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SECTION 1 - CHAPTER IV.

of

C. A. P. 63

A. L.'s 1 - 8 INCLUDED.

R. C. A. F. SIGNAL MANUAL.

TRANSMITTER, TYPE AT-1
(12 Volt)

STORES REFERENCE NO. 10D/1267

and

TRANSMITTER, TYPE AT-7
(24 Volt)

STORES REFERENCE NO. 10D/1429

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GENERAL PURPOSE TRANSMITTER

TYPE AT-1

STORES REFERENCE NO. 10D/1267

and

GENERAL PURPOSE TRANSMITTER

TYPE AT-7

STORES REFERENCE NO. 10D/1429

1. GENERAL

1.1 Use

The Type AT-1 Transmitter (12 Volt) is intended for General Purpose use for all Aircraft except fighters. The Type AT-7 Transmitter (24 Volt) has similar applications.

1.2 Frequency Range

The Transmitter is arranged for operation on two CHANNELS designated "A" and "B" which divide the frequency range of the transmitter in the following manner:

Channel	Frequency Range
A	1.5 to 5 megacycles 500 kc.) crystal control 375 kc.) only
B	5 to 20 megacycles.

Both A and B CHANNELS are arranged for operation on either Master Oscillator or Crystal at the will of the operator. In addition, as indicated above, the "A" CHANNEL is provided with two low-frequency crystals in a single holder which may be plugged into a socket provided for that purpose within the unit. When the Transmitter is operated on these two low frequencies, an external Antenna Loading Coil is required, Ref. No. 10D/1286.

1.3 Facilities

The transmitter may be completely controlled from the Wireless Operator's position. Three types of transmission are possible, namely, radio telephony (R.T.), modulated continuous wave telegraphy (M.C.W.) and continuous wave telegraphy (C.W.) Full side-tone facilities on all modes of operation are provided, and, in addition, intercommunication may be achieved when the transmitter is used in Conjunction with a Type AR-2 Receiver. Switch-

ing of I/C facilities in large aircraft is done by means of the Intercommunication Switching Unit, Ref. No. 10D/1276.

1.4 Remote Control

By means of a LOCAL-REMOTE switch, control may be transferred to the Pilot's position where the Remote Control Unit is located. By means of three simple toggle switches,

(a) The Pilot may turn the Transmitter ON and OFF.

(b) He may select one of two pre-determined frequencies which may be either crystal controlled or selected by means of the variable oscillator controls as set up by the Wireless Operator.

(c) He may switch the M.C.W. NOTE from HIGH to LOW for M.C.W. Transmission.

2. DESCRIPTION

In order to make possible the installation of the transmitter either alongside or above its companion receiver, the case of the transmitter is so designed that no projections are present on any surface except the front panel. Power control, the cable connector and release catches for the shock mounting are located on, or are accessible from the front of the Unit, 10D/1276.

2.1 Weight and Dimensions

The weight and dimensions of the transmitter, together with those of accessory equipment, are given in Table I.

TABLE I

Stores Ref.No.	Unit	Weight	Maximum Dimensions
10D/1267	Type AT-1 Trans.	38-3/4 lb.	13-5/16" x 10-1/4" x 14-3/4"
10D/1268	Trans. Remote Control Unit	1 lb.	5-7/64" x 2-1/16" x 2-21/32"
10D/1286	Antenna Loading Coil	2 lbs.	5-9/32" x 4-1/32" x 5-9/32"
10D/1270	Junction Box	3-1/3 lbs.	10-9/64" x 10-3/16" x 2-5/32"
10D/1276	I/C Switching Unit	1 lb.	5-33/64" x 2-33/64" x 2-13/16"
10D/1271) 10D/1278)	T. Transit Case) R. Transit Case)	15-1/2 lbs.	15-1/2" x 12" x 16-7/8"
10D/1275	Type AR-2 Receiver	35.4 lbs.	13-5/16" x 10-1/4" x 15"
10D/1277	Rec.Remote Control Unit	2.6 lbs.	7-1/4" x 6" x 3".
10B/1282	Loop Control Unit	2.6 lbs.	7-1/4" x 6" x 3"
10B/1281	Type C1 Loop	4.8 lbs.	7" x 13" x 20-1/4"
5E-570	Trans. Cable	5.45 oz/ft	
5E/568	T.R.C. Cable	1.0 oz/ft	
5E/566	Batt. Cable	3.17 oz/ft	
5E/585	I/C Cable	9.15 oz/ft	
5E/571	Rec. Cable	11. oz/ft	
5E/569	Rec.R.C.Cable	5.45 oz/ft	
5E/566	Loop Cable	5.5 oz/ft	
5E/505	Loop Lighting or Key Cable	1. oz/ft	
10B/1283 10B/1284	Casing Flexible) Shafting Flexible)	2.3 oz/ft	

2.2 Shock Mounting

The complete Transmitter is mounted on a shock mounting plate employing six individual Lord type shock mountings. Each individual shock mounting is provided with a travel-limiting washer which is to prevent the unit from tearing loose from its mounting in the event of failure of the shock mountings themselves. The design of the shock mounting is such that the complete Transmitter unit in its case may be made to either slide out on its tray or be lifted out vertically, in which case only about half an inch of forward motion is required to release the unit from the tray. The catches which secure the unit firmly in place are located at the front and in the accompanying photograph, (Figure 1) the catches are shown in their engaged position. In order to release them, the two catches are withdrawn toward the centre of the unit.

2.3 Functional Controls

The arrangement of controls on the front panel of the transmitter is such that almost all functional controls are located in a horizintal line across the centre of the Transmitter panel. The transmission switch is located at the lower left-hand corner of the unit, while the high voltage fuse and the connecting plug are located at the lower right-hand corner. The functional controls consist of:

(a) The CONTROL Switch designated "LOCAL-REMOTE" which determines the position from which control of the transmitter is possible, is located on the horizontal centre line at the extreme left of the front panel. In the LOCAL position all controls may be operated by the Wireless Operator. In the REMOTE position the Pilot has control of the POWER ON-OFF switch and the CHANNEL switch.

(b) The METER switch which provides three positions by means of which the meter may be switched to three different positions during tuning.

(c) The MILLIAMMETER, which is used in conjunction with the METER switch described in (b), is located directly in the centre of the panel and associated with it is an adjustment meter lighting device located directly above the meter itself. The illumination of the meter dial is adjustable by means of a rotatable control which incorporates a rod of Lucite. The meter light screws into a socket in the centre of the control. The design of the device is such that the lamp burns continuously while power is on the transmitter, but illumination of the meter dial is only possible when the Lucite inserts are in vertical alignment, in which case an indication that power is on the trans-

mitter is given by the glowing of the small Lucite jewel at the top of the lamp and by the illumination of the meter dial scale by reflection of the light which has passed through the opposite end of the Lucite rod, where it is reflected from the white painted inner surface of the meter bezel. The intensity of the illumination may be controlled to a degree or completely shut off by the rotation of the meter lamp control.

(d) The NOTE switch is located to the right of the B Channel crystal. By means of this switch the Wireless Operator is able to select the required modulation note for the M.C.W. signals or C.W. Keying-tone in the side-tone circuit.

(e) The CHANNEL switch is located to the right of the note switch. By means of this switch the Wireless Operator is able to select either the A or B Channel, providing the CONTROL switch is set to the LOCAL position.

(f) The POWER ON-OFF switch for LOCAL CONTROL is located on the extreme right centre of the equipment.

(g) The TRANSMISSION switch by means of which the Wireless Operator alone is able to determine the Mode of Operation of the transmitter is located at the extreme lower left hand corner. This switch provides the switching facilities necessary for securing operation on R.T., M.C.W. or C.W.

(h) At the extreme lower right hand corner the POWER AND CONTROL CIRCUIT CONNECTOR PLUG to the transmitter is located.

(i) The HIGH VOLTAGE FUSE which isolates the high voltage circuit dynamotor completely from the rest of the circuit is located just to the left of the connector plug.

2.4 Tuning Controls

The mechanical arrangement of the component parts of the transmitter is such that all front panel tuning controls having to do with the A CHANNEL are located to the left of the vertical centre line of the front panel, while those associated with the B CHANNEL are located to the right. The A CHANNEL CRYSTAL is located to the left of the meter while the B CHANNEL CRYSTAL is located to the right.

(a) At the bottom of the front panel, just to the left of the centre, the CHANNEL A Master Oscillator (M.O.) crystal selector switch is located. By means of this switch the frequency determining element of the oscillator is selected and may be Master Oscillator, A CHANNEL XTAL or the 500 kc. or 375 kc. crystals, if provided.

(b) The ROTATABLE TUNING CONTROL designated "FREQUENCY A" located on the lower left portion of the front panel is the frequency determining control for the Master Oscillator of the A CHANNEL and also the plate circuit tuning control for the A CHANNEL CRYSTAL (XTAL).

(c) At the top of the panel directly above the "FREQUENCY A" control, the ANTENNA COUPLING A control is located. By means of this control, which consists of a 12 point switch associated with 12 fixed condensers, the matching of the final stage of the transmitter to the aircraft antenna is accomplished.

(d) In the extreme upper left corner, the ANTENNA LOADING A tuning control is located. This control consists of a rotating coil and trolley by means of which the number of turns in the circuit is varied in accordance with the tuning requirements.

(e) For the B CHANNEL the MASTER OSCILLATOR-CRYSTAL switch is located to the right of the centre line at the bottom of the front panel. By means of this switch, the frequency determining components of the oscillator for the B CHANNEL are selected. For this channel, operation may be secured on either the B CHANNEL CRYSTAL (XTAL) or the B CHANNEL Master Oscillator.

(f) The FREQUENCY B oscillator tuning control for the B CHANNEL is located directly to the right of the CRYSTAL-Master Oscillator switch for the B CHANNEL. This rotatable control determines the frequency of the master oscillator for the B CHANNEL and also provides the plate tuning facilities for the B CHANNEL oscillator when crystal controlled.

(g) At the top of the front panel and to the right of the vertical centre line, the ANTENNA COUPLING B control, consisting of a 12 point switch associated with 11 fixed condensers, is located. By means of this control, the proper circuit matching conditions for the output stage to the antenna may be achieved.

(h) The ANTENNA LOADING B control is located at the upper right hand corner of the front panel. By means of this rotatable control the number of turns of the coil in series with the antenna circuit may be varied in accordance with the tuning requirements.

2.5 Tuning Coil Construction

All the tuning controls in the transmitter, which are rotated by means of a knob and crank assembly, are constructed in a similar manner. These controls rotate coils which are asspciated with trolleys, by means of which the number of turns in the circuit is varied as the coil is rotated from the front shaft on which the crank and knob are secured. The number of turns in the circuit is indicated on a revolution counter, the dial of which is exposed through a cutout in the blister which covers the gear assembly between the drive shaft and the revolution counter. Each control is provided with a locking device which clamps the skirt of the knob in each case to prevent rotation of the counter after it has been adjusted.

2.6 Antenna Connections

Two antenna terminals are provided on the transmitter. The terminal located directly to the left of the centre at the top of the unit is for connection to the aircraft antenna system, while the terminal located to the right is for connection to the companion receiver antenna post.

2.7 Case Catches

The transmitter is secured in its case by means of four slotted catch screws which are located on horizontal and vertical lines approximately in the centre of the unit. These four screws engage with elastic-stop-nut-anchor-lugs which rotate into position to engage with a slot in the case as the screw is tightened, finally coming to rest with the screw pulling the anchor-lug up tight against the slot in the case and thereby securing the transmitter firmly in the case. In order to release these catches, it is necessary to rotate the screws in a counter-clockwise direction until the anchor-lug has rotated out of the slot. This will generally take place after five or six turns of the screw, after which the screw will be found to be perfectly free for about three-quarters of a turn, at which time the anchor-lug again is prevented from rotating freely by striking the case and may unscrew to the point where it will not go any further on account of a pin through the shaft of the screw. When this point is reached, no attempt should be made to force the rotation any further. It is not necessary, in fact, to rotate the screw so far that this condition occurs.

2.8 Location of Apparatus - Top View of Chassis

The location of apparatus on the upper right side of the chassis may best be described with reference to the photograph, (Figure 2) showing the top view of the chassis. On this photograph the various component parts are given their schematic designation for identification. In the centre of the unit the Channel Relay D1 is located with all other apparatus arranged around it in order to secure shortest possible leads. To the right of the channel relay in Figure 2, the oscillator tube V1 is located. On the extreme right, the A Channel Output Coil, L8 is located, while the associated A Channel Antenna Coupling Switch S4 may be seen mounted on the rear of the front panel. The Keying Relay, D5 is located directly in the centre of the rear of the front panel, while directly to the left of it are located in turn the B Channel Antenna Coupling Switch Assembly, S3, and the B Channel Antenna Loading Coil, L9.

The High-Note Low Note Relay D6 is located to the left of the channel relay in the photograph. The photograph also shows the location of the dynamotor with its shock mounting in the foreground of the picture. The R.F. Amplifier Output Tube, V2, together with its plate choke L7, is located in the lower centre of the picture. Next to these is turn are located the Diode Voltmeter Vacuum Tube V5 and the Audio Oscillator Tube V4. To the left centre the High Voltage Filter Condenser C34 may be seen, while the Modulator Tube V3 is shown in the lower left hand corner.

2.9 Location of Apparatus - Bottom View of Chassis

Location of the apparatus mounted on the bottom side of the chassis is illustrated in the photograph (Figure 3) showing the bottom view of the chassis. The photograph also shows apparatus in the Oscillator compartment at the front of the transmitter which is normally covered by an aluminum shield. The apparatus mounted beneath the chassis may be identified from the designations appearing on Figure 4 showing the location of resistors, fuse and thermostat, and Figure 5 showing the location of condensers and coils. Referring to photograph (Fig.3) the main subassembly may be seen, notably the bottom section of the Channel Relay D1 located near the centre of the unit in the oscillator section. On the right hand side in the Figure, the B Channel ganged oscillator tuning coils, L1, L5, are located, while the A Channel coils L2, L6, are located on the left hand side. The Dynamotor Starting Relay D7 is located on the centre partition at the right hand side. Directly above it, and to the right in the oscillator compartment the location of the main fuse, F1, is shown. In the oscillator compartment at the rear of the front panel, three switch assemblies are shown, namely the Transmitter switch S9 at the extreme left, with the A and B M.O. Crystal Switches S1 and S2 located on the left and right hand sides of the centre line respectively. Other apparatus in the illustration may be identified from the associated schematic designation by reference to the Parts List and Circuit Schematic.

3. Power Input

The power input to the transmitter delivered from the aircraft battery with 13.25 volts at the transmitter is illustrated for various conditions in Table II.

TABLE II

Condition	A Channel	B Channel
Telephone Stand-by	2.5 amps.	3.5 amps.
R.T.	14.5 "	15.5 "
C.W. "Key Up"	11. "	12.5 "
C.W. "Key Down"	16.5 "	17.5 "
M.C.W. "Key Up"	11. "	11.5 "
M.C.W. "Key Down"	15. "	16. "

4. Power Output

The nominal power output of the transmitter to the antenna circuit for the highest allowable battery voltage of 14.5 volts is rated at 20

watts C.W. and 7-1/2 watts R.T. and M.C.W. unmodulated carrier. Maximum ratings up to 36 watts, C.W. and 13 watts R.T. may sometimes be achieved (see Table VII). The actual power delivered to the antenna circuit may vary considerably over the frequency band and also is largely dependent on the particular type of antenna being used. The power delivered to the antenna is also dependent on the aircraft battery voltage and the normal variations in output are given in the table VII settings included in the Section 13 under "Operation".

5. Antenna Characteristics

The characteristics of the antenna which it is possible for the transmitter to properly tune and match are listed in Table III.

TABLE III

Channel	Frequency	Antenna Resistance	Antenna Capacity
A	375 kc.	5 - 12 ohms	*350 mmf to 1200 mmf
A	500 kc.	5 - 12 "	*350 mmf to 650 mmf
A	1.5 mc.	1 - 12 "	100 mmf to infinite
A	5 mc.	1 - 5 "	100 mmf to infinite
**B	5 mc.	5 - 150 "	100 mmf to infinite
B	20 mc.	1 - 12 "	50 mmf approx.to infin.

* At least one Step of 10D/1286 Antenna Loading Coil must be in the circuit.

** Transmitter will also deliver normal power output into a 70 ohm transmission line when the output circuit is shunted with a 200 mmf. condenser which is provided externally in the Antenna Loading Coil position "O". The transmitter is also capable of tuning antenna which are slightly inductive, provided the inductive reactances of the antenna do not exceed 100 to 200 ohms.

6. THEORY - SIMPLIFIED CIRCUITS

6.1 Radio Frequency Circuits - C.W. Transmission

The basic circuit design features of the transmitter may best be understood by referring to Figure 6 in which the conditions of operation for C.W. transmission with the key down are shown in schematic form. In Fig. 6, V1 is the oscillator tube which is a beam power tetrode. The oscillator circuit is designed to provide both crystal and master oscillator control on each of two channels. The circuit elements for Channel B only are shown on Fig. 6. The oscillator functions as an oscillator doubler circuit in which the control grid and the screen of the oscillator tube operate as a triode oscillator and the plate circuit operates as an amplifier tube for the second harmonic. In this transmitter the circuit elements are arranged so that this doubling action takes place at all frequencies between 1.5 and 20 megacycles for master oscillator operation. In the oscillator circuit the frequency determining

elements are L1 and C1 connected between the control grid of the oscillator tube and ground. The oscillator is essentially a Colpitts triode oscillator in which the screen functions as a plate and operates at ground potential as far as radio frequencies are concerned, being bypassed to ground by Condenser C4. The necessary feed-back to produce oscillation is provided by means of condensers C9 and C5 connected between grid and cathode and the cathode and screen respectively. The cathode operates above ground potential. This is accomplished in the circuit by means of a Choke L4. The plate circuit of the oscillator is tuned to the second harmonic of the frequency determined by L1 and C1, by means of the coil condenser combination L5 and C11. A unique feature of the circuit design is the fact that coils L1 and L5 in the grid and plate circuits are ganged together and both oscillator and doubler circuits are tuned simultaneously and track together across the frequency range. This is made possible by employing identical roller coils and fixed condensers such that the capacity in condenser C11 in the plate circuit is one quarter the capacity in condenser C1. Under these conditions the anti-resonant frequency of the plate tank circuit is double that of the grid tank circuit which determines the oscillator frequency. In the plate circuit of the oscillator tube the direct current voltage is blocked from the tank circuit by condenser C10 and is fed through the plate choke L3. This choke is actually used as a plate tank circuit element for low frequency operation as explained in detail later. The radio frequency amplifier tube V2 is also of the beam power tetrode type and operates as a Class C amplifier for C.W. transmission. It derives its grid excitation from the oscillator across its grid leak R7. Means are provided for measuring the current in the grid leak to indicate the presence of grid driving voltage and to facilitate adjustment. A high grid bias is produced across the grid leak R7, and grid blocking condenser C12 isolates the direct current circuit from the oscillator tank element. Sufficient bias to prevent damage to the tube occuring during periods when the transmitter is being tuned is provided by means of the voltage drop across the cathode resistor R11, and means are provided in this circuit for measuring at the cathode the combined plate and screen currents. For the condition of C.W. transmission, the screen voltage is operating at the maximum value consistent with the capabilities of the tube and in the screen supply circuit this condition is achieved by means of a resistor R18, which is connected in parallel with the permanently connected screen resistors R9.2 and R9.3,by means of a section of the transmission switch S9.3. Plate voltage is fed to the amplifier tube through the radio frequency choke L7 and is blocked from the output circuit by condenser C21. The output circuit of the Transmitter is the simplest possible and consists of a network having an "L" configuration consisting of a series of fixed antenna coupling condensers mounted on the switch assembly S3 and the variable antenna loading inductance L9. The adjustment of the output circuit is accomplished by means of a diode voltmeter V5 connected across the plate circuit of the output tube. Correct adjustment of the output circuit is indicated by this meter. Since the voltmeter V5 is connected across the plate circuit of the output tube which requires to be operated into a definite impedance , for a given power output, the voltage across this part of the circuit is approximately constant. Hence when the ad-

justments of the antenna coupling condensers and the antenna loading coil have been properly accomplished, regardless of the amount of current flowing in the antenna circuit, the reading of the voltmeter for the correct adjustment will always be the same. In practice only one milliammeter is used for all the circuit adjustments, as explained in detail later. The keying of the transmitter is accomplished by means of relay D5 which transfers the antenna between the transmitter and the companion receiver, and also applies voltage to both the oscillator and the radio frequency amplifier screens simultaneously. In the "Key UP" position, both the amplifier and oscillator screens are simultaneously connected by the contacts of relay D5 to the oscillator resistor R6, with the result that oscillations are stopped both by the reduction of the screen voltages to a very low value and by the effective increase in the grid-to-cathode voltage on the oscillator tube, caused by the additional current flowing from the high voltage supply through both the oscillator and amplifier screen supply resistors. As the transmitter is keyed on C.W. transmission, an audible keying tone corresponding to the signal transmitted is fed to the side-tone circuit of the equipment. This keying tone is produced by a triode oscillator V4 connected in a Hartley circuit. This audio NOTE oscillator derives its plate voltage from the oscillator screen supply via the contacts of the keying relay and feeds tone, corresponding to the dots and dashes transmitted, to the side-tone circuit through the input transformer T1.

6.2 Simplified Control Circuits

In Figure 6 the simplified control circuits are shown with the transmitter arranged for C.W. TRANSMISSION and LOCAL CONTROL by the Wireless Operator. The diagram shows the transmitter in the KEY DOWN condition, so that the keying relay D5 is in the operated position. C.W. transmission conditions of operation are determined by the TRANSMISSION switch S9 which has five sections controlling various parts of the circuit as shown in the diagram. The main functions accomplished by this switch are the starting of the dynamotor by Section S9.4 which operates dynamotor starting relay D7, the connection of the keying relay D5 through S9.5 to the keying circuit, and the removal of the microphone from the circuit by S9.1 and the provision of proper screen voltage for C.W. transmission, as well as provision of plate voltage to the audio oscillator by means of switch S9.3 and connection of the output of the audio oscillator to the side-tone circuit by switch S9.2. In the diagram switch S11 is the POWER ON-OFF switch, while the double section switch S10.1 and S10.2 is the LOCAL-REMOTE CONTROL switch shown in the LOCAL position. When the transmitter is arranged for REMOTE CONTROL by the Pilot, switch S10 takes up the dotted position and the three switches at the bottom of the diagram, shown by dotted lines, control the operation of the transmitter from the Pilot's position. By means of these switches the Pilot has control of the POWER and he may select either CHANNEL A or B. The CHANNEL switch S7 has been shown in the diagram selecting CHANNEL B in which the operation of the transmitter above has been described as a typical example.

6.3 Simplified Circuit - M.C.W. Transmission

The essential differences in the condition of the operation of the transmitter for M.C.W. as compared to C.W. TRANSMISSION are illustrated in Figure 7. This diagram shows essentially two things. First, that the audio modulator tube V3 is connected into the circuit by means of a section of the transmission swithh S9.2 connecting transformer T1 to the grid of V3. Second, that the radio frequency amplifier screen voltage has been reduced by the opening of the contacts of switch S9.3, disconnecting R18 from the screen supply circuit. The output of the modulator tube is coupled directly to the screen of the output amplifier V2 through the coupling condenser C32, and modulation of the radio frequency output is accomplished by the application of audio frequency voltage to the screen of the putput tube alone. The modulator tube is also of the Beam power tetrode type and is arranged as a conventional Class A resistance coupled amplifier, operating with the tube very slightly loaded. The radio frequency amplifier tube V2 operates essentially as a grid modulated Class C amplifier, although the modulating voltage is actually applied to the screen as a matter of convenience in order to separate the audio frequency circuit entirely from the radio frequency circuit up to the point where the actual electron stream within the tube is reached. With the exception of the fact that the tone from the audio oscillator V4 is applied as a modulating voltage to the screen of the output amplifier, the operation and control of the transmitter for M.C.W. is similar in every respect to that described for C.W. transmission. On the Remote Control Unit the Pilot has the choice of two NOTES - HIGH or LOW as may be required for artillery co-operation. The operation of D6 governs this function as shown in Figure 6.

6.4 Simplified Circuits - R.T. Transmission

The essential differences between conditions of operation for R.T. TRANSMISSION as compared to C.W. transmission are illustrated in Figure 8. In this condition of operation the screen voltage is reduced in the same manner as described for M.C.W. Transmission, with the modulator tube V3 and the radio frequency amplifier tube V2 functioning in exactly the same way. The essential differences lie in the arrangement of control circuits. The changes in the condition of the circuit are accomplished by means of the transmission switch S9 which is shown on Figure 8 and alters the circuit in the following way. Plate voltage is entirely removed from audio oscillator V4 by the opening of the switch S9.3 in its plate supply circuit, and, in addition, the audio oscillator is disconnected from the transformer T1 by switch S9.2. Switch S9.2 also connects the input transformer T1 to the grid of the modulator tube V3 as previously described for M.C.W. For R.T. TRANSMISSION, the essential differences in the control circuits are that the microphone is connected into the circuit by means of switch S9.1 and the control of both the dynamotor starting relay D7 and the keying relay D5 are switched to the PRESS-TO-Talk switch of the MICROPHONE and the key no longer has any control. In the circuit, resistor R12 is the microphone current supply resistor and condenser C29 the necessary by-pass and filter condenser for the microphone supply circuit. For REMOTE CONTROL, conditions are the same as described for C.W. transmission, except for the fact that control of transmission originates from the MICROPHONE instead of the key in the manner described.

7. THEORY - DETAILED DESCRIPTION

Referring to Figure 9, the oscillator circuit of the transmitter employs an RK-39 Vacuum Tube in a circuit arrangement specially designed to provide both Crystal and Master Oscillator control. The oscillator functions as an oscillator doubler circuit in which the control grid and the screen of the oscillator tube as a triode oscillator and the plate circuit operates as an amplifier to the second harmonic. When operating as a Master Oscillator the circuit elements are arranged so that this doubling action takes place in order to produce all frequencies between 1.5 and 20 megacycles in the plate circuit of the oscillator. For crystal operation, the highest actual crystal frequency employed is 5 megacycles with the plate circuit tuned to 10 megacycles. Sufficient output from the oscillator on crystal operation is possible so that the final r.f. amplifier tube is operated also as a frequency doubler in order to achieve carrier output with the crystal operation in the range from 10 to 20 megacycles. For the two lower frequencies, 500 and 375 kilocycles, however, the fundamental frequency of the crystal controlling element applies throughout. As already described in connection with the simplified circuit diagram, the oscillator circuit is essentially a triode Colpitts oscillator in which the screen of the beam power tube functions as a plate which is, as far as radio frequency potential is concerned, directly connected to ground through the by-pass condenser C4. The r.f. potential of the cathode of the tube is kept above ground by means of the choke L4 in the cathode circuit, and condensers C9 and C5 from grid to cathode, and screen to cathode respectively, divide the voltage developed between grid and screen in the proper manner to produce the necessary feedback conditions for oscillation. With the circuit arranged in this way, the two terminal oscillator is produced so that it is convenient to employ a simple anti-resonant circuit consisting, for example, of L1 and C1 in the B CHANNEL, as the frequency determining element in which only the inductance is variable and in which, furthermore, the adjustment of the inductance is accomplished by means of a single control throughout the complete range of the channel involved. At the same time, this circuit arrangements makes possible the substitution of a crystal as means of frequency control without further change to the oscillator circuit. As a means of protection to the tube, both plate and screen voltages are fed through a series resistance, while sufficient bias to prevent damage to the tube in case of failure to oscillate is always provided by means of the cathode resistance R6 which is bypassed by condenser C8. Plate voltage is shunt fed to the oscillator tube through the plate choke L3. The by-pass condenser C65 and the plate dropping resistor R5 constitute an additional filter between the oscillator plate circuit and the rest of the transmitter power supply. Condenser C10 is the grid blocking condenser which isolates the direct current circuit through the grid leak R2 up to the grid of the oscillator tube from the master oscillator grid tank circuits.

