AIRCRAFT COMMUNICATION EQUIPMENT

TRANSMITTER MODEL AVT-15 OR MODEL AVT-15A
RECEIVER MODEL AVR-20A
ANTENNA SYSTEM MODEL AVA-120

U. S. Signal Corps Contract No. W-2126 SC-22
Date of Contract: 19 January, 1942
Order No. 163-WFSCPD-42

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Manufactured by
RCA Manufacturing Company, Inc.
Camden, N. J., U. S. A.

A SERVICE OF THE RADIO CORPORATION OF AMERICA

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COMMUNICATION SYSTEM
TECHNICAL SUMMARY

ELECTRICAL CHARACTERISTICS—

Transmitter Unit:

Type of Transmission ..... Telephone

Frequency Range ..... 2500-6700 kc

Frequency Control ..... Low Temperature-Coefficient V-Cut Crystal

Frequency Stability ..... 0.02 per cent

Power Output (Maximum) at 3105 kc, into 19-ohm resistive antenna:

Model AVT-15 ..... 7.6 watts

Model AVT-15A ..... 6.5 watts

Power Supply:

Model AVT-15 ..... 10.8-14.4 v d.c.

Model AVT-15A ..... 5.4-7.2 v d.c.

CURRENT CONSUMPTION:	**Transmit**	**Standby**
Model AVT-15	5.7 amperes	0.95 ampere
Model AVT-15A	10.2 amperes	1.75 amperes

Receiver Unit:

Type of Reception ..... Phone and cw

Tuning Frequency Range ..... 2300 to 6700 KC

Intermediate Frequency ..... 455 kc

Average Selectivity (23 kc off resonance) ..... 60 db

Sensitivity (6 milliwatts output) ..... 5 microvolts

Current Consumption:

Heater (6 volt Model) ..... 1.05 ampere at 6 volts

Heater (12 volt Model) ..... 0.6 ampere at 12 volts

Plate ..... 57 ma at 250 volts

Output Impedance ..... 2000 ohms

TUBE COMPLEMENT—

Transmitter Unit:

Oscillator 1 RCA-6L6

Modulator 1 RCA-6L6

Voltage Limiter 1 RCA-991

Receiver Unit:

RF Amplifier 1 RCA-6S7

First Detector—Oscillator 1 RCA-6K8

IF Amplifier—CW Oscillator 1 RCA-6F7

Second Detector—AVC-Output 1 RCA-6B8

Voltage Regulator 1 RCA-991

MECHANICAL SPECIFICATIONS—

	Height	**Width**	**Depth**	**Weight**
Transmitter Unit	7 13/16 inches	8 7/16 inches	10¾ inches	18.5 pounds
Receiver Unit	5 5/16 inches	6⅜ inches	5 13/16 inches	6.2 pounds

(Weight of transmitter unit includes remote control panel and cable.)

EQUIPMENT

The Aircraft Communication System includes the following items:

	Item	Stock No.
1	Model AVT-15 Transmitter (12 volt), **or**	MI-5881
1	Model AVT-15A Transmitter (6 volt)	MI-5882
1	Model AVR-20A Receiver (12 volt), **or**	MI-5978A
1	Model AVR-20A Receiver (6 volt)	MI-5979A
1	Remote Control Panel and Connecting Cable	MI-5883A
1	Interconnecting Cable	MI-5884A
1	AVA-120 Antenna System	MI-19705-1 or MI-19705-3

EQUIPMENT OPERATION

This equipment consists of a Model AVR-20A Aircraft Receiver, either 6-volt or 12-volt, a Model AVT-15 (12 volt) or a Model AVT-15A (6 volt) Aircraft Transmitter, and a Model AVA-120 Antenna System. These units comprise a complete aircraft communication installation for communication from the aircraft to ground stations or to other aircraft. The equipment is simple and direct in operation, and the following instructions outline the steps necessary to operate this equipment.

CAUTION—The transmitter must not be operated in a hangar or while the plane is being fueled or near fuel supplies.

1. Plug in headphones and microphone in respective jacks.
2. Throw ship's master battery switch to ON position.
3. Turn receiver on by rotating volume control clockwise.
4. Set VAR.-CRYSTAL switch to variable tuning. Crystal tuning is available only when crystals are used in receiver.
5. Tune receiver carefully to desired signal. The use of CW position is very helpful in spotting desired signal when awaiting for desired signal to appear.
6. For CW reception throw CW-PHONE switch to CW; for phone reception throw CW-PHONE switch to PHONE.
7. To operate transmitter throw ON-OFF switch on either remote control panel or on transmitter to ON position. Jewel lights on remote control panel and transmitter panel should glow, indicating that transmitter is on. Receiver must be on before transmitter can be turned on.
8. Allow 30 seconds for filaments to warm up.
9. Set transmitter controls and antenna for desired frequency and selected operation as indicated on TUNING CHART.
10. Press microphone switch and talk directly into microphone with lips barely touching.
11. To turn transmitter off, reverse above procedure. Receiver and transmitter can both be turned off by means of receiver volume control.
12. Master battery switch must always be turned off before leaving ship.

NOTE: Antenna current must always register on meter when transmitting. Failure to do so may be caused by improper adjustments, especially with transmitter TUNING control being set too sharp (by favoring too much towards the low number side).

For further information on the adjustment and operation of this equipment, see the following pages which describe each unit in detail.

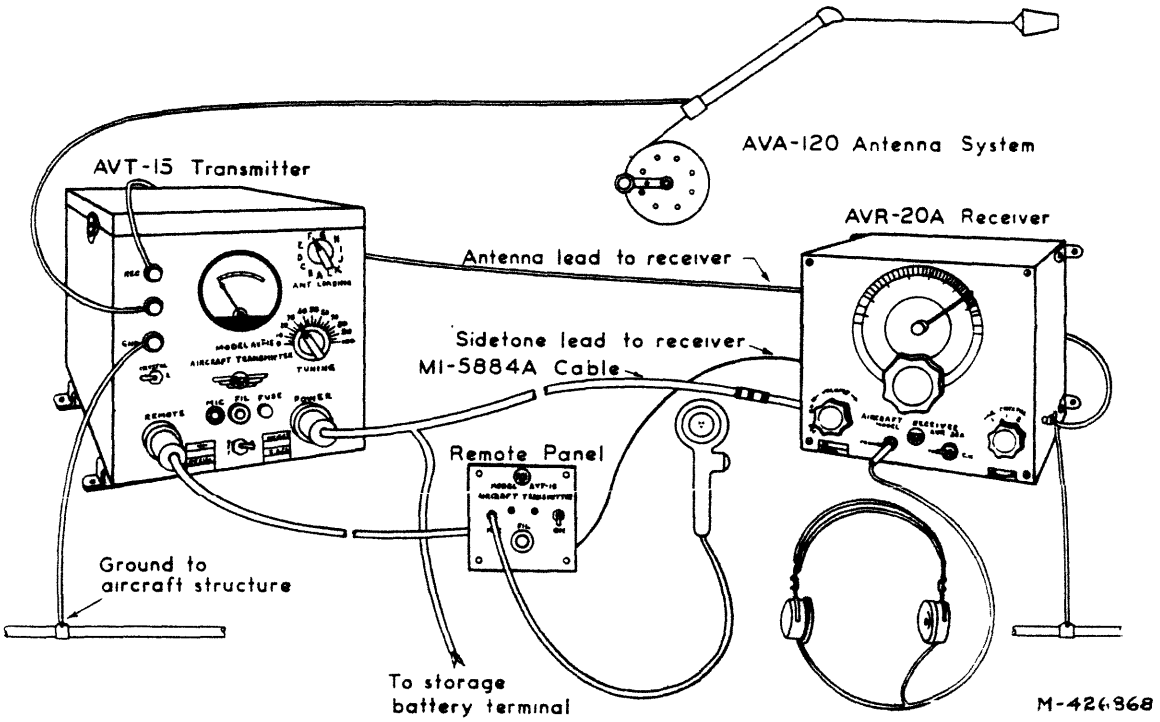


Figure 1—Interconnection Diagram of Aircraft Communication Equipment

SECTION II

TRANSMITTER UNIT

DESCRIPTION

The Models AVT-15 and AVT-15A Aircraft Transmitters provide means for establishing reliable radio-telephone communication over moderate distances on any frequency within the band of from 2500 to 6700 kilocycles. The equipment is small in size and light in weight, thus being especially suited to installation in small aircraft or as auxiliary equipment in large aircraft. Except for the difference in the battery supply voltage, these transmitters are identical and will therefore be considered as one unit.

The transmitter is mounted in a small lacquer-finished aluminum case which is equipped with two shock-insulated mounting brackets. Mounted on the front panel are the following items:

1. Antenna current-indicating meter
2. Antenna loading switch
3. Oscillator tuning control
4. Power-supply cable-receptacle
5. Filament switch
6. Pilot lamp
7. Fuse holder
8. Microphone jack
9. Remote-control cable-receptacle
10. Crystal selector switch
11. Antenna, Ground and Receiver binding-posts

Two RCA-6L6 tubes are employed in the transmitter, one as a crystal-controlled oscillator and the other as a modulator.

Two crystal mounting sockets are provided in the transmitter. These sockets are located on the top of the chassis to the left of the oscillator plate inductance and in front of the oscillator tube. The socket nearest to the edge of the chassis will be referred to as crystal socket No. 1, the other as No. 2. Operative connection to either socket is provided by the double-pole double-throw crystal selector switch (S3).

Operation of the transmitter on any frequency within the band of from 2500 to 6700 kilocycles may be obtained by installing a crystal ground to the desired frequency and tuning the transmitter to resonance as described in the "Basic Tuning Procedure" section of this book.

Operation on the second harmonic of the crystal frequency may be obtained by retuning the transmitter if the *harmonic* lies within the frequency range 2500 to 6700 kc.

Plate and screen voltages for the transmitter tubes are obtained from the filtered output of a synchronous vibrator. A filter section is connected across the terminals of the vibrator to reduce surge voltages and sparking of the vibrator.

Direct current for the microphone is obtained from the voltage drop across resistor R4 which is located in the cathode circuit of the modulator tube.

An important feature of this equipment is the provision for using the plate voltage supply of the transmitter to furnish plate voltage to an aircraft receiver. Thus, the weight and cost of a separate plate voltage supply for the receiver is eliminated.

Approximately 110 milliamperes at 250 volts is available from the power supply of the AVT-15 transmitter for the operation of any suitable receiver.

The following RCA receivers may be operated from an AVT-15 (12 volt) Transmitter:

a—1 or 2 Model AVR-15's
b—1 or 2 Model AVR-20A's (12 volt)
c—1 Model AVR-15 and 1 Model AVR-20A (12 volt)

The Model AVT-15 Transmitter is wired at the factory to provide the proper plate voltage for the operation of a Model AVR-20A Receiver. Figure 2 shows the changes that must be made in the connections between the taps on the voltage-dropping resistor (R8) to accommodate the other combinations.

