TRANSMITTER - RECEIVER.

TYPE ATR-5.

STORES REFERENCE NO. 10-D - 1546.

INDEX OF ILLUSTRATIONS.

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TRANSMITTER-RECEIVER

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1.0 GENERAL.

1.1 Use.

The Type ATR-5 is a two channel transmitter and receiver complete with integral power supply and is intended for use on "Fighter" Aircraft.

1.2 Frequency Range.

The unit is designed for operation in the frequency range of 3.0 to 6.3 mc. Each channel is adjustable over this range independent of the other, thus permitting two pre-set frequencies to be set up for both the transmitter and the receiver.

The frequency bands are designated "Yellow" and "Green".

1.3 Facilities.

The unit is provided for radio-telephone communication only. Side-tone on transmission and intercommunication overriding a received signal are also available.

1.4 Transmitter.

The transmitter is crystal controlled, and is designed to deliver its power to an antenna of the dimensions usually associated with "Fighter" Aircraft. The speech circuits are designed to permit of full modulation of the carrier from a type C-1 Reference No. 10A-1422 microphone.

1.5 Receiver.

The receiver is a high sensitivity superheterodyne, all circuits of which are pretuned to the desired frequencies. The heterodyne oscillator can be varied in frequency above or below the pre-set frequency by an amount sufficient to ensure continuous reception under all conditions.

1.6 Remote Control.

Remote Control of all essential functions is provided by a Remote Control Unit, Ref. No. 10D/1547, which may be mounted at any point up to 15 or 20 feet from the ATR-5.

2.0 DESCRIPTION.

2.1 Weight and Dimensions.

A chassis type of construction is employed, the receiver occupying the left section and the transmitter the centre and right sections.

The weights and dimensions of the unit and accessories are as indicated in Table I.

TABLE I.

STORES REF.NO.	UNIT	WEIGHT	MAXIMUM DIMENSIONS
10D/1546	Type ATR-5 Transmitter and Receiver with shock mounting.	43 lbs.12 oz.	20x11-5/16x11-3/8 High.
10D/1547	Remote Control.	1 lb. 1 oz.	4 x 6 x 2-9/32 High.
10D/1501	Transit Case	28 lbs.4 oz.	26¾x12-1/8x15¾ High.
5A/	Battery Cable.	4 oz/ft.	
5A/	Remote Control Cable.	3 oz/ft.	
5A/	Microphone and receiver cable.	1.5 oz/ft.	
10H/1977	Battery cable plug connector.	1.5 oz.	
10H/1979	Remote control plug connector.	2.5 oz.	
10H/1978	Microphone and receiver cable plug connector.	2.0 oz.	

2.2 Shock Mounting.

The mounting tray into which the unit slides is equipped with four Lord shock mountings. Each shock mounting is fitted with washers to limit the travel and safe-guard the unit in event of failure of the rubber mounting. Quick release catches are employed which permit the easy removal of the unit from the tray. To release them, the catches are withdrawn toward the centre of the unit.

Fig.IV is a photograph showing the arrangement of the Shock Mounting tray.

2.3 Functional Controls.

All controls which are frequently used are conveniently grouped along the top of the front panel and towards the left. Figure I being a photograph of the unit, indicates the positions of these controls.

(a) The power control switch marked "Start-Stop" is located in the upper left hand corner.

(b) The "Trans-Rec-I.C." switch to the right of the Start-Stop switch controls the condition of the unit. The normal (centre) position of the switch places the Unit in the "Receive" condition. To transmit, the switch is turned to "Trans." and to communicate with a possible second operator it is turned to "I.C."

(c) The "Volume" control, next to the right, controls the output of the receiver to the headphones. This control also governs the volume of side tone and intercommunication.

(d) Next to the right is the "Fine Tune" control which varies the receiver heterodyne frequency as mentioned in paragraph 1.5. The calibration of this control is 0 centered, turning the control to the right increases the frequency and to the left decreases the frequency.

(e) To the right of the Fine Tune control is the "Band" switch, the positions of which are coded "Yellow" and "Green". All tuning controls and the crystal sockets are color coded to correspond with the positions of this switch.

(f) The "Meter" switch located immediately below the meter, controls the circuit in which meter readings are obtained on the transmitter.

(g) The "Crystal Heater" switch, located to the right of the nameplate controls the battery current to the crystal thermostats.

(h) Control of all essential functions of the unit may be transferred from the Local (on the unit's panel) to the Remote Control Unit by means of the "Local Remote" switch.
Functions so transferred are:-

(1) "Start - Stop"
(2) "Volume" Control.
(3) "Fine Tune" Control.
(4) "Band" Switch.

Figure V, being a photograph of the Remote Control Unit, shows the location of these controls.

In cases where the installation is for the use of a single operator, the Unit may be used alone and controls manipulated on its front panel, or the unit may be located in a less accessible place, and the Local-Remote switch left permanently in the Remote position.

The equipment is then controlled entirely from the Remote Control Unit.

In cases where provision is required for two operators either may be given control of the four above listed functions by the Local Remote switch. Regardless of the position of this switch, either operator can transmit during which time there is continuous Side Tone in both headsets. It is also possible for either operator to communicate with the other without the necessity of transmitting carrier. During such intercommunication, the speaker has side tone as well.

(i) A Modulator gain control is provided on the right hand side of the unit. This control is provided with a slot for screwdriver adjustment to suit the voice level at which the crew speak.

(j) A Sensitivity control for the receiver is provided on the left hand side of the unit. It has a screwdriver slot for adjustment to suit the electrical noise conditions of the aircraft in which the Unit is installed.

(k) Three cable connector sockets are provided in the lower right hand corner. The one at the left accommodates the 12 wire cable from the Remote Control Unit. The centre, the local microphone and headset cable and the right takes the battery cable.

On the right hand side, space is provided for an additional cable connector socket to accommodate cable connections to further apparatus.

(1) Above the cable connectors are two fuse holders located in the primary leads from the battery.

2.4 Tuning Controls.

All tuning controls are accessible from the front and are fitted for screwdriver adjustment. Snap on covers close the tuning holes when not in use.

(a) The Receiver Tuning Controls are located below the Volume and Fine Tune Controls. Two apertures reveal the dial calibrations and are color coded to correspond with the positions of the Band switch. Immediately below each aperture is the corresponding adjusting shaft. About 1-1/2" to the left and slightly below each adjusting shaft is the dial lock.

(b) The "Crystal Tune" controls are located at the lower centre of the front panel and are color coded. The corresponding dial locks are adjacent to the apertures through which the dial calibrations are visible.

(c) The "P.A.Tune" controls are located one above the other to the right of the meter, the dial locks being adjacent to them. They are color coded in the usual manner.

(d) A removable door marked "Ant. Tune" provides access to two coil tapping wheels which slide on vertical rods. These wheels give a means of tapping the Antenna coil turn by turn. A spot of color at the lower end of each rod identifies the band to which each tap belongs.

(e) To the left of the antenna coil and accessible through the removable door is a bank of four fixed padding condensers, which by means of links can be connected in parallel with the P.A. Tune condensers.

2.4 - (f). In sets from Serial No. 168 up, a switch is provided to remove the H.T. from the P.A. valve V2 when the Antenna Tune door is removed for tuning the antenna circuit. This is a single-pole, double-throw, spring-return switch mounted below the Antenna and Power Transfer Relay E1. It is arranged so that removal of the Antenna Tune door releases the switch, thus placing the unit in the "Receive" condition regardless of the position of the Send-Receive - I.C. switches. With this switch thus released, it is impossible to receive an R.F. burn from the antenna coil or its taps. This switch is designated S12 on Fig. X and Fig. XV.

The lower pair of pads (color coded yellow) correspond to the lower P.A. Tune condenser also coded yellow. The upper pair, coded green, correspond with the upper P.A. Tune condenser coded Green. The lower pad condenser of each pair is 100 mmf and the upper 200 mmf. Thus the order of the pads from the bottom up is 100 mmf, 200 mmf, 100 mmf, and 200 mmf.

2.5 Antenna and Ground Connections.

In the upper right hand corner is the antenna bushing and immediately below it is the Ground terminal.

2.6 Dust Cover and Base Plate.

A perforated and screened dust cover is held in place by two draw bolts, one located at each end. An internal flange along the front and sides of the cover hold it snugly to the unit's case.

A sheet aluminum base plate is fastened to flanges and partitions on the chassis base by twenty-three bolts.

2.7 Location of Apparatus - Top View of Chassis.

A top view of the chassis with the dust cover removed is shown in Figure II. Parts thereon are identified by the symbols by which they are designated on the schematic Diagram of Connections, Figure X.

2.8 Location of Apparatus - Bottom View of Chassis.

Figure III shows a bottom view of the unit with the base plate removed. As in the case of paragraph 2.7 all parts are identified by their schematic symbols.

Figures VII and VIII show two additional bottom views, the former showing largely the location of resistors and the latter condensers and coils.

[redacted]

range.

The actual power delivered to the antenna will depend largely on the characteristics of the antenna used.

5.0 ANTENNA CHARACTERISTICS.

The transmitter is designed to properly tune and match an antenna whose apparent resistance is from 1 to 40 ohms and capacitive reactance of from 1000 to 0 ohms.

5.1 The receiver is designed to operate on any antenna whose capacity is in excess of 25 mmf.

6.0 THEORY OF OPERATION.

Transmitter.

The transmitter proper consists of a crystal controlled Oscillator, Power Amplifier and Modulator, Fig. XVIII shows a simplified circuit of the transmitter.

7.0 CRYSTAL OSCILLATOR.

The crystal oscillator comprises a 6L6 beam pentode valve V1 with the crystal connected between grid and ground and a tuned plate circuit consisting of an inductance and variable condenser.

7.1 Two crystals are provided, the desired one being selected by a section of the band change switch S8-1. The crystals are of the Western Electric Aircraft Type 5B, with an integral thermostat and heater. Below 0° C. the thermostat closes and maintains the temperature within the crystal holder at 0° C. with an ambient down to -40° C. The heaters are supplied from the 12 volt supply line through the "Crystal Heater Switch", S4 ; it will be noted that S4 is connected to the supply line whether the Unit is operating or not, thus insuring that the crystals will be at operating temperature after periods of non-operation. During long idle intervals at sub-zero temperature, S4 may be turned "OFF" so as to conserve battery energy. At an ambient of -40° C. a half-hour interval is required after turning S4 "ON" before the crystals are up to operating temperature. This does not preclude the operation of the transmitter during this period but the frequency may be outside the tolerance specified until operating temperature is reached. To avoid grounding the 12 volt supply line to the chassis, terminal No.3 of the crystal holders (it is common to the crystal and the heater) is bypassed by C26.

7.2 The oscillator tuned plate circuit comprises a coil L1 and either of two variable condensers C2 and C3 selected by the band switch S8-2. These condensers are provided with a rough dial calibration to assist in tuning the oscillator. The oscillator plate is series fed through L1, C5 being provided so that C2 and C3 may be connected with their frames grounded.

7.3 Oscillator plate voltage is obtained from the high voltage supply through a dropping resistor R4. The voltage is further reduced through R3 for the valve screen, C1 being the screen bypass. No limiting bias is provided as the resistance of R4 is sufficient to limit the power input to the oscillator valve to a safe value even though bias is removed by the oscillator stopping.

Operating bias is obtained by grid current flowing through the grid leak R1.

7.4 During tuning of the oscillator, resonance is indicated by measuring the grid current of the Power Amplifier valve. This provides a better indication than the usual plate current "dip" due to the oscillator being supplied with plate voltage through a series resistor.

8.0 <u>POWER AMPLIFIER.</u>

The Power Amplifier V2 is an 807 beam pentode valve operating as a Class C plate modulated amplifier.

8.1 The radio frequency energy to drive the Power Amplifier is obtained through a blocking condenser C4 from a tap on the oscillator plate coil L1. R8 AND R59 ARE provided as "parasitic suppressors". Part of the bias is developed by the grid current flowing through the grid leak R5. The grid current after passing through R5 further passes through R2 for metering. This is discussed in more detail subsequently.

The remainder of the operating bias is obtained by the valve cathode current flowing through the cathode resistor R7. In addition, the cathode resistor provides a limiting bias to prevent damage to the 807 should the oscillator fail to function. The cathode current is further conducted through R18 for metering. C8 is the cathode bypass condenser.

8.2 The power amplifier is "shunt fed" through a choke L2 which in turn is fed through the secondary of the Modulator Transformer T2. C8 provides a bypass so as to prevent R.F. currents flowing back into the Modulator Transformer. As it is necessary to modulate the screen of the Power Amplifier as well as the plate, the s reen dropping resistor R6 is supplied from the Modulated plate supply, C7, being the screen bypass.

9.0 POWER AMPLIFIER OUTPUT CIRCUIT.

The output of the Power Amplifier is fed into what is known as an "L" network which serves to tune the antenna reactance and match the antenna resistance to the valve.

9.1 Suppose the L network is feeding an antenna which exhibits a pure resistance, i.e. no reactance. The antenna can be replaced by a resistance connected between the antenna and ground terminals. An examination of the "L" network reveals that it is really a parallel resonant circuit in which the antenna resistance is in series with the inductance. The well known parallel resonance formula for this is approximately $R = \frac{XL^2}{r} = \frac{XC^2}{r}$

at resonance where R is the parallel resistance.
XC is the reactance of the condenser.
XL is the reactance of the inductance.
r is the series resistance.

In our case "r" is made up of the resistance of the antenna plus the apparent resistance of the coil and R is the resistance into which the Power Amplifier valve works.

An approximate value of the R into which a valve operating class C should work is given by $R = 500 \frac{Eb}{Ib}$

where Eb is the D.C. valve plate voltage and Ib is the rated D.C. plate current in milliamperes.

From this formula it is apparent that if our parallel resistance R is too high, the Power Amplifier Valve will not draw enough current and thus will not deliver the full power of which it is capable. Conversely, if R is too low, excessive current will be drawn and the valve overloaded.

In the formula $R = \frac{XL^2}{r} = \frac{XC^2}{r}$

the value of "r" is fixed by the antenna but the value of XC and XL can be changed at will to control the resultant R. The normal procedure of adjusting the "L" network is to choose a comparatively large inductance i.e. a high value of XL and tune the circuit to resonance as indicated by the dip in plate current of the Power Amplifier. If the value of current at the minimum of the dip is below the allowable current, the inductance should be reduced, thus reducing XL and retuning. This is continued until the correct value of plate current is obtained. If, however, the first value of inductance tried produces too high a plate current at the dip, the inductance must be increased and the circuit retuned.

It is seldom, however, that an antenna appears as a pure resistance as in most cases, some reactance either inductive or capacitive is present. For short antennae such as are usual on aircraft, the antenna appears as a resistance and capacitive reactance in series.

More inductance in the antenna coil will now be required as in addition to the inductive reactance required to fulfil the above formula an added inductive reactance is required to cancel the capacitive reactance of the antenna.

12.2 In the case of the P.A. cathode, the cathode current passes through R18 to ground. When metering this circuit the meter is connected across R18, which then acts as a multiplier shunt. The value of R18 is such that the correct P.A. cathode current equals twenty times the meter reading.

12.3 The Mod. Cathode current is metered in the same manner as the P.A. cathode current, R19 being the shunt. The multiplier in this case is also twenty.

13.0 POWER SUPPLY.

The normal power supply of the unit is the aircraft's 12 volt storage battery. See Fig. XVII for a simplified power supply circuit.

All the valves in both the receiver and transmitter are operated so that two valves are in series. To equalize the voltage drop across the receiver valves, the centre taps of the three pairs of valves in series are connected together.

The dynamotor is supplied from the 12 volt line through heavy duty chokes L5 and L6. These with condensers C22 and C23 inside the dynamotor end bell and C24 and C25 provide the necessary "hash" filtering in the primary circuits. To prevent possible hash radiation from the battery cable C82 and C83 are provided at the power cable entrance. Further hash filtering is supplied by C41 and C81 on the filament leads in the receiver. Adequate filtering is thus provided to ensure exceptionally quiet operation of the receiver.

The secondary side of the dynamotor generates a nominal voltage of 400 volts, hash filtering being provided by C21 inside the dynamotor end bell and L7.

C20 filters the audio frequency components due to the commutator ripple.

R E C E I V E R.

14.0 THEORY OF OPERATION.

See simplified Wiring Diagram, Fig. XIX.