7.1 Master Oscillator Circuits

When the oscillator tube V1 is operated on either channel as a Master Oscillator, the frequency is determined by the coil condenser connected between the control grid and ground. In this transmitter

the frequency determining elements consist of stable fixed ceramic condensers having the proper negative temperature coefficient to compensate for the positive temperature drift coefficient of the rest of the circuit, and stable variable inductances wound on threaded ceramic forms. The coefficient of thermal expansion of the ceramic form of these coils is extremely small and is approximately equal to that of the silver coated Invar which is used for the winding. The inductance is varied by the rotation of the coil which causes a trolley or roller to travel along the turns of the coil, short-circuiting the unused portion. Circuit connections to the coils are made by means of collector rings and wiping springs at the high potential end and collector springs on the hubs at the ground potential end. All connections employ a silver-to-silver contact, with the exception of the wiping and collector springs which have a special contact metal, spot welded to the springs. The resulting coil is highly stable over extreme ranges of temperature and humidity variation. By carefully selecting materials used in the construction of these coils, it has been possible to produce an electric oscillator which has a stability - as regards temperature and humidity range - which approaches very closely the figure obtainable with crystals. In the plate circuit of the oscillator, an identical coil is used except that copper wire is used instead of Invar. The two coils are ganged together so that each has approximately the same amount of inductance in the circuit at the same time. The plate circuit is then tuned by means of another fixed condenser which brings the total plate circuit capacity to ground, including stray circuit capacities, to one quarter of the total capacity across the grid circuit; since the inductances are equal, the anti-resonant frequency of the plate circuit is double that of the grid circuit. As the coils are rotated to vary the oscillator frequency from one end of the range to the other, the plate circuit is made to track with the grid circuit automatically at double the resonant frequency of the grid circuit which is the frequency determining element. Furthermore, this construction makes it possible to achieve this result by means of a single rotatable control. In order to secure reasonably uniform conditions of operation throughout the frequency range of the equipment, it is necessary in practice to equalize, or maintain reasonably constant, the output r.f. voltage of the oscillator which is impressed upon the grid of the following stage. In order to achieve this result, both master oscillator plate circuits have been equipped with equalizer circuits which compensate for variations in the driving power of the grid circuit of the oscillator in such a way as to produce a reasonably uniform output voltage.

7.2 Crystal Oscillator Circuits

When operating as a Crystal Oscillator, the oscillator circuit of the transmitter is so arranged that the CRYSTAL is connected between the control grid of the oscillator tube and ground, replacing the coil condenser combination of the grid circuit used for master oscillator control. The circuit, however, still employs the same coil condenser cimbination which is tuned to double the crystal frequency by rotating the frequency control in the same manner as would be done for master oscillator. Actual cyrstal frequencies should not exceed 5 megacycles for satisfactory operation, as explained under "Operation" (paragraph No. 13) and Tables V and VI.

7.3 Channel A - Master Oscillator

The circuit is arranged for operation on CHANNEL A by means of the channel relay which switches the necessary elements into grid and plate circuits respectively, by means of switch D1.1 and D1.2. Selection of Master Oscillator or Crystal operation on this channel is always under the control of the Wireless Operator by means of switch S1 consisting of two sections. The grid circuit section S1.1 selects the coil condenser combination L2-C2 on position 8 of the switch, while the plate section of the switch, S1.2, simultaneously selects the corresponding plate circuit elements L6 and C13, which constitute the plate tank circuit. In combination with this is the trimmer condenser C72 for tracking purposes, and the equalizer circuit consisting of condenser C67, resistor R35 and inductance L10 connected in series across the plate tank circuit.

7.4 Channel A - Crystal Oscillator

Operation of CHANNEL A on CRYSTAL (XTAL) designated "AX" is accomplished by rotating switch S1 so that section S1.1 makes contact to terminal 9, which connects the crystal into the grid circuit of the oscillator tube. At the same time S1.2 again makes connection to the A Channel tank coil condenser combination L6-C13 via contact #9.

7.5 Channel A - 500 kc. Crystal Oscillator

By means of switch S1 the Wireless Operator is able to secure operation of the transmitter on low frequency crystals. The 500 kc. CRYSTAL is switched into the grid circuit of the oscillator by S1.1 rotated to pick up terminal 10. At the same time S1.2 connects resistors R13.1 and R13.2 across the plate circuit of the oscillator tube. When operating on 500 kc. the necessary grid driving voltage for the following stage is developed across the oscillator plate choke L3. The circuit is actually untuned, and a portion of the developed voltage is fed to the grid of the following stage by means of the blocking condenser C10 and the grid blocking condenser C12, and the load resistors R13.1 and R13.2 which form a voltage divider across the plate choke L3. When operating on the 500 kc. crystal no doubling is used in the plate circuit and the fundamental crystal frequency is fed straight through the circuit.

7.6 Channel A - 375 kc. Crystal Oscillator

Crystal operation on 375 kc. is secured by rotating switch S1 so that S1.1 connects the 375 kc. CRYSTAL in the grid circuit of the oscillator and S1.2 connects C15 into the plate circuit. The correct amount of grid driving voltage applied to the grid of the final stage is secured by means of the condensers C10, C12 and C15 which form a divider across the plate choke L3, across which voltage is developed in the plate circuit of the oscillator. As in the case of 500 kc. operation, the final crystal frequency is fed straight through the circuit.

7.7 Channel B - Master Oscillator

Operation of the transmitter on CHANNEL B is accomplished by means of the channel relay D1, which connects the grid circuit elements of the oscillator of the B CHANNEL into the circuit by means of Section D1.1 and the plate circuit elements by means of D1.2. In order to secure Master Oscillator operation of the B CHANNEL, it is necessary for the Wireless Operator to rotate switch S2 in the grid circuit of the oscillator to a position such that the frequency determining elements L1-C1 are connected into the grid circuit through contact No. 4. No additional switching is required in the plate circuit of the oscillator on this channel as this is accomplished by the operation of the channel relay D1.2 which connects into the circuit the plate tuning elements L5 and C11 in conjunction with the associated trimmer condenser C73 for tracking purposes, and the equalizer, consisting of resistor R36 and inductance L11, connected in series across the tank circuit.

7.8 Channel B - Crystal Oscillator

For CRYSTAL operation of the B CHANNEL it is necessary to rotate switch S2 and connect CRYSTAL "BX" into the circuit through contact No. 3 of the switch. The plate circuit remains connected as described above for the master oscillator. The limitation on the operation of crystals in this channel is that the crystal frequency must not be greater than 5 megacycles. The plate circuit of the oscillator for crystal oscillation will not normally be tuned to a frequency higher than 10 megacycles This adjustment corresponds to a final output carrier frequency of either 10 or 20 mc. depending upon the adjustment made in the final output circuit. The CRYSTAL FREQUENCIES required for corresponding CARRIER FREQUENCIES are tabulated under "Operation", Tables IV and V.

7.9 Oscillator Output

Indication that the oscillator circuit of the transmitter is functioning is derived from the grid circuit of the final amplifier tube across meter shunt R8, which is in series with the grid leak R7 of the final amplifier tube. The grid current drawn by the final stage is a positive indication of the operation of the oscillator. On Master Oscillator, the grid current is controlled by the design of the equalizers and the adjustment of the trimmer condensers for the A and B CHANNELS as described above, but for crystal operation it is possible to alter the driving voltage by the adjustment of the oscillator FREQUENCY A or B controls. By the adjustment of these controls in conjunction with the milliammeter MA1, with the meter switch S13 rotated to the GRID position, an indication of the variation in grid current with tuning is obtained, and it is possible to peak the grid driving voltage or to reduce it to an optimum value. For CRYSTAL operation, however, the setting of the frequency control always corresponds closely to the oscillator plate circuit calibration chart supplied for Master Oscillator operation. The indication of the meter is secured by means of the voltage drop across the meter shunt R8, (which is by-passed by condenser C16) in series with multiplier resistor R21, through contact No. 8 of S13.2, through the meter to contact No. 2 of S13.1 to ground.

7.10 Radio Frequency Amplifier

The excitation voltage derived from the plate circuit of the oscillator tube V1 is fed directly to the grid of the power amplifier tube V2

through the blocking condenser C10. The power amplifier tube is a type RK-39 beam power tetrode which operates as a Class C amplifier. The plate circuit of the amplifier tube is coupled directly to the antenna circuit by means of an "L" network which provides the simplest possible impedance matching arrangement. Provisions have been made in the design of the output circuit for tuning antennas having characteristics which lie within the range given in Table III, paragraph 5. In the circuit diagram R7 is the grid leak and R8 is the meter shunt for measuring the percentage grid current in the circuit. This grid current is used as an indication of the amount of grid driving voltage supplied by the oscillator, and is primarily used in the adjustment of the oscillator as previously described. Sufficient cathode bias to prevent overloading of the tube under all conditions of operation is supplied by means of cathode resistors R11 and R10 which are by-passed by C20. In addition to supplying a portion of the cathode bias, resistor R10 is also used as a meter shunt for measuring the cathode current of the amplifier tube. The current actually measured by this means is the sum of the plate and screen currents but is actually referred to as the PLATE current on the METER switch S13, by means of which the milliammeter MA1 may be connected across the meter shunt R10. This is accomplished when S13.1 is rotated to connect with contact No. 3 which connects the multiplier resistor R22 in series with the meter across the meter shunt R10. Sufficient grid bias is developed across the grid leak resistor R7 to cause the tube to operate as an efficient Class C amplifier. Screen voltage is fed by the amplifier tube in the junction between the bleeder resistors R9.3 and R9.4 across the high voltage supply, through series resistors R9.2 and R9.1. Condenser C17 is the radio frequency by-pass condenser and also serves as a means of limiting the high frequency audio response of the transmitter. Plate voltage is fed to the amplifier tube through the choke L7 directly from the high voltage supply. Condenser C21 is a plate blocking condenser. In order to satisfy various conditions of operation, the screen voltage applied to the amplifier tube is changed in accordance with the mode of operation required. For R.T. operation the screen voltage is approximately 100 to 125 volts, and is derived in the manner just described. This same voltage is applied under conditions of M.C.W. operation. For R.T. and M.C.W. operation, screen modulation is employed, and the screen voltage is reduced in order to allow for the voltage swing due to modulation. For C.W. operation, the screen voltage is increased up to between 250 and 300 volts by reducing the value of the series screen resistance. This operation is accomplished by means of a section of the transmission switch S9.3 which connects resistor R18 across the screen supply resistors R9.3 and R9.2.

7.11 Output Circuit - Channel A

For operation on CHANNEL A, the sections of the channel relay D1.3 and D1.4 connect into the circuit the antenna loading coil L8 and the antenna coupling condensers associated with the switch S4. By means of a series of fixed condensers mounted on the switch, it is possible to produce the impedance match necessary to satisfy the

requirements of the amplifier plate circuit. The antenna loading coil L8, by means of which the antenna circuit is brought to resonance, is a roller coil constructed in a similar manner to the oscillator coils previously described.

7.12 Output Circuit, 500 and 375 kc. Operation - Channel A

When operating on either 500 or 375 kc. crystals, the output circuit of the transmitter requires the accessory ANTENNA LOADING COIL, Reference No. 10D/1286, connected in series with the antenna circuit external to the transmitter. This coil provides the necessary inductance in order to tune the antennas generally encountered in aircraft for these frequencies. Apart from this change, operation on the two low frequency crystals is no different to that of other frequencies in the A CHANNEL.

7.13 Output Circuits - Channel B

The contacts of the channel relay sections D1.3 and D1.4 connect into the circuit the proper elements for operation on Channel B which consist of the antenna coupling condensers associated with the switch S3 and the antenna loading coil L9. The antenna loading coil is a roller coil constructed in the same manner as the other previously described.

7.14 Antenna Meter Diode

In order to accomplish the correct tuning adjustment of the output circuit, a diode vacuum tube voltmeter has been incorporated in the amplifier plate circuit of the transmitter. This voltmeter consists essentially of the diode 6H6 vacuum tube V5 which rectifies a portion of the output voltage derived across resistors R23 and R39 connected across the amplifier plate circuit. Radio frequency voltage is fed through the diode blocking condenser C70 to the two plates of the diode in parallel. Resistor R24 is the direct current load resistance for the diode, while resistance R25 connected between the cathodes of the diode and ground is the meter shunt across which direct current voltage is developed proportional to the radio frequency voltage impressed upon the plate of the diode. Condenser C64 is a radio frequency by-pass for the meter. When the METER switch S13 is rotated to the ANT. position, which corresponds to contact No. 4 of S13.1, the milliammeter is connected across the meter shunt R25 in the diode circuit in series with its multiplier resistor R26. In this way the direct current milliammeter is used to indicate the r.f. voltage across the plate circuit of the amplifier tube. When operating correctly, this tube operates into an impedance of approximately 2600 ohms. This adjustment is obtained by the proper selection of coil and condenser values used in the tuning of the output circhit. For any given mode of operation, the voltage developed across the plate circuit is approximately the same because the amplifier tube operates in such a way that it delivers about the same output power to the "L" network throughout the frequency range, and the "L" network is always adjusted to present approximately the same impedance. For convenience in the operation of the transmitter, the meter shunts have been selected so that the meter reading of the ANT. diode is approximatdly the same as the plate current reading for all correct adjustments. Correct adjustment is indicated when the antenna coupling condenser has

been selected and the circuit tuned to resonance by means of the antenna loading coil so that the minimum dip of the plate current meter occurs with the peak of the antenna meter and both readings are approximately the same.

7.15 Filament By-passings

In order to reduce interaction between various circuits as a result of radio frequency voltages picked up and transmitted by the filament circuits of the amplifier and oscillator tubes, the filaments of which are connected in series, by-pass condensers are connected from each side of the filament supply to ground and from the centre tap between the filaments of the tubes V1 and V2 to ground. These by-pass condensers are C19, C18 and C6.

7.16 Modulator

The modulator tube V3 is an RK-39 beam power tetrode operating at a very conservative rating as a resistance coupled amplifier supplying modulated voltage to the screen of V2 through the coupling condenser C32. The plate resistor for this tube is R16. Screen voltage is derived from the main power supply through the series resistor R15 and the screen is by-passed to ground by condenser C31. In order to protect the tube from overload and to obviate the necessity for fixed grid bias, the cathode resistor R17 is employed, which is by-passed by condenser C33. The grid leak for this tube is R14. For R.T. or M.C.W. operation, the modulating signal is fed into the grid circuit of this tube through the contacts of the transmission switch S9.2. For C.W. transmission, the grid circuit is disconnected by the same switch, so that the tube is inoperative, although it is still allowed to draw plate and screen current. On R.T. the signal from the MICROPHONE, which is fed into the transmitter from terminal 1 of J1, is fed to the input winding of the transmitter T1, the high impedance secondary of which is loaded down with a condenser C28 to materially reduce the frequence response above 3,000 cycles. Sidetone is fed from the MICROPHONE through a low impedance winding of T1, sidetone resistor R29, to terminal 10 of J1 and finally to the OUTPUT CIRCUIT of the Radio Receiver.

7.17 Audio Oscillator - M.C.W. Note and Keying Tone

The audio NOTE or tone which is used as a source of modulation for M.C.W. transmission and for keying -tone on C.W. transmission is generated by the audio oscillator circuit associated with the audio oscillator tube V4 which is a 6J5 triode. The oscillator tube is connected in a conventional Hartley circuit and employs the transformer T2 as the centre tapped inductance in the tuned circuit. The frequency of the oscillator is changed by means of a series of tuning condensers C22 - C27 inclusive, associated with the switch S12. Plate voltage for this oscillator is derived from the V1 oscillator screen supply at the contact No. 5 of the keying relay D5 and is fed through switch S9.3 and a resistance capacity filter R32 and C66 and shunt feeding plate resistor R19. The filter is necessary in order to prevent audio voltage from modulating the screen of the radio frequency oscillator. The plate supply is derived in this way as a con-

venient means of keying the audio oscillator simultaneously with the radio Frequency circuits, so that KEYING TONE corresponding to the signal transmitted on C.W. transmission may be fed into the SIDE-TONE circuit for monitoring purposes. Bias is supplied by the cathode resistor R27 which is unbypassed in order to improve the wave form of the oscillator by means of the negative feedback developed across this resistor. Condenser C58 is the plate blocking condenser which isolates the tuned circuit from high voltage, and also serves as a coupling condenser between the plate circuit of the oscillator tube and the audio input transformer T1. The output voltage is fed through the tone attenuator resistor R38 and the switch S9.2 to the secondary winding of the input transformer T1. When the transmission switch S9 is set for either C.W. or M.C.W. operation, the NOTE or tone is then fed through a low impedance winding of the transformer R1 and the sidetone resistor R29 to the sidetone terminal 10 of the connector plug receptacle J1, from which point it finally reaches the earphones of the Operator through the outputcircuit of the companion radio receiver. When the switch S9 is set for M.C.W. transmission, the note also reaches the grid of the modulator and in this way is used to modulate the transmitted signal. The NOTE or frequency of the audio oscillator may be changed at the will of the Wireless Operator by means of the NOTE switch designated S12 to the following frequencies:

1850 cycles, 1450 cycles, 1000 cycles, 750 cycles,
650 cycles, 550 cycles.

The 1850 cycle warning signal is obtained by means of condenser C27 alone tuning the transformer T2. By means of the high note - low note relay D6, two notes are made available at the will of the Pilot who has control of the relay D6 by means of a HIGH NOTE - LOW NOTE switch on the Transmitter Remote Control Unit, Reference No. 10D/1268. The HIGH NOTE is always 1850 cycles, while the other note is pre-determined by the setting of the NOTE switch S12, which is under the control of the Wireless Operator and which connects additional capacities in parallel with condenser C27 when the relay D6 is operated from the Pilot's position.

7.18 Keying and Break-In Operation

Complete break-in operation of the transmitter is made possible by the action of keying relay D5. In order to reduce arcing of the key and the microphone press-to-talk switch, as the keying relay is operated the arc-suppression condenser C59 is connected across the key contact. With every operation of the key, or the microphone press-to-talk switch in the case of R.T. operation, this relay performs the following functions:

1. It transfers the antenna connected to contact No. 3 from the receiver antenna post, connected to contacts No. 8 and No. 10, to the transmitter output circuit connected to contact No. 4. At the same time it places a ground on the receiver antenna post via contacts 10 and 11.

2. It removes a connection between the oscillator cathode resistor R6, the oscillator screen supply and the amplifier screen supply simultaneously. This operation is achieved by the opening

of contacts 7 and 2, and results in the restoration of screen voltage to both the oscillator and amplifier tubes, as well as the removal of additional oscillator cathode bias developed across R6.

3. Simultaneously with operation 2 above, it connects through contact No. 5, the oscillator screen supply to the audio oscillator so that keying tone is generated during the periods of transmission on C.W. and M.C.W.

The sequence in which the contacts of the relay function is controlled entirely by the design of the relay. The wiping armature contacts are rigidly attached to a slider which moves between fixed contacts of the relay in accordance with the pulses from the key. Electrical connection is made between the moving contacts by means of pigtail connections, which connect the contacts on the slider to fixed terminals on the terminal plate.

7.19 Meter Circuits

As explained in the text, all metering for operating and tuning the transmitter is accomplished by means of a single METER MA1 associated with a double pole, triple throw switch S13, by means of which the meter may be switched, with due regard to proper polarity, across meter shunts in the amplifier GRID, the amplifier cathode (PLATE) and ANT. diode voltmeter circuits. Associated with the switch S13 are three multiplier resistors; R21 for the amplifier grid circuit, R22 for the amplifier cathode circuit, and R26 for the diode voltmeter circuit. The milliammeter actually functions as a voltmeter reading voltage drop across the meter shunt resistors, but is calibrated in percentage. The meter scale is illuminated by means of a lamp ML in series with a resistor R28 connected across the filament supply.

8. TRANSMISSION SWITCH

The three modes of operation, C.W., M.C.W. and R.T. are controlled by a five-section, three-position switch designated S9.1 - S9.5. This switch performs the following functions, corresponding to the type of TRANSMISSION being employed:

8.1 C.W. Transmission

S9.1 connects microphone terminal 1 of J1 to the I/C terminal 11 of J1 so that I/C facilities are possible in cases where the aircraft installation does not include an intercommunications switching unit.
S9.2 connects the secondary of the input transformer T1 to the audio oscillator through the attenuator resistor R38 through contacts 1 and 11. At the same time the grid circuit of the modulator tube is open. In this way the audio note is transmitted to the transformer T1 through the sidetone circuit, terminal 10 to J1.

S9.3 increases the screen voltage on the amplifier tube by connecting R18 in parallel with screen supply resistor R9.3 and R9.2 through contacts 3 and 1-2. At the same time this switch section connects the plate voltage supply to the audio oscillator through contacts 8 and 9.

S9.4 completes the circuit of the dynamotor starting relay D7 through contacts 10-12 and 3 to the negative filament operating the relay and starting the dynamotor. It also disconnects the microphone PRESS-TO-TALK circuit connected to contact No. 5, making it impossible to start the dynamotor by operation of the microphone PRESS-TO-TALK switch.

S9.5 connects the keying relay to the KEY terminal 4 of J1 through contacts 11 and 6.

8.2 M.C.W. Transmission

S9.1 connects microphone terminal 1 of J1 to I/C terminal 11 of J1 through contacts No. 4 and 10-12.

S9.2 connects the output of the audio oscillator to both the input transformer T1 and the grid of the modulator tube by contacts 1, 4 and 12. In this way the audio note is transmitted to both the side-tone circuit and the modulator circuit.

S9.3 disconnects R18 from the screen supply circuit of V2 and connects the plate supply to the audio oscillator V4 through contacts 8 and 10.

S9.4 disconnects R18 from the screen supply circuit of V2 and connects the plate supply to the audio oscillator V4 through contacts 10-12 and 4.

S9.5 disconnects R18 from the screen supply circuit of V2 and connects the plate supply to the audio oscillator V4 through contacts 11 and 7.

8.3 R.T. Transmission

S9.1 connects the microphone terminal 1 of J1 to the microphone input winding of T1, completing the microphone direct current supply circuit through contacts 10-12 and 5. The circuit to the I/C connection is open, but sidetone is fed through T1, R29, terminal 10 of J1 to the Receiver Output circuit.

S9.2 completes the circuit from the secondary of the input transformer T1 to the grid of the modulator tube through contacts 1 and 4, and at the same time disconnects the audio oscillator connection. In this way the circuit is completed from the microphone to the grid of the modulator tube and the circuit is arranged for R.T. operation.

S9.3 disconnects the screen supply resistors R18 from the amplifier screen circuit and also opens the plate supply to the audio oscillator tube V4 so that no audio tone is generated.

S9.4 connects the circuit of the dynamotor starting relay D7 to the microphone press-to-talk terminal 3 of J1 through contacts 5 and 10-12, so that control of the dynamotor starting originates from the microphone press-to-talk switch.

S9.5 connects the circuit of the keying relay D5 through contacts 11 and 8 to the press-to-talk terminal 3 of J1, so that control of the keying relay originates from the operation of the microphone press-to-talk switch, which operates both the keying relay D5 and the dynamotor starting relay D7 simultaneously.

9. LOCAL-REMOTE CONTROL, OFF-ON POWER AND CHANNEL SWITCHES

The position at which the transmitter can be controlled is transferred from the Wireless Operator to the Pilot by means of the LOCAL-REMOTE switch S10. This is a double-pole, double throw switch in which section S10.1 transfers control of the channel relay D1 from the CHANNEL switch S7 to the remote channel switch located on the Transmitter Remote Control Unit, reference No. 10D/1268, through terminal 5 to J1; S10.2 section transfers the control of battery power to the transmitter from the POWER ON-OFF switch S11 to the remote power switch on the Transmitter Remote Control Unit through terminal 9 of J1. When the LOCAL-REMOTE switch is set to the LOCAL position, the POWER ON-OFF switch S11 on the transmitter controls the battery supply to the filaments and control circuits of the transmitter, while the CHANNEL switch S7 controls the selection of CHANNEL A or CHANNEL B by means of relay D1. When S10 is switched to the REMOTE position, the transmitter may only be turned on and off and the channel selected by the control switches located in the Transmitter Remote Control Unit.

10. CRYSTALS

As previously mentioned the oscillator circuits for both the A CHANNEL and the B CHANNEL are arranged to operate as crystal controlled oscillators. These CRYSTALS, designated "AX" and "BX" plug into sockets mounted one on each side of the Meter. Each CRYSTAL is equipped, as integral parts, with a thermostat and a heater designed to maintain the Crystal plate at a temperature not lower than 0° C. The heater is capable of heating the Crystal plate to 0° C in 30 minutes when the ambient temperature is -40° C. All CRYSTALS are cut to an accuracy of plus or minus .02% and maintain this accuracy over a temperature range of 0° to +60° C.

11. FUSES

The transmitter is fused in two places for protection of the

aircraft battery in the apparatus within the transmitter itself.

F1 is the main fuse in the 12 volt power supply from the battery.
F3 is the fuse from the high voltage lead of the dynamotor for protection of the dynamotor against failure in the high voltage circuit.

12. DYNAMOTOR AND POWER SUPPLY

The DYNAMOTOR high voltage power supply designated MG1 is a part of the transmitter. This DYNAMOTOR delivers power from the 12 volt battery at approximately 500 volts and 200 ma. maximum. Radio interference from the primary side of the dynamotor is filtered externally by means of condensers C69.1 and C69.2 mounted beneath the dynamotor terminal strip on the rear of the chassis and, in addition, condensers C60.1, C60.2 and C61.1, C61.2 are connected from each brush to ground. These condensers are mounted directly on the brushes and are covered by the endbell. On the high voltage side of the dynamotor condensers C63.1 and C63.2 are connected across the brushes and the choke L12 is connected in series with the positive high voltage lead from the dynamotor. These components likewise are mounted beneath the endbell of the dynamotor in order to secure the shortest possible leads for bypassing and filtering of dynamotor noise. The HIGH VOLTAGE FUSE, F3, which is removable from the front panel, is connected between the filtered dynamotor supply and the main power supply filter condenser, C34, from which point voltage is finally fed to all plate supply leads in the transmitter.

13. OPERATION

In the operation of the transmitter all tuning adjustments are made by the Wireless Operator and the CONTROL switch is set for LOCAL CONTROL.

13.1 Tuning Adjustments

In order to adjust the transmitter to any desired frequency, the following routine should be followed:

(a) Switch the LOCAL-REMOTE CONTROL switch to the LOCAL position.

(b) Switch the POWER switch to the ON position.

(c) Select the desired CHANNEL, A or B, by means of the channel switch.

(d) Rotate the FREQUENCY A or B control to the approximate setting corresponding to the required frequency as given in Table IV.

(e)Set the XTAL M.O. switches for CHANNEL A or B to M.O. or XTAL as required.

(f) If the ANT. COUPLING A or B settings are already known,

set these switches to the correct position for the type of antenna being used. If the settings are not known, set the switches to the value which would be expected from Table VI giving typical output circuit settings. The actual setting will be determined from the method outlined in paragraph (n) below.

(g) Rotate the ANT. LOADING COILS A or B to the proper setting, if the tuning points have already been determined. When the settings are not known, set the number of turns to a value which might be expected by reference to the table of output settings, Table VI. The exact tuning point will be determined by the method outlined in paragraph (n) below.