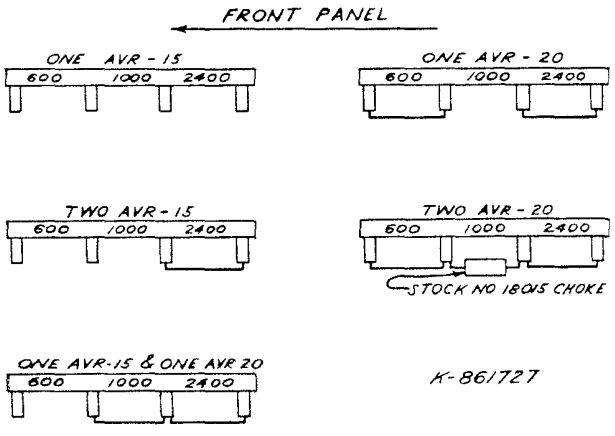


Figure 2—Dropping resistor connections in Model AVT-15 (12 volt) Transmitter (K-861727)

Approximately 60 ma. at 230 volts is provided by the power supply of the Model AVT-15A (6 volt) Transmitter. This power is available for the operation of any suitable receiver such as the Model AVR-15A or the Model AVR-20A (6 volt) If less than 230 volts is required from the AVT-15A Transmitter for the operation of other equipment, the jumper should be removed from resistor R8 in the power supply circuit.

Attention is called to the difference in terminal connections (1 to 8) as shown in the schematic diagrams (Figures 3 and 4) for the alternative conditions where the transmitter is used with or without an associated receiver. The transmitter is wired at the factory for use with an AVR-20A Receiver.

REMOTE CONTROL PANEL. A Model MI-5883A Remote Control Panel with its associated connecting cable allows remote control operation of the transmitter. This unit consists of a 3¼" x 3¼" panel, drilled for mounting in a standard "A-N" instrument opening, and a six-wire cable. Mounted on the panel are a microphone jack, a pilot lamp, and a filament switch.

TRANSMITTER INSTALLATION

The transmitter unit is equipped with mounting plates attached to the shock mounting straps by means of wing nuts. These plates are drilled for mounting screws and may be mounted on any suitable horizontal surface within the plane. The transmitter case may then be attached and secured by means of the wing nuts which are drilled for safety wires.

The remote control panel should be mounted within easy reach of the pilot or operator. The card on which the tuning information is recorded *must* be located well within the operator's range of vision.

A good ground connection to the metal fuselage of the plane is necessary and may be made by using a piece of ½-inch or larger metal braid, preferably brazed to the fuselage; however, it may be clamped by means of a ground clamp to a clean bright area on any nearby metal structural member.

Control and power cables should be anchored firmly in their sockets by means of the locking rings provided with each plug. Sufficient slack in the cables is necessary to provide freedom of action for the shock mounts and ease of removing the equipment from the mounting case.

Battery connections must be clean and tight and *kept that way* to insure prompt starting of the vibrator and to maintain the full voltage at the transmitter. *Deviation from proper voltage will cause short tube life and poor transmitter performance.* The transmitter is fused for 10 amperes in the Model AVT-15 and for 20 amperes in the Model AVT-15A.

The yellow sidetone lead from the transmitter control panel should be connected to the receiver output circuit. A small tip jack is provided at the back of the receiver for this purpose.

TRANSMITTER TUNING

CAUTION—Because of the battery current drain required to operate the transmitter, never use the aircraft battery for extended adjustments or transmissions on the ground. Disconnect the aircraft battery and use a heavy duty battery connected externally to the main bus of the ship if extended tuning adjustments are to be made. Adjustments should be made with the ship outside the hangar and away from any gasoline supply to avoid fire hazards in case of accidental arcing during operation.

BASIC TUNING PROCEDURE. The following is a step-by-step procedure to be observed in adjusting the transmitter:

1. Disconnect the antenna from the transmitter at the binding post marked "ANT"

2. Install a crystal ground to the desired frequency in crystal socket No. 1 or 2 and set the Crystal Selector switch to the proper position, depending on which crystal socket is used.

3. Connect the frequency-band tap lead to the proper tap (A, B, or C) located at the rear end of the oscillator plate tank inductance (L2) inside the transmitter. The frequency band covered by each of these taps is indicated by the table on page 8.

4. Connect an external milliammeter having a range of 0-100 ma. in the oscillator plate circuit. Leads from the meter should be connected to a telephone plug, with the lead from the *positive* (+) side of the meter connected to the *tip* of the plug. Insert the plug in the oscillator plate-current-meter jack (J2). This jack is located on the right-hand side of the chassis, between the oscillator tube and the vibrator.

5. Turn on the AVR-20A Receiver by rotating the volume control clockwise, and turn the transmitter filament switch to the "ON" position either at the transmitter or at the remote control panel and allow the tubes to heat up. The jewel light on the transmitter and on the remote control panel should glow, indicating that the transmitter is on. The receiver must be on before the transmitter can be turned on.

6. Plug a microphone into the microphone jack on the transmitter or on the remote control panel. Press the microphone switch button and rotate the "TUNING" control on the front panel of the transmitter to resonance. Resonance is indicated by *minimum* oscillator plate current, which should be about 15 or 20 ma.

7. To insure crystal starting and stable operation, decrease the capacitance by turning the "TUNING" control in the direction of the higher numbers until the plate current *increases* about five (5) ma. above its minimum value. Check the crystal starting by triggering the microphone switch button several times. The plate current meter should indicate the same reading each time the button is pressed. Lock the "TUNING" control in position and then attach the antenna to the binding post marked "ANT"

8. The transmitter should now be tuned to the antenna, and the plane should be taken into the air for this adjustment.

With the plane flying level at cruising speed, press the microphone button and let out the antenna while watching the antenna current meter on the front panel of the transmitter. As the antenna length increases, the current will gradually increase until a maximum is reached, after which it will begin to decrease. Carefully reel in and let out the antenna until it is certain that the peak in the antenna current has been reached. The "ANT. LOADING" switch (S4) should be left on tap A. The antenna current peak should be between 0.45 and 0.6 ampere for a plate current indication of from 45 to 55 ma. If the plate current is not within these limits, adjust the coupling tap switch (S5) inside the transmitter to the proper tap to obtain the correct value of plate current. Readjust the "TUNING" control to obtain minimum plate current and maximum antenna current after each tap change. To accomplish this, first unlock the control by rotating locking ring to the left (counterclockwise) and adjust the "TUNING" control as necessary. Operate the microphone "PRESS-TO-TALK" button several times to make certain that the oscillator starts readily as indicated by the plate current meter and the antenna current meter. If intermittent or poor oscillator starting is evident, slightly rotate the "TUNING" control clockwise from the optimum setting toward the *higher* numbers, recheck the crystal operation and, when satisfactory, relock the control. Check the transmitter modulation by whistling into the microphone, during which time the antenna current should increase about 20 per cent, which indicates complete modulation.

It may be found, while the antenna is being adjusted, that the oscillator will stop as the antenna current approaches a maximum and will start again as the antenna is let out farther. Instead of continuing to a maximum, however, the antenna current will decrease as more antenna is let out. In other words, an antenna-current maximum cannot be reached by adjusting the antenna length. In this case, adjust the "TUNING" control slightly, and again reel in and let out the antenna until the peak in antenna current is reached and the oscillator starts consistently when the microphone switch button is triggered.

Record the number of antenna turns, "TUNING" control setting, and other pertinent readings on the tuning chart.

To adjust the transmitter for short-distance communication from the ground or the air with the antenna entirely reeled in, the antenna loading coil must be used. With the transmitter turned on, and the antenna connected, press the microphone switch button and rotate the "ANT. LOADING" switch *clockwise* until *maximum* antenna current is obtained. Readjust the "TUNING" control for *minimum* plate current. The antenna current reading will be somewhat higher than that which is obtained with a trailing antenna. Lock the "TUNING" control and record the dial settings on the tuning chart.

The output system of this transmitter is sufficiently flexible to permit efficient transfer of energy to any general type of antenna despite a comparatively wide variation in dimensions. By means of the coupling tap switch, coupling, up to six turns in one-half turn steps can be obtained. This will provide operation into antennas having a resistance component of from 1 to 40 ohms, providing the antenna is resonant; that is, the reactive component is tuned out.

The length of antenna which should be released can be stated only approximately since the overall antenna characteristics are affected by the length and mechanical disposition of the flexible conduit within the fuselage as well as the length of wire actually trailing the ship. The following table indicates approximate practical lengths:

Frequency in KC	Approximate Total Length (subtract length inside fuselage)
3000	75 feet
4000	55 feet
5000	45 feet
6000	40 feet

To obtain the approximate antenna length for frequencies other than those given in the preceding paragraph, use the following formula:

$$L = \frac{233{,}000}{f} - K$$

in which:

L = Antenna length, outside fuselage (feet)
K = Antenna lead-in, transmitter to fairlead (feet)
f = Frequency (kc)

Band	Frequency Range (KC)
A	2500 to 6200
*B	2700 to 6400
C	3000 to 6700

* Connected to this tap at factory.

The transmitter is supplied for operation on the fundamental frequency of any crystal within the 2500-6700 kc range. The transmitter may also be operated at the second harmonic frequency of any crystal if this *harmonic* is within the frequency range 5000 to 6700 kc. If harmonic operation is desired, the jumper across condenser C-1 in the oscillator circuit should be removed. For harmonic operation, the crystal should be placed in crystal socket No. 1 and the "CRYSTAL" selector switch in position No. 1. The transmitter is supplied with a 330 mmfd. condenser as C-1 for harmonic operation in the frequency range 5900 to 6400 kc. To obtain harmonic operation outside this range, it will be necessary to change the value of condenser C-1. The amount of capacitance required to insure operation on the desired frequency may be obtained from the following table:

Condition	Fundamental Range (KC)	Second Harmonic Range (KC)	Cathode Tuning Capacitance for Second Harmonic Operation (C1) mmfd
1	2500-2800	5000-5600	560 (Stock No. 12537)
2	2800-2950	5600-5900	390 (Stock No. 13894)
*3	2950-3200	5900-6400	330 (Stock No. 12952)
4	3200-3350	6400-6700	150 (Stock No. 12725)

* Operative condition as connected at factory.

Example: For a frequency of 4000 kc in a ship having a lead-in (distance between transmitter and entrance fairlead) of five feet, the approximate antenna length for one-quarter wavelength should be:

$$L = \frac{233{,}000}{4{,}000} - 5 = 58.25 - 5 = 53 \text{ feet, 3 inches}$$

The exact length cannot be pre-calculated because in some installations the lead-in or flexible antenna conduit may be closer to the metal structure of the ship than in others, and this variation in distance affects the total length of antenna required for resonance.

