitude of the signal before it is applied to the detector of the receiver. Each primary and secondary of the i-f transformers is resonated by a fixed capacitor and an inductor with a movable metal core. The amplification of the first i-f stage is controlled by the R-F GAIN control which changes the cathode bias on tube V5 (fig. 13). Capacitor C86 is the fixed capacitor in the tuned grid circuit and capacitor C33 and resistor R14 are the grid circuit decoupling combination. Resistor R15 is the cathode resistor and is bypassed by capacitor C34. The fixed capacitor in the tuned plate circuit is C87. This circuit is decoupled by resistor R17 and capacitor C36.

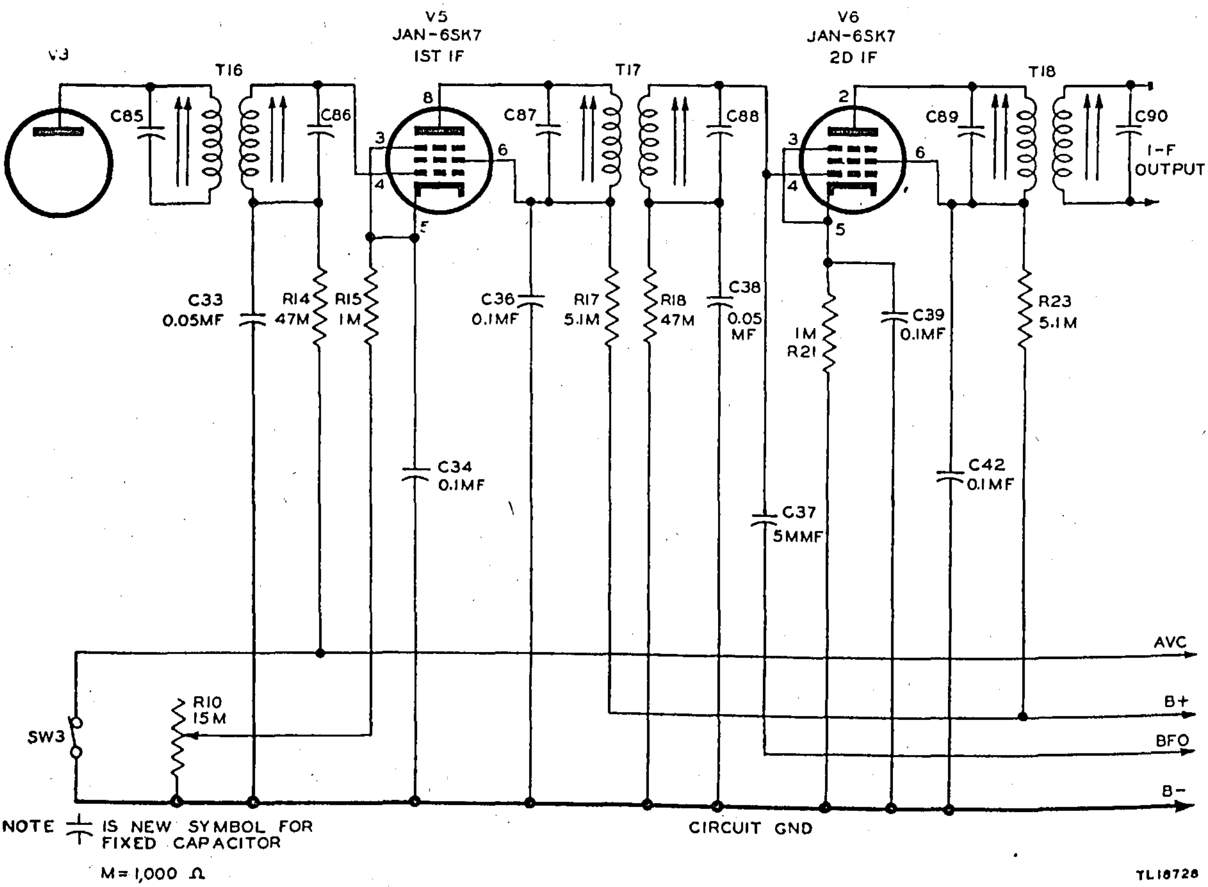


Figure 13. I-f amplifier, functional diagram.

b. The second i-f stage V6 is similar to the first i-f stage. However, the cathode bias is not adjustable and a bfo signal is applied through capacitor C37 to the grid of the tube. The audio signal varies the grid bias on the i-f stage at an audio rate. Thus the i-f signal is effectively modulated and an audio tone is produced in output of the receiver.

18. DETECTOR, A-V-C, AND AUDIO AMPLIFIERS.

The i-f signal is applied to the diode detector through transformer T18 which is resonated by fixed capacitor C90 and the transformer secondary with a movable metal core. Audio signal is developed across the diode load resistors R26 and R40 by the rectified components of diode current. When switch SW7 is in the OFF position, as shown in figure 14, the audio signal across resistor R40 is applied through capacitor C51 and A.F. GAIN control resistor R30 to the grid of the triode section of tube V8. A-v-c voltage is taken off the diode load through isolating resistor R24. The diode load is bypassed for r-f voltage by capacitor C43. The triode section of tube V8 is the first audio amplifier and obtains its bias from the cathode resistor R27 which is bypassed by capacitor C44. Capacitor C81 bypasses the higher audio frequencies, shunting the higher frequency noises to ground. The plate load resistor is R28; the plate decoupling combination is resistor R28 and capacitor C45. Audio signal is coupled through capacitor C47 and appears across grid resistor R32 and on the grid of the audio output tube V10. The audio signal is transferred from the plate circuit of tube V10 to the loudspeaker by output transformer T19. The cathode bias combination is resistor R33 and capacitor C48. A small amount of negative voltage feedback is fed back from plate to grid through capacitor C46 and resistor R31 to minimize distortion and improve low frequency response. Switch SW9 switches the speaker in or out of the circuit. When the speaker is OFF, resistor R34 is shunted across the secondary of the output transformer to reflect the proper load to the audio output tube.

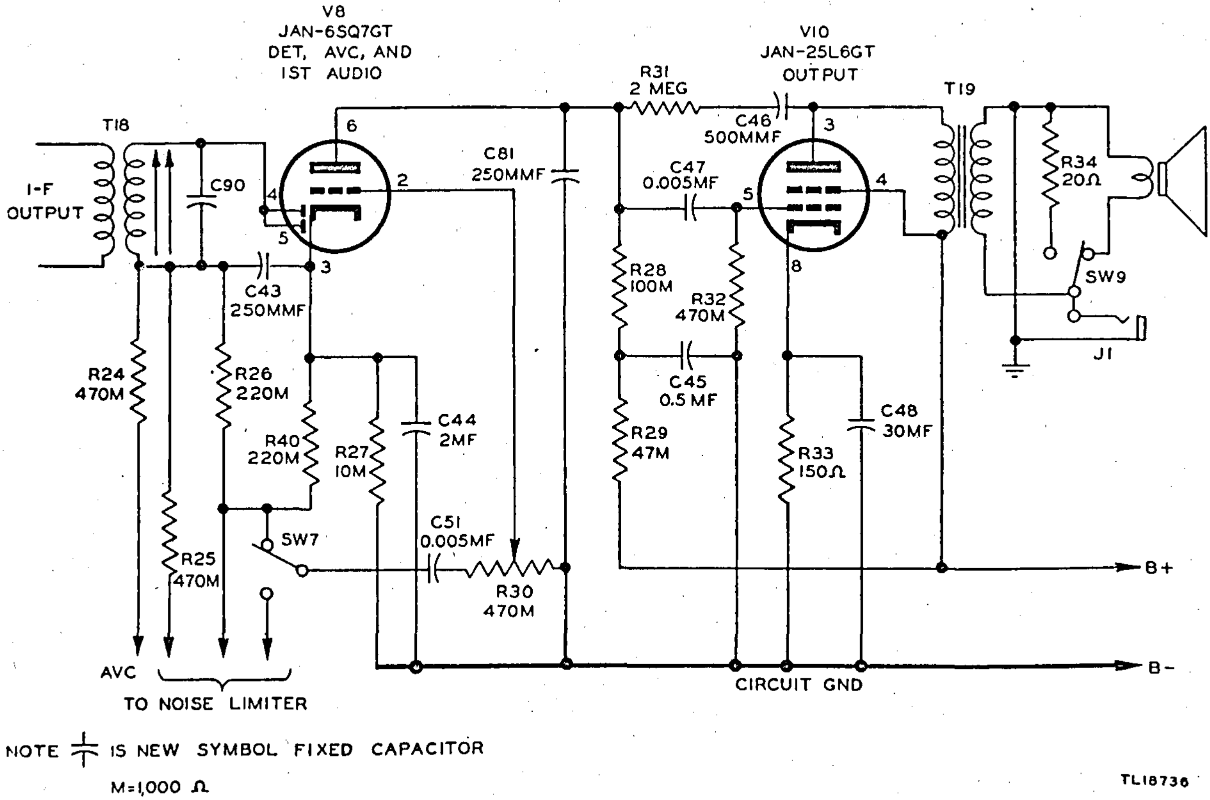


Figure 14. Detector, a-v-c, and audio amplifier, functional diagram.

19. NOISE LIMITER.

Noise limiter V9 removes the noise impulses on the received signal by shorting the cathode (at ground potential) of the diode detector V8 to the grid of the first audio amplifier. The noise limiter circuit operates when switch SW7 is placed in the ON position which connects the cathode of the noise limiter to the audio grid through capacitor C51 (fig. 15). When ON, noise impulses are applied to the diode detector, the rectified component of current flowing through resistor R26 (detector diode load resistor) causes number 1 section of the noise limiter to conduct (fig. 16). The conducting diode forms a low impedance path for the audio voltage developed across detector diode load resistor R40, applying signal directly to the grid of the audio amplifier. The average current drawn by section one develops a voltage across resistor R41 which biases the second section of the noise limiter diode to cut-off until a noise impulse is applied to the plate of the second section through capacitor C49 (fig. 17). When the noise impulse reaches an amplitude in excess of the bias across resistor R41, the second section conducts, and so far as audio is concerned, connects the grid of the audio amplifier to ground. This method of noise limiting is automatic and requires no adjustment. It is not affected by changes in signal strength, as any change in strength develops a greater bias across resistor R41, changing the level at which noise limiting begins to accommodate the strength of the received carrier.

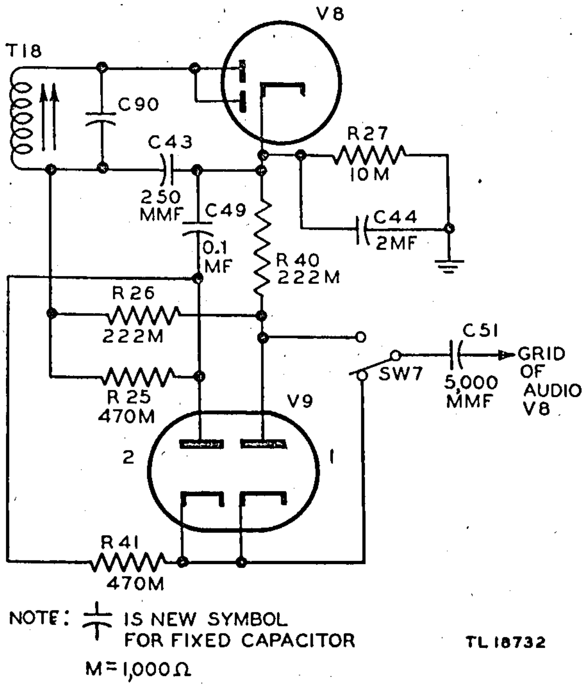


Figure 15. Noise limiter, functional diagram.

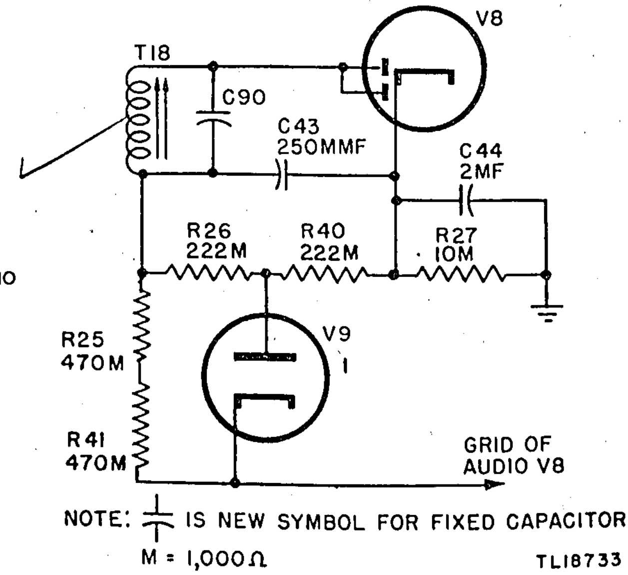


Figure 16. Noise limiter, operating with normal signal (no noise) present, functional diagram.

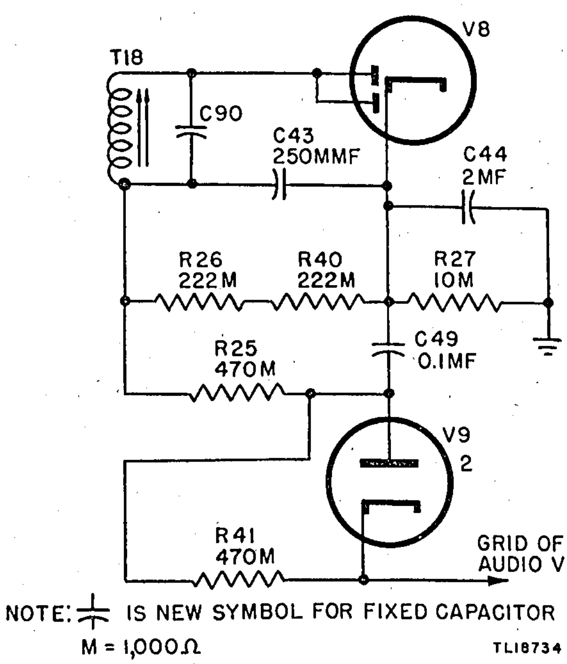


Figure 17. Noise limiter, operating with noise signal present, functional diagram.

20. BEAT-FREQUENCY OSCILLATOR.

Figure 18 shows a functional diagram of the bfo. The bfo modulates the received carrier at an audio rate in the grid circuit of the last i-f stage. A triode tube V-7 connected in a Hartley circuit generates the audio signal which is applied through coupling capacitor C37 to the control grid of i-f amplifier tube V6. Inductor L6 and capacitor C74 resonate at the audio frequency. Inductor L6 is tapped for the cathode feedback connection. Oscillator bias is developed by the flow of grid current through resistor R39 which is bypassed by capacitor C75. The beat-frequency oscillator is turned on by closing switch SW5 which applies plate voltage to the B.F.O. potentiometer R20. Resistor R19 is a part of the plate voltage divider and prevents shorting of the B supply. The plate supply line is bypassed by capacitor C73.

