AN 08-30APR4-2

HANDBOOK OF OPERATING INSTRUCTIONS

for

RECEIVING EQUIPMENT AN/APR-4

RESTRICTED

(For Official Use Only)

Approved 8 AUGUST 1944

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LIST OF REVISED PAGES ISSUED

NOTE: A heavy black vertical line, to the left of the text on revised pages, indicates the extent of the revision. This line is omitted where more than 50 per cent of the page is revised.

This issue contains no revisions.

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Destruction of Abandoned Materiel in the Combat Zone

In case it should become necessary to prevent the capture of this equipment and when ordered to do so, DESTROY IT SO THAT NO PART OF IT CAN BE SALVAGED, RECOGNIZED OR USED BY THE ENEMY. BURN ALL PAPERS AND BOOKS.

Means:-

1. Explosives, when provided.
2. Hammers, axes, sledges, machetes, or whatever heavy object is readily available.
3. Burning by means of incendiaries such as gasoline, oil, paper, or wood.
4. Grenades and shots from available arms.
5. Burying all debris or disposing of it in streams or other bodies of water, where possible and when time permits.

Procedure:-

1. Obliterate all identifying marks. Destroy nameplates and circuit labels.
2. Demolish all panels, castings, switch- and instrument-boards.
3. Destroy all controls, switches, relays, connections, and meters.
4. Rip out all wiring and cut interconnections of electrical equipment. Smash gas, oil, and water-cooling systems in gas-engine generators, etc.
5. Smash every electrical or mechanical part, whether rotating, moving, or fixed.
6. Break up all operating instruments such as keys, phones, microphones, etc.
7. Destroy all classes of carrying cases, straps, containers, etc.
8. Bury or scatter all debris.

DESTROY EVERYTHING!

★

Unsatisfactory Report

For U. S. Army Air Force Personnel:

In the event of malfunctioning, unsatisfactory design, or unsatisfactory installation of any of the component units of this equipment, or if the material contained in this book is considered inadequate or erroneous, an Unsatisfactory Report, AAF Form No. 54, or a report in similar form, shall be submitted in accordance with the provisions of Army Air Force Regulation No. 15-54 listing:

1. Station and organization.
2. Nameplate data (type number or complete nomenclature if nameplate is not attached to the equipment).
3. Date and nature of failure.
4. Airplane model and serial number.
5. Remedy used or proposed to prevent recurrence.
6. Handbook errors or inadequacies, if applicable.

For U. S. Navy Personnel:

Report of failure of any part of this equipment during its guaranteed life shall be made on Form N. Aer. 4112, "Report of Unsatisfactory or Defective Material," or a report in similar form, and forwarded in accordance with the latest instructions of the Bureau of Aeronautics. In addition to other distribution required, one copy shall be furnished to the inspector of Naval Materiel (location to be specified) and the Bureau of Ships. Such reports of failure shall include:

1. Reporting activity.
2. Nameplate data.
3. Date placed in service.
4. Part which failed.
5. Nature and cause of failure.
6. Replacement needed (yes—no).
7. Remedy used or proposed to prevent recurrence.

For British Personnel:

Form 1022 procedure shall be used when reporting failure of radio equipment.

SAFETY NOTICE

Operation of this equipment involves the use of high voltages which are dangerous to life. The power cable should be disconnected if the receiver is to be removed from its case for inspection or repair.

SECTION I
GENERAL DESCRIPTION

1. GENERAL.

a. PURPOSE.—Receiving Equipment AN/APR-4 is a search receiver intended for use in aircraft or on naval vessels. With the complete set of tuning units it can be used to:

(1) Determine the presence and measure the frequency of any radar or radio signals within the range of 38 to 2400 megacycles. Pulsed signals of less than 10 microseconds can be detected only by using Pulse Analyzer AN/APA-6 or AN/APA-11 in conjunction with the receiver.

Note

When a wider frequency range is necessary alternate units, part of Receiving Equipments SCR-587-A and AN/APR-1, may be employed. They may also be used in place of the tuning units supplied in case of faulty operation. The alternate tuning units available cover the frequencies from 40 to 3400 megacycles. (Refer to sec. V, par. 1 *b*.)

(2) Determine what modulation may be present on these signals.

(3) Give a rough indication of the relative field strength of these signals.

b. POWER SUPPLY.—The following table lists the a-c and d-c power supply requirements for Radar Set AN/APR-4.

Volts	*Frequency*	*Amperes*	*Watts*
80 or 115	60 to 2600	1	80 to 125
28	———	less than 1	20 to 25

2. EQUIPMENT SUPPLIED.

The following table lists the equipment supplied with Receiving Equipment AN/APR-4.

Quantity	*Name of Unit*	*Army Type Designation*	*Navy Type Designation*	*Dimensions (in inches)*	*Weight (in pounds)*
1	Radar Receiver	R-54/APR-4	R-54/APR-4	8 x 10½ x 21½	29
1	Tuning Unit	TN-16/APR-4	TN-16/APR-4	8 x 6½ x 14 1/16	12.75
1	Tuning Unit	TN-17/APR-4	TN-17/APR-4	8 x 6½ x 14 1/16	12.75
1	Tuning Unit	TN-18/APR-4	TN-18/APR-4	8 x 6½ x 14 1/16	12.75
1	Tuning Unit	TN-19/APR-4	TN-19/APR-4	8 x 6½ x 14 1/16	12.75
1	Tuning Unit	TN-54/APR-4	TN-54/APR-4	8 x 6½ x 14 1/16	12.75
4	Case	CY-31/APR-4	CY-31/APR-4	10½ x 7¾ x 6½	6.8
1	Mounting Base	MT-171/U	MT-171/U		
1	Switching Assembly	SA-23/APR-4	SA-23/APR-4		3.4
1	*Antenna Assembly, consisting of:				
	1 Antenna	AT-49/APR-4	AT-49/APR-4	6 x 7	2.3
	1 Antenna Cover, with Base Assembly	CW-33/APR-4	CW-33/APR-4		
	or				
	1 Antenna Cover	CW-46/APR-4		8½ x 8½ x 30	3.75
1	*Antenna Stub	AT-38/APT	AT-38/APT	29	10.0
	or				
1	Antenna Stub	AT-38A/APT	AT-38A/APT	29	10.0
1	*Fan Antenna, consisting of:				
	1 Antenna Support	AB-27/A	AB-27/A	½ x 2¾	0.62
	2 Insulator	IN-88			
	1 Tension Unit				
	20 ft. Antenna Wire	W-106-A			
	2 Thimble	AN-100-3	AN-100-3		
as req'd	*Radio Frequency Cable	RG-8/U	RG-8/U		
as req'd	Wire	AN-20			

Quantity	*Name of Unit*	*Army Type Designation*	*Navy Type Designation*	*Dimensions (in inches)*	*Weight (in pounds)*
3	*Radio Frequency Plug	UG-21/U	UG-21/U	1½ x ⅝	.3
3	*Radio Frequency Adapter	UG-27/U	UG-27/U	1.37 x 1.25 x .68	.2
3	*Plug	PL-259		3/9 x 1½	.05
3	*Adapter	M-359		¾ x 1¼ x 1¼	.076
1	Cable Adapter	AN3057-12	AN3057-12	1 9/16 x 1 3/16	.06
1	Plug	AN3108-22-4S	AN3108-22-4S	3 1/32 x 1 19/32 x 2.17	.216

* Issued in double the above quantities for installations requiring a larger antenna pattern. See the installation instructions for these antennas in section II, paragraph 1*b* (3), (4), and (5).

3. EQUIPMENT REQUIRED BUT NOT SUPPLIED.

The following table lists the equipment required but not supplied for Receiving Equipment AN/APR-4.

Quantity	*Name of Unit*	*Army Type Designation*	*Navy Type Designation*	*Required Characteristics*
1	Headset			8000-ohm impedance, or
1	Plug	PL-55		600-ohm
1	Panoramic Adapter, with cable and power supply	AN/APA-1b		impedance with Adaptor MC-385C
1	Pulse Analyzer	AN/APA-6 or AN/APA-11		
1	Test Oscillator	TS-47/APR		

SECTION II
INSTALLATION AND ADJUSTMENT

1. INSTALLATION.

a. PRELIMINARY.

(1) UNPACKING.—Unpack the equipment carefully to prevent damage to the diode meter or controls.

(2) INSPECTION.—Inspect Radar Receiver R-54/APR-4 (see figs. 2-1 and 2-2) for loose tubes or damaged equipment, as follows:

(a) Remove the three screws in the top of the case and unlock the two fasteners in the rear end of the case.

(b) Remove the receiver from the case.

(c) Press all tubes firmly into their sockets.

(d) Check for loose or damaged parts.

(3) SELECTION OF PROPER POWER SUPPLY VOLTAGE TAP ON RADAR RECEIVER R-54/-APR-4.—All receivers are connected at the factory for 115 volts, 60 to 2,600 cycle-operation. If 80-volt operation is required change the tap on the power transformer T-103 (fig. 2-3) as follows:

(a) With receiver removed from its case, place it in an inverted position.

(b) Remove the thermo-switch from its clip (figs. 2-3 and 2-4).

(c) Remove the thermo-switch clip and the capacitor clamp.

(d) Remove capacitor C-109-2 from its mounting socket. Use caution to prevent damage to the heater. Swing capacitor C-109-2 and heater to one side (fig. 2-3).

(e) Unsolder the black and white lead connected to terminal No. 3 of power transformer T-103. The heater must remain connected to terminal No. 3.

(f) Connect the black and white lead to terminal No. 2. Solder this connection carefully so as to prevent damage to the glass bushing. Never allow solder to flow onto the glass.

(g) Carefully insert capacitor C-109-2 into its socket. The heater winding must be centered between the base of the capacitor and the clamp.

CAUTION

The heater winding must be on capacitor C-109-2 (nearest the tuner frame) and not on capacitor C-109-1.

(h) Replace the hold-down clamp and the thermo-switch clip. (See figs. 2-3 and 2-4.)

(i) Insert thermo-switch into clip, making sure the locating pin engages the hole provided in the clip.

(j) Paint "80 VOLTS ONLY" in red paint on panel near power plug.