TRANSMITTER FREQUENCY RANGE. To cover properly the fundamental range of 2500 to 6700 kc, the oscillator tank coil (L2) is tapped, thus dividing the range into three bands. Referring to Figure 5, a side view of the tank coil is shown identifying the coil taps which are designated as Bands A, B, and C. To change bands, the frequency-band tap lead must be unsoldered and resoldered to the proper tap. The fundamental coverage of each band is as follows:

To tune the transmitter to a harmonic frequency, use the following procedure:

Place the crystal in crystal socket No. 1 and the "CRYSTAL" selector switch in position No. 1. Unlock the "TUNING" control and disconnect the antenna. Press the microphone switch button and rotate the "TUNING" control toward the high-numbered position of the dial, and at the same time observe the reading on the plate current meter. A dip in the plate current will be noted at two points, one toward the high-numbered end of the dial and the other at the low-numbered end. The dip at the high-numbered end is the second harmonic frequency of the crystal; the dip at the low-numbered end is the crystal fundamental frequency. Select the dip at the high-numbered end and adjust the setting of the control to obtain minimum plate current (about 15 to 20 ma.), then detune slightly on the high-frequency (higher-numbered) side of resonance until the plate current increases approximately five ma., to insure oscillator starting, then re-attach the antenna lead to the transmitter. Take the plane into the air and let out the antenna until a peak antenna current is obtained, as explained on the preceding pages.

TRANSMITTER MAINTENANCE

GENERAL CARE. The equipment has been carefully designed and strongly constructed; therefore with ordinary care, it should function in a satisfactory manner over long periods of time. For best results, a definite schedule of inspection should be established.

The complete equipment should be inspected and cleaned at regular periods, at the time of top engine overhauls, or every 60 days if the transmitter is used frequently. At this time, the tubes should be checked and the relay contacts cleaned. To clean relay contacts, use carbon tetrachloride (carbona) applied with a soft brush, then burnish the contacts with a burnishing tool, such as a Stock No. 22963 Contact Cleaning Tool. *When cleaning relay contacts, do not distort the contact springs.*

The vibrator unit should under no circumstances be tampered with. If its operation is unsatisfactory and no fault is found with wiring or other components, the vibrator should be replaced. Adjustment of the vibrator unit is impossible since it is hermetically sealed in a metal shell. The life of the vibrator unit is conservatively set at 200 hours of operation. It is recommended that spare tubes and a spare vibrator be carried with the equipment.

The tubes are equipped with clamps to insure their permanent location in sockets. *When replacing tubes, tighten these clamps only just enough to insure positive contact between the flange on the tube and the arm on the clamp.*

SERVICE HINTS. A study of the schematic diagram is necessary for intelligent service and maintenance of this equipment. By the use of the schematic diagram and a resistance meter, open or shorted circuits can be quickly located. The tubes can be readily tested in any modern tube tester.

CAUTION—When making extensive ground tests, disconnect the aircraft battery and connect an external battery of high current capacity to the main bus of the ship. If this equipment is installed in an aircraft equipped with electrically fired flares, make sure that the flare wiring is thoroughly shielded and the shielding thoroughly grounded. Never operate this equipment when the ship is in the hangar, is being fueled, or is near fuel storage. Be sure to turn the filament switch "OFF" when making any changes to the equipment. Avoid contact with any of the component parts while the transmitter is in operation; severe shock and damage to the equipment may result from carelessness. When taking voltage readings, be sure that the test prods are well insulated.

Localizing the Source of Trouble. If a transmitter failure occurs, a systematic check is usually the quickest way to ascertain the cause of this failure.

(a) If the transmitter has normal RF output but no modulation, it is natural to assume that the trouble is in the audio circuit. Check the microphone, the modulator tube, and the various component parts of the audio circuit to locate trouble of this nature. Condenser C-6 should be carefully checked as a possible cause of such trouble. Low modulation may be directly due to improper tuning of the transmitter.

(b) If there is no RF output, as indicated by the antenna current meter or by a milliammeter connected in the plate circuit of the oscillator tube through jack J2, the tuning should be checked. Sluggish or intermittent starting of the oscillator may be caused by the tuning capacitor being adjusted to the incorrect (low-numbered) side of resonance. Make sure that the proper tap is used on the tank coil to cover the range of the frequencies used. Also check to see that the proper value of capacitor C-1 in the oscillator circuit is used to cover the range of the crystal frequencies used when the transmitter is being operated on the second harmonic of the crystal frequency. The relay contacts should also be checked and kept absolutely clean, but not polished. The very slight roughness that normal cleaning leaves on these contacts materially aids the relay in being self-cleaning. All jack and switch contacts should be checked.

(c) Should the voltages be low on the transmitter as a whole, it is natural to assume that the trouble is in the power supply circuit. Normal plate supply voltage at the tube plate terminals is approximately 300 volts. Check to see that the battery rating of the aircraft electrical system corresponds with the rating of the transmitter. Low voltages may be due to defective or leaky operation of condensers C-9 and C-10 in the power supply circuit.

(d) Complete failure of the equipment to operate may be due to the plane's storage battery being completely discharged, an open fuse, or to a broken lead.

The aircraft battery should be checked to see that it is properly charged. If the vibrator fails to start, it will be frequently found that the only trouble is that the battery is badly run down and in need of a charge.

Slightly reduced over-all voltage in the various high-voltage leads accompanied by an abnormally high vibrator noise level in the side-tone is an indication of faulty vibrator operation. A check should be made to see that the grounding ring on the vibrator is clean. A defective vibrator should always be replaced.

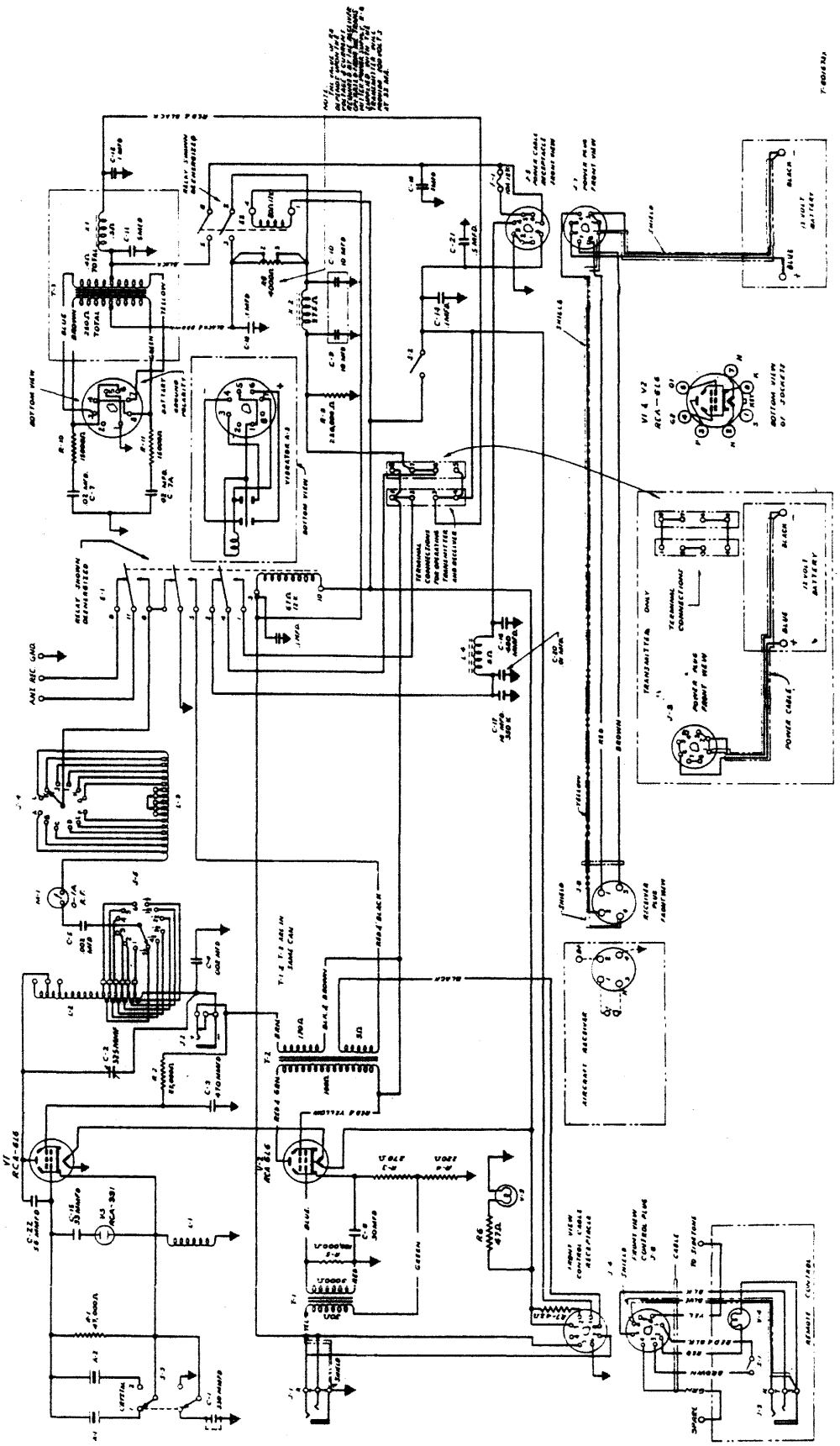


Figure 3—Model AVT-15 Transmitter (12 volt) Wired for use with an Associated Receiver (Schematic T-601673X)