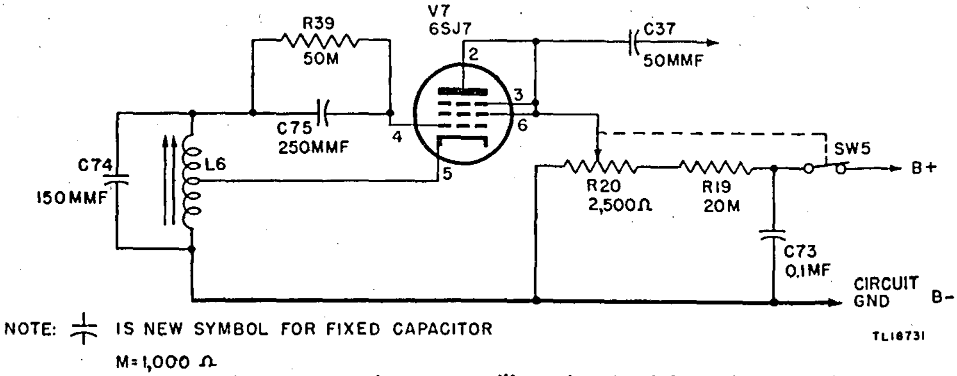


Figure 18. Beat-frequency oscillator, functional diagram.

21. POWER AND FILAMENT CIRCUIT.

Radio Receiver R-96/SR operates from either 115 volts d-c or 115 volts a-c at 50 to 60 cycles (fig. 19). For a-c operation, the line voltage is rectified by a half-wave rectifier V11 and filtered by a filter consisting of inductor L8 and capacitors C50 and C60. The line voltage is filtered by inductor L7 and capacitor C77. There is an on-off switch SW8 which is a part of the A.F. GAIN control in one side of the line, and two fuses, one in each side of the line. A series circuit supplies the proper heater voltages to all the tubes. Capacitors C78 and C95 are bypass capacitors and keep the r-f and a-f ground voltages at the same potential as the d-c circuit ground. There is no direct connection between receiver and circuit grounds. This is to prevent short-circuiting the power line if the line plug is inserted the wrong way. Resistors R59, R60, and R61 are voltage dropping ballast resistors for the filaments of the tubes.

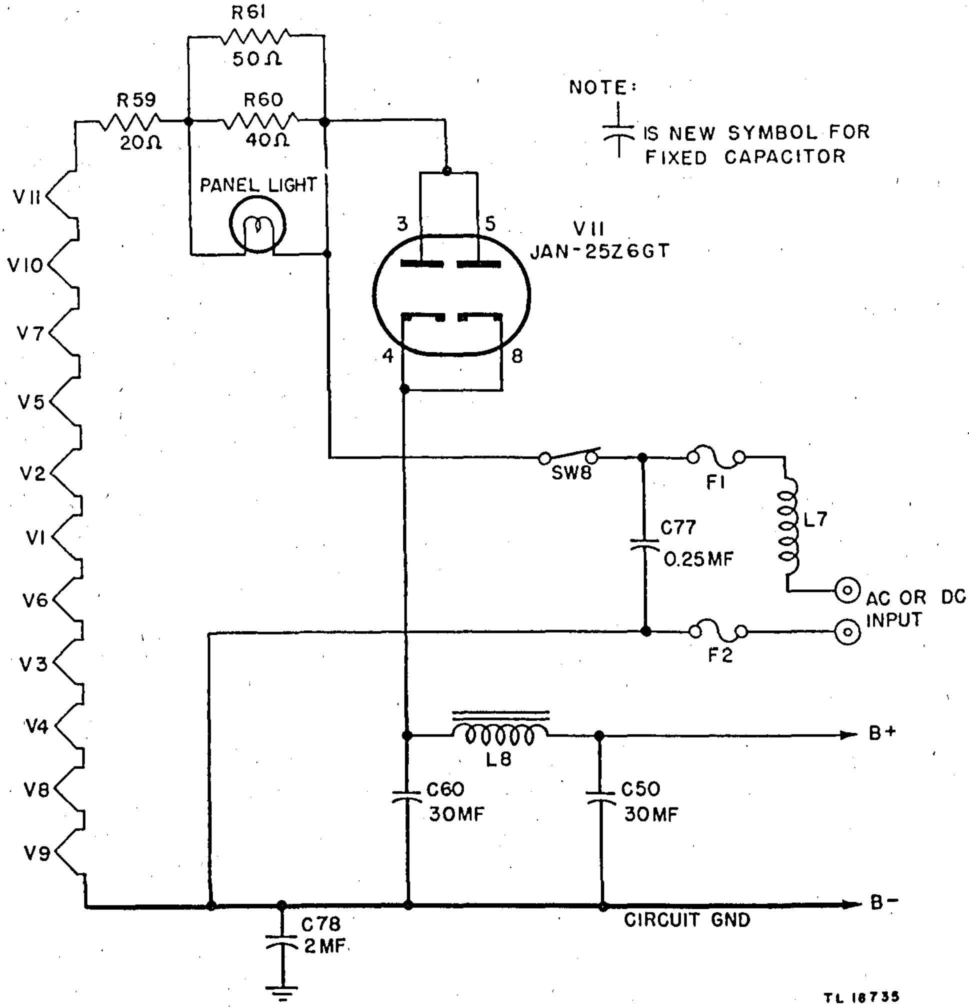


Figure 19. Power supply and filament circuit.

SECTION IV

MAINTENANCE

NOTE: Failure or unsatisfactory performance of equipment used by Army Ground Forces and Army Services Forces will be reported on W. D., A.G.O. Form No. 468 (Unsatisfactory Equipment Report). If Form No. 468 is not available, see TM 37-250. Failure or unsatisfactory performance of equipment used by Army Air Forces will be reported on Army Air Forces Form No. 54 (unsatisfactory report).

22. ALIGNMENT.

a. Test Equipment. The alignment of the receiver MUST NOT BE DISTURBED UNLESS ADEQUATE EQUIPMENT AND EXPERIENCED PERSONNEL ARE AVAILABLE. The equipment required is as follows:

- 1 ea signal generator covering a frequency range of 130 to 12,500 kc such as Signal Generator I-72-( ).
- 1 ea power output meter, such as contained in Test Set I-56-( ).
- 1 ea capacitor, 50 to 100 mmf.
- 1 ea insulated screwdriver.
- 1 ea dummy load (30 ohm resistor and 300 mmf capacitor).

The signal generator should be an accurately calibrated instrument producing modulated signal over the frequency range above. This generator should have an output of 100 microvolts and an output impedance of approximately 70 ohms for best results when aligning the r-f and mixer oscillator circuits. For i-f alignment, these values are not critical. The frequency calibration of the signal generator is extremely important if the receiver dial calibration is to be correct. The output meter should respond to the modulation frequency of the signal generator, preferable 400 cycles, and should provide at least half-scale deflection for 10 volts. Its internal resistance should be greater than 500 ohms.

b. General. The receiver has been accurately aligned at the factory and under normal operating conditions should retain this adjustment indefinitely. When either sensitivity or selectivity (or both) appear to be below normal and all tubes have been checked, it may be desirable to check the alignment. Removing the top shield cover on the r-f and mixed oscillator compartments will make all adjustments accessible. If the following instructions are carefully carried out, no difficulty should be experienced in restoring the original performance of the receiver.

CAUTION: Any changes from original settings will be relatively small and extreme care should be exercised when checking adjustments. This is especially true of the mixer oscillator circuits which should not be disturbed unless the main tuning dial is definitely known to be off calibration. DO NOT manipulate the insulated screwdriver indiscriminately.

Connect the power line cord to the power source and throw the SEND-REC. switch to the REC. position. Allow the receiver to warm up approximately one hour before beginning adjustments. Connect the output meter to the speaker terminals located at the rear of the receiver chassis.

23. INTERMEDIATE FREQUENCY.

a. Adjust the signal generator to 550 kc with modulation on, and connect the output lead through a small fixed capacitor (50 to 100 mmf) to the lug of the stator plates of the second section of the tuning capacitor (fig. 5). Take care that this lead is not grounded. The ground connection of the signal generator test lead should be connected to some nearby part of the receiver chassis. The front panel controls should be set as follows:

Tuning dial	—510 KC
BAND SWITCH	—Position 2
B.F.O.	—Off
AVC	—Off
SPKR	—On
R.F. GAIN	—Full on
A.F. GAIN	—Full on
N.L.	—Off

b. Increase the output of the signal generator until a convenient deflection is obtained on the output meter. If necessary, the A.F. GAIN control may be decreased should the output be too great with a minimum output from the signal generator.

c. Refer to operation 1 on alignment procedure chart (par. 52) and loosen the locknuts on the i-f transformer trimmer slugs.

d. Carefully adjust the tuning slugs of each i-f transformer for maximum output, starting with the last i-f transformer (T18). After each adjustment, it may be necessary to reduce the output of the signal generator.

24. B.F.O. SWITCH.

If no further alignment is anticipated, the B.F.O. should now be adjusted. Turn the modulation OFF on the signal generator, leaving it set at 550 kc as previously used. Turn the B.F.O. switch ON and advance the B.F.O. control until the output is maximum. Adjust the beat-frequency oscillator pitch by turning the screwdriver slotted 6-32 machine screw which projects through the top of the bfo shield can (L-6) to approximately 1,000 cycles.

NOTE: If alignment of the mixer oscillator is anticipated, the B.F.O. should be adjusted to zero beat instead of 1,000 cycles. The final adjustment for the bfo in this case is described under the alignment of the mixer oscillator.

25. MIXER OSCILLATOR.

a. The accuracy of the main dial calibration depends solely on the mixer oscillator frequency, which is 550 kc (the i-f frequency) higher than the signal frequency. For example, when the receiver is tuned to a 10.0 mc (megacycles) signal the frequency of the mixer oscillator must be 10.550 mc. While the frequency of the mixer oscillator can be measured directly if accurate frequency measuring equipment is available, it is far simpler to check it by tuning in signals of KNOWN frequency and noting the main dial readings.

b. If it has been determined that the dial calibration is sufficiently in error to require correction, this may be accomplished as follows. Refer to the alignment chart (par. 52) which gives the trimmers to be adjusted as well as the signal frequencies at which the settings should be made.

c. The output of the signal generator should be unmodulated and the B.F.O. control on the receiver ON. The beat oscillator frequency for this adjustment should be at zero beat as described in B.F.O. adjustment above (par. 24).

d. Headphones or the loudspeaker is used to make the adjustments by the zero beat method. The signal generator with dummy load (par. 52) is connected to the antenna terminal for this test.

(1) Band 5. (Refer to operations 2 and 3 of paragraph 52.) Set the generator to 11.5 mc and tune the receiver to 11.5 mc. Adjust the output of the signal generator to a reasonable value (approximately 50 microvolts if the instrument is directly calibrated). Vary the tuning of the signal generator a slight amount each side of the correct frequency (11.5 mc) until the signal is found, and then tune the signal generator for zero beat in the speaker or headphones. Should this frequency not correspond to the dial calibration of the receiver, tune the receiver to the low-frequency end of the band (6.5 mc) and check the calibration at that point. Should both calibrations be off approximately the same amount and in the same direction, the oscillator inductance (T-22) should be adjusted first to correct the calibration at 6.5 mc. If the correction to be made is such that when the signal generator is set to 6.5 no signal is heard, tune the signal generator toward the correct frequency a small amount, bringing the mixer oscillator to zero beat each time in small steps. Turn the receiver dial to the high-frequency end at 11.5 mc, set the signal generator at 11.5 mc, and adjust C-61 for zero beat. Recheck the receiver at 6.5 mc. By correcting the calibration at the two ends of the band alternately, and by adjusting T-22 for correction at 6.5 mc and C-61 for 11.5 mc, the calibration can be corrected at both ends of the dial.

(2) Alignment of the other bands is done by the procedure described above except that the frequencies used are as follows:

(a) Band 4—adjust T-23 for correction at 3.5 mc and C-62 for correction at 5.8 mc (operations 5 and 6, par. 52).

(b) Band 3—adjust T-24 for correction at 1.6 mc and C-63 for correction at 2.8 mc (operations 8 and 9, par. 52).

(c) Band 2—adjust T-20 for correction at 280 kc and C-64 for correction at 480 kc (operations 11 and 12 ,par. 52).

(d) Band 1—adjust T-21 for correction at 140 kc and C-67 for correction at 240 kc (operations 14 and 15, par. 52).

(3) After the last frequency correction adjustment of the mixer oscillator is completed, leaving the signal generator set on this frequency, the bfo may now be adjusted from zero beat to a pitch of about 1,000 cycles.

(4) This completes the mixer oscillator and bfo adjustments.

26. R-F STAGES.

To align the r-f and mixer input stages, the signal generator is used with modulation ON and connected to the antenna terminals. The output meter, connected to the speaker terminals, is used for an indicator.

a. Band 5 (see operations 2 and 3, par. 52). Set the signal generator and the receiver tuning at 6.5 mc and adjust T-11, T-6, and T-1 for maximum output. Then set the signal generator and the receiver tuning at 11.5 mc and adjust C-24, C-12, and C-1 for maximum output.

b. Band 4 (see operations 5 and 6, par. 52). Set the signal generator and the receiver tuning at 3.5 mc and adjust T-12, T-7, and T-2 for maximum output. Then set the signal generator and the receiver tuning at 5.8 mc and adjust C-25, C-13, and C-2 for maximum output.

c. Band 3 (see operations 8 and 9, par. 52). Set the signal generator and the receiver tuning at 1.6 mc and adjust T-13, T-8, and T-3 for maximum output. Then set the signal generator and the receiver tuning at 2.8 mc and adjust C-26, C-14, and C-3 for maximum output.

d. Band 2 (see operations 11 and 12, par. 52). Set the signal generator and receiver tuning at 480 kc and adjust C-27, C-15, and C-4 for maximum output. Then set the signal generator and the receiver tuning at 280 kc and adjust T-20 for maximum output.

e. Band 1 (see operations 14 and 15, par. 52). Set the signal generator and receiver tuning at 240 kc and adjust C-28, C-16, and C-5 for maximum output. Then set the signal generator and the receiver tuning at 140 kc and adjust T-21.

NOTE: It will be observed that alignment of the r-f and mixer input stages can be carried on simultaneously with alignment of the mixer oscillator. First, align the mixer oscillator for a particular frequency as described, then, turn off the B.F.O. and turn on the signal generator modulation for alignment of the corresponding r-f and mixer oscillator frequency.

27. MEANING OF PREVENTIVE MAINTENANCE.

Preventive maintenance is a systematic series of operations performed at regular intervals on equipment, when turned off, to eliminate major break-downs and unwanted interruptions in service, and to keep the equipment operating at top efficiency. To understand what is meant by preventive maintenance, it is necessary to distinguish between preventive maintenance, trouble shooting, and repair. The prime function of preventive maintenance is to *prevent* breakdowns and, therefore, the need for repair. On the other hand, the prime function of trouble shooting and repair is to locate and correct *existing* defects. The importance of preventive maintenance cannot be overemphasized. The entire system of radio communication depends upon each set's being *on the air* when it is needed and upon its *operating efficiency.* It is vitally important that radio operators and repairmen maintain their radio sets properly.

NOTE: The operations in paragraphs 28 through 35 are first and second echelon (organization operators and repairmen) maintenance.

28. DESCRIPTION OF PREVENTIVE MAINTENANCE TECHNIQUES.

a. General. Most of the electrical parts used in Radio Receiver R-96/SR require routine preventive maintenance. Those requiring maintenance differ in the amount and kind required. Because hit-or-miss maintenance techniques cannot be applied, definite and specific instructions are needed. This section contains these specific instructions and serves as a guide for personnel assigned to perform the six basic maintenance operations, namely: Feel, Inspect, Tighten, Clean, Adjust, and Lubricate. Throughout this manual the letter system for the six operations is as follows:

F—Feel.
I—Inspect.
T—Tighten.
C—Clean.
A—Adjust.
L—Lubricate.

