FOR OFFICIAL USE ONLY

T. O. NO. 08-45-16

INSTRUCTION MANUAL

FOR

OPERATION AND MAINTENANCE

OF

TRANSMITTER

MODEL AVT-15, 15-A

This Handbook replaces T. O. No. 08-45-16 dated 14 July 1944.

COMPEYER LITHOGRAPH CORP. CLEVELAND OHIO
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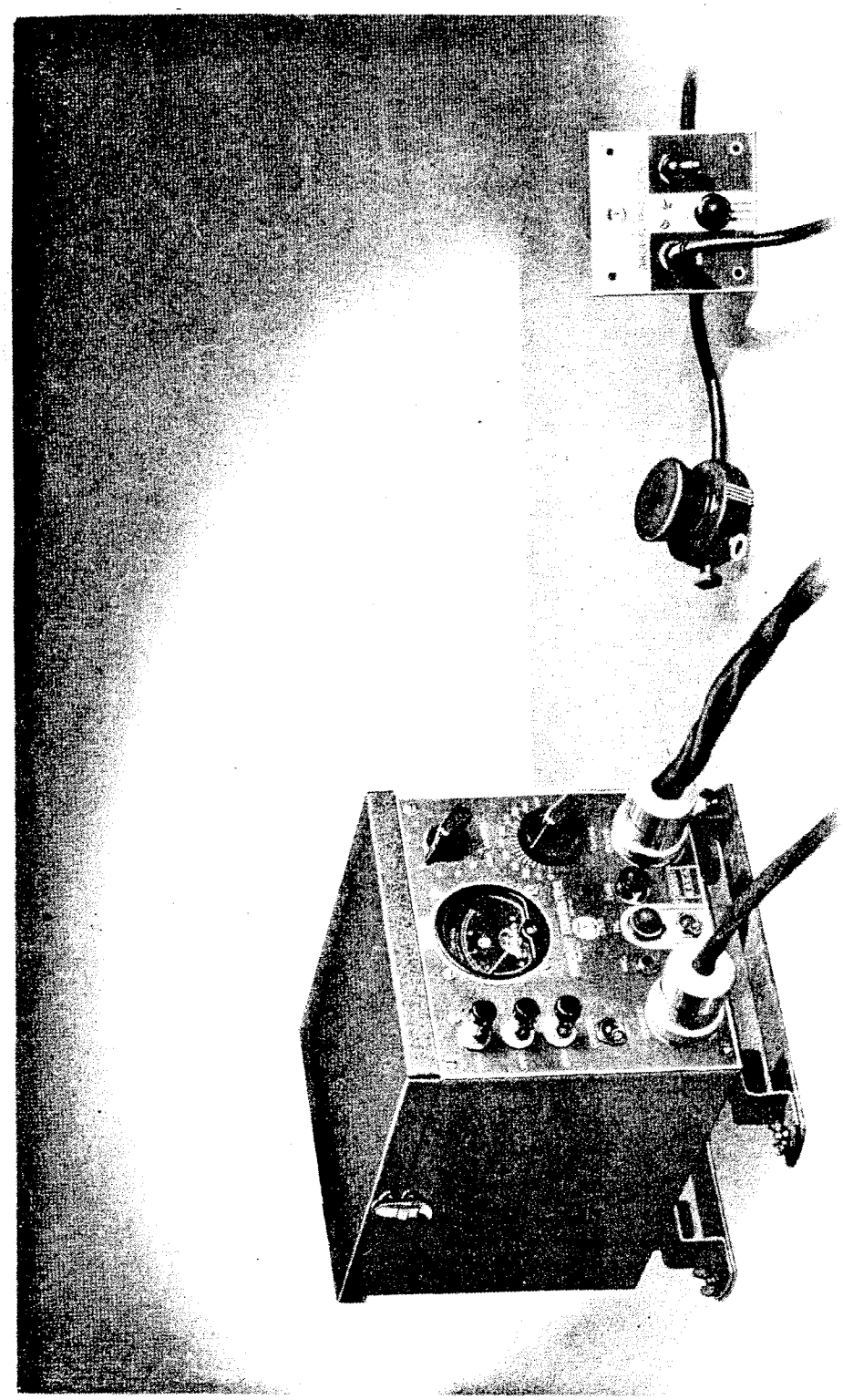

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Figure 1—Model AVT-15 or AVT-15A Aircraft Transmitter (Less Model AVA-41 Antenna System)

TECHNICAL SUMMARY

ELECTRICAL CHARACTERISTICS—

Type of Transmission ..... Telephone
Frequency Range ..... 2500-6700 kc
Frequency Control ..... Low Temperature-Coefficient V-Cut Crystal
Frequency Stability ..... 0.02 percent

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.

Power Consumption:	*Transmit*	*Standby*
Model AVT-15	68.4 watts	11.4 watts
Model AVT-15A	61.2 watts	10.5 watts

TUBE COMPLEMENT—

Oscillator 1 RCA-6L6
Modulator 1 RCA-6L6
Voltage Limiter 1 RCA-991

MECHANICAL SPECIFICATIONS—

Overall Dimensions:
- Height ..... 7-13/16 inches
- Width ..... 8-7/16 inches
- Depth ..... 10¾ inches

Weight (Including Remote Control Panel and Cable) ..... 18½ pounds

EQUIPMENT

The aircraft transmitter equipment described in this book is comprised of the following items:

Item	*Stock No.*
1 Transmitter Unit (locally controlled), complete with 3105 kc crystal and tubes:	
Model AVT-15 (B.A.C.A. 215) 12-volt supply	MI-5881
Model AVT-15A (B.A.C.A. 216) 6-volt supply	MI-5882

The following equipment may be obtained on separate order:

1 Remote Control Panel and Connecting Cable	MI-5883
1 Model AVA-41A Antenna System (C.A.A.T.C. 226)	MI-5911

The following equipment is required but is not furnished:

1 Storage Battery ..... 6 or 12 volts

DESCRIPTION

The Models AVT-15 and AVT-15A Aircraft Transmitters provide the means for establishing reliable radiotelephone communication over moderate distances on any frequency within the band of from 2500 to 6700 kc. 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.

TRANSMITTER 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 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).

Only one crystal is furnished with the transmitter. This crystal will provide fundamental operation on 3105 kc. Operation on the second harmonic of the crystal frequency may be obtained by retuning the transmitter.

Operation of the transmitter on any frequency within the band of from 2500 to 6700 kc may be obtained by installing a crystal ground to the desired frequency in crystal socket No. 2 and tuning the transmitter to resonance as described in the "Installation" section of this book.

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.

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 (ma) 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 this source:

1 Model AVR-15
2 Model AVR-20's
1 Model AVR-20
1 Model AVR-15 and 1 Model AVR-20
2 Model AVR-15's

The Model AVT-15 transmitter is wired at the factory to provide the proper plate voltage for the operation of a Model AVR-20 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.

Approximately 30 ma at 250 volts is provided by the power supply of the Model AVT-15A transmitter. This power is available for the operation of any suitable receiver such as the Model AVR-15A.