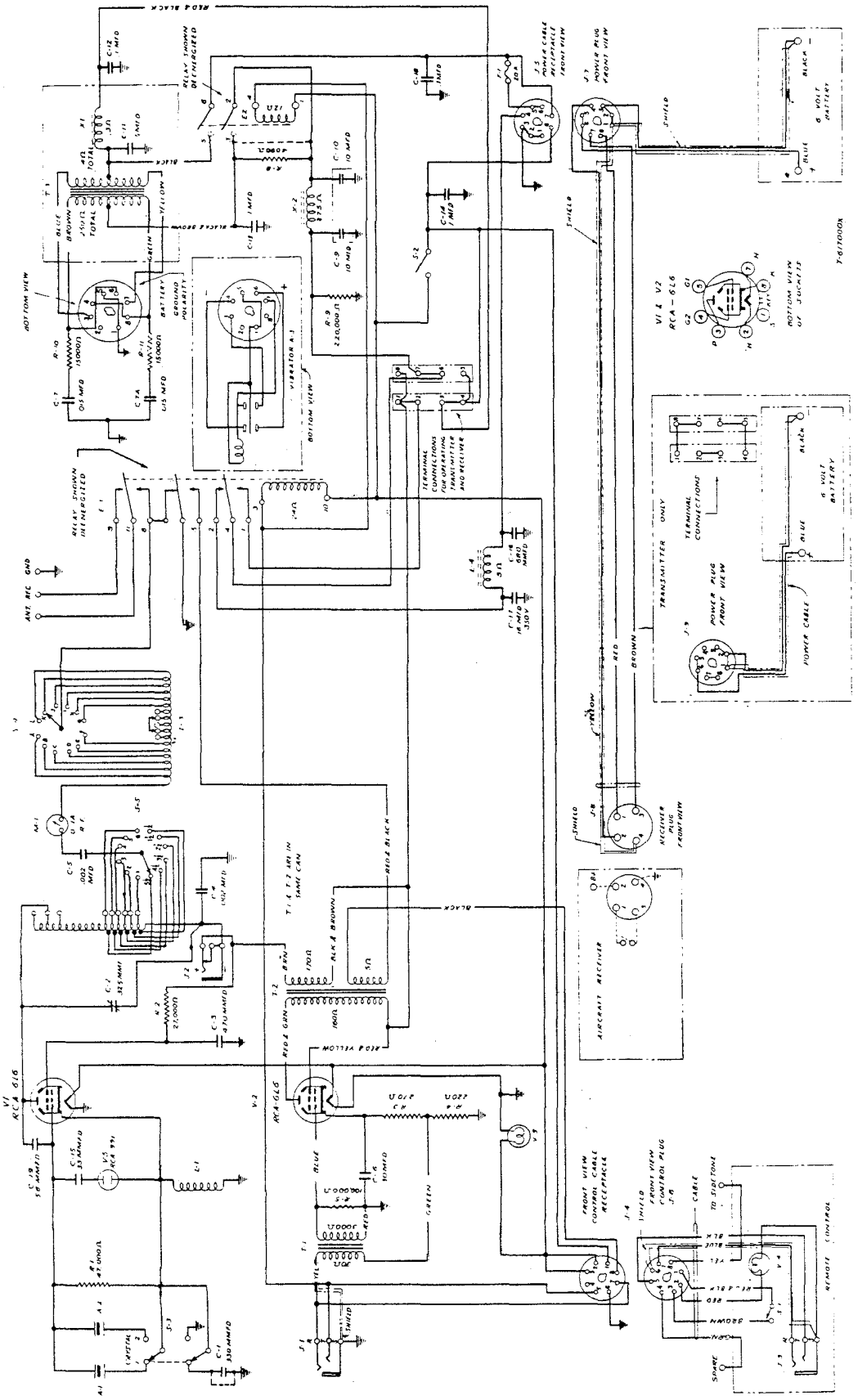


Figure 4—Model AVT-15A Transmitter (6 volt) Wired for use with an Associated Receiver (Schematic T-617000X)

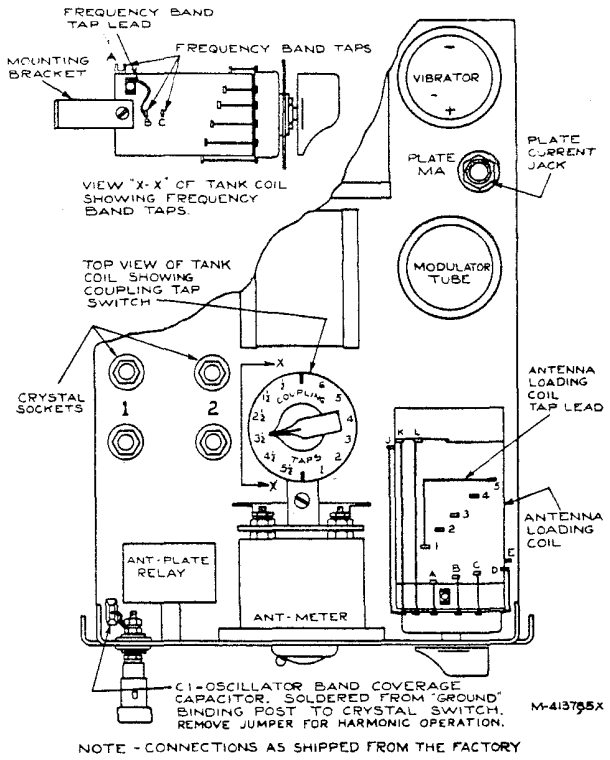


Figure 5—Transmitter Band Change (Connections M-413785X)

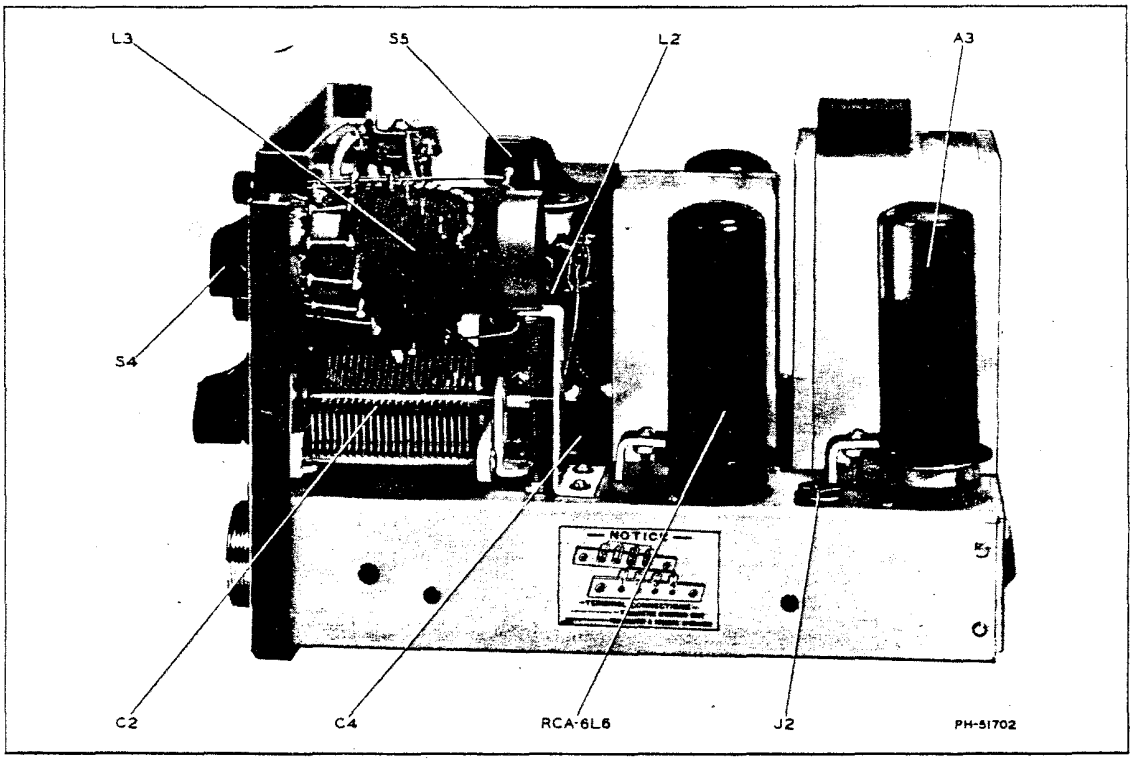


Figure 6—Transmitter Chassis (Right-Hand Side View)

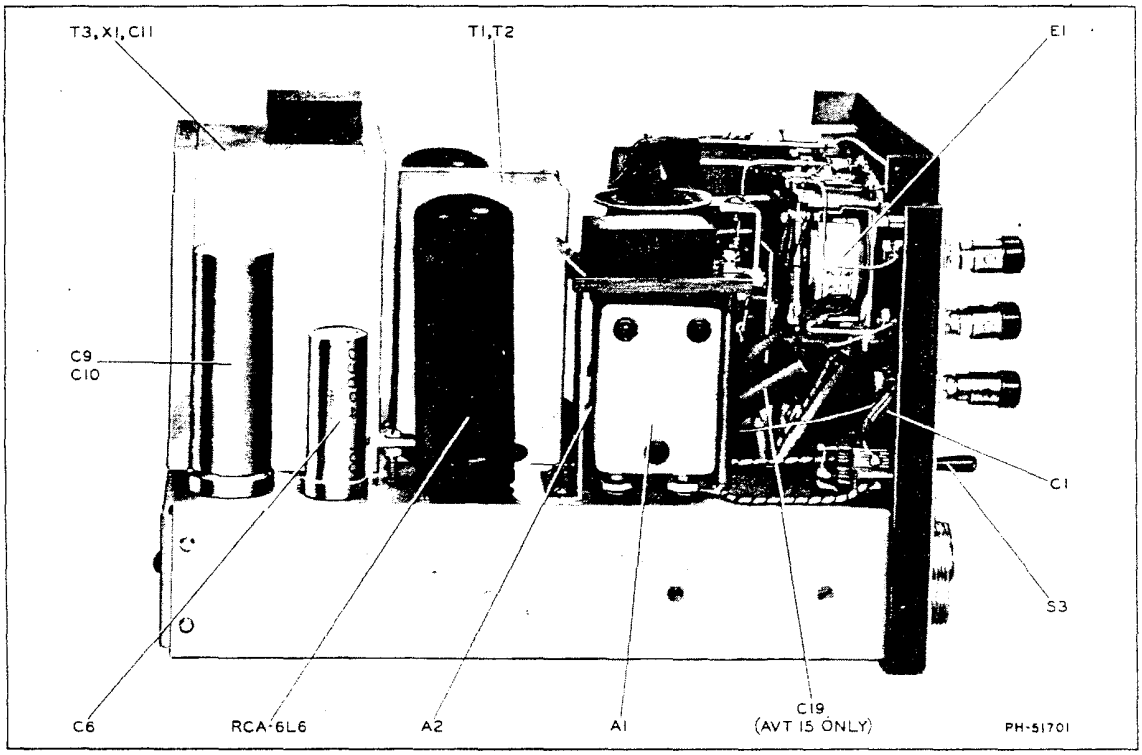


Figure 7—Transmitter Chassis (Left-Hand Side View)

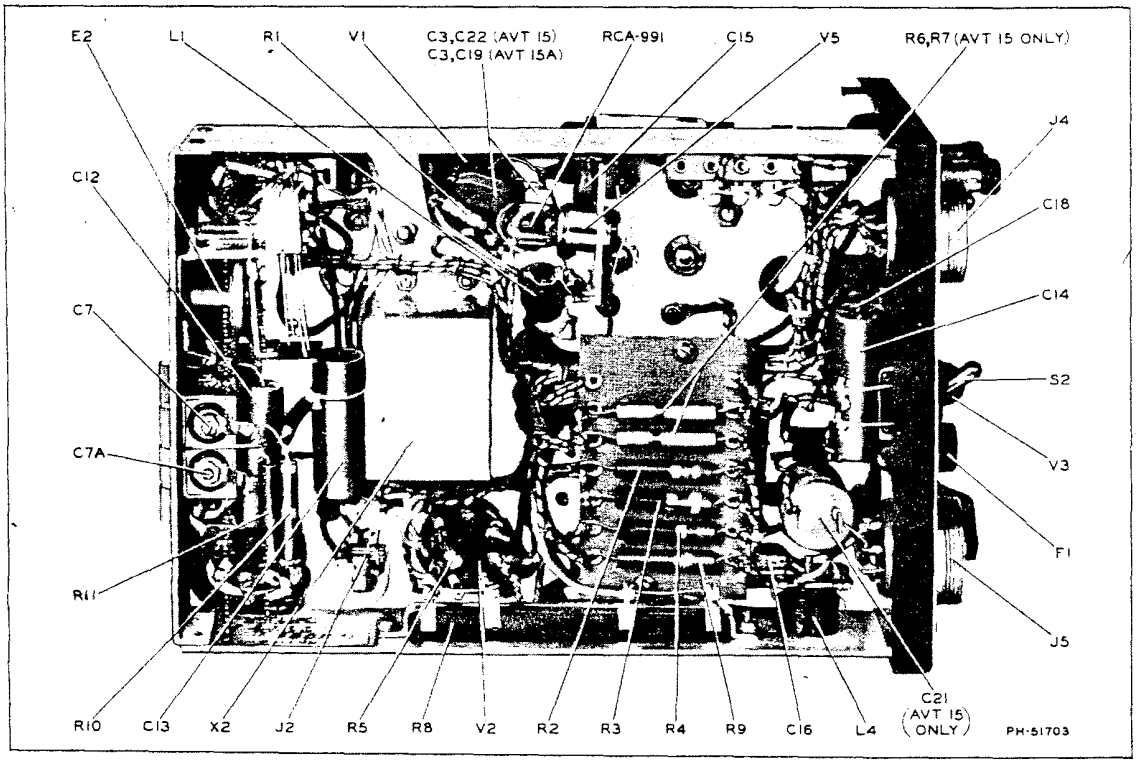


Figure 8—Transmitter Chassis (Bottom View)