The first two operations establish the need for the other four. The selection of operations is based on a general knowledge of field needs. Rapid changes in weather (such as heavy rain followed by blistering heat), excessive dampness, snow, and ice tend to cause corrosion of exposed surfaces and parts. Without frequent inspections and the necessary performance of tightening, cleaning, and lubricating operations, equipment becomes undependable and subject to break-down when it is most needed.

b. Feel. The feel operation is used most often to check rotating machinery, such as blower motors, converters, etc., and to determine if electrical connections, bushings, etc., are overheated. Feeling indicates the need for lubrication or the existence of similar types of defects requiring correction. The maintenance man must become familiar with the normal operating temperatures of motors, etc., to recognize signs of overheating.

NOTE: It is important that the feel operation be performed as soon as possible after shut-down and always before any other maintenance is done.

c. **Inspect.** Inspection is the most important operation in the preventive maintenance program. A careless observer will overlook the evidences of minor trouble. Although these defects may not interfere with the performance of the equipment, valuable time and effort can be saved if they are corrected before they lead to major break-downs. Make every effort to become thoroughly familiar with the indications of normal functioning, in order to be able to recognize the signs of a defective set. Inspection consists of carefully observing all parts of the equipment, noticing their color, placement, state of cleanliness, etc. Inspect for the following conditions:

(1) Overheating, as indicated by discoloration, blistering, or bulging of the parts or surface of the container; leakage of insulating compounds; and oxidation of metal contact surfaces.

(2) Placement, by observing that all leads and cabling are in their original positions.

(3) Cleanliness, by carefully examining all recesses in the units for accumulation of dust, especially between connecting terminals. Parts, connections, and joints should be free of dust, corrosion, and other matter. In tropical and high-humidity locations, look for fungus growth and mildew.

(4) Tightness, by testing any connection or mounting which appears to be loose.

d. **Tighten, Clean, and Adjust.** These operations are self-explanatory. Specific procedures to be followed in performing them are given wherever necessary throughout this section.

CAUTION: Screws, bolts, and nuts should not be tightened carelessly. Fittings tightened beyond the pressure for which they are designed will be damaged or broken.

Whenever a loose connection is tightened, it should be moistureproofed and fungiproofed again by applying the varnish with a small brush.

e. **Lubricate.** Lubrication refers to the application of grease or oil to the bearings of motors or other rotating shafts. It may also mean the application of a light oil to door hinges or other sliding surfaces on the equipment (not to switch contacts).

29. PREVENTIVE MAINTENANCE TOOLS AND MATERIALS.

The following preventive maintenance tools and materials will be needed:

Common hand tools.
Clean cloth.
#0000 sandpaper.
Crocus cloth.
Fine file or relay burnishing tool.
Dry-cleaning solvent.

NOTE: Gasoline will not be used as a cleaning fluid for any purpose. Solvent, Dry-cleaning, is available as a cleaning fluid through established supply channels. Oil, Fuel, Diesel, may be used for cleaning purposes when dry-cleaning solvent (SD) is not at hand. Carbon tetrachloride will be used as a cleaning fluid only in the following cases: where inflammable solvents cannot be used because of the fire hazard, and for cleaning electrical contacts including relay contacts, plugs, commutators, etc.

30. VACUUM TUBES.

a. **General.** Preventive maintenance on vacuum tubes includes inspection and cleaning. Work on the tube sockets and mountings involves inspection, tightening, adjusting, and cleaning.

b. **Inspect. (I).** Replace tubes which have loose grid caps or loose envelopes. The firmness of tubes in their sockets must be determined by inspection.

c. **Tighten. (T).** Tighten all loose connections on tube sockets. If the connections are dirty or corroded, they must be cleaned before they are tightened.

d. **Clean. (C).** Thoroughly clean the tubes when inspection shows cleaning to be necessary.

31. CAPACITORS.

a. **Inspect. (I).** Inspect the terminals of the capacitors for corrosion and loose connections. Examine the leads for poor insulation, cracks, and evidences of dry rot.

CAUTION: Before maintenance work is begun on capacitors it is absolutely necessary to short them out with a well-insulated screwdriver or a capacitor shorting tool to prevent electrical shock.

b. **Tighten. (T).** All loose terminals, mountings, and connections on the capacitors must be tightened.

c. **Clean. (C).** Clean the insulating bushings, the cases of the capacitors, and any connections that are dirty or corroded.

32. RESISTORS.

a. **Inspect. (I).** Inspect the coating of the vitreous-enameled resistors for signs of cracks and chipping, especially at the ends. Examine the bodies of all types of resistors for blistering, discoloration, and other indications of overheating.

b. Tighten. (T). Tighten all loose resistor connections and mountings.

c. Clean. (C). The vitreous-enameled resistors must be kept clean to avoid flash-over or leakage. They will ordinarily be wiped with a dry cloth. However, if the dirt deposit is unusually hard to remove, use carbon tetrachloride.

33. FUSES.

a. Inspect. (I). Inspect the fuse ends for evidence of burning, charring, and corrosion, the fuse clips for dirt, loose connections, and proper tension.

b. Tighten. (T). The tension of the fuse clips may be increased by pressing the sides close together.

c. Clean. (C). Clean all fuse ends and clips with fine sandpaper; wipe them with a clean cloth.

34. TRANSFORMERS AND FILTER CHOKES.

a. Feel. (F). Feel the windings of all transformers and chokes for overheating. If an excessively high temperature is found in any component, it indicates an internal defect or an overload in the circuit and requires a circuit analysis.

b. Inspect. (I). Inspect transformers and chokes for general cleanliness and for tightness of connections, connecting lugs or terminals, mounting brackets, and rivets.

c. Tighten. (T). Tighten all loose mounting screws or connections.

d. Clean. (C). Clean the transformers and chokes with a dry cloth.

35. WIRE AND CABLES.

a. Inspect. (I). Inspect the wires and cables for cracked or deteriorated insulation, frayed or cut insulation at the connecting and supporting point, and for fungus growth.

b. Tighten. (T). Tighten all loose couplings and cable connections.

c. Clean. (C). Clean all dust, dirt, mold, and fungus growth from wires and cables.

36. PURPOSE AND USE OF CHECK LIST.

The following check list is a summary of the preventive maintenance operations performed on Radio Receiver R-96/SR. The time intervals shown on the check list may be reduced at any time by the local commander. For best performance of the equipment, it is recommended that the operations be performed at least as frequently as called for in the check list.

Item No.	Operation	Item	When performed			Echelon
			Daily	Weekly	Monthly	
1	FITC	Transformers		X		2d
2	ITC	Tubes	X			2d
3	ITC	Wires and cables		X		1st
4	ITC	Capacitors		X		2d
5	ITC	Resistors		X		2d
6	ITC	Fuses (a-c and d-c)	X			1st
7	ITC	Switches and contactors		X		2d
8	ICA	Relays			X	2d

F	I	T	C	A	L
Feel	Inspect	Tighten	Clean	Adjust	Lubricate

37. TROUBLE SHOOTING.

No matter how well equipment is designed and manufactured, faults occur in service. When such faults occur, the repairman must locate and correct them as rapidly as possible. This section contains information to aid personnel engaged in the important duty of trouble shooting. (Remember, however, that preventive maintenance will minimize the necessity of trouble shooting.)

a. Trouble-shooting Data. Take advantage of the material supplied in this manual to help in the rapid location of faults. Consult the following trouble-shooting data when necessary:

(1) Block diagram of the set (fig. 7).

(2) Complete schematic diagram (fig. 21). This diagram includes all parts and shows all the connections (power, input, and output) to other units.

(3) Simplified and partial schematics (figs. 8 through 19). These diagrams are particularly useful in trouble shooting, because the repairman can follow the electrical functioning of the circuits more easily than on

the regular schematics, thus speeding trouble location.

(4) Voltage and resistance data at all socket connections (par. 50).

(5) Illustrations of components. Front, top, and bottom views aid in locating and identifying parts (figs. 5 and 6).

(6) Pin connections (fig. 20).

(a) Seen from the bottom, pin connections are numbered in a clockwise direction around the sockets. On octal sockets the first pin clockwise from the keyway is pin No. 1. Pin numbers appear on both the schematic diagrams and the wiring diagrams, so that any tube element can be readily located.

(b) Plugs and receptacles are numbered on the side to which the associated connector is attached. To avoid confusion, some individual pins are identified by letters which appear directly on the connector.

b. Trouble-shooting Steps. The first step in servicing a defective radio set is to sectionalize the fault. Sectionalization means tracing the fault to the component responsible for the abnormal operation of the set. The second step is to localize the fault. Localization means tracing the fault to the defective part responsible for the abnormal condition.

(1) Use of the equipment performance check list and the starting procedure aids in tracing the fault to the defective component. The procedures to be followed are explained in subparagraphs c and d.

(2) Some faults such as burned-out resistors, r-f arcing, etc., can be located by sight, smell, and hearing. The majority of faults, however, must be located by checking voltages and resistances.

c. Starting-procedure Sectionalization. The starting procedure is the systematic method used to put the set on the air. This procedure is used in sectionalization when the cause of the set failure is not known. In most cases, it will trace the defect to a particular component. The steps of the starting procedure are performed in sequence until an abnormal result is obtained. As each step is performed, the visible and audible results of the action are noted.

d. Localization. Localization is the tracing of the fault to a particular part. Paragraph 47 of this section describes the method of localizing faults within the individual components. These paragraphs contain trouble-shooting charts which list symptoms and their causes. The charts also give the procedure for finding out which of the probable troubles is the exact one. In addition, there is a drawing which shows the resistance and the voltage at every socket pin connection. The method of using the voltage and resistance data in checking a circuit is described in detail in paragraphs 38 and 39 of this section.

38. VOLTAGE MEASUREMENTS.

a. General. Voltage measurements are an almost indispensable aid to the repairman, because most troubles either result from abnormal voltages or produce abnormal voltages. Voltage measurements are taken easily, because they are always made between two points in a circuit and the circuit need not be interrupted.

(1) Complete information on normal operating voltages is given in the voltage charts. Unless otherwise specified, these voltages are measured between the indicated points and ground.

(2) Always begin by setting the voltmeter on the highest range so that the voltmeter will not be overloaded. Then, if it is necessary to obtain increased accuracy, set the voltmeter to a lower range.

(3) In checking cathode voltage, remember that a reading can be obtained when the cathode resistor is actually open. The resistance of the meter may act as a cathode resistor. Thus, the cathode voltage may be approximately normal only as long as the voltmeter is connected between cathode and ground. Before the cathode voltage is measured, make a resistance check with the circuit not operating to determine whether the cathode resistor is normal.

b. Precautions Against High Voltage. Certain precautions must be followed when measuring voltages above a few hundred volts. High voltages are dangerous and can be fatal. When it is necessary to measure high voltages, observe the following rules:

(1) Connect the ground lead to the voltmeter.

(2) Place one hand in your pocket. This will eliminate the possibility of making accidental contact with either ground or another part of the circuit and causing the electricity to travel from one hand to the other.

(3) If the voltage is less than 300 volts, connect the test lead to the hot terminal (which may be either positive or negative with respect to ground).

(4) If the voltage is greater than 300 volts, shut off the power, connect the hot test lead, step away from the voltmeter, turn on the power, and note the reading on the voltmeter. Do not touch any part of the voltmeter, particularly when it is necessary to measure the voltage between two points both of which are above ground.

c. **Voltmeter Loading.** It is essential that the voltmeter resistance be at least 10 times as large as the resistance of the circuit across which the voltage is measured. If the voltmeter resistance is comparable to the circuit resistance, the voltmeter will indicate a voltage lower than the actual voltage present with the voltmeter removed from the circuit.

(1) The resistance of the voltmeter on any range can always be calculated by the following simple rule: Resistance of voltmeter equals the ohms per volt multiplied by the full-scale range in volts. Two examples are shown below:

(a) What is the resistance of a 1,000-ohm-per-volt voltmeter on the 300-volt range?

R = 1,000 ohms per volt x 300 volts = 300,000 ohms.

(b) What is the resistance of a 20,000-ohm-per-volt voltmeter on the 300-volt range?

R = 20,000 ohms per volt x 300 volts = 6 megohms.

(2) To minimize the voltmeter loading in high-resistance circuits, use the highest voltmeter range. Although only a small deflection will be obtained (possibly only 5 divisions on a 100-division scale), the accuracy of the voltage measurement will be increased. The decreased loading of the voltmeter will more than compensate for the inaccuracy which results from reading only a small deflection on the scale of the voltmeter.

(3) When a voltmeter is loading a circuit, the effect can always be noted by comparing the voltage reading on two successive ranges. If the voltage readings on the two ranges do not agree, voltmeter loading is excessive. The reading (not the deflection) on the highest range will be greater than that on the lowest range. If the voltmeter is loading the circuit heavily, the deflection of the pointer will remain nearly the same when the voltmeter is shifted from one range to another.

(4) The voltage and resistance measurements used in this manual are based on readings taken with an actual meter. The ohm-per-volt sensitivity of the meter which was used is 1,000 ohms per volt. The trouble shooter should use a meter having the same ohm-per-volt sensitivity. Because the meter used in testing for the voltage will produce the same amount of loading as the meter used in measuring the voltage, it is unnecessary to consider the effect of loading.

39. RESISTANCE MEASUREMENTS.

a. **Normal Resistance Values.** When a fault develops in a circuit, its effect will very often show up as a change in the resistance values. To assist in the localization of such faults, trouble-shooting data includes the normal resistance values as measured at the tube sockets and at key terminal points. These values are measured between the indicated points and ground, unless otherwise stated. Often it is desirable to measure the resistance from other points in the circuit, in order to determine whether the particular points in the circuit are normal. The normal resistance values at any point can be determined by referring to the resistance values shown in the schematic diagram, or by use of the resistor color code.

b. **Precautions.** (1) Before making any resistance measurements, turn off the power. An ohmmeter is essentially a low-range voltmeter and battery. If the ohmmeter is connected to a circuit which already has voltages in it, the needle will be knocked off scale and the voltmeter movement may be burned out.

(2) Capacitors must always be discharged before resistance measurements are made. This is very important when checking power supplies that are disconnected from their load. The discharge of the capacitor through the meter will burn out its movement and in some cases may endanger life.

c. **Correct Use of Low and High Ranges.** It is important to know when to use the low-resistance range and when to use the high-resistance range of an ohmmeter. When checking the circuit continuity, the ohmmeter should be set on the lowest range. If a medium or high range is used, the pointer may indicate zero ohms, even if the resistance is as high as 500 ohms. When checking high resistances or measuring the leakage resistance of capacitors or cables, the highest range should be used. If a low range is used, the pointer will indicate *infinite* ohms, even though the actual resistance is less than a megohm.

d. **Parallel Resistance Connections.** In a parallel circuit the total resistance is less than the smallest resistance in the circuit. This is important to remember when shooting trouble with the aid of a schematic diagram.

(1) When a resistance is measured and the value is found to be less than expected, make a careful study of the schematic to be certain that there are no resistances in parallel with the one that has been measured. Before replacing a resistor because its resistance measures too low, disconnect one terminal from the circuit and measure its resistance again, to

make sure that the low reading does not occur because some part of the circuit is in parallel with the resistor.

(2) In some cases it will be impossible to check a resistor because it has a low-voltage transformer winding connected across it. If the resistor must be checked, disconnect one terminal from the circuit before measuring its resistance.

e. Checking Grid Resistance. When checking grid resistance, a false reading may be obtained if the tube is still warm and the cathode is emitting electrons. Allow the tube to cool, or reverse the ohmmeter test leads so that the negative ohmmeter test lead is applied to the grid.

f. Tolerance Values For Resistance Measurements. Tolerance means the normal difference that is expected between the rated value of the resistor and its actual value.