The receiver is a six-tube superheterodyne receiver with two double purpose tubes. Five of the tubes are metal, the output tube being glass. The glass tube and one of the metal tubes have the grid terminal on top. One stage of R.F. amplification with a three section gang tuning condenser is employed. The I.F. amplifier consists of a two stage amplifier with three I.F. transformers. A diode second detector operates directly into the power output tube without any intermediate A.F. amplification. A separate diode is used to provide A.V.C. voltage. By means of delay circuits this diode is inoperative unless the signal is above normal output.

14.1 The volume control is located in the secondary of the output transformer, which is a low impedance circuit. The volume control is of the constant impedance type.

14.2 A fine tuning control is provided for the oscillator circuit by which the oscillator frequency can be changed,a small amount to compensate for small differences or changes in signal frequency or receiver adjustment.

14.3 Two complete and independent gang condensers are used, one or the other being selected by means of the frequency selector switch. This same switch also selects the transmitter frequency. Thus the receiver can be pre-tuned to two specific frequencies and one or the other frequency can be received by means of the Band selector switch. The use of gang condensers with calibrated scales greatly simplifies the tuning of the receiver to specific frequencies over the usual method of individual adjustments on the antenna circuit, the detector circuit and the oscillator circuit.

14.4 The heaters of the tubes are supplied from the battery operating the set and the high tension is supplied by the dynamotor used for the transmitter. Suitable dropping resistors are employed to reduce the dynamotor voltage to a proper value for the receiver.

14.5 The receiver is turned on and off by the main on-off control of the set. Three other controls are provided for the receiver, viz.- volume, fine tuning and frequency selector.

When transmitting, the receiver is made inoperative by switching off the antenna and also the high tension supply to all of the tubes except the power output tube, which remains active for the side tone circuit. See paragraph 11.0.

14.6 To prevent the tuning of the receiver shifting with changes in temperature the tuned circuits of the oscillator, detector, and antenna circuits are compensated for temperature changes by means of compensating condensers having a temperature capacity characteristic such that they counteract the temperature frequency characteristic of the other parts of their respective circuits.

15.0 DETAILED DESCRIPTION.

Antenna:-

The same antenna is used for transmitting and receiving.

15.1 Power Supply:-

See Dynamotor and Heater Circuits, Fig. XVII.

The receiver has three supply circuits, one for the heater circuits of the tubes, one high tension supply for the power output tube, and a high tension supply for all the other tubes which is switched by the Send-Receive relay.

15.2 The heater circuit is turned on by the main ON-OFF switch and remains on as long as this switch is closed. Thus in switching from "Transmit" to "Receive" the set becomes fully operative as soon as the high tension is applied.

15.3 All other power is from the high tension dynamotor, which runs continuously while the set is turned on. The high tension, after passing through the main filters L7, C20, and C21, is fed to the receiver through three branches. Since the voltage of the dynamotor, 460 volts, is considerably higher than that required by the receiver, each of these branches requires a dropping resistor to reduce the voltage to the required value. Each branch has a suitable bypass condenser which forms the effective source of power for the various circuits.

15.4 One branch supplies the screen and plate circuit of the output tube. This line is permanently connected to the high tension supply so that the output tube is operative continuously while the set is turned on. This is for the purpose of providing transmitter side tone in the headphones.

The other two branches are fed from the high tension section of the send-receive relay, these circuits being open while transmitting. This makes the receiver inoperative when the set is on transmit. One of these branches feeds the plate and screen of the fine tuning control tube.

The third branch is the general high tension supply for the remainder of the set.

15.5 The voltage dropping resistor for the power tube is R53 and the bypass condenser is C75. The screen of the power tube is connected to this condenser. The primary of the output transformer (T9) is connected between this condenser and the plate of the power tube. Condenser C76, .001 mfd is connected across the primary of the output transformer to bypass any residual R.F. reaching this part of the circuit and to suitably limit the upper audio frequencies.

15.6 The voltage dropping resistor and bypass condenser for the fine tuning control tube, V7 are R30 and C42. The plate of V7 is fed through the tank winding of T5. This high tension is fed in shunt with the oscillator series tracking condensers C48 and C79 by the resistor R31. From the junction of C42, R30 and R31, the resistor R32 drops the voltage to the proper value for the screen of V7, C45 bypasses the screen. To stabilize the plate and screen voltage of this tube, there is a bleeder current from screen to ground through the resistances R33, R36, R58 and either R16 or R56. A further function of this latter resistance network is described in connection with the fine tuning control tube. (See Para. 19.5)

15.7 R54 is the dropping resistor for the general high tension supply and C77 the bypass condenser. The screens and plates of V5, V6, V8 and V9 are supplied from R54.

Each plate and screen is isolated from this supply and from each other by individual de-coupling resistors and bypass condensers. In the case of the screens these resistors perform the additional function of reducing the voltage to the proper value for the screens. On V6 the screen voltage is stabilized by the bleeder resistor R25. This stabilization is to minimize changes in oscillator frequency with variations in plate current due to the action of the A.V.C.

16.0 R.F. CIRCUITS.

The R.F. circuits, other than the fine tuning control, are conventional, the only unique feature being the use of two gang tuning condensers. The general arrangement is such that the receiver can be pretuned to two selected frequencies, one by means of each gang condenser. The condensers are locked in position and then the receiver will be tuned to one or the other frequency dependent on the position of the "frequency selector" switch, S2, when on "local" or S11 when on "remote". One coil system is used for each of the three circuits, antenna, detector and oscillator.

16.1 The gang condensers are adjusted by means of a screw driver slot in the end of a vernier drive shaft, reached by removing a snap-button on the front panel. A similar snap-button exposes the screw which locks the condenser. The vernier drive shaft operates the condenser through spur gears of 6:1 ratio. The scales which are calibrated in Megacycles are visible through windows in the panel, directly above the adjusting shafts.

16.2 See Fig. XIX.

Each gang condenser is fitted with a trimmer condenser for each section for the purpose of aligning the circuits to the scale calibration at the high frequency end of the range, and also to each other. The trimmers for the R.F. C29, C31, and Det. C37, C40, sections are of the mica compression type, and are part of the gang condenser assembly. The trimmers for the oscillator sections, C51, C53, are small air dielectric variable condensers. These are mounted below the base and have a screw driver adjustment accessible through holes in the base. These trimmers are located directly behind (as viewed from the front panel) their respective gang condenser.

16.3 Negative temperature coefficient compensating condensers are connected across the tuned circuits of the R.F., Detector, and Oscillator circuits. In the oscillator circuit this compensating condenser C80 has a capacity of 29 mmf, and in the other two circuits the capacity of C44 and C46 is 30 mmf. In the R.F. circuit an additional padding capacity C43 of 7-1/2 mmf is used. This condenser is of the low loss silver mica type.

16.4 The oscillator series tracking condenser is made up of two condensers in parallel. One, C79, is a 500 mmf negative temperature coefficient compensating condenser, and the other, C48, is a 1200 mmf low loss silver mica condensers.

16.5 The oscillator-mixer tube, V6, is a metal tube type 6SA7. All connections are through the base. The circuit used is the cathode tap type. Since it is desired to bring the plate supply of the fine tuning control tube through the tank coil of T5, the cathode of the oscillator is connected to a separate winding so connected that the cathode is effectively connected at a point part way up the tank circuit coil.

16.6 The A.V.C. voltage is supplied to the R.F. and Detector circuits across condensers C27 and C35 in series with the low potential ends of the coils T3 and T4. The capacity of these condensers is .01 mfd. and they are of the moulded mica low loss type. Isolating resistors R20 and R24 of 100,000 ohms, are used in each feed to prevent inter-reaction from one circuit to another.

16.7 The inductance of the coils of the tuned circuits of the R.F. (T3) Detector (T4) and Oscillator (T5) is variable by means of adjustable iron cores. These cores are of the moulded powdered iron type, and have a long threaded stud which fits in a threaded bushing in the chassis base. These studs have a screwdriver slot in the end and extend some distance above the chassis allowing for considerable movement of the core and corresponding variation in inductance of the coil. This adjustment is to take care of small circuit variations between chasses and to permit exact alignment near the low frequency end of the tuning range of one circuit with the other and also with the scale calibration. These three adjusting studs are on a line running from the front panel, and between the two gang condensers. (See Fig. XIX). The first, or antenna circuit adjustment, T3, is located ahead of the gang condensers, about three quarters of an inch back of the front panel. The second or detector circuit adjustment, T4, is located about on the line of the shields between the R.F. and Det. sections of the gang condensers. The third or oscillator adjustment, T5, is located just behind the line joining the back end-plates of the gang condensers. The R.F. amplifier tube V5, is a type 6SK7. This is an all-metal tube with no top connection, both plate and grid connections being through the base.

17.0 I.F. CIRCUITS.

The intermediate frequency amplifier is tuned to 465 kc. Three I.F. transformers are used. The transformers between the detector and first I.F. amplifier tubes, T6, and between the first and second I.F. tubes, T7, have two tuned coupled circuits. The transformer between the second amplifier and the diodes, T8, has two very tightly coupled circuits, and only the primary is tuned.

In all cases the tuning is by fixed condensers and variable inductances, the fixed condensers are of the low loss silver mica moulded bakelite type. The inductances are adjusted by movable iron cores in a similar manner to the R.F. coils. The adjusting studs of the iron cores are normally prevented from turning by pressure springs of piano wire pressing on the sides of the studs.

17.1 The first I.F. transformer, T6, is located about the middle of the left hand side of the chassis. (See Fig. II and Fig. XIX). The adjusting screws for tuning the primary and secondary of the transformer project through the left side of the shield can. Clearance holes are provided in the sloping side of the chassis to give access to these adjusting screws. The second I.F. transformer, T7, is located at the rear left corner of the chassis. The adjusting screws also project through the left side of the shield can, and are reached from the left side of the chassis. The third I.F. transformer, T8, is mounted at the rear of the chassis in line with and to the right of the second I.F. transformer. It is in a shorter shield can than the other I.F. transformers. The single adjusting screw projects through the back of the shield can, and is reached from the rear of the chassis.

17.2 The first I.F. amplifier tube, V8, is a type 6SK7 tube, the same as the R.F. amplifier. The second I.F. amplifier tube V9, is a type 6B8. This is a metal tube with the control grid connection at the top of the tube. This tube is located between the second and third I.F. transformers, and the connection from the second transformer to the control grid comes directly from the secondary circuit through a bushing in the side of the shield can adjacent to the grid cap.

This tube also contains two diode rectifiers. One of these is used to supply the audio output, and the other for the A.V.C.

These two diodes are coupled by the condenser C70. One side of the secondary of the third I.F. transformer, T8, connects to one diode. The other side of the secondary is bypassed by an R.F. bypass condenser C73 of 500 mmfd. Then follows a filter resistor R48 of 10,000 ohms, and a second bypass condenser C71 also of 500 mmfd. The load resistor, R49, of 150,000 ohms, is connected from this point to the cathode of the tube V9. By this method of connection no steady voltage exists between the diode and cathode which would produce a threshold effect. The top end of the load resistor is connected to the control grid of the type 38 power output tube, V10, through a .01 mfd moulded low loss mica condenser C72. A grid leak R50 of 500,000 ohms from grid to ground maintains the grid of V10 at an average zero potential. The bias for this tube is obtained by a cathode resistor R52 of 1000 ohms, which is bypassed by a 1. mfd condenser C74. This condenser is of the oil impregnated paper type, which has a very small change in capacity under low temperature conditions.

17.3 The output transformer, T9, has a .001 mfd condenser, C76, across the primary, to bypass any R.F. reaching this point. The secondary is designed to match the tube output to a 200 ohm load. The output of this transformer goes to the Local-Remote switch S3, and from there to either the local or remote volume control R15 or R56. See Fig. XI. The volume controls are of the constant impedance "T" pad network type consisting of three simultaneously adjusted variable resistance units. Provided the actual load is 200 ohms, it presents a constant load of 200 ohms to the tube at all times.

17.4 After passing through the volume control, the output comes back to the Local-Remote switch, S3, and then feeds the output line which has two terminations, the local output plug connector, P3, and thence through the corresponding output plug cable connector P4, and output cable to the local headphones, and also to the remote control plug connector, P5.

If the remote control unit is used, the remote control headphones are connected in parallel with the local headphones, through the remote control cable connector plug, P6, the remote control cable, and remote control unit.

18.0 The A.V.C. and audio circuits as used on this receiver are unique in that the full burden of preventing overload on any part of the circuit is entirely a function of the A.V.C. system inasmuch as the volume control is located between the secondary of the output transformer and the headphones.

18.1 The only requirement necessary when the volume control is so located is that no overloading occurs even when receiving strong signals modulated to high percentages. This condition is achieved by the following means. No audio amplification, as such, is used, the diode detector working directly into the power output tube, the necessary overall amplification being obtained by an additional stage of I.F. amplification. A power output tube is used that will not overload with any signal which the diode detector will deliver to it. Also increasing the number of tubes before the detector gives an additional tube to which A.V.C. can be applied, thus increasing the effectiveness of the A.V.C. action producing a more constant output. This arrangement markedly increases the normal signal voltage at the diode. To prevent overloading of the tube supplying the diode transformer, this tube is not A.V.C.'d.

18.2 A feature of this system of controlling volume in the output circuit over the more normal method where the volume control is located in the diode output circuit and a stage of audio amplification is used between the volume control and the output tube is that the power tube is usually working at a fairly high level, and this is then attenuated down to a suitable value for the headphones. A severe shock to the system, such as received noise, can only drive the power tube to maximum output and thus will only increase the signal in the headphones by a corresponding amount. In the other arrangement the input to the audio system is reduced until the output is the required level. However, a sufficiently severe shock from noise can again drive the power tube to maximum output but in this case the full output of the power tube is applied to the headphones which will cause severe "acoustic shock".

This limiting feature combined with the effectiveness of the A.V.C. system provides a very effective method of reducing or limiting "acoustic shock".

19.0 The theory of operation of the fine tuning control tube, V7, which is a type 6SJ7 tube, is as follows:-

If an additional inductance were connected in parallel with the tank coil of the oscillator circuit (T5), the effective inductance would be reduced, and the frequency would be increased. Also the current taken by the extra coil would lag approximately 90° behind the voltage across the main coil. Also the amount of this current would depend on the inductance of the extra coil. Thus a circuit which will draw a lagging current will have the same effect as an actual inductance connected in parallel with the main inductance, and the effective size of the added inductance and the amount of change of frequency due to it will depend on the amount of current drawn by the added circuit.

19.1 When a resistor and condenser are connected in series and the resistance of the resistor is at least several times the reactance of the condenser for the frequencies concerned, the combination will have approximately unity power factor and the current through the combination will be in phase with the applied voltage. Also the voltage across a condenser lags 90° behind the current through the condenser. Thus the voltage across the condenser will lag 90° behind the voltage across the resistor-condenser combination. If the voltage across this condenser is applied to the control grid of a tube, the current drawn by this tube will increase and decrease as the voltage across the condenser is alternately positive and negative, and this current change will lag 90° behind the voltage across the resistor-condenser combination.

19.2 If, now, the resistor-condenser combination is connected across the tank coil (T5) of the oscillator circuit, and the plate current of the control tube is drawn through the tank coil, the control tube will draw a current lagging 90° behind the voltage across the tank coil and so will effectively be an additional inductance in parallel.

19.3 The average current drawn by the control tube will be determined by the mean bias of its control grid, and varying this bias will change the average current and so the effective size of the parallel inductance and thus the frequency.

19.4 In this unit the actual application of these principles are as follows:-

The fine tuning control tube V7 is a type 6SJ7 tube.

The resistor-condenser combination across the tank coil of T5 consists of R34 of 15,000 ohms and the grid capacity of the tube V7. C49 is a blocking condenser of 250 mmfd. to isolate the grid from the H.T. circuit, and R35 is the grid bias feed resistor of 100,000 ohms. The high end of R34 is connected to the "hot" end of the tank coil, as is also the plate of V7.

19.5 Between the cathode of V7 and ground there is the variable resistor R16 of 1000 ohms (or R56 in the remote control unit) which adjusts the bias on the tube, and constitutes the "fine tuning control." R51 provides a fixed minimum bias for the tube. This resistance is 400 ohms. To maintain linearity of frequency change in the fine tuning control, a steady current is maintained through it by grounding the screen bleeder resistor, R33, through the control.

19.6 To prevent a high voltage appearing on the cathode when the local-remote switch is operated, and the control circuit is momentarily opened, the resistor, R58, of 15,000 ohms, is connected directly from the screen to ground. This resistor also forms part of the network providing proper cathode and screen voltages for the control tube.