TRANSMITTER PARTS LIST

MODEL AVT-15 TRANSMITTER UNIT (MI-5881)

Symbol No.	Description	Stock No.	Symbol No.	Description	Stock No.
	ELECTRICAL ITEMS		L3	Coil, antenna loading	18189
			L4	Coil, r-f choke	33169
A1, 2	Quartz Crystal (specify frequency) AVA-10		M1	Meter, 0-1 ampere r-f	18188
	Socket, crystal holder, General Radio Type 274S		R1	Resistor, 47,000 ohms, ¼ watt	12412
			R2	Resistor, 27,000 ohms, 1 watt	13477
			R3	Resistor, 270 ohms, 1 watt	30497
			R4	Resistor, 220 ohms, 1 watt	30496
A3	Vibrator, plug-in, 12 volts	18204	R5	Resistor, 100,000 ohms, ¼ watt	14560
	Socket, plug-in vibrator	18195	R6, 7	Resistor, 47 ohms	18190
A4	Lamp, panel indicator	31480	R8	Resistor, 4,000 ohms, tapped	43911
	Socket, panel indicator lamp	31365	R9	Resistor, 220,000 ohms, 1 watt	30684
			R10, 11	Resistor, 15,000 ohms, 1 watt	5114
	Jewel, panel indicator lamp, ruby, Drake Mfg. Co., Type 40		S2	Switch, S.P.S.T. toggle type	7900
			S3	Switch, D.P.D.T. toggle type	12956
			S4, 5	Switch, 12-contact, rotary	18191
C1	Capacitor, 330 mmfd	12952	T1	Transformer, microphone, combined in pack with T2	18208
C2	Capacitor, 325 mmfd, tuning	18196			
C3	Capacitor, 470 mmfd	30433	T2	Transformer, modulation, combined in pack with T1 (See T1)	
C4, 5	Capacitor, 0.002 mfd, 2,500 v, (Sangamo Type BE-25)		T3	Transformer, plate power, combined in pack with C11 and XI	18206
C6	Capacitor, 40 mfd, 25 v	19807			
C7, 7A	Capacitor, double section, 0.02 mfd each section	5070	X1	Reactor, combined in pack with T3 and C11 (See T3)	
C9, 10	Capacitor, double section, 10 mfd each section	32342	X2	Reactor, plate power filter	5066
			V1, 2	Socket, octal base tube	31319
C11	Capacitor, 0.5 mfd, combined in pack with T3 and X1 (See T3)		V3	Socket panel indicator lamps	31365
C12, 13, 14	Capacitor, 0.1 mfd	4839		MISCELLANEOUS ITEMS	
C15	Capacitor, 33 mmfd	12984			
C16	Capacitor, 680 mmfd	14498		Binding Post, "XL" Laboratories, Type B1	
C17	Capacitor, 16 mfd, 350 v	32405		Cable, battery power supply, approximately 10 feet long, complete with 8-contact female plug	18210
C18	Capacitor, same as C12				
C19, 20	Capacitor, 0.01 mfd	4858			
C21	Capacitor, 0.5 mfd	43910		Plug, battery power supply cable, 8-contact, female	30115
C22	Capacitor, 5.6 mmfd	12814			
E1	Relay, antenna (12 v)	18199		Cable, side tone, 6 feet long, complete with 8-contact, male plug	18312
E2	Relay, power (12 v)	18197			
F1	Fuse, 10 amperes	6148			
	Fuse Holder, Littlefuse, Type 1075, black			Plug, side tone, cable, 8-contact, male	18212
J1	Jack, microphone	17469		Clamp, tube and vibrator	18192
J2	Jack, tuning meter	7961			
J4	Receptacle, remote control cable (female)	18194		Knob, antenna loading and oscillator coupling control	7960
J5	Receptacle, power cable (male)	30110			
L1	Coil, oscillator cathode tuning	18201		Locking Wheel, tuning control	18193
L2	Coil, oscillator plate tank	18209			

MODEL AVT-15A TRANSMITTER UNIT (MI-5882)

Symbol No.	Description	Stock No.	Symbol No.	Description	Stock No.
	ELECTRICAL ITEMS		C1	Capacitor, 330 mmfd	12952
			C2	Capacitor, 325 mmfd, tuning	18196
A1, 2	Quartz Crystal (specify frequency) AVA-10		C3	Capacitor, 470 mmfd	30433
	Socket, crystal holder, General Radio Type 274S		C4, 5	Capacitor, 0.002 mfd, 2,500 v (Sangamo Type BE-25)	
			C6	Capacitor, 40 mfd, 25 v	19807
			C7, 7A	Capacitor, 0.015 mfd	12233
A3	Vibrator, plug-in (6 v)	18205	C9, 10	Capacitor, double section, 10 mfd each section	32342
	Socket, plug-in vibrator	18195			
A4	Lamp, panel indicator	31480	C11	Capacitor, 0.5 mfd, combined in pack with T3 and X1 (See T3)	
	Jewel, panel indicator lamp, ruby, Drake Mfg. Co., Type 40		C12, 13, 14	Capacitor, 0.1 mfd	4839
			C15	Capacitor, 33 mmfd	12984

Symbol No.	Description	Stock No.	Symbol No.	Description	Stock No.
C16	Capacitor, 680 mmfd	14498	T1	Transformer, microphone, combined in pack with T2	18208
C17	Capacitor, 16 mfd, 350 v	32405	T2	Transformer, modulation, combined in pack with T1	(See T1)
C18	Capacitor, same as C12		T3	Transformer, plate power, combined in pack with C11 and X1	18207
C19	Capacitor, 5.6 mmfd	12814	X1	Reactor, combined in pack with T3 and C11	(See T3)
E1	Relay, antenna (6 v)	18200	X2	Reactor, plate power filter	5066
E2	Relay, power (6 v)	18198	V1, 2	Socket, octal base tube	31319
F1	Fuse, 20 amperes	3646	V3	Socket, panel indicator lamp	31365
	Fuse Holder, Littlefuse, Type 1075, black			MISCELLANEOUS ITEMS	
J1	Jack, microphone	17469		Binding Post, "XL" Laboratories, Type B1	
J2	Jack, tuning meter	7961		Cable, battery power supply, approximately 10 feet long, complete with 8-contact female plug	18210
J4	Receptacle, remote control cable (female)	18194		Plug, battery power supply cable, 8-contact, female	30115
J5	Receptacle, power cable (male)	30110		Cable, side tone, 6 feet long, complete with 8-contact male plug	18312
L1	Coil, oscillator cathode tuning	18201		Plug, side tone cable, 8-contact, male	18212
L2	Coil, oscillator plate tank	18209		Clamp, tube and vibrator	18192
L3	Coil, antenna loading	18189		Knob, antenna loading and oscillator coupling control	7960
L4	Coil, r-f choke	33169		Locking Wheel, tuning control	18193
M-1	Meter, 0-1 ampere, r-f	18188			
R1	Resistor, 47,000 ohms, ¼ watt	12412			
R2	Resistor, 27,000 ohms, 1 watt	13477			
R3	Resistor, 270 ohms, 1 watt	30497			
R4	Resistor, 220 ohms, 1 watt	30496			
R5	Resistor, 100,000 ohms, ¼ watt	14560			
R8	Resistor, 4,000 ohms	43911			
R9	Resistor, 220,000 ohms, 1 watt	30684			
R10, 11	Resistor, 15,000 ohms, 1 watt	5114			
S2	Switch, S.P.S.T. toggle type	7900			
S3	Switch, D.P.D.T. toggle type	12956			
S4, 5	Switch, 12-contact, rotary	18191			

REMOTE CONTROL PANEL (MI-5883A)

Symbol No.	Description	Stock No.	Symbol No.	Description	Stock No.
	Cable, remote control, approximately 10 feet long, complete with 8-contact male plug	18211		Jack, microphone	17469
				Jewel, pilot lamp, ruby, Drake Mfg. Co., Type 20	
				Lamp, pilot	31480
				Switch, S.P.S.T.	18019

INTERCONNECTING CABLE (MI-5884A)

Symbol No.	Description	Stock No.	Symbol No.	Description	Stock No.
	Plug, interconnecting cable, 4-contact female and shell	30567		Plug, interconnecting cable, 8-contact female	30115

ANTENNA SYSTEM (MI-19705-1 OR MI-19705-3)

(See page 23)

SECTION III

RECEIVER UNIT

DESCRIPTION

The Model AVR-20A Aircraft Communication Receiver is sturdily constructed to insure a long and satisfactory service. The receiver is housed in a metallic cabinet with the controls on the front panel. The power cable equipped with a four-prong plug emanates through the left-hand wall of the cabinet (facing the front panel). The antenna ("ANT.") terminal and the wing-nut terminal used to terminate the ground connection protrude through the right-hand wall. At the lower rear of the cabinet is located a pin jack for the transmitter sidetone connection.

The receiver uses four tubes in a superheterodyne circuit, which provides good sensitivity and selectivity throughout the tuning range of 2,300 to 6,700 kilocycles. Provision is made for operation with either variable or crystal controlled oscillator. Facilities are provided within the unit for insertion of two crystals to be used for "locking-in" the oscillator frequency at two frequencies within the overall tuning range. It is recommended that the two crystal frequencies be separated by at least 300 kilocycles. The selection of tuning control is made by rotating the three-position switch marked "VAR.-CRYSTAL" located on the panel of the receiver. A CW oscillator is incorporated in the circuit to permit CW reception or to aid in the location of weak signals.

The output circuit of the receiver is designed to accommodate two pairs of headphones. Most of these receivers incorporate transformer coupling to the headphones, although a small number have a condenser in the output circuit and use impedance coupling to the headphones.

The receiver must be mounted in an upright position. Mounting holes are provided in the four corners at each side of the receiver cabinet. The rubber shock mounts should be used in securing the receiver in position. All nuts, screws and bolts must be securely locked in place by lockwashers, locknuts or safety wire to prevent loosening due to vibration. The location of the unit and the arrangement of the cables must be such that any effect on the aircraft's magnetic compass is constant with the power switch in the "ON" position.