(1) Most resistors that are used in radio circuits have a tolerance of at least 20 percent. For example, the grid resistor of a stage might have a rated value of 1 megohm. If the resistor were measured and found to have a value between 0.8 megohm and 1.2 megohms, it would be considered normal. As a rule, the ordinary resistors used in circuits are not replaced unless their values are off more than 20 percent. Some precision resistors and potentiometers are used. When a resistor is used whose value must be very close to its rated value, the tolerance is usually stated on the diagram or in the maintenance list.

(2) The tolerance values for transformer windings are generally between 1 and 5 percent. As a rule, suspect a transformer which shows a resistance deviating more than 5 percent from its rated value. Allow the transformer to cool off before the resistance test is made.

g. High-resistance Measurements. Many leakages will not show up when measured at low voltages. Most ohmmeters use a maximum test voltage of 15 volts on the highest resistance range. Where it is necessary to measure resistance above a few megohms or the leakage resistance betwen conductors of a cable, the test should be made using an applied voltage of 100 volts or more. Where it is possible to ground one end of the resistance being checked, one of the low-voltage power supplies in the equipment can be used to provide about 300 volts for making these high-resistance measurements. The meter used should have an ohm-per-volt sensitivity of 1,000 ohms or more. The resistance of the meter is equal to the ohm-per-volt sensitivity multiplied by the range to which the meter is set. The derivation of the formula $R_x = \frac{300R_m}{V}$ is shown below.

R_x is the unknown resistance, R_m is the meter resistance, and V is the voltmeter reading.

$$\frac{R_x}{R_m} = \frac{300-V}{V}$$

If R_x is very large, V will be small in comparison to 300. Assuming that 300-V can be replaced by 300, the formula $\frac{R_x}{R_m} = \frac{300}{V}$ is obtained. When solved for R_x this gives $R_x = \frac{300R_m}{V}$. When making the measurement, the meter should first be put on the 300-volt scale to protect it in case R_x is very low. If the voltage used is not 300 volts, the correct value should be inserted in the formula in place of 300.

40. CAPACITOR TESTS.

Capacitors which are leaky or shorted can be found by resistance checks of the stage. A capacitor which is suspected of being open can best be checked by shunting a good capacitor across it. In i-f circuits, keep the lead to the capacitor as short as the original capacitor leads. In low-frequency circuits (less than 1 megacycle) the test capacitor leads may be several inches long.

41. CURRENT MEASUREMENTS.

Current measurements, other than those indicated by panel meters, are not ordinarily required in trouble shooting in the radio set. Under special circumstances where the voltage and resistance measurements by themselves are not sufficient to localize the trouble, a current measurement can be made by opening the circuit and connecting an ammeter to measure the current. This procedure is not recommended except in very difficult cases.

a. When the meter is inserted in a circuit to measure current, it should always be inserted away from the r-f end of the resistance. For example, when measuring *plate* current, do not insert the meter next to the plate of a tube, but insert it next to the end of the resistor which connects to the power. This precaution is necessary to keep the meter from upsetting the r-f voltages.

CAUTION: A meter has least protection against damage when it is used to measure current. Always set the current range to the highest value. Then if necessary, decrease the range to give a more accurate reading. Avoid working close to full-scale reading because this increases the danger of overload.

b. In most cases, the current to be measured flows through a resistance which is either known or can be measured with an ohmmeter. The current flowing in the circuit can be determined by dividing the voltage drop across the resistor by its resistance value. The drop across the cathode resistor is a convenient method of determining the cathode current.

42. TUBE CHECKING.

Tube checkers are used to check the emission of electrons from the cathode, to test for shorted elements, and to check the transconductance of the tube. Tube checkers will not test the performance of high-voltage tubes or rectifiers or of some special tubes in the modulator and rectifier. Tube checkers are useful, however, for checking receiving type tubes used in the various components.

a. Results obtained from a tube checker are not always conclusive, because the conditions are not the same as those under which the tube operates in the set. For this reason, the final test of a tube must be its replacement with a tube which is known to be good. In many cases it is quicker and more reliable to replace a suspected tube with a good one than to check it with the tube checker.

b. An operating chart and an instruction book or technical manual are provided with the tube checker. This chart indicates the setting of the tube checker for each tube type. The number of controls, their arrangement, and their settings vary with different types of tube checkers.

43. I-F ALIGNMENT.

A signal generator is used in aligning receiver i-f and r-f stages. The modulated output is fed to the grid of the stage preceding the stage being aligned. This is done to prevent the shunting effect of the signal generator from upsetting the circuit being aligned. The stage closest to the detector is aligned first. By working backward through the i-f stages, they are all brought into alignment. Each stage is adjusted to produce maximum indication on the output meter. Adjust the stages with a nonmetallic aligning tool. If no tool is available, one can be made from a dry wooden rod. At all times, use the minimum signal generator output that will produce a satisfactory indication.

44. REPLACING PARTS.

Careless replacement of parts often makes new faults inevitable. Note the following points:

a. Before a part is unsoldered, note the position of the leads. If the part, such as a transformer, has a number of connections to it, tag each of the leads.

b. Be careful not to damage other leads by pulling or pushing them out of the way.

c. Do not allow drops of solder to fall into the set, since they may cause short circuits.

d. A carelessly soldered connection may create a new fault. It is very important to make well-soldered joints, since a poorly soldered joint is one of the most difficult faults to find.

e. When a part is replaced in r-f or i-f circuits, it must be placed exactly as the original one was. A part which has the same electrical value but different physical size may cause trouble in high-frequency circuits. Give particular attention to proper grounding when replacing a part. Use the same ground point as in the original wiring. Failure to observe these precautions may result in decreased gain or possibly in oscillation of the circuit.

45. TROUBLE-SHOOTING PROCEDURES.

The accompanying trouble-shooting charts, if properly used, simplify trouble shooting. The first chart covers sectionalizing trouble in Radio Receiver R-96/SR. This chart lists the various symptoms that may be recognized easily and gives the probable location of the trouble in the receiver. This chart isolates the trouble to a particular stage in the receiver. The second chart localizes the trouble to the individual part within the circuit or stage that is at fault. Much time is saved if the operator studies the charts and sets up a systematic method of trouble shooting, first sectionalizing the trouble to the particular faulty stage, then localizing the trouble to the individual part. Whenever the receiver fails or otherwise requires trouble shooting, *the tubes should always be tested before the methods outlined in the trouble-shooting charts are applied.* Defective tubes cause the majority of all radio failures.

46. SECTIONALIZING TROUBLE IN RADIO RECEIVER R-96/SR.

Symptoms	Probable trouble	Corrections
1. Receiver dead; pilot lamp not lighted.	1. Fuse F1 or F2 blown. Open filament of one or more of the tubes. No power at the receptacle.	1. Replace fuse. Replace defective tube. Correct power source.
2. Receiver dead; pilot light not lighted.	2. Open filament resistors R60 and R61, or R59.	2. Replace defective resistor.
2A. Receiver dead; pilot light lighted.	2A. Stand-by switch SW4 open. Power plug reversed in socket (if d-c current is used). Defective stage.	2A. Close switch. Reverse plug. See localizing chart.
3. Receiver weak with antenna connected; strong signal with signal generator connected to antenna post.	3. Open antenna lead.	3. Repair antenna lead.
4. Weak signal with signal generator connected to antenna post; strong when connected to control grid of tube V1.	4. Antenna stage misaligned. Antenna stage defective.	4. Align stage. See localizing chart.
5. Weak signal with signal generator connected to grid of tube V1 but strong when connected to grid of tube V2.	5. R-f stage misaligned. R-f stage defective.	5. Align stage. See localizing chart.
6. 550-kc signal from signal generator fed to grid of tube V3 heard strong, but weak when fed to grid of V2.	6. 2d r-f stage misaligned. 2d r-f stage defective.	6. Align stage. See localizing chart.
7. 550-kc signal heard stronger when fed to grid of tube V5 than when fed to grid of V3.	7. First i-f stage misaligned. First i-f stage defective.	7. Align stage. See localizing chart.
8. 550-kc signal heard stronger when fed to grid of tube V6 than when fed to grid of V5.	8. 2d i-f stage misaligned. 2d i-f stage defective.	8. Align stage. See localizing chart.
9. Audio signals heard with headset connected across resistor R32 but not at phone jack.	9. Defective tube V10. Defective audio stage.	9. Replace tube. See localizing chart.
10. No received signals heard although 550-kc signal fed to the antenna post is heard.	10. Defective h-f oscillator.	10. See localizing chart.

47. LOCALIZING TROUBLE IN RADIO RECEIVER R-96/SR.

Symptoms	Probable trouble	Corrections
1. Voltages at all pins of tube V1 normal except:		
a. No voltage at plate.	a. Open switch SW1. Open primary of T6, T7, T8, T9, or T10. Open resistor R4. Shorted capacitor C17.	a. Repair or replace switch SW1. Replace defective coil. Replace resistor. Replace capacitor.
b. No voltage at screen.	b. Open resistor R2. Shorted capacitor C8.	b. Replace resistor. Replace capacitor.
2. Signal heard strong when fed to grid of tube V1 but weak or not at all when fed to antenna post.	2. Open or shorted switch SW1. Open primary or secondary of transformer T1, T2, T3, T4, or T5. Open capacitor C6. Shorted capacitor C1, C2, C3, C4, C5, or C10.	2. Repair or replace switch SW1. Replace defective coil. Replace capacitor. Repair or replace defective capacitor.
3. Voltages at all pins of V2 normal except:		
a. No voltage at plate.	a. Open switch SW1. Open primary of T11, T12, T13, T14, or T15. Open resistor R8.	a. Repair or replace switch SW1. Replace defective coil. Replace resistor.
b. No voltage at screen.	b. Open resistor R7. Shorted C21.	b. Replace resistor. Replace capacitor.
4. Signals heard strong when fed to grid of tube V2 but weak or not at all when fed to grid of tube V1.	4. Open or shorted switch SW1. Open transformer T6, T7, T8, T9, or T10. Open capacitor C18. Shorted capacitor C12, C13, C14, C15, C16, or C20.	4. Repair or replace switch SW1. Replace defective transformer. Replace capacitor. Repair or replace capacitor.
5. Voltages normal at all pins of V3 except:		
a. No voltage at plate.	a. Open primary of transformer T16. Open resistor R13.	a. Replace transformer T16. Replace resistor R13.
b. No voltage at screen.	b. Open resistor R50.	b. Replace resistor R50.
6. 550-kc signal from signal generator fed to grid of tube V3 heard strong, but weak when fed to grid of tube V2.	6. Open capacitor C23. Open transformer T11, T12, T13, T14, or T15. Shorted capacitor C24, C25, C26, C27, C28, or C30.	6. Replace capacitor C23. Replace defective transformer. Replace or repair defective capacitor.
7. Voltages normal at all pins of tube V5 except:		
a. No voltage at plate.	a. Open primary of transformer T17.	a. Replace transformer T17.
b. No voltage at plate or screen.	b. Open resistor R17. Open connection.	b. Replace resistor R17. Repair open connection.

47. LOCALIZING TROUBLE IN RADIO RECEIVER R-96/SR (contd).

Symptoms	Probable trouble	Corrections
8. 550-kc signal heard stronger when fed to grid of tube V5 than when fed to grid of tube V3.	8. Open or shorted transformer T16 or shorted capacitor C85 or C86.	8. Replace transformer T16.
9. Voltages normal at all pins of tube V6 except:		
a. No voltage at plate.	a. Open primary of transformer T18.	a. Replace transformer T18.
b. No voltage at plate or screen.	b. Open resistor R23.	b. Replace resistor R23.
10. 550-kc signal heard stronger when fed to grid of tube V6 than when fed to grid of tube V5.	10. Open or shorted transformer T17, or shorted capacitor C87 or C88.	10. Replace transformer T17.
11. No audio signals heard with headphones connected across resistor R32.	11. Open resistor R26 or R30. Open capacitor C51 or C47. Shorted capacitor C43, C51, or C47.	11. Replace open resistor. Replace capacitor. Replace capacitor.
12. Audio signals heard with headset connected across resistor R32 but not at phone jack.	12. Open transformer T19. Open circuit at jack.	12. Replace transformer T19. Repair open circuit.
13. No received signals heard although 550-kc signal fed to the antenna post is heard.	13. Open or shorted switch SW1 or SW2. Open or shorted coil T22, T23, T24, T20, or T21. Open capacitor C52, C53, C54, C71, C68, or C59. Shorted capacitor C52, C53, C54, C84, C61, C83, C62, C82, C63, C65, C64, C66, C67, C40, C59, C68, or C71. Open resistor R38, R52, or R58. Open coil L5. Defective crystal.	13. Repair or replace defective switch. Replace coil. Replace capacitor. Replace capacitor. Replace resistor. Replace coil. Replace crystal.
14. No audible note on c-w reception with B.F.O. turned on.	14. Open coil L6. Open capacitor C75 or C37. Open resistor R19 or R20. Shorted capacitor C74, C75, or C37.	14. Replace coil. Replace capacitor. Replace resistor. Replace capacitor.
15. Noise limiter not effective.	15. Open capacitor C49. Defective switch SW7. Open resistor R25.	15. Replace capacitor. Replace switch. Replace resistor.
16. No plate or screen voltage on the receiver.	16. Plug reversed in power receptacle (when operating on d-c current). Open coil L8. Shorted capacitor C50, C60, or C73. Open circuit in wiring. Incorrect voltage input. Switch SW4 grounded.	16. Reverse plug. Replace coil. Replace capacitor. Repair open circuit. Check line voltage. Replace switch.

48. REPLACEMENT OF PARTS.

a. **R-f Coils.** Use care in removing coils so that adjacent wiring is not disturbed and soldering iron heat does not damage adjacent parts. After removing a wire, tag it to make sure it will be reconnected correctly.

NOTE: Leads to r-f coils must be replaced in their exact original location or the calibration of the receiver will be affected.

b. **I-f Transformer Assemblies.** The plate lead of input transformer T16 goes through a small grommet in the i-f chassis and connects to the mixer plate V3, pin 3. Remove this lead before attempting to remove the transformer assembly.

c. **Trimmer Capacitors.** Carefully remove the leads from the capacitors, then remove the 4-40 screws. Be careful not to lose the small phenolic washers under the nuts and the metal spacer between the capacitors and the chassis, as the new part will require the use of these. Do not tighten the 4-40 screws too tight. Too great a pressure will break the ceramic capacitors or the phenolic washers.

d. **Tuning Capacitors.** First disconnect the couplings to the shaft of the capacitors. Locate the three mounting spade bolts on the capacitor and remove the nuts from under the chassis. *Note carefully that some of these spade bolts are used to secure other parts.* In replacing the new capacitors make sure that all parts that were secured by the old capacitor spade bolts are secured properly. Some capacitor spade bolts are common ground connections.

e. **Parts Mounted on Terminal Boards.** Those parts which are accessible can be removed with the terminal boards in position. For the parts not accessible, loosen the terminal board, taking care that the nuts and bolts used (in some cases) to secure the terminal board, are not lost.

f. **Filter Choke.** When removing the filter choke, be careful not to damage the resistors which are secured by the stud bolts which hold the transformer to the chassis.

g. **BAND SWITCH.** (1) To replace switch decks first remove ½″ Cinch Button from center of the 3 Cinch Buttons on back of chassis. Loosen shaft coupling found next to switch shaft and remove shaft through ½″ hole in back of chassis. To replace switch deck in front section unsolder wire from defective switch deck, tagging each lead as it is removed. Unscrew 5-40 nut from back of last switch deck and pull threaded shaft through ⅜″ holes in front panel till the defective deck is clear. Take care not to lose metal spacers and phenolic washers. To replace switch decks in rear switch section unsolder leads from defective switch deck and tag each lead as it is removed. Remove two ⅜″ cinch buttons from back of chassis. Unscrew 5-40 nuts from front of threaded shafts and pull threaded shafts through ⅜″ holes in back of chassis till defective switch deck is clear. Take care not to lose metal spacers and phenolic washers.