20.0 RECEIVER SENSITIVITY CONTROL.

To take care of noise level conditions encountered in different installations (ignition noise, commutators, voltage regulators, etc.) a control has been incorporated in the unit so that the maximum sensitivity with no signal input can be reduced below normal as required to suit the conditions of individual planes.

20.1 The cathode bias resistors R21 and R40 of V5, the R.F. amplifier and V8, the 1st. I.F. amplifier respectively have not been returned to ground, but have been brought to a common point and thence through the variable resistor R36 of 1500 ohms to ground. Thus the nominal bias on these two tubes can be increased above normal and the sensitivity of the receiver correspondingly reduced.

The sensitivity of the receiver can be reduced from better than 5 microvolts to poorer than 25 microvolts.

20.2 This control, R36, is located on the left side of the outside of the unit about half way from top to bottom, and one quarter way back from the front. It is screw driver adjusted, and is intended to be an installation adjustment only.

21.0 CONTROL CIRCUITS.

The normal power supply for the unit is the 12 volt aircraft storage battery. A cable plug and receptacle are provided for connection to the battery or connecting block. Both sides of the power supply line are fused with 30 ampere anti-vibration aircraft type fuses mounted in special holders which permit them to be extracted from the front panel.

Receptacles are also provided for the plugs on the microphone and headset cable and the Remote Control Unit cable.

21.1 Remote Control Switch.

The Local-Remote switch is provided to transfer the control of essential functions from the "Local" controls mounted on the front panel to their duplicates on the Remote Control Unit. The functions so transferable are:-

(1) Start - Stop.
(2) Band Change.
(3) Receiver Volume Control.
(4) Receiver Fine Tuning,

and the gunner or the pilot has sole control over them.

21.2 Trans.-Receive-I.C. Switch.

Transfer from the Transmit to the Receive condition is accomplished by the Antenna and Power Transfer Relay E1. This relay is provided with two coils,one of which when excited makes contact on the Transmit position, and the other in the Receive position. This obviates the necessity of relying on spring tension to maintain contact. The relay is of the 2 P.D.T. type, one pole transfers the antenna from transmitter to receiver and the other, the plate supply power. The power transfer poles are provided with arc suppressors consisting of C15, C16 and R17. This relay is controlled by a section of the Send-Receive Inter-Communication switches S6, on the Unit, and S10 on the Remote Control Unit. In the Receive and I.C. position of these switches the relay is held in the Receive condition, when either S6 or S10 is turned to Transmit, the relay transfers the Antenna and Power to the transmitter. A simplified circuit of this feature is shown on Fig. XV.

These switches also control the microphone current. In the Receive position, microphone current does not flow, while in Transmit or I.C. the microphone is in circuit. Figure XIII shows a simplified circuit. The switches are so connected that either or both microphones may be placed in circuit and at any time either crew member may actuate the transfer relay regardless of the position of the Local Remote switch. The Transmit positions of the switches are "locking" while the I.C. positions are spring return to the normal Receive position.

If the unit is to be operated without the Remote Control Unit, a pair of terminals on a small bakelite panel mounted on S6 must be connected together with a jumper. This jumper must be removed before the Remote Control Unit is connected.

21.3 Band Change.

The transmitter band change switches S8-1, S8-2, and S8-3 and the Receiver band change switches S8-4, S8-5, and S8-6 are actuated through bell cranks and a connecting link by a trunnion on the threaded shaft of a small motor. The motor is of the 12 V. D.C. double field reversing type. A limit switch, S7, stops the motor when all the band switches are positioned; if the motor overtravels, S7 provides a reverse pulse. This insures that the band switches will position properly regardless of line voltage and ambient temperature. Band selection is governed by the Band switch S6 on the front panel or S11 on the Remote Control Unit. The positions of S6 and S11 are marked "yellow" and "green"; all the tuning controls on both the Transmitter and Receiver associated with each of the respective bands are similarly identified by a "Yellow" or "Green" mark so as to facilitate tuning adjustments. A simplified schematic of the band change circuit is shown in Fig. XVI.

21.4 Power Control.

The starting and stopping of the unit is controlled by the Power Control Relay E2. When this closes, filament voltage is applied to all valves, relays, and the microphone as well as primary voltage on the dynamotor.

This relay is actuated by the "Start" switches either S1 on the front panel or S9 on the "Remote" unit.

Fig. XIV shows a simplified circuit of this control.

21.5 Volume Control.

Fig. XI shows a simplified detail of the Volume circuit, with switching from Local to Remote.

21.6 Fine Tune Control.

Fig. XII shows a simplified detail of the Fine Tune control circuit with switching from Local to Remote.

22.0 INSTALLATION INSTRUCTIONS.

In most cases the position in which the unit will be mounted will be governed by the space available. Insofar as is possible the location chosen should provide the shortest possible connection from the antenna terminal of the unit to the lead-in bushing of the aircraft. Consideration must also be given to the accessibility of the controls for tuning and adjustment.

22.1 The shock mounting tray must be attached to the aircraft in an approved manner. Sufficient clearance must be provided around the chassis so that the unit cannot bump against anything as it moves on the shock mountings.

22.2 The lead from the antenna terminal to the lead-in bushing should be Unispark 7 wire with sufficient slack so that it will not be broken when the chassis moves on the shock mountings. To avoid serious detuning of the antenna circuit as the plane manoeuvres, the flexible wire must not be closer than 4 inches to the metal of the air frame.

As very high voltages are present on the antenna lead while transmitting its placement should be such as to preclude the possibility of the personnel making accidental contact with it.

22.3 The three cables connecting to the unit must be provided with a loop allowing sufficient slack so as not to interfere with the action of the shock absorbing mountings.

22.4 The ground lead should be flexible braid and provide as short a lead as possible to the metal of the air frame.

23.0 CABLES.

Provision is made for three cable connections to the Unit, one to the battery, one to the Remote Control Unit and one for the "Local" microphone and handset.

The cables must be clamped to the air frame to avoid excessive wear. Care must be taken that the clamps will not cut the cable.

To obtain maximum life from the cables, they should be located so they are not subject to excessive heat, oil or gasoline.

23.1 The Local microphone and headset cable should be terminated on a terminal block to which socket type 29 is wired.

23.2 To install the plugs on their cables, remove about 3" of the outer rubber sheath taking care to avoid cutting the cable shield. Cut the cable shield about 2" from the end and fold the remaining inch back over the outer sheath.

Loosen the cable clamp to remove both the back cover and contact holder of the plug. Insert the cable into the plug and solder the leads to the terminals. Care must be taken in soldering to preclude possible damage by overheating the contacts. The wires must be tinned before insertion and the soldering iron placed in contact with the wire rather than the plug contacts. Possible shorts may be avoided by placing a 1" sleeve of systerflex (varnished cambric) tubing over each lead before soldering to the plug, and then shoving the tubing ahead so that it completely covers the connection. Re-assemble the plug and tighten the cable clamp. Trim the excess cable shield that extends out of the plug. The cable sheath must make good electrical contact with the plug.

Where the Remote control cable enters the Remote Control Unit, good electrical contact must be made between the cable sheath and the metal case.

24.0 Remote Control Unit.

The location of the Remote Control Unit is not critical and should be mounted in the most convenient place available.

25.0 Operating Instructions.

After the cables, antenna and ground connections are made, the Unit is ready for operation.

If a Remote Control Unit is NOT used, it is necessary to connect a jumper across the two terminals located on the back of the Transmit-Receive-I.C. switch S6. These are accessible with the dust cover removed. This jumper MUST be removed when a Remote Control Unit is connected.

Place the Transmit-Receive-I.C. switches on both the Unit and the Remote Control Unit in the Receive position and the Local-Remote switch at Local. Control of all facilities is now available on the Unit.

The unit is put into operation by moving the Power Switch to the Start position. As soon as the valves have reached their operating temperature the receiver should be checked first.

26.0 RECEIVER.

With the controls set according to the previous paragraph (25.0) the unit will be in the receive condition, and the receiver will be functioning. Three controls will completely govern the operation of the receiver: These are:-

(1) Band Selector Switch. This switch will determine which of the two frequencies, designated by "Yellow" and "Green", the receiver is tuned to.

(2) Volume Control. This control determines the loudness of the signal delivered to the headphones.

(3) Fine Tune Control. This control permits a small adjustment either way from normal of the superheterodyne oscillator to permit precise tuning of the oscillator to the incoming signal. The purpose of this control is to compensate for (a) small errors in tuning the receiver, (b) small variations in receiver tuning, (c) Small differences in signal frequency of various transmitters.

The variation in tuning by this control varies from plus or minus 15 kc at 3 mc to plus or minus 35 kc at 6 mc.

These three controls can be transferred from the "local" positions on the unit to the "remote control unit" by the "Local-Remote" switch.

26.1 Adjusting the receiver.

To adjust the receiver, proceed as follows:-

A highly accurate source of signal of the required frequency must be available. This can be either a local oscillator such as a "standard signal generator", crystal monitor, or the actual signal to which it is required to tune the receiver.

26.2 Set the "Fine Tune" control to "O". Set the "Band" switch to the band it is desired to tune to this frequency.

Remove the snap-on buttons covering the adjusting shaft and dial lock for that band.

With the scale on the condenser as a guide to the required setting, tune in the signal.

26.3 Whatever the source, the signal must be sufficiently small to not produce marked A.V.C. action. If a "standard" signal generator is used, the output from the generator will be connected to the antenna and ground terminals of the unit. The antenna may or may not be disconnected from the unit as determined by the amount of "noise" being received by means of the antenna. The input signal to the unit can be adjusted by the controls on the generator.

26.4 If a heterodyne wavemeter or portable oscillator is used, the strength of the signal received by the unit can be adjusted by moving the oscillator nearer to or further away from the antenna lead, as required.

When an outside signal is being used, the received signal can be reduced, if necessary, to a suitable strength by removing the antenna lead from the antenna terminal and supporting the lead close to the antenna terminal. If this gives too much reduction in signal, a suitable short length of wire should be attached to the antenna terminal, and brought into more or less close relation to the antenna to produce a suitable signal pick-up.

26.5 Tune the gang condenser as accurately as possible with the volume control set for as loud a signal as the noise level will permit, and the signal input reduced as much as possible.

Lock the adjustment by means of the dial locking screw.

Check the tuning by means of the "Fine Tune" control. This should show the maximum signal at the centre "O" position.

Proceed in a similar manner with the other band.

26.6 CAUTION.

On account of a very slight reaction of the tuning of the "yellow" band on the "green" band when the "yellow" and "green" bands are both tuned to a high frequency due to the closeness of the two gang condensers, the tuning of the "green" band should be checked after any adjustment of the "yellow" band.

If both bands are being changed at the same time, adjusting the yellow band first will remove any difficulty from this cause.

Disconnect the signal generator or other source of signal from the unit, replace the antenna connection, and snap-on covers.

The receiver is now ready for use.

26.7 Use of Sensitivity Control.

Where excessive noise from electrical circuits in aircraft is encountered, the sensitivity of the receiver may be reduced as outlined in paragraph 20. Care should be taken not to reduce the sensitivity to such an extent that the operating range of the aircraft is impaired. The sensitivity should be kept as high as possible consistent with good signal to noise ratios.

27.0 D A N G E R.

Before handling any transmitter circuit components, place the Unit in the "Receive" condition or turn the power off. Failure to do so may result in dangerous shocks or painful burns.

Transmitter.

The oscillator crystals are inserted in their sockets; these are located on the chassis below and slightly to the left of the meter. The crystal sockets are coded to correspond with the yellow and green coding of the position of the Band switches, and tuning components. The crystal sockets are only accessible with the dust cover removed, all other tuning controls are accessible from the front of the panel.

27.1 Set both Crystal Tune controls C2 and C3 to the calibrated dial setting to correspond with their respective crystal frequencies. To ensure stability and quick starting the condensers should be set slightly to the high frequency side of the calibration.

Turn the power switch to Start and allow sufficient time for the valves to warm up. With the Meter switch S5 in the P.A. grid position turn the Transmit-Receive-I.C. switch S6 to Transmit. Quickly adjust the Oscillator tuning condensers until a grid current of 2 to 4 ma is obtained on each band. By manipulation of the Band Switch S2 make sure that the oscillator starts promptly on each band.

27.0 - (a) On sets from Serial No. 168 up, a gate switch has been added to minimize the possibility of R F burns while tuning the transmitter. The tuning procedure as outlined in the following paragraphs will, as a result, be changed slightly. First remove the "Antenna Tune" door and turn the Trans-Rec-I C switch S6 to Trans. Now in subsequent paragraphs wherever the instructions require that S6 be turned to Trans., merely depress the bakelite button of the gate switch S12. Similarly, where they require that S6 be turned to Rec., merely release the button of S12. After the transmitter tuning has been completed, replace the "Antenna Tune" door, when Transmit-Receive switching will be controlled entirely by S6 on the Main Unit, or by S10 on the Remote Control Unit.

27.2 Return the Transmit-Receive-I.C. switch to Receive position. Disconnect the links coupling the fixed padding condensers across the P.A. Tune Condensers C13 and C14. For the band selected for adjustment first set the coil tap towards the bottom of the coil. For frequencies near 3 mc, the coil tap should be tried on the bottom turn, for 6.3 mc, approximately half way up the coil, for other frequencies proportionately between.

Make sure that the tapping wheel rests on one turn only, i.e. does not bridge adjacent turns. With the Meter Switch in the P.A. Cathode position, turn Transmit-Receive-I.C. switch to Transmit and rotate the corresponding P.A. Tuning condenser (either C13 or C14) until resonance is indicated by the "dip" in the meter reading. If this dip does not occur within the range of the tuning condenser, restore the Transmit-Receive-I.C. switch to Receive, and move the coil tapping wheel up two turns, switch to transmit and try the tuning again. Repeat this process until resonance is reached. The cathode current as indicated at this position will be below 40 ma (2 ma as indicated on the meter, the multiplier being 20).

27.3 It is now necessary to increase the loading on the valve, this is done by moving the coil tap up one turn at a time and retuning for the current "dip". Each time this is done the required P.A. tune condenser capacity will increase. This may continue to a point where the required capacity exceeds the maximum of the variable which is 150 mmf. Two fixed padding condensers one of 100 mmf and the other of 200 mmf capacity are provided for each P.A. Tune variable condenser. When maximum capacity is reached on the variable condenser, connect the 100 mmf pad across it by means of the link provided and continue the process of moving the tap up a turn and retuning until the P.A. Cathode current is between 80 and 90 ma (4.0 to 4.5 ma on the meter).

If the capacity thus provided is still insufficient, disconnect the 100 mmf pad and connect the 200 mmf pad. If still greater capacity is required, connect both the 100 mmf and 200 mmf in parallel across the variable.

Restore the Meter switch to the P.A. Grid position and check the crystal tune for 2 to 4 ma grid current.

Repeat the above for the second band.

Recheck the tuning of the first band.

During the "Tuning Up" procedure, the applied battery potential should be between 12 and 13 volts.

Until the characteristics of the Antenna being used are known particular care must be taken to avoid tuning to the harmonic of the crystal frequency. The use of a receiver at a moderate distance from the transmitter will readily indicate whether this has been done (or use a crystal monitor).

An R.F. ammeter of about 0 to 1.5 amps. range will be found useful but not essential during the tuning process.

27.4 If the above instructions are not followed carefully under certain conditions, positions of "false dip" in P.A. cathode current will be noted. These are readily detected by turning the meter switch to P.A. Grid - if the meter reads "0" the dip indicates a false peak and should be neglected. If instructions as to tuning procedure are followed exactly, no such false dips will appear.

27.5 All dial readings and the positions of the coil taps should be recorded for future reference on similar aircraft.

Lock all dial controls securely.

27.6 The transmitter is now ready for Modulation. Turning the Transmit-Receive-I.C. switch to Transmit automatically supplies microphone current. Place the Meter switch in the Mod. Cathode position, the meter now indicates the cathode current of both modulator valves. A continuous whistle into the microphone will produce a rise in Modulation Cathode current and a rise of approximately 15% in antenna current if an antenna ammeter is used.

Due to the regulation of the dynamotor and the battery supply, it is not possible to judge the degree of modulation by the antenna current rise. A listening test on a good receiver will provide a satisfactory indication of modulation. A modulation gain control is provided on the right hand side of the Unit. This control should be set so that satisfactory modulation is attained under the extraneous noise conditions in which the Unit operates. Screw driver adjustment is provided as the control will be pre-set.