Attention is called to the difference in terminal connections (1 to 8) as shown in the schematic diagrams (Figures 6 and 7) for the alternative conditions where

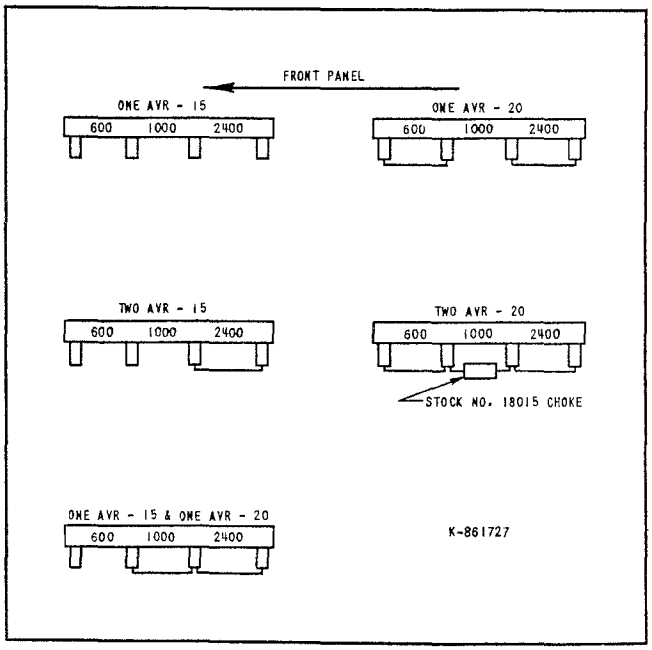


Figure 2—Receiver Voltage Supply (Resistor Changes K-861727)

the transmitter is used with or without an associated receiver. When the transmitter power supply is used to supply plate power to an associated receiver, it is necessary to replace the battery cable that is supplied with the transmitter by an MI-5884A battery cable. When the plate power for the combination of two Model AVR-15's, two Model AVR-20's or one Model AVR-15 and one Model AVR-20 is obtained from the Model AVT-15 transmitter, a special battery cable is required.

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.

ANTENNA SYSTEM.

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 is necessary. For this reason, use of the Model AVA-41 Antenna System is strongly recommended. 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. It is particularly efficient on frequencies below 4000 kc because it is not necessary to use the antenna loading coil in the transmitter, and the power otherwise absorbed by the loading coil may be put into the antenna, thus increasing the radiated power.

REMOTE CONTROL PANEL.

The MI-5883 Remote Control Panel with its associated Connecting Cable is not supplied with the transmitter but must be ordered separately. This unit is comprised of a 3¼" x 3¼" panel, drilled for mounting in a standard "A-N" instrument opening, and a six-wire cable ten feet long. Mounted on the panel are a microphone jack, a pilot lamp and a filament switch.

INSTALLATION

Considerable thought and care should be exercised in locating the equipment and making the installation. The mounting location will vary for different types of planes as well as with personal preference. One thing, however, should be kept in mind and that is the convenience of tuning the transmitter while the plane is in flight.

Operating into a retractable trailing-wire (reel) antenna will require no change in the transmitter. The transmitter can be unpacked, installed in the ship and flight tuned without change except possibly a shift in the position of the coupling tap switch to obtain maximum output.

LOCATION.

In those installations where the transmitter is operated directly (without the remote control panel), it is necessary to locate the transmitter within reach of the pilot, preferably in such a position that he can see the front panel when in flight. The card on which the tuning information is recorded *must* be located well within the pilot's range of vision.

The remote control panel, if used, should be mounted in the cockpit within easy reach of the pilot. Where space permits, the panel may be mounted either in front of, or behind, a standard "A-N" instrument opening on the instrument board. The mounting screw holes have standard "A-N" instrument case mounting dimensions. The location selected should be such that no mechanical interference will result from the microphone being plugged into the control panel jack.

TRANSMITTER UNIT. — The transmitter unit is shipped 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 easily 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.

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 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.

It is important that the two primary power leads connecting to the transmitter be kept as far as possible from the magnetic compass of the ship. The two-wire cable constituting the positive and negative battery leads should interconnect the battery and transmitter directly; that is to say, the negative battery lead should not be grounded at the power supply unit in such a manner that the fuselage will constitute the return part of the circuit, or heavy circulating currents in the fuselage or hull will cause serious magnetic compass deviations. It is characteristic of all radio transmitters, regardless of type, that they will cause some magnetic compass deviation when the transmitter is in operation. The design of these aircraft transmitters is such as to reduce this condition to a minimum.

The 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.

The sidetone lead (yellow) should be connected to the high side of the aircraft receiver headphone circuit (tip of telephone jack). On those transmitters using the remote control panel, the yellow lead extends from the cable at the panel. When the remote control panel is not used, this lead should be attached to a plug and inserted in the "REMOTE" cable receptacle on the transmitter

front panel. All transmitters ordered without remote control will be supplied with this plug.

The transmitter is fused for 10 amperes in the Model AVT-15 and for 20 amperes in the Model AVT-15A. Control and power cables may be run through conduit if desired, but this is not essential because the cables are well shielded. If not run through conduit, the cables should be taped or clamped securely to the structure of the ship to prevent unnecessary wear and accidental damage.

All electrical cables should be properly attached and secured. 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.*

These transmitters are connected at the factory for use with the negative terminal of the battery grounded. For operation with the positive side of the battery grounded, remove the vibrator and rotate it 180 degrees so that the *positive* (+) sign stamped on the vibrator is nearest the back of the transmitter (see label on top of power transformer). For connections to the battery, refer to the schematic diagrams, Figures 6 and 7.

BATTERY POWER SOURCE.—The storage battery required for operation is not furnished with this equipment since in general the aircraft battery will be utilized.

The Model AVT-15 Transmitter requires a power source capable of supplying a steady operating current of about six amperes at a nominal potential of 12 volts. At this voltage, the transmitter requires a full load current of 5.7 amperes and a stand-by current of 0.95 ampere. A 12-volt storage battery having at least a 19-ampere-hour capacity, charged by means of a constant-voltage generator at a rate of at least five amperes, will fulfill the requirements.

The Model AVT-15A Transmitter requires a power source capable of supplying a steady operating current of about 12 amperes at a nominal potential of six volts. At this voltage, the transmitter requires a full load current of 10.2 amperes and a stand-by current of 1.75 amperes. A 6-volt storage battery having at least a 38-ampere-hour capacity, charged by means of a constant-voltage generator at a rate of at least ten amperes, will fulfill the requirements.

ANTENNA.—Instructions for the installation of the Model AVA-41 Antenna System are contained in the instruction book which is packed with it (IB-26314).

The short lead from the transmitter to the antenna reel or 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 sidetone connection from the tertiary winding on the modulation transformer should be connected to the *high* side of the headphone jack (600-ohm phone circuit) on the receiver control panel. In remotely-controlled installations, a lead is provided in the transmitter remote control cable for this purpose. In locally-controlled installations, a separate plug and lead is supplied to plug in the "REMOTE" socket. In each case, the lead is coded in *yellow* braid for identification.

TUNING.

The installation of the transmitter and the associated antenna having been completed, the equipment should be adjusted for operation and the dial settings recorded on the tuning chart.

CAUTION.—Because of the battery current drain required to operate the transmitter, never use the aircraft battery for extended adjustments or tests made on the ground. Disconnect the aircraft battery and use a heavy-duty battery connected externally to the main bus of the ship before starting the tuning adjustments. 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.

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.

When using the Model AVA-41 Antenna System, 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)*
3105	70 feet
5000	45 feet
6210	35 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)

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:

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

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.

The tuning of the transmitter into the Model AVA-41 Antenna System, and into a "T" radio beacon antenna, will be discussed in this instruction book. For information on other types, the data given under "Antennas" in the Models AVT-7B and AVT-12B instruction books can be used.