(2) To replace the BAND SWITCH, first remove the front panel from the chassis. Then remove the front plate from the r-f tuning section, taking care not to damage the dial. Unsolder ten leads that come from the r-f section to the i-f section through the terminal board. Unsolder lead from plate of 6SA7, pin No. 3. Locate and remove three screws that hold the chassis to the r-f chassis. Loosen coupling between detent switch sections of the BAND SWITCH. Remove the antenna feed-through insulator. Remove screws from the r-f shield that holds the r-f chassis in place.

(3) To remove the front switch assembly, take out the three screws from the back plate of the r-f chassis and slide the plate back until the end of the switch is clear. To remove the front section of this switch assembly, unsolder all leads to the switch and four leads to the metal-cased capacitors mounted on the sides of the baffle shield, and remove the baffle shield as part of this switch assembly.

(4) The back decks of the rear switch assembly may be removed by removing the nuts from the through-bolts.

h. **Fuse.** Remove the chassis from the dust cover, which will give access to fuse extractor post mountings. Turn the fuse cover counterclockwise four turns and remove the fuse holder.

i. **Panel Lamp.** Remove the panel lamp jewel by unscrewing it counterclockwise. Pilot light bulb (bayonet type) must be pushed in and twisted counterclockwise to be removed.

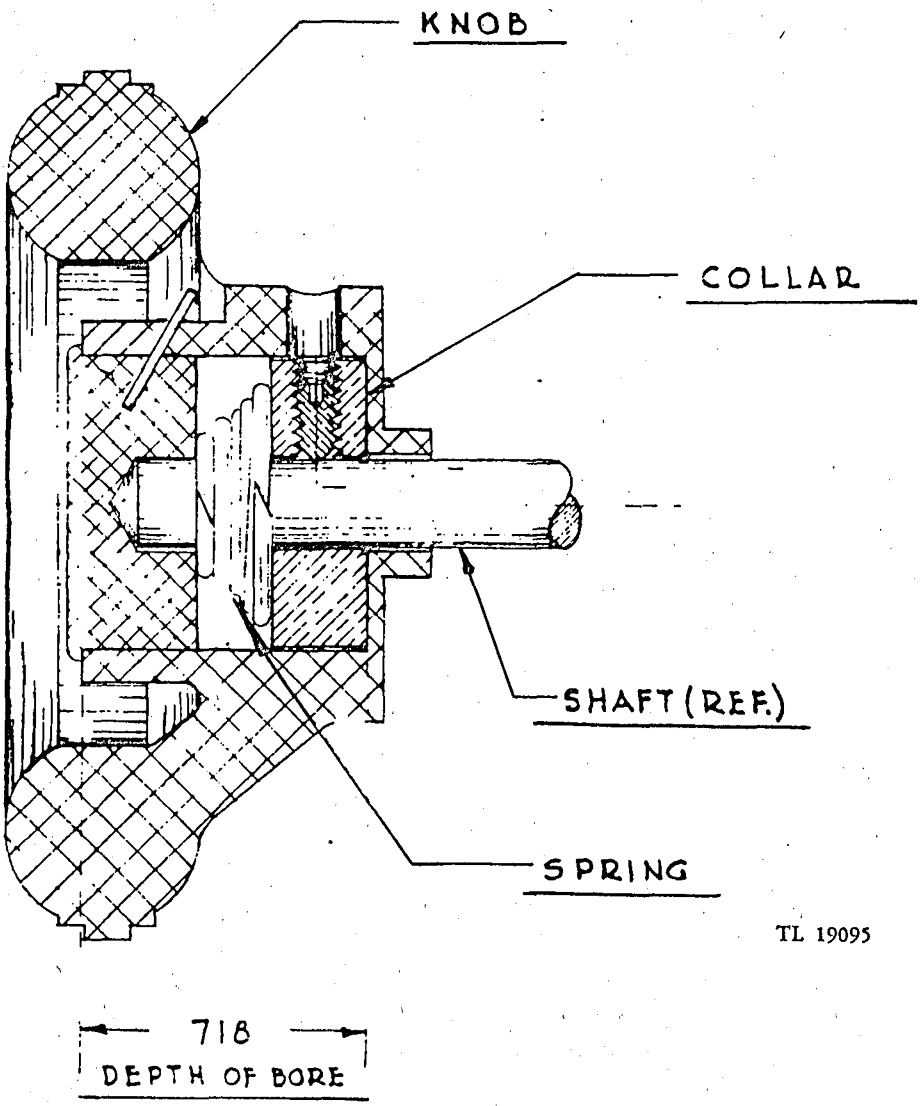


Figure 25. Sectional view, friction drive knob.

49. FRICTION DRIVE KNOB.

a. The friction drive knob, as shown in figure 25, is attached to the control shaft of the vernier drive mechanism of the receiver. Its purpose is to prevent damage to the main ganged variable capacitors. The compression spring of the clutch is so loaded that the knob will slip when the capacitor rotor plates have reached the end of their travel.

b. The knob contains a brass collar threaded for an 8-32 setscrew that couples directly to the control shaft of the vernier dial mechanism. The plug, made of black phenolic, is forced into the knob and secured by a metal pin. Pressure of the compression spring acting against the phenolic surface of the plug furnishes the friction clutch action between the knob and the collar.

c. The knob assembly may be easily taken apart by removing the pin, as indicated in figure 25. If it is necessary to remove the clutch from the knob for maintenance, it is possible to remove the pin with either a pair of long-nosed pliers or side-cutters, however, no maintenance should be required on this assembly.

SECTION V
SUPPLEMENTARY DATA

50. RECEIVER PERFORMANCE CHARACTERISTICS.

With a dummy antenna of 30 ohms and 300 mmf in series, with receiver volume control, r-f sensitivity control set to maximum, and a signal output of 50 milliwatts into the loudspeaker or a noninductive resistor equal to the loudspeaker impedance at 400 cycles, the following conditions exist:

a. Sensitivity with a-c operation, 30 percent, 400-cycle modulation from 135 kc to 510 kc, the average based on three frequencies is equal to or better than 10 microvolts. The sensitivity taken at any one frequency in this band is not poorer than 15 microvolts.

b. On frequencies between 1,485 kc and 12,120 kc, the average sensitivity based on three frequencies in any band is not poorer than 5 microvolts. The sensitivity taken at any one frequency in this band is not poorer than 10 microvolts.

c. The sensitivity of the receiver on d-c operation is not less than 80 percent of that given above.

d. A-v-c characteristics with variation of input are as follows:

Input microvolts	Signal output db
10	0
50	+ 6 max
500	+10 "
5,000	+12 "
50,000	+15 "

e. Signal-to-noise ratio is better than minus 12 db at 10 microvolts input; better than minus 20 db at 50 microvolts input.

f. Selectivity without avc and with the receiver tuned to resonance and gain set to give 50 mw output is better than:

Signal decrease in db	Total (kc) band width
6	6
22	9
40	15
60	30

g. Image rejection ratio with AVC OFF is better than values given in the table below:

Frequency	Image rejection ratio
510 kc	not less than 25,000
1.1 mc	not less than 2,000
2.5 mc	not less than 3,000
5.0 mc	not less than 1,500
10.0 mc	not less than 1,000
12.0 mc	not less than 600

h. Audio output is greater than 1 watt with less than 10 percent distortion at 400 cycles.

i. Dial calibration accuracy is plus or minus 1 percent.

j. Receiver dial reset accuracy is 0.03 percent.

51. TABLE OF POINT-TO-POINT VOLTAGES AND RESISTANCES.

Before making the tests given in the following charts, set the receiver controls as follows:

a. Set the R.F. and A.F. GAIN controls to maximum.

b. Turn the AVC switch OFF and the B.F.O. switch OFF except when measuring tube V7, then injection should be full on.

c. Set the CRYSTAL switch in the MANUAL position.

d. Make all a-c and d-c voltage measurements with power source of 115 volts, 60 cycles. Some plate voltages will be about 10 percent lower for 115-v d-c power source. All voltage measurements are from pin indicated to B-bus. Resistance measurements must be made with the receiver disconnected from the power supply source. All tubes are in position for both voltage and resistance measurements.

NOTE: D-C voltage measurements made with 20,000 ohms/volt meter.

SOCKET OF TUBE JAN-6SK7 (V1) 1ST R-F AMPLIFIER

Pin No.	1	2	3	4	5	6	7	8
Meter Scale		50 v ac	10 v dc		10 v dc	100 v dc	50 v ac	100 v dc
Voltage		30 v ac	3.4 dc	0	3.4 v dc	60 v dc	36 v ac	87 v dc
Resistance	*100,000	*34	*200	*2,000,000	*1,000	†50,000	*30	†5,000

SOCKET OF TUBE JAN-6SK7 (V2) 2D R-F AMPLIFIER

Pin No.	1	2	3	4	5	6	7	8
Meter Scale		50 v ac	10 v dc		10 v dc	100 v dc	50 v ac	100 v dc
Voltage	0	43 v ac	3.8 v dc	0	3.8 v dc	62 v dc	37 v ac	87 v dc
Resistance	*100,000	*30	*200	*2,000,000	*1,000	†50,000	*28	†5,000

SOCKET OF TUBE JAN-6SA7 (V3) MIXER

Pin No.	1	2	3	4	5	6	7	8
Meter Scale		50 v ac	100 v dc	250 v dc	10 v dc	10 v dc	50 v ac	
Voltage	0	24 v ac	95 v dc	100 v dc	—.5 v dc	2. v dc	18 v ac	0
Resistance	*0	*22	†2,000	†0	*100,000	*200	*17	*2,000,000

51. TABLE OF POINT-TO-POINT VOLTAGES AND RESISTANCES (contd).

SOCKET OF TUBE JAN-6SJ7 (V4) OSCILLATOR

Pin No.	1	2	3	4	5	6	7	8
Meter Scale		10 v ac		10 v dc		100 v dc	50 v ac	250 v dc
Voltage	0	18	0	6. v dc	0	95 v dc	12 v ac	95 v dc
Resistance	*100,000	*17	*0	*20,000	*0	‡27,000	10	†40

SOCKET OF TUBE JAN-6SK7 (V5) 1ST I-F AMPLIFIER

Pin No.	1	2	3	4	5	6	7	8
Meter Scale		50 v ac	10 v dc		10 v dc	100 v dc	50 v ac	100 v dc
Voltage	0	49 v ac	4.7 v dc	0	4.7 v dc	75 v dc	43 v ac	75 v dc
Resistance	*100,000	*40	*1,000	*50,000	*1,000	†5,000	*35	†5,000

SOCKET OF TUBE JAN-6SK7 (V6) 2D I-F AMPLIFIER

Pin No.	1	2	3	4	5	6	7	8
Meter Scale		50 v dc	10 v dc		10 v dc	100 v dc	50 v ac	100 v dc
Voltage	0	30 v ac	8.6 v dc	0	8.6 v dc	90 v dc	24 v ac	90 v dc
Resistance	*100,000	*24	*5,000	*50,000	*5,000	†5,000	*18	†5,000

SOCKET OF TUBE JAN-6SJ7 (V7) BFO OSCILLATOR

Pin No.	1	2	3	4	5	6	7	8
Meter Scale		50 v ac		10 v dc			250 v ac	
Voltage	0	49 v ac	0	—.2 v dc	0	0	55 v ac	0
Resistance	*100,000	*36	*2,500	*50,000	*0	*2,500	*40	*2,500

51. TABLE OF POINT-TO-POINT VOLTAGES AND RESISTANCES (contd).

SOCKET OF TUBE JAN-6SQ7 (V8) DETECTOR AND 1ST A-F AMPLIFIER

Pin No.	1	2	3	4	5	6	7	8
Meter Scale		50 v ac	10 v dc	10 v dc	10 v dc	100 v dc	50 v ac	50 v ac
Voltage	0	12	1 v dc	.4 v dc	.4 v dc	80 v dc	6 v ac	12 v ac
Resistance	*100,000	*500,000	*10,000	*510,000	*510,000	†150,000	*3	*8

SOCKET OF TUBE JAN-6H6GT (V9) NOISE LIMITER

Pin No.	1	2	3	4	5	6	7	8
Meter Scale		10 v ac	10 v dc	10 v dc	10 v dc		10 v ac	10 v dc
Voltage	0	0	.4 v dc	.8 v dc	.4 v dc	0	6 v ac	.8 v dc
Resistance	*100,000	*0	*260,000	*1,510,000	*1,010,000	....	*3	*1,510,000

SOCKET OF TUBE JAN-25L6GT (V10) A-F POWER AMPLIFIER

Pin No.	1	2	3	4	5	6	7	8
Meter Scale		100 v ac	250 v dc	250 v dc			100 v ac	10 v dc
Voltage	NC	55 v ac	95 v dc	100 v dc	0	NC	80 v ac	6.8 v dc
Resistance		*42	†80	†0	*500,000	....	*52	*150

SOCKET OF TUBE JAN-25Z6GT (V11) RECTIFIER

Pin No.	1	2	3	4	5	6	7	8
Meter Scale		250 v ac	250 v ac	250 v ac	250 v ac		100 v ac	250 v dc
Voltage	NC	105 v ac	115 v ac	115 v ac	115 v ac	NC	80 v ac	115 v dc
Resistance	....	*65	....		....	....	*52	

*Measurements to B— Bus.
†Measurements to B+ Bus.
‡Manual crystal switch in crystal position.

NOTE: Tube resistances vary greatly. Continuity *only* is important for filament circuits.