Typical operating voltages and currents are indicated in Table III.

TABLE III.

VOLTAGE	MEASURED AT	VOLTS	
Osc. Plate	Junction of C5 and R4.	155	
Osc. Screen	Pin 4 of V1.	90	
P.A. Plate	Terminal of C8.	370	
P.A. Screen	Pin 2 of V2.	280	(*)
P.A. Cathode	Pin 4 of V2.	20	(x)
Mod. Plate	Pin 3 of V3.	370	
Mod. Screen	Pin 4 of V3.	250	
Mod. Cathode	Pin 8 of V3.	17	

These readings are taken with a 20,000 ohm/Volt-meter.

P.A. Grid Current - 2.3 ma.

P.A. Cath.Current - 80 ma.

Mod.Cath. Current - 86 ma.

and battery voltage of 12.2 volts.

(w) P.A. Screen voltage will vary considerably with the drive and loading on the valve.

(x) P.A. Cathode voltage will vary with the loading on the valve.

28.0 SERVICE INSTRUCTIONS.

General.

The complete Unit should receive the regular periodical inspections covering the operation of all control circuits, cables and connections.

28.1 Every 100 hours of operation the following oiling operations will be required.

(1) Band change switch bearings.

(2) Band change switch coupling rod bearings.

(3) The trunnion on the threaded shaft of Band change switch motor.

Numbers 2 and 3 above are provided with felt oil retainers - care should be taken to saturate the felt with oil. The lubricant to be used is Sperry Gyro oil, and is obtainable from -

Hughes Owens Co. Ltd.,
527 Sussex St.
Ottawa.

28.2 If the Unit is to be subjected to excessive cold, the above oil should be applied sparingly to the contact points of the Band change switches. This will prevent the switches freezing due to moisture condensing on the metal.

28.3 The bearings of potentiometers and switches may be oiled with Sperry Gyro Oil when necessary.

29.0 Band Change Switch Motor.

If the Band Change switch is used frequently, the brushes should be inspected every six months and replaced before they are worn sufficiently to endanger the commutator. The bearings should be oiled at the same interval with Sperry Gyro Oil.

29.1 To disassemble the motor for inspection, remove the brushes, then take out the two main frame screws from the shaft end. Also remove the end bearing plate from the end opposite the shaft extension.

30.0 DYNAMOTOR.

Every hundred hours the end bells should be slipped back sufficiently to permit inspection of the brushes and commutators. The brushes should be removed for inspection one at a time so as to avoid the possibility of interchanging them. It will be noted that they are polarized and marked to agree with the markings on the brush holders.

30.1 Replacement brushes may be ordered from the makers of the machine.

Eicor Inc.
515 South Laflin St.,
Chicago, U.S.A.

and can be obtained from Canadian Marconi Company, Montreal.

After a new brush is installed, it must be seated by wrapping a piece of 3.0 Garnet paper around the commutator, the abrasive side next the brush. Pull the sand paper out in the direction of rotation a sufficient number of times to seat the brush. Blow out the dust with compressed air and run the dynamotor at normal load for several hours before regular operation is resumed.

30.2 Normal operation will produce a dark polished surface on the commutator. This coating should be retained whenever possible. If the commutator requires cleaning, remove all traces of oil or grease and touch it lightly while running with 000 sandpaper (not emery cloth) following which the slots should be cleaned out with a narrow instrument. Avoid scratching the commutator surface. If the commutator is rough it must be turned down on a lathe using very light cuts and then undercutting the mica to a depth of .025". Subsequently the surface should be polished with 8-0 Garnet sandpaper.

30.3 The bearings are factory lubricated for 1000 hours operation or six months ordinary service. Only sufficient grease should be applied to the bearings to cover the balls, do not pack the bearings with grease. The following lubricants are recommended.

N.Y. & N.J. Lubricant Co. "F-927."

Master Lubricants Co. "Lubrico M-6."

Imperial Oil Co. "Hymelt #0"

30.4 In case of low output voltage:-

(a) Investigate the radio equipment for any possibility of trouble.

(b) See that proper input voltage is maintained at the primary brushes.

(c) High input current may indicate a short or ground in the dynamotor.

(d) Inspect brushes for wear, spring pressure and free movement in the brush holders.

In case of High Ripple:-

(a) Check brush spring tension.

(b) Check commutators for wear and being out of round.

(c) Check for brush sticking in holders.

30.5 In case of excessive mechanical noise:-

(a) Inspect bearings and lubrication.

(b) Inspect brushes for proper seating or chattering.

(c) Inspect armature for free rotation.

31.0 RELAYS.

31.1 The relay contacts should be inspected regularly. Normally the contacts should be darkened, - this is a normal condition and the coating should not be disturbed. If, however, the points become pitted, they should be polished with 000 sandpaper.

31.2 The Side Tone Relay E3 may require adjustment. As the back contacts are not used, they must be screwed back sufficiently to permit the armature to come to rest on the stop provided. The front contacts must be adjusted so that they make contact a short distance before the armature closes.

32.0 TRANSMITTER

All tuning controls should be adjusted under normal conditions every 50 hours of operation. More frequent checks may be required under abnormal conditions.

Sufficient metering facilities are provided to facilitate the localization of trouble should it occur.

The only components which are at all subject to failure are the valves. Due to the nature of the filament supply voltage, a somewhat reduced life will be obtained. The excessive voltage with high charging rates will tend to reduce the emission of the valves prematurely yet sufficient emission powers must be retained to permit operation when the battery is not being charged. The operation should be checked regularly with 11 volts supply.

Possible failures in component parts can usually be localized by usual circuit testing methods.

33.0 RECEIVER.

CAUTION:- When the top cover is removed, and the unit is running in the "receive" condition, there is danger of receiving a severe shock from any of the three resistors R30, R53, R54. See Fig. II.

33.1 The alignment of the circuits and the sensitivity should be checked under normal conditions every 100 hours of service or every four months, whichever is the shorter. Also all of the R.F. or I.F. circuits should be re-aligned whenever a tube is replaced in one or the other of these circuits.

33.2 Alignment.

The following apparatus is required to align the receiver:-

(1) Standard Signal Generator, having the following frequencies:- 465 kc, 3.25 mc, 4.5 mc, and 6.0 mc, and outputs from 1 microvolt to 100,000 microvolts modulated 30% at (preferably) 1000 c.p.s. or (alternatively) 400 c.p.s.

(2) An output measuring device to be substituted for the headphones and to be preferably calibrated in milliwatts. Should be capable of reading from 1 milliwatt to 1500 milliwatts. Load impedance 250 ohms.

As an aid to making adjustments, a pair of high resistance headphones may be connected in parallel with the output meter, or low impedance phones with 25,000 ohms in series may be used, but the response in the low impedance phones will be much reduced.

33.3 All measurements unless stated otherwise, are based on a "standard output" defined as follows:-

Standard Output	-	50 milliwatts.
Modulation Freq.	-	1000 c.p.s.
Modulation %.	-	30%.
Output Load Resistance.	-	250 ohms.

If the standard signal generator is only modulated at 400 c.p.s. the following may be used:-

Standard Output	-	40 milliwatts
Modulation Frequency	-	400 c.p.s.
Modulation %	-	30%.
Output Load Resistance	-	250 ohms.

34.0 I.F. ADJUSTMENT.

The I.F. frequency is 465 kc. For routine adjustments other than for the purpose of localizing a fault or unless the circuits are very badly out of alignment, a single over-all adjustment of the I.F. is usually sufficient and all measurements of sensitivity made at R.F. (signal) frequencies.

Measurements of I.F. sensitivity cannot be made at the converter (V6) signal grid without special means. This is due to the R.F. inductances and the A.V.C. bypasses (T3 with C27 and T4 with C35) being tuned approximately to 465 kc and acting as an effective short circuit on the signal generator at 465 kc if that frequency is applied to V5 or V6 signal grid.

34.1 To measure the I.F. sensitivity at the converter grid, it is necessary to remove the bottom cover plate from the unit and short circuit the secondary of T4 by putting a jumper around C46 mounted between S8-5 and C35. See Fig. VIII.
The oscillator must also be stopped by a jumper around C80, mounted on T5. See Fig. VIII.

To apply the I.F. input to V8 signal grid (terminal 4) it is necessary to have the cover plate removed from the bottom of the unit.

See Fig. II for location of I.F. adjustments. Snap-on cover must be removed for access to primary adjustment of T6 (1st. I.F. transformer).

TABLE IV.

I.F. MEASUREMENTS.

V9 - 6B8, 2nd. I.F. Amplifier Grid.
Input on signal grid terminal (cap) through 0.1 mfd. condenser, 100,000 microvolts. Output to be 6.25 milliwatts plus or minus 20%.
Bandwidth at 5 times down = 49 kc plus or minus 5%.

V8 - 6SK7, 1st. I.F. Amplifier Grid.
Input on signal grid (terminal 4) through 0.1 mfd. condenser.
Sensitivity = 2700 microvolts plus or minus 10%.
Bandwidth at 100 times down = 44½ kc plus or minus 5%.

V6 - 6SA7, Converter Signal Grid.
Input through 0.1 mfd. condenser on terminal of middle section of one gang condenser. Put "Band" selector switch in proper position to use that gang condenser.
Stop oscillator coil T5 and detector coil T4 as described in Para. 34.1.
Sensitivity = 60 microvolts plus or minus 25%.
Bandwidth for 100 times down = 20 kc plus or minus 5%.

35.0 R.F. ADJUSTMENTS AND MEASUREMENTS.

To Set Dials on Shafts.

Loosen the two set screws in the dial hub, turn the condenser until it is against its stop at maximum capacity. Turn the dial until it reads "0". This is the next scale mark on the low frequency side of 3 mc.

Tighten the two set screws, observing that the scale does not shift its position.

35.1 Adjustment of R.F. Circuits.

See Fig. IX for location of R.F. adjustments.
Set Fine Tune control at "0" (mid-scale). Set "Band" switch to "green".
Loosen the dial lock and set "Green" scale to read "6".
Apply a 6.0 mc signal from a standard signal generator to the "ANT." and "GND." terminals of the receiver, using a 50 mmf condenser as a dummy antenna. This dummy antenna should be located immediately at the antenna terminal.

35.2 Adjust the oscillator trimmer condenser for this band, C53, to tune in this signal. Then adjust the detector and antenna circuit trimmers located on top of the middle and front sections respectively of the gang condenser C40 and C31 for maximum output.

Turn the condenser so that the scale reads 3.25 and adjust the signal generator to give 3.25 mc.

Adjust the oscillator inductance iron core, T5, to tune in the 3.25 mc signal. Then adjust the detector and antenna circuit inductances T4 and T3 for maximum output by means of their iron cores. The "yellow" condenser should be turned to maximum capacity while making these adjustments.

Go back to the 6 mc scale setting and signal and re-adjust all three trimmers C53, C40 and C41 for optimum setting.

Check the 3.25 mc scale setting and adjustments.

Continue to cross adjust the 6 mc and 3.25 mc adjustments until both are correct.

35.3 After the "green" circuits have been aligned, change the "band" switch to "yellow".

<u>N.B.</u> The 3.25 mc adjustment of the oscillator T5, detector T4, and antenna T3 coils has already been made and no further adjustment of these coils is necessary.

Set the "yellow" scale to read 6 mc and adjust the oscillator trimmer C51, the detector trimmer C37 and antenna trimmer C29 for optimum.

No cross adjustment of 6 mc and 3.25 mc is necessary because the iron cores have already been adjusted on the "green" band.

As a final check set the "yellow" scale to 3.25 mc and verify that the iron cores are already in correct adjustment for this band.

N.B. When adjusting C51 and C53 do not allow the screw driver to form a circuit between the shaft and chassis as this will cause a change in tuning.

35.4 <u>R.F. Sensitivities.</u>

V6 - 6SA7 Converter Signal Grid. Input through 0.1 Mfd. condenser on middle section of proper gang condenser, depending on setting of "band" switch.

<u>TABLE V.</u>

<u>Frequency</u>	<u>Sensitivity.</u>
3.25 mc	130 plus or minus 25% microvolts.
4.5 mc	120 " " " 25% "
6.0 mc	110 " " " 25% "

V5 - 6SK7 R.F. Amplifier Signal Grid. Input through 0.1 mfd condenser to front section of gang condenser.

TABLE VI.

Frequency	Sensitivity.
3.25 mc	18 plus or minus 25% microvolts.
4.5 mc	18 " " " 25% "
6.0 mc	18 " " " 25% "

Ant. - Input through 50 mmf dummy antenna located at antenna terminal.

TABLE VII.

Frequency	Sensitivity.
3.25 mc	3 plus or minus 50% microvolts.
4.5 mc	3 " " " 50% "
6.0 mc	3 " " " 50% "

35.5 Image Ratio.

TABLE VIII.

Frequency	Image Ratio.
3.25 mc	3500:1 plus or minus 25%.
4.5 mc	1300:1 plus or minus 25%.
6.0 mc	400:1 plus or minus 25%.

35.6 Noise Ratio.

To be better than 4:1 at the three test frequencies.

35.7 Selectivity. - overall.

TABLE IX.

Frequency	Band Width for 1000 Times Down.
3.25 mc	30 kc plus or minus 5%.
4.5 mc	30.5 kc plus or minus 5%.
6.0 mc	31. kc plus or minus 5%.

35.8 Fine Tuning Control.

Measure change in tuning as control is turned (a) to the left, (b) to the right, from the centre "0" position.

TABLE X.

Frequency	Left 4	Left 2	Right 2	Right 4
3.25 mc	19 kc plus or minus 15%	10 kc plus or minus 20%	14 kc plus or minus 20%	24 kc plus or minus 20%.
4.5 mc	26 kc plus or minus 15%	13½ kc plus or minus 20%	19 kc plus or minus 20%	34 kc plus or minus 20%.
6.0 mc	35 kc plus or minus 15%	18 kc plus or minus 20%	25 kc plus or minus 20%	45 kc plus or minus 20%.

See also voltage tests on Fine Tuning Control Table XIII.

35.9 A.V.C.

Make test at 4.5 mc, volume control at maximum output, modulation frequency 1000 c.p.s.

TABLE XI.

Microvolts Input.	Milliwatts output.
100,000	525 plus or minus 10%.
10,000	430 plus or minus 10%.
1,000	310 plus or minus 10%.
100	240 plus or minus 10%.
10	160 plus or minus 10%.

35.10 R.F. Hash.

R.F. interference from dynamotor to be inaudible in headphones at any point on the tuning scale. Test in a shielded room with an antenna approximately ten feet long.

35.11 Volume Control.

To have smooth variation in output. Minimum signal to be less than 0.05 milliwatts with 100,000 microvolts modulated 30% at 4.5 mc applied to antenna and ground terminals.

35.12 Remote Control.

Check operation of remote "Fine Tune" and "Volume" control to same specifications as for local controls.

36.0 VOLTAGES.

All voltage measurements based on 12.2 volts at battery end of 15 feet of battery supply cable, and measured with a 1000 ohms per volt voltmeter. All voltages are measured from the points specified to the chassis unless stated otherwise. Unit in receive condition. See Diagram of Connections, Fig. X.

TABLE XII.

H.T.

At dynamotor H.T. choke L7	-	460 volts plus or minus 5%.
General H.T. supply, hot terminal of C77, Fig.VIII	-	215 volts plus or minus 5%.
Fine Tuning H.T. Supply, hot terminal of C42, Fig. VIII. Fine Tune Control at 0	-	240 volts plus or minus 10%.
V5 Plate, terminal 8	-	210 volts plus or minus 5%.
V6 Plate, terminal 8	-	215 volts plus or minus 5%.
V7 Plate, bottom of C48, Fig. VIII, Fine tune control at 0.	-	170 volts plus or minus 10%.

V8 Plate, terminal 8 -	210 volts plus or minus 5%.
V9 Plate, Terminal 3 -	210 volts plus or minus 5%.
V10 Plate, Terminal 2 -	210 volts plus or minus 5%.

Screens:-

V5 Screen, Terminal 6 -	105 volts plus or minus 10%.
V6 Screen, Terminal 4 -	80 volts plus or minus 10%.
V7 Screen, Terminal 6, Fine Tune Control at 0.-	63 volts plus or minus 10%.
V8 Screen, Terminal 6 -	105 volts plus or minus 10%.
V9 Screen, Terminal 6 -	120 volts plus or minus 10%.
V10 Screen, Terminal 3 -	220 volts plus or minus 10%.