The AVA-120 Anterma System is used for the receiver as well as for the transmitter, a change-over relay in the transmitter automatically making the proper connections when the microphone switch button is pressed and released.

OPERATION

To operate the receiver, plug the headphones into the "PHONES" jack and turn the receiver on by a clockwise rotation of the combination "VOLUME" control and "ON-OFF" switch. A distinct click will be heard indicating that the power is turned on but several seconds must be allowed to elapse for the receiving tubes to attain their normal operating temperatures. When the tubes are properly heated, a hiss or signal will be heard upon further rotation of the volume control.

VARIABLE TUNING. Should it be desired to use the receiver "variable tuned," rotate the oscillator switch (S3) to the "VAR." position. Advance the volume control nearly to maximum and rotate the tuning knob until a signal is heard. The tuning dial scale is calibrated in kilocycles to facilitate location of the transmitting station. Tune the receiver until maximum volume is obtained from the station desired (at that setting of the volume control) and adjust the volume control to obtain the desired operating level. A slight readjustment of the volume control may be required from time to time to compensate for variations in signal strength.

FIXED TUNING (CRYSTAL-CONTROL). Provision is made in this receiver for the use of a "lock-in" crystal control. Space is provided for two crystals, the resonant frequencies of which are determined by the crystals used. Each crystal must have a frequency equal to the carrier frequency of the desired signals plus the intermediate frequency of 455 kc.

To operate the receiver with crystal control, it is only necessary to throw the oscillator switch (S3) to either one of the two "CRYSTAL" positions indicated. Rotate the tuning control to the desired frequency as indicated by the pointer on the dial scale. With the receiver functioning properly, the noise output near the correct setting of the dial will rise sharply and then go down as the receiver is tuned through the desired frequency range. The tuning of the receiver should be left at the point where maximum noise output is obtained if no signal of the desired frequency

is present at the time of tuning. When the receiver is tuned in this manner, any signal corresponding in frequency to that of the crystal will be heard provided that it is of sufficient strength.

MODULATED SIGNAL RECEPTION. To receive modulated (voice or tone-telegraph) signals, place the "PHONE-C.W." switch (S2) in the "PHONE" position.

CW RECEPTION. To receive CW (continuous wave or telegraph) signals, shift the "PHONE-C.W." switch to the "C.W." position. Then tune in the desired signal by means of the tuning knob and dial. The tuning control should be adjusted so that the desired signal produces a beat note (whistling tone) of approximately 1000 cycles in the headphones. The cw oscillator is also very helpful in locating weak phone or tone-telegraph signals by means of the audio beat note produced with the desired carrier as outlined above. When used for this purpose after the signal has been located, turn off the cw oscillator by placing the "PHONE-C.W." switch to the "PHONE" position and retune the receiver slightly to obtain maximum output.

To discontinue receiver operation, turn the equipment off by rotating the combination volume control and power switch to the extreme counterclockwise position. A distinct click will be heard to indicate that the power is turned off.

RECEIVER MAINTENANCE

If the receiver fails to operate in any of its operative positions, check the applied voltage from the power supply unit and make certain that all switch contacts are securely made. The tube socket voltage readings should be made using a high resistance voltmeter connected between the various tube socket terminals and ground. The normal tube operative voltages are shown on Figure 12. Any marked variation of voltage readings on any of the tubes indicates either a defective tube or a breakdown in the association circuit. A tube checker should be used to indicate the condition of the tubes.

Should a check prove the tubes to be satisfactory, a continuity test on the receiver circuits and elements must be made which necessitates removing all power connections, antenna and ground connections and withdrawing the entire equipment from the housing. An ohmmeter is used to check the circuit for continuity. The schematice diagram, Figure 9, together with the chassis photographs facilitate the location of component parts. A test oscillator and chanalyst will greatly facilitate the location of faults.

At the conclusion of the test, replace the equipment in the housing and reconnect any leads removed for test purposes.

ALIGNMENT PROCEDURE. Before proceeding with actual alignment operations, set the "PHONE"—"C.W." switch in the "PHONE" position and the "Oscillator" switch in the "VAR." (variable tuning) position.

Turn the volume control to a position near maximum (clockwise).

Plug an output meter (a low-range rectifier type a-c voltmeter can be used) into the "PHONE" jack. Connect the output of a test oscillator with the "low" side to receiver ground and the "high" side through a 100-mmfd series capacitor (artificial antenna), to points as indicated in the tabulation below. Do not remove the grid leads from the tubes when making these connections.

NOTE: An RCA Stock No. 167 Test Oscillator or equivalent and an RCA Stock No. 12636 Air Trimmer Wrench will be found very satisfactory for use in aligning these receivers.

Perform the alignment in the proper sequence as illustrated on page 18, starting with No. 1 and following all operations across, then No. 2, etc. Regulate the test oscillator output so that a minimum signal is applied at all times to the receiver to produce an observable output indication.

RECEIVER ALIGNMENT PROCEDURE

Order of Alignment	TEST OSCILLATOR			Tuning Dial Setting	Circuits to Adjust	Adjustment Symbols	Adjust to Obtain
	Connection to Receiver	Artificial Antenna Series Capacitor	Frequency Setting				
1	RCA ~~67F~~ 6F7 IF Grid Cap.	0.1 mfd	455 kc	2500 kc	2nd IF Transf.	T3	Max. output
2	RCA-6K8 Det. Grid Cap.	0.1 mfd	455 kc	2500 kc	1st IF Transf.	T2	Max. output
3*	RCA-6K8 Det.	0.1 mfd	455 kc	2500 kc	CW Osc.	L1*	1000 cycle beat note
4	Ant. Post.	100 mmfd	6300 kc	6300 kc	RF Osc.	C23**	Max. output
5	Ant. Post.	100 mmfd	6300 kc	6300 kc	Det.; RF Ampl.	C24; C25	Max. output
6	Ant. Post.	100 mmfd	2500 kc	2500 kc	RF Osc.	T6	Max. output
7	Ant. Post.	100 mmfd	2500 kc	2500 kc	Det.; RF Ampl.	T4; T5	Max. output
8	Ant. Post.	100 mmfd	6300 kc	6300 kc	RF Osc.	C23**	Max. output
9	Ant. Post.	100 mmfd	6300 kc	6300 kc	Det.; RF Ampl.	C24; C25	Max. output

* Before making this adjustment, turn the "PHONE—C.W." switch to the "C.W." position. When completed, return that switch to the "PHONE" position. Headphones should be substituted for the output meter during this adjustment.

** Use minimum capacitance peak (adjustment plunger pulled furthest out) if two peaks can be obtained.

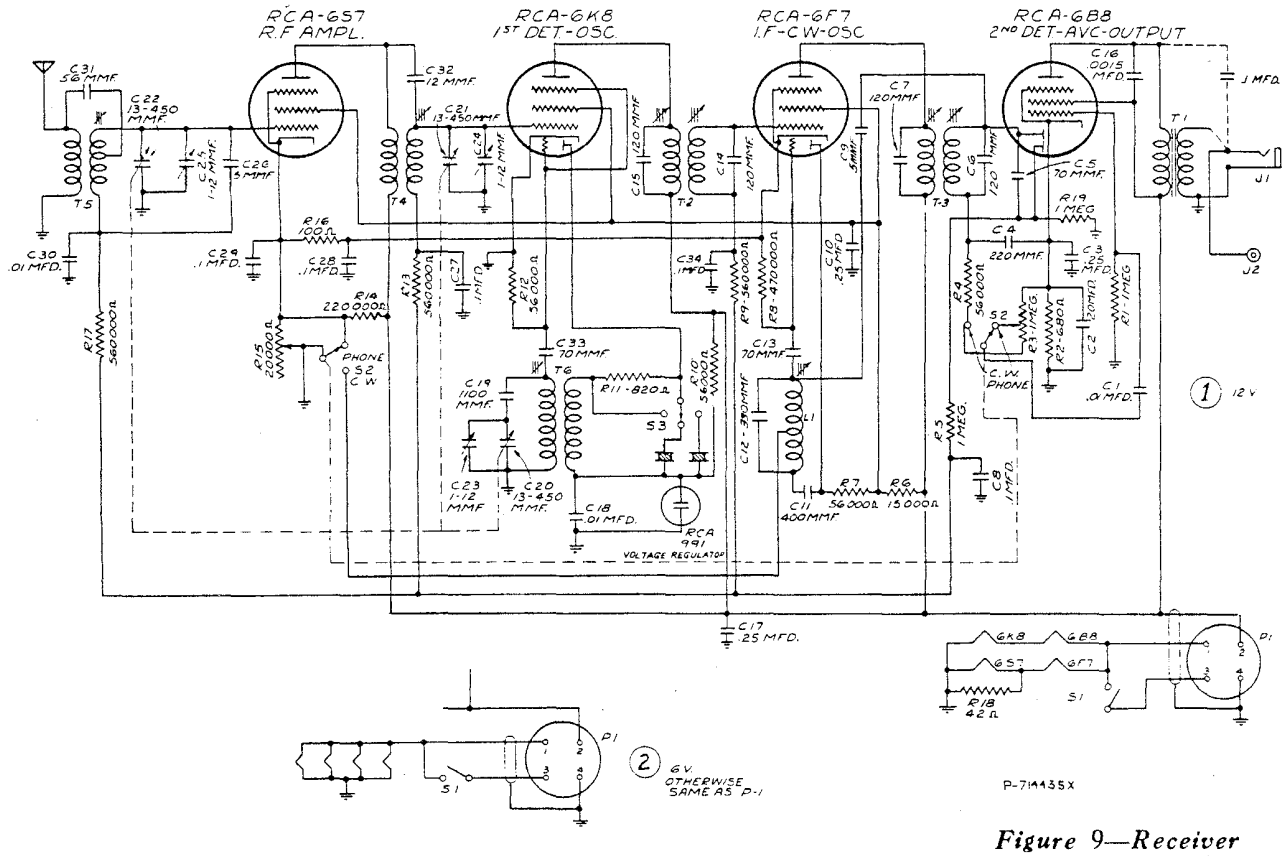


Figure 9—Receiver (Schematic P-714435X)