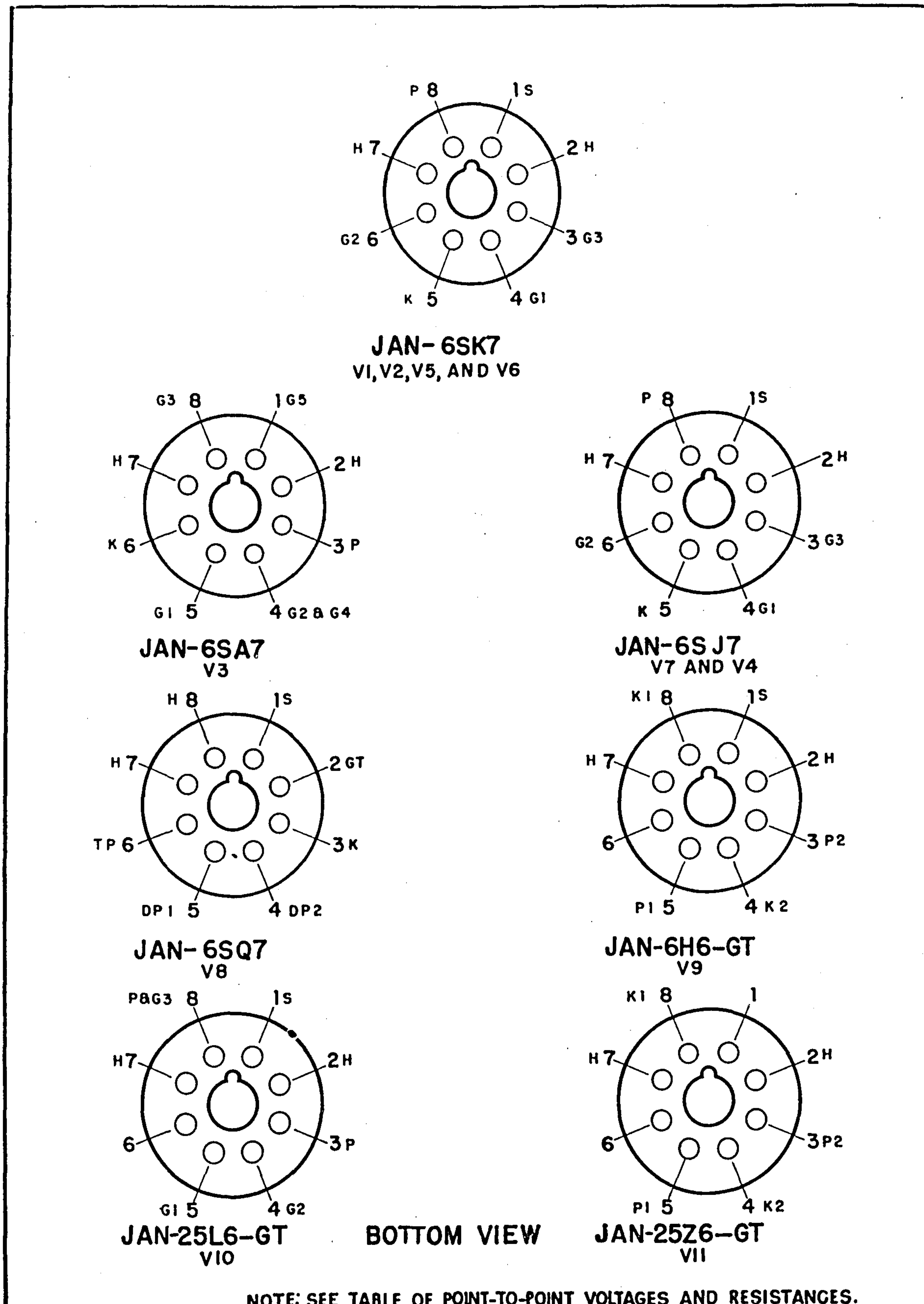


Figure 20. Tube socket terminals, bottom view. TL 18727

52. ALIGNMENT PROCEDURE CHART (fig. 2).

Operation No.	Connect signal generator to	Signal generator frequency	Dummy load	Set dial to	Band No.	[1]Adjust for maximum signal peak
1	Stator plate of mixer tuning capacitor	550 kc	None	510 kc	2	T18 (two adjustments) T17 (two adjustments) T16 (two adjustments)
2	Antenna	11.5 mc	30 ohms and 300 mmf in series	11.5 mc	5	C61, C24, C12, C1 (H.F.)
3	Antenna	6.5 mc	30 ohms and 300 mmf in series	6.5 mc	5	T22, T11, T6, T1 (L.F.)
4	Repeat operations No. 2 and 3 to get best alignment at both points.					
5	Antenna	5.8 mc	30 ohms and 300 mmf	5.8 mc	4	C62, C25, C13, C2 (H.F.)
6	Antenna	3.5 mc	30 ohms and 300 mmf	3.5 mc	4	T23, T12, T7, T2 (L.F.)
7	Repeat operations No. 5 and 6.					
8	Antenna	2.8 mc	30 ohms and 300 mmf	2.8 mc	3	C63, C26, C14, C3 (H.F.)
9	Antenna	1.6 mc	30 ohms and 300 mmf	1.6 mc	3	T24, T13, T8, T3 (L.F.)
10	Repeat operations No. 8 and 9.					
11	Antenna	480 kc	30 ohms and 300 mmf	480 kc	2	C64, C27, C15, C4 (H.F.)
12	Antenna	280 kc	30 ohms and 300 mmf	280 kc	2	T20 (L.F.)
13	Repeat operations No. 11 and 12.					
14	Antenna	240 kc	30 ohms and 300 mmf	240 kc	1	C67, C28, C16, C5 (H.F.
15	Antenna	140 kc	30 ohms and 300 mmf	140 kc	1	T21 (L.F.)
16	Repeat operations No. 14 and 15.					
17 B.F.O. switch on		140 kc	30 ohms and 300 mmf	140 kc Modulation off signal generator	1	L6 for required beat note

[1]Adjustment sequence shown for steps 2 through 16 is: Osc., Mixer, 2d R.F. and 1st R.F.

PARTS LEGEND

Reference Symbol	*Value*
C1, C2, C3, C4, C5, C12, C13, C14, C15, C16, C24, C25, C26, C27, C28, C61, C62, C63, C64, C67	7-45 mmf; 500 vdcw
C6, C18, C23, C43, C81	250 mmf; 500 vdcw
C8, C9, C19, C21, C22, C32, C34, C36, C39	0.1 - 0.1 mf; 400 vdcw
C10, C20, C30, C40	2 Section; 261 - mmf.
C11	0.002 mf; 500 vdcw
C17, C42, C49, C73	0.1 mf; 400 vdcw
C33, C38, C57, C72	0.05 to 0.05 mf; 400 vdcw
C37	5 mmf; 500 vdcw
C44, C78	2 mf; 400 vdcw
C45	0.5 mf; 400 vdcw
C46	500 mmf; 500 vdcw
C47, C51, C95	0.005 mf; 500 vdcw
C48	30 mf; 150 vdcw
C50, C60	30 mf; 200 vdcw
C52	0.0025 mf; 500 vdcw
C53	0.0014 mf; 500 vdcw
C54	0.0014 mf; 500 vdcw
C55	680 mmf; 500 vdcw
C56	330 mmf; 500 vdcw
C58, C77	.25 mf; 400 vdcw
C59, C68	47 mmf; 500 vdcw
C65	100 mmf; 500 vdcw
C66	180 mmf; 500 vdcw
C71	20 mmf; 500 vdcw
C74, C75	Part of BFO Assy (L6)
C82	20 mmf; 500 vdcw
C83	15 mmf; 500 vdcw
C84	10 mmf; 500 vdcw
C85, C86	470 mmf; 500 vdcw (Part of T16)
C87, C88	470 mmf: 500 vdcw (Part of T17)
C89, C90	470 mmf; 500 vdcw (Part of T18)
C94, C96, C97, C98, C99	10,000 mmf; 300 vdcw
L4	35 Ohms D.C.
L5	35 Ohms D.C.
L6	7.5 Ohms D.C.
L7	.5 Ohms D.C.
L8	120 Ohms D.C.
R1, R6, R11	200 Ohms, 1 W.

Reference Symbol	*Value*
R2, R7, R14, R18, R29, R58	47,000 Ohms, 1 W.
R3, R5, R9, R31	2 Meg; 1 W.
R4, R8, R13, R17, R23	5100 Ohms, 1 W.
R10	15,000 Ohms
R15, R21, R52	1000 Ohms; 1 W.
R19	20,000 Ohms; 1 W.
R20	2500 Ohms; 3 W.
R22, R28, R56	100,000 Ohms; 1 W.
R24, R25, R32, R41	470,000 Ohms; 1 W.
R26, R40	222,000 Ohms; 1. W.
R27	10,000 Ohm; 1 W.
R30	500,000 Ohms; 1 W.
R33, R36	150 Ohms; 1 W.
R34, R59	20 Ohms; 10 W.
R38	27,000 Ohms; 1 W.
R39	Part of BFO Assy. (L6)
R50	2,000 Ohms; 1 W.
R51	2,500 Ohms; 1 W.
R60	40 Ohms; 10 W.
R61	50 Ohms; 1 W.
T1	Pri. 3 Ohms, Sec. .1 Ohms D.C.
T2	Pri. 5 Ohms, Sec. .1 Ohms D.C.
T3	Pri. 11.5 Ohms, Sec. 1.2 Ohms D.C.
T4	Pri. 50 Ohms, Sec. 12.5 Ohms D.C.
T5	Pri. 110 Ohms, Sec. 16 Ohms D.C.
T6	Pri. 9 Ohms, Sec. .1 Ohms D.C.
T7	Pri. 20 Ohms, Sec. .1 Ohms D.C.
T8	Pri. 50 Ohms, Sec. 1.2 Ohms D.C.
T9	Pri. 5 Ohms, Sec. 12.5 Ohms D.C.
T10	Pri. 8 Ohms, Sec. 16 Ohms D.C.
T11	Pri. 9 Ohms, Sec. .1 Ohms D.C.
T12	Pri. 20 Ohms, Sec. .1 Ohms D.C.
T13	Pri. 50 Ohms, Sec. 1.2 Ohms D.C.
T14	Pri. 5 Ohms, Sec. 12.5 Ohms D.C.
T15	Pri. 8 Ohms, Sec. 16 Ohms D.C.
T16	Pri. 2.8 Ohms, Sec. 2.8 Ohms D.C.
T17	Pri. 2.8 Ohms, Sec. 2.8 Ohms D.C.
T18	Pri. 2.8 Ohms, Sec. 2.8 Ohms D.C.
T19	Pri. 80 Ohms, Sec. .2 Ohms D.C.
T20	Pri. 1.5 Ohms, Sec. 2.5 Ohms D.C.
T21	Pri. 2 Ohms, Sec. 3 Ohms D.C.
T22	Pri. .8 Ohms, Sec. .1 Ohms D.C.
T23	Pri. 1.1 Ohms, Sec. .3 Ohms D.C.
T24	Pri. .6 Ohms, Sec. .6 Ohms D.C.

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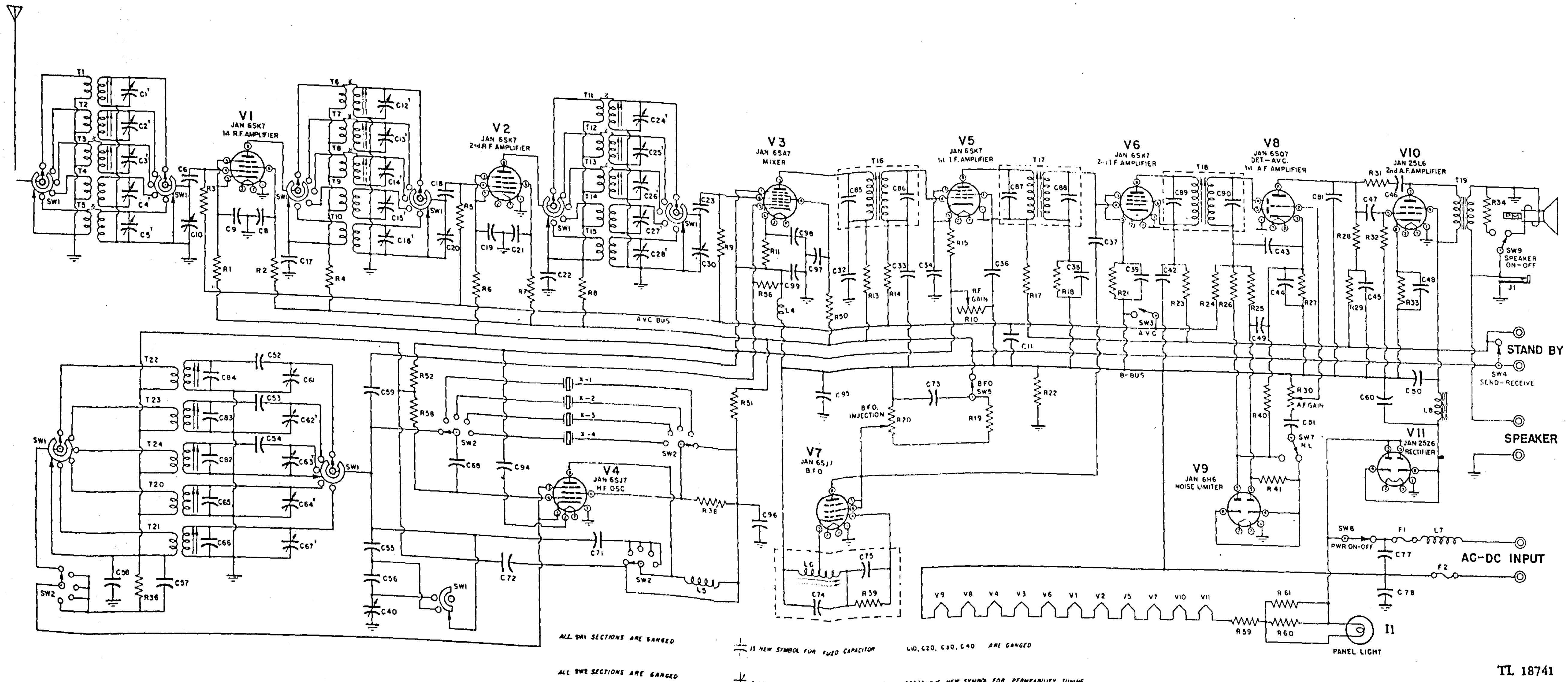

Figure 21. Radio Receiver R-96/SR, schematic diagram.

53. MAINTENANCE PARTS FOR RADIO RECEIVER R-96/SR.

The following information was compiled on 16 April 1945. The appropriate section of the ASF Signal Supply Catalog for Radio Receiver R-96/SR is:

Fixed Plant Maintenance List

SIG 10-341, Radio Receiver, Marine, R-96/SR

For the index of available catalog sections, see the latest section of ASF Signal Supply Catalog SIG 2.

Ref symbol	Signal Corps stock No.	Name of part and description	Mfrs part and code No.
C1, 2, 3, 4, 5, 12, 13, 14, 15, 16, 24, 25, 26, 27, 28, 61, 62, 63, 64, 67	3D9045V-5	CAPACITOR, variable: 7-45 mmf.	822BN (C4)
C6, 18, 23, 43, 81	3K2024122	CAPACITOR, mica: 0.00025-mf; 500 vdcw.	CM20B251K
C8, 9, 19, 21, 22, 32, 34, 36, 39	3DA100-317	CAPACITOR, paper: dual; 0.1 - 0.1 mf.	2XDMRW4-.1 (S5)
C10, 20, 30, 40	3D9261VE3	CAPACITOR, variable: air; 2-sec; 261 mmf per sec.	60 (01)
C11	3DA2-80	CAPACITOR, mica: 0.002-mf; 500 vdcw.	1W5D2 (C15)
C17, 42, 49, 73	3DA100-316	CAPACITOR, paper: oil; 0.1-mf; 400 vdcw.	XDMBW4-.1 (S5)
C33, 38, 57, 72	3DA50-143	CAPACITOR, paper: oil, dual, 0.05-0.05 mf, 400 vdcw.	2XDMRW4-.05 (S5)
C37	3D9005-2.2	CAPACITOR, silver mica: 0.000005-mf; 500 vdcw.	MOSCW (S5)
C44, 78	3DB2-8.4	CAPACITOR, paper: oil; 2-mf; 400 vdcw.	XDMRW4-2 (S5)
C45	3DA500-92	CAPACITOR, paper: oil; 0.5-mf; 400 vdcw.	XDMRW4-.5 (S5)
C46	3D9500-30	CAPACITOR, mica: 0.0005-mf; 500 vdcw.	MWBW1422-10 (S5)
C47, 51, 95	3DA5-154	CAPACITOR, mica: 0.005-mf; 500 vdcw.	MWBW1239-10 (S5)
C48	3DB30-39	CAPACITOR, electrolytic: 30-mf; 150 vdcw.	BS47 (M1)
C50, 60	3DB30-40	CAPACITOR, electrolytic: 30-mf; 200 vdcw.	A331 (M1)
C52	3D9250-46.2	CAPACITOR, ceramic: 0.0025-mf; 500 vdcw.	N150 (E3)
C53	3DA1.400-4	CAPACITOR, ceramic: 0.0014-mf; 500 vdcw.	N270 (E3)
C54	3DA1.400-5	CAPACITOR, ceramic: 0.0014-mf; 500 vdcw.	N750 (E3)
C55	3D9680-9	CAPACITOR, ceramic: 0.000680-mf; 500 vdcw, type F.	NPO (E3)