(h) Set the METER switch to the GRID position.

(i) Set the TRANSMISSION switch to R.T. or M.C.W. since mistune conditions have less tendency to overload the output tube under these conditions. The mistune condition should not be allowed to remain for more than five minutes continuously.

(j) In order to set the transmitter on the exact frequency required on MASTER OSCILLATOR operation it is necessary to monitor the transmitter on a receiver which has been set to the desired frequency by means of a crystal calibrator standard. The Transmitter may also be set by means of any substandard wavemeter. If the dial calibration of the receiver is sufficiently accurate, the dial setting may be used as a means of tuning the transmitter to the exact frequency required. The associated Reference No. 10D/1275 Receiver will generally be satisfactory for this purpose since various points on its dial may be checked for calibration accuracy against the crystals contained in the transmitter. The fundamental and all the harmonics may readily be picked up on the receiver from the 500 kc. CRYSTAL or the 375 kc. CRYSTAL, as well as the A and B CHANNEL CRYSTALS. The tuning points obtained may be compared with the crystal frequency in order to determine the accuracy of calibration of the receiver dial.

(k) Set the NOTE switch to the required frequency.

(l) Apply plate voltage to the transmitter by operating the PRESS-TO-TALK SWITCH of the MICROPHONE for R.T. transmission, or by pressing the key for M.C.W. or C.W. transmission.

(m) Note the existance of grid current for M.O. operation, normal values being per table VII. For CRYSTAL operation peak the grid current by rotating the FREQUENCY A or B control slightly to secure resonance of the oscillator cir-

cuit. Carrier frequency derived from crystal frequencies in accordance with Table V will have settings of the FREQUENCY A or B corresponding to Table IV. On the B CHANNEL, however, where crystal frequencies never exceed 5 mc. and the carrier frequency is actually four times the crystal frequency in the range between 10 and 20 megacycles, the FREQUENCY B control is set to a value corresponding to one half the carrier frequency, as indicated on Table IV.

(n) Set the METER switch to the ANT. position and rotate the ANT. LOADING A or B control until resonance is indicated by peaking on the ANT. meter. The object of this adjustment is to obtain an ANTENNA meter reading at the peak, which is approximately equal to the plate meter reading at the dip. If this adjustment is not secured on the first try by the adjustment of the ANTENNA LOADING coil alone, it is necessary to repeat the tuning operation for other settings of the ANTENNA COUPLING A or B controls until these two meter readings correspond. An indication of the direction in which adjustment is required to be made at any stage in the tuning operation may be gained by comparison of the ANT. and PLATE meter readings at the tuning point. These indications are:

1. If the PLATE meter reading is higher than the ANT. meter reading, the dial setting of the ANTENNA COUPLING control is too high.

2. If the PLATE meter reading is below the ANT. meter reading, the dial setting of the ANTENNA COUPLING is too low.

By comparison of the two meter readings after the output circuit has been brought to resonance each time by means of the ANT. LOADING adjustment, it will be possible to bring the meter readings within 10% of being equal, providing the constants of the antenna being tuned lie within the range previously given in Table III. Failure to obtain the required adjustment between PLATE and ANT. meter readings may mean either that the antenna being tuned has characteristics lying beyond the range over which the transmitter is capable of perfectly matching the circuit or, as will be more generally the case, that the output circuit has been tuned to a higher harmonic of the oscillator circuit. Normal output circuit meter readings are given in Table VII. If an error has been made it should be evident by comparison with Table VI and from the comparative signal strength indicated by change in noise level due to the a.v.c. action of the monitoring receiver.

(o) A positive indication of correct adjustment of the output circuit for R.T. transmission is given when sustained modulation from a whistle in the microphone causes an upward swing of the ANT. meter.

(p) If the exact carrier frequency on master oscillator has not been obtained at first reading, rotate the FREQUENCY control A or B until a zero beat note of the carrier has been obtained as compared to the crystal calibrator standard on the monitoring receiver, or by reference to a wavemeter.

(q) Retune the output circuit in the manner described in (n) above if necessary.

(r) When the proper settings have been obtained for all controls clamp them securely by means of the lock nuts.

(s) Set TRANSMISSION Switch to mode of operation required.

13.2 Antenna Loading Coil

The Antenna Loading Coil, Reference No. 10D/1286, Figure 13, provides external means of making it possible to tune and match aircraft antenna on 500 and 375 kc. and, in addition, may also be used for matching the output of the transmitter to a 70 ohm transmission line for the higher frequencies of CHANNEL B. The rules governing yhe settings of the ANT. LOADING COIL are:

1. For operation of the transmitter on the A or B Channel, Xtal or M.O., the antenna coil should be OUT.

2. For matching a 70 ohm line at the higher B Channel frequencies, set to position 0.

3. For operation on 500 or 375 kc., the antenna loading coil must be set to a position not lower than position 1. Fine adjustment between steps of the antenna loading coil switch points is obtained by means of the ANT. LOADING A control of the transmitter.

13.3 Sidetone and Intercommunication

SIDETONE and INTERCOMMUNICATION circuits from the transmitter are completed through the radio receiver output circuit and the I/C amplifier of the radio receiver. In large aircraft the necessary switching facilities for the MICROPHONE and HEADPHONES are provided by the INTERCOMMUNICATION Switching Unit, Reference 10D/1276, the simplified schematic of which is shown in Figure 11. This accessory unit, which is under the control of the Wireless Operator determines from what points the transmitter may be operated on R.T., and control of the transmitter by the Wireless Operator, Pilots and Forwards of the crew of the aircraft can only be accomplished when the Wireless Operator has set the switches to the RADIO position. For this position of the switches, the MICROPHONE circuits of the Wireless Operator, Pilots and Forwards in the aircraft are connected into the transmitter and, at the same time, the circuit of the PRESS-TO-TALK SWITCH of the MICROPHONES is completed in a similar manner. For all other positions of the I/C switches, the press-to-talk circuit is

disabled and the microphones are connected into the I/C system. For small aircraft intercommunication is available by connecting all headphones in parallel. Under these conditions I/C is automatically obtained when the installation is on the RECEIVE position for C.W. and M.C.W. operation, but not for R.T. operation. SIDETONE or KEYING TONE are present for all modes of operation.

13.4 Transmitter Remote Control Unit

When the Wireless Operator sets the LOCAL-REMOTE CONTROL switch on the transmitter to the REMOTE Position, control of the POWER and the selection of the CHANNEL are located in the Remote Control Unit, Reference No. 10D/1268, which is operated by the Pilots. This unit is illustrated in Fig. 14. Control of the M.C.W. HIGH NOTE - LOW NOTE is always possible only from this control unit. When the H.N.-L.N. switch is set to the HIGH NOTE position, rotation of the NOTE switch on the transmitter results in no operating changes. When the M.C.W. H.N.-L.N. switch on the remote control unit is set by the Pilot to the LOW NOTE position, the M.C.W. is determined by the setting of the NOTE switch on the transmitter under the control of the Wireless Operator. On the front panel of the Transmitter Remote Control Unit, two small plates of Lamicoid material are provided by means of which data pertaining to operation of the equipment may be recorded, in pencil if desired. Markings on this material may be readily erased.

13.5 Junction Box

The interconnections between all the various units associated with the General Purpose Equipment are made in a junction box, Reference No. 10D/1270, which is shown in Figure 12. The interconnections are shown in Fig. 10. As shown in Fig. 12, the cable to each unit has a definite location at which it enters the junction box through the cable clamps at the end of the terminal strips. This is arranged in such a way as to secure the shortest possible wiring to the terminals within the junction box. One of the most important factors in making the connections at the junction box is the matter of grounding the shields of the cables, since the manner in which the shields are grounded has the greatest influence upon the problem of electrical noise in the receiver originating both from the aircraft and from the operation of the radio equipment itself. The most satisfactory arrangement for grounding the cable shields together is to strap all the shields at each end of the junction box together, by means of a piece of braid soldered to the shields and the whole connection taken directly to a ground lug on the case of the junction box, which is located near the centre of the cable clamp. Individual conductor shields are connected to ground terminals as shown in Figure 22.

TABLE IV

MASTER OSCILLATOR FREQUENCY SETTINGS

CHANNEL A.

Frequency	Turn Counter Setting Frequency A.	Possible Setting Deviation - M.O. only
1.5 mc.	072.0	Plus or minus 1.0
1.6 "	063.0	" " 1.0
1.7 "	057.0	" " 0.9
1.8 "	051.5	" " 0.9
1.9 "	047.5	" " 0.8
2.0 "	044.0	" " 0.8
2.1 "	040.5	" " 0.7
2.2 "	037.6	" " 0.7
2.3 "	035.0	" " 0.7
2.4 "	033.0	" " 0.7
2.5 "	031.0	" " 0.6
2.6 "	029.0	" " 0.6
2.7 "	027.5	" " 0.6
2.8 "	026.0	" " 0.6
2.9 "	024.8	" " 0.6
3.0 "	023.5	" " 0.5
3.2 "	021.5	" " 0.5
3.4 "	019.7	" " 0.5
3.6 "	018.2	" " 0.5
3.8 "	017.0	" " 0.5
4.0 "	015.8	" " 0.4
4.2 "	015.0	" " 0.4
4.4 "	014.0	" " 0.4
4.6 "	013.2	" " 0.4
4.8 "	012.5	" " 0.4
5.0 "	011.25	" " 0.5
5.2 "	010.5	" " 0.5

TABLE IV (Continued)

MASTER OSCILLATOR FREQUENCY SETTINGS

CHANNEL B.

Frequency	Turn Counter Setting Frequency B		Possible Setting Deviation - M.O.only
5.0 mc.	031.5		Plus or minus .8
5.2 "	030.4		" " .3
5.4 "	029.2		" " .3
5.6 "	028.0		" " .3
5.8 "	026.2		" " .3
6.0 "	024.8		" " .3
6.2 "	023.6		" " .3
6.4 "	022.4		" " .3
6.6 "	021.2		" " .3
6.8 "	020.4		" " .3
7.0 "	018.6		" " .3
7.5 "	017.4		" " .3
8.0 "	015.8		" " .3
8.5 "	014.3	Xtal Only	" " .3
9.0 "	013.0	Approx.Settings	" " .3
9.5 "	012.1		" " .3
10.0 "	011.2	013.9	" " .3
11.0 "	009.8	022.0	" " .3
12.0 "	008.2	024.8	" " .4
13.0 "	007.8	021.0	" " .3
14.0 "	007.2	018.6	" " .3
15.0 "	006.5	017.4	" " .3
16.0 "	006.0	015.8	" " .3
17.0 "	005.5	014.3	" " .3
18.0 "	005.0	013.0	" " .3
19.0 "	004.4	012.1	" " .3
20.0 "	004.0	011.2	" " .3

TABLE V

CRYSTAL FREQUENCIES

Channel	Crystal Frequency	Carrier Output Frequency
A	375 kc.	375 kc.
	500 kc.	500 kc.
	.750 to 2.5 mc.	1.6 mc. to 5.0 mc.
B	2.5 to 5.0 mc.	5.0 mc. to 10. mc.
	2.5 to 5.0 mc.	10.0 mc.to 20. mc.

TABLE VI

OUTPUT CIRCUIT SETTINGS (Calculated)

CHANNEL A

Carrier Freq. M.C.	Ant. Coupling A Setting	Ant. Loading A Setting	Ant.Loading Coil Setting	Ant. Resistance Ohms	Approx. Ant. Capacity Mmfds.
.375	11	114.0	3	14	350
.375	12	003.5	1	14	1200
.500	9	095.0	1	6	350
.500	9	000.0	1	6	650
1.5	8	096.0	Out	1	100
1.5	11	030.0	"	1	500
1.5	6	101.0	"	12	100
1.5	6	039.0	"	12	500
2.0	7	058.0	"	1	100
2.0	10	021.0	"	1	500
2.0	6	063.0	"	12	100
2.0	6	029.0	"	12	500
3.0	1	032.0	"	1	100
3.0	7	013.5	"	1	500
3.0	1	032.5	"	12	100
3.0	2	018.8	"	12	500
4.0	5	022.0	"	1	100
4.0	6	009.8	"	1	500
4.0	1	022.0	"	12	100
4.0	1	013.5	"	12	500
5.00	3	016.6	"	1	100
5.0	6	007.5	"	1	500
5.0	1	014.6	"	10	100
5.0	1	010.0	"	10	500

NOTE: These output circuit settings are calculated for antenna with characteristics given in the table. The settings will therefore vary, depending on the characteristics of the antenna in actual use.

TABLE VI (Continued)

OUTPUT CIRCUIT SETTINGS (Calculated)

CHANNEL B.

Carrier Freq. M.O.	Ant. Coupling B Setting	Ant. Loading B Setting	Ant.Loading Coil Setting	Ant. Resistance Ohms.	Approx. Ant. Capacity Mmfds.
5.0	11	040.0	Out	5	100
5.0	12	019.0	"	5	500
5.0	9	043.5	"	12	100
5.0	9	024.0	"	12	500
5.0	3	048.5	"	100	500
5.0	4	036.5	0	70	-
7.5	9	021.2	Out	5	100
7.5	9	013.4	"	5	500
7.5	6	026.5	"	12	100
7.5	7	016.2	"	12	500
7.5	1	039.0	"	70	100
7.5	3	026.2	0	70	-
10.0	7	016.2	Out	5	100
10.0	8	009.9	"	5	500
10.0	4	019.0	"	12	100
10.0	4	014.0	"	12	500
10.0	2	017.1	0	70	-
15.0	4	010.5	Out	5	100
15.0	4	007.7	"	5	500
15.0	2	012.0	"	12	100
15.0	3	008.7	"	12	500
15.0	1	011.1	0	70	-
20.00	7	006.2	Out	1	100
20.0	8	005.2	"	1	500
20.0	3	008.0	"	5	100
20.0	3	006.2	"	5	500
20.0	1	008.8	"	12	100
20.0	1	007.1	"	12	500
20.0	1	007.5	0	70	-

NOTE: These output circuit settings are calculated for antenna with characteristics given in the table. The settings will therefore vary, depending on the characteristics of the antenna in actual use.

TABLE VII

METER READINGS.

The following are test readings which should be attained on a test set-up when the Transmitter is correctly adjusted.

	FREQ. MC'S.	M. O.	D.C.V.	CW PANEL METER READINGS GRID	CW PANEL METER READINGS PLATE	CW PANEL METER READINGS ANT.	DUMMY ANTENNA OHMS.	AMPS IN DUMMY CW	C.W.	WATTS R/T
A Channel	0.375X	-	13.25 volts measured at the input plug on the transmitter front panel.	Between 10 and 140	Between 80 and 105.	A reading that when switched to R/T, increases when modulation applied.	16	1.06	18.0	8.0
	0.500X	-					16	1.11	19.5	9.5
	1.45 MO	73 +0.9 - 1.0					4.13	1.9	15.0	4.5
	3.105X	20 - 23					4.2	2.07	18.0	6.5
	3.105 MO	21.7 ±0.5					4.2	2.07	18.0	5.5
	5.0 MO	11.25 ±0.5					4.3	2.02	17.5	6.0
B Channel	5.0	31.5 ±0.8					4.3	1.9	15.5	5.5
	6.21X	20 - 23					4.35	2.00	17.5	5.5
	6.21 MO	22.1 ±0.6					4.35	2.00	17.5	5.0
	12.0 MO	8.2 ±0.4					4.65	2.00	18.5	7.0
	20.0	4.5 ±0.3					5.2	1.90	18.7	11.0
							Hot.Res.measured on "Q" meter or Twin T Bridge.	LIMITS -8%	LIMITS -15%	

All tuning to be done on CW.

At 1.45 mc "A" channel and 5 mc's "B" channel the output circuits shall tune and load a dummy of 100 mmfd in series with 8 ohms.

REMARKS: 24 volt Transmitters to meet similar requirements on 26.5 volts at input plug.

14. INSTALLATION

14.1 Mounting Dimensions

By reference to the figures listed below which show the outline dimensions of the various units, the mounting centres for installation purposes are given. In the case of the transmitter shock mounting tray it should be noted that a 1/4" maximum clearance is available for the thickness of the mounting screw heads. Failure to observe this precaution in installation will result in fouling between the transmitter shock mounting and the screw heads.

Figure 16 - Transmitter, Outline Dimensions
Figure 17 - Transmitter, Remote Control Outline Dimensions
Figure 18 - Antenna Loading Coil, Outline Dimensions
Figure 19 - Junction Box, Outine Dimensions
Figure 20 - I/C Switching Units, Outline Dimensions

14.2 Junction Box and Cables

The electrical connections for the cables between all the units associated with the General Purpose Equipment and the junction box are shown in Fig. 10., Interunit Wiring and Intercommunication Circuit Schematic. Junction box connections in the system should be made through the proper cable entry, according to the engraving on the cable clamp at each end of the junction box as shown in Fig. 12. Wherever possible, cables entering the junction box should first be equipped with plugs at their other end for connection with the unit, since it is far more convenient to make the connections between the cable and the plug at a work bench. The junction box end of each cable should be prepared for connection to the terminals by first skinning back the rubber jacket to provide ample length for each lead to reach its proper terminal with about one inch of slack. The rubber jacket should be cut neatly down to the copper braid shield on the cable by means of a wet knife. The outer cable shield should be allowed to protrude beyond the end of the rubber by about 1/4" and, after being tinned around its full circumference, should have all frayed ends removed by means of a pair of cutters. This protruding end of the shield is to be used as the ground connection to the shield of the cable, and the arrangement of the ground connection in the junction box is to be in accordance with Fig. 22. The ground connection to these outer cable shields are to be completed by the shortest possible route to a centrally located ground lug in each end of the junction box metal case. Connections of the outer shields are made with heavy tinned copper braid which is sweated to the exposed end of the individual cable shield. Ground connections to shields on individual conductors in the cable are to be made from these leads to the terminals shown in Fig. 22 in the junction box. The rubber jackets of the cable should be taped with friction tape (single width) to a diameter sufficient to give secure clamping action of all cables at the same time at this point by the cable clamp. The cable having been prepared in this way, the cable clamp should be tightened down to take all the strain by means of six screws in the top provided for this purpose.

14.3 Junction Box Connections

Connections to the junction box terminals should be made progressively, starting at the end nearest the cable entry. Each conductor should be laid in the space between terminal strips directly opposite the cable entry and cut to a length which allows about one-half inch of slack, with the conductor routed next to the bottom of the junction box. A rubber sleeve provided with the junction box should be slipped over each lead in turn as it is cut to length. Then each lead should be soldered securely to a lug provided with the junction box and the rubber sleeve should be slipped back over the connection. Finally the lug should be secured to the terminal and precautions should be taken to ensure that every screw is equipped with a lock washer. Running lists for the complete equipment are given in Table X.

14.4 Cable Connections to Plugs

One of the most important matters in the installation of radio equipment is the making of connections between cables and plugs in such a way that no individual conductor is subjected to tension which would be likely to cause failure of either the conductor itself or the joint. The object is to make the connection in such a way that all stress is taken by the outer cable jacket and shield and transmitted to the shell of the connector plug without stressing the individual conductor. The perfection with which the connections are made to the plug is largely a matter of skill of the technician who makes the connection, and it is therefore important that only qualified personnel, who have developed a technique for this type of work by experience or practice, should be detailed to this work. As already pointed out in connection with the junction box, it is most convenient and efficient to make the connections with the plugs at a work bench where the cable and plug may be held in convenient positions by means of a vise or fixture. In connecting the plugs and cables, the following procedure will be of assistance:

(a) Skin back the rubber jacket for approximately 3" and trim neatly around the circumferance by means of a wet knife.

(b) Tin and sweat with solder the outer shield of the cable for about 1/4" beyond the rubber jacket around the circumference.

(c) Trim around the circumference of the shield, removing all frayed ends and sharp edges to a distance of about 1/4" beyond the end of the rubber jacket.

(d) Wrap the ground connecting braid of the shield and sweat securely with solder around the circumference of the shield.

(e) Slide on the gland and outer shell of the plug in the

proper manner to fit for the final assembly. (This will not be necessary when the far end of the cable is short and free.)

(f) Decide at what angle the cable is to leave the plug.(Different typles of aircraft requiring different arrangements of the unit will require a cable to be brought out at different angles.)

(g) Prepare the leads for connection to the plug terminals, leaving a slack - depending on the angle of cable entry - of about 1-3/4" to 2-1/2" from the end of the chield.

(h) Slide on 1/2" of 1/8" or 3/16" diameter varnished cambric sleeving, as required, on each conductor before soldering to the plug connections.

(i) Begin making connections to contact located nearest the cable exit for each row of terminals in turn. This would generally mean that connections are made in consecutive order of numbering in groups of increasing or decreasing numbers. When it is not convenient to prepare the leads in accordance with (g) above, the following method will be found satisfactory. Cut the leads to length in order of connection as above, leaving 1/4" to 1/2" more length than required for the direct connention. The conductors which are routed over the top require more slack to allow for flexing, but too much slack should be avoided, otherwise the conductor will become jammed too tightly when the outer shell of the plug is finally assembled. Prepare the end of the lead, removing the insulation for 3/16". Slide on the sleeving, if this has not already been done. Tin the end first and solder the connections in order as above. Slide the tip of lead each time into the recess in the plug terminal provided for the purpose, making certain that colour coding is as shown in Fig. 9. Make sure that the solder has flowed freely and has tinned both the contact and the lead. Do not use an excessive amount of solder but make sure that the connection is secure, since subsequent failure of a contact may result in the necessity of undoing a large number of connections in order to gain access to the faulty one. Slide the sleeving over each contact in turn as the joint is completed in order to prevent short-circuit to adjacent contacts.

(j) Tape the jacket of the cable tightly with friction tape to a diameter sufficient to cause secure clamping action between the plug half-shell and the cable jacket.

(k) When the connections have all been made, slide the shell of the plug into position and screw it firmly in place.

(l) Make the ground connection between the cable shield and the ground lug provided within the half-shell of the plug by means of the braid already attached. Allow about 1/4" of slack.

(m) Assemble the outer half-shell in position and squeeze the two shells together in a vice to clamp the cable tightly, while screwing the gland into position and tightening the clamping screws.

14.5 Radio Frequency Ground Connections

It is important that the r.f. ground connection for the transmitter be made as short and direct as possible to the airframe by means of a heavy copper braid corresponding to not less than #10 B&S gauge. This connection has to be left with enough slack for removal of the plug from the transmitter. It should be equipped with a connecting lug for connection to the ground terminal screw on the transmitter connector plug. In making the ground connection to the airframe, it will be found most satisfactory, from the standpoint of noise elimination in the associated receiver, to make both r.f. ground connections solidly at the same point with as short leads as possible.

14.6 Microphone Connections

Figure 23 illustrates the method of making microphone, headphone, helmet cord and plug connections.

15. MAINTENANCE

As a precaution against troubles occuring during flight, the transmitter should be removed from the aircraft at routine intervals, consistent with the service in which it is employed, for inspection. At this time the transmitter should be removed from its case and given a thorough visual inspection for faulty contacts on coils or relays, and special attention should be paid to the removal of all dirt or specks of metal.

15.1 Cleaning of contacts

Cleaning of relay and switch contacts should be done only by qualified personnel since the utmost care must be exercised in the handling of these contacts. For cleaning contacts, a light camels hair artists brush, dipped in carbon tetrachloride should be used. The carbon tetrachloride will quickly remove all injurious dirt at the contact and it may be used quite freely without fear of damage to the metal

15.2 Cleaning of Coils

The inclusion of specks of material between turns of the coils is a most serious hazard to the operation of the equipment. At each routine inspection the oscillator coil should be carefully examined for dirt of all kinds. All foreign material may be removed by means of a tooth brush dipped in carbon tetrachloride. The bristles should be pressed in between the winding of the coil as it is rotated from end to end. At the same time careful examination of the roller should be made for dirt which may be removed by brushing the grooves with carbon tetrachloride. The roller rod should also be cleaned with carbon tetrachloride by means of a camels hair brush. Carbon tetrachloride should also be used to clean the collector ring and wiping spring contacts, as well as the contacts of the hub connector spring. These cleaning operations should be performed with extreme care in order that the adjustment of the springs may not be damaged, causing skipping contacts.

15.3 Adjustment of Contacts

Adjustment of relay and switch contacts, as well as all coil contacts, should be made only by qualified personnel in repair depots. The careful technique involved in the making of these adjustments requires the skill of a technician, who has had experience in making such adjustments. As relays and switches are operated, the existence of sufficient bite or pressure between contacts should be just visible by the motion of the contact as the wiper slides into position. In the case of relays, this contact pressure must not exceed the point where excessive friction will result in the failure of the relay to operate under low voltage conditions. On coils, positive contact pressure between wiping springs and the collector rings, as well as between the rolling contact and the winding, should be present for all positions of the rotatable control.

15.4 Lubrication

A minimum amount of lubrication is allowed in the transmitter. The only places which should be lubricated are coil bearings at which no electrical contact is made and the rubbing surfaces of the sliders and slider guides of the channel relay and the keying relay. Other points which may be lubricated slightly are the solenoid plungers of the channel relay and the hinges of the keying relay. For the lubrication of these points a very light clock oil should be used in order to prevent sticking at low temperatures.

15.5 Circuit Trouble

In order to assist in the tracing of circuit trouble, typical voltages throughout the circuit are given in Table VIII. The meter multipliers are given in Table II although it is not necessary in general to know the absolute value of current being measured since the percentage ratings are sufficient indication of the correctness of operation of the equipment. The circuit may be traced for continuity by means of the schematic, Fig. 9, and the Wiring Diagram, Fig. 15.

16. Alignment of Circuit

NOTE: ALIGNMENT OF CIRCUITS IS TO BE CARRIED OUT ONLY AT

REPAIR DEPOTS BY QUALIFIED PERSONNEL.

The correct operation of the transmitter should be checked in a complete system in accordance with Fig. 10 set up on a test bench. This will make possible the checking of controls and the tracking of circuits. When the transmitter has been equipped with a fullcomplement of vacuum tubes, fuses and crystals, the operation of controls should be carried out as outlined below.

16.1 Local Control

(a) Set the LOCAL-REMOTE switch to LOCAL.
(b) Set POWER switch to ON. Observe filament and meter lamp light.
(c) On R.T. Control Unit, switch H.N.-L.N. switch to L.N. Observe that D6 relay operates.

(d) Set TRANSMISSION switch to M.C.W. and C.W. in turn. Dynamotor starting relay D7 operates and dynamotor starts. Operate Channel switch from A to B and note operation of channel relay D1 for B position of switch.
(e) With conditions as in (d) above, operate the key and note operation of keying relay D5.
(f) Set TRANSMISSION switch to R.T. If I/C unit is in circuit use W/O microphone and switch to RADIO. Press the Press-to-Talk switch on the W/O Microphone; dynamotor relay D1 will operate, starting dynamotor. Also observe that the CHANNEL switch on B, channel relay D1 also operates. D1 will release when the microphone Press-to-Talk switch is released after the dynamotor has stopped.

16.2 Remote Control

(a) Set the LOCAL-REMOTE CONTROL switch to REMOTE.
(b) On the Transmitter Remote Control Unit, set POWER switch to ON. Filaments and meter lamp lights.
(c) Observe that H.N.-L.N. switch controls operation of D6 as in 16.1 (c).
(d) Set TRANSMISSION switch to M.C.W. and C.W. in turn. Dynamotor starting relay D7 operates and dynamotor starts as in 16.1 (d). Operate CHANNEL switch of Transmitter Remote Control Unit from A to B and note operation of channel relay D1 for B position of switch.
(e) With conditions as in (d) above, operate the key and note operation of keying relay D5.
(f) Set the TRANSMISSION switch on R.T. and note operation as in 16.1 (f).