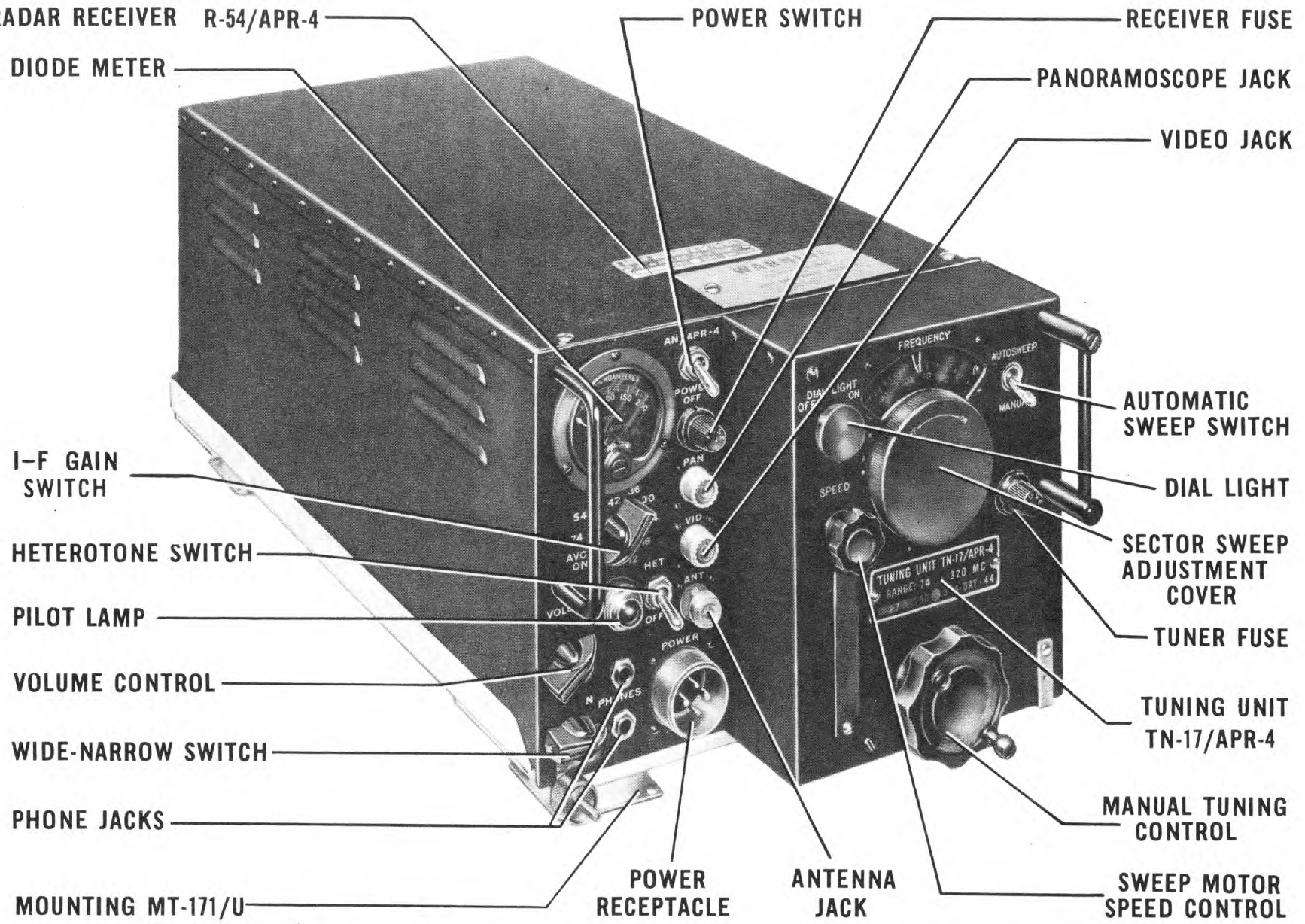


Figure 2-1. Radar Receiver R-54/APR-4 with Tuning Unit TN-17/APR-4

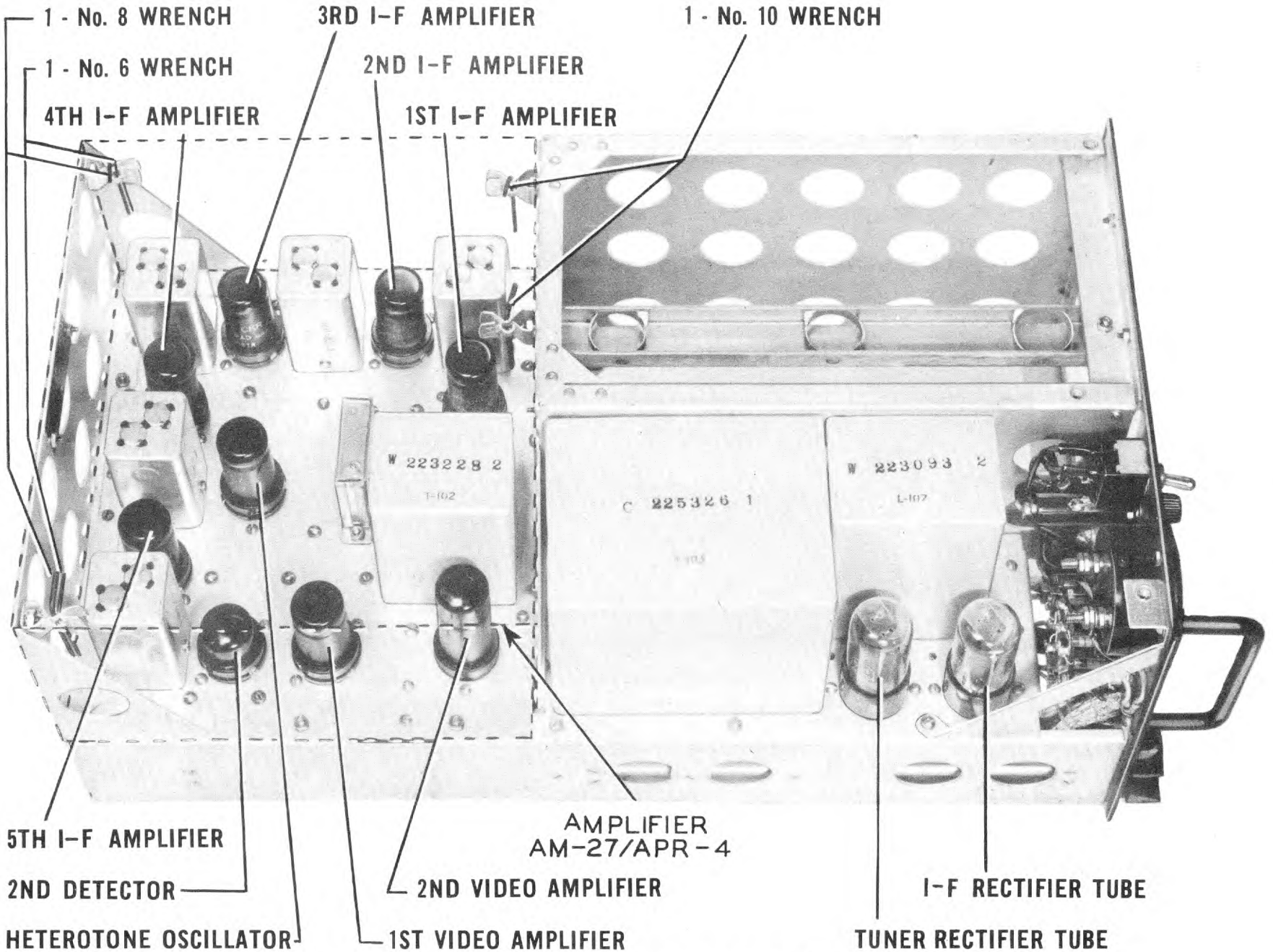


Figure 2-2. Radar Receiver R-54/APR-4—Tube and Wrench Locations

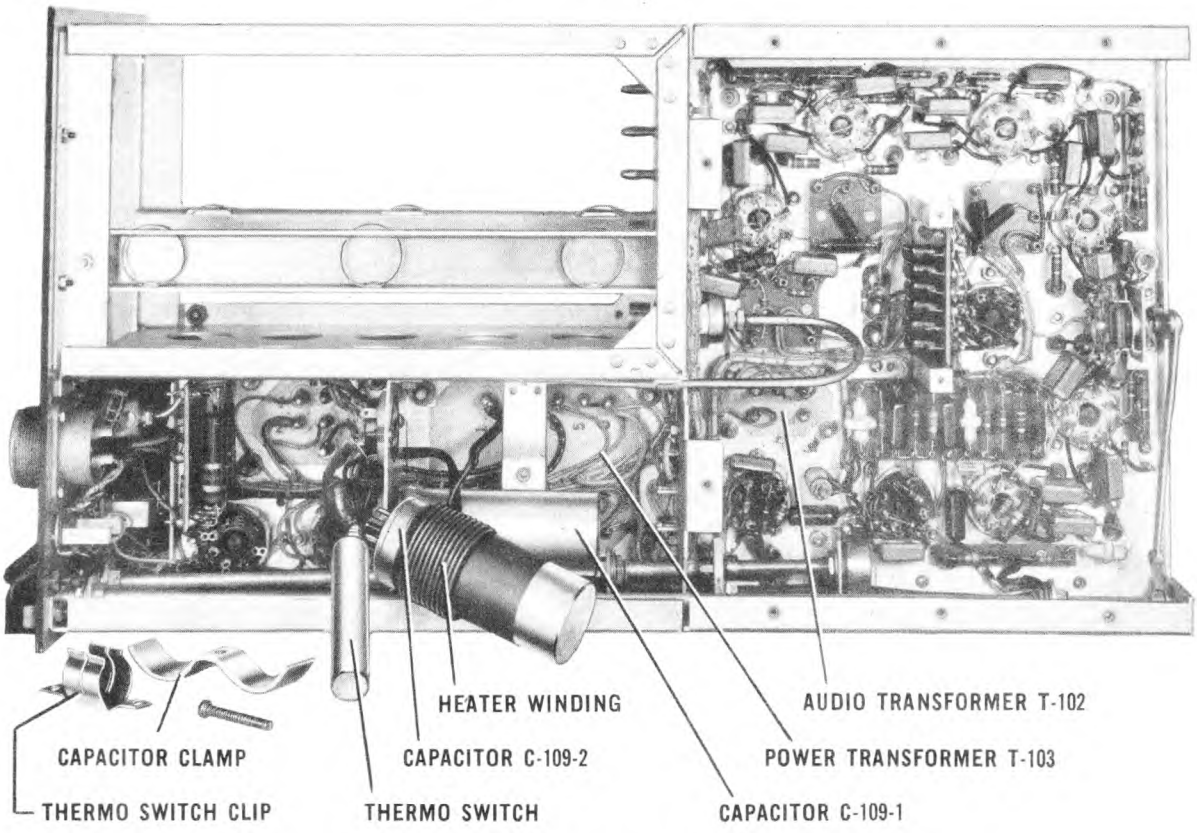


Figure 2-3. Radar Receiver R-54/APR-4—Transformer Locations

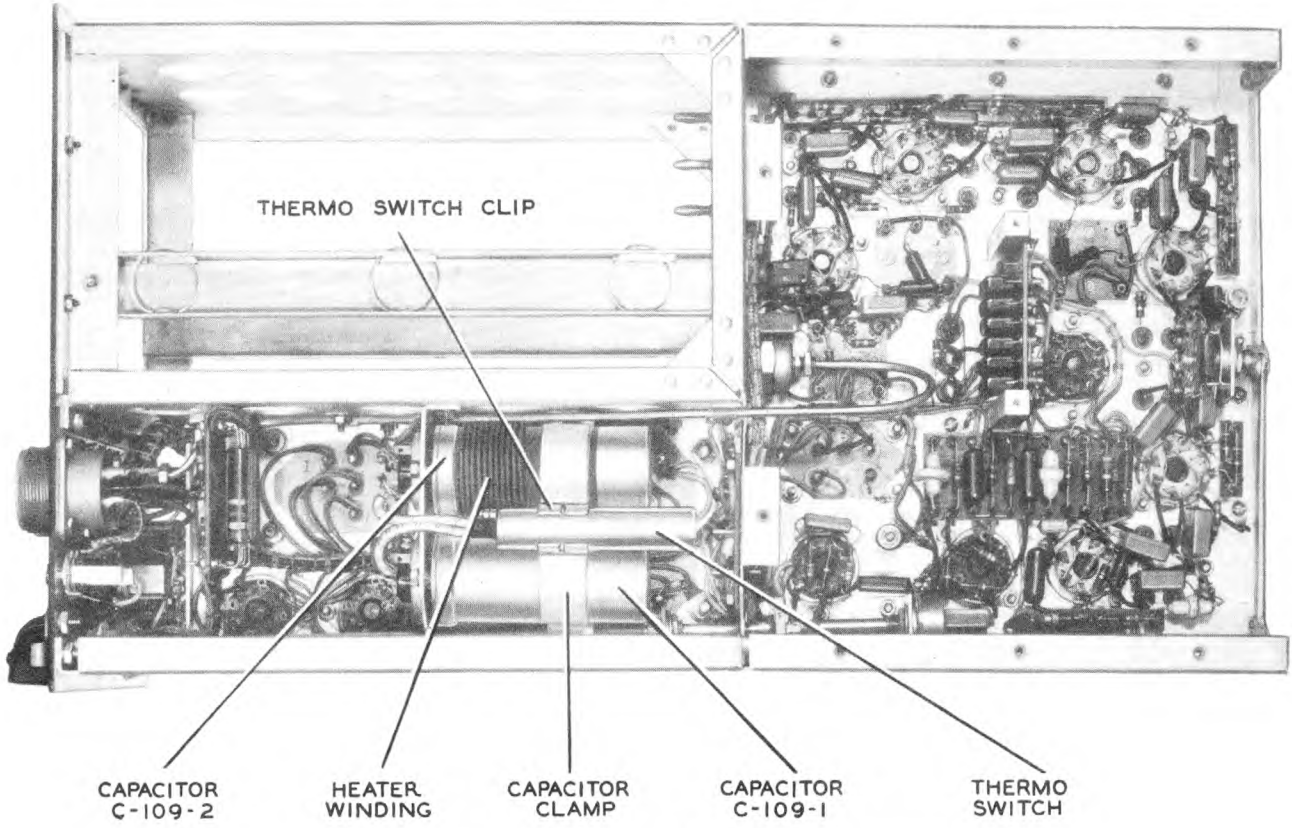


Figure 2-4. Radar Receiver R-54/APR-4—Bottom View

(k) Replace the receiver in its case and fasten the case securely.

(4) SELECTION OF PROPER HEADSET IMPEDANCE.—The receiver is connected at the factory for proper operation with 8000-ohm headsets. To use 600-ohm headsets, use Adapter MC-385-C or reconnect the audio transformer T-102 (fig. 2-3) as follows:

(a) Remove the receiver from its case and place it in an inverted position.

(b) Remove the screws which hold the cover on the underside of Amplifier AM-27/APR-4.

(c) Carefully unsolder the lead which is connected to terminal No. 3 of the audio transformer T-102 and reconnect this lead to terminal No. 4. Solder this connection carefully so as to prevent damage to the glass bushing. Never allow solder to flow onto the glass.

(d) Replace cover on Amplifier AM-27/APR-4 and carefully tighten all screws.

CAUTION

All screws must be in place to prevent regeneration in the amplifier.

(e) Replace the receiver in its case and fasten the cover securely.

(5) BENCH TEST.—Before installation, perform the following tests to insure that the equipment is in good working order.

WARNING

Operation of this equipment involves the use of high voltages which are dangerous to life. The power cable should be disconnected if the receiver is to be removed from its case for inspection or repair.

(a) SELECTIVITY.—The following equipment is required to test the selectivity:

Quantity	*Equipment*
1	General Radio 804B or 804C signal generator (or equivalent) (Generators having binding posts on the output are not satisfactory as it will be impossible to obtain an adequate ground connection)
1	Variac with line voltmeter
1	Power source of 115 volts, 60 to 2,600 cycle

1. Remove the receiver from its dust cover and connect it to the a-c line through the main power cord and the variac. Keep the voltage at the receiver adjusted to exactly 115 volts. The cover screws on Amplifier AM-27/APR-4 must all be in place and must fit tightly.

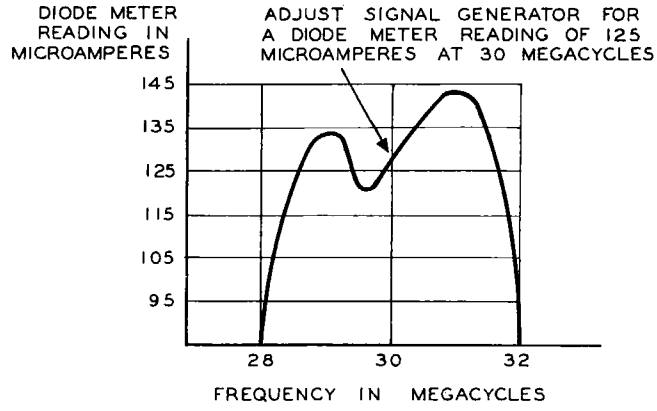
2. Connect the signal generator to the i-f input receptacle J-101-2.

3. Turn the receiver power switch to the on position and allow approximately two minutes for warm-up before proceeding.

4. Set the i-f gain switch to "12."

5. Turn the wide-narrow switch to the "W" position and the heterotone switch off.

6. Turn the signal generator on and adjust it for 30 megacycles, adjusting the attenuator control to produce a reading of 125 microamperes on the diode meter. Slowly change the signal generator frequency and note the output at the highest peak and the lowest valley as well as the frequencies corresponding to the points at which the diode meter reads 95 microamperes. The curve obtained should conform to the one given in the graph below.