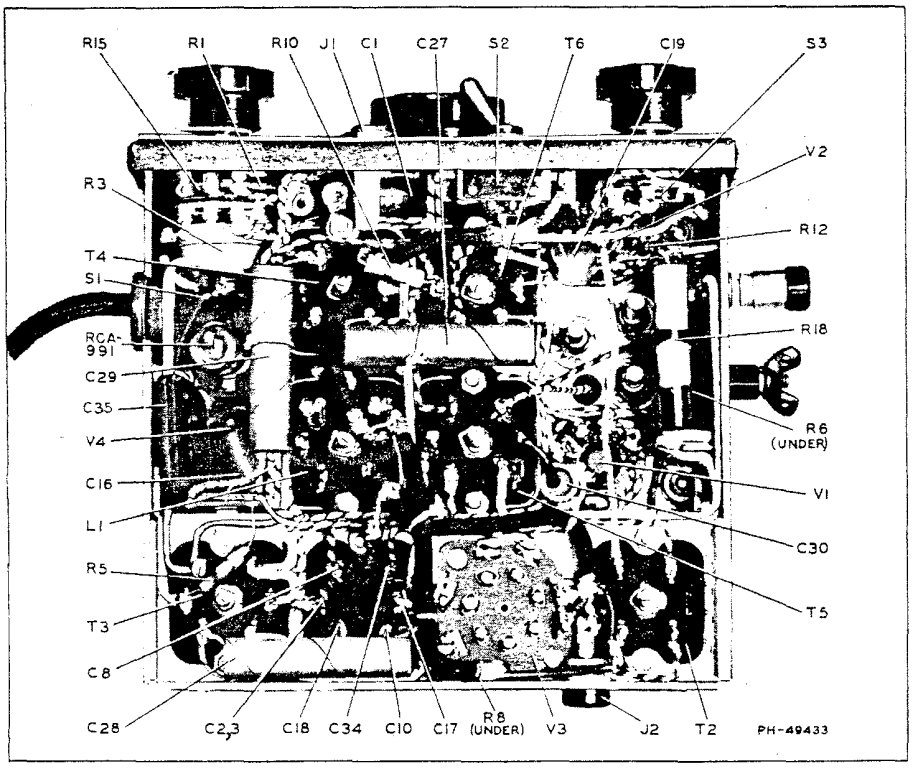


Figure 10—Receiver Chassis, Bottom View

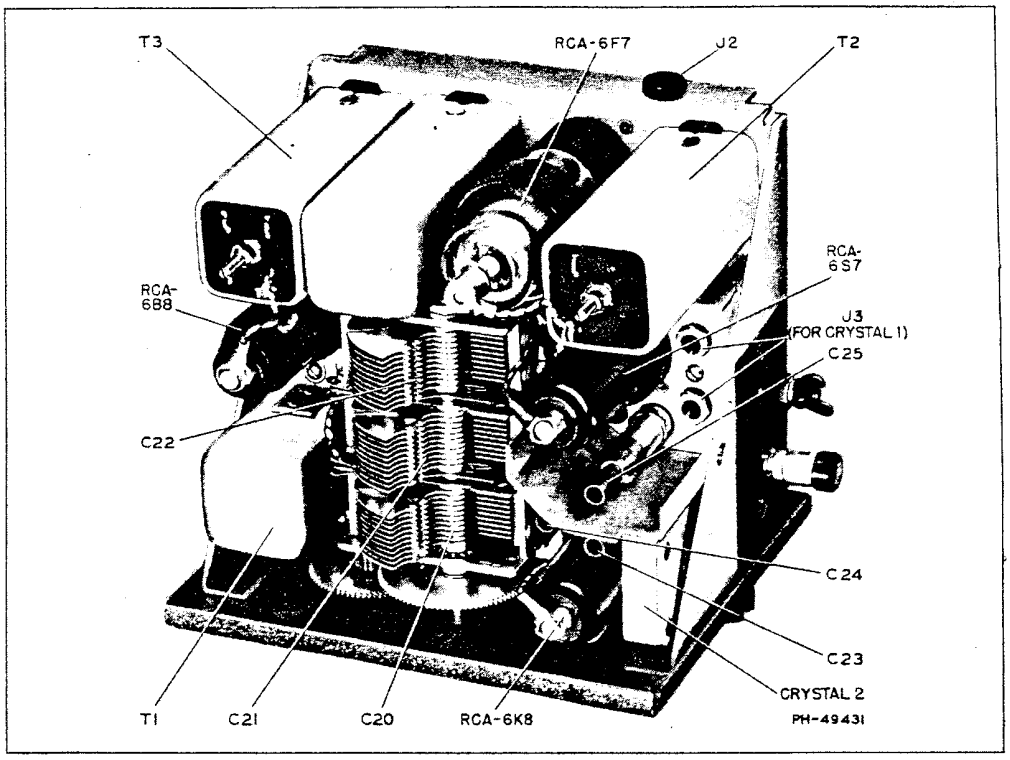


Figure 11—Receiver, Chassis, Top View

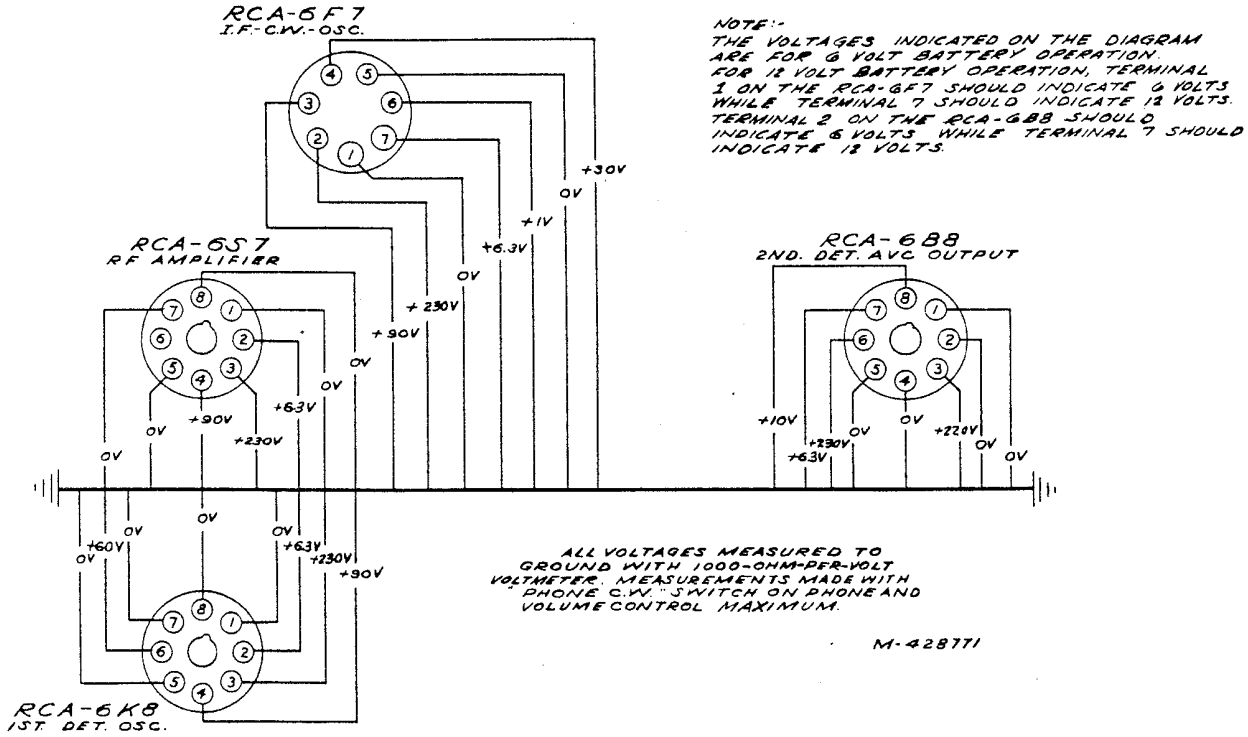


Figure 12—Receiver
(Socket Voltage Diagram M-428771)

RECEIVER PARTS LIST

Symbol No.	Description	Stock No.
C1	Capacitor, 0.01 mfd	4858
C2	Capacitor, 20 mfd (combined with C3, C8, C10, C17, C18, C34)	35499
C3	Capacitor, 0.25 mfd (combined with C2, C8, C10, C17, C18, C34)	
C4	Capacitor, 220 mmfd (combined with T3, R2, R4, R19, C5, C6, C7)	35494
C5	Capacitor, 70 mmfd (combined with T3, R2, R4, R19, C9, C6, C7)	35493
C6	Capacitor, 120 mmfd (combined with T3, R2, R4, R19, C9, C5, C7)	35492
C7	Capacitor, Same as C6, combined with T3, R2, R9, R19, C4, C5, C6)	
C8	Capacitor, 0.1 mfd (combined with C2, C3, C10, C17, C18, C34)	
C9	Capacitor, 5 mmfd (combined with L1, C11, C12, C13, R7)	35515
C10	Capacitor, 0.25 mfd (combined with C2, C3, C8, C17, C18, C34)	
C11	Capacitor, 400 mmfd (combined with L1, C9, C12, C13, R17)	35520
C12	Capacitor, 330 mmfd (combined with L1, C9, C11, C13, R7)	12952
C13	Capacitor, Same as C5 (combined with L1, C9, C11, C12, R7)	
C14, 15	Capacitor, Same as C6 (combined with T2, R9)	
C16	Capacitor, 0.0015 mfd	33806
C17	Capacitor, 0.25 mfd (combined with C2, C3, C8, C10, C18, C34)	
C18	Capacitor, 0.01 mfd (combined with C2, C3, C8, C10, C17, C34)	
C20	Capacitor, Variable tuning, 13-450 mmfd (combined with C21, C22)	35485
C21	Capacitor, Variable, 13-450 mmfd (combined with C20, C21)	
C22	Capacitor, Variable, Same as C21	
C23	Capacitor, Trimmer (1 to 12 mmfd)	12714
C24	Capacitor, Trimmer capacitor, Same as C23	
C25	Capacitor, Trimmer, Same as C23	
C26	Capacitor, Same as C9	
C27	Capacitor, 0.1 mfd	32786
C28, 29	Capacitor, Same as C27	
C30	Capacitor, 0.01 mfd	14393
C31	Capacitor, 56 mmfd	35516
C32	Capacitor, 12 mmfd (combined with T4, R14, R16)	35508
C33	Capacitor, Same as C5	
C34	Capacitor, 0.1 mfd (combined with C2, C3, C8, C10, C17, C18)	

Symbol No.	Description	Stock No.
J1	Jack, Phone Jack	35502
J2	Jack, Phone Pin	18348
J3	Jack for crystal mounting	16888
L1	Coil, CW oscillator (combined with C9, C11, C12, C13, R7)	35518
R1	Resistor, 1 megohm, ½ watt	35521
R2	Resistor, 680 ohms, ½ watt (combined with T3, R4, R19, C4, C6, C7)	35496
R3	Resistor, 1 megohm (combined with R15, S1)	
R4	Resistor, 56,000 ohms, ½ watt (combined with T3, R3, R19, C4, C5, C6, C7)	35497
R5	Resistor, Same as R1	
R6	Resistor, 15,000 ohms, 2 watts	35523
R7	Resistor, 56,000 ohms, ½ watt (combined with L1, C9, C11, C12, C13, C14)	35519
R8	Resistor, 470,000 ohms, ½ watt	35524
R9	Resistor, 560,000 ohms, ½ watt (combined with T2, C14, C15)	35495
R10	Resistor, 68,000 ohms, ½ watt	14138
R11	Resistor, 820 ohms, ½ watt	35513
R12	Resistor, Same as R7	
R13	Resistor, Same as R9	
R14	Resistor, 220,000 ohms, ½ watt	35510
R15	Potentiometer, Volume control, 20,000 ohms (combined with S1 and R3)	35504
R16	Resistor, 100 ohms, ½ watt	35509
R17	Resistor, Same as R9	
R19	Resistor, 1 megohm, ½ watt combined with T3, R2, R4, C4, C5, C6, C7)	35498
S1	Switch—Filament (combined with R3, R15)	
S2	Switch, Phone, CW toggle switch	33142
S3	Switch, Crystal selector	35503
T1	Transformer, Output	
T2	Transformer, First I-F (combined with R9, C14, C15)	35490
T3	Transformer, Second I-F (combined with R2, R4, R19, C4, C5, C6, C7)	35491
T4	Coil, Detector, less shield (combined with C32, R14, R16)	35507
T5	Coil, Antenna coil (includes C26, R13, R17)	43893
T6	Coil, Oscillator coil, less shield (includes C33, R11)	35511
V1, V2	Socket, standard octal base	35500
V3	Socket, small 7 pin	33144
V4	Socket, Same as VI	