If the Model AVA-41 Antenna System is installed, as recommended, with the entrance fairlead forward and the rudder-post fairlead attached to the vertical fin in the tail group (as described in IB-26314 which is packed with the Model AVA-41), a sufficient length of antenna wire will remain outside and above the ship with the antenna reeled in to provide for short distance "on the ground" contacts. Other methods of providing for longer distance ground communication are described subsequently within this section under the heading "Combination of Reel and "T" Antennas."

BASIC TUNING PROCEDURE.—The following is a step-by-step procedure to be observed in adjusting this equipment:

1. Install a crystal ground to the desired frequency.

2. 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). The frequency band covered by each of these taps is indicated under "Transmitter Adjustments for Operation on Frequencies Other Than 3105 or 6210 kc."

3. Connect an external milliammeter having a range of 0-150 ma, in the oscillator plate circuit, then turn the filament switch to the "ON" position and allow the tubes to heat up.

4. With the antenna disconnected, tune the oscillator plate tank to resonance. Resonance is indicated by *minimum* oscillator plate current. This current should be about 15 or 20 ma.

5. To insure crystal starting, *decrease* the capacitance by turning the "TUNING" control in the direction of higher numbers until the oscillator plate current *increases* about five (5) ma. Check the crystal starting by triggering the microphone switch-button several times. Lock the "TUNING" control in position and then attach the antenna.

6. Determine the approximate antenna length required for the frequency to be used by means of the formula previously given. Convert this length in feet to turns by reference to the "Turns-Feet" chart which is included with the Model AVA-41 Antenna System.

7. Assuming use of the Model AVA-41 Antenna System as furnished, select the method of tuning desired; that is, method A or method B, as subsequently described under "Retractable Antenna." The "ANT. LOADING" switch should be placed in the "A" position and antenna resonance obtained by lengthening or shortening the antenna.

8. If the length of antenna required is found to be too long for practical use, this length can be shortened by adding turns to the antenna loading coil to the circuit; that is, by rotating the antenna loading switch clockwise. It must be remembered, however, that the addition of turns included on the loading coil will reduce the amount of useful energy radiated by the antenna, therefore, the effective range of the transmitter will be reduced.

RETRACTABLE ANTENNA.—There are two satisfactory methods of tuning the transmitter to the Model AVA-41 Antenna System. Either method is satisfactory from the standpoint of transmitter performance. The first method (A) utilizes a single length of antenna for both 3105 and 6210 kc which, from the pilot's viewpoint, is highly desirable. For this reason, it is recommended over the second method. The second method (B) uses two different lengths of antenna, one for 3105 kc and one for 6210 kc. Tuning procedure for each method will be treated separately.

(A) FIRST METHOD.—Place the "CRYSTAL" selector switch in the No. 1 position and, after connecting the leads from an external 0-150 (ma) milliammeter to a telephone plug (meter, leads and plug not supplied), insert the plug into 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. An entrance slot has been provided in the side of the transmitter case for the passage of the meter leads. In connecting the meter leads to the plug, the lead from the *positive* (+) side of the meter should be connected to the *tip* of the plug.

Take the ship into the air. Turn the filament switch to the "ON" position and allow 40 seconds for the tubes to heat up. 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 the locking ring to the left (counterclockwise) then operate the microphone "PRESS-TO-TALK" button several times to make certain that the crystal oscillator starts readily. The latter can be determined by observing the antenna meter which should indicate current flow when the button is pressed. If intermittent or poor crystal starting is evident, slightly rotate the "TUNING" control clockwise from the optimum

setting toward *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 percent which indicates complete modulation.

Record the antenna-reel turn-counter, "TUNING" control, and other pertinent readings on the tuning chart.

For 6210-kc operation, place the "CRYSTAL" selector switch in position No. 1. Unlock the "TUNING" control and disconnect the antenna. Rotate the control clockwise to about "90" on the dial, at the same time observing the reading on the external plate meter. A dip in plate current will be noted at two points, one at about "90" on the dial, the other at approximately "30." The first-mentioned dip (approximately "90") is the second harmonic of 3105 kc, or 6210 kc. The second is the fundamental or 3105 kc. Select the 6210-kc dip 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 crystal starting, then re-attach the antenna lead to the transmitter.

Leave the antenna reeled out to the same length determined for 3105 kc. Observe the plate current value recorded on the external plate meter. Rotate the "ANT. LOADING" switch *clockwise* until *maximum* plate current is obtained. Readjust the "TUNING" control for *minimum* plate current. The antenna current reading will be considerably lower than previously obtained on 3105 kc. Lock the "TUNING" control and record the dial settings on the tuning chart. Operation on 3105 and 6210 kc can now be obtained with the same antenna length.

(B) SECOND METHOD.—Proceed exactly as outlined for the 3105-kc adjustment, and as outlined for tuning the transmitter to 6210 kc *without* an antenna.

Re-attach the antenna and let out antenna until an antenna current maximum is obtained. Less than one-half the number of turns on the antenna reel should be required to resonate the antenna to 6210 kc as for 3105 kc. Check modulation and crystal starting as previously described. Lock the "TUNING" control. Record all readings on the "TUNING CHART."

COMBINATION OF TRAILING WIRE AND "T" ANTENNAS.—Unless the Model AVA-41 Antenna System is installed as recommended, it is usually necessary to provide for "on the ground" contacts by means of an additional fixed antenna, usually the "T" antenna normally used for beacon reception. To accomplish this, proceed as follows: Procure a Model AVA-24A (MI-5872) Antenna-Change Relay and Model AVA-39 (MI-5877) Antenna Load Coil. Connect the relay and load coil as indicated in the instruction book for the Model AVA-24A (IB-26310).

Regardless of which of the two methods of tuning, outlined under "Retractable Antenna," is used, the procedure for tuning the "T" antenna remains the same. With the transmitter properly tuned for operation on 3105 kc using the trailing wire, place the switch supplied with the Model AVA-24A in the "T" antenna position. Vary the tap lead on the Model AVA-39 Load Coil until *maximum* antenna current, as indicated by the antenna current meter on the transmitter, is obtained. Solder the tap lead at this point.

Operation on either the trailing-wire, or the "T" antenna can now be obtained by placing the antenna switch in the proper position. No change in transmitter tuning is required.

TRANSMITTER ADJUSTMENTS FOR OPERATION ON FREQUENCIES OTHER THAN 3105 OR 6201 KC.—For those installations in which the frequencies used are other than 3105 kc and the 6210-kc second harmonic of 3105 kc, it may be necessary to change some of the transmitter connections. The following explanation will cover changes necessary to operate at any frequency within the transmitter 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 8, 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:

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

**Connected to this tap at factory.*

The fundamental frequencies from 2500 to 3350 kc and the second harmonics of these frequencies (5000 to 6700 kc), the crystal should be placed in crystal socket No. 1 and the "CRYSTAL" selector switch in position No. 1.

As adjusted at the factory, operation of the transmitter may be obtained at any fundamental frequency in the "B" band (between 2950 and 3200 kc) and at the second harmonic of any frequency within that range (5900 to 6400 kc). To obtain fundamental and/or harmonic operation outside these respective ranges, it will be necessary to change the value of the oscillator cathode tuning capacitor (C1). The amount of capacitance required to insure operation on the desired frequency may be obtained from the following table.

In tuning the oscillator plate tank, the tap used on the inductor (L2) must be selected with respect to the *fundamental* of the oscillator frequency.