LIMITS: The highest peak shall be less than 25 microamperes above the lowest valley. The bandwidth between the points which read 95 microamperes shall be at least 3.9 megacycles but not over 4.4 megacyles. The mean frequency shall be 30 megacycles plus or minus 0.25 megacycles.

(b) SENSITIVITY. — Using the same equipment set up as in *(a)* above, adjust the signal generator to 30 megacycles, the carrier level to 100, and the attenuator to zero.

1. Turn the i-f gain switch on the receiver to "O" and the wide-narrow switch to "W."

2. Read the diode meter.

3. Set the attenuator on the signal generator to give an increase of 100 microamperes in the diode meter reading.

4. Read the microvolts setting of the signal generator attenuator. This reading must be not more than 56 microvolts nor less than 35 microvolts.

5. Turn the wide-narrow switch to the "N" position.

6. Repeat steps 2-4 given below. The sensitivity in the narrow position should be somewhat greater than in the wide position. However, to avoid regeneration troubles, the input required to give an increase of 100 microamperes on the diode meter should never be less than 20 microvolts.

b. INSTALLATION OF UNITS.

(1) RADAR RECEIVER R-54/APR-4.

(a) Attach Mounting MT-171/U to a flat surface at the chosen location in the aircraft or ship. This must be in a position convenient to the operator. Allow sufficient clearance for normal swaying of the unit on the mounting.

(b) Slide Radar Receiver R-54/APR-4 into Mounting Base MT-171/U until the pins at the back of the mounting engage the holes in the back of the receiver case and chassis. Swing the left hand knurled nut on Mounting Base MT-171/U over the catch on the lower left hand corner of the receiver panel and tighten by hand. Secure the knurled nut by means of a safety wire through the holes provided in the nut and in the front cross member of the mounting.

Figure 2-5. Tuning Unit TN-18/APR-4—Mounted in Spare Case

(2) CASES CY-31/APR-4.—Mount Cases CY-31/APR-4 (see figs. 2-5 and 5-1) so that they are conveniently located near Radar Receiver R-54/APR-4 (see figs. 2-1 and 5-2).

(3) TUNING UNITS.—Slide the desired tuning unit (see sec. V, par. 1*b*) into position on the tracks provided in the large rectangular hole in the panel of Radar Receiver R-54/APR-4, properly engaging the plugs and jacks. Swing the right hand knurled nut on Mounting Base MT-171/U over the hold-down lug on the lower right hand corner of the tuning unit panel and tighten by hand. The receiver will then be locked in its mounting base, and the tuning unit in the receiver. Install the remaining tuning units in their cases.

(4) FAN ANTENNA. — Install Antenna Base AB-27/A, connecting to it two 53-inch lengths of Wire W-106-A. Connect a third wire, equal length of Wire W-106-A, to the two free ends. This forms an equilateral triangle with the angle between any two wires of 60 degrees. Connect an Insulator IN-88 at each of the two free corners of the triangle formed by the wires and attach supporting wires to the insulators. Attach one of the supporting wires to the tail assembly and one to the fuselage. Keep the fan as far as possible from the metal skin of the ship. Place a tension unit, Signal Corps Drawing ES-C-52098-A, in the supporting wire.