16.3 Counter Settings

Before making the adjustments for tracking and measurement, a check should be made to determine that the turn counters for the coils are set as follows:

A Band Frequency)	Counter set at 0000
B Band Frequency)	with roller against
Ant. Loading A)	front stop.
Ant. Loading B)	Counter set at 0000 with roller
Band Output)	against rear stop.

16.4 Channel A - M.O. Tracking and Alignment

(a) Set the controls on the transmitter for LOCAL CONTROL on CHANNEL A.
(b) Rotate the FREQUENCY A control to 010.0 turns after 16.3.
(c) Set the Channel A XTAL M.O. switch to M.O.
(d) Set the TRANSMISSION switch to R.T.
(e) Switch meter switch to GRID.
(f) Press microphone press-to-talk switch, starting dyna-

motor as in 16.1 (f).
(g) With conditions as in (f) above, adjust trimmer condenser C72 for maximum grid current (30% Min.) (with bottom oscillator compartment shield screwed securely in position).
(h) Rotate FREQUENCY A control from 010.0 turns to approximately 074.0 turns and observe variation in grid drive from 30 min. to 120 max. across the band. Grid drives outside these limits indicate:

1. Defective equalizer circuit connection or components.
2. Incorrect adjustment of the plate circuit trimmer condenser.
3. Poor coil or relay or switch contact, causing a poor roller or wiping spring contact throughout the range. These are dependent on correct mechanical adjustment of spring tensions and complete freedom from adhering dirt. Clean contacts with carbon tetrachloride if necessary.
4. Short-circuited turns caused by small specks of metal will show sharp dip in grid current or complete disappearance of grid current. Clean with carbon tetrachloride to remove this trouble. A sharp dip in grid current will also be caused by poor grounding of the oscillator compartment shield. Tightening of the four mounting screws which ground this plate to the chassis will remedy this trouble.

16.5 Channel B, Tracking and Alignment

(a) Set the CHANNEL switch to B.
(b) Rotate FREQUENCY B control to 004.2 turns after as per 16.3
(e) Set Meter switch to GRID.
(d) Set Channel B XTAL M.O. switch to M.O.
(e) Set TRANSMISSION switch to R. T.
(f) Press Microphone press-to-talk switch, starting dynamotor.
(g) With conditions as in (f) above, adjust trimmer condenser C73 to maximum grid current (30% Min.) (with bottom oscillator compartment shield screwed securely in position.
(h) Rotate FREQUENCY B control from 004.2 turns to approximately 032.0 turns and observe variation in grid from 30 min. to 120 max. across the band. Remarks in 16.4 (h) apply here also, but in addition low 20 M.C. drive indicates that another oscillator tube should be selected.

16.6 Crystal Operating and Tuning

For crystal operation and for output circuit tuning procedure, refer to OPERATION, Section 13.

16.7 Vacuum Tube Requirements

Oscillator stability and output at 20 MC are largely dependent on selection of good tubes. Bad tubes are characterized by:

(a) Unsteady note or "chirping" as the transmitter is keyed.
(b) Audible parasitics or sideband hash in the 5 to 7 MC range

of the B CHANNEL.
(c) Low drive at 20 MC.

In the R.F. amplifier stage a defective tube is characterized by:

(d) Low output
(e) Bright glow in the cathode region due to gas (a slight glow is allowable in this stage).

Sustained off-tune conditions, especially on C.W., cause this tube to "gas" and should be avoided. Owing to the action of the "getter" most tubes recover after a short period of normal operation.

17. REMOVAL OF PARTS

From inspection of the chassis, The removal of defective parts for repair or replacement will, in general, be self-evident. For several of the main assemblies, removal is more difficult and a definite procedure should be followed, as outlined below:-

17.1 Oscillator Coil Assemblies may be removed by performing the following operations:

(a) Remove the front knob.
(b) Remove the blister.
(c) Remove the counter.
(d) Remove the two nuts which secure the front of the coil to the front panel.
(e) Remove the oscillator compartment shield.
(f) From the rear of the chassis, by means of a long screwdriver, remove the four mounting screws in the centre partition. Access to these screws may be gained through holes in the rear of the chassis.
(g) Carefully disconnect the oscillator grid connection between the front end of the oscillator coil and the Xtal M.O. switch.
(h) Remove the connection to the oscillator plate coil wiping spring.
(g) When all connections are carefully freed from the coil, withdraw it carefully from the chassis, taking care not to damage switch contact or wiper spring contacts on the coil as it is removed. The screwdriver used for the removal of the coils should have approximately a 3/16" diameter shaft, not less than 7" long, with a 1/4" blade. A little beeswax on the blade will assist in holding screws in difficult positions.

17.2 The removal of the ANTENNA LOADING B COIL is accomplished by removal of the knob, the blister, the counter and the two front panel mounting nuts which are located beneath the blister. The rear mounting of the coil is released by the removal of two mounting screws.

17.3 The ANTENNA LOADING A COIL may be removed from the chassis without disturbing the counter assembly on the front panel. It does, however, require to have the knob and the blister removed in order that access may be gained to the two front mounting nuts. The rear mounting is released by means of two mounting screws on the mounting bracket. The counter assembly does not need to be disturbed, owing to the presence of the detachable flexible coupling at the front end of the coil.

17.4 The KEYING RELAY may be removed from the chassis when the ANTENNA COUPLING A switch has been partially removed from the chassis by removal of its knob and mounting nut. The oscillator tube shield in the oscillator tube also has to be removed, as well as the low frequency crystal. In order to remove the KEYING RELAY, remove the four mounting screws through holes in the top contact plate. Two of these holes are exposed only when the armature is pushed to the operated position. Disconnect all leads from the relay to other apparatus and cable and then carefully slide it off the mounting bracket into the free space provided by the loosening of the ANTENNA COUPLING A switch from its mounting.

17.5 The METER LAMP ASSEMBLY may require alignment. Sometimes this may be done from the front panel alone by means of a thin (3/32") spanner wrench for 11/16" nut. Generally the top case catch will have to be removed for accessibility. When adjustment of this clamp is impossible by these means access may be gained to the rear clamping nut of the assembly only by the removal of the ANTENNA COUPLING A switch from the front panel and the loosening of the keying relay from its mounting bracket by the removal of four screws.

17.6 The METER may only be removed by first removing the meter lamp assembly by the method given in 17.5, after which it may be removed from the front panel by the removal of three mounting screws. When the mounting screws have been removed, the connections to the meter may be removed through the holes in the front panel.

17.7 TOGGLE CONTROL SWITCHES located either side of the chassis may be removed for access to the rear connections by removing the hex. nut from the front panel and pulling the switch out through a hole in the side of the chassis where it may be inspected or serviced or changed with comparative ease.

17.8 The CHANNEL RELAY may be released from the chassis by means of its four mounting screws, but special care should be exercised in disconnecting the many leads connecting it to other apparatus. On the top side of the chassis, in addition to the contacts, the two resistors R23 and R39 have to be disconnected from the stand-off bushing and the plate coupling condenser C21 must be disconnected from the top of L7. Beneath the chassis in the oscillator compartment, all leads to both terminal plates have to be removed. In disconnecting the wires from the relay contacts, the utmost care should be exercised to avoid straining the contacts.

17.9 The DYNAMOTOR may be completely removed from the chassis by removing the four screws from the shock mountings and disconnecting the four leads which are soldered to the dynamotor strip beneath the chassis. The low voltage commutators of the motor may be serviced or cleaned without removing the dynamotor from the chassis. In order to do this it is only necessary to remove the modulator tube and the end-bell from the dynamotor.

TABLE VIII

TYPICAL TEST VOLTAGES

The following voltages should be taken against ground with a 1,000 or 2,000 ohms per volt voltmeter. The input voltage at the transmitter should be set to 13.25 volts for AT-1 Transmitter or 26.5 volts for AT-7 Transmitter.

Mode of Operation	C.W.	M.C.W.	R.T.
Amplifier (V-2) Plate at base of L7	560	580	580
" (V-2) Screen Grid	180	95	110
" (V-2) Cathode	29	18	19

NOTE: The screen voltage on V-2 will vary with grid drive between 150 and 300 volts.

Oscillator (V-1) Plate at base of L3	280	285	280
" (V-2) Screen Grid	260	260	280
" (V-2) Cathode	29	18	19
Modulator (V-3) Plate	205	250	215
" (V-3) Screen Grid	265	230	260
" (V-3) Cathode	30	28	31
Audio Tone Oscillator (V-4) Plate	36	39	0
" " " (V-4) Cathode	5.2	5.4	0

TABLE IX

METER MULTIPLIERS

Actual Current Milliampers.	Meter	Multiplier
Amp. Plate Current	Plate %	X 1
Amp. Grid "	Grid %	X .04

TABLE X

SCHEDULE OF INTERCONNECTIONS

FOR

GENERAL PURPOSE WIRELESS EQUIPMENT

TRANSMITTER - TYPE AT-1 OR AT-7.
RECEIVER - TYPE AT-2.

ABBREVIATIONS AND NOTES

The following abbreviations are used throughout this table:

Bk - Black	I/C - Intercommunication
Bl - Blue	L - Loop
Br.- Brown	LC - Loop Control
Gr - Green	R - Receiver
Or - Orange	T - Transmitter
Rd - Red	RRC - Receiver Remote Control
Wh - White	TRC - Transmitter, Remote Control
Yl - Yellow	A/C - Aircraft
RF - Radio Frequency	ACC - Aircraft Accumulator - General Service.
SHLD - Braided Metal Shield	

NOTE 1:- Numbers in brackets, e.g.(14) indicate size of wire - B&S Gauge

2:- Conductor colors, in two color designations, are given Body color first and tracer colors second.

3:- If the total length of run between Junction Box and Battery Terminals is less than 5 feet, use Cable 5E/567. If run is greater than 5 feet but does not exceed 15 feet, use Ducel 37-5E/466. If in excess of 15 feet use two conductors or Unical 64-5E/516.

4:- Where Junction Box external circuit connections are not explained reference should be made to the Terminal having the lower number which appears earlier in the list and which will have details.

TABLE X (Continued)

TRANSMITTER - TYPE AT-1 and AT-7
R.C.A.F. Ref. No. 10D/1267 and 10D/1429
CABLE - R.C.A.F. Ref. No. 5E/570
PLUG, RECEPTACLE 10H/2517

TERMINAL	COND.COLOR	JUNCTION BOX INTERCONNECTIONS		COND.COLOR	TERMINAL	CIRCUIT FUNCTION
1	Rd Yl	17 to	13	Rd Yl	I/C 15	Microphone Input
2	Not connected					
3	Yl Bl	17	15	Yl Bl	I/C 1	"Press-to-talk" Trans. Control
4	Rd Bl (18)	19	34	Blue (18)	Key-Morse	Keying Circuit Transmitter
		19	18	Bare	T 3	Press-to-talk Circuit
5	Bl Wh	20	4	Bl Wh (14)	TRC 4	Remote Control Channel Selector
6	Bl Or (18)	21	3	Bl Or	TRC 3	Remote Control Channel Selector
7	Bl Gr	22	5	Bl Gr	TRC 5	Remote Control H-L Note
8	Rd Bk (14)	23	1	Rd Bk (14)	TRC 1	Negative Filament Transmitter
		23	59			Not Used
		1	33	Rd (14)	Key-Morse	Transmitter Keying Circuit
9	Bl Bk (14)	24	2	Bl Bk (14)	TRC 2	Remote Control ON-OFF
10	Gr Yl Shld	25	38	Gr Yl	R 5	Sidetone Output
11	Gr Br Shld	26	40	Gr Br	R 8	Microphone Switch I/C
			12	Gr Br Shld	I/C 13	Selector Switch Microphone
12	Not connected					
13	Rd (14)	28	30	ACC	Positive	Positive Battery Supply
				Rd (14)	See Note 2	
		28	36	Rd (14)	R 3	Positive Battery Supply
		30	63	Bl	LC 4	Positive Battery Supply
		30	64	Rd	RRC 16	Positive Battery Supply
14	Cable & Con-	Gnd	29			Ground (Cable Shield &
	ductor	43	6			(3 conductor
	Shields	6	14			(shields to be
		29	43	Yl Gr		(bonded together
		43	76	Yl Gr		(at trans.plug.
		6	80			
		43	46	Rd Gr	R 14	Remote R.F.GAIN (only when (R.R.C.U.not used.

TABLE X (Continued)

TERMINAL	COND.COLOR	JUNCTION BOX INTERCONNECTIONS	COND. COLOR	TERMINAL	CIRCUIT FUNCTION
15	Bk (14)	27 to 31	ACC	Negative See Note 2	Negative Battery Supply
		27 37	Bk (14)	R 4	Negative Battery Supply
		27		LC 2	B.F.O. Switch

TABLE X (Continued)

TRANSMITTER REMOTE CONTROL
R.C.A.F. Ref. No. 10D/1268
CABLE - R.C.A.F. Ref. No. 5E/568

TERMINAL	COND.COLOR	JUNCTION BOX INTERCONNECTIONS	COND.COLOR	TERMINAL	CIRCUIT FUNCTION
1	Rd Bk (14)	1 to 23	Rd Bk (14)	T 8	Negative Fil.Cct.Transmitter
		1 33	Rd	Key-Morse	Keying Circuit Transmitter
2	Bl Bk (14)	2 24	Bl Bk (14)	T 9	Remote Control ON-OFF
3	Bl Or (14)	3 21	Bl Or (18)	T 6	Remote Control Channel Selector
4	Bl Wh (14)	4 20	Bl Wh	T 5	Remote Control Channel Selector
5	Bl Gr	5 22	Bl Gr	T 7	Remote Control HIGH-LOW NOTE
6	Cable)	Gnd 6			Ground
	Shield)	6 14			
		6 43			
		6 80			

TABLE X (Continued)

RECEIVER - TYPE AR-2
R.C.A.F. Ref. No. 10D/1275
CABLE - R.C.A.F. No. 5E/571
PLUG, RECEPTACLE 10H/2515

TERMINAL	COND.COLOR	JUNCTION BOX INTERCONNECTIONS		COND. COLOR	TERMINAL	CIRCUIT FUNCTION
1	Wh Shld	60		Wh Shld	L 1	R.F.Connection to Loop
2	Bk Shld	61		Bk Shld	L 5	R.F.Connection to Loop
3	Rd (14)	36 to	28	Rd (14)	T 13	Positive Battery Supply to Transmitter
		28	30	A/C Accumu-lator	Positive See Note 2)	Positive Battery Supply to Trans.
		30	63	Bl	LC 4	Positive Battery Supplt to Trans.
		30	64	Rd	RRC 16	Positive Battery Supply to Trans.
4	Bk (14)	37	27	Bk (14)	T 15	Negative Battery Supply to Trans.
5	Gr Yl	38	25	Gr Yl Shld	T 10	Sidetone Input to Output Amplifier
6	Yl Bk	35			LC 1	B.F.O. Switch
7	Bl Yl	39	11	Bl Yl	I/C 11	Radio Receiver Output
8	Gr Br	40	26	Gr Br Shld	T 11	I/C Amplifier Input
		26	12	Gr Br Shld	I/C 13	Selector Switches, Microphone Sect.
			12		A/C Wiring	I/C - Microphone - Rear Crew
9	Bl Br	41	10	Bl Br	L/C 12	I/C - Amplifier Output
				Gr	A/C Wiring	I/C - Receivers Rear Crew
10	Bl Rd	42	9	Shield	Gr Yl to T 10)	Sidetone return to Transmitter
Gnd 11	Yl Gr	43	29	Shields	(TRC RRC-LC	
		45	6		(Key & Acc.Cable & Ground	
					(Ground	
		6	14	Shields	I/C Cable	Ground
		43	76	Yl Gr	RRC 4	Ground
		43	46	Rd Gr	R 14	Remote R.F. Gain Circuit (only when RRC not used

TABLE X (Continued)

TERMINAL	COND.COLOR	JUNCTION BOX INTERCONNECTIONS		COND.COLOR	TERMINAL		CIRCUIT FUNCTION
12	Bk Rd (14)	44	to 79	Bk Rd (14)	RRC	1	Remote Control ON-OFF
13	Bk Yl (14)	45	78	Bk Yl (14)	RRC	2	Remote Control ON-OFF
14	Rd Gr	46	77	Rd Gr	RRC	3	Remote Control R.F. GAIN
15	Rd Br	47	S1				Muting Relay Switch Circuit
		S1	15	Yl Bl	I/C	1	Muting Relay Switch Circuit
16	Bk Gr	48	62	Rd	LC	1	Loop Control Dial Lamp Supply
17	Bk Br	49	74	Bk Br	RRC	6	Remote Control Band Switch No.1 Band
18	Bk Yl	50	73	Bk Yl	RRC	7	Remote Control Band Switch No.2 Band
19	Bk Or	51	72	Bk Or	RRC	8	Remote Control Band Switch No.3 Band
20	Bk Wh	52	71	Bk Wh	RRC	9	Remote Control Band Switch No.4 Band
21	Bk Bl	53	70	Bk Bl	RRC	10	Remote Control Band Switch No.5 Band
22	Gr Bl	54	69	Gr Bl	RRC	11	Remote Control Band Mode of Operation R.T.
23	Gr Or	55	68	Gr Or	RRC	12	Remote Control Band Mode of Operation M.C.W.
24	Gr Wh	56	67	Gr Wh	RRC	13	Remote Control Band Mode of Operation C.W.
25	Gr Bk	57	66	Gr Bk	RRC	14	Remote Control Band Mode of Operation D.F.LOOP
26	Gr Rd	58	65	Gr Rd	RRC	5	Remote Control Band Mode of Operation SENSE
11	Conductor Shields	43	29				Ground
			14				
			6				
			76				
			80				
11	Cable Shield Gnd.		43,29,14,6,76,80				

TABLE X (Continued)

RECEIVER REMOTE CONTROL
R.C.A.F. Ref. No. 10D/1277
cable - R.C.A.F. Ref. No. 5E/569
PLUG RECEPTACLE 10H/2516

TERMINAL	COND.COLOR	JUNCTION BOX INTERCONNECTIONS		COND.COLOR	TERMINAL		CIRCUIT FUNCTION
1	Bk Rd (14)	79	to 44	Bk Rd (14)	R	12	Remote ON-OFF Switch
2	Bk Yl (14)	78	45	Bk Yl (14)	R	13	Remote ON-OFF Switch
3	Rd Gr	77	46	Rd Gr	R	14	Remote R.F.Gain Control
4	Yl Gr	76	43	Yl Gr	R	11	Ground
5	Gr Rd	65	58	Gr Rd	R	26	Remote Mode of Operation Switch) SENSE)
6	Bk Br	74	49	Bk Br	R	17	Remote Band Switch No. 1 Band
7	Bk Yl	73	50	Bk Yl	R	18	Remote Band Switch No. 2 Band
8	Bk Or	72	51	Bk Or	R	19	Remote Band Switch No. 3 Band
9	Bk Wh	71	52	Bk Wh	R	20	Remote Band Switch No. 4 Band
10	Bk Bl	70	53	Bk Bl	R	21	Remote Band Switch No. 5 Band
11	Gr Bl	69	54	Gr Bl	R	22	Remote Mode of Operation Switch R.T.
12	Gr Or	68	55	Gr Or	R	23	Remote Mode of Operation Switch) M.C.W.)
13	Gr Wh	67	56	Gr Wh	R	24	Remote Mode of Operation Switch C.W.
14	Gr Bk	66	57	Gr Bk	R	25	Remote Mode of Operation Switch) D.F. LOOP)
15	Bk Gr (14)	75					Not used
16	Rd	64	30	Acc.			Lamp Battery Supply
Shield not connected		Grd	80				Ground
			43				
			29				
			76				
			6				
			14				

TABLE X (Continued)

INTER-COMMUNICATION SWITCH BOX
R.C.A.F. Ref. No. 10D/1276
CABLE - R.C.A.F. Ref. No. 5E/585

TERMINAL	COND.COLOR	JUNCTION BOX INTERCONNECTIONS		COND. COLOR	TERMINAL	CIRCUIT FUNCTION
1	Y1 B1 (14)	15 to 18		Y1 B1	T 3	Selector Switch Transmitter Start
		15	S1			Muting Relay Switch
2	A/C Wiring to Y1 Wire in Socket 29			Forward	Crew	Microphone - Forward Crew
3	A/C Wiring to Gr Wire in Socket 29			Forward	Crew	Transmitter Start - Forward Crew
4	A/C Wiring to Rd Wire in Socket 29			Forward	Crew	Receivers - Head Set - Forward Crew
5	A/C Wiring to Y1 Wire in Socket 29			Pilots	Pilots	Microphone - Pilots
6	A/C Wiring to Gr Wire in Socket 29			Pilots	Pilots	Transmitter Start - Pilots
7	A/C Wiring to Rd Wire in Socket 29			Pilots	Pilots	Receivers - Head Set - Pilots
8	A/C Wiring to Y1 Wire in Socket 29			Forward	W/Operator	Microphone - Wireless Operator
9	A/C Wiring to Gr Wire in Socket 29			Forward	W/Operator	Transmitter Start - W/Operator
10	A/C Wiring to Rd Wire in Socket 29			Forward	W/Operator	Receivers - Head Set - W/Operator
11	A/C B1 Y1	11 to 39		B1 Y1	R 7	Selector Switch - Radio Receiver
12	B1 Br	10	41	B1 Br	R 9	Selector Switch - I/C
14	Conductor Shields	14	6			Ground
			29			
			43			
			76			
			80			
14	Cable Shield Gnd		14			
			6			
			29			
			43			
			76			
			80			

TABLE X (Continued)

TERMINAL	COND.COLOR	JUNCTION BOX INTERCONNECTIONS	COND. COLOR	TERMINAL	CIRCUIT FUNCTION
13	Gr Br Shld	12 to 26	Gr Br Shld	T 11	Selector Switch - Microphone
		12	A/C Wiring	Mic +	Microphone - Rear crew
		26 40	Gr Br	R 8	Receiver I/C Input
15	Rd Yl Shld	13 17	Rd Yl Shld	T 1	Microphone into Transmitter
16	Bl Rd	31 27	Bk (14)	T 15	Negative Power Supply
		31	Bk (14)	ACC Neg.	Negative Power Supply
		31	A/C Wiring	Tel	Microphone - Rear crew
		27 37	Bk (14)	R 4	Negative Battery in Receiver
16	A/C Wiring to Bl wire in Socket 29		Forward crew		Common Negative Supply
	A/C Wiring to Bl wire in Socket 29		Pilots		Common Negative Supply
	A/C Wiring to Bl wire in Socket 29		W/Operation		Common Negative Supply

TABLE X (Continued)

TELEGRAPH KEY - TYPE F
R.C.A.F. Ref. No. 10F/774
CABLE - R.C.A.F. No. 5E/505

TERMINAL	COND. COLOR	JUNCTION BOX INTERCONNECTIONS		COND. COLOR	TERMINAL	CIRCUIT FUNCTION
Key-Morse	Rd	33 to	1 to 23	Rd Bl (14)	T 8	Negative Filament Circuit Transmitter
Key-Morse	Bl	34	19	Rd Bl (18)	T 4	Keying Circuit Transmitter
	Cable Shield	Gnd	43			Ground
			29			
			76			
			80			
			6			
			14			

TABLE X (Continued)

LOOP REMOTE CONTROL
R.C.A.F. Ref. No. 10B/1282
CABLE: R.C.A.F. No. 5E/505
PLUG RECEPTACLE 10H/1518

TERMINAL	COND.COLOR	JUNCTION BOX INTERCONNECTIONS	COND. COLOR	TERMINAL	CIRCUIT FUNCTION
LC1	Rd	62 to 48	Bk Gr	R 16	Dial Lamp Negative Supply
LC2		27 31			Negative Power Supply
		27 37	Bk (14)	R 4	Negative Power Supply
LC3		35	Yl Bk	R 6	B.F.O. Relay Switch
LC4	Bl	63 30-28-36	Acc		Dial Lamp Positive Supply
		3 36	Rd	R 3	Receiver Positive Battery
	Shield	Gnd 29			Ground
		76			
		80			
		6			
		14			
		43			

TABLE X (Continued)

LOOP
R.C.A.F. Ref. No. 10B/1281
CABLE - R.C.A.F. No. 5E/566
PLUG RECEPTACLE No. 10H/2519

TERMINAL	COND. COLOR	JUNCTION BOX INTERCONNECTIONS	COND. COLOR	TERMINAL	CIRCUIT FUNCTION
L1	Wh Shld	60	Wh Shld	R 1	Loop R.F. Connection to Receiver
L5	Bk Shld	61	Bk Shld	R 2	Loop R.F. Connection to receiver
L3	Shields	43 to 29	A/C Gnd		Ground
		76			
		80			
		6			
		14			

TABLE X (Continued)

SOCKETS 29

1	Rd	Receivers	(Plug 58 - Gr)
2	Gr	Transmitter Start	(Plug 58 - Bl)
3	Bl	Common Lead	(Plug 58 - Rd)
4	Yl	Microphone	(Plug 58 - Yl)

TABLE X (Continued)

JUNCTION BOX
R.C.A.F. Ref. No. 10D/1270

TERMINAL	COND.COLOR	JUNCTION BOX INTERCONNECTIONS		COND. COLOR	TERMINAL		CIRCUIT FUNCTION
TRC 1	Rd Bk (14)	1	to 23	Rd Bk (14)	T	8	Negative Filament Circuit Transmitter
			33	#2 Dumet 4	Morse Key		Transmitter Keying Circuit
TRC 2	Bl Bk (14)	2	24	Bl Bk (14)	T	9	Transmitter Remote Control ON-OFF
TRC 3	Bl Or (14)	3	21	Bl Or (18)	T	6	Transmitter Remote Control Channel Selector switch
TRC 4	Bl Wh (14)	4	20	Bl Wh	T	5	Transmitter Remote Control Channel Selector switch
TRC 5	Bl Gr	5	22	Bl Gr	T	7	Transmitter Remote Control H-L NOTE switch
		6	43		A/C Ground		Ground
		6	80				
		7	not connected				
		8	not connected				
		9	to Shield of Gr Yl Conductor				
		9	42	Bl Rd	R	10	Sidetone return to Transmitter
I/C 12	Bl Br	10	41	Bl Br	R	9	Selector Switches - I/C Amplifier Output
I/C 11	Bl Yl	11	39	Bl Yl	R	7	Selector Switches, Radio Receiver Output
I/C 13	Gr Br Shld	12	26	Gr Br Shld	T	11	Selector Switches - Microphone Transmitter (I/C)
Socket) 29 Yl)	(Rear Crew)			A/C Wiring			Microphone - Rear Crew
		26	40	Gr Br	R	8	I/C Amplifier Input
I/C 15	Rd Yl Shld	13	17	Rd Yl Shld	T	1	Microphone into Transmitter
I/C 14	Shields	14	6				Ground
			29				
			43				
			76				
			80				
I/C 1	Yl Bl (14)	15	18	Yl Bl	T	3	Selector Switch Transmitter Start

TABLE X (Continued)