CRYSTAL IN SOCKET NO. 1				
Condition	*Crystal Frequency KC*	*Fundamental Range (KC)*	*Second Harmonic Range (KC)*	*Cathode Tuning Capacitance for Second Harmonic Operation (C1) mmfd*
1	2650	2500-2800	5000-5600	560 (Stock No. 12537)
2	2875	2800-2950	5600-5900	390 (Stock No. 13894)
*3	3105	2950-3200	5900-6400	330 (Stock No. 12952)
4	3275	3200-3350	6400-6700	150 (Stock No. 12725)
**Operative condition as connected at factory.*				
CRYSTAL IN SOCKET NO. 2				
—	—	2500-6700	—	No capacitor required.
—	—	2500-3350	5000-6700	Remove bus wire link and install capacitor as per conditions 1 to 4 above.

TWO FUNDAMENTAL FREQUENCIES IN THE SAME BAND.—To operate the transmitter with the "CRYSTAL" selector switch in the No. 2 position and within the *same* frequency band as that covered when the switch is in the No. 1 position, it is necessary to remove the grounded end of the bus connection between the inside top terminal of the "CRYSTAL" selector switch and ground. The end of the bus that was connected to ground should now be connected to the terminal of the "CRYSTAL" selector switch to which the cathode tuning capacitor (C1) is connected (outside top terminal).

TWO FUNDAMENTAL FREQUENCIES IN DIFFERENT BANDS.—To operate the transmitter on two low frequencies (and their second harmonics) which are in *different* fundamental frequency bands and more than 2 percent apart, the bus connection between the inside top terminal of the "CRYSTAL" selector switch and ground must be removed. A capacitor must then be installed between these two points. The value of this capacitor is determined by the frequency and is indicated in the foregoing table.

OPERATION

CAUTION.—The transmitter must not be operated in a hangar or while the plane is being fueled or near fuel supplies. The "FIL." switch should be kept in the "OFF" position at all times when the aircraft is not in actual flight.

When the transmitter is properly tuned to the antenna, the steps necessary to place it in operation are as follows:

1. Select the desired frequency by means of the "CRYSTAL" selector switch and make sure that the "TUNING" control is set to the proper calibration.

2. Turn the transmitter on and *wait approximately 40 seconds* for the tube heaters to reach operating temperature.

3. Let out the antenna to the correct length while the plane is still traveling at a relatively low speed.

4. Operate the "PRESS-TO-TALK" switch on the microphone and speak directly and distinctly into the microphone, keeping the lips no more than one-half to one inch from the front of the microphone case. The "sidetone" connection will permit the voice to be heard in the operator's headphones.

Operation of the Model AVT-15 or AVT-15A Transmitter in conjunction with the Model AVR-7 series of aircraft receivers is a simple matter. In the case of the Model AVR-7B, a beacon antenna of the "T" type will generally be used and, therefore, no antenna connection to the "REC." post on the transmitter will be necessary. The antenna connection to the Model AVR-7C for high-frequency operation is more satisfactorily made to the transmitting antenna through the "REC." post on the transmitter. The Models AVR-7D, E, F and G receivers may also be connected to the transmitting antenna, if desired, for maximum range of operation. (See antenna connection information on page 12 of the instruction book covering these receivers.) The antenna relay transfers the transmitting antenna to the receiver when the transmitter is not in operation. The transmitting antenna should never be used for radio-beacon flying since its directional characteristics are such as to give a widening of the beam; also, the cone of silence, if present, will not appear when over the radio range station.

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

If a fixed trailing wire antenna is used, frequent checks must be made to maintain it at the proper length.

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 r-f 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.

(b) If there is no r-f 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 (high capacitance) side of resonance. 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. 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 (C1) in the oscillator circuit is used to cover the range of the crystal frequencies used.

(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. Check to see that the battery rating of the aircraft electrical system corresponds with the rating of the transmitter.

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 clamp which holds the vibrator in its socket is not set up too snugly. The screw that holds this clamp should not be set up tightly. The clamp should only press against the flange of the vibrator sufficiently to keep the vibrator from being jarred from its socket. A defective vibrator should always be replaced.

PARTS LIST

MODEL AVT-15 TRANSMITTER UNIT MI-5881

Symbol No.	*Description*	*Stock No.*
	Electrical Items	
A1, 2	Quartz Crystal, "V" cut	MI-5737-2
	Socket, crystal holder, General Radio Type 274S	
A3	Vibrator, plug-in, 12 volts	18204
	Socket, plug-in vibrator	18195
A4	Lamp, panel indicator	31480
	Socket, panel indicator lamp	31365
	Jewel, panel indicator lamp, ruby, Drake Mfg. Co., Type 40	
C1	Capacitor, 330 mmfd	12952
C2	Capacitor, 325 mmfd, tuning	18196
C3	Capacitor, 470 mmfd	30433
C4, 5	Capacitor, 0.002 mfd, 2500 v, (Sangamo Type BE-25)	
C6	Capacitor, 40 mfd, 25 v	19807
C7, 7A	Capacitor, double section, 0.02 mfd each section	5070
C9, 10	Capacitor, double section, 10 mfd each section	32342
C11	Capacitor, 0.5 mfd, combined in pack with T3 and X1	(See T3)
C12, 13, 14	Capacitor, 0.1 mfd	4839
C15	Capacitor, 33 mmfd	12984
C16	Capacitor, 680 mmfd	14498
C17	Capacitor, 16 mfd, 350 v	32405
C18	Capacitor, same as C12	
C19, 20	Capacitor, 0.01 mfd	4858
C21	Capacitor, 0.5 mfd	43910
C22	Capacitor, 5.6 mmfd	12814
E1	Relay, antenna (12 v)	18199
E2	Relay, power (12 v)	18197
F1	Fuse, 10 amperes	6148
	Fuse Holder, Littlefuse, Type 1075, black	
J1	Jack, microphone	17469
J2	Jack, tuning meter	7961
J4	Receptacle, remote control cable (female)	18194
J5	Receptacle, power cable (male)	30110
L1	Coil, oscillator cathode tuning	18201
L2	Coil, oscillator plate tank	18209
L3	Coil, antenna loading	18189
L4	Coil, r-f choke	33169
M1	Meter, 0-1 ampere, r. f.	18188
R1	Resistor, 47,000 ohms, 1/4 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, 1/4 watt	14560
R6, 7	Resistor, 47 ohms	18190
R8	Resistor, 40,000 ohms, tapped	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
T1	Transformer, microphone, combined in pack with T2	18208
T2	Transformer, modulation, combined in pack with T1	(See T1)
T3	Transformer, plate power, combined in pack with C11 and X1	18206
X1	Reactor, combined in pack with T3 and C11	(See T3)
X2	Reactor, plate power filter	5066
V1, 2	Socket, octal base tube	31319
V3	Socket, panel indicator lamp	31365
	Miscellaneous Items	
	Binding Post, "XL" Laboratories, Type B1	
	Cable, battery power supply, approximately 10 feet long complete with 8-contact female plug	18210
	Plug, battery power supply cable, 8-contact, female	30115
	Cable, side tone, 6 feet long, complete with 8-contact, male plug	18312
	Plug, side tone cable, 8-contact, male	18212
	Clamp, tube and vibrator	18192
	Knob, antenna loading and oscillator coupling control	7960
	Locking Wheel, tuning control	18193

MODEL AVT-15A TRANSMITTER UNIT MI-5882

	Electrical Items	
A1, 2	Quartz Crystal, "V" cut	MI-5737-2
	Socket, crystal holder, General Radio Type 274S	
A3	Vibrator, plug-in (6 v)	18205
	Socket, plug-in vibrator	18195
A4	Lamp, panel indicator	31480
	Jewel, panel indicator lamp, ruby, Drake Mfg. Co., Type 40	