MISCELLANEOUS

Knob, Tuning knob	33154
Knob, Volume control or crystal switch knob	33148
Nut, Clamping nut for trimmer cap	14028
Panel, Front panel for receiver unit	43894
Pointer, Dial pointer	35505
Contact assembly for RCA-991 tube	35501

SECTION IV

ANTENNA SYSTEM

DESCRIPTION

The satisfactory performance of an aircraft transmitter depends to a large extent on the proper installation and adjustment of the equipment and on the antenna system employed. Where maximum efficiency and greatest transmission distances are desired, a controllable length trailing-wire antenna system, such as the RCA Model AVA-120, is necessary. The retractable trailing-wire antenna is considerably more efficient than any other type of antenna because it can always be reeled out until it exactly resonates at the frequency used. This type of antenna has the added feature of providing short distance communication from the ground or the air by use of the length of wire remaining between the fuselage and the rudder post when the antenna is completely reeled in. Three typical installation versions of the Model AVA-120 Antenna System are shown on page 23, each of which is highly practical and efficient.

Figures 13 and 15 show typical installations with the antenna passing through the entrance fairlead attached to the top of the fuselage and through the fairlead attached to the vertical fin. By this arrangement the antenna can be reeled in until the antenna drag unit reaches the rear guide fairlead. The section between the rear guide fairlead and the entrance fairlead is of sufficient length to permit short distance transmission and eliminates the necessity of a second short fixed antenna, generally provided for ground communication.

The reel is unlocked by pulling out the handle a quarter of an inch from the bakelite disc so that a retaining pin is disengaged from one of a series of holes located in the steel mounting plate. By holding out the handle, the antenna may be extended or retracted. Releasing the handle causes the retaining pin to engage one of the holes in the back plate and securely locks the reel in position.

The short lead from the transmitter to the entrance fairlead connection should be installed in such a way that it will not sway or move about and should be kept as far as practicable, **and never closer than two inches,** from the metal structure of the plane. This lead should not be run parallel to a metallic object for any distance unless **12 inches** or more separation is provided.

The correct length for the antenna is determined experimentally as described on page 7 of this book.

SUGGESTION. Unless the antenna wire is retracted before landing, the wire and drag unit may be lost or damaged. In order to prevent this difficulty many pilots clip a spring type wooden clothespin on the throttle whenever the antenna is extended, serving as a reminder to reel in the antenna before landing. The clothespin is moved from the throttle to the reel when the reeling-in operation has been completed.

ANTENNA SYSTEM MAINTENANCE

The antenna system should be inspected at regular periods, such as at the time of top engine overhaul, or at least every sixty days. All electrical and mechanical connections should be inspected and tightened; all insulators and fairleads should be wiped clean of any dirt or grease which may have accumulated. Reel out the antenna and inspect it for broken strands. If broken strands are observed, replace the antenna with MI-5912-3 antenna wire, which has been especially designed for this service and is coated with a special lubricant. Do not clean wire with carbon tetrachloride or any other kind of solvent. Inspect the drag unit and replace it if it has become damaged.

It will be necessary to "pre-wear" new antenna wire until the mechanical action is smooth before putting the system into service. This will require the services of two persons: one person to hold the reel handle and a second person to draw the antenna out to its full length by walking back from the plane with the drag unit. Hold the antenna wire taut while it is again reeled in. This procedure should be repeated about fifteen times or until the antenna wire passes back and forth through the fairleads and conduit (if used) smoothly and freely. Keep the antenna wire free of dirt. After the "pre-wear" process has been completed and before the plane is taken into the air, a test should be made to determine the pull that must be exerted to pay out the antenna. This test can be accomplished by attaching a spring balance to the drag unit end of the antenna and slowly drawing out the antenna (not faster than two feet per second) by means of the bal-

FIGURE 13

AVA-120 Antenna System–*ASSEMBLY–1*

TOP EXIT WITH FLEXIBLE CONDUIT

ORDER COMPLETE ASSEMBLY BY STOCK No. MI-19705-1

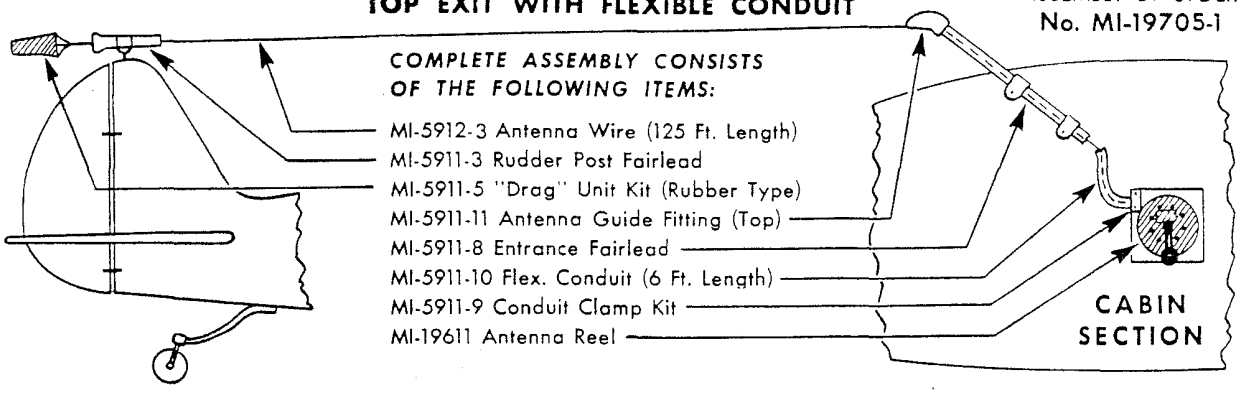


FIGURE 14

ASSEMBLY–2

BOTTOM EXIT WITH FLEXIBLE CONDUIT

ORDER COMPLETE ASSEMBLY BY STOCK No. MI-19705-2

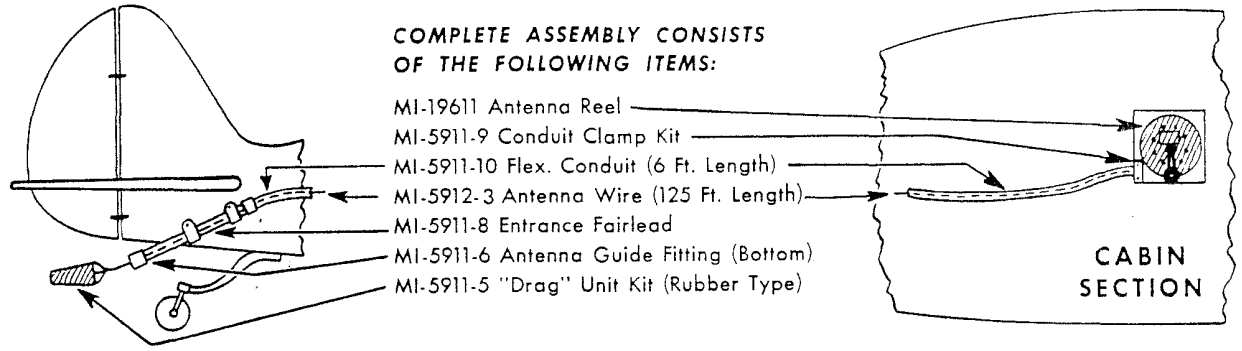
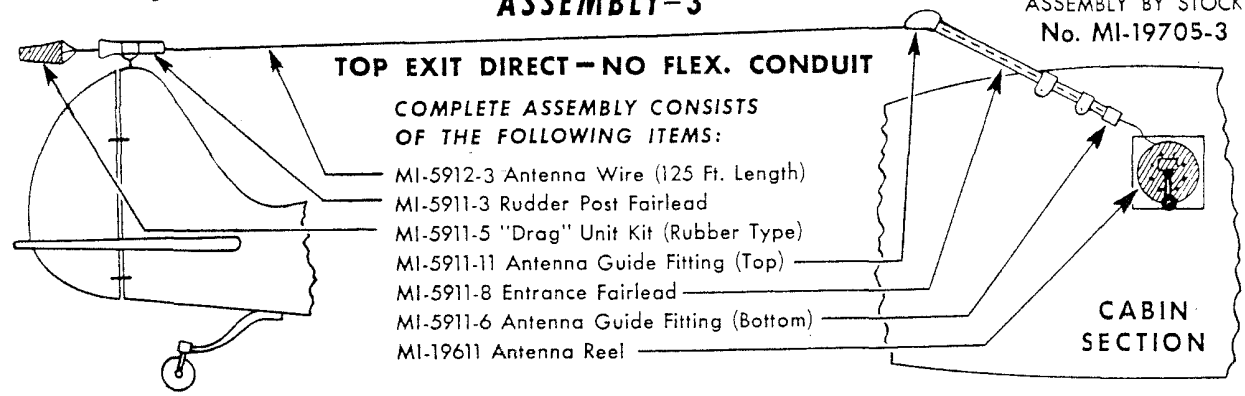


FIGURE 15

ASSEMBLY–3

TOP EXIT DIRECT – NO FLEX. CONDUIT

ORDER COMPLETE ASSEMBLY BY STOCK No. MI-19705-3



Note: When ordering above *units state* assembly stock number. Indicate deduction of individual stock numbers, if any items of assembly are not required.

WEIGHT TABLE

MI-19611 . . . 22 oz.	MI-5911-8 . . . 7.0 oz.	MI-5911-10 . . . 12.0 oz.
MI-5911-5 . . . 4.0 oz.	MI-5911-3 . . . 3.0 oz.	MI-5911-11 . . . 5.0 oz.
MI-5912-2 . . . 9.0 oz.	MI-5911-9 . . . 1.5 oz.	MI-5911-6 . . . 3.0 oz.

ance, noting the pull indicated. The pull for average installations should not exceed twelve ounces. If the pull is greater than twelve ounces, installation changes should be made in an effort to reduce friction.

The antenna reel should function with a minimum of oiling or attention. If oil is used, it should be used sparingly and should be of a grade that will not congeal at the lowest temperature at which the plane will be used. Univis No. 40, a Standard Oil Co. product, congeals at −47 degrees C. and is recommended for this service. Do not allow oil to get on the back steel mounting plate as it may cause the pin which locks the reel to slip.