Cathodes:-

V5 Cathode, terminal 5 -	3 volts plus or minus 10%.
V6 Cathode, terminal 6 -	0 volts (grounded)
V7 Cathode, terminal 5 Fine Tuning control at 0. -	2.5 volts plus or minus 10%.
V8 cathode, terminal 5 -	2.9 volts plus or minus 10%.
V9 cathode, terminal 8 -	31.0 volts plus or minus 10%.
V10 cathode, terminal 4 -	22.0 volts plus or minus 10%.

Miscellaneous.

Top of C64 at end of yellow A.V.C. lead from 2nd. I.F. Transformer, T7, See Fig.VIII.	- 28.5 volts plus or minus 10%.
Top of C64, end of yellow A.V.C. lead from 2nd. I.F.Transformer T7 to V9, terminal 8.	2.5 volts plus or minus 10%.
C82 to C83 at Fuses F1 and F2	- 11.8 volts plus or minus 5%
V5 terminal 2 and V6 terminal 7	- 11.6 volts Plus or minus 5%.

TABLE XIII.

36.1 Fine Tune circuit voltages.

	Control Position.		
	Left	Centre	Right.
Plate Supply, hot terminal of C42.	245	240	222
Plate,bottom of C48	195	170	120
Screen,V7,terminal 6	65	63	56
Cathode V7,terminal 5	3.6	2.5	1.0
Control,hot terminal.	3.5	2.2	0.05
V7 terminal 5, to hot terminal of fine tuning control.	0.1	0.3	0.95

Tolerances on above voltages plus or minus 10%, except hot terminal of control in right hand position may be between 0.0 volts and 0.2 volts.

36.2 Sensitivity Control voltages.

TABLE XIV.

Sensitivity control at maximum sensitivity.	0.0 volts to 0.5 volts
Sensitivity control at minimum sensitivity.	15 volts plus or minus 20%

TRANSMITTER-RECEIVER

TYPE ATR-5

STORES REFERENCE - NO.10-D-1546.

PARTS LIST.

C O N D E N S E R S.

REF. NO.	SCHEMATIC DESIGNATION	NOMENCLATURE	DESCRIPTION
10C/1716	C1	Osc. Cathode Bypass	C.D. 4STL, .002 mfd. 1000 V.
10C/1870	C2)	Osc. Tuning Condenser.	Marconi 87719.
10C/1870	C3)		
10C/1871	C4	P.A. Grid Coupling Condenser.	C.D. 4STL, 100 mmf. 1000 V.
10C/1756	C5	Osc. Plate Bypass.	C.D. 4STL, .01 mfd. 1000 V.
10C/1716	C6	P.A. Cathode Bypass.	Identical with C1.
10C/1872	C7	P.A. Screen Bypass.	C.D. 4STL, .002 mfd. 2500 V.
10C/1691	C8	P.A. Plate Bypass.	C.D. 4STL, .01 mf. 2500 V.
10C/1873	C9)		C.D. 9STL, 200 mmf. 5000 V.
10C/1874	C10)	P.A. Tuning Pads.	C.D. 9STL, 100 mmf. 5000 V.
10C/1874	C11)		Identical with C10.
10C/1873	C12)		Identical with C9.
10C/1875	C13)	P.A. Tuning Condensers.	Marconi 87446.
10C/1875	C14)		

SHEET 2.

REF. NO.	SCHEMATIC DESIGNATION	NOMENCLATURE	DESCRIPTION.
10C/1876	C15)) C16)	Relay Arc Suppressor Condensers.	Dual .05 mfd. C.D. MC-521, Dykanol C.
10C/1691	C17	P.A. Plate Blocking Condenser.	Identical with C8.
10C/1877	C18	Mod. Screen Bypass.	C.D. MC-461, 1 mfd. 1000 V. Dykanol C.
10C/1878	C19	Microphone Bypass.	C.D. MC-544, 2 mfd. 1000 V. Dykanol C.
10C/1879	C20	Power Supply Filter Condenser.	C.D. MC-520, 4 mfd. 1000 V. Dykanol C.
10C/1880	C21	Dynamotor Secondary Hash Filter.	.01 mfd. Aerovox 1450 Low Loss.
10C/1758 10C/1758	C22)) C23)	Dynamotor Primary Hash Filter.	.01 mfd. plus or minus 10%, Aerovox 1467. Low Loss. R.C.A.F. plus or minus 5 %.
10C/1718	C24)) C25)	Filament Supply Hash Filter.	Dual .25 mfd. C.D. MC-446 Dykanol C.
10C/1756	C26	Crystal Bypass.	Identical with C5.
10C/1758	C27	Ant.Coil A.V.C.Bypass.	Identical with C22.
10C/1881	C28	Ant.Coil Gang Tuning Condenser "Yellow".	Marconi 87025, with 88114 rear bracket.
10C/~~1882~~ 1881	C29	Ant.Coil Trimmer, Condenser "Yellow".	Part of C28.
10C/1884	C30	Ant.Coil Gang Tuning Condenser "Green".	Marconi 87025, with 88115 rear bracket.
10C/~~1882~~ 1884	C31	Ant. Coil Trimmer Condenser "Green".	Part of C30.

REF. NO.	SCHEMATIC DESIGNATION	NOMENCLATURE	DESCRIPTION.
10C/1758	C32	Ant. Stage Cathode Bypass.	Identical with C22.
10C/1758	C33	Det. Coil Primary, H.T. Bypass.	Identical with C22.
10C/1758	C34	V5 R.F. Amp. Screen Bypass.	Identical with C22.
10C/1758	C35	Det. Coil A.V.C. Bypass.	Identical with C22.
10C/1881	C36	Det. Coil Gang Tuning Condenser "Yellow".	Part of C28.
10C/1881	C37	Det. Coil Trimming Condenser "Yellow".	Part of C28.
10C/1758	C38	V6 Det. Screen Bypass.	Identical with C22.
10C/1884	C39	Det. Coil Gang Tuning Condenser "Green".	Part of C30.
10C/1884	C40	Det.Coil Gang Trimming Condenser "Green".	Part of C30.
10C/1758	C41	V6 Heater Bypass.	Identical with C22.
10C/1885	C42	Fine Tuning H.T. Bypass.	Dual 0.5 mfd. 600 V. C.C. Dykanol C. MC-519, Type I.T., one section.
10C/1817	C43	Ant. Stage Fixed Tuning Condenser.	7-1/2 mmfd, plus or minus .5 mmfd, Aerovox type 1469 low loss silver mica. R.C.A.F. plus or minus 2%.
10C/1886	C44	Ant.Stage Compensating Condenser.	Centralab 30 mmfd. plus or minus 2-1/2%. Class D, Coeff.- .00075.
10C/1758	C45	V7 Fine Tuning Control Tube Screen Bypass.	Identical with C22.

SHEET 4.

REF. NO.	SCHEMATIC DESIGNATION	NOMENCLATURE	DESCRIPTION.
10C/1886	C46	Det.Stage Compensating Condenser.	Identical with C44.
10C/1758	C47	Osc. Grid Blocking Condenser.	Identical with C22.
10C/1887	C48	Cso. Series Tracking Condenser.	1200 mmfd. plus or minus 1%, Aerovox type 1464 low loss silver mica.
10C/~~[illegible]~~ 947	C49	V7 Fine Tuning Tube Grid Blocking Condenser.	250 mmfd. plus or minus 10% Aerovox type 1468, low loss. R.C.A.F. plus or minus 5%.
10C/~~[illegible]~~ 1881	C50	Osc. Tuning Gang Condenser "Yellow".	Part of C28.
10C/1889	C51	Osc. Parallel Trimmer "Yellow".	Sickles, Type ATR-22, 2-9 mmfd.
10C/~~[illegible]~~ 1884	C52	Osc. Tuning Gang Condensor "Green"	Part of C30.
10C/1889	C53	Osc. Parallel Trimmer "Green".	Identical with C51.
10C/1890	C54	1st. I.F. Transformer Primary Tuning.	220 mmfd plus or minus 2-1/2% Aerovox type 1469 low loss silver mica.
10C/1761	C55	1st. I.F. Transformer Secondary Tuning.	170 mmfd. plus or minus 2-1/2% Aerovox type 1469 low loss silver mica. R.C.A.F. plus or minus 2%.
10C/1758	C56	V7 Fine Tuning Tube Cathode Bypass.	Identical with C22.
10C/1758	C57	1st. I.F. Transformer H.T. Bypass.	Identical with C22.

REF. NO.	SCHEMATIC DESIGNATION	NOMENCLATURE	DESCRIPTION.
10C/1758	C58	1st. I.F. Transformer A.V.C. Bypass.	Identical with C22.
10C/1758	C59	V8 I.F. Amp. Screen Bypass.	Identical with C22.
10C/1758	C60	V8 I.F. Amp. Cathode Bypass.	Identical with C22.
10C/1758	C61	2nd. I.F. Transformer H.T. Bypass.	Identical with C22.
10C/1890	C62	2nd. I.F. Transformer Primary Tuning.	Identical with C54.
10C/1761	C63	2nd. I.F. Transformer Secondary Tuning.	Identical with C55.
10C/1758	C64	2nd. I.F. Transformer bias Bypass.	Identical with C22.
10C/1758	C65	A.V.C. Line Bypass.	Identical with C22.
10C/1758	C66	V9, 2nd. Det. Screen Bypass.	Identical with C22.
10C/1758	C67	V9, 2nd. Det. Cathode Bypass.	Identical with C22.
10C/1891	C68	3rd. I.F. Transformer Primary Tuning.	110 mmfd. plus or minus 2-1/2% Aerovox type 1469, low loss silver mica.
10C/~~[illegible]~~ 946	C69	3rd. I.F. Transformer H.T. Bypass.	Identical with C22.
10C/1812	C70	Audio A.V.C. Diodes Coupling Condenser.	100 mmfd. plus or minus 10%, Aerovox type 1468, low loss. R.C.A.F plus or minus 5%.
10C/~~[illegible]~~ 948	C71	Diode output 2nd. Filter condenser.	500 mmfd. plus or minus 10% AEROVOX type 1468 low loss.

REF. NO.	SCHEMATIC DESIGNATION	NOMENCLATURE	DESCRIPTION.
10C/1758	C72	Audio Coupling Condenser.	Identical with C22.
10C/~~1092~~ 948	C73	Diode Output 1st. Filter Condenser.	Identical with C71.
10C/1819	C74	V10 Output Tube Cathode Bypass.	1.0 mfd. ~~600~~ ~~1000~~ 600 Volt. C.D. MC-461, Dykanol C. Type FT.
10C/1885	C75	V10 Output Tube Screen Bypass.	2nd. Section of C42.
10C/~~1885~~ 950	C76	Output Transformer Primary R.F. Bypass.	.001 mfd. plus or minus 10%, Aerovox type ~~1467~~ 1468 low loss.
10C/1894	C77	H.T. Line Bypass.	4.0 mfd. ~~400~~ ~~1000~~ 600 Volt C.D. MC-520 Dykanol C. Type JT.
10C/1771	C78	Det. Coil Primary Tuning Condenser.	35 mmfd. plus or minus 2-1/2% Aerovox type 1469 low loss silver mica. R.C.A.F. plus or minus 2%.
10C/1895	C79	Osc. Series Tracking Compensating Condenser.	Centralab 500 mmfd. plus or minus 2-1/2% Class B. coeff.- .00075.
10C/1896	C80	Osc. Parallel Tracking Compensating Condenser.	Centralab 29 mmfd plus or minus 1% Class D. Coeff. - .00075.
10C/1758	C81	V5 Heater Bypass.	Identical with C22.
10C/1758	C82	Battery Line Bypass, at fuse.	Identical with C22.
10C/1758	C83	Do.	Identical with C22.

NOTE — All Voltages Specified above are test Values

I N D U C T A N C E S.

REF. NO.	SCHEMATIC DESIGNATION	NOMENCLATURE	DESCRIPTION.
10C/1897	L1	Osc. Plate Coil	Marconi 87470.
10C/1898	L2	P.A. Plate Choke	Hammarlund CHX.
10C/1898	L3	Antenna Static Drain.	Identical with L2.
10C/1899	L4	Antenna Coil.	Marconi 87340.
10C/1900	L5)	Dynamotor Primary Chokes	Marconi 88087
10C/1900	L6)		
10C/1901	L7	Dynamotor Secondary Choke	Marconi D-87875

R E S I S T O R S.

REF. NO.	SCHEMATIC DESIGNATION	NOMENCLATURE	DESCRIPTION.
10C/959	R1	Osc. Grid Leak	100,000 ohms plus or minus 10%, I.R.C.BT$\frac{1}{2}$.
10C/1671	R2	Meter Shunt.	500 ohms, I.R.C. BW$\frac{1}{2}$.
10C/958	R3	Osc.Screen Resistor.	50,000 ohms plus or minus 10%, I.R.C.BT$\frac{1}{2}$.
10C/1653	R4	Osc. Plate Supply Resistor.	20,000 ohms, plus or minus 10%, I.R.C. AB, C Coating.
10C/1903	R5	P.A. Grid Leak	10,000 ohms, plus or minus 10%, I.R.C.BT2.
10C/1904	R6	P.A.Screen Resistor.	15,000 ohms, plus or minus 10%, I.R.C. DG, C Coating.
10C/2750	R7	P.A.Cathode Resistor.	250 ohms, plus or minus 10%, I.R.C. DG, C Coating.
10C/1676	R8	Parasitic Suppressor.	100 ohms, I.R.C. BT$\frac{1}{2}$ plus or minus 10%.
10C/967.	R9	Side Tone Resistor.	20,000 ohms, plus or minus 10%, I.R.C. BT$\frac{1}{2}$.
10C/1906	R10	Mod. Gain Control.	Marconi 87703.
10C/1907	R11	Mod.Cathode Resistor.	200 ohms, I.R.C. DG, C Coating.
10C/964	R12)	Mod. Screen Voltage Divider.	20,000 ohms, I.R.C. DG, C Coating.
10C/1909	R13)	Mod. Screen Voltage Divider.	8,000 ohms, I.R.C. DG, C Coating.
10C/1910	R14	Meter Compensator.	Marconi 87689.

REF. NO.	SCHEMATIC DESIGNATION	NOMENCLATURE	DESCRIPTION.
10C/1911	R15	Volume Control.	Marconi 87435.
10C/1912	R16	Fine Tuning Control.	Marconi 87434.
10C/~~1913~~ 1676	R17	Relay Arc Suppressor.	100 ohms, I.R.C. BW½.
10C/1914	R18	P.A. Cathode Meter Shunt.	0.5 ohms, I.R.C. BW½ 2% Tolerance.
10C/1914	R19	Mod. Cathode Meter Shunt.	Do.
10C/~~1002~~ 959	R20	Ant.Coil A.V.C.Filter.	Identical with R1.
10C/1915	R21	V5 R.F. Amp. Cathode,	250 ohms, plus or minus 10%, I.R.C. Type BT½.
10C/~~1916~~ 975	R22	V5 R.F. Amp. Screen Dropping Resistor.	50,000 ohms, plus or minus 10%, I.R.C. Type BT, 1 Watt.
10C/1673	R23	Det. Coil H.T. Filter.	1000 ohms plus or minus 10%, I.R.C. Type BT, 1/2 Watt.
10C/~~1002~~ 959	R24	Det.Coil A.V.C.Filter.	Identical with R1.
10C/~~1017~~ 974	R25	V6 Det. Screen Bleeder.	20,000 ohms plus or minus 10%, I.R.C. Type BT, 1 Watt.
10C/1918	R26	V6 Det.Screen Dropping Resistor.	11,000 ohms plus or minus 5%, Type AB, 4 watts, Terminal No. 1, C Coating.
	R27		
10C/~~1059~~ 968	R28	V6 Osc. Grid Leak.	Identical with R3.
	R29		
10C/1919	R30	V6, V7, Osc. & Fine Tuning H.T. Dropping.	24,000 ohms plus or minus 5%, I.R.C. Type DH, 10 Watts. C Coating, No.2 Terminal.

SHEET 10.