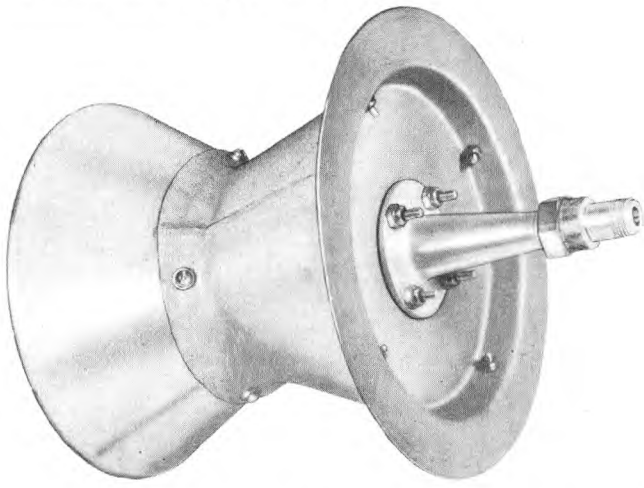


Figure 2-6. Antenna Assembly AT-49/APR-4

(5) ANTENNA AT-49/APR-4.—Mount Antenna AT-49/APR-4 (see figs. 2-6 and 2-7) on the underside of the airplane so that the axis of the cone makes an angle of approximately 45 degrees with the horizontal. When two antennas are used they should be mounted on opposite sides of the ship with the axis

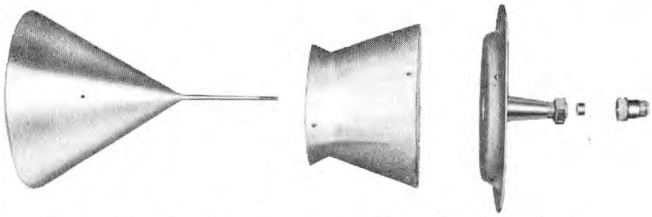


Figure 2-7. Antenna Assembly AT-49/APR-4—Disassembled View

of each of them 45 degrees from the horizontal. Antenna Cover CW-46/APR-4 (see fig. 2-8) or Antenna Cover CW-33/APR-4 is used with the antenna.

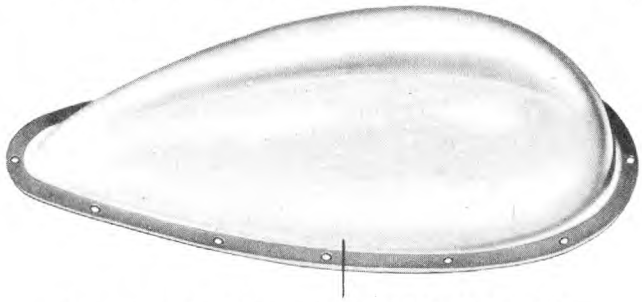


Figure 2-8. Antenna Cover CW-46/APR-4—Exterior View

(6) ANTENNA STUB AT-38/APT. — Mount Antenna Stub AT-38/APT on the underside of the airplane so that the axis of the stub makes an angle of approximately 45 degrees with the horizontal. When two antennas are used they should be mounted on opposite sides of the ship with the axis of each of them 45 degrees from the horizontal.

(7) SWITCHING ASSEMBLY SA-23/APR-4.—Install Switching Assembly SA-23/APR-4 (see figs. 2-9 and 2-10) at a place convenient to the operator of the receiver.

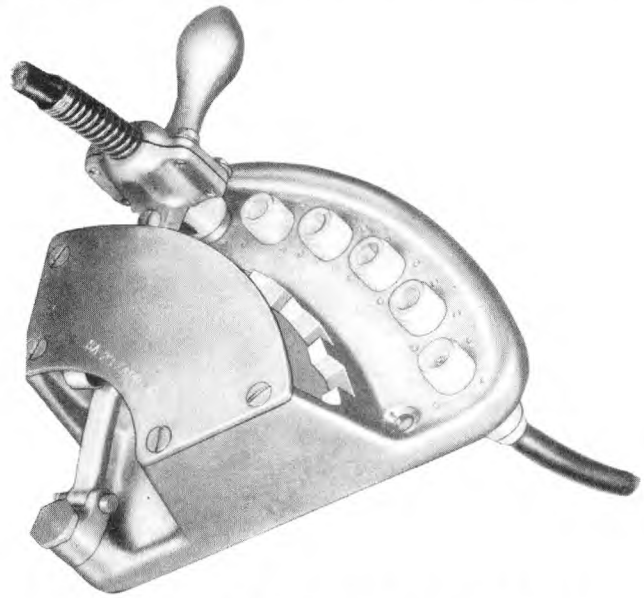


Figure 2-9. Switching Assembly SA-23/APR-4—Front View

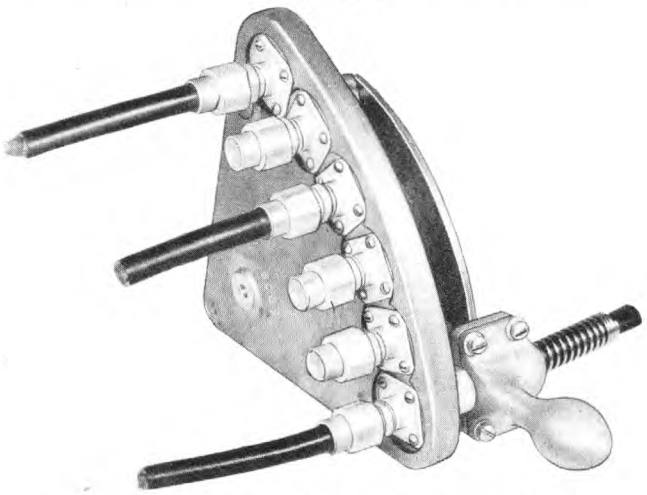


Figure 2-10. Switching Assembly SA-23/APR-4—Rear View

c. CABLING CONNECTIONS.

(See figure 5-4.)

(1) MAKING CABLES.

(a) POWER CABLE.—Attach plug AN3108-22-4S to cable AN-20 as indicated.

(b) ANTENNA CABLES.—Attach Radio Frequency Plug UG-21/U to Radio Frequency Cable RG-8/U as indicated in figure 5-3.

(c) VIDEO CABLE AND PANORAMIC CABLE.—See handbook of operating instructions for panoramic- or pulse-analyzing equipment for information about these cables.

(2) INTERCONNECTION OF UNITS.

(a) ANTENNA CABLES TO SWITCHING ASSEMBLY SA-23/APR-4.—Terminate the coaxial cables from the antennas in the fixed portion of the switch as shown in figures 2-9 and 2-10. Terminate the coaxial cable from the receiver in the place provided in the handle of the switch.

(b) For interconnection of other cables refer to wiring diagram, figure 5-4.

2. AFTER-INSTALLATION TEST.

WARNING

Operation of this equipment involves the use of high voltages which are dangerous to life. The power cable should be disconnected if the receiver is to be removed from its case for inspection or repair.

a. Plug a headset into one of the "PHONE" jacks.

b. Turn i-f gain switch to "AVC ON" position.

c. Turn wide-narrow switch to "W" position.

d. Turn heterotone switch to "OFF" position.

e. Turn power switch to the on position.

f. Check pilot lamp. It must light.

g. Diode meter must read 20 microamperes or more.

h. Turn the volume control clockwise until tube noise is audible in the headset.

i. Turn heterotone switch to the "HET" position. If the heterotone is operating properly, a faint 1000-cycle tone will be audible in the headset. Turn heterotone switch to "OFF" position.

j. Turn i-f gain switch clockwise. There should be no noise audible on positions "74" to "36." From positions "36" to "O," the noise should increase in intensity. On position "O" there should be approximately the same amount of noise as in the "AVC ON" position. Return the i-f gain switch to "AVC ON."

k. Turn the wide-narrow switch to "N." The switch should operate smoothly and the tube noise decrease slightly. Return switch to the "W" position.

l. Turn tuner "DIAL LIGHT" to the "ON" position. "FREQUENCY" dial should be illuminated.

m. Remove sector sweep adjustment cover. Sector sweep arms should rotate freely when the locking nuts are loosened. Tighten the nuts and replace cover.

n. Turn automatic sweep switch to "AUTO-SWEEP." Dial should rotate to end of sector arm and then reverse.

o. Turn sweep motor speed control clockwise. Rate

of sweep should increase. This control will vary the speed from a 1-1 to a 2-1 ratio.

p. Turn automatic sweep switch to "MANUAL." Turn manual tuning control. This should operate smoothly over the entire tuning range.

q. Repeat steps *l* to *p* inclusive with each tuner.

r. If suitable signal sources are available, check overall operation of tuners and receiver by adjusting tuner to the frequency of the test signal. The diode meter deflection should increase when a signal is received.

SECTION III
OPERATION

1. STARTING AND STOPPING THE EQUIPMENT.

a. STARTING EQUIPMENT.—Throw the power switch up to the on position. The pilot lamp should light and the diode meter should read 20 microamperes or more, indicating that power is being applied to the set. Automatic sweep may be provided by placing the automatic sweep switch in the "AUTO-SWEEP" position.

b. STOPPING EQUIPMENT. — Throw the automatic sweep switch to the "MANUAL" position and throw the power switch to the "POWER OFF" position.

2. OPERATION.

(See figure 2-1.)

a. DETECTION AND FREQUENCY MEASUREMENT OF RADIO AND RADAR SIGNALS.—Manual tuning, as explained in sub-paragraph (2) below, is used for the accurate detection and frequency measurement of radio and radar signals. Automatic tuning, explained in sub-paragraph (4) below, is employed for the automatic, continuous coverage of a particular frequency range to determine the presence of radio and radar transmissions and their approximate frequency.

(1) PRELIMINARY.

(a) Select the proper tuning unit (see sec. V, par. 1*b*) for the desired frequency range. Slide it into position in the large rectangular hole in the front panel of the receiver, making sure that it rests upon the tracks provided. Clamp it securely in place with the knurled locking nut located on the right side of the receiver mounting.

(b) Select the proper antenna for the frequency range desired (the fan antenna covers 38 to 95 megacycles, Antenna Stub AT-38/APT covers 74 to 300 megacycles, and Antenna AT-49/APR-4 covers 300 to 3300 megacycles) by means of Switching Assembly SA-23/APR-4. (See figs. 2-9 and 2-10.) To do this, raise the hand lever out of its notch and turn it until it is over the notch associated with the proper antenna; then lower the lever into the desired notch.

(c) Plug the headset into one of the phone jacks.

(d) Turn the i-f gain switch to the "AVC ON" position.

(e) Turn the wide - narrow switch, marked "W— N," to the "N" position when using Tuning Units TN-16/APR-4 and TN-17/APR-4. Turn the switch to the "W" position when using Tuning Units TN-18/APR-4 and TN-19/APR-4.

(f) Throw the power switch up to the on position and allow 30 seconds for the equipment to reach proper operating temperature. At below zero Fahrenheit temperatures, allow ten minutes or more for warm-up.

1. Radar Receivers R-54/APR-4 having a serial number between 26 and 521 are not equipped with a special heater. These models will have considerable hum when operated at temperatures below —49 degrees Fahrenheit. With the heterotone switch on, there will also be a strong 1000-cycle tone in the headset, even though no signal is being received. However, if these equipments were turned on at a higher temperature and kept in continuous operation, they would continue to perform satisfactorily at temperatures as low as —67 degrees Fahrenheit.