53. MAINTENANCE PARTS FOR RADIO RECEIVER R-96/SR (contd).

Ref symbol	Signal Corps stock No.	Name of part and description	Mfrs part and code No.
C56	3D9330-11	CAPACITOR, ceramic: 0.00033-mf; 500 vdcw, type F.	NPO (E3)
C58, 77	3DA250-21.5	CAPACITOR, paper: oil; 0.25-mf; 400 vdcw.	XDMRW4.-.25 (S5)
C59, 68	3D9047-17	CAPACITOR, silver mica: 0.000047-mf; 500 vdcw.	MOSOW (S5)
C65	3D9100-195	CAPACITOR, ceramic: 0.0001-mf; 500 vdcw, 1 3/32" x ¼".	N150 (E3)
C66	3D9180-10	CAPACITOR, ceramic: 0.00018-mf; 500 vdcw, type D.	N150 (E3)
C71	3D9020-9.1	CAPACITOR, mica: 0.00002-mf; 500 vdcw.	MOBW (S5)
C74	NSNR	CAPACITOR: part of coil assembly L6.	
C75	NSNR	CAPACITOR: part of coil assembly L6.	
C82	3D9020-25	CAPACITOR, ceramic: 0.00002-mf; 500 vdcw.	N750 (E3)
C83	3D9015-56	CAPACITOR, ceramic: 0.000015-mf; 500 vdcw, ⅜" x 13/16" D.	N750 (E3)
C84	3D9010-94	CAPACITOR, ceramic: 0.00001-mf; 500 vdcw, type C.	N750 (E3)
C85	NSNR	CAPACITOR: part of transformer T16.	
C86	NSNR	CAPACITOR: part of transformer T16.	
C87	NSNR	CAPACITOR: part of transformer T17.	
C88	NSNR	CAPACITOR: part of transformer T17.	
C89	NSNR	CAPACITOR: part of transformer T18.	
C90	NSNR	CAPACITOR: part of transformer T18.	
C94, 96, 97, 98, 99	3K4010314	CAPACITOR, mica: 0.01-mf; 300 vdcw.	CM40A103M
L5	3C326-100.1	COIL, r-f choke; 2.5mh @ 125 ma.	02242 (M11)
L6	2Z9644.30	COIL ASSEMBLY: bfo; 549-kc (includes capacitors C74, 75, coil L6 and resistor R39).	03186 (M11)
L7	3C323-142B	COIL, r-f choke: 300 uh @ 850 ma.	30-9 (R30)
L8	3C323-96C	COIL, filter choke: 12h @ 100 ma.	169 (E41)
	2Z3273-48	COUPLER, solid: for shafts ¾" x ½" OD.	71-4 (R30)
	2Z3291-2	COUPLER, flexible: for ¼" shafts.	250 (J4)
	2Z3876.76	DIAL DRIVE ASSEMBLY: 20-1 ratio.	41-65 (R30)

Ref symbol	Signal Corps stock No.	Name of part and description	Mfrs part and code No.
	2Z5991-40	DIAL LAMP ASSEMBLY: white jewel.	DV88 (D2)
	2Z3714-99	DIAL LOCK DISC.	41-46 (R30)
	2Z7258.47	DIAL POINTER: graduations on end.	41-31 (R30)
	2ZA1352-88	DIAL WINDOW: freq calibration.	41-49 (R30)
F1, 2	3Z1950	FUSE: type 3AG.	1043 (L3)
	2Z4960-8	HAND WHEEL: 2¼" with pointer.	310 (G5)
	2Z4928-35	HANDLE: for panel.	14-3 (R30)
	3Z3275-9	HOLDER: fuse.	1075F (L3)
	3G1450-14.2	INSULATOR, stand-off: ⅜" x ⅜" x ⅞".	M7462510-5 (P39)
	3G112-64.1	INSULATOR, feed-through: ⅜" ID, 1" lg x ⅝" OD.	44 (J4)
J1	2Z5534A	JACK, single-ckt: phone.	JK-34A (N16)
	2Z5790-10	KNOB: bar.	K120 (G15)
	2Z5753.63	KNOB: friction drive.	41-68 (R30)
V12	6Z6806.29	LAMP: 6-8 v, 150 ma.	S-47 (G3)
	2Z3022-62	PLUG: a-c.	61-MP11 (A13)
	2Z3022-63	PLUG: a-c input.	61-MP10 (A13)
R1, 6, 11	3RC30BF201J	RESISTOR, carbon: 200-ohm; 1-w.	RC30BF201J
R2, 7, 14, 18, 29, 58	3RC30BF473K	RESISTOR, carbon: 47,000-ohm; 1-w.	RC30BF473K
R3, 5, 9, 31	3RC30BF205J	RESISTOR, carbon: 2-meg; 1-w.	RC30BF205J
R4, 8, 13, 17, 23	3RC30BF512J	RESISTOR, carbon: 5,100-ohm; 1-w.	RC30BF512J
R10	2Z7270.184	RESISTOR, pot: 15,000-ohm; 2¼-w.	J (A5)
R15, 21, 52	3RC30BF102K	RESISTOR, carbon: 1,000-ohm; 1-w.	RC30BF102K
R19	3RC30BF203J	RESISTOR, carbon: 20,000-ohm; 1-w.	RC30BF203J
R20	2Z7269.157	RESISTOR, pot: 2,500-ohm; 2-w; with switch SW5.	J (A5)
R22, 28, 56	3RC30BF104K	RESISTOR, carbon: 100,000-ohm; 1-w.	RC30BF104K

53. MAINTENANCE PARTS FOR RADIO RECEIVER R-96/SR (contd).

Ref symbol	Signal Corps stock No.	Name of part and description	Mfrs part and code No.
R24, 25, 32, 41	3RC30BF474K	RESISTOR, carbon: 470,000-ohm; 1-w.	RC30BF474K
R26, 40	3RC30BF224K	RESISTOR, carbon: 220,000-ohm; 1-w.	RC30BF224K
R27	3RC30BF103K	RESISTOR, carbon: 10,000-ohm; 1-w.	RC30BF103K
R30	2Z7272-198	RESISTOR, pot: 500,000-ohm; 1-w; with switch SW8.	J (A5)
R33, 36	3RC30BF151K	RESISTOR, carbon: 150-ohm; 1-w.	RC30BF151K
R34, 59	3Z6002-50	RESISTOR, w-w: 20-ohm; 10-w.	WP-20K (C10)
R38	3RC30BF273K	RESISTOR, carbon: 27,000-ohm; 1-w.	RC30BF273K
R39	NSNR	RESISTOR: part of coil assembly L6.	
R50	3RC30BF202J	RESISTOR, carbon: 2,000-ohm; 1-w.	RC30BF202J
R51	3RC30BF242J	RESISTOR, carbon: 2,500-ohm; 1-w.	RC30BF242J
R60	3Z6004-33	RESISTOR, w-w: 40-ohm; 10-w.	WP-B10F (C10)
R61	3RC30BF510J	RESISTOR, carbon: 50-ohm; 1-w.	RC30BF510J
	6Z7567-1	RECEPTACLE: a-c.	61-F11 (A13)
	2Z8076-47	SCALE: vernier dial; 0-180°.	41-41 (R30)
	3Z7650-3	SHAFT, sw: steel, 13" lg x 1/4" diam.	18-63 (R30)
	2Z8761-22	SOCKET: crystal mtg.	33002 (M4)
	2Z8678.127	SOCKET, tube: ceramic.	65A (F11)
	2Z8659-6	SOCKET, tube: octal; mica filled.	MIP 8-T (A13)
	6C35-6	SPEAKER: 5" PM.	PM5-FS (C67)
SW1	3Z9903A-44	SWITCH, band change: 1-pole, 5-position, 9-sec.	18-20.21 (R30)
SW2	3Z9626-40.6	SWITCH, crystal-manual: 4-pole, 5-position.	18-19 (R30)
SW3, 4	3Z9859-8.1	SWITCH, toggle: SPST.	20994 (A17)
SW5	NSNR	SWITCH, bfo: part of resistor R20.	
SW7	3Z9858-8.45	SWITCH, rotary: SPDT; toggle action.	1565 (A17)
SW8	NSNR	SWITCH, power: part of resistor R30.	
SW9	3Z9846.2	SWITCH, toggle: SPDT.	21350 (A17)

53. MAINTENANCE PARTS FOR RADIO RECEIVER R-96/SR (contd).

Ref symbol	Signal Corps stock No.	Name of part and description	Mfrs part and code No.
T1	2C4180-96/C1	TRANSFORMER, r-f ant: band 5.	03172 (M11)
T2	2C4180-96/C2	TRANSFORMER, r-f ant: band 4.	03166 (M11)
T3	2C4180-96/C3	TRANSFORMER, r-f ant: band 3.	03160 (M11)
T4, 5	2C4180-96/C7	TRANSFORMER, r-f ant: bands 2 and 1.	03154 (M11)
T6, 11	2C4180-96/C9	TRANSFORMER, r-f interstage: band 5.	03174 (M11)
T7, 12	2C4180-96/C10	TRANSFORMER, r-f interstage: band 4.	03168 (M11)
T8, 13	2C4180-96/C12	TRANSFORMER, r-f interstage: band 3.	03162 (M11)
T9, 10 14, 15	2C4180-96/C11	TRANSFORMER, r-f interstage: bands 2 and 1.	03156 (M11)
T16	2Z9642.60	TRANSFORMER: 1st i-f; 550-kc; includes capacitors C85, 86.	03180 (M11)
T17	2Z9642.61	TRANSFORMER: 2d i-f; 550 kc; includes capacitors C87, 88.	03162 (M11)
T18	2Z9642.59	TRANSFORMER, diode detector: half-wave; 550-kc, includes capacitors C89, 90.	03184 (M11)
T19	2Z9632.272	TRANSFORMER, sprk: pri 2,000-ohm; sec 3.6-ohm.	148 (E41)
T20, 21	2C4180-96/C80	TRANSFORMER, osc: bands 2 and 1.	03158 (M11)
T22	2C4180-96/C66	TRANSFORMER, osc: band 5.	03176 (M11)
T23	2C4180-96/C65	TRANSFORMER, osc: band 4.	03170 (M11)
T24	2C4180-96/C4	TRANSFORMER, osc: band 3.	03164 (M11)
V1, 2, 5, 6	2J6SK7	TUBE: type 6SK7.	JAN6SK7
V3	2J6SA7	TUBE: type 6SA7.	JAN6SA7
V4	2J6SJ7	TUBE: type 6SJ7.	JAN6SJ7
V7	2J6SJ7	TUBE: type 6SJ7.	JAN6SJ7
V8	2J6SQ7GT	TUBE: type 6SQ7GT.	JAN6SQ7GT
V9	2J6H6GT	TUBE: type 6H6GT.	JAN6H6GT
V10	2J25L6GT	TUBE: type 25L6GT.	JAN25L6GT
V11	2J25Z6GT	TUBE: type 25Z6GT.	JAN25Z6GT

54. LIST OF MANUFACTURERS.

Code	Manufacturer's Name
A5	Allen-Bradley Co., Milwaukee, Wis.
A13	American Phenolic Corp., Chicago, Ill.
A17	Arrow-Hart & Hegeman Co., Hartford, Conn.
C4	Centrolab, Milwaukee, Wis.
C10	Clarostat Mfg. Co., Inc., Brooklyn, N. Y.
C15	Cornell-Dubilier Electric Corp., South Plainfield, N. J.
E41	Electronic Components Co., Los Angeles, Calif.
F11	Franklin, A. W. Mfg. Co., New York, N. Y.
G31	Girard-Hopkins, Inc., Oakland, Calif.
J4	Johnson, E. F. Co., Weseca, Minn.
L3	Leich Sales Corp., Chicago, Ill.
M1	Mallory, P. R. & Co., Indianapolis, Ind.
M4	Millen, James Mfg. Co., Inc., Malden, Mass.
M11	Meissner Mfg. Co., Mt. Carmel, Ill.
N16	National Fabricated Products, Chicago, Ill.
O1	Oak Mfg. Co., Chicago, Ill.
O5	Owens Illinois Glass Co., Toledo, Ohio.
P39	Pacific Clay Products Co., Los Angeles, Calif.
R2	RCA Mfg. Co., Camden, N. J.
R30	Radiation Products, Inc., Los Angeles, Calif.
S5	Solar Mfg. Corp., Bayonne, N. J.
S19	Sylvania Electric Products, Inc., Emporium, Pa.
S24	Stackpole Carbon Co., St. Mary's, Pa.

APPENDIX

MOISTUREPROOFING AND FUNGIPROOFING

55. GENERAL.

When operated in tropical areas where temperature and relative humidity are extremely high, Signal Corps equipment requires special attention. These are some of the problems met:

a. Resistors, capacitors, coils, chokes, transformer windings, etc., fail because of the effects of fungus growth and excessive moisture.

b. Electrolytic action, often visible in the form of corrosion, takes place in resistors, coils, chokes, transformer windings, etc., causing eventual break-down.

c. Hook-up wire insulation and cable insulation break down. Fungus growth accelerates deterioration.

d. Moisture forms electrical leakage paths on terminal boards and insulating strips, causing flash-overs and crosstalk.

e. Moisture provides leakage paths between battery terminals.

56. TREATMENT.

A moistureproofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable degree of protection against fungus growth, insects, corrosion, salt spray, and moisture. The treatment involves the use of a moisture- and fungi-resistant varnish applied with a spray gun or brush. Refer to TB SIG 13, Moistureproofing and Fungiproofing Signal Corps Equipment, for a detailed description of the varnish-spray method of moistureproofing and fungiproofing and the supplies and equipment required in this treatment.

CAUTION: Varnish spray may have poisonous effects if inhaled. To avoid inhaling spray, use respirator if available; otherwise, fasten cheesecloth or other cloth material over nose and mouth. Never spray varnish or lacquer near an open flame. Do not smoke in a room where varnish or lacquer is being sprayed. The spray may be highly explosive.

57. RADIO RECEIVER R-96/SR.

a. Preparation. Make all repairs and adjustments necessary for proper operation of the equipment.

b. Disassembly.

(1) Disconnect the receiver from its power source.

(2) Disconnect antenna and ground leads and all interconnecting wires at rear of chassis.

(3) Remove the six holding screws SS1 (fig. 22) from the front panel of the receiver and pull the chassis forward by the handles until free of the cabinet.

(4) Remove the shield cover from the r-f and mixer-oscillator sections by taking out six screws as shown in figure 23.

(5) Remove the two shield covers from the bottom of the chassis by taking out the 16 screws as shown in figure 24.

(6) Remove the speaker from the cabinet by unsoldering the two speaker leads and taking out the four bolts that hold the speaker to the cabinet.

(7) Remove the four crystals X1, X2, X3, and X4 (fig. 23) from their sockets.

(8) Remove Tube JAN-25Z6GT(V11) (fig. 23) and Tube JAN-25L6GT(V10) (fig. 23) from their sockets.

c. Cleaning. Clean all dirt, dust, rust, and fungus from the equipment to be processed. Clean all oil and grease from the surfaces to be varnished.

NOTE: Unless cleaning is done carefully and thoroughly, the effectiveness of the moistureproofing and fungiproofing treatment will be impaired.

d. Masking.

(1) Front Panel.

(a) Mask the glass face of tuning dial A (fig. 22) with paper and masking tape.

(b) Mask openings around toggle switches SW3, SW4, and SW9 (fig. 22).

(c) Mask sleeve of phone jack J1 (fig. 22).