TERMINAL	COND.COLOR	JUNCTION BOX INTERCONNECTIONS		COND.COLOR	TERMINAL		CIRCUIT FUNCTION
		15	to S1				
		S1	47	Rd Br	R	15	Muting Relay Switch Circuit
		16	Not connected				
		17	to 13				
		18	15				
T 4	Rd Bl (18)	19	34	#1 Cond.Dumet 4 Morse Key			Keying Circuit Transmitter
		20	4				
		21	3				
		22	5				
		23	1				Negative Filament Transmitter
		23	59				Not used
		24	2				
T 10	Gr Yl Shld	25	38	Gr Yl	R	5	Sidetone Output Transmitter
		26	40	Gr Br	R	8	I/C Switches Microphone
		26	12				
T 15	Bk (14)	27	31	Negative Batt.			Negative Battery Supply I/C Common Wire
			37	Bk (14)	R	4	Negative Battery Supply
T 13	Rd (14)	28	30	Positive Batt.			Positive Battery Supply
		28	36	Rd (14)	R	3	Positive Battery Supply
T 14	Cable Shield	29	Gnd.	A/C Ground			Ground
		29	43				
+ ve	ACC	30	28				
		30	63	Bl	LC	4	Positive Battery Supply
		30	64	Rd	RCC	16	Positive Battery Supply
		31	27				
		32	Not used				
		33	1				Keys
		34	19				Keys
R 6	Yl Bk	35			LC	3	B.F.O. Relay Switch Circuit
		36	28				
R 4	Blk. (14)	37	27	Bl (14)	T	13	Negative Power Supply

TABLE X (Continued)

TERMINAL	COND.COLOR	JUNCTION BOX INTERCONNECTIONS		COND.COLOR	TERMINAL	CIRCUIT FUNCTION
		37 to C1 to 39		Bl Yl	R 7	Rec. Output
		38 to 25				
		39	11			
		39	C1			
		40	26			
		41	10			
		42	9			
Key Morse	Shield	Gnd				
LC	Shield	Gnd				
R 11	Shields	43	29			Ground
			76			
			80			
			14			
			6			
		43	46	Bare	R 14	Connected only when RRC not used
R 12	Bk Rd (14)	44	79	Bk Rd (14)	RRC 1	Remote ON-OFF Receiver
R 13	Bk Yl (14)	45	78	Bk Yl (14)	RRC 2	Remote ON-OFF Receiver
R 14	Rd Gr	46	77	Rd Gr	RRC 3	Remote R.F.Gain Receiver
		46	43			
R 15	Rd Gr	47 to S1 to 15		Yl Bl (14)	I/C 1	Muting Relay Switch Circuit
R 16	Bk Gr	48 to 62		Rd	LC 1	L.C.Dial Lamp Supply
R 17	Bk Br	49	74	Bk Br	RRC 6	Remote No.1 BAND Switch Receiver
R 18	Bk Yl	50	73	Bk Yl	RRC 7	Remote No.2 BAND Switch Receiver
R 19	Bk Or	51	72	Bk Or	RRC 8	Remote No.3 BAND Switch Receiver
R 20	Bk Wh	52	71	Bk Wh	RRC 9	Remote No.4 BAND Switch Receiver
R 21	Bk Bl	53	70	Bk Bl	RRC 10	Remote No.5 BAND Switch Receiver
R22	Gr Bl	54	69	Gr Bl	RRC 11	Remote R.T.Mode of Operation Switch Receiver
R 23	Gr Or	55	68	Gr Or	RRC 12	Remote M.C.W. Mode of Operation Switch Receiver
R 24	Gr Wh	56	67	Gr Wh	RRC 13	Remote C.W. Mode of Operation Switch Receiver
R 25	Gr Bk	57	66	Gr Bk	RRC 14	Remote D.F.LOOP Mode of Operation Switch Receiver

TABLE X (Continued)

TERMINAL	COND.COLOR	JUNCTION BOX INTERCONNECTIONS	COND.COLOR	TERMINAL	CIRCUIT FUNCTION
R 26	Gr Rd	58 to 65	Gr Rd	RRC 5	Remote SENSE Mode of Operation Switch Receiver
		59 23			
R 1	Wh Shld	60	Wh Shld	L 1	R.F. Connection to Loop
R 2	Bk Shld	61	Bk Shld	L 5	R.F. Connection to Loop
		62 48			
		63 30			
		28			
		36			
		64			
		64 30			
		28			
		36			
		63			
		65 58			
		66 57			
		67 56			
		68 55			
		69 54			
		70 53			
		71 52			
		72 51			
		73 50			
		74 49			
RRC 15	Bk Gr (14)	75	Spare		
RRC 4	Yl Gr	76 43			Ground
		6			
		14			
		29			
		76			
		80			

TABLE X (Continued)

TERMINAL	COND.COLOR	JUNCTION BOX INTERCONNECTIONS			COND.COLOR	TERMINAL	CIRCUIT FUNCTION
		77	to	46			
		78		45			
		79		44			
RRC Cable	Shield	Gnd		80			Ground
				6			
				43			
				29			
				14			
				76			

TABLE XI

PARTS LIST

CONDENSERS

Ref. No.	Sch. No.	Nomenclature	Description
10C/1688	C1	"B" Channel Osc. Grid	2-200 uuf condensers Centralab type 810 +- 1% Coeff. .00004 uuf/uuf/° C +-.000015 uuf/uuf/°C.
10C/1689	C2	"A" Channel Osc. Grid	5-200 uuf condensers Centralab type 810 +- 1% Coeff. 00004 uuf/uuf/°C +- .000015 uuf/uuf/°C.
10C/1690	C3	R.F. Osc. Grid	.003 ufd +- 5%, Cornell-Dubilier type 1 RSP.
10C/1691	C4	R.F. Osc. Screen	.01 uf +- 10%, Cornell-Dubilier type 4-11010.
10C/11599	C5	R.F. Osc. Scn.-cathode	450 uuf +- 5% Cornell-Dubilier type 2RS.
10C/1691	C6	R.F. Osc. Filament	.01 uf +- 10% Cornell-Dubilier type 4-11010.
10C/1691	C7	R.F. Osc. Cathode	.01 uf +- 10% Cornell-Dubilier type 4-11010.
10C/1695	C9	R.F. Osc.Grid-Cathode	100 uuf +- 5% Centralab type 810. .00003 uuf/uuf/°C, +- .000003 uuf/uuf/°C.
10C/1727	C10	R.F. Osc. Plate	75 uuf +- 5% Cornell-Dubilier type 2RS.
10C/1697	C11	"B" Channel Osc. Plate	50 uuf +- 1% Cornell-Dubilier type 2RS.
10C/2533	C12	R.F. Osc. Plate	.003 uf +- 5% Cornell-Dubilier type 2RS.
10C/1699	C13	"A" Band R.F.Osc.Plate	175 uuf +- 5% Cornell-Dubilier type 2RS.
10C/1800	C14	R.F. Osc. Plate-Grid	5 uuf +- 1 uuf Cornell-Dubilier type 5R
10C/1737	C15	R.F. Osc. Plate	300 uuf +- 5% Cornell-Dubilier type 2RS.
10C/1701	C16	R.F.Amp.Grid Meter Shunt	.25 uf + 20% -10% Cornell-Dubilier type DYRT 6025-1.

Ref. No.	Sch. No.	Nomenclature	Description
10C/2534	C17	R.F. Amp. Screen	.003 uf +- 5% Cornell-Dubilier Type 4-12030.
10C/1691	C18	R.F. Osc. Filament	.01 uf +- 10% Cornell-Dubilier type 4-11010.
10C/1691	C19	R.F. Amp. Filament	.01 uf +- 10% Cornell-Dubilier type 4-11010 .
10C/1691	C20	R.F. Amp. Cathode	.01 uf +- 10% Cornell-Dubilier type 4-11010 .
10C/1698	C21	R.F. Amp. Plate	.003 uf +- 10% Cornell-Dubilier Type 4L-22030 .
10C/1707	C22.1	Audio Osc. V-4	.01 uf +- 3% Cornell-Dubilier type 1WS.
10C/1707	C22.2	Audio Osc. Note	.01 uf +- 3% Cornell-Dubilier type 1WS.
10C/1709	C22.3	Audio Osc. Note	.002 uf +- 3% Cornell-Dubilier type 1 WS.
10C/1707	C23.1	Audio Osc. Note	.01 uf +- 3% Cornell-Dubilier type 1WS.
10C/1713	C23.2	Audio Osc. Note	.0052 uf +- 3% Cornell-Dubilier type 1WS.
10C/1707	C24.1	Audio Osc. Note	.01 uf +- 3% Cornell-Dubilier type 1 WS
10C/1713	C25	Audio Osc. Note	.0052 uf +- 3% Cornell-Dubilier type1WS
10C/1714	C26	Audio Osc. Note	.0014 uf +- 3% Cornell-Dubilier type 1WS.
10C/1715	C27	Audio Note Note	.0017 uf +- 3% Cornell-Dubilier type 1WS
10C/1716	C28	Modulator Grid	.002 uf +- 10% Cornell-Dubilier type 4-12020
10C/1717	C29	Microphone Supply	8 uf + 20% - 0% Special Capacity. Mfg. to Dwg.AFD-1001
10C/1718	C31	Modulator Screen	2 x .25 uf +-10% Cornell-Dubilier type MC/446
10C/1701	C32	Mod. Plate Coupling	.25 uf +- 20% Cornell-Dubilier type DYRT 6025-1

Ref. No	Sch. No.	Nomenclature	Description
10C/1758	C33	Mod. Cathode	2 x 5 uf +20% - 10% Cornell Dubilier type DYRT 6055.
10C/1721	C34	High Tension Filter	4 uf +- 10% Cornell-Dubilier type MC/447.
10C/1722	C25	"B"Band Ant.Coupler No.1	10 uuf +- 5% Cornell-Dubilier type 2RS.
10C/1723	C36	"B"Band Ant.Coupler No.2	15 uuf +- 5% Cornell-Dubilier type 2RS.
10C/1724	C37	"B"Band Ant.Coupler No.3	35 uuf +- 5% Cornell-Dubilier type 2RS.
10C/1725	C38	"B"Band Ant.Coupler No.4	50 uuf +- 5% Cornell-Dubilier type 2RS.
10C/1726	C39	"B"Band Ant.Coupler No.5	60 uuf +- 5% Cornell-Dubilier type 2RS.
10C/1727	C40	"B"Band Ant.Coupler No.6	75 uuf +- 5% Cornell-Doubilier type 2RS.
10C/1728	C41	"B"Band Ant.Coupler No.7	100 uuf +- 5% Cornell-Dubilier type 2RS.
10C/1729	C42	"B"Band Ant.Coupler No.8	125 uuf +- 5% Cornell-Dubilier type 2RS.
10C/1730	C43	"B"Band Ant.Coupler No.9	165 uuf +- 5% Cornell-Dubilier type 2RS.
10C/1731	C44	"B"Band Ant.Coupler No.10	200 uuf +- 5% Cornell-Dubilier type 2RS.
10C/1732	C45	"B"Band Ant.Coupler No.11	250 uuf +- 5% Cornell-Dubilier type 2RS.
10C-1725	C46	"A"Band Ant.Coupler No.1	50 uuf +- 5% Cornell-Dubilier type 2RS.
10C/1728	C47	"A"Band Ant.Coupler No.2	100 uuf +- 5% Cornell Dubilier type 2RS.
10C/1735	C48	"A"Band Ant.Coupler No.3	150 uuf +- 5% Cornell Dubilier type 2RS.
10C/1731	C49	"A"Band Ant.Coupler No.4	200 uuf +- 5% Cornell Dubilier type 2RS.

Ref. No.	Sch. No.	Nomenclature	Description
10C/1737	C50	"A"Band Ant.Coupler No.5	300 uuf +- 5% Cornell-Dubilier type 2RS.
10C/1738	C51	"A"Band Ant.Coupler No.6	500 uuf +- 5% Cornell-Dubilier type 2RS.
10C/1739	C52	"A"Band Ant.Coupler No.7	600 uuf +- 5% Cornell-Dubilier type 2RS.
10C/1740	C53	"A" Band Ant.Coupler No.8	750 uuf +- 5% Cornell-Dubilier type 2RS.
10C/1741	C54	"A"Band Ant.Coupler No.9	900 uuf +- 5% Cornell-Dubilier type 2RS.
10C/1742	C55	"A"Band Ant.Coupler No.10	575 uuf +- 5% Cornell-Dubilier type 2RS.
10C/1743	C56	"A"Band Ant.Coupler No.11	700 uuf +- 5% Cornell-Dubilier type 2RS.
10C/1746	C58	Audio Osc. Plate blocking	.01 uf +-5% Cornell-Dubilier type 4-11010.
10C/1701	C59	Keying Suppressor	.25 uf+ 20% - 10% Cornell-Dubilier type DYRT 6025-1.
10C/1748	C60.1	Dynamotor Suppressor	.003 uf +- 10% Cornell-Dubilier type 1RSP.
10C/1748	C60.2	Dynamotor Suppressor	.003 uf +- 10% Cornell-Dubilier type 1RSP.
10C/1748	C61.1	Dynamotor Suppressor	.003 +- 10% Cornell-Dubilier type 1RSP.
10C/1748	C61.2	Dynamotor Suppressor	.003 uf +- 10% Cornell-Dubilier type 1RSP.
10C/1748	C63.1	Dynamotor Suppressor	.003 uf +- 10% Cornell-Dubilier type 1RSP.
10C/1748	C63.2	Dynamotor Suppressor	.003 uf +- 10% Cornell-Dubilier type 1RSP.
10C/1748	C64	V-5 Cathode	.003 uf +- 10% Cornell-Dubilier type 1RSP.
10C/1690	C65	Osc.Plate Supply Bypass	.003 uf +- 5% Cornell-Dubilier type 1RSP.
10C/1691	C66	Audio Osc. Plate	.01 uf +- 10% Cornell-Dubilier type 4-11010.

Ref. No.	Sch. No.	Nomenclature	Description
10C/1757	C67	"A" Band Osc. Plate Equalizer	.001 uf +-5% Cornell-Dubilier type 1RS.
10C/1758	C69	Dynamotor Filter	2 x .25 uf +20% -10% Cornell-Dubilier, type 6055.
10C/2535	C70	Diode Coupling	.01 uf +-5% Cornell-Dubilier type 1WS.
10C/1731	C71	"A"Band Ant.Coupler No.12	200 uf +-5% Cornell-Dubilier type 2RS.
10C/1760	C72	"A"Band Osc.Plate Trimmer	3 - 25 uuf White Radio type M.
10C/1760	C73	"B"Band Osc.Plate Trimmer	3 - 25 uuf White Radio type M.
10C/10878	C74	Dynamotor Filter	.1 uf +20% -10% Cornell-Dubilier type DYR 6010.
RESISTORS			
10C/959	R2	Osc. Grid Leak	.1 Megohm +-5% 1/2 watt I.R.C. type F-1/2.
10C/959	R2.1	Osc. Grid Leak	.1 Megohm +-5% 1/2 watt I.R.C. type F-1/2.
10C/1652	R3	Osc. Screen Grid	15,000 ohms +- 5% 2 watt I.R.C. type BT2.
10C/1653	R4.1	Osc. Screen Grid	20,000 ohms +-5% 10 watt I.R.C. type DG "C"Coating #2 Terminal.
10C/1653	R4.2	Osc. Screen Grid	20,000 ohms +-5% 10 watt I.R.C. type DG "C" Coating #2 Terminal.
10C/1654	R4.3	Osc. Screen Grid	25,000 ohms +-5% 10 Watt I.R.C. type DG "C"Coating #2 Terminal.
10C/1655	R5	Osc. Plate	5,000 ohms +-5% 20 watt I.R.C. type DG "B"Coating #2 Terminal.
10C/1656	R6	Osc. Cathode	400 ohms +-5% 2 watt I.R.C. type BT2.
10C/1653	R7	R.F. Amp. Grid Leak	20,000 ohms +-5% 10 watt I.R.C. type DG "C"Coating #2 Terminal.
10C/5298	R8	R.F. Amp. Meter Shunt	82 ohms +-10% I.R.C.type BW-1/2.

Ref. No.	Sch. No.	Nomenclature	Description
10C/1654	R9.1	R.F. Amp. Screen	25,000 ohms +- 5% 10 watt I.R.C. type DG "C"Coating #2 Terminal.
10C/1654	R9.2	R.F. Amp. Screen	25,000 ohms +- 5% 10 watt I.R.C. type DG "C"Coating #2 Terminal.
10C/1654	R9.3	R.F.Amp. Screen Grid	25,000 ohms +- 5% 10 watt I.R.C. type DG "C"Coating #2 Terminal.
10C/1660	R9.4	R.F.Amp. Screen Grid	50,000 ohms +- 5% I.R.C. Special to dwg. AFD-1091-1.
10C/1661	R10	R.F. Amp. Cathode	130 ohms +- 5% 2 watt I.R.C. type BT2.
10C/1662	R11	R.F. Amp. Cathode	300 ohms +- 5% 4 watts I.R.C. type AB "C"Coating #2 Terminal.
10C/1663	R12	Microphone Supply 12 volt sets only	1,000 ohms +- 5% 1 watt I.R.C. type BT1.
10C/1810	R12	Microphone Supply 24 volt sets only	2,000 ohms +- 5% 1 watt I.R.C. type BT1.
10C/1664	R13.1	R.F. Osc. Plate	15,000 ohms +- 5% 1/2 watt I.R.C. type BT-1/2
10C/1664	R13.2	R.F. Osc. Plate	15,000 ohms +- 5% 1/2 watt I.R.C. type BT-1/2
10C/1665	R14	Modulator Grid Leak	.5 Megohms +- 5% 1 watt I.R.C. type BT1
10C/1666	R15	Modulator Screen Grid	.25 Meg ohms +- 5% 2 watt I.R.C. type BT2
10C/1654	R16	Modulator Plate	25,000 ohms +- 5% 10 watt I.R.C. type DG "C"Coating #2 Terminal.
10C/1668	R17	Modulator Cathode	2,000 ohms +- 5% 2 watt I.R.C. type BT2.
10C/1669	R18.1	R.F.Amp. Screen Grid C.W.	10,000 ohms +- 5% 10 watt Marsland type MC "C" Coating. #2 Terminal.

Ref. No.	Sch. No.	Nomenclature	Description.
10C/1669	R18.2	R.F.Amp. Screen Grid C.W.	10,000 ohms +- 5% 10 watt Marsland type MC "C" Coating #2 Terminal.
10C/1670	R19	Audio Osc. Plate	.2 megohms +- 5% 1 watt I.R.C. type BT1.
10C/1671	R21	R.F. Amp. Grid Meter Multiplier	500 ohms +- 5% 1/2 watt I.R.C. type BT-1/2.
10C/1672	R22	R.F. Amp. Cathode Meter Multiplier	18,600 ohms +- 5% 1/2 watt I.R.C. type BT-1/2.
10C/968	R23	Antenna Meter Circuit	.1 megohm +- 5% 1 watt I.R.C type F1.
10C/1664	R24	Antenna Meter Circuit	10,000 ohms +- 5% 1/2 watt I.R.C. type BT-1/2
10C/1675	R25	Antenna Meter Shunt	10,000 ohms +- 5% 1/2 watt I.R.C. type BT-1/2
10C/1676	R26	Antenna Meter Multiplier	100 ohms +- 5% 1/2 watt I.R.C. type BW-1/2
10C/1677	R27	Audio Osc. Cathode	4,000 ohms +- 5% 1 watt I.R.C. type BT1
10C/1678	R28	Meter Lamp Circuit	65 ohms +- 5% 2 watt I.R.C. type BW2.
10C/1658	R29	Side Tone	100 ohms +- 5% 1 watt I.R.C. type BW1
10C/1650	R30	Modulator Filament	7.5 ohms +- 5% 10 watt I.R.C. type AB "B"Coating #2 Terminal.
10C/1681	R31	Meter Lamp 24 V. Sets	80 ohms +- 10% 2 watt I.R.C. type BW2.
10C/1682	R32	Audio Osc. Plate	.1 megohm +-5% 1/2 watt I.R.C. type BT-1/2.
10C/2532	R35	"A"Band Osc. Plate Equalizer	4,000 ohms +-5% 1 watt I.R.C. type BT1.
10C/1683	R36	"B" Band Osc. Plate Equalizer	4,000 ohms +-5% 2 watt I.R.C. type BT2.

Ref. No.	Sch. No.	Nomenclature	Description
10C/1685	R37	Filament Resistance 24 volt sets only	40 ohms +-10% 10 watt I.R.C type AB "B"Coating #2 Terminal.
10C/1682	R38	Tone Attenuator	.1 megohm +-5% 1/2 watt I.R.C. type BT-1/2
10C/2793	R39	Diode Shunt	10,000 ohms +-5% 1/2 watt I.R.C. type BT-1/2
10C/2332	R40	Relay Resistance 12 volt sets only.	10 ohms +-10% 10 watt I.R.C. type AB "B"Coating #2 Terminal.
10C/6539	R40	Relay Resistance 24 volt sets only.	20 ohms +-10% 10 watt I.R.C. type AB "B"Coating #2 Terminal.
10C/4549	R41	Antenna Leak	10 megohms +-20% 1 watt I.R.C. type BT1.
		INDUCTANCES	
10D/1778	L1	"B"Band Osc.Grid Coil	Roller Coil Ass'y to Dwg. AFD-875.
10D/1779	L2	"A"Band Osc. Grid Coil	Roller Coil Ass'y to Dwg. AFD-874.
10C/1781	L3	Osc.Plate Shunt Feed Choke	4 Pie Duolateral Coil to Dwg. AFD-640.
10A/1781	L4	Osc. Cathode Choke	Duolateral Coil to Dwg. AFD-642.
	L5	"B"Band Osc.Plate Coil	Part of L1.
	L6	"A"Band Osc. Plate Coil	Part of L2.
10C/1784	L7	R.F. Amp.Plate shunt Feed Choke	4 Pie Duolateral Coil to Dwg. AFD 641.
10D/1785	L8	"A"Band Output Coil	Roller Coil Ass'y to Dwg. AFD-205.
10D/1786	L9	"B"Band Output Coil	Roller Coil Ass'y to Dwg. AFD-38.

Ref. No.	Sch. No.	Nomenclature	Description
10D/1787	L10	"A"Band Osc. Plate Equalizer	Duolateral Coil to Dwg. AFD-677
10D/1788	L11	"B"Band Osc. Plate Equalizer	Duolateral coil to Dwg. AFD-847
10C/14206	L12	Dynamotor Filter	Duolateral Coil to Dwg. AFD-2211
FUSES AND FUSE MOUNTINGS			
5C/316	F1	Main Fuse	Littelfuse #1167 type 5 AG., 30 Amp.
10H/1792	FM1	Mounting for F1	Littelfuse type #1196.
5C/314	F3	Dynamotor high voltage Fuse	Littelfuse Amplifier Fuse Type 4AG 1/2 Amp. 500 volts.
10H/14205	FM3	Mounting for F3	Littelfuse type 1212B.
SWITCHES			
10F/1762	S1.1	"A"Band Crystal M.O.	Rotary Wafer switch Oak Mfg. Co to Dwg. AFD-442.
	S1.2	"A"Band Crystal M.O.	Part of S1.1
10F/1763	S2	"B" Band Crystal M.O.	Rotary Wafer Switch, Oak Mfg. Co to Dwg. AFD-786
10F/1764	S3	"B" Band Antenna	Rotary Wafer Switch, Oak Mfg. Co. to Dwg. AFD-551.
10F/1765	S4	"A" Band Antenna	Rotary Wafer Switch, Oak Mfg. Co. to Dwg. AFD-443.
10F/1767	S7	Channel Switch	S.P.D.T., A.H.& H. type 21349-D.
10F/1769	S9.1 to S9.5	Transmission Switch	Rotary Wafer Switch Oak Mfg. Co. to Dwg. AFD-446.
10F/1767	S10.1 S10.2	Local-Remote Switch	D.P.D.T., A.H.& H. type 20905-AX.

Ref. No.	Sch. No.	Nomenclature	Description
10F/1767	S11	Power Off-On Switch	S.P.D.T., A.H. & H. type 21349-D
10F/1772	S12	Note Switch	Rotary Wafer Switch, Oak Mfg. Co. to Dwg. AFD-444.
10F/1773	S13.1 S13.2	Meter Switch	Rotary Wafer Switch, Oak Mfg. Co. to Dwg. AFD-445.
VACUUM TUBES AND SOCKETS			
10E/1303	V1	R. F. Oscillator	Raytheon type RK-38
10E/1303	V2	R. F. Amplifier	Raytheon type RK-38
10E/1303	V3	Modulator	Raytheon type RK-38
10E/1298	V4	Audio Tone Oscillator	Marconi R.V.C. type 6J5.
10E/1297	V5	Ant. Meter Diode	Marconi R.V.C. type 6H6.
10H/1749	VS1	Socket for V1	Amphenol type SS-5.
10H/1749	VS2	Socket for V2	Amphenol type SS-5.
10H/1749	VS3	Socket for V3	Amphenol type SS-5.
10H/1750	VS4	Socket for V4	Amphenol type SS-8.
10H/1750	VS-5	Socket for V5	Amphenol type SS-8.
10H/2435	VS6	Socket for "B" Band Xtal	Special to Dwg.AFD-1084.
10H/2435	VS7	Socket for"A" Band Xtal	Special to Dwg. AFD-1084.
10H/1751	VS8	Socket for 500-375 Xtal	Freidman Co. Type KS-7704.
METERS			
10A/1791	Ma1	Meter	Weston Model 506 D.C.Milli-ammeter 1 Ma.Movement type S5750.
5A/588	ML.	Meter Light	Kollsman Inst.Co. type 71A.
10A/1790	MLA	Meter Light Ass'y	Special Ass'y to Dwg. AFD-343.

RELAYS

Ref. No.	Sch. No.	Nomenclature	Description
10F/1774	D1	Wave change Relay 12 Volt sets only	Special to Dwg. AFD-534.
10F/1805	D1	Wave change Relay 24 Volt sets only	Special to Dwg. AFD-1049
10F/1775	D5	Keying Relay, 12 Volt Sets	Allied type AK-12 Volt.
10F/4282	D5	Keying Relay, 24 Volt Sets	Allied type AK-24 Volt
10F/1776	D6	Nigh Note-Low Note Relay 12 volt sets	Price Bros. Type 02-P-12V.
10F/1807	D6	High Note-Low Note Relay 24 volt sets	Price Bros. Type 02-P-24V.
10F/1777	D7	Dyn. Starting 12 V. Sets	Price Bros. Type 19A-12V DC.
10F/1806	D7	Dyn. Starting 24 V. Sets	Price Bros. Type 19A-24V DC.

TRANSFORMERS

10A/1794	T1	Microphone Input	Special to Dwg. AFD-365.
10A/1795	T2	Audio Tone Osc.	Special to Dwg. AFD-991.

DYNAMOTORS

10A/9461	MG1	High Voltage Power Supply, 12 Volt Sets	Eicor Frame 3420, Input 12 V at 13 A, Output 500 V at 200 Ma. to Dwg. AFD-2209.
10A/14207	MG1	High Voltage Power Supply, 24 Volt Sets	Eicor Frame 3420 , Input 24 V at 6.5 A, Output 500 C at 200 Ma. to Dwg. AFD-2210.

ACCESSORIES

Ref. No.	Sch. No.	Nomenclature	Description
10F/657		Telegraph Key	N.E.Co. Type F, Flameproof.
10F/2505	C2	Microphone	N.E.Co. to Dwg. AFD-179
10H/1423		Microphone Cord	N.E.Co. to Dwg. AFD-364
10A/1421		Headphones	N.E.Co. to Dwg. AFD-140
10D/1270		Junction Box	
10X/Freq.	AX	"A" Channel Crystal	Marconi Crystal in Type 5MB Holder, Frequency as specified in Table V to Specification W/16/40.
10X/Freq.	BX	"B"Channel Crystal	Marconi Crystal in Type 5MB Holder,Frequency as specified in Table V to Specification W/16/40.
10X/375-500		500 KC - 375 KC Crystal	Marconi Crystal in Type 5MB Holder to Specification W/16/40
10D/1268		Trans. Control Unit Consisting of:-	Pilot's Remote Control
10F/1767	(S1-TR	Power On-Off Switch	S.P.D.T. A.H.& H.type 2134-D
	)S2-TR	Channel Switch	S.P.D.T. A.H.& H.type 2134-D
	(S3-TR	HN/LN Switch	S.P.D.T. A.H.& H.type 2134-D
10D/1276	I/C Switching Unit Consisting of:		
10F/1736	(S1-1S	I/C Switching	Rotary Wafer Switch Oak Mfg. Co. to Dwg. AFD-1042.
	)S2-2S	I/C Switching	Part of S1-1S
	(S3-3S	I/C Switching	Part of S1-1S
10H/1517	JIT	Cable Connector Plug	Cannon Plug Receptacle 90° to Dwg. AFD-1024.