Symbol No.	Description	Stock No.
	Electrical Items—(Cont)	
C1	Capacitor, 330 mmfd	12952
C2	Capacitor, 325 mmfd, tuning	18196
C3	Capacitor, 470 mmfd	30433
C4, 5	Capacitor, 0.002 mfd, 2500 v (Sangamo Type BE-25)	
C6	Capacitor, 40 mfd, 25 v	19807
C7, 7A	Capacitor, 0.015 mfd	12233
C9, 10	Capacitor, double section, 10 mfd each section	32342
C11	Capacitor, 0.5 mfd, combined in pack with T3 and X1	(See T3)
C12, 13, 14	Capacitor, 0.1 mfd	4839
C15	Capacitor, 33 mmfd	12984
C16	Capacitor, 680 mmfd	14498
C17	Capacitor, 16 mfd, 350 v	32405
C18	Capacitor, same as C12	
C19	Capacitor, 5.6 mmfd	12814
E1	Relay, antenna (6 v)	18200
E2	Relay, power (6 v)	18198
F1	Fuse, 20 amperes	3646
	Fuse holder, Littlefuse, Type 1075, black	
J1	Jack, microphone	17469
J2	Jack, tuning meter	7961
J4	Receptacle, remote control cable (female)	18194
J5	Receptacle, power cable (male)	30110
L1	Coil, oscillator cathode tuning	18201
L2	Coil, oscillator plate tank	18209
L3	Coil, antenna loading	18189
L4	Coil, r-f choke	33169
M1	Meter, 0-1 ampere, r. f.	18188
R1	Resistor, 47,000 ohms, 1/4 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, 1/4 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
T1	Transformer, microphone, combined in pack with T2	18208
T2	Transformer, modulation, combined in pack with T1	(See T1)
T3	Transformer, plate power, combined in pack with C11 and X1	18207
X1	Reactor, combined in pack with T3 and C11	(See T3)
X2	Reactor, plate power filter	5066
V1, 2	Socket, octal base tube	31319
V3	Socket, panel indicator lamp	31365
	Miscellaneous Items	
	Binding Post, "XL" Laboratories, Type B1	
	Cable, battery power supply, approximately 10 feet long, complete with 8-contact female plug	18210
	Plug, battery power supply cable, 8-contact, female	30115
	Cable, side tone, 6 feet long, complete with 8-contact male plug	18312
	Plug, side tone cable, 8-contact, male	18212
	Clamp, tube and vibrator	18192
	Knob, antenna loading and oscillator coupling control	7960
	Locking Wheel, tuning control	18193
	ANTENNA SYSTEM MI-5911	
	For parts, see IB-26314	
	REMOTE CONTROL PANEL MI-5883	
	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-5884	
	Plug, interconnecting cable, 4-contact female and shell	30567
	Plug, interconnecting cable, 8-contact female	30115

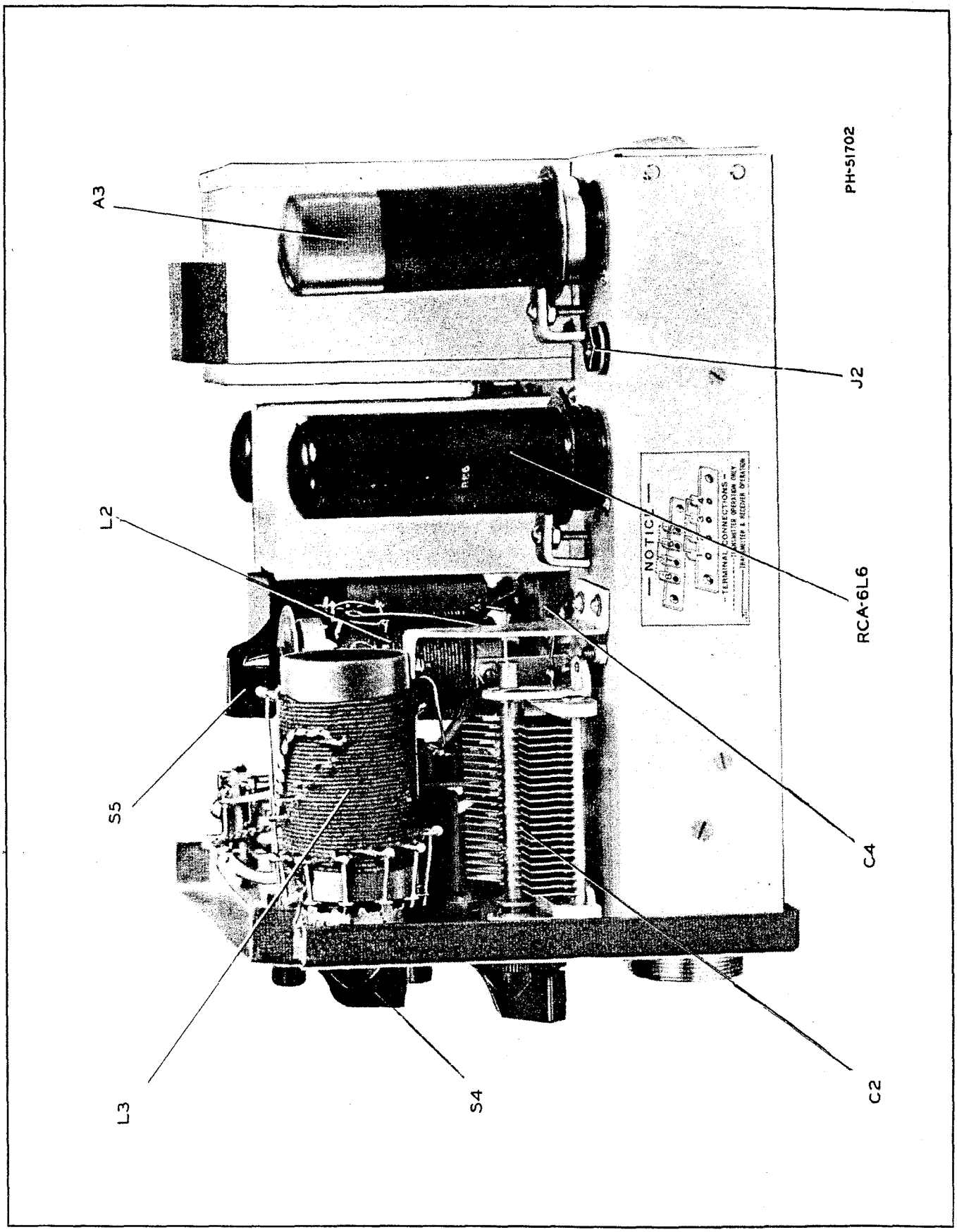


Figure 3—Transmitter Chassis (Right-Hand Side View)