2. Radar Receivers R-54/APR-4 with serial numbers other than 26 to 521 inclusive are equipped with a special heater and can be turned on at any temperature down to —67 degrees Fahrenheit, operating satisfactorily after a ten-minute warm-up period.

(g) Advance the volume control clockwise until noise is heard in the headset.

(2) MANUAL TUNING.

(a) Throw the automatic sweep switch to the "MANUAL" position.

(b) Rotate the i-f gain switch clockwise from the "AVC ON" position until the diode meter reads approximately 100 microamperes.

(c) Rotate the manual tuning control until a tone is heard in the headset or an indication is seen on the oscilloscope or panoramic adapter.

(d) Rock the manual tuning control until a maximum diode meter reading is obtained. Turn the i-f gain control counterclockwise, if necessary, to keep the diode meter on scale.

(e) Read the frequency of the received signal on the dial marked "FREQUENCY."

(3) DIFFERENTIATION BETWEEN TRUE RESPONSE AND IMAGE WITH MANUAL TUNING. —Since this receiving equipment uses an intermediate frequency of 30 megacycles, a strong signal may ap-

pear at several places on the dial due to the formation of image frequencies. Therefore, a received signal may be either a true signal which is given by the "FREQUENCY" dial or an image frequency of an extremely strong signal whose true frequency is one other than the "FREQUENCY" dial setting. To determine the true frequency of a signal suspected of being an image, follow the procedure outlined below.

(a) Note the i-f gain switch setting and the diode meter reading.

(b) Tune to the frequency given in the right hand column of the chart below.

Tuning Unit	*Image Frequency*
TN-16/APR-4	Image appears 60 megacycles *below* true response
TN-17/APR-4	Image appears 60 megacycles *below* true response
TN-18/APR-4	Image appears 60 megacycles *above* true response
TN-19/APR-4	Image appears 60 megacycles *above* true response

(c) If the signal received at the setting indicated in the chart above is stronger than the original (refer to par. 2*b* of this section), then the original signal was the image and the latter is the true response. If the signal received at the setting in the chart above is weaker, then the original signal was the true response and the latter is the image.

(4) AUTOMATIC TUNING.

(a) Throw the automatic sweep switch to the "AUTOSWEEP" position.

(b) Adjust the speed at which the tuning range is swept to the desired speed by means of the sweep motor speed control, labeled "SPEED" on the front panel.

(c) Set the frequency limits of the sector to be covered by the automatic sweep.

1. Remove the sector sweep adjustment control cover, located just below the dial marked "FREQUENCY," by rotating it to the left as far as it will go and pulling it outward.

2. Set the two knurled screws under the cover to the ends of the frequency band to be swept. (See fig. 3-1.)

3. Replace the cover by pushing it into place and rotating it to the right.

(d) The receiver is now set up for automatic tuning and will continuously sweep the range selected at the speed selected.

(5) MODULATED AND UNMODULATED SIGNALS.

(a) Modulated signals, such as voice, code, and pulses, may be distinguished audibly by use of the headset. The use of panoramic- or wave-analyzing equipment will assist in the identification of the type of modulation present. (See the instruction books furnished with these accessories for a detailed description of their use.)

Note

When using a pulse analyzer in conjunction with the receiver, set the video gain controls on the receiver and analyzer so that a response of one-quarter to three-quarter inches in height is obtained on the cathode ray tube. Otherwise, too much gain will give a distorted picture of pulse duration.

(b) If there is no modulation present on the signal carrier being received, there will be no sound in the headset when the heterotone switch is in the "OFF" position. Throw this switch up to the on position to make an unmodulated signal audible. With the heterotone switch in the on position, excessive noise will also appear as an audible 1000-cycle note. Therefore, when using the heterotone switch, set the i-f gain switch as low as possible in order to keep spurious tones due to noise at a minimum.

b. RELATIVE MEASUREMENT OF SIGNAL STRENGTH.

Note

Relative field strengths can be determined to an accuracy of approximately 30 percent. Do not attempt comparisons between frequencies requiring different tuning units, since the tuning units differ in sensitivity.

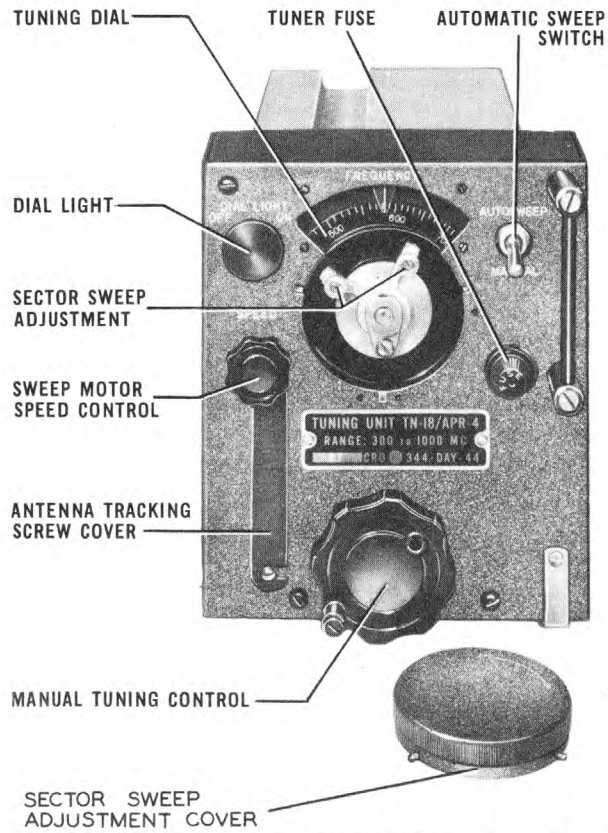


Figure 3-1. Tuning Unit TN-18/APR-4—Front View with Sector Sweep Cover Removed

(1) Tune in one of the signals to be compared as described in sub-paragraphs *a* (1), (2), and (3) of this paragraph.

(2) Adjust the i-f gain switch for a mid-scale reading of the diode meter.

(3) Note the diode meter reading and the setting of the i-f gain control.

(4) Tune in the other signal to be compared as in steps (1), (2), and (3) above.

(5) If the i-f gain switch was in the same position when receiving both signals, their relative strengths can be determined simply by taking the ratio of their diode meter readings.

(6) If it was found necessary to rotate the i-f gain switch clockwise to keep the second meter reading on scale, the first signal was of greater amplitude than the second.

(7) If it was found necessary to rotate the i-f gain control counterclockwise to keep the second meter reading on scale, the first signal was of lesser amplitude than the second.

SECTION IV
EMERGENCY OPERATION AND REPAIR

1. EMERGENCY OPERATION.

a. HETEROTONE CIRCUIT.—In case of failure of the circuit, turn the heterotone switch to "OFF." The presence of unmodulated (CW) signals will be indicated by an increased deflection of the diode meter and by a change in the sound of the "tube noise" in the headset.

b. VIDEO AMPLIFIER.—In case of failure of the video amplifier (in Amplifier AN-27/APR-4) received signals will be indicated by increased deflection of the diode meter.

c. HEATER AND THERMO SWITCH. — The heater and thermo switch are provided to keep the ambient temperature of the electrolytic condensers correct for proper operation. The heater is wound around the condenser can of condenser C-109-2. The switch is constructed to close at approximately —13°F (—25°C) automatically and to open at approximately —4°F (—20°C). The electrolytic condensers fail to operate properly at temperatures below —22°F (—30°C). The switch will have to be replaced in the following cases:

(1) SWITCH FAILS TO CLOSE.—If the switch fails to close, no heat will be applied to the condensers and they will freeze, thus causing a hum in the receiver.

(2) SWITCH FAILS TO OPEN.—If the switch does not open, excessive heat will be applied to the condenser causing damage to it. When the switch opens normally at —4°F (—20°C) the temperature of the set keeps the condensers at the proper temperature. This usually takes about 10 minutes from the time the equipment is turned on.

2. FUSE REPLACEMENT.

A blown fuse in Radar Receiver R-54/APR-4 is indicated if the pilot lamp does not light and the diode meter shows no indication when the power switch is turned on. A blown fuse in the tuning unit is indicated by failure of the automatic sweep motor to run when the automatic switch is turned to "AUTO-SWEEP" and the sweep motor speed control turned full clockwise. Receiver or tuner fuses may be replaced as follows:

a. Turn power switch to "POWER OFF" and automatic sweep switch to "MANUAL."

b. Unscrew fuse cap (see fig. 2-1) by turning counterclockwise.

c. Withdraw cap and fuse from body of holder.

d. Remove burned-out fuse from cap.

e. Insert new fuse into cap.

CAUTION

Use only two ampere-type 4AG fuses for replacement.

f. Replace cap and fuse.

3. LAMP REPLACEMENT.

a. TO REPLACE RECEIVER PILOT LAMP.

(1) Remove red jeweled cap (see fig. 2-1) by pulling outward on knurled ring.

(2) Remove bulb by pressing it in and rotating it counterclockwise.

(3) Replace with new 6- to 8-volt bulb, single contact bayonet base (Mazda 47 or equal).

(4) Replace jeweled cap and rotate it until the locking springs engage the notches in the body of the assembly.

b. TO REPLACE TUNING UNIT DIAL LIGHT.

(1) Remove dial light knob by pulling it straight outward.

(2) Remove bulb by pressing in and rotating counterclockwise.

(3) Replace with new 6- to 8-volt bulb, single contact bayonet base (Mazda 47 or equal).

(4) Replace dial light knob and rotate it until the stop pin engages the slot.