CABLES

5E/570	Transmitter to Junction Box	12 Conductor Cable
5E/568	Transmitter Remote Control to Junction Box	5 Conductor Cable
5E/567	Battery to Junction Box	4 Conductor Cable

Ref. No.	Sch. No.	Nomenclature	Description
5E/585		I/C Switching Unit to Junction Box	6 Conductor Cable
5E/505		Keys to Junction Box	2 Conductor Cable

NOTE: For other Cables running to Junction Box from the Radio Receiver and Accessories see Receiver Parts List,

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ACCESSORIES FOR LOW FREQUENCY 500 KC. and 375 KC.

10D/1286		Antenna Loading Coil Mfg. to Dwg.AFD-119. Consisting of	
10C/2000	C1A	Antenna Loading	.003 uf +- 5% Cornell Dubilier type 1 RSP
10A/2001	L1A	Loading Coil	Special Inductance to Dwg. AFD-221
10F/2002	S1A	Switch	Rotary Switch to Dwg. AFD-1021.

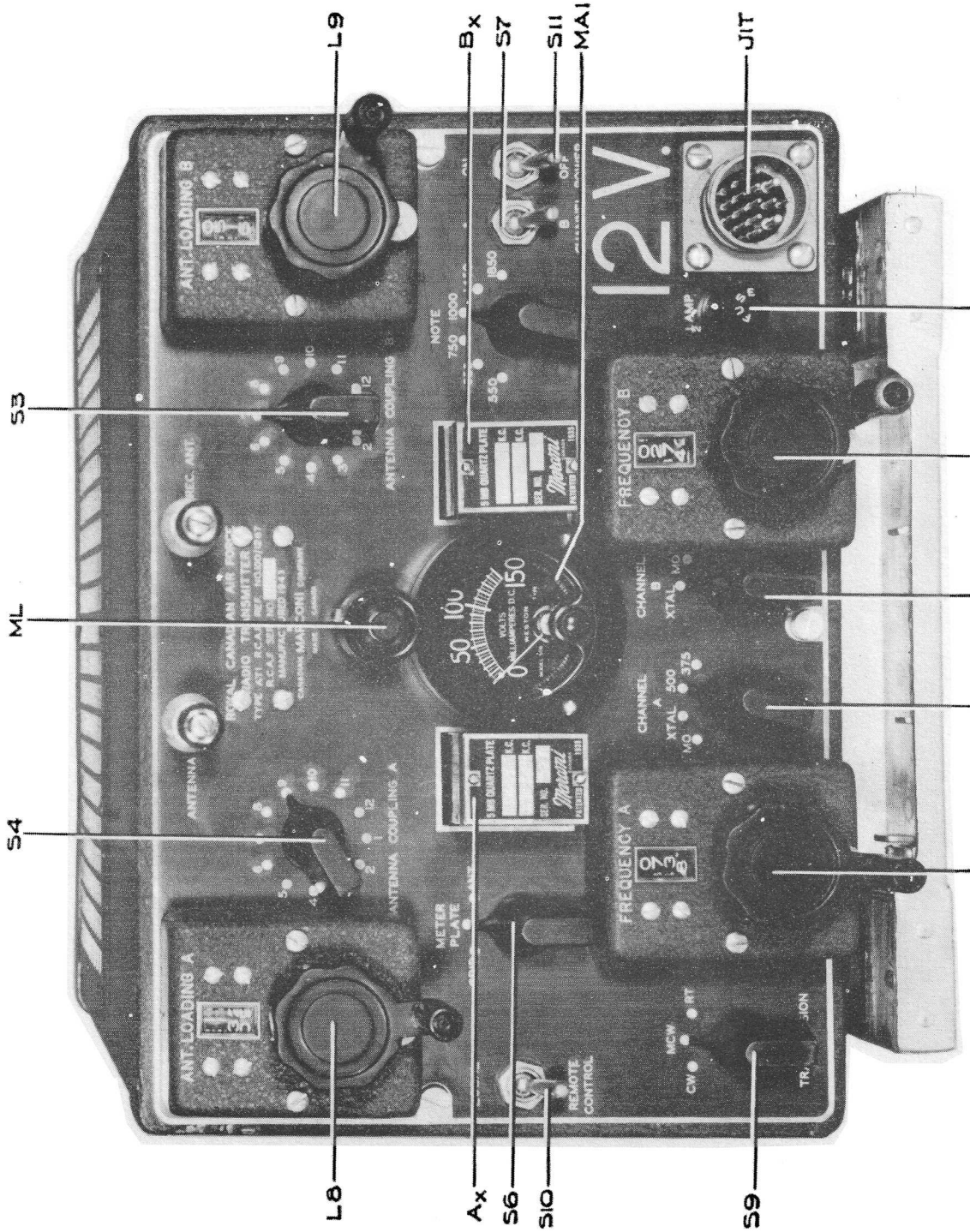


FIG.1 GENERAL PURPOSE TRANSMITTER FRONT VIEW

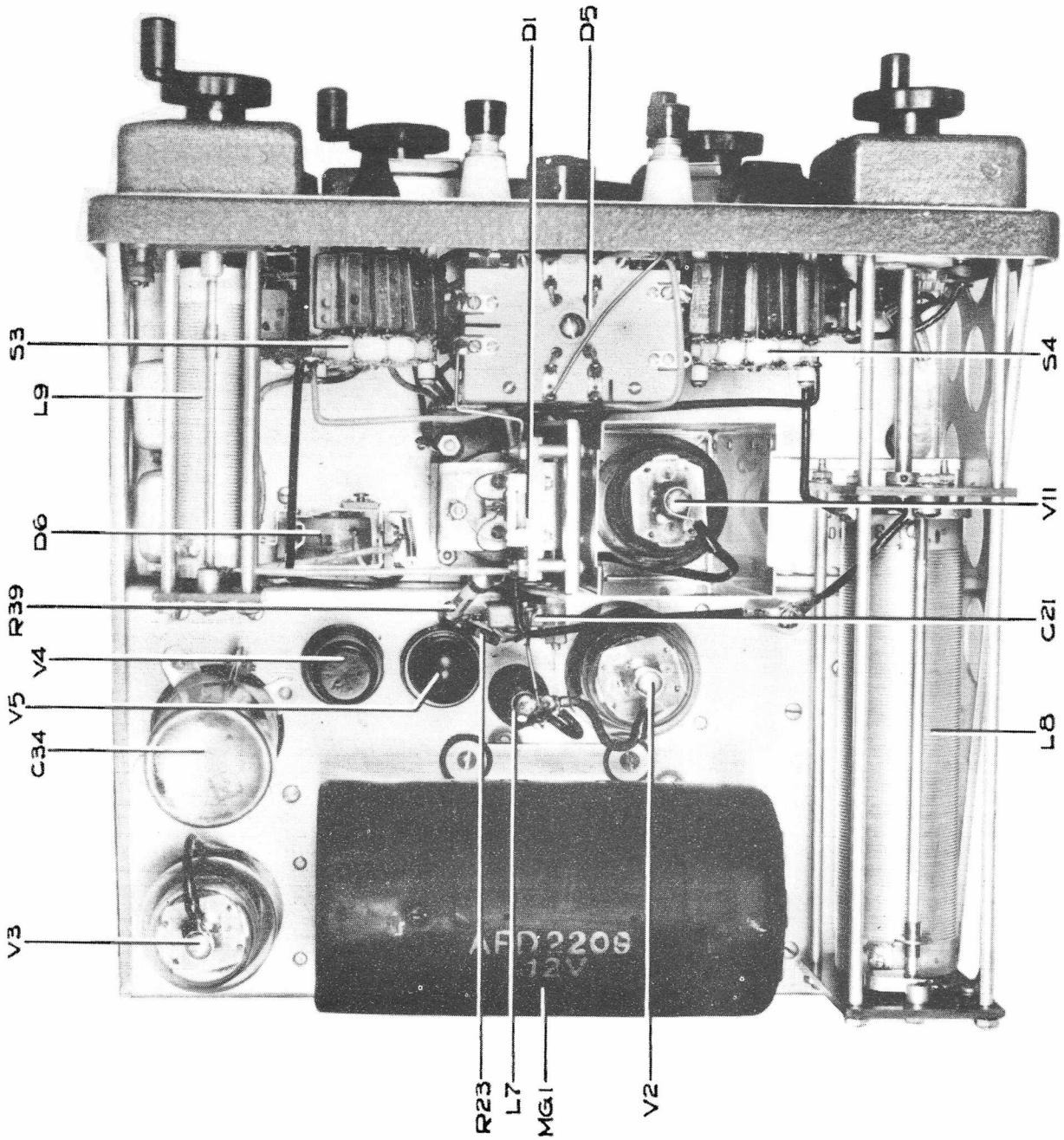


FIG. 2 GENERAL PURPOSE TRANSMITTER CHASSIS ASS'Y. TOP VIEW

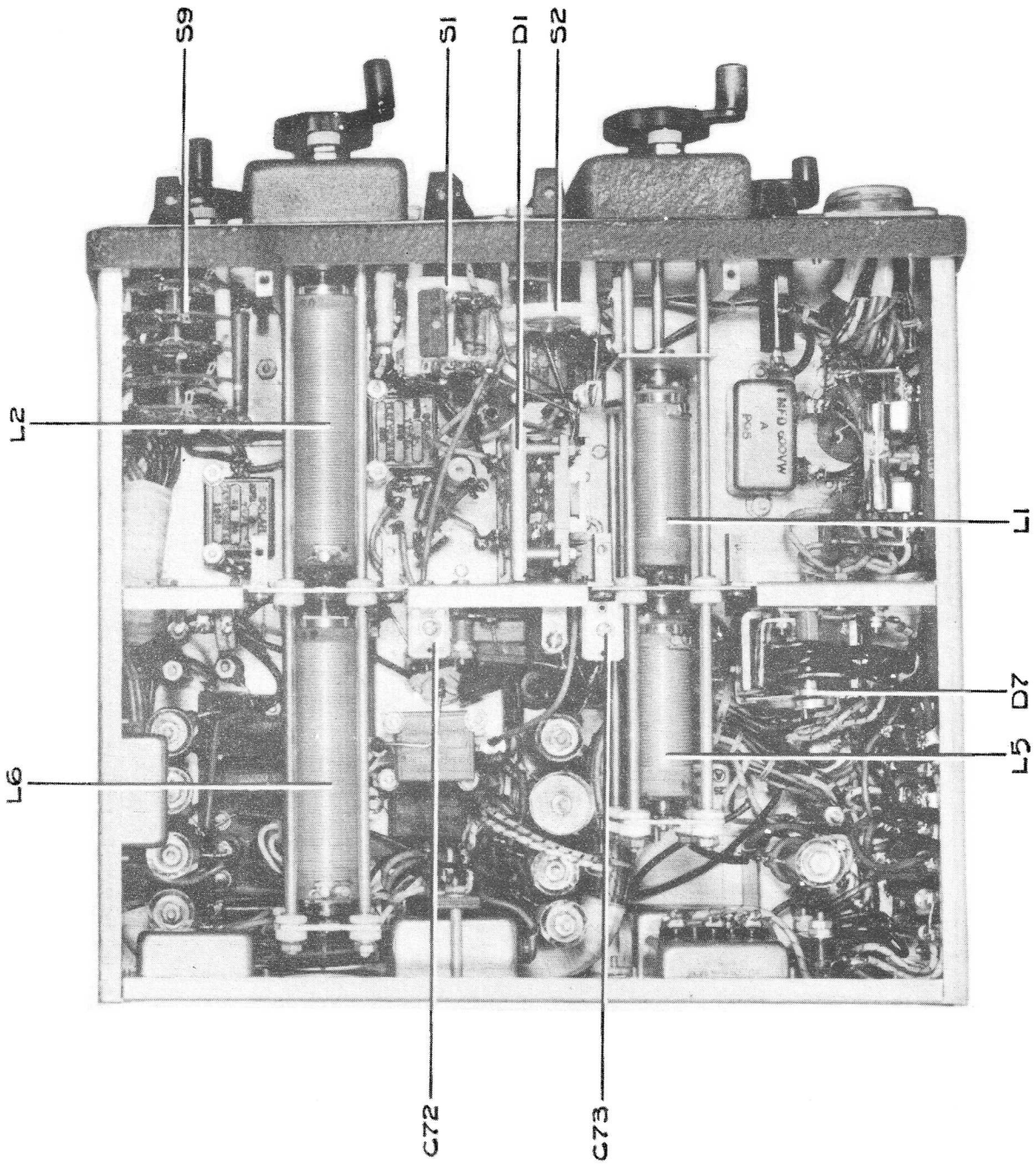
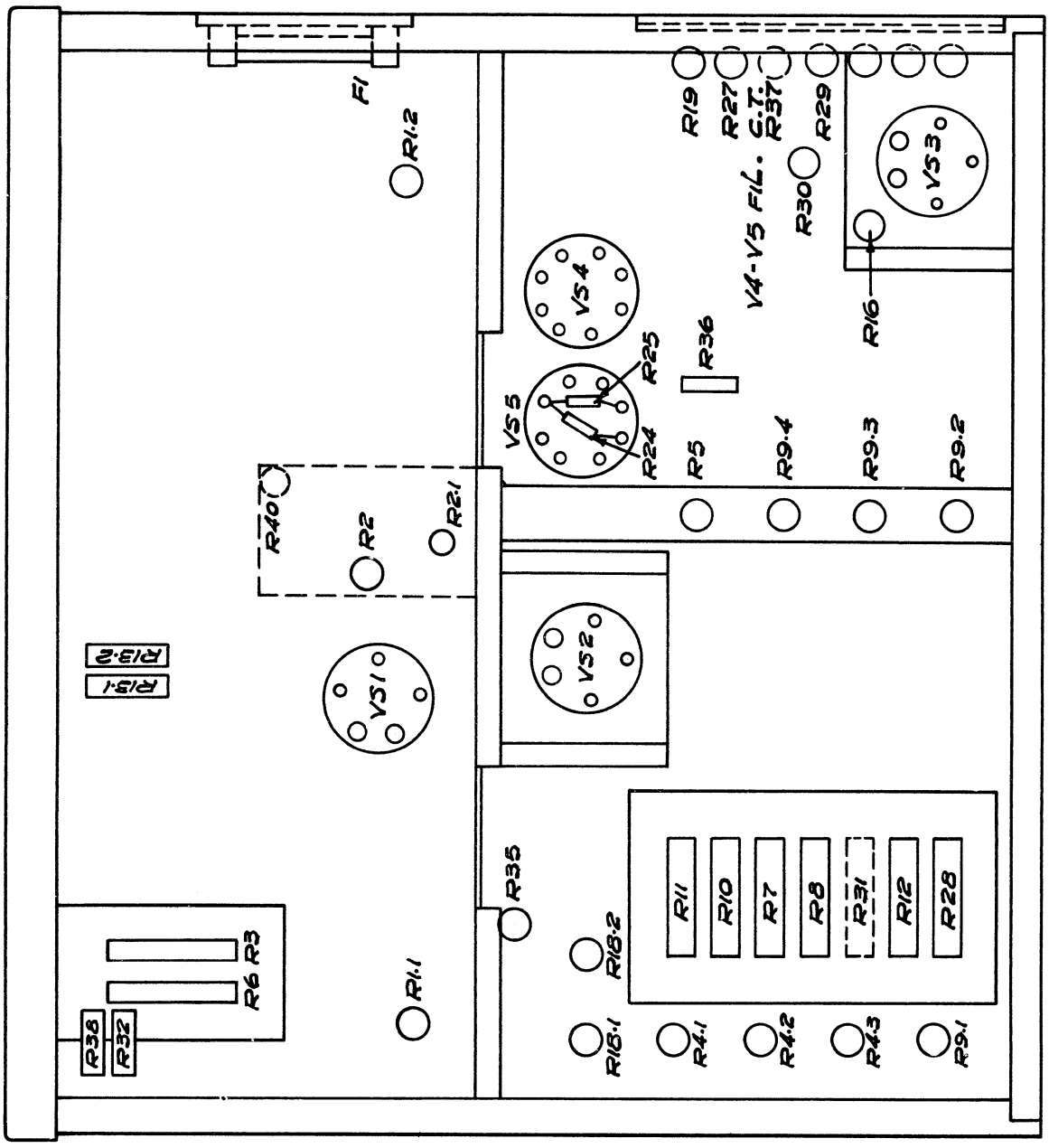


FIG. 3 GENERAL PURPOSE TRANSMITTER CHASSIS ASS'Y. BOTTOM VIEW



BOTTOM VIEW OF CHASSIS

FIG.4 LOCATION OF RESISTORS AND MAIN FUSE

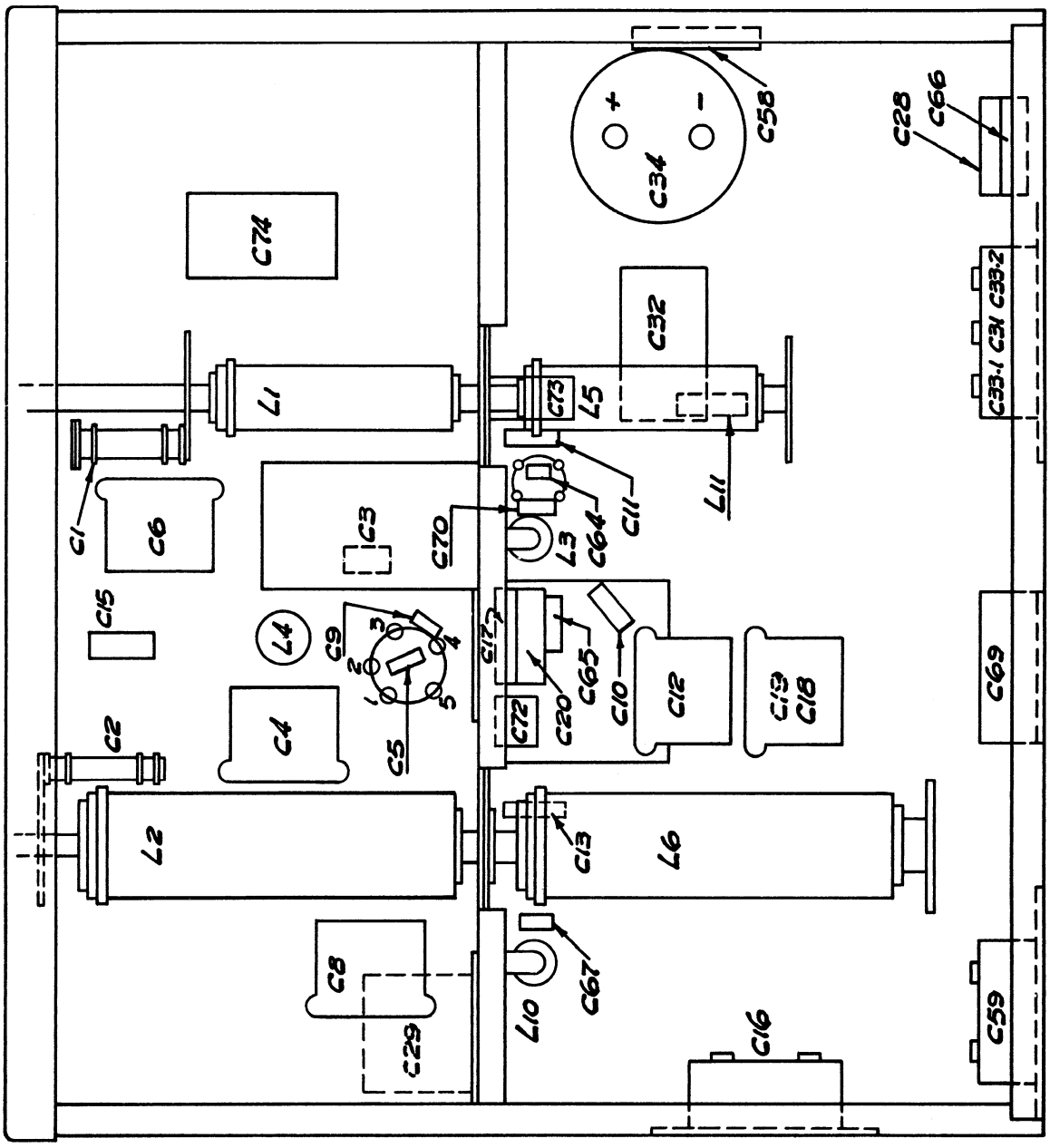


FIG.5 LOCATION OF COILS AND CONDENSERS

BOTTOM VIEW OF CHASSIS

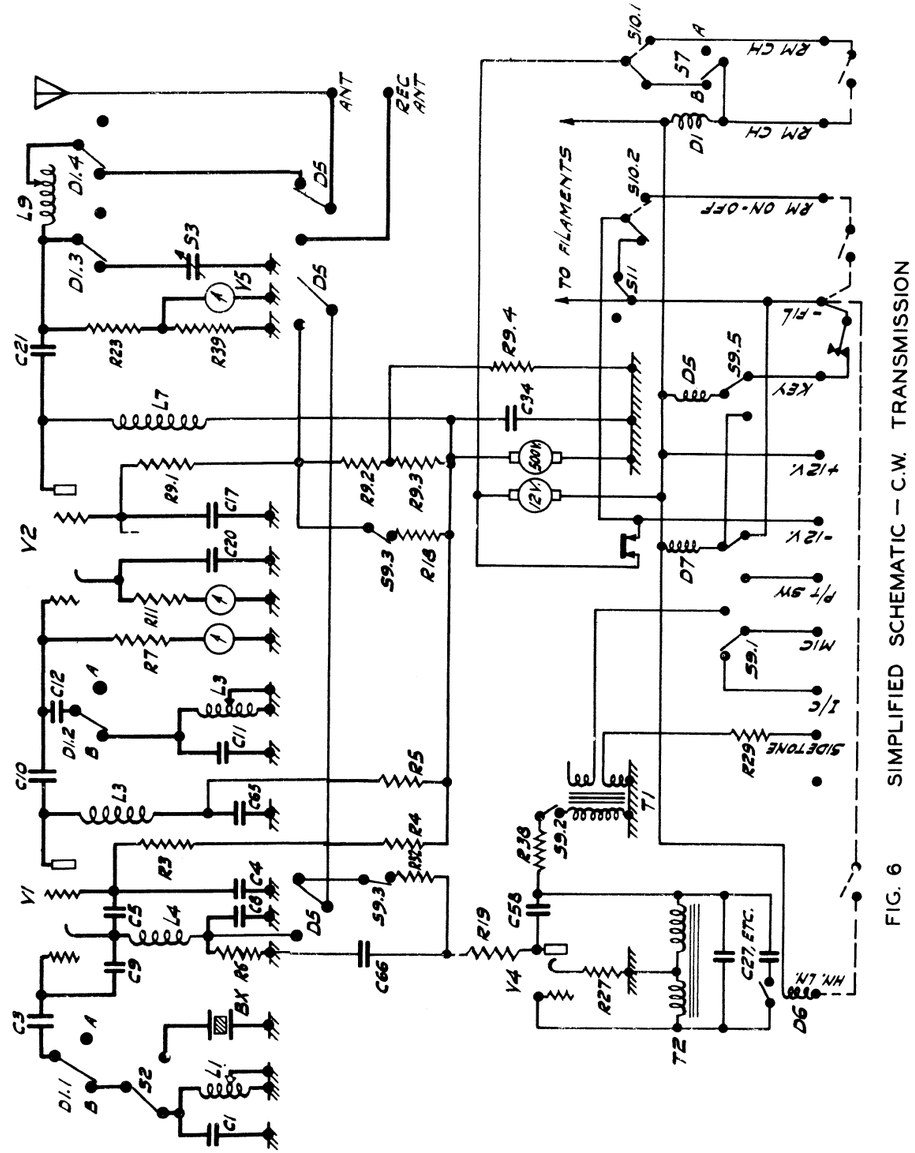
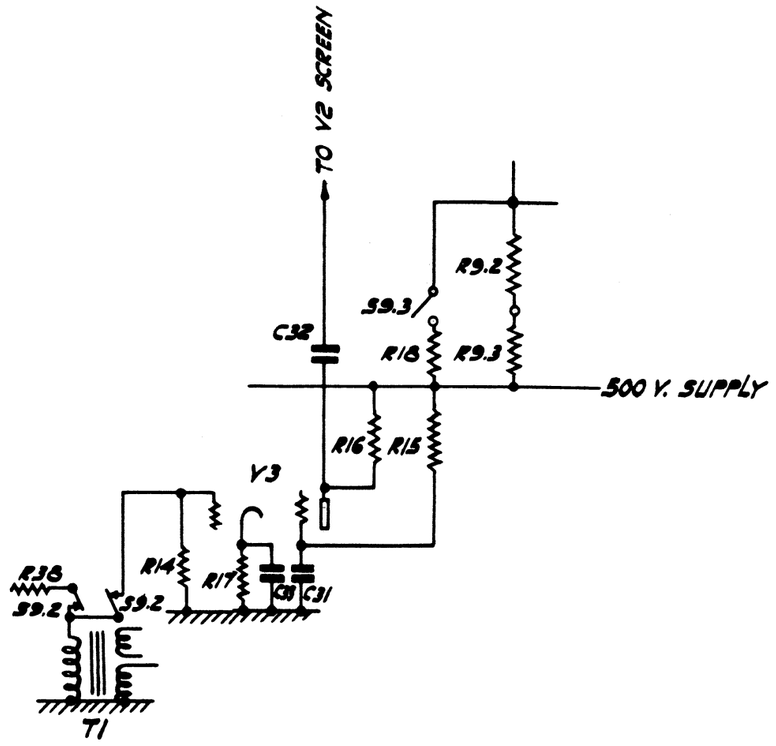