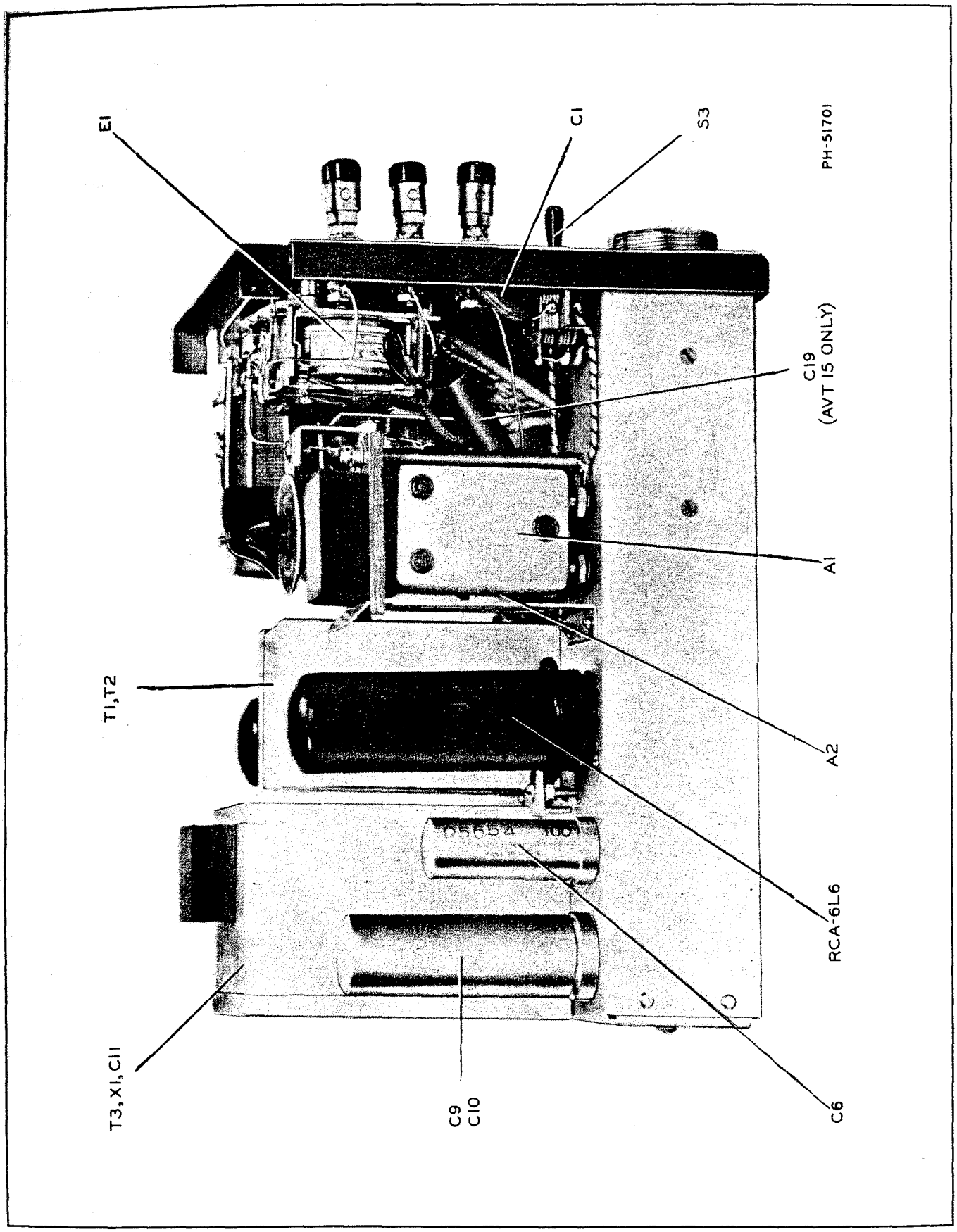


Figure 4—Transmitter Chassis (Left-Hand Side View)

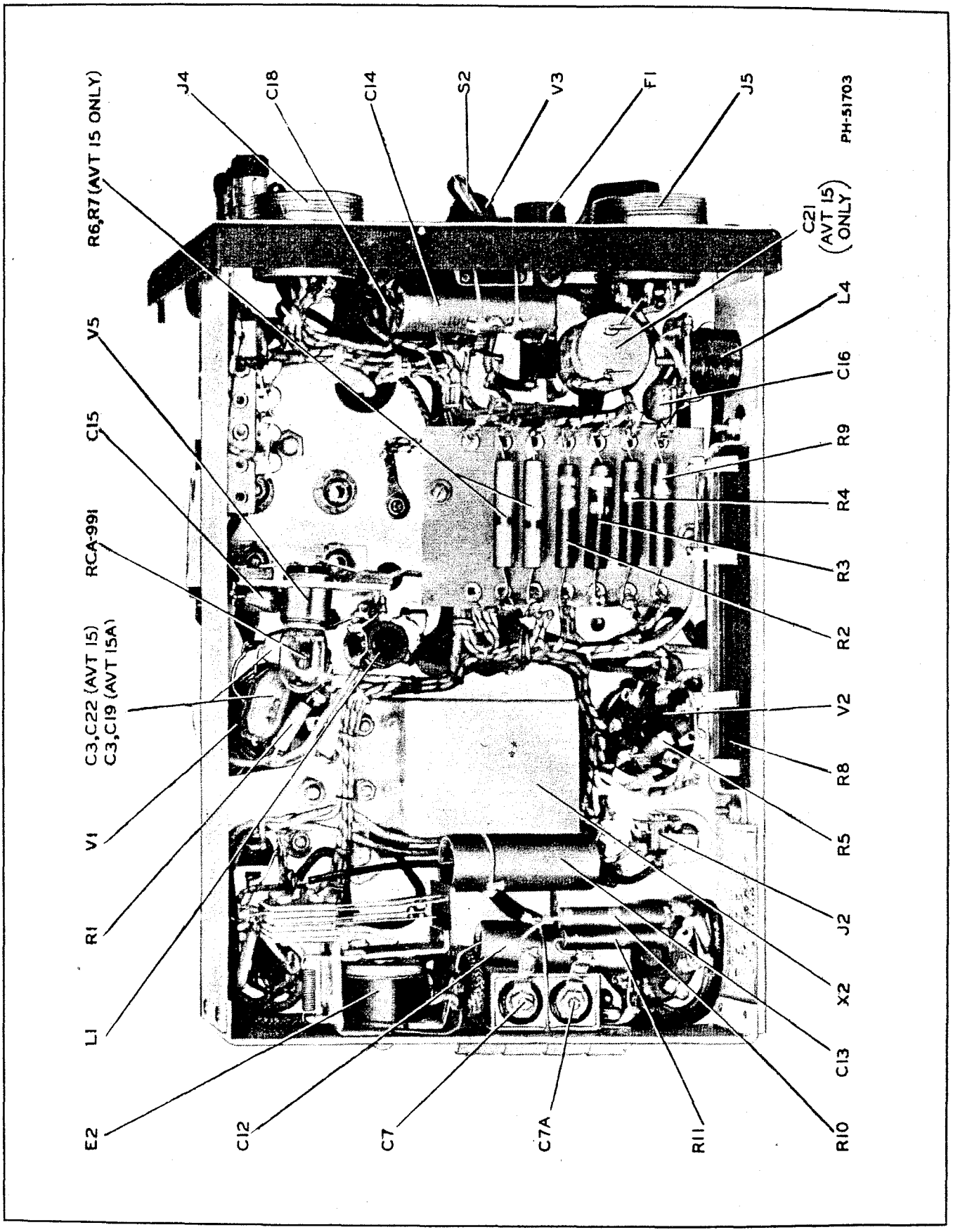


Figure 5—Transmitter Chassis (Bottom View)