REF. NO.	SCHEMATIC DESIGNATION	NOMENCLATURE	DESCRIPTION.
10C/~~1016~~ 975	R31	V7 Fine Tuning H.T. Feed.	Identical with R22.
10C/1654	R32	V7, Fine Tuning Screen Dropping.	25,000 ohms, plus or minus 5%, I.R.C. Type AB, 4 watts, C Coating Terminal No.1.
10C/1883	R33	V7, Fine Tuning Screen Bleeder.	25,000 ohms plus or minus 10%, I.R.C. Type BT, 1 Watt.
10C/~~1664~~ 2484	R34	V7 Fine Tuning Grid Signal Supply.	15,000 ohms plus or minus 10%, I.R.C. Type BT, 1/2 Watt.
10C/~~1882~~ 959	R35	V7 Fine Tuning Grid Bias Supply.	Identical with R1.
10C/1920	R36	Sensitivity Control.	1500 ohms plus or minus 10% Potentiometer Marconi No. 88992.
10C/1673	R37	1st. I.F. Transformer H.T. Filter.	Identical with R23.
10C/~~1882~~ 959	R38	1st. I.F. Transformer A.V.C. Filter.	Identical with R1.
10C/~~1016~~ 975	R39	V8, 1st I.F. Amp. Screen Dropping.	Identical with R22.
10C/1915	R40	V8, 1st. I.F. Amp. Cathode	Identical with R21.
10C/1673	R41	2nd. I.F. Transformer H.T. Filter.	Identical with R23.
10C/1921	R42	A.V.C. Diode Output Filter.	1.5 megohms, plus or minus 10%, I.R.C. Type BT, 1/2 Watt.

REF. NO.	SCHEMATIC DESIGNATION	NOMENCLATURE	DESCRIPTION.
10C/1651	R43	A.V.C. Diode Load.	1.0 megohm plus or minus 10%, I.R.C. Type BT, 1/2 Watt.
10C/~~[illegible]~~ 975	R44	V9, 2nd. I.F. Amp. Screen Dropping.	Identical with R22.
10C/1915	R45	V9, 2nd. I.F. Amp. Cathode.	Identical with R21.
10C/1922	R46	V9, A.V.C. Diode Delay Voltage.	3,000 ohms plus or minus 10%, I.R.C., Type BT, 1/2 Watt.
10C/1673	R47	3rd. I.F. Transformer H.T. Filter.	Identical with R23.
10C/1675	R48	Audio Diode Output Filter.	10,000 ohms plus or minus 10%, I.R.C. Type BT, 1/2 Watt.
10C/1923	R49	Audio Diode Output Load.	150,000 ohms, plus or minus 10%, I.R.C. Type BT, 1/2 Watt.
10C/~~[illegible]~~ 962	R50	V10, Output Tube Grid Bias Supply.	500,000 ohms, plus or minus 10%, I.R.C. Type BT, 1/2 Watt.
10C/1924	R51	V7 Control Tube Minimum Bias.	400 ohms plus or minus 10%, I.R.C. Type BT, 1/2 Watt.
10C/1663	R52	V10 Output Tube Cathode.	1,000 ohms plus or minus 10%, I.R.C. Type BT, 1 Watt.
10C/1925	R53	V10 Output Tube H.T. Supply Dropping.	11,500 ohms plus or minus 5%, I.R.C. Type F.D. 22 WATTS ~~[illegible]~~, C Coating Terminal No. ~~[illegible]~~ 4

SHEET 12.

REF. NO.	SCHEMATIC DESIGNATION	NOMENCLATURE	DESCRIPTION
10C/1926	R54	Main H.T. Dropping.	5,300 ohms plus or minus 5%, I.R.C. Type FD, 22 Watts, C Coating Terminal No.2.
10C/~~1905~~ 967	R55	Side Tone Resistor.	Identical with R9.
10C/1912	R56	See Remote Control Unit.	Identical with R16.
10C/1911	R57	See Remote Control Unit.	Identical with R15.
10C/1927	R58	Local-Remote Switch Voltage Limiter.	15,000 ohms plus or minus 10%, I.R.C. Type BT, 1 Watt.
10C/1675.	R59.	PARASITIC SUPPRESSOR.	Identical with R8.

T R A N S F O R M E R S.

REF. NO.	SCHEMATIC DESIGNATION	NOMENCLATURE	DESCRIPTION.
10A/1928	T1	Microphone Transformer.	Marconi 86322.
10A/1929	T2	Modulator Transformer.	Marconi 86321.
10A/1930	T3	~~Antenna Coil~~. TRANSFORMER	Marconi 87210.
10A/1931	T4	~~Detector Coil~~. TRANSFORMER	Marconi 87211.
10A/1932	T5	~~Oscillator Coil~~. TRANSFORMER	Marconi 87212.
10A/1933	T6	1st. I.F. Transformer.	Marconi D-87185.
10A/1934	T7	2nd. I.F. Transformer.	Marconi D-87200.
10A/1935	T8	3rd. I.F. Transformer.	Marconi D-87205.
10A/1936	T9	Audio Output Transformer.	Marconi D-86557.

SHEET 14.

R E L A Y S.

REF. NO.	SCHEMATIC DESIGNATION	NOMENCLATURE	DESCRIPTION
10F/1937	E1	Transfer Relay	Marconi 87345.
10F/1938	E2	Starting Relay	Marconi 87691.
10F/1939	E3	Side Tone Relay	Marconi 87692.

S W I T C H E S.

REF. NO.	SCHEMATIC DESIGNATION	NOMENCLATURE	DESCRIPTION
10F/1940	S1	Start Stop Switch.	A.H. & H. 20992 Bat Lever.
10F/1941	S2	Band Switch.	A.H. & H. 21349 Bat Lever.
10F/1942	S3	Local Remote Switch.	Marconi 88989.
10F/1940	S4	Crystal Heater Switch.	Identical with S1.
10F/1943	S5	Meter Switch.	Marconi 88988.
10F/1944	S6	Trans.Rec.I.C.Switch.	Marconi 87690.
10F/1945	S7	Motor Unit Switch.	Marconi 87420.
10F/1946	S8-1	Crystal Selector Switch.)	Centralab Switch Section V.
10F/1946	S8-2	Osc. Condenser Selector Switch.)	
10F/1947	S8-3	Ceramic Plunger Assy.	Marconi 87396.
10F/1948		Contact Disc.	Marconi 87411.
10F/1949		Contact Disc Springs. (2 required).	Marconi 87410.

REF. NO.	SCHEMATIC DESIGNATION	NOMENCLATURE	DESCRIPTION
10F/1950		Mycalex Contact Plate.	Marconi 87395.
10F/1951		Mycalex Top Guide.	Marconi 87420.
10F/1952	S8-4	Ant. Circuit (Rec.) Selector Switch.	Marconi 87240 - first section.
10F/1952	S8-5	Det. Circuit (Rec.) Selector Switch.	Marconi 87240 - Second Section - Identical with S8-4.
10F/1952	S8-6	Osc. Circuit (Rec.) Selector Switch.	Marconi 87240 - Third Section.
10F/1953	S8 Motor	Band Switch Motor.	Marconi 87021.
10F/1954		Trunion.	Marconi 87397.
10F/1955		Bell Crank.	Marconi 87401.
10F/1956		Square Rod.	Marconi 87425.
10F/1957		Switch Lever (2 Req'd).	Marconi 87427.
10F/1958		Bell Crank Pedestal.	Marconi 87400.
10F/1959		Bell Crank to Pedestal Shaft.	Marconi 87404.
10F/1960		Bell Crank to S8-3 Pin.	Marconi 87406.
10F/1961		Switch Lever to Rod. Pin (2 req'd.)	Marconi 87426.
10F/1962		Felt Washer.	Marconi 87388.
10F/1963		Metal Washer.	Marconi 87391.
10F/1964		Cotter Clip.	Marconi 68065.
10F/2502.	S12.	GATE SWITCH	MARCONI 93279
10F/2503		BUTTON FOR ABOVE	MARCONI 93280

SHEET 16.

VALVES.

REF. NO.	SCHEMATIC DESIGNATION	NOMENCLATURE	DESCRIPTION.
10E/~~1965~~ 1579	V1	Oscillator Valve.	R.V.C. 6L6.
10E/846	V2	P.A. Valve.	R.V.C. 807.
10E/~~1965~~ 853	V3	Modulator Valve.	~~Same as V1.~~ RVC. 6L6G
10E/~~1965~~ 853	V4	Modulator Valve.	~~Same as V1.~~ RVC. 6L6G
10E/1302	V5	R.F. Amplifier Valve.	R.V.C. 6SK7.
10E/~~1966~~ 1576	V6	Detector Oscillator Valve.	R.V.C. 6SA7.
10E/1967	V7	Fine Tuning Control Valve.	R.V.C. 6SJ7.
10E/1302	V8	1st. I.F. Amplifier Valve.	Same as V5.
10E/~~1968~~ 1417	V9	2nd. I.F. Amplifier-Diode Valve.	R.V.C. 6B8.
10E/~~1969~~ 1575	V10	Output Power Valve.	R.V.C. 38.

S O C K E T S.

REF. NO.	SCHEMATIC DESIGNATION	NOMENCLATURE	DESCRIPTION
10H/1750		V1 Socket.	Amphenol RSS-8.
10H/1749		V2 Socket.	Amphenol RSS-5.
10H/1750		V3 Socket.	Amphenol RSS-8.
10H/1750		V4 Socket.	Amphenol RSS-8.
10H/1750		V5 Socket.	Amphenol RSS-8.
10H/1750		V6 Socket.	Amphenol RSS-8.
10H/1750		V7 Socket.	Amphenol RSS-8.
10H/1750		V8 Socket.	Amphenol RSS-8.
10H/1750		V9 Socket.	Amphenol RSS-8.
10H/1749		V10 Socket.	Amphenol RSS-5.
10H/1751		X1 Socket) Crystals	W.E. KS-7704.
10H/1751		X2 Socket) Crystals	W.E. KS-7704.

SHEET 16.

M I S C E L L A N E O U S.

REF. NO.	SCHEMATIC DESIGNATION	NOMENCLATURE	DESCRIPTION
10H ~~10A~~/1970	P1	Battery Cable Plug.	Cannon WKCS-32SL.
10H ~~10A~~/1971	P3	Mic. Cable Plug.	Cannon WK-4-32SL.
10H ~~10A~~/1972	P5	Remote Cable Plug.	Cannon GK-12-32SL.
10A/1973		Meter.	Weston No.506, 0-10 ma, Flush Mounting, metal case, Aeroplane pivots.
10B ~~10A~~/1974		Antenna Bushing.	Johnson No.20 White.
10H ~~10A~~/1793		Fuse Holder.	Littlefuse 1212-A.
5C/316	F1	Fuse, 30 Amps.	Littlefuse 1099.
5C/316	F2	Fuse, 30 Amps.	Littlefuse 1099.
10A/1975		Dynamotor.	Marconi 88083.

REMOTE CONTROL UNIT.

REF. NO.	SCHEMATIC DESIGNATION	NOMENCLATURE	DESCRIPTION
10C/1912	R56	Fine Tuning Control.	Identical with R16.
10C/1911	R57	Volume Control.	Identical with R15.
10F/1940	S9	Start Stop Switch.	Identical with S1.
10F/1976	S10	Trans.Rec.I.C. Switch.	Marconi 89084.
10F/1941	S11	Band Switch.	Identical with S2.

A C C E S S O R I E S.

REF. NO.	SCHEMATIC DESIGNATION	NOMENCLATURE	DESCRIPTION
10H/1977	P2	Battery Cable Receptacle.	Marconi 89073.
10H/1978	P4	Mic. Cable Plug.	Marconi 89074.
10H/1979	P6	Remote Cable Plug.	Marconi 89075.
5E/		Battery Cable.	Marconi 89076.
5E/		Microphone Cable.	Marconi 89077.
5E/		Remote Cable.	Marconi 89078.
10D/1980		Shock Mounting.	Marconi 88001.
10D/1501		Transit Case.	Marconi 85196.