FIG. 6 SIMPLIFIED SCHEMATIC — C.W. TRANSMISSION



OTHERWISE SAME AS FIG. 6

FIG. 7 SIMPLIFIED SCHEMATIC - M.C.W. TRANSMISSION

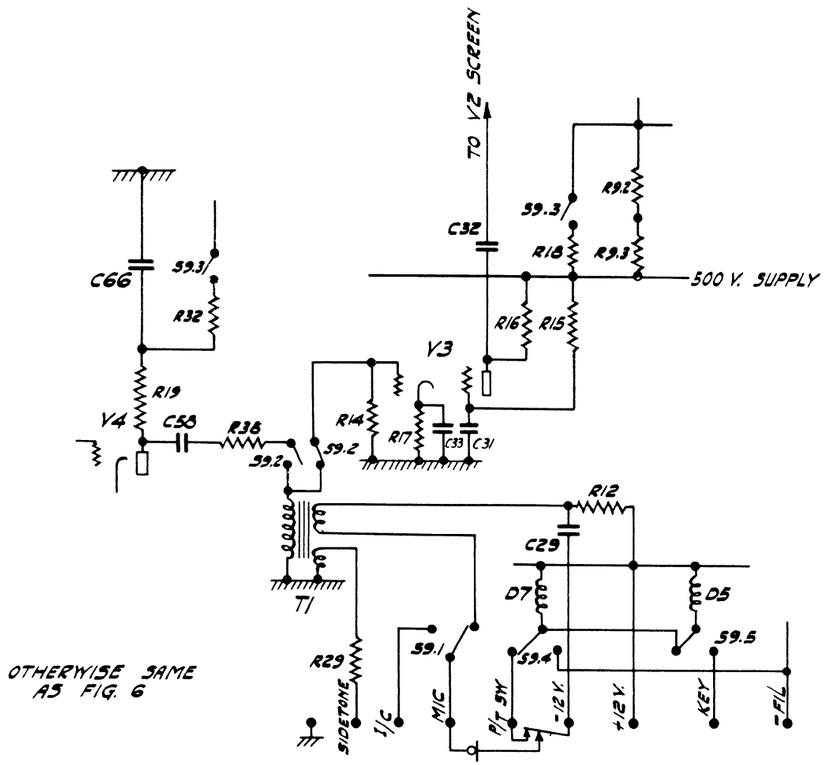
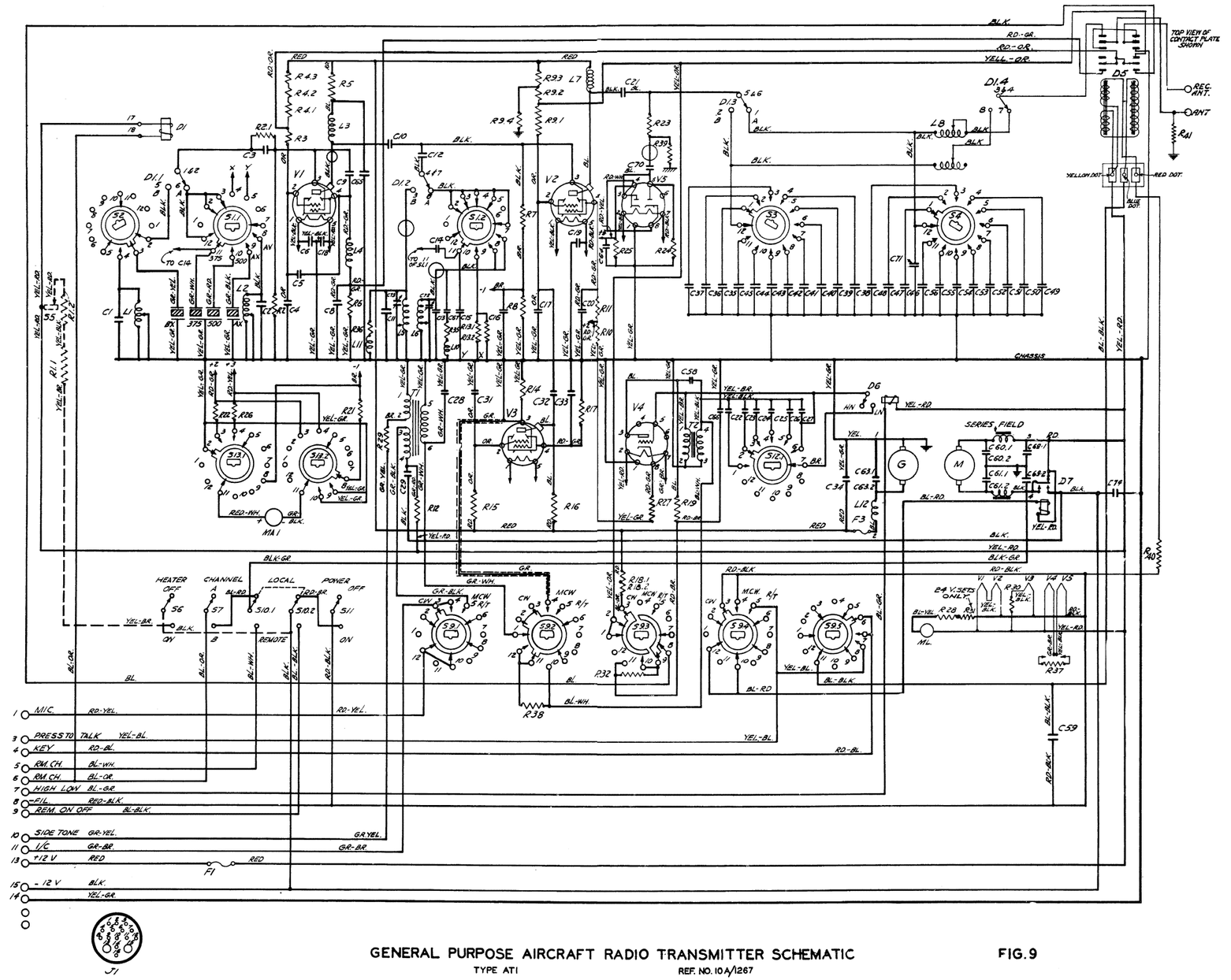


FIG. 8 SIMPLIFIED SCHEMATIC — R/T TRANSMISSION

NOTES

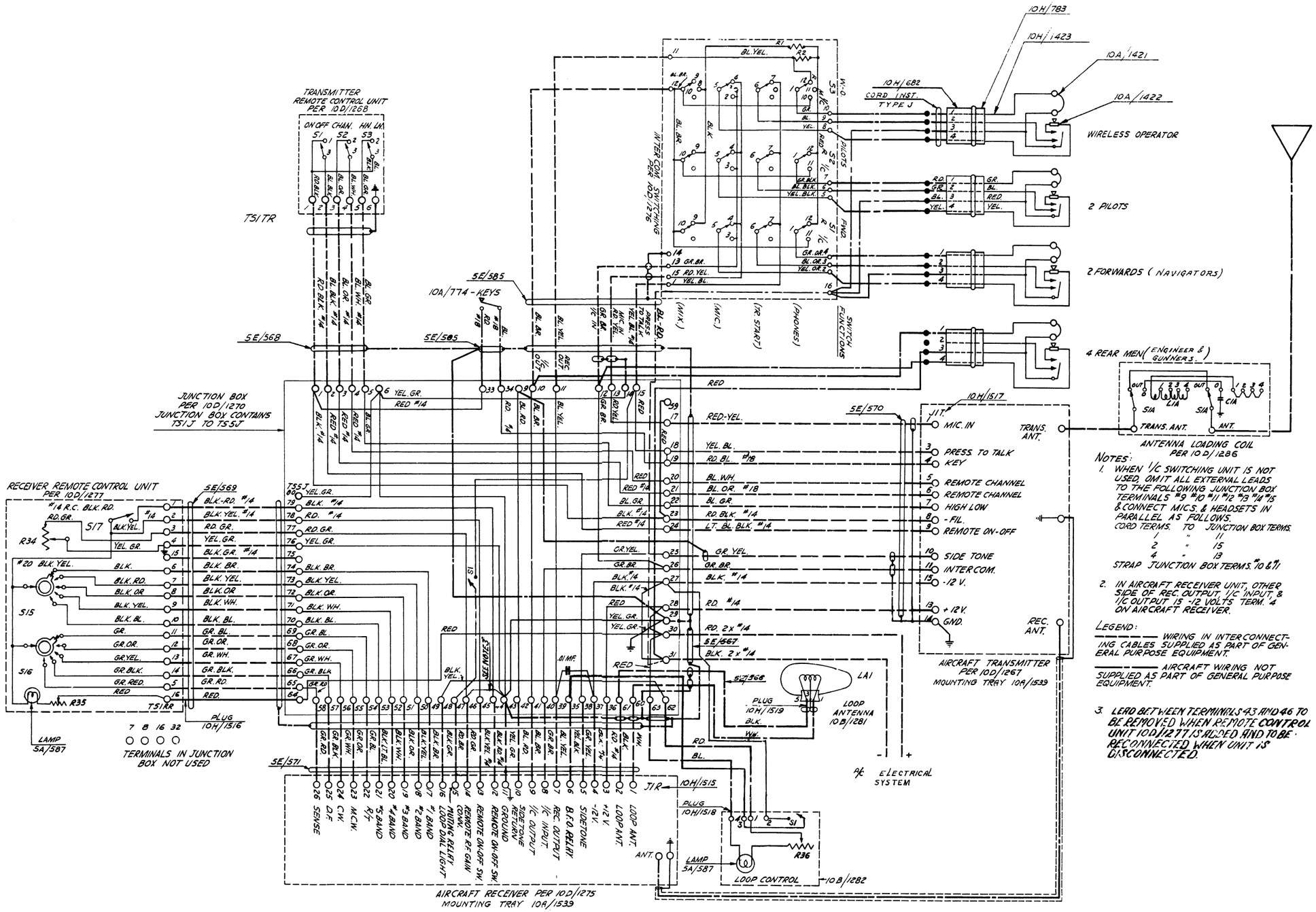
1. FRONT PANEL ENGRAVING FOR SWITCHES S3, S4 IS ROTATED AHEAD ONE NOTCH.
   FRONT PANEL Nº 1 IS SWITCH POSITION 12 SHOWN.
   " " Nº 2 " " " 1 " .
   ETC.

2 COMPONENTS SHOWN DOTTED (S5, R11, R12, S6) HAVE BEEN REMOVED FROM LATER PRODUCTION LOTS.



GENERAL PURPOSE AIRCRAFT RADIO TRANSMITTER SCHEMATIC
TYPE AT1 REF. NO. 10A/1267

FIG. 9



NOTES:

1. WHEN 1/C SWITCHING UNIT IS NOT USED, OMIT ALL EXTERNAL LEADS TO THE FOLLOWING JUNCTION BOX TERMINALS #9 #10 #11 #12 #13 #14 #15 & CONNECT MICS. & HEADSETS IN PARALLEL AS FOLLOWS.

CORD TERMS.	TO	JUNCTION BOX TERMS.
1	"	11
2	"	15
4	"	13

STRAP JUNCTION BOX TERMS. #10 & #11

2. IN AIRCRAFT RECEIVER UNIT, OTHER SIDE OF REC. OUTPUT 1/C INPUT, & 1/C OUTPUT 15 -12 VOLTS TERM. 4 ON AIRCRAFT RECEIVER.

LEGEND:

——— WIRING IN INTERCONNECTING CABLES SUPPLIED AS PART OF GENERAL PURPOSE EQUIPMENT.

- - - - - AIRCRAFT WIRING NOT SUPPLIED AS PART OF GENERAL PURPOSE EQUIPMENT.

3. LEAD BETWEEN TERMINALS 43 AND 46 TO BE REMOVED WHEN REMOTE CONTROL UNIT 10D/1277 IS ADDED AND TO BE RECONNECTED WHEN UNIT IS DISCONNECTED.

GENERAL PURPOSE EQUIPMENT INTER-UNIT WIRING & INTERCOMMUNICATION CIRCUITS SCHEMATIC

FIG.10

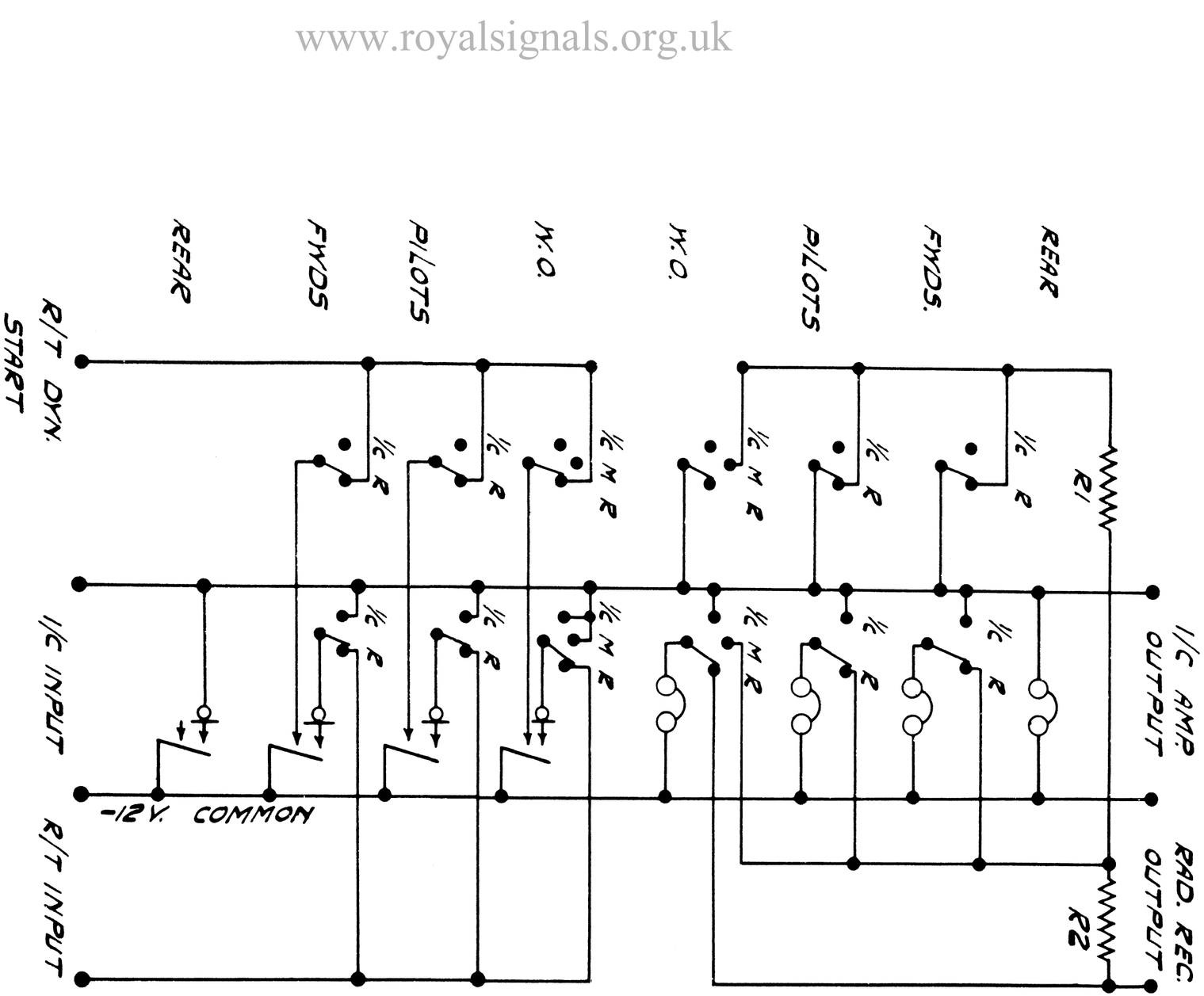
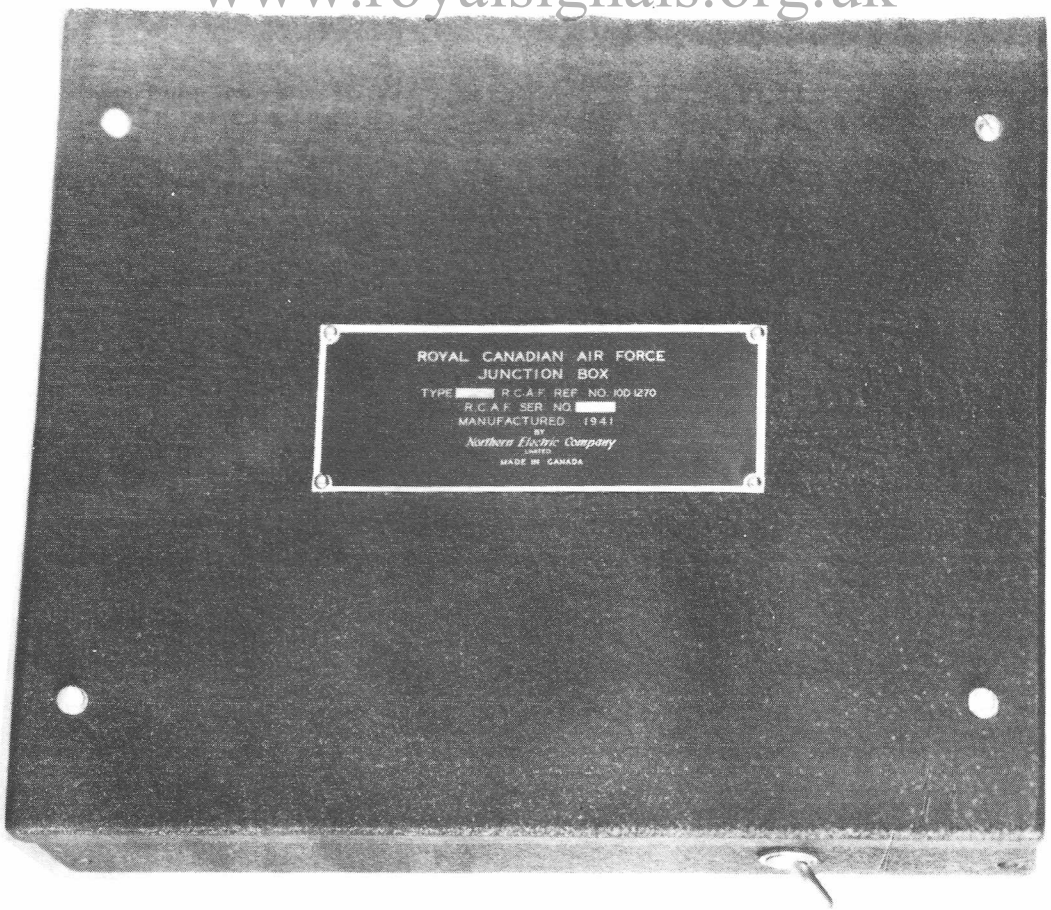


FIG 11 SIMPLIFIED SCHEMATIC — I/C SYSTEM



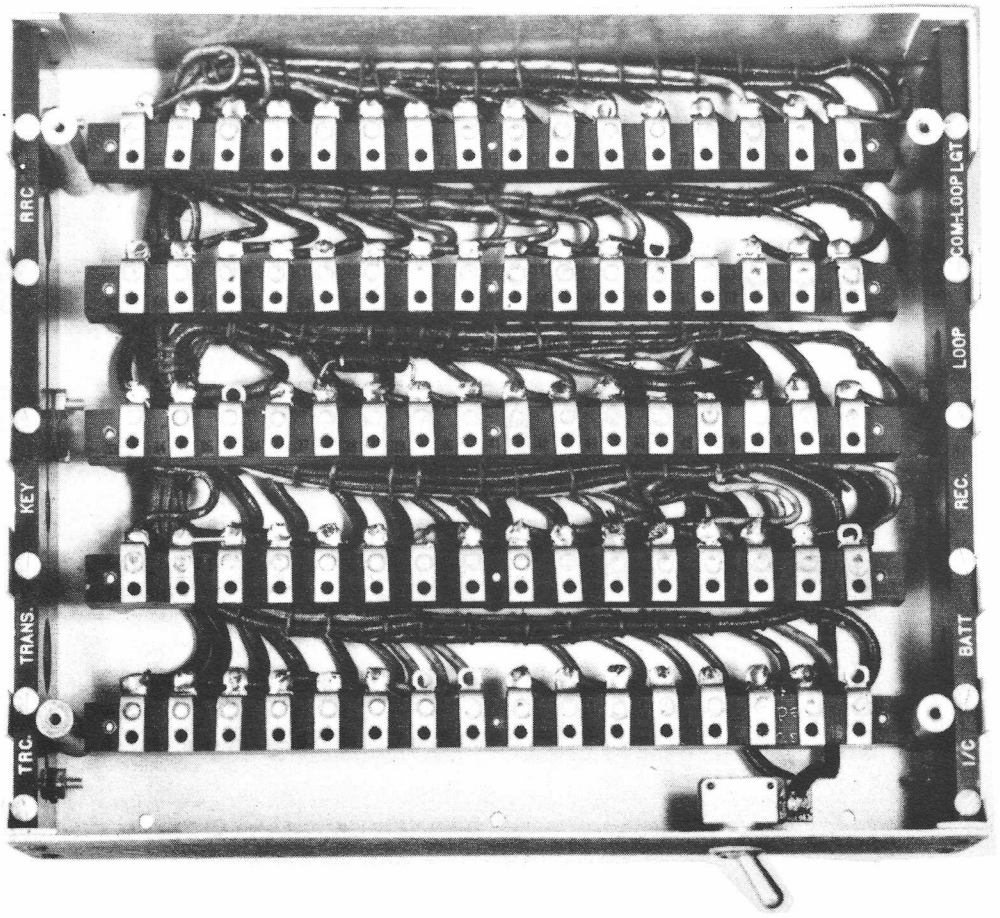


FIG. 12 JUNCTION BOX REF. NO. 10D/1270

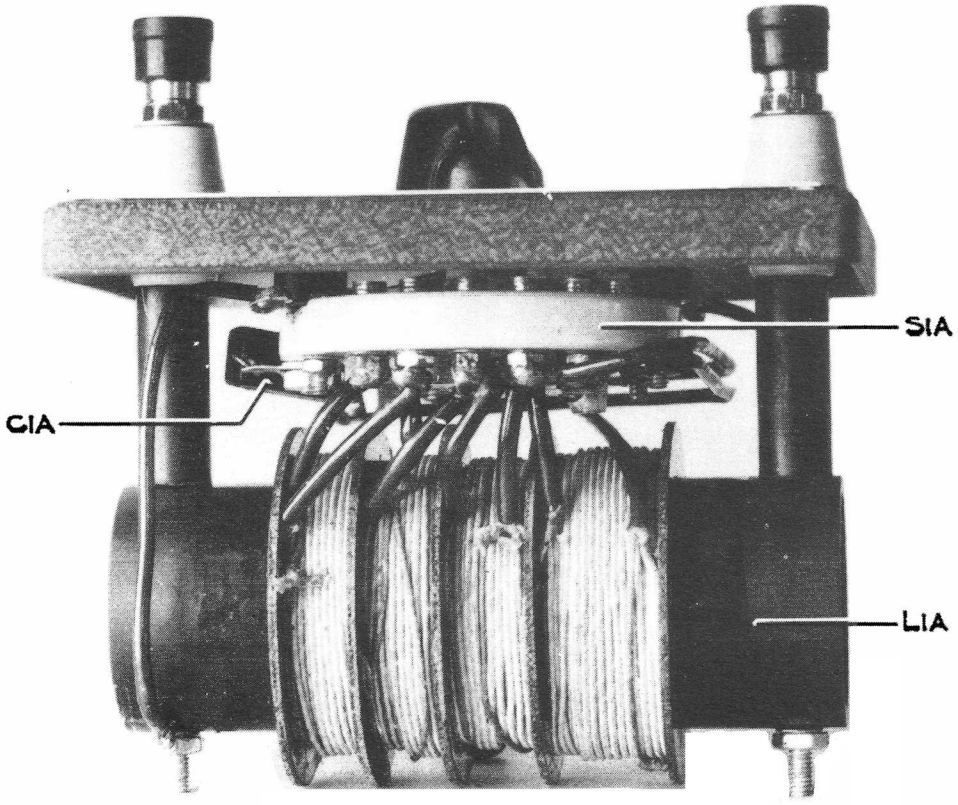


FIG. 13 ANTENNA LOADING COIL REF. NO. 10A/1286

FIG. 14 TRANSMITTER REMOTE CONTROL UNIT REF. NO. 10D/1268

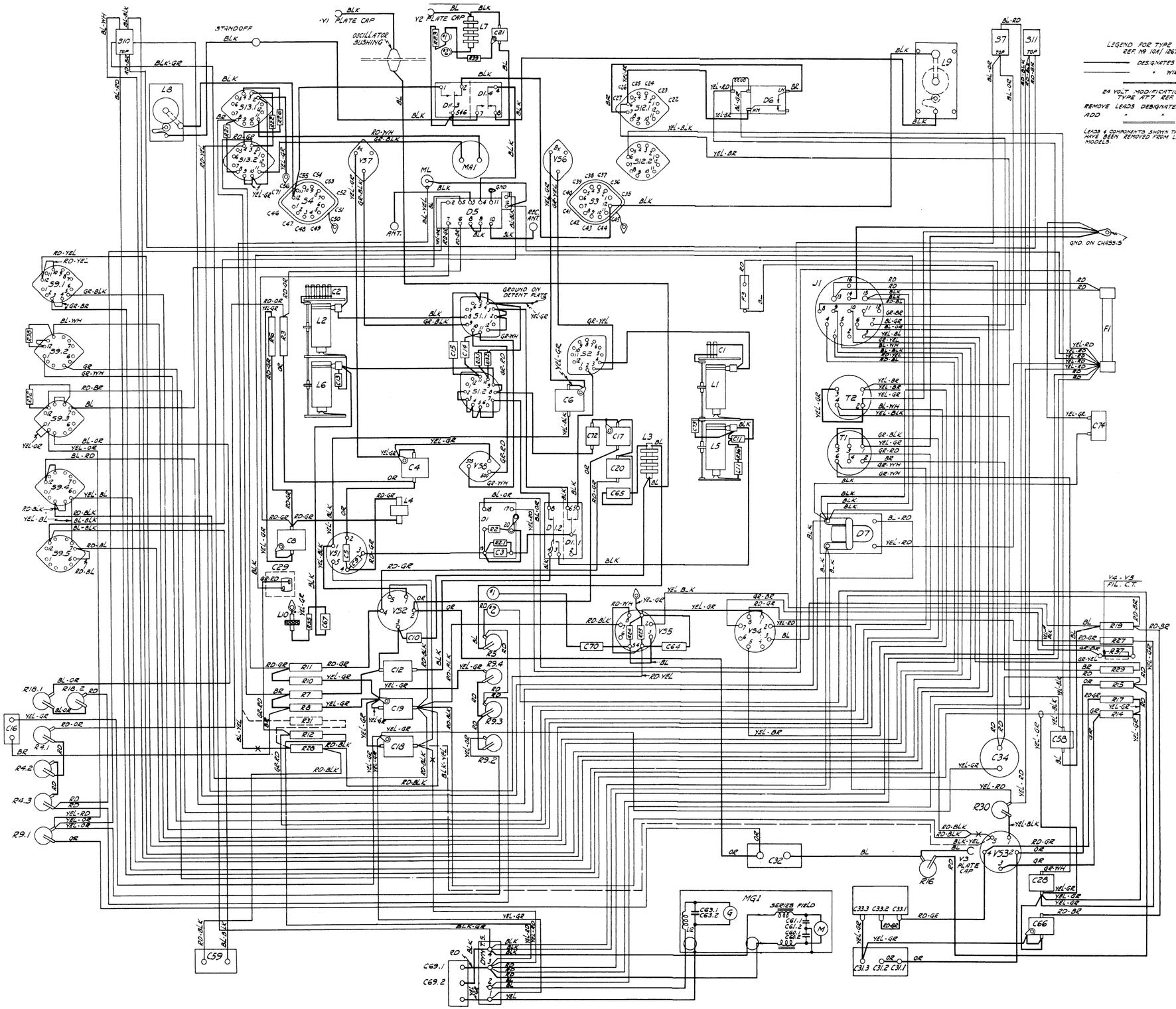
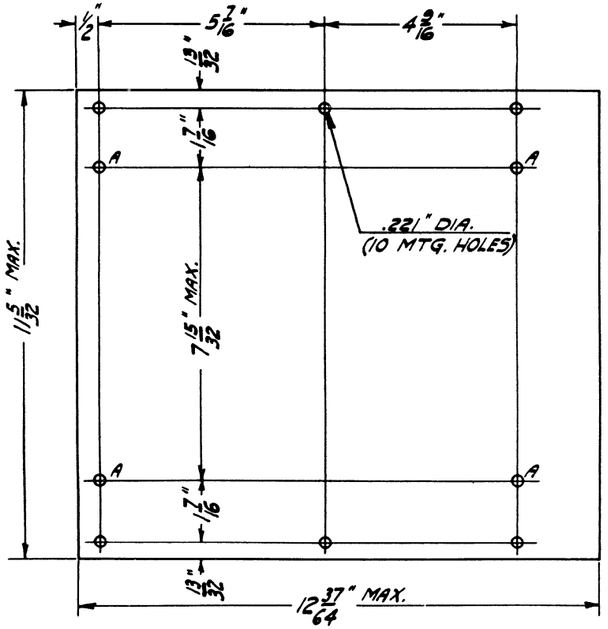
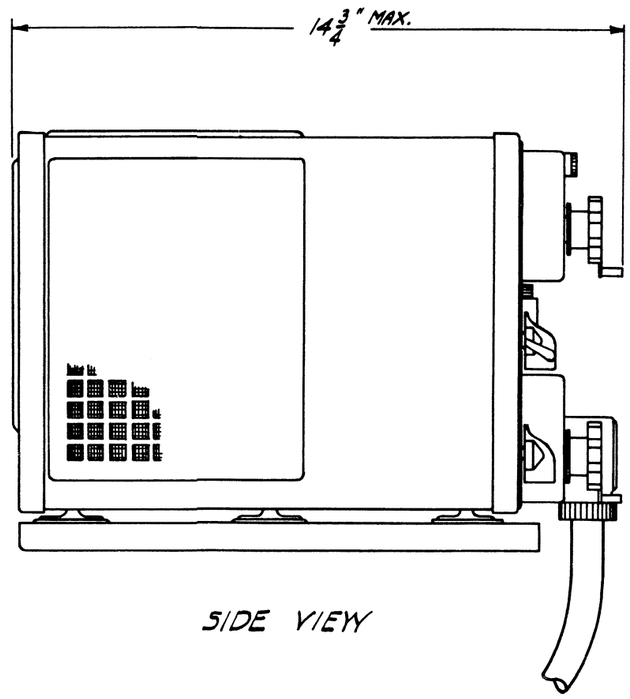