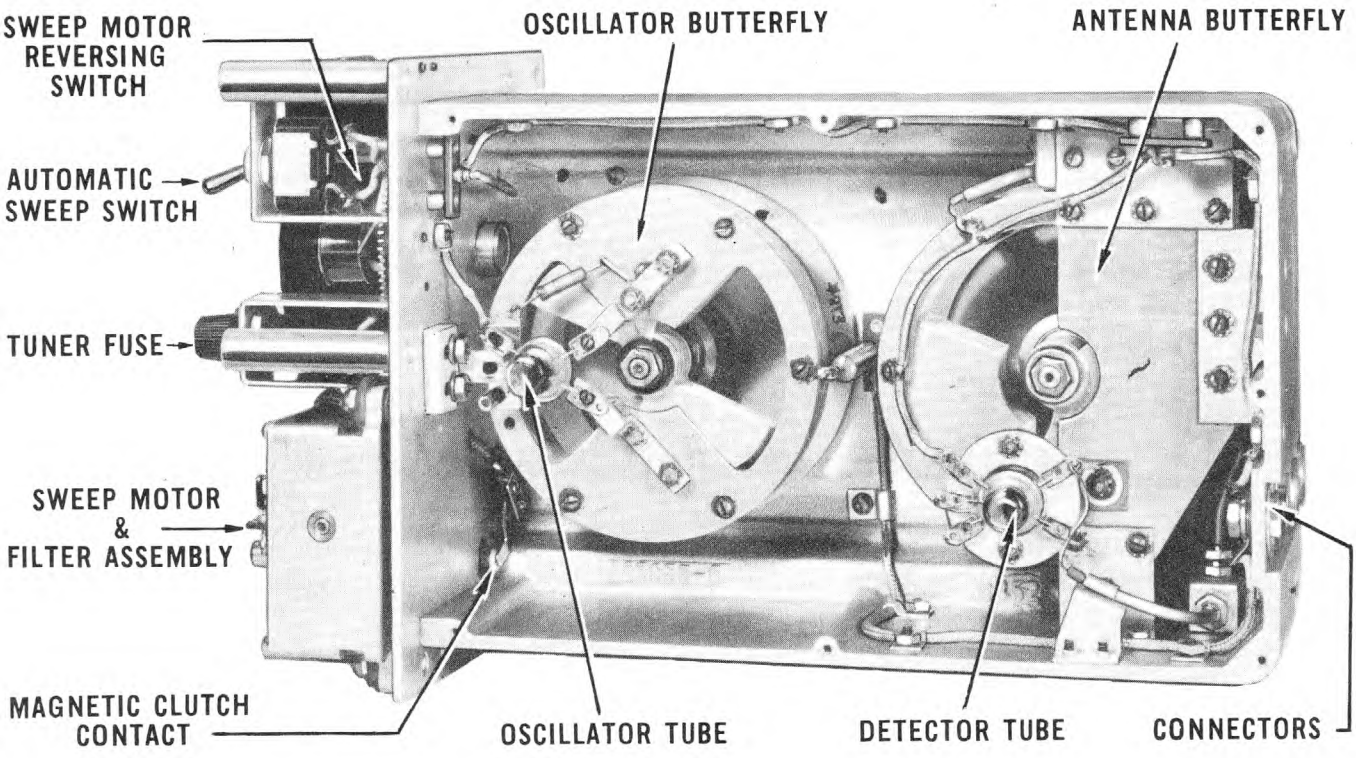


Figure 4-1. Tuning Unit TN-17/APR-4—Right Side View, Covers Removed

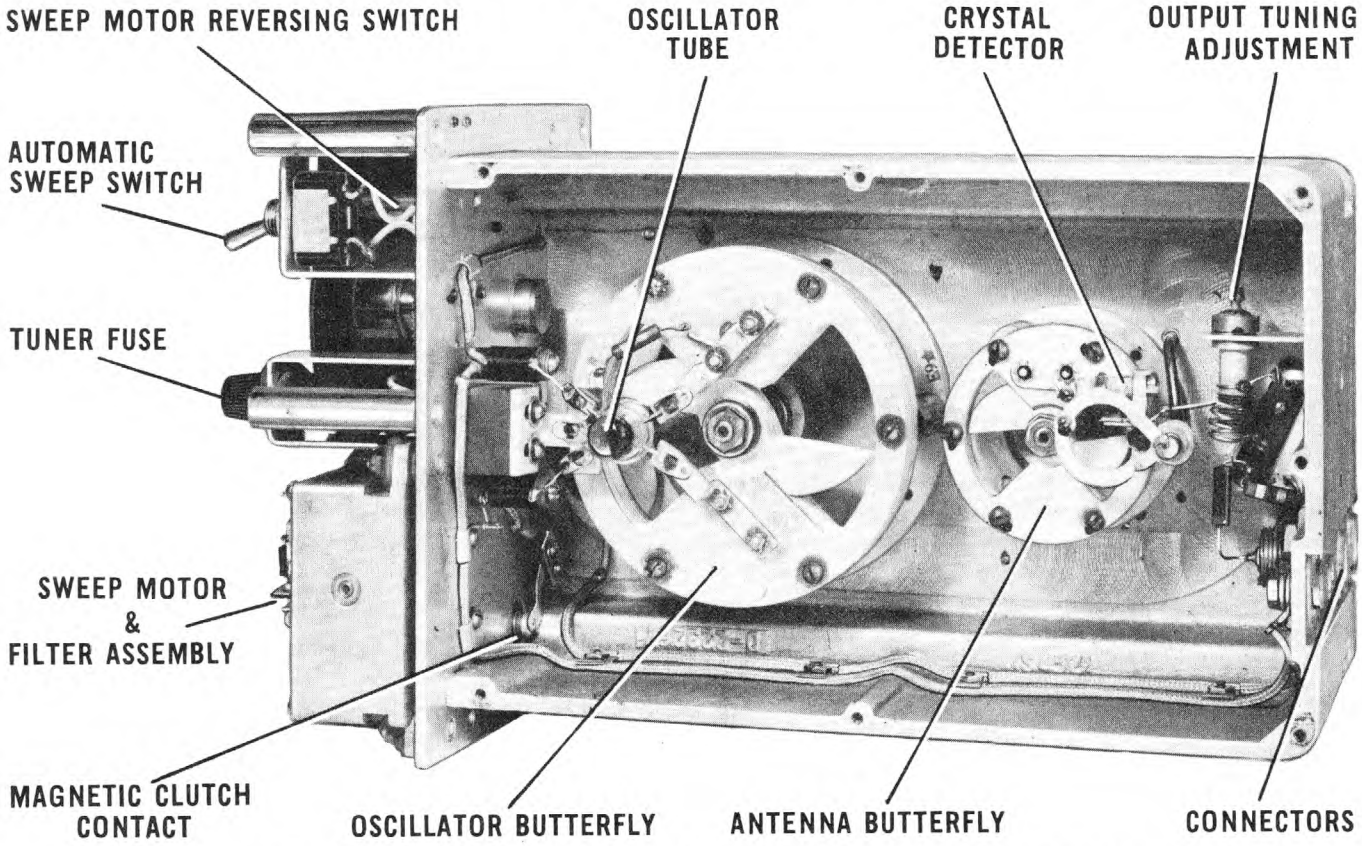


Figure 4-2. Tuning Unit TN-18/APR-4—Right Side View, Covers Removed

4. TUBE REPLACEMENT.

a. GENERAL.—Faulty tubes may be indicated by loss of sensitivity and volume or failure of the heterotone generator. The filament in all glass tubes should glow a dull cherry red when the power is on. Except at extremely low temperatures all metal tubes should feel warm or hot when touched. (See fig. 2-2, amplifier tubes; fig. 4-1, Tuning Unit TN-17/APR-4 tubes; fig. 4-2, Tuning Unit TN-18/APR-4 tubes.)

b. REPLACEMENT OF RADIO RECEIVER R-54/APR-4 (INCLUDING AMPLIFIER AM-27/APR-4) TUBES.

(1) Disconnect all cords and loosen the two knurled hold-down nuts at the lower corners of the receiver panel. Remove the receiver from Mounting Base MT-171/U.

(2) Remove the screws in the top of the case and loosen the fasteners in the rear of the case.

(3) Withdraw the receiver from the case.

(4) Replace defective tube by one known to be good. Use JAN-type tubes as indicated by each socket.

(5) Slide receiver into the case; lock rear fasteners, and replace top screws.

(6) Return receiver to mounting base and tighten hold-down nuts securely.

(7) Connect all cables and cords.

c. REPLACEMENT OF TUBES OR CRYSTALS IN TUNING UNITS.

(1) Loosen the hold-down nut which is located under the right hand corner of the tuning unit.

(2) Withdraw the tuning unit from Radar Receiver R-54/APR-4.

(3) Remove the flat screws holding the cover to the tuning unit housing (left side cover on Tuning Unit TN-16/APR-4 and right side cover on Tuning Units TN-17/APR-4, TN-18/APR-4, and TN-19/APR-4).

(4) Replace faulty tube or crystal.

(5) Replace the cover and slide the tuning unit into place in Radar Receiver R-54/APR-4.

(6) Tighten the hold-down nut securely.

IMPORTANT

Changing tubes may affect the dial calibration and the sensitivity to some extent; however the units will still be operative and should be realigned and recalibrated only with the aid of suitable test equipment.

SECTION V
SUPPLEMENTARY DATA

TABLE 5-1. SERVICE CONDITIONS

Service Conditions	*Limiting Factors*
Temperature range	—67 to 162 F. —55 to 72 C.
Altitude range	0 to 50,000 ft.
Humidity range	0 to 95%

TABLE 5-2. TUNING UNIT FREQUENCY DATA

Tuning Units	*Frequency Range in Megacycles*	*Accuracy of Frequency Calibration*	*Oscillator Range in Megacycles*
TN-16/APR-4	38 to 95	1%	68 to 125
TN-17/APR-4	74 to 320	1%	104 to 350
TN-18/APR-4	300 to 1000	1%	135 to 485
TN-19/APR-4	950 to 2200	1%	306.6 to 790

NOTE

The following alternate tuning units may be used.