(2) Top of Receiver Chassis.

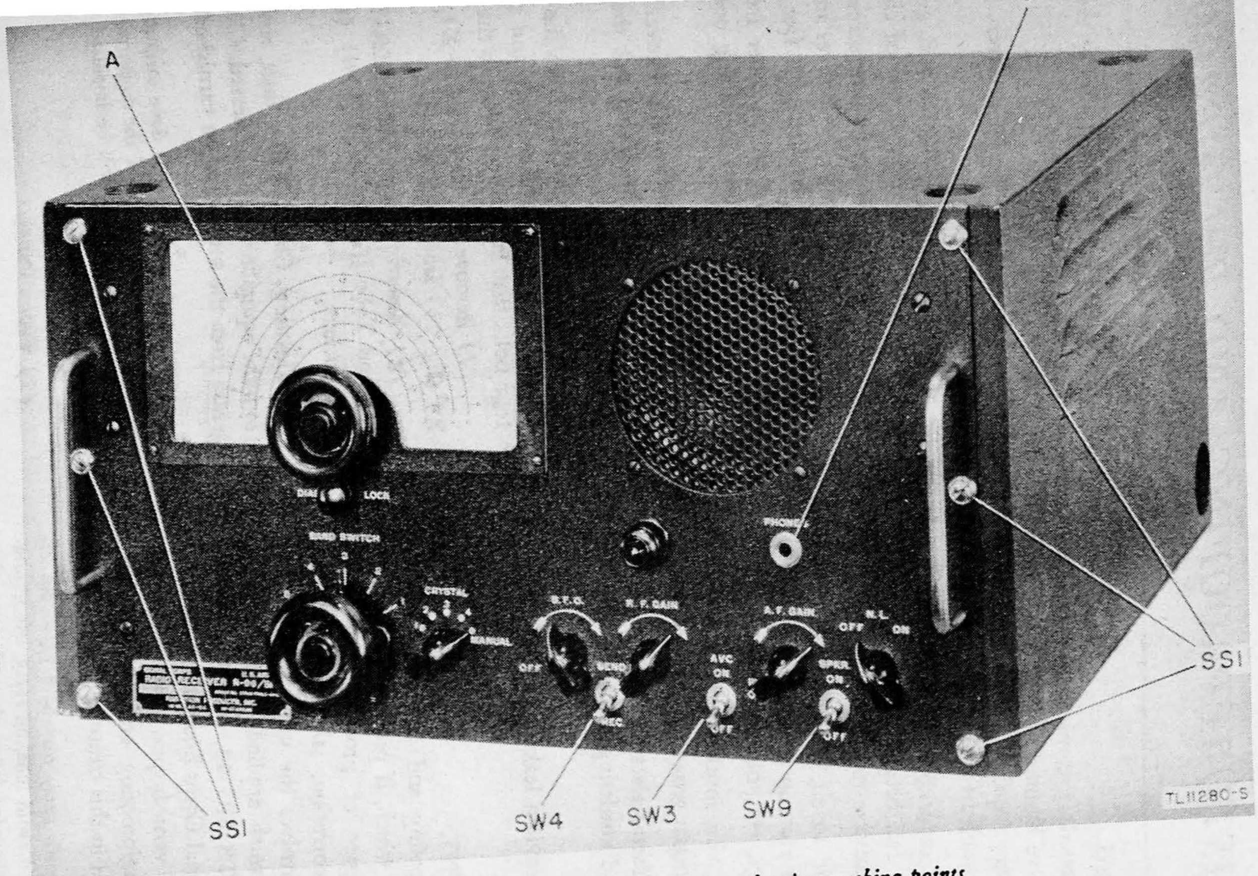

Figure 22. Radio Receiver R-96/SR, front view, showing masking points.

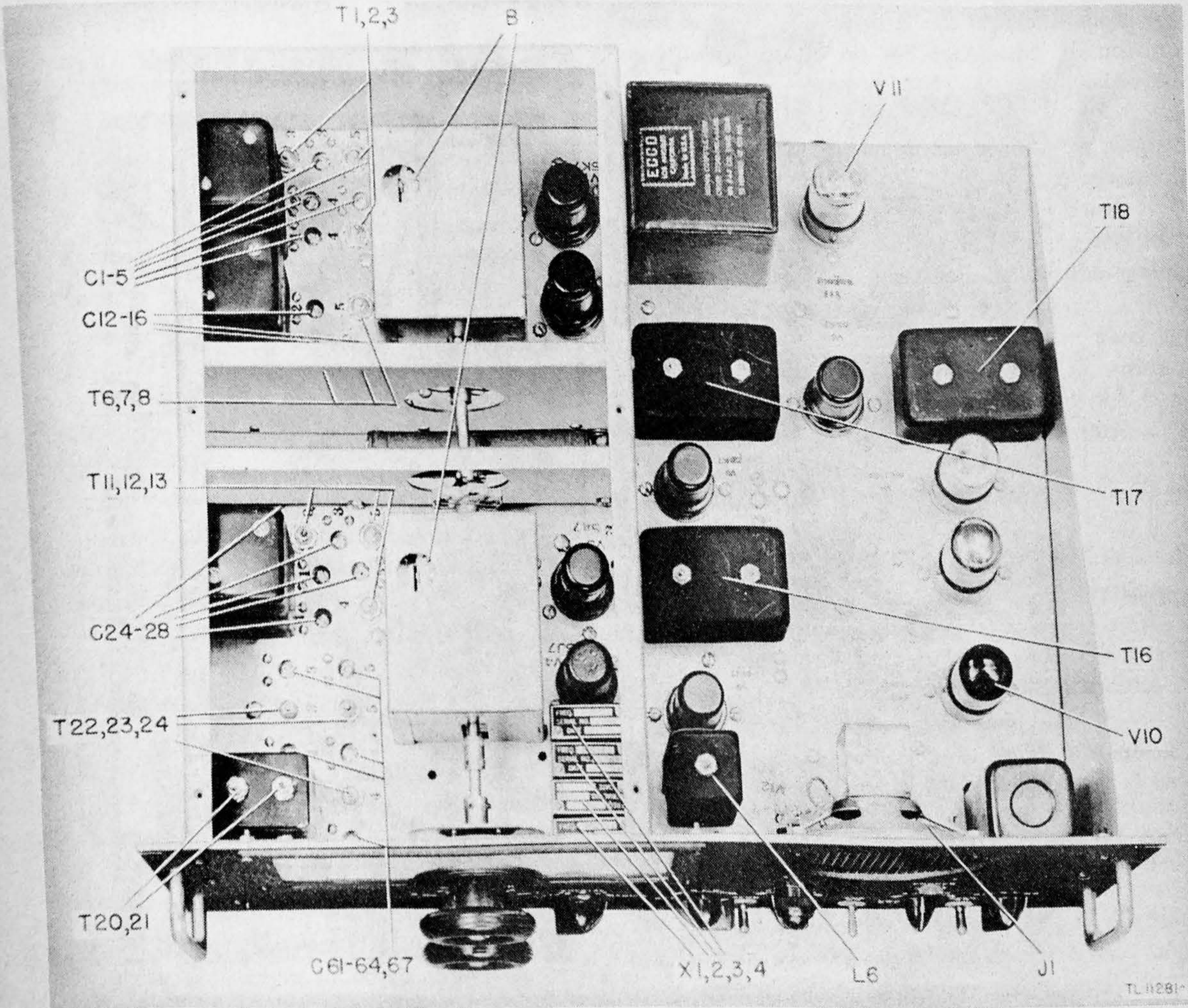

Figure 23. Radio Receiver R-96/SR, top view, showing masking points.

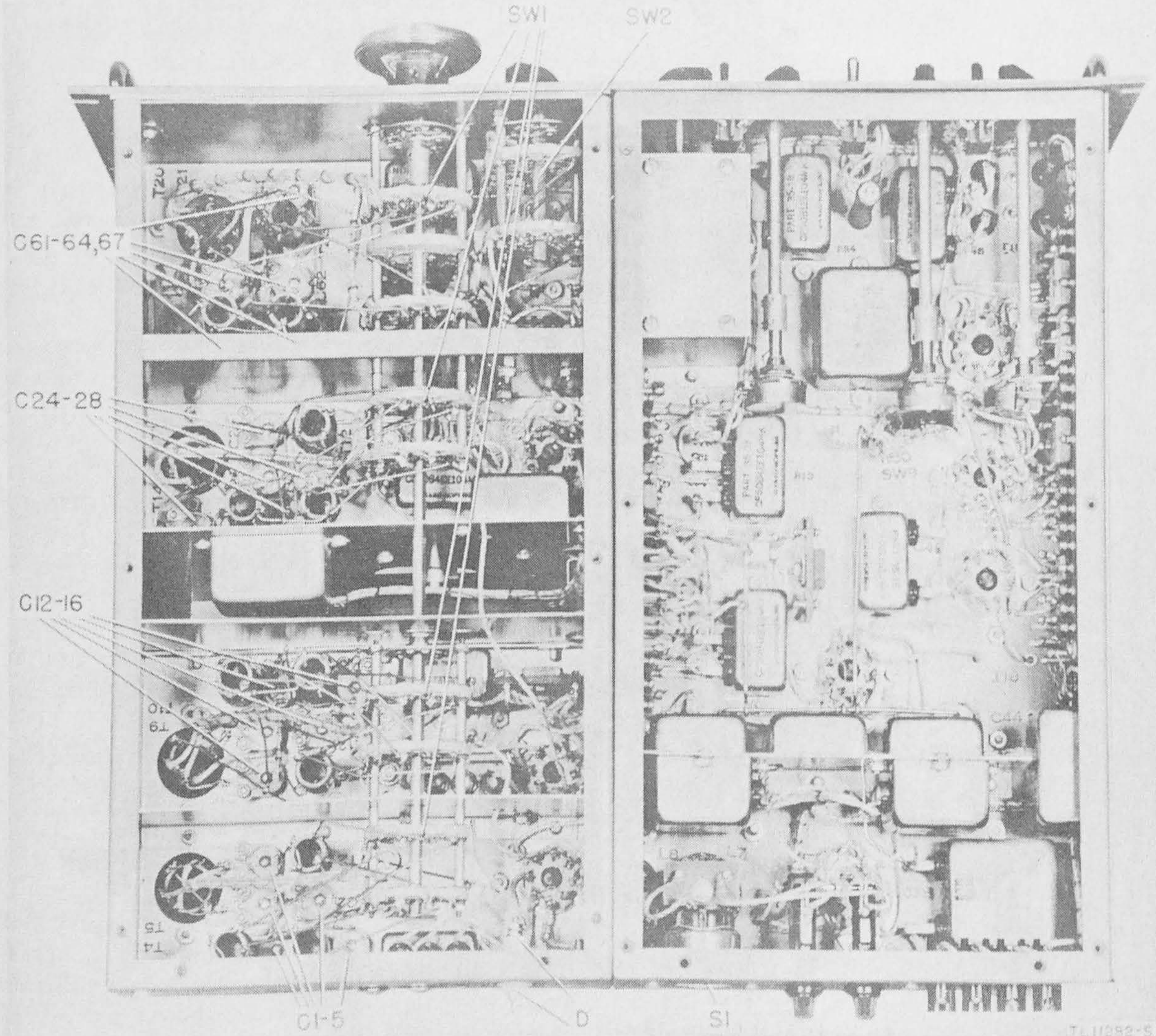

Figure 24. Radio Receiver R-96/SR, bottom view, showing masking points.

(a) Cover the tuning capacitors B with paper and masking tape (fig. 23).

(b) Mask the adjusting screws of antenna transformers T1, T2, and T3 (fig. 23), interstate transformers T6, T7, and T8 (fig. 23), mixer transformers T11, T12, and T13 (fig. 23), and oscillator transformers T20, T21, T22, T23, and T24 (fig. 23).

(c) Cover holes above adjusting screws for trimmer capacitors C1 to C5, C12 to C16, C24 to C28, C61 to C64, and C67 (fig. 23) in r-f and mixer-oscillator sections.

(d) Mask the adjusting screws on the three i-f transformer shield cans T16, T17, and T18 (fig. 23) and BFO shield can L6 (fig. 23).

(e) Mask tops of sockets from which Tubes JAN-25Z6GT and JAN-25L6GT have been removed.

(f) Mask sockets from which the four crystals X1, X2, X3, and X4 (fig. 23) have been removed.

(g) Mask contacts and sleeve of phone jack J1 (fig. 23).

(h) Mask edges on the back of front panel and edges to which shield cover is fastened, to insure good grounding.

(3) **Bottom of Receiver Chassis.**

(a) Stuff tissue paper between the sections and completely cover band changing switch SW1 (fig. 24) with masking tape.

(b) Completely mask crystal-manual tuning switch SW2 (fig. 24).

(c) Mask the 20 trimmer capacitors C1 to C5, C12 to C16, C24 to C28, C61 to C64, and C67 (fig. 24) in r-f and mixer-oscillator sections.

(d) Mask antenna feed-through insulator D (fig. 24).

(e) Mask power input receptacle S1 (fig. 24).

(f) Tighten screw terminals at rear of chassis to prevent lacquer from getting under screw heads.

(g) Mask edges to which shield covers are fastened, to insure good grounding.

(h) Fill the ends of all r-f, i-f, and oscillator transformers with tissue paper to protect the tuning slugs from varnish.

(i) Mask the ends of the wires that were disconnected from the speaker.

(j) Mask the edge of the tuning dial brake disk and brake.

e. Drying. Place the equipment to be treated in a drying oven and bake for 4 to 6 hours at a temperature of 140° F.

CAUTION: Do not exceed 140° F. If impregnates should begin to melt in any components, decrease the temperature and increase the drying time 1 hour for each 10° F. decrease in temperature.

f. Varnishing.

(1) Apply three coats of moistureproofing and fungiproofing varnish (Lacquer, Fungus-resistant, Spec No. 71-2202 [Stock No. 6G1005.3], or equal). Allow each coat to air-dry for 15 or 20 minutes before applying the next coat.

(2) Apply varnish immediately after the equipment is dried. If varnish is not applied immediately, moisture condenses on the equipment. Varnish applied over the moisture peels off readily after the varnish has dried.

(3) Spray one coat of the varnish on all parts of the receiver chassis and inside of the cabinet. It will not be necessary to spray the front panel.

(4) Spray the speaker with only one very light coat of varnish. Too much varnish on the speaker cone will impair its operation.

(5) Using a brush, touch up any parts not reached by the spray. Make certain that all wiring is completely covered with varnish. Make sure that all components are adequately protected by varnish.

g. Reassembly.

(1) Remove all masking tape being careful not to peel varnish from nearby areas.

(2) Reassemble by following instructions for disassembly in reverse order, and test the operations of the receiver.

(3) Make a complete operational check to be sure the equipment is in good operating condition.

(4) Align the receiver if necessary.

NOTE: The electrical characteristics of electronic equipment are subject to change over a period of approximately 10 days after application of the lacquer spray treatment. For this reason, it is desirable to wait until this period has elapsed before making the final check.

h. Marking. Mark the letters MFP and the date of treatment near the most conspicuous or most important nameplate on the receiver and in such a location that the marking will not become obliterated or rubbed off. In the absence of a nameplate, place the marking where it can be read easily and is not subject to wear.

EXAMPLE: MFP—8 June 1945.

58. MOISTUREPROOFING AND FUNGIPROOFING AFTER REPAIRS.

If, during repair, the coating of protective varnish has been punctured or broken, and if complete treatment is not needed to reseal the equipment, apply a brush coat to the affected part. Be sure the break is completely sealed.

U. S. GOVERNMENT PRINTING OFFICE : O—1949