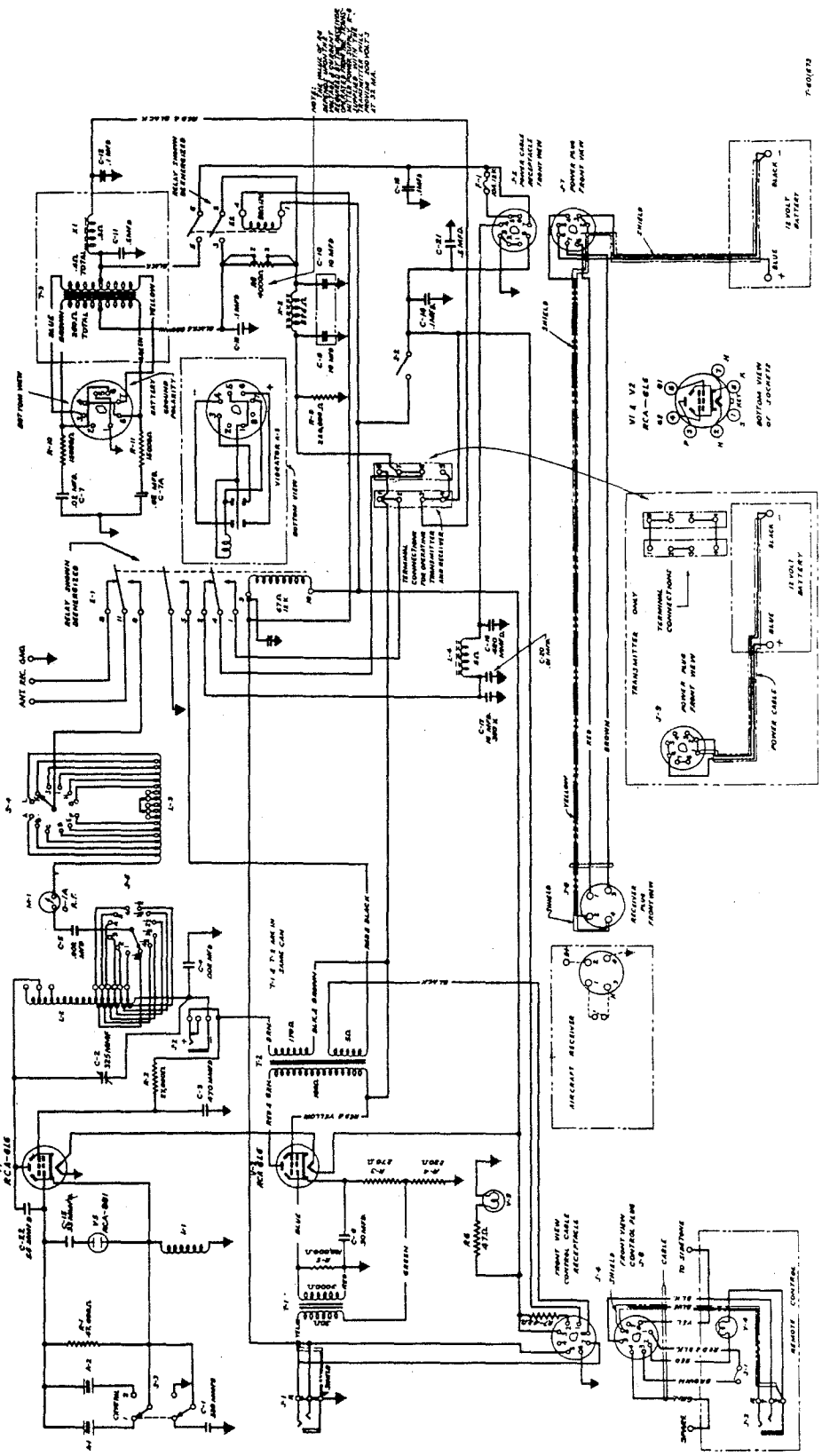


Figure 6—Model AVT-15 Transmitter (Schematic T-601673)

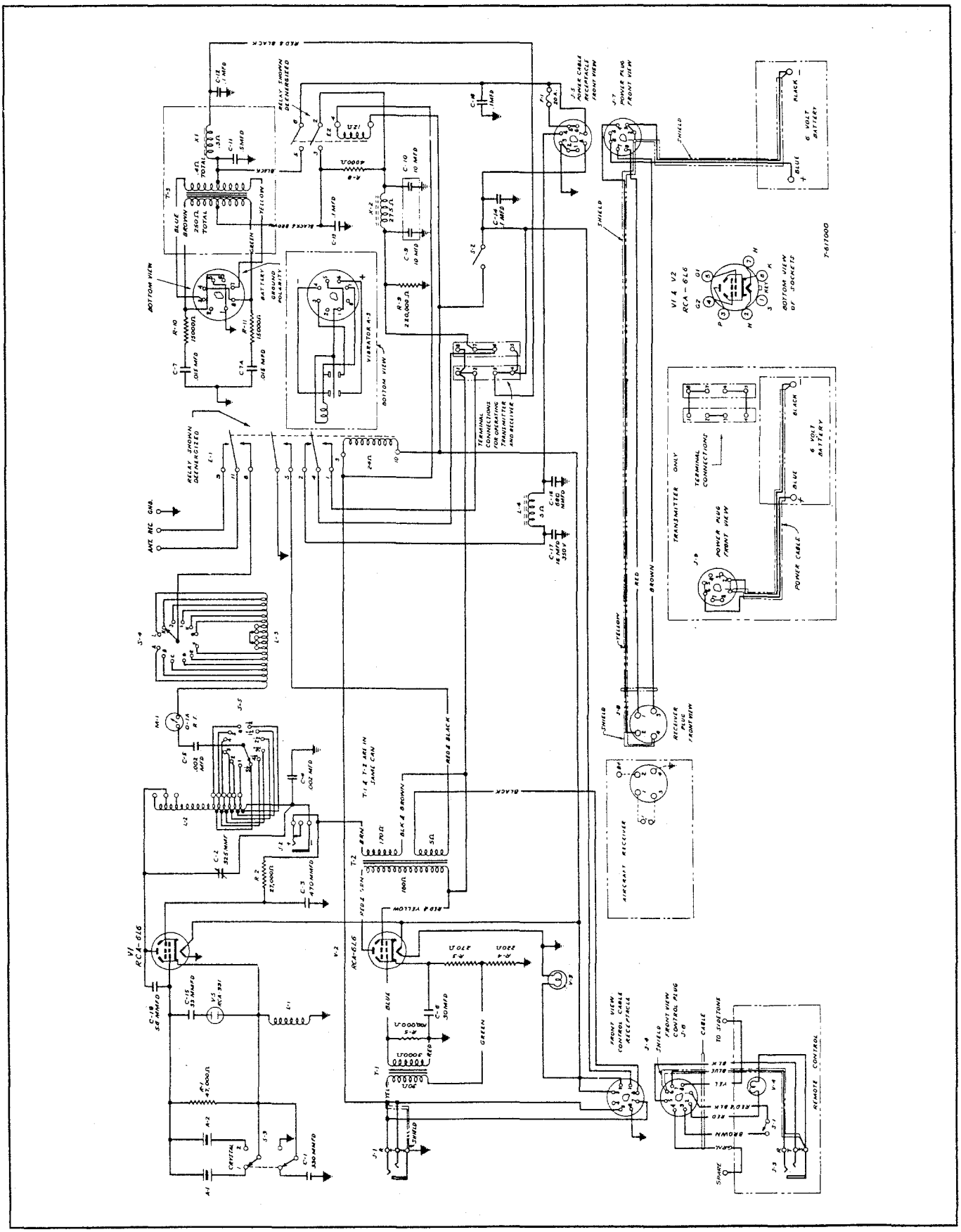
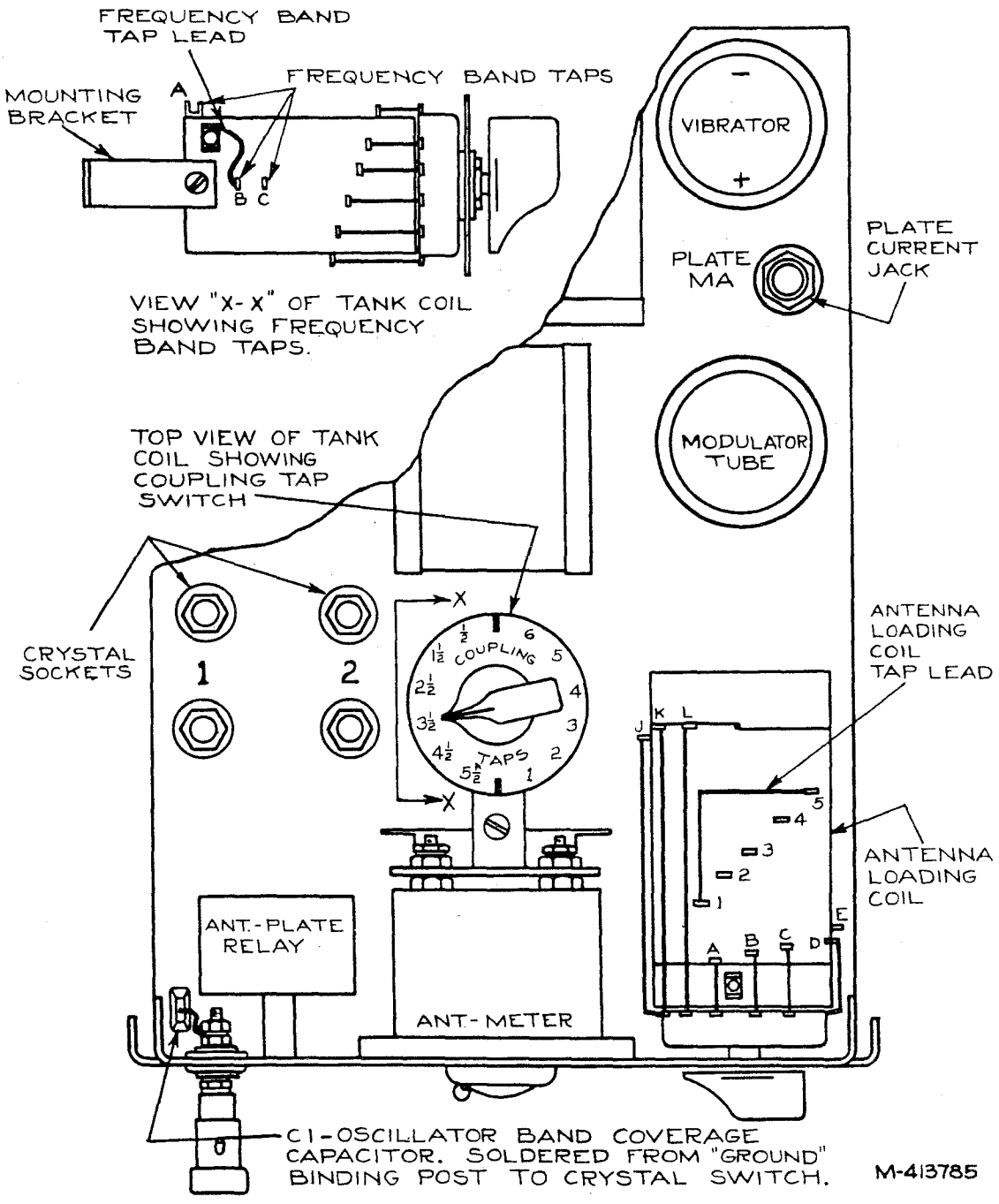