Tuning Unit	*Frequency Range in Megacycles*	*Tuning Unit*	*Frequency Range in Megacycles*
TU-57-A	300 to 1000	TU-59-A	975 to 3300
TU-57-B	300 to 1000	TN-1/APR-1	38 to 95
TU-58-A	74 to 320	TN-2/APR-1	74 to 320
TU-58-B	74 to 320	TN-3/APR-1	300 to 1000
TU-56-A	38 to 95	TN-4/APR-1	Tentative

TABLE 5-3. TUBE COMPLEMENT OF RADAR RECEIVER R-54/APR-4

Reference Symbol	*Stock No.*	*Type Designation* (Jan)	*Type Designation* (VT)	*Function*	*Location of Spares*
V-101-1 to V-101-7	2J-6AC7	JAN-6AC7	VT-112	I-F amplifiers and video amplifiers	None
V-102	2J-6H6	JAN-6H6	VT-90	Detector	None
V-103	2J-6AG7	JAN-6AG7	VT-247	Video amplifier	None
V-104-1 and V-104-2	2J-5Y3GT	JAN-5Y3GT	VT-197-A	Power supply	None

TABLE 5-4. FUSE COMPLEMENT

Type No.	*Stock No.*	*Current Rating*	*Location (Active Fuse)*	*Spare Fuse*
4AG	3Z2602.7	2 ampere	Panel	None

TABLE 5-5. PILOT LAMP COMPLEMENT

Type Designation	*Stock No.*	*Location (Active)*	*Spare*
Mazda Type 47 6-8 volt	2Z5952	Panel	None

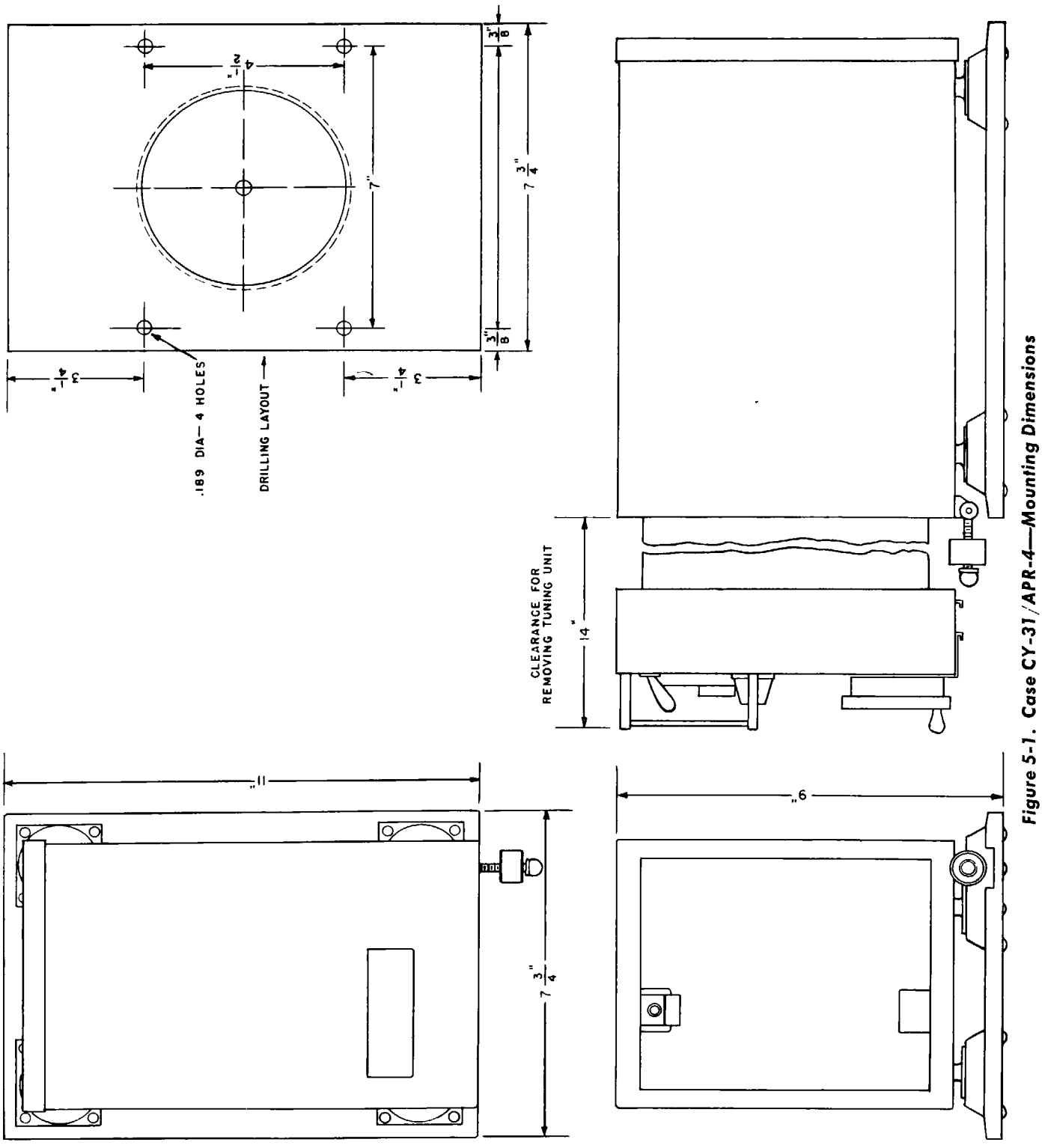


Figure 5-1. Case CY-31/APR-4—Mounting Dimensions

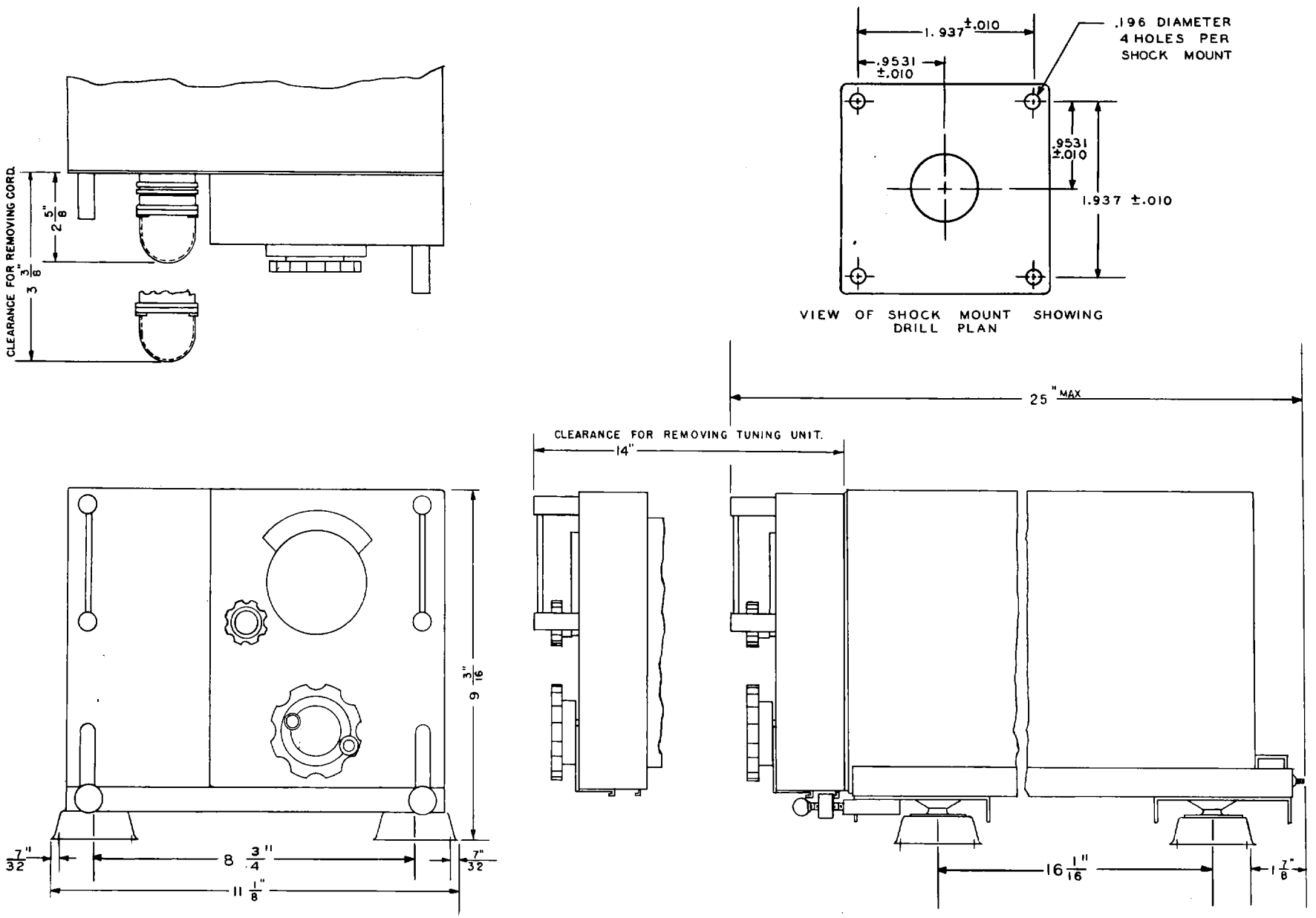
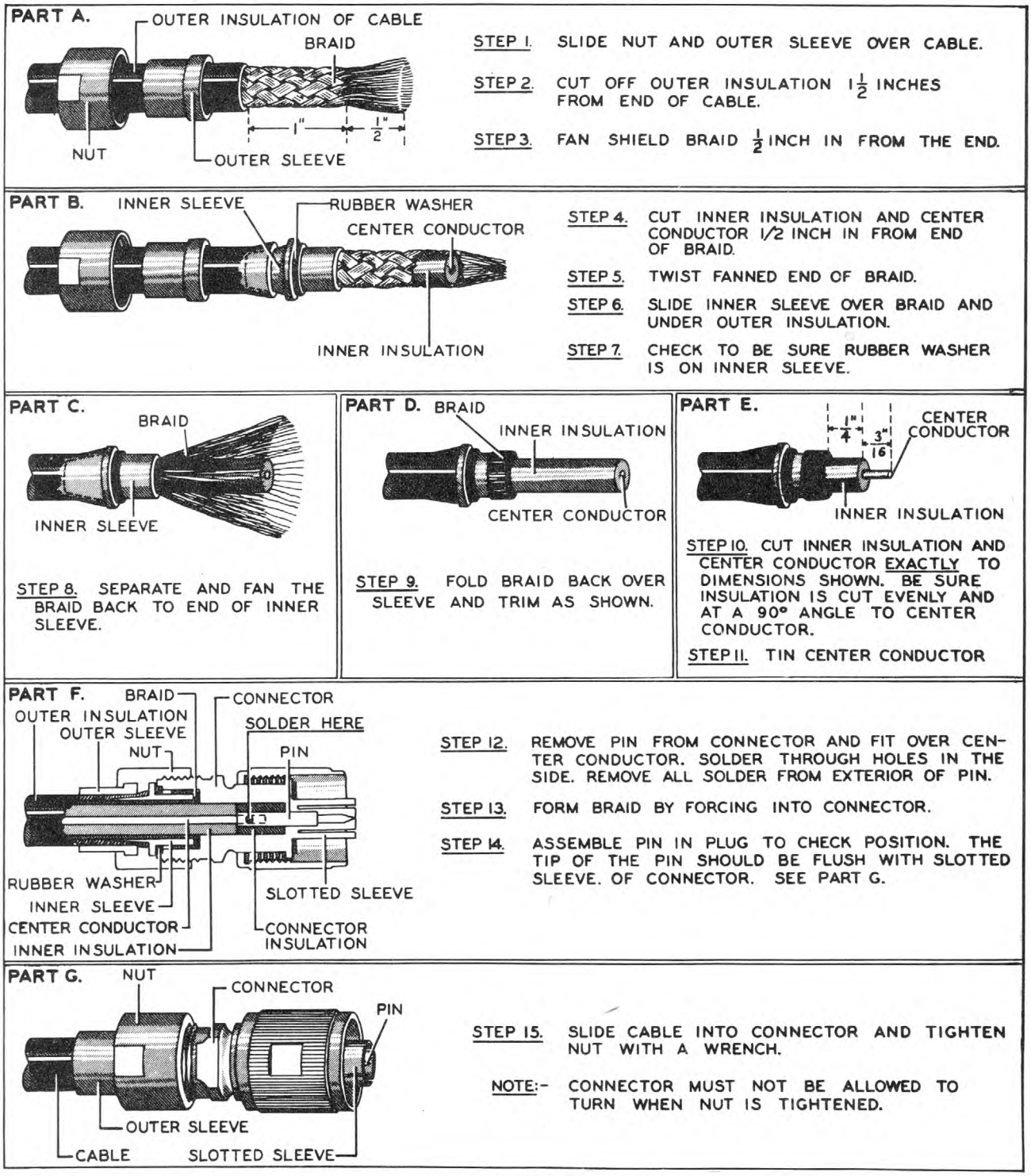


Figure 5-2. Receiving Equipment AN/APR-4—Mounting Dimensions

IMPORTANT

These plugs will cause a mis-match of impedance in the circuit unless the instructions given below are followed exactly. Extreme care must be taken in cutting the cable insulation so that no air gaps exist between the insulation of the cable and the plug.