TRANSMITTER RECEIVER
TYPE ATR5
R.C.A.F. REF. 10D-1546

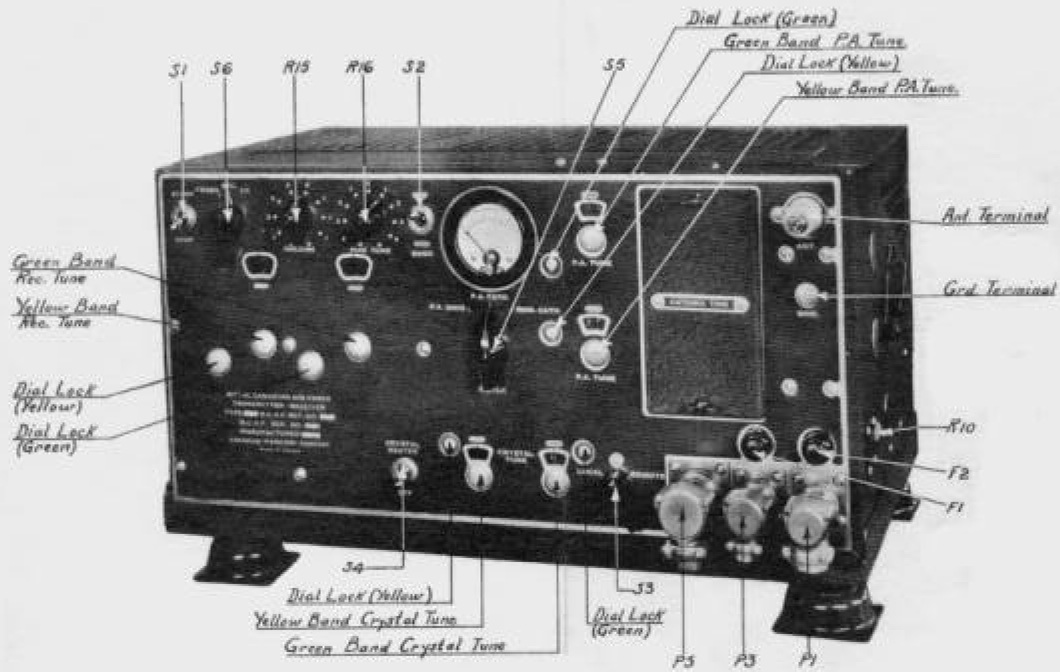


FIG. 1

TRANSMITTER RECEIVER
TYPE ATR5
R.C.A.F. REF. 10D-1546

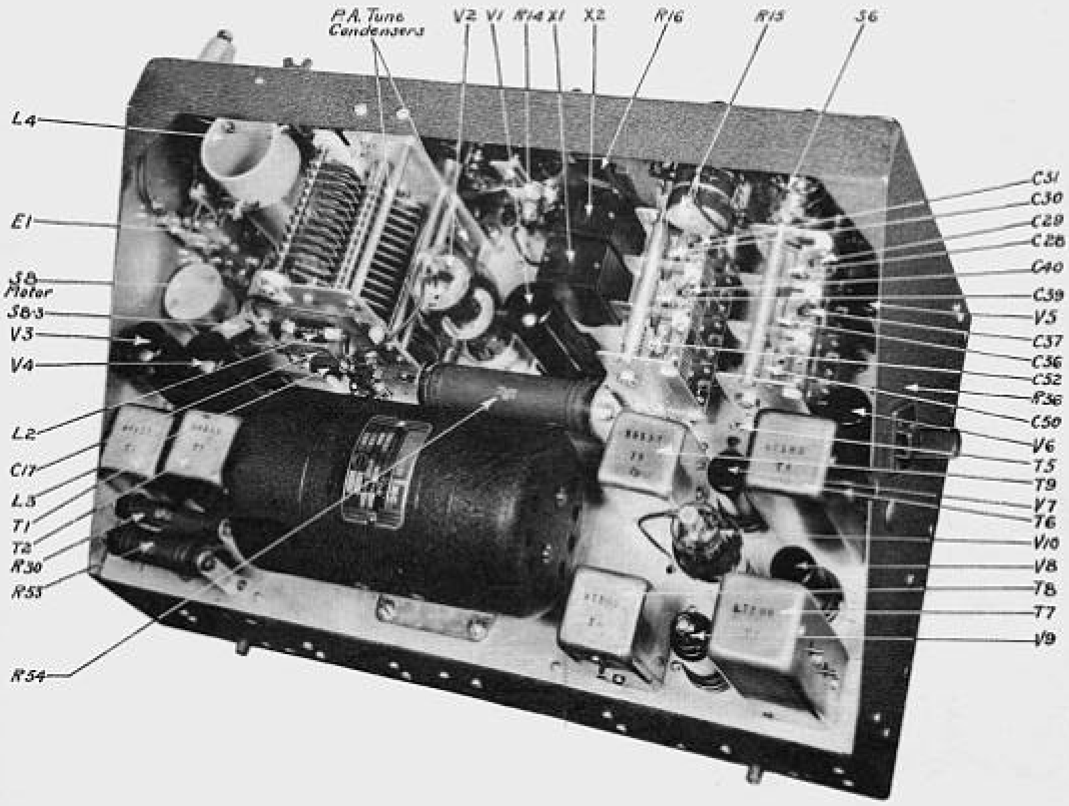


FIG. 11

TRANSMITTER RECEIVER
TYPE ATR5
R.C.A.F. REF. 10D-1546

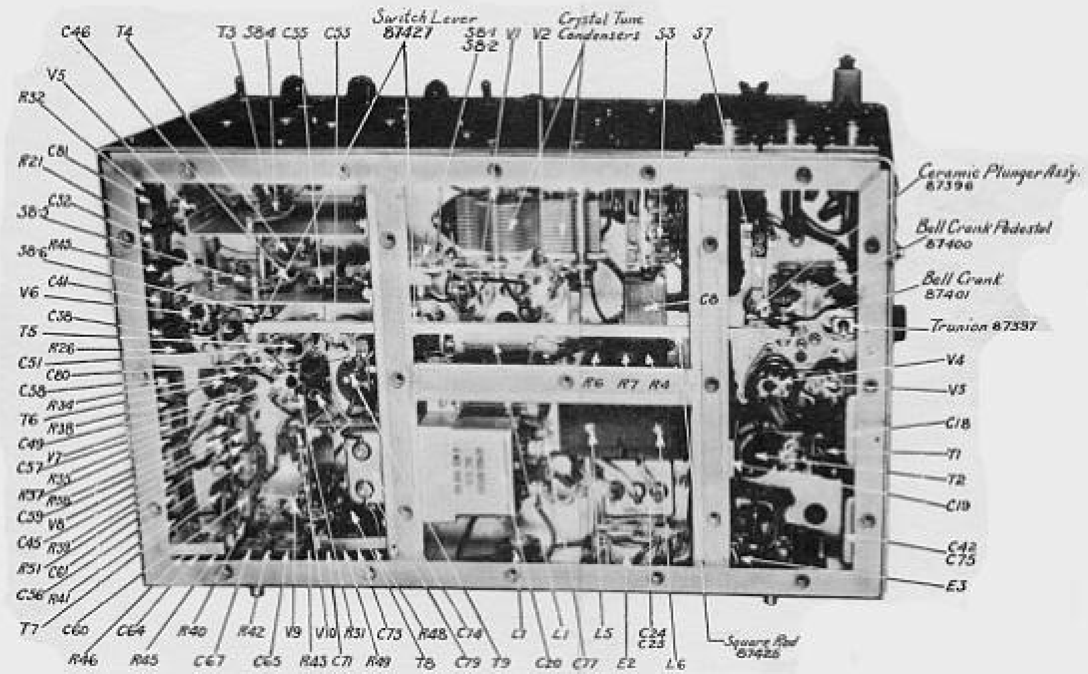


FIG. III

TRANSMITTER RECEIVER
TYPE ATR5
R.C.A.F. REF. 10D-1546

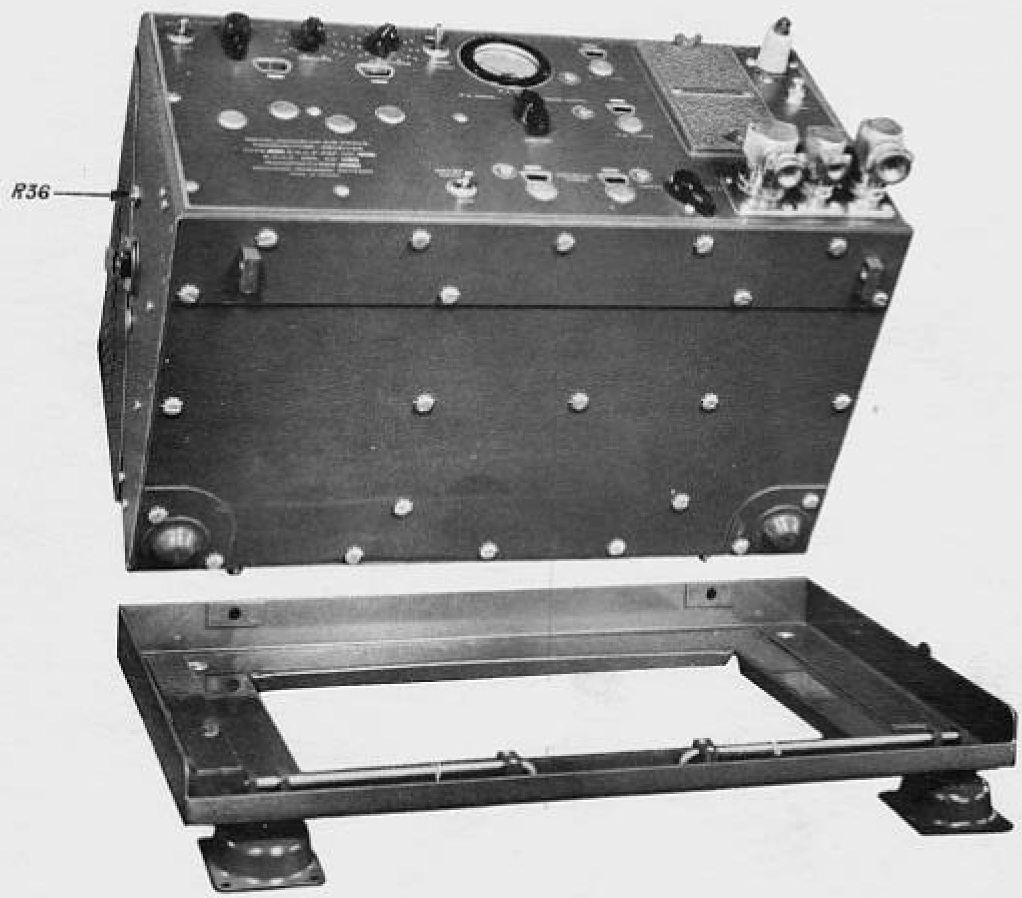


FIG. IV

TRANSMITTER RECEIVER ATR5
REMOTE CONTROL UNIT
R.C.A.F. REF. 10D-1547

FIG. V

TRANSMITTER RECEIVER ATR5
REMOTE CONTROL UNIT
R.C.A.F. REF. 10D-1547

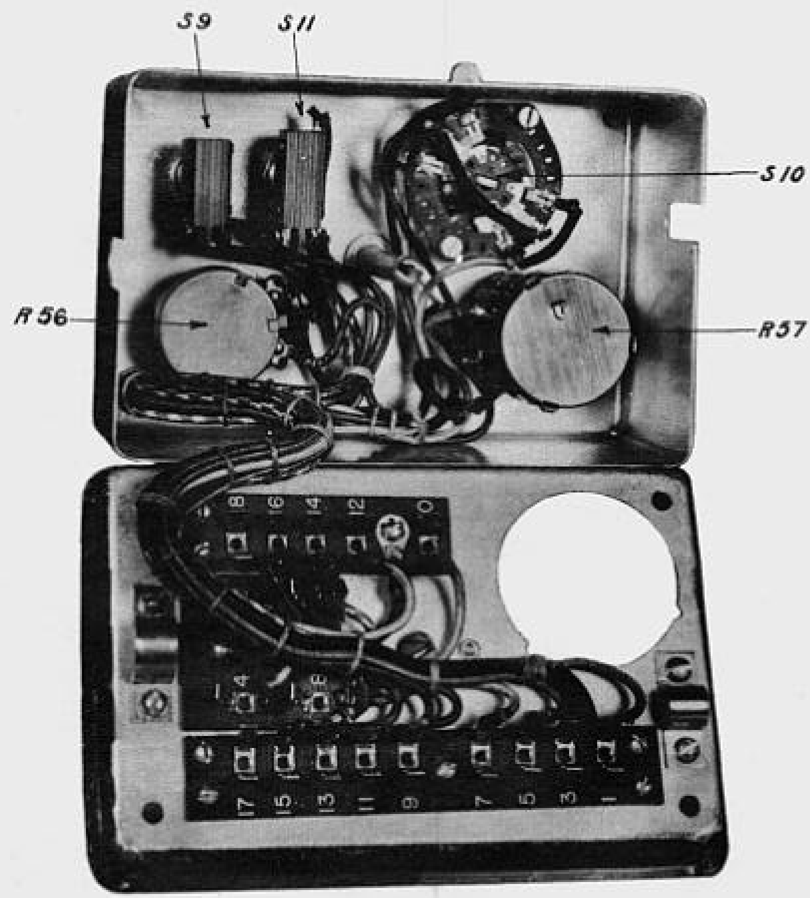
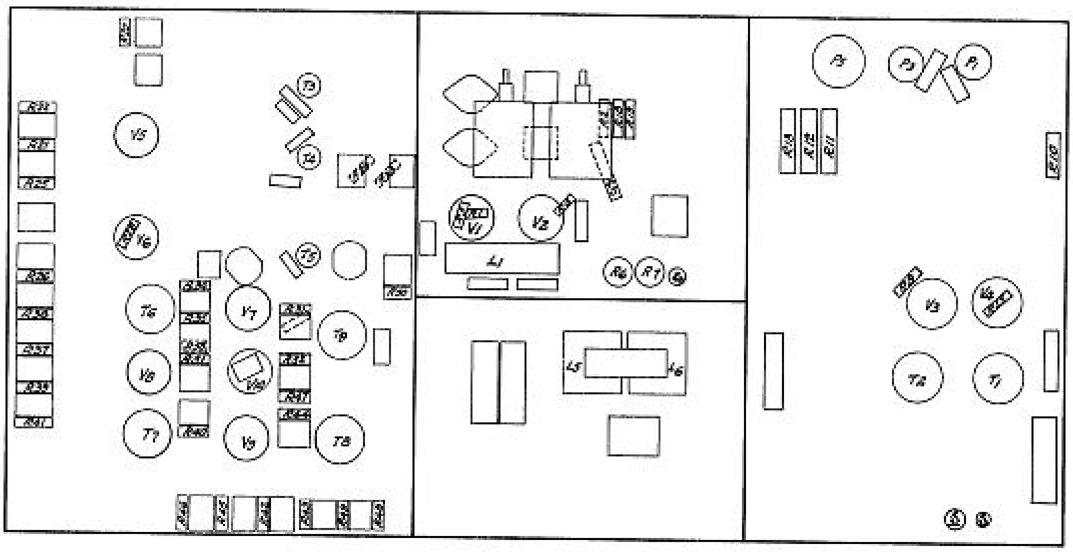