Figure 7—Model AVT-15A Transmitter (Schematic T-617000)



NOTE:-CONNECTIONS AS SHIPPED FROM THE FACTORY

Figure 8—Transmitter Band Change (Connections M-413785)

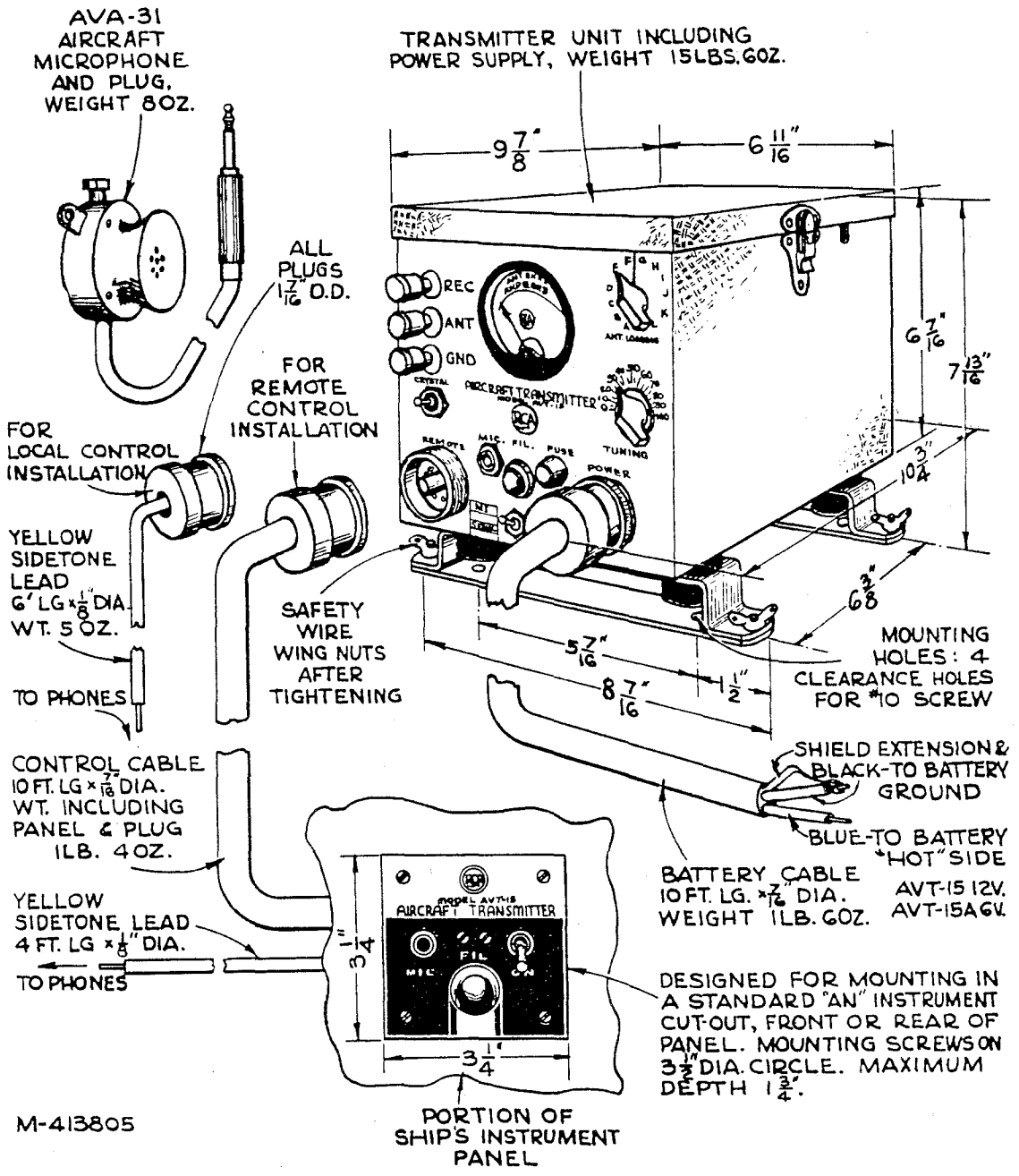


Figure 9—Transmitter and Remote Control (External Connections M-413805)