NOTE

Plug and jack are put on cable in the same manner.

Figure 5-3. Installation Instructions for Radio Frequency Plug UG-21/U (Formerly referred to as Navy Type C-49268 or simply Type N Plug)

RESTRICTED
AN 08-30APR4-2

WIRE TABLE

ALL WIRE TO BE AIRCRAFT CABLE PER SPEC. AN-J-C-48 UNLESS OTHERWISE SPECIFIED

\+ INDICATES INDIVIDUALLY SHIELDED WIRES PER SPEC. 95-27273

⊗ INDICATES WIRES WHOSE VOLTAGE DROP MUST NOT EXCEED LIMITS OF SPEC. 95-32310

REF. NOTE	WIRE NO.	MAXIMUM OPERATING VOLTAGE	MAX ALLOWABLE RESISTANCE IN OHMS (70°C)	MINIMUM CABLE SIZE PERMITTED
4	1757	115 A.C.	.500	AN-20 ⊗ +
4	1758	28 D.C.	.700	AN-20 ⊗
4	1759	115 A.C.	.500	AN-20 ⊗ +
	1760	0	.020	AN-20 ⊗

NOTES:-

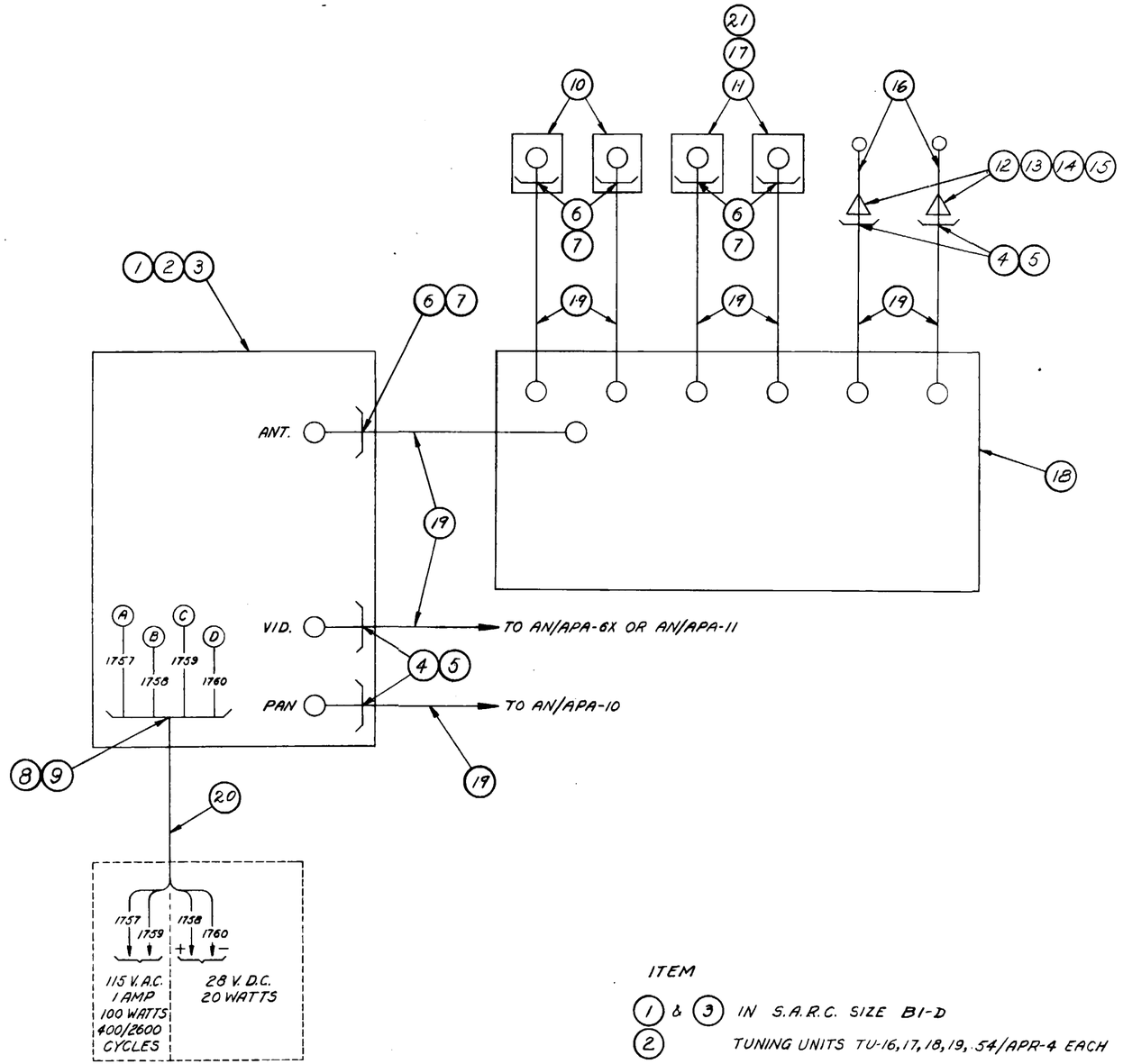
5 CASES CY-31/APR-4 SHALL BE MOUNTED CLOSE TO THIS EQUIPMENT AND THE SPARE TUNING UNITS INSTALLED IN THEM.

4 IF WIRE 1758 IS ROUTED CLOSE TO OR THROUGH AN INTERFERENCE AREA, IT SHOULD BE SHIELDED. WIRES 1757 AND 1759 SHOULD BE SIZE AN-16 SHIELDED, BECAUSE OF THE HIGH SENSITIVITY OF THIS RECEIVER. THIS WIRE WAS PROCURED IN BULK ON THE BASIS OF 60 FEET PER INSTALLATION.

3 TUNING UNIT TN-54/APR-4 WILL NOT BE AVAILABLE IN EARLY PRODUCTION. SHOULD BE AVAILABLE ABOUT SEPTEMBER 1944.

2 SPECIFIC REQUIREMENTS MAY REQUIRE THE USE OF ONE OF EACH TYPE OF ANTENNA FOR COMPLETE BAND COVERAGE OR TWO OF EACH TYPE (ONE ON EACH SIDE OF AIRPLANE) FOR COMPLETE BAND COVERAGE ON BOTH SIDES OF AIRPLANE. THIS WILL INCREASE THE QUANTITY REQUIRED OF ITEMS AS NOTED IN COMPONENT TABLE.

1 ALL TERMINAL STRIPS REQUIRED IN THE INSTALLATION OF THE WIRING SHALL BE MADE OF SUITABLE INSULATING MATERIAL AND WITH TERMINAL SPACING TO PREVENT VOLTAGE BREAKDOWN.



ITEM	WEIGHT
(1) & (3) IN S.A.R.C. SIZE B1-D	32.25
(2) TUNING UNITS TU-16,17,18,19,.54/APR-4 EACH	12.75

COMPONENT TABLE

	ITEM	QUAN. REQ'D.	EQUIPMENT NOMENCLATURE		SPEC OR INSTALLATION DRAWING
			DESCRIPTION	TYPE NO.	
*	1	1	RADAR RECEIVER	R-54/APR-4	H44G3448
*	2	1	TUNING UNIT	TN-16/APR-4	
*	3	1	MOUNTING BASE	MT-171/U	H44G3448
*	4	3 OR 4	PLUG (NOTE 2)	PL-259	H43G11747
*	5	3 OR 4	ADAPTER (NOTE 2)	M-359	H43G11747
*	6	3 OR 5	RADIO FREQUENCY PLUG	UG-21/U (NOTE 2)	H44D9867
*	7	3 OR 5	RADIO FREQUENCY ADAPTER	UG-27/U (NOTE 2)	
*	8	1	PLUG	AN-3108-22-45	AN 9534
*	9	1	ADAPTER	AN-3057-12	AN 3057
*	10	1 OR 2	ANTENNA STUB (NOTE 2)	AT-38/APT OR AT-38-A/APT	
*	11	1 OR 2	ANTENNA (NOTE 2)	AT-49/APR-4	
*	12	1 OR 2	ANTENNA SUPPORT (NOTE 2)	AB-27/A	
*	13	2 OR 4	INSULATOR (NOTE 2)	IN-88	
*	14	1 OR 2	TENSION UNIT (NOTE 2)		
*	15	1 OR 2	THIMBLE AN 100-3 (NOTE 2)	AN-100-3	AN100
*	16	AS REQ'D	WIRE	W-106-A	
*	17	1 OR 2	ANTENNA COVER (NOTE 2)	CW-33/APR-4 OR CW-46/APR-4	
*	18	1	SWITCHING ASSEMBLY	SA-23/APR-4	H44B26605
*	19	AS REQ'D.	RADIO FREQUENCY CABLE	RG-8/U	
*	20	AS REQ'D	CABLE (SHIELDED)	AN-16 (NOTE 4)	95-27273
*	21		BASE ASSEMBLY FOR ANT. COVER CW-33/APR-4		
*		1	TUNING UNIT	TN-17/APR-4	
*		1	TUNING UNIT	TN-18/APR-4	
*		1	TUNING UNIT	TN-19/APR-4	
*		1	TUNING UNIT (NOTE 3)	TN-54/APR-4	
*		4	CASE (NOTE 5)	CY-31/APR-4	

* - INDICATES GOVERNMENT FURNISHED EQUIPMENT

Figure 5-4. Receiving Equipment AN/APR-4—Cording Diagram

RESTRICTED