FIG. VI

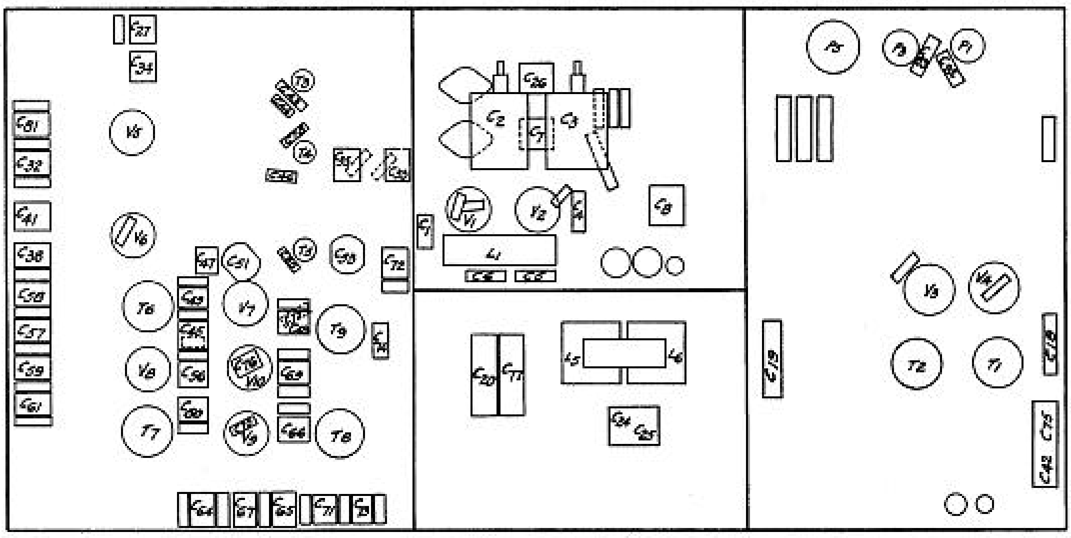


Resistor Location Chart

Fig. VII

Transmitter Receiver ATR5

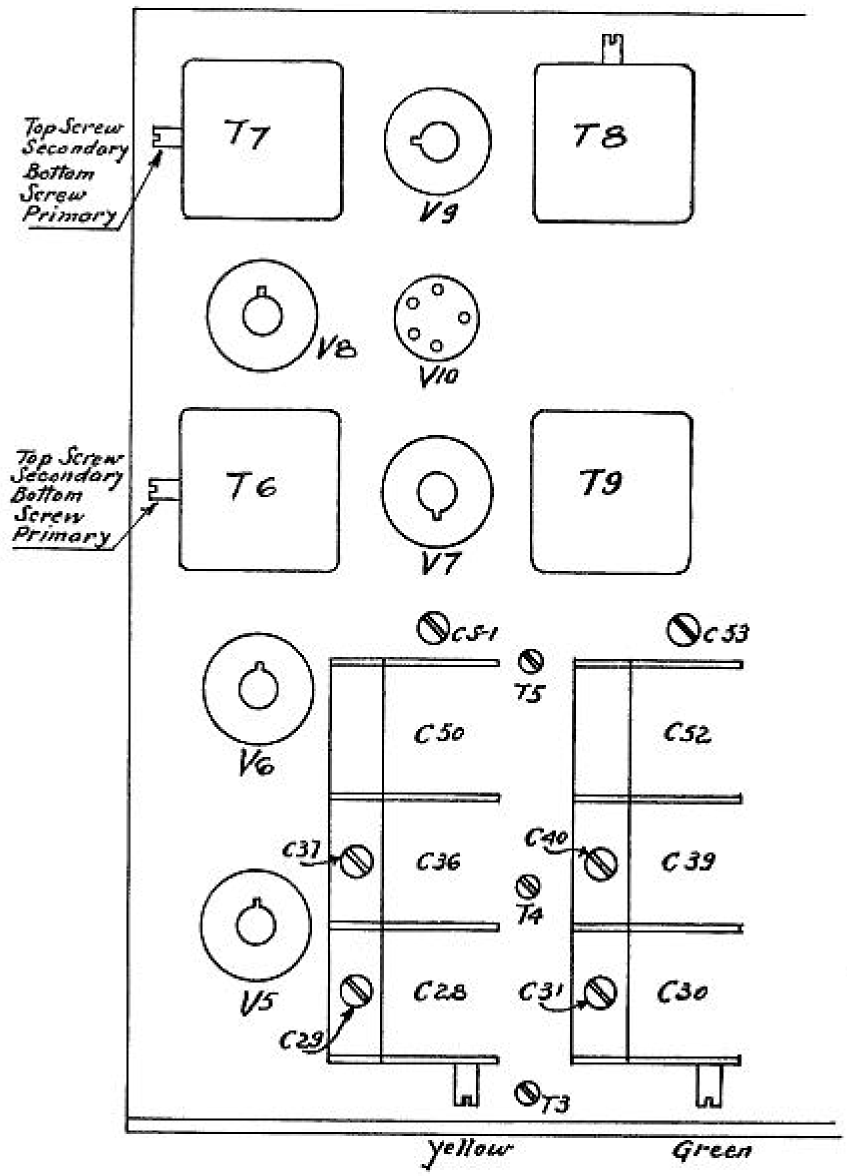
R.C.A.F. Ref. 10D-1546



Condenser Location Chart

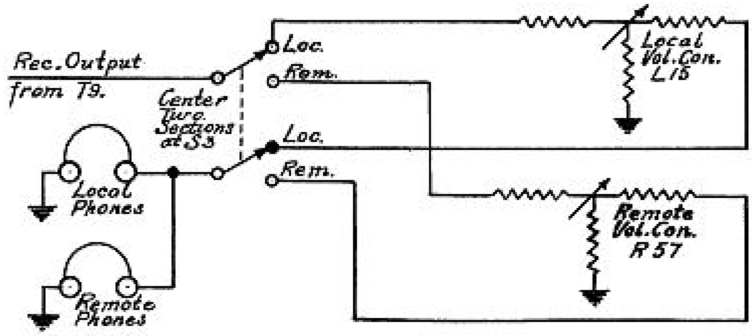
Fig. VIII

Transmitter Receiver ATR5
R.C.A.F. Ref. 10D-1546



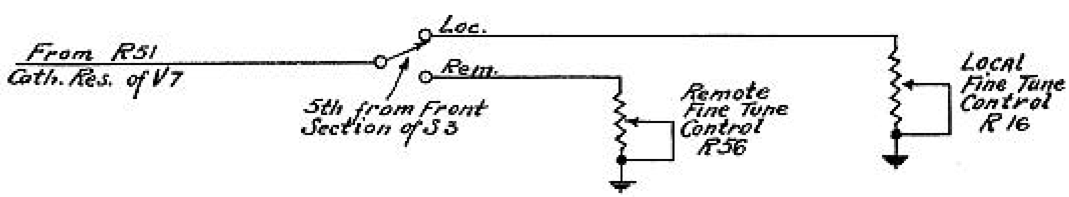
Receiver Valve and Adjustment Location

Fig. IX



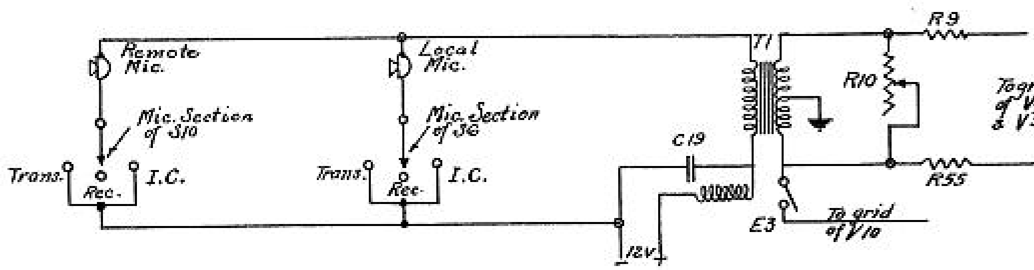
Simplified Volume Control Circuit

Fig. XI

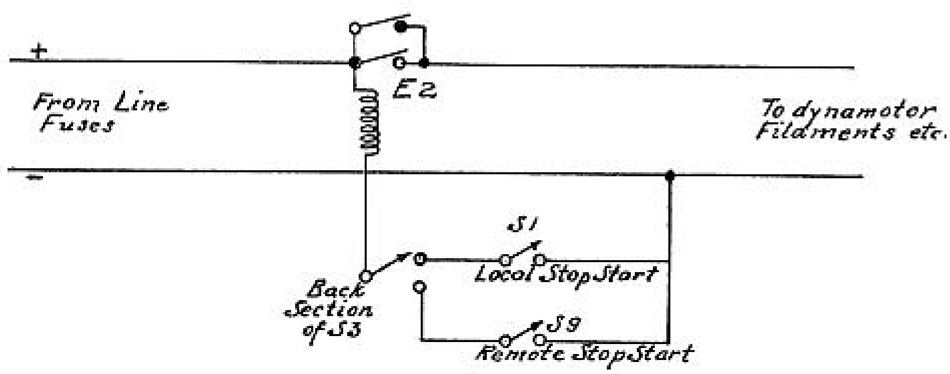


Simplified Fine Tune Control Circuit — Fig. XII

Transmitter Receiver ATR5
R.C.A.F. Ref. 10D-1546

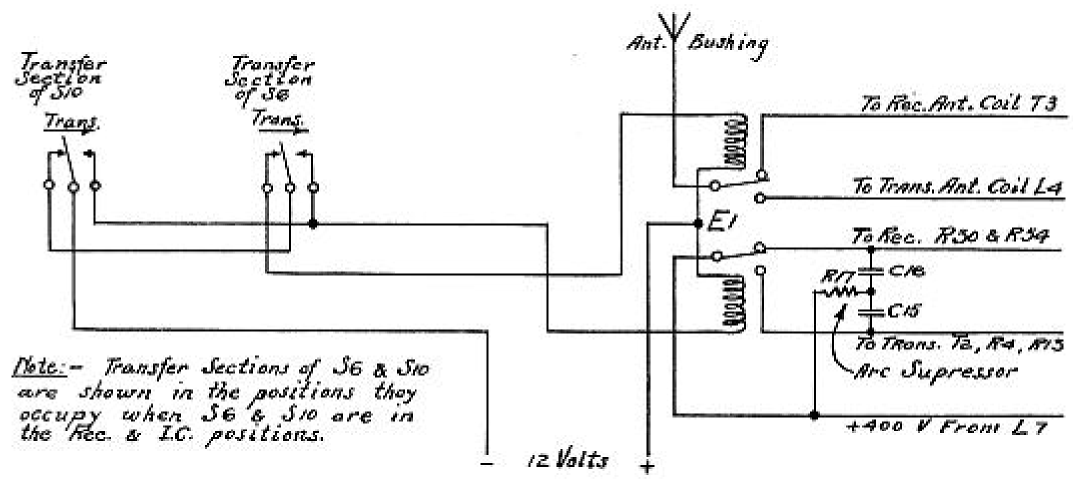


Simplified Microphone & Side Tone Circuit Fig. XIII



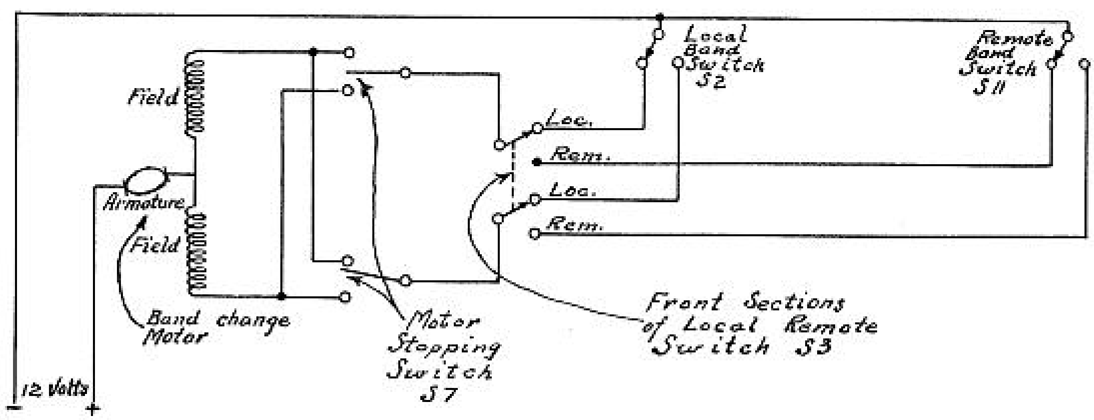
Simplified Power Control Circuit

Fig. XIV



Simplified Power & Antenna Transfer Circuits

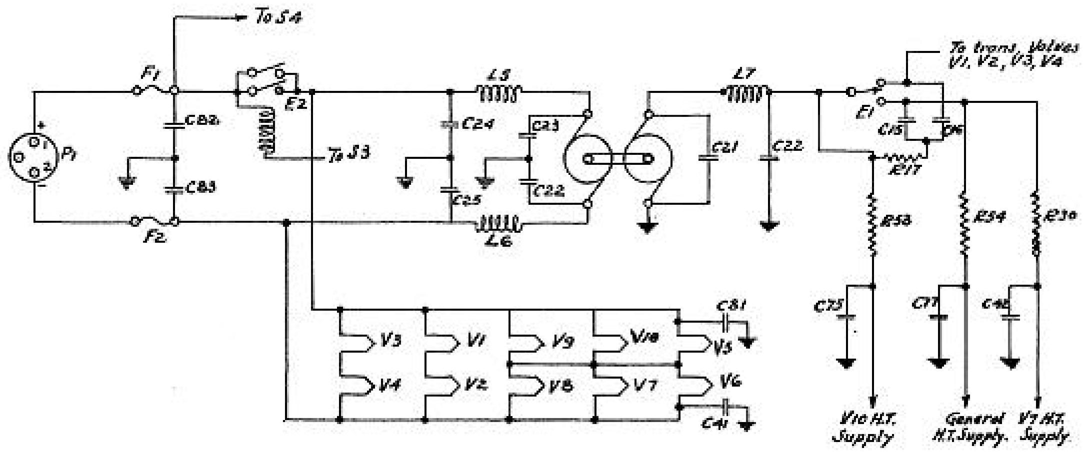
Fig. XV



Simplified Band Change Motor Control

Fig. XVI

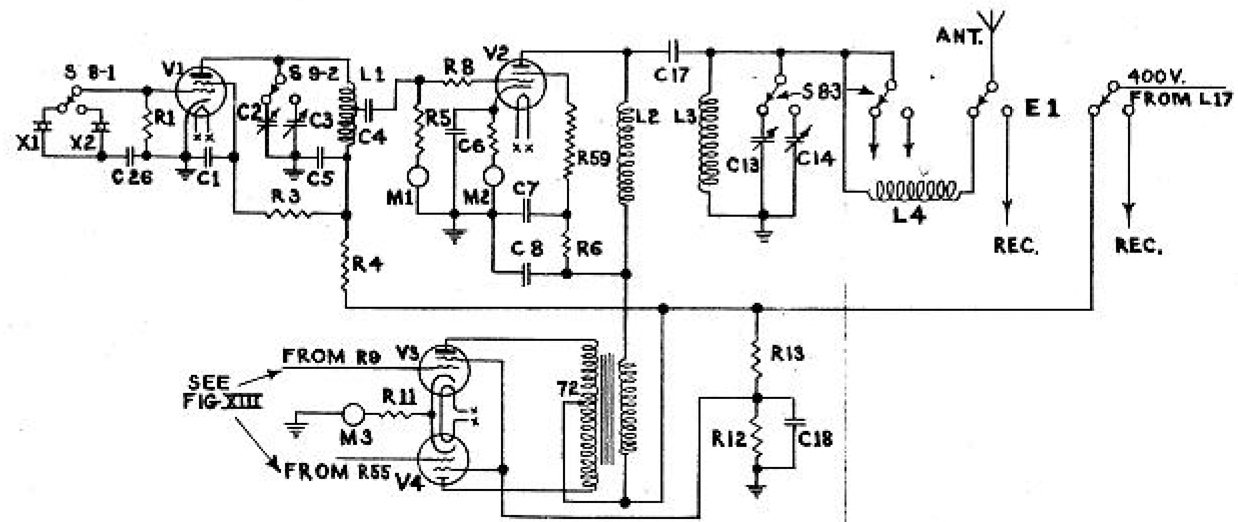
Transmitter Receiver ATR5
R.C.A.F. Ref. 10D-1546



Dynamotor & Heater Circuits

Fig. XVII

TRANSMITTER RECEIVER ATR 5.
R.C.A.F. REF. IOD-1546.



SIMPLIFIED TRANSMITTER SCHEMATIC.

FIG. XVIII

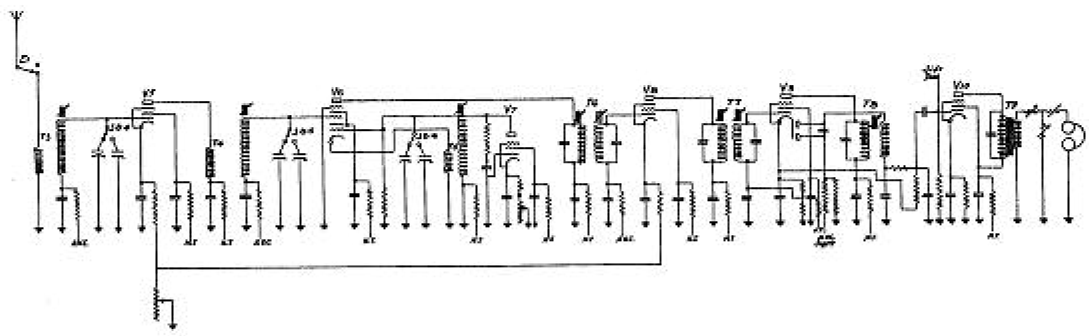
TRACED FROM CANADIAN MARCONI DWG 94448.

NOTE :–

M1. INDICATES "P.A. GRID" POSITION AT METER SW.
M2. " "P.A. CATH." " " "
M3. " "MOD. CATH." " " "

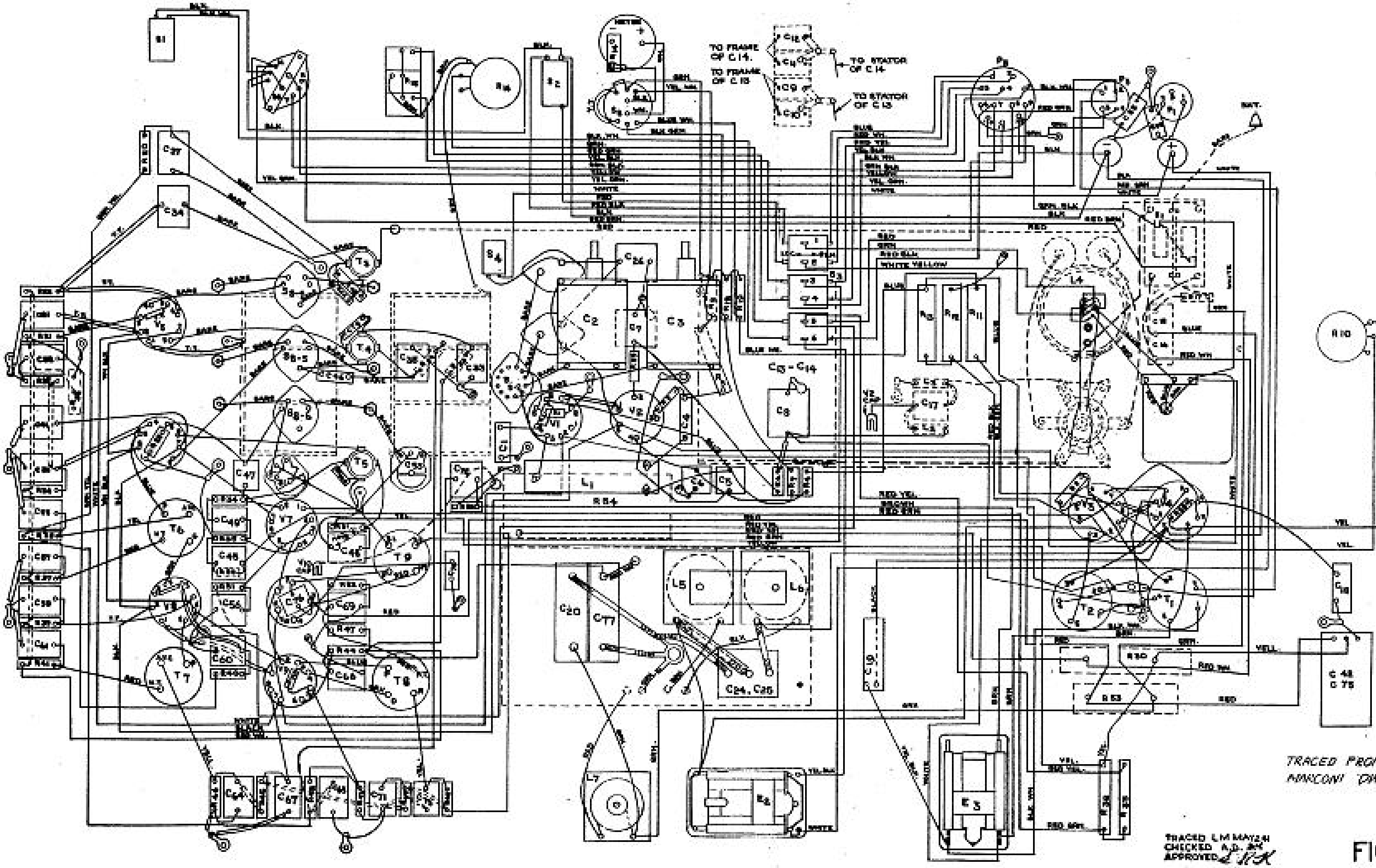
TRACED BY MG APRIL 90
CHECKED BY RM.
APPROVED BY D.R.K.

Transmitter Receiver ATR5
R.C.A.F. Ref. 10D-1546



Simplified Receiver Diagram

Fig. XIX



TRACED FROM C
MARCONI DWG

TRACED L.M. MAY 24 '41
CHECKED A.D.
APPROVED

FIGU