FIG. 15 TRANSMITTER WIRING DIAGRAM



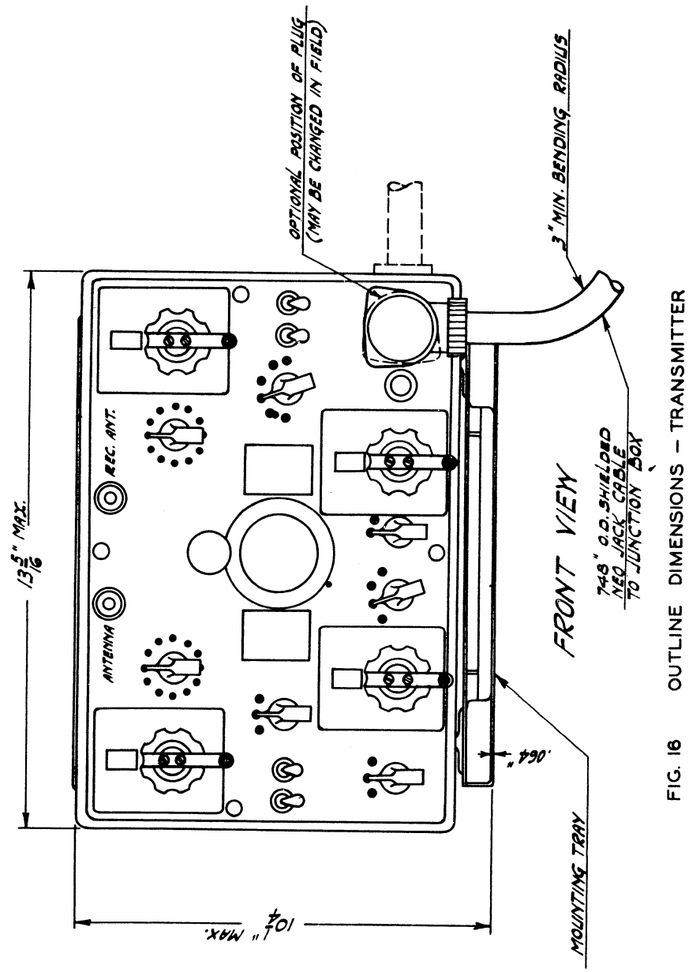
BOTTOM VIEW OF MTG. TRAY
(SHOWING 10 MOUNTING HOLES)
(SEE NOTES 2 & 3)



SIDE VIEW

NOTE

1. THIS UNIT BEING MOUNTED ON RUBBER CUSHIONS, SPACE IS TO BE ALLOWED FOR SWAY.
2. 1/4" MAX. CLEARANCE IS AVAILABLE FOR THICKNESS OF MOUNTING SCREW HEADS.
3. IN MOUNTING, DISREGARD HOLES MARKED "A" IF NECESSARY.



FRONT VIEW

FIG. 16 OUTLINE DIMENSIONS – TRANSMITTER

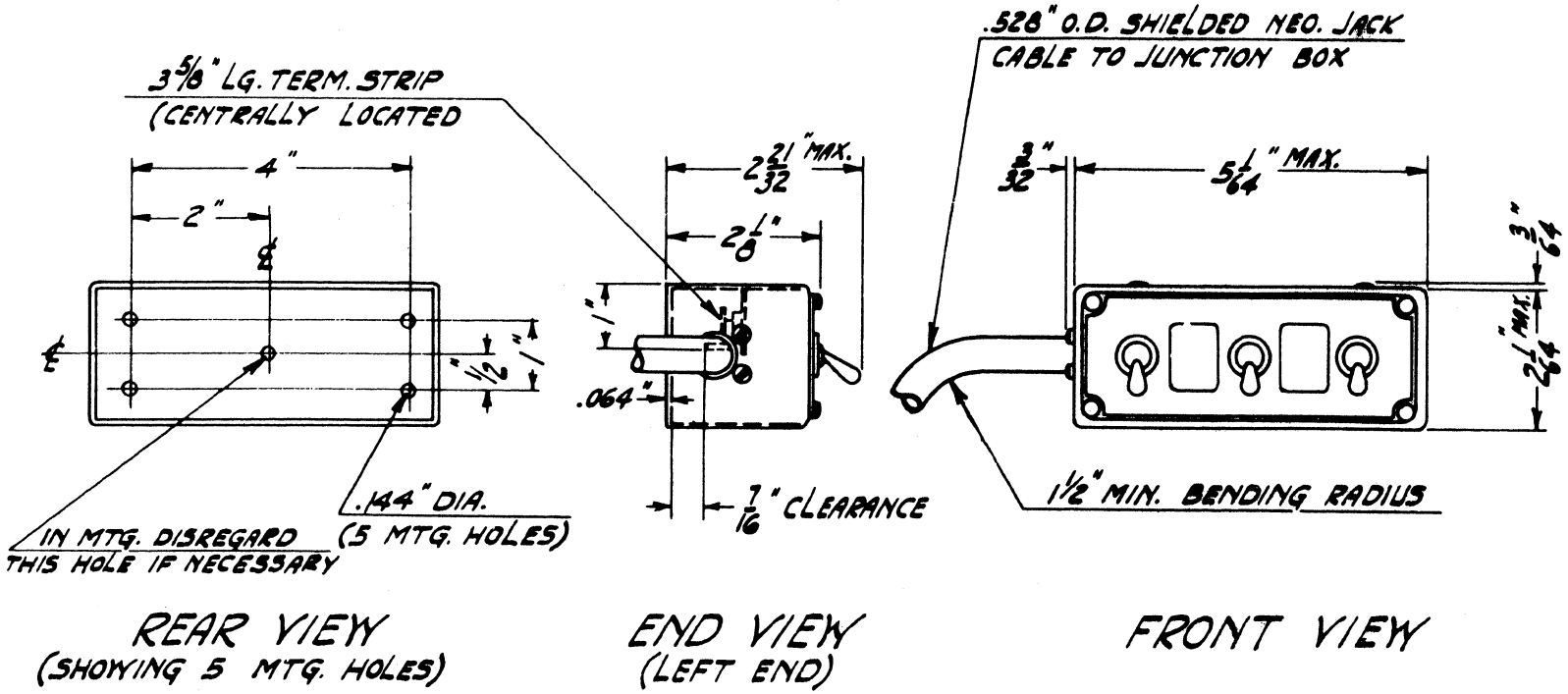
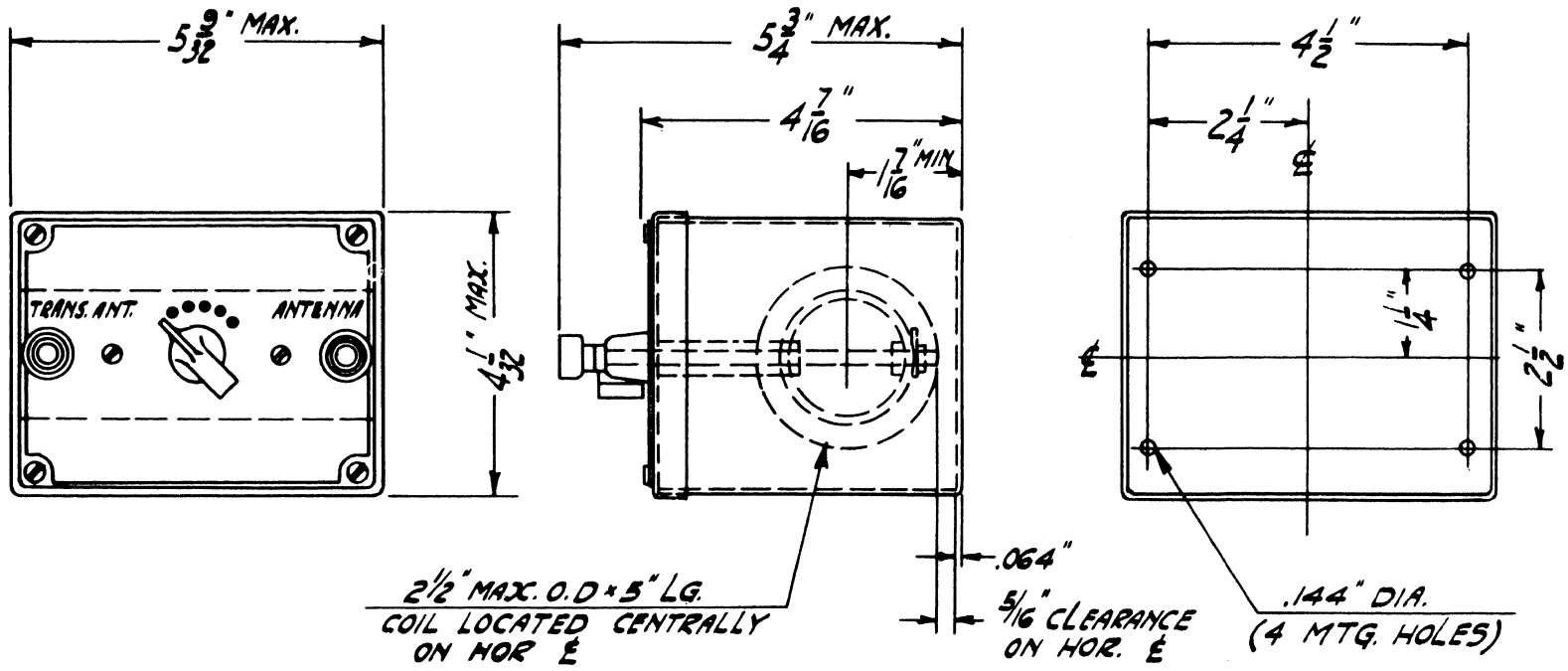


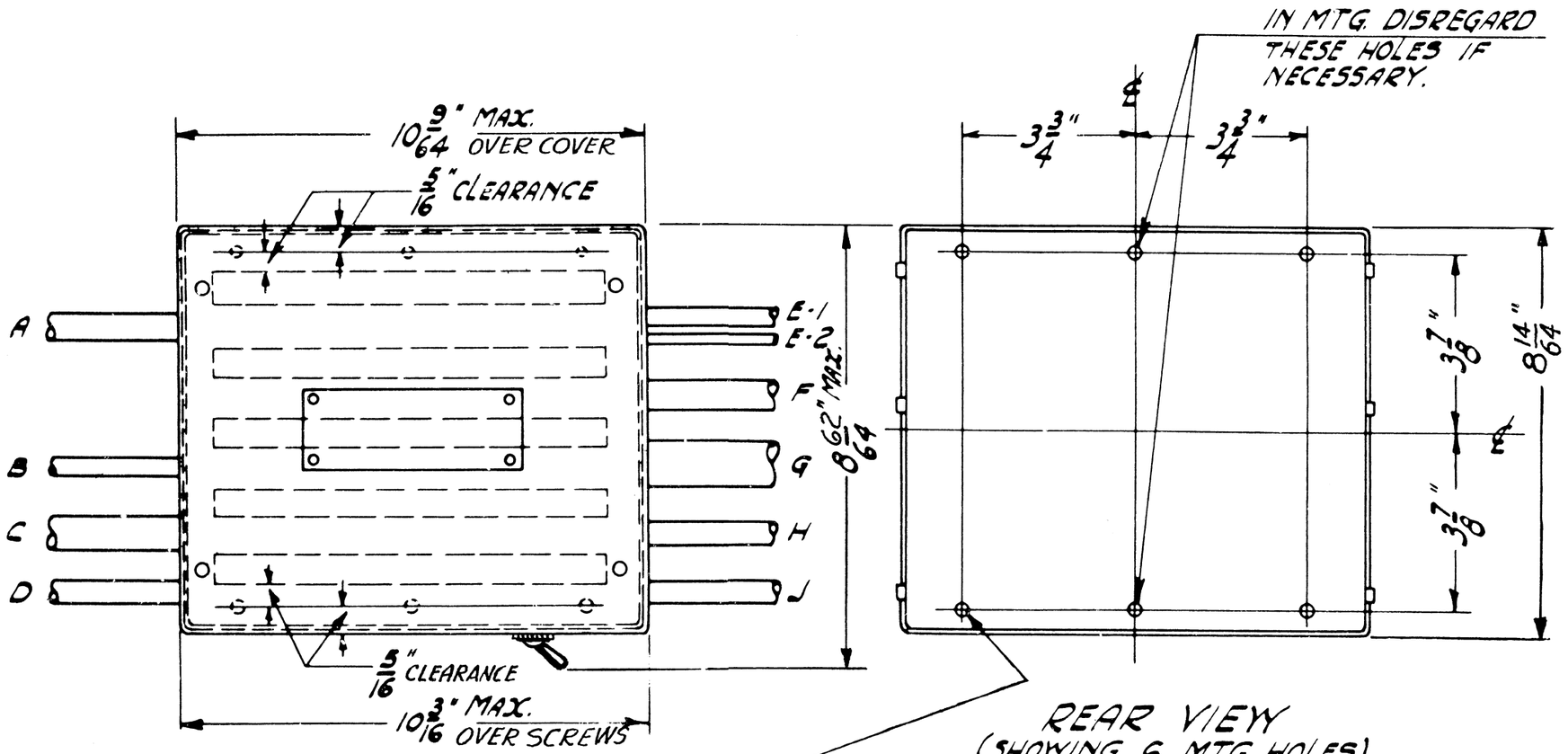
FIG. 17 OUTLINE DIMENSIONS TRANSMITTER CONTROL UNIT



NOTE:

1 - THE WEIGHT OF THIS UNIT, COMPLETE, IS 2 LBS. 1 OUNCE.

FIG. 18 OUTLINE DIMENSIONS — ANTENNA LOADING COIL



CABLE DESIG.	DESTINATION	SIZE O. D.	MIN. BENDING RADIUS
A	REC. REMOTE CONT.	.717"	6"
B	KEYS	A/C WIRING	
C	TRANSMITTER	.748"	3"
D	TRANS. REMOTE CONT.	.528"	1½"
E-1	LOOP R.C. (LIGHT)	A/C WIRING	
E-2	CREW'S HEADSETS		
F	LOOP ANTENNA	.672"	4"
G	RECEIVER	1.010"	6"
H	BATT	.486"	1½"
J	½ UNIT	.553"	1½"

FIG. 19 OUTLINE DIMENSIONS – JUNCTION BOX

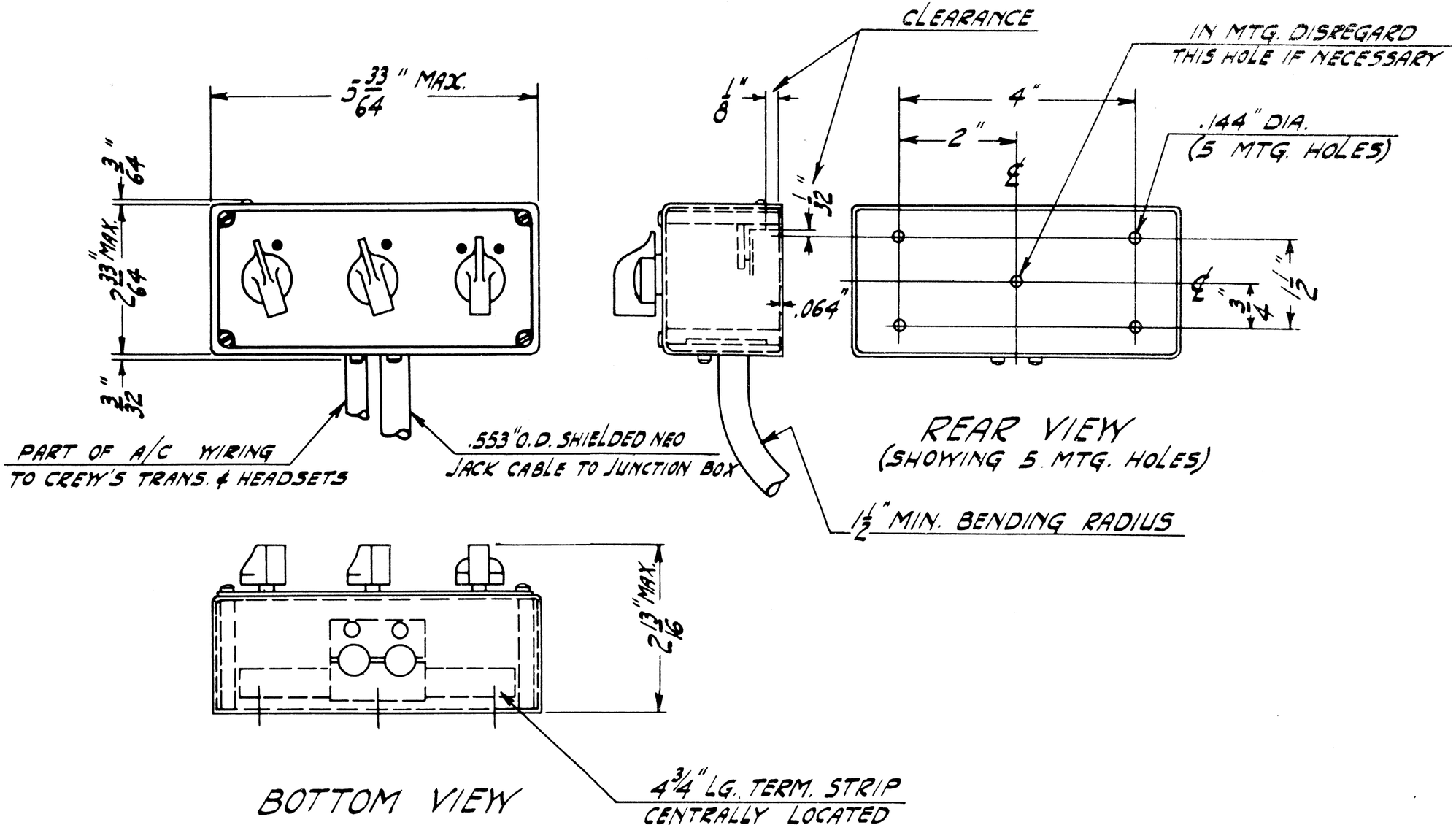


FIG. 20 OUTLINE DIMENSIONS — I/C SWITCHING UNIT

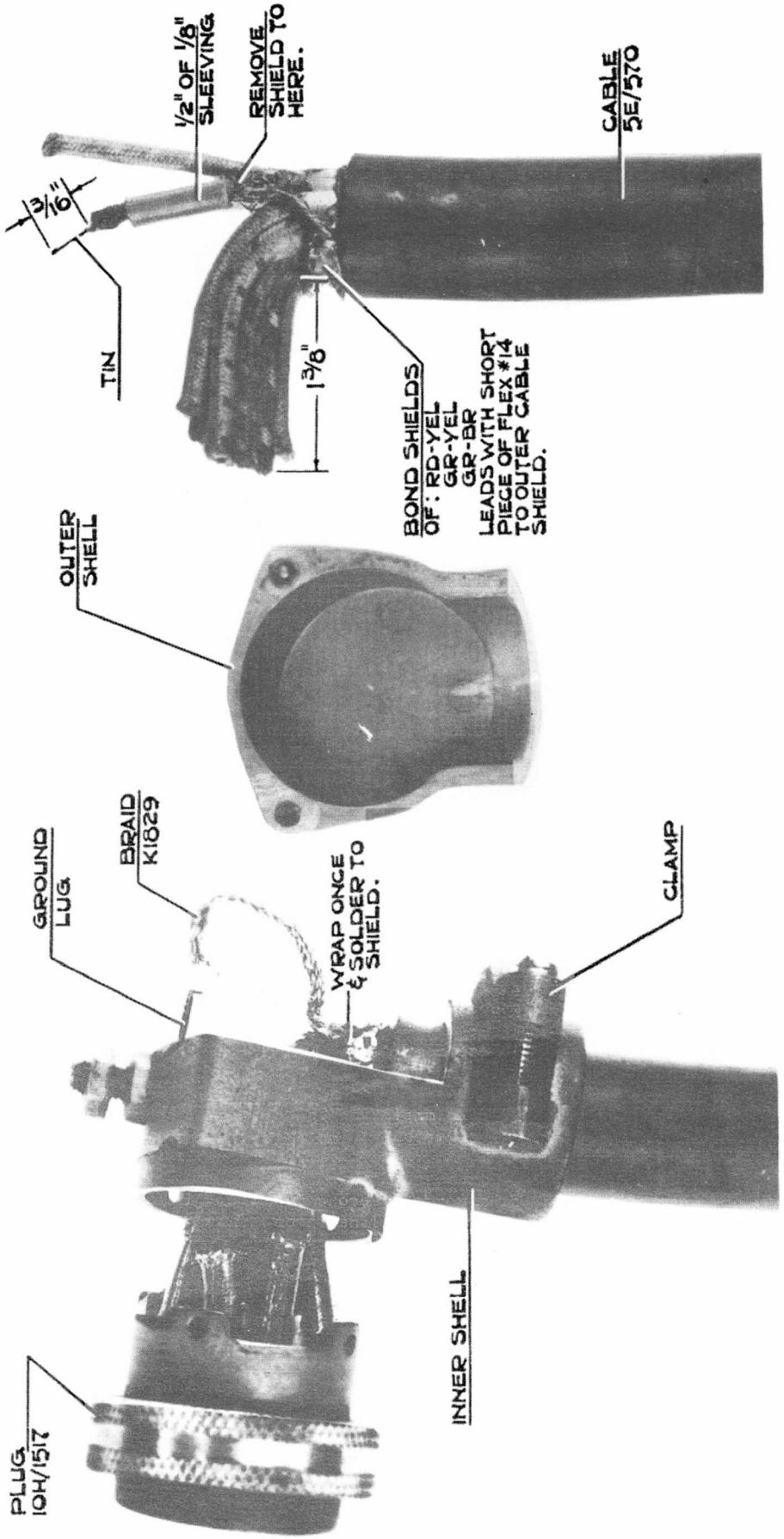
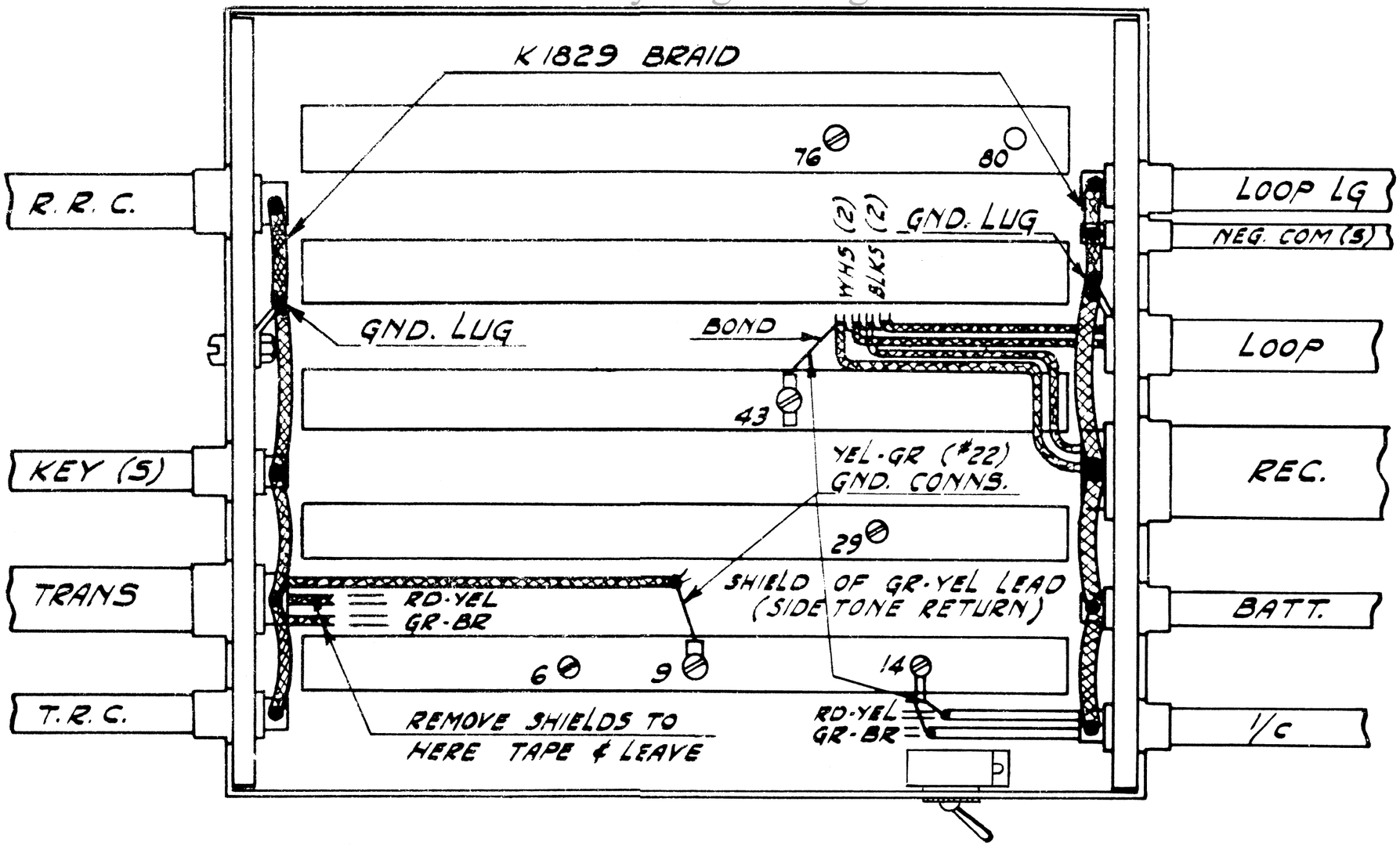


FIG. 21 PLUG AND CABLE CONNECTIONS



NOTES - 1. SOLDERED JOINTS TO SHIELDS SHOWN THUS

2. TAPE JOINTS OF INDIVIDUAL CONDUCTOR SHIELDS & INDIVIDUAL SHIELDS AS REQUIRED TO INSULATE FROM OTHER TERMINALS.

FIG. 22 CABLE SHIELD GROUNDS JUNCTION BOX