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SECTION ONE

CHAPTERS 1 TO 7

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SECTION 1

TRANSMITTERS

LIST OF CHAPTERS

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SECTION 1, CHAPTER 1

TRANSMITTER T.70

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TRANSMITTER T.70

(Stores Ref. 10A/7755)

INTRODUCTION

1. Transmitter T.70 is a ground station transmitter, employing a master-oscillator, and is designed for continuous wave, interrupted continuous wave, or radio-telephonic transmission on the frequency bands 6,000 to 2,500 kilocycles.

2. The transmitter incorporates a master-oscillator valve, an amplifying valve, a modulator valve and a sub-modulator (or speech amplifying valve). Temperature control is not fitted, but bv allowing the temperature within the master-oscillator chamber to reach a steady state before making the final tuning adjustments, it is possible to work within very small limits of frequency variations due to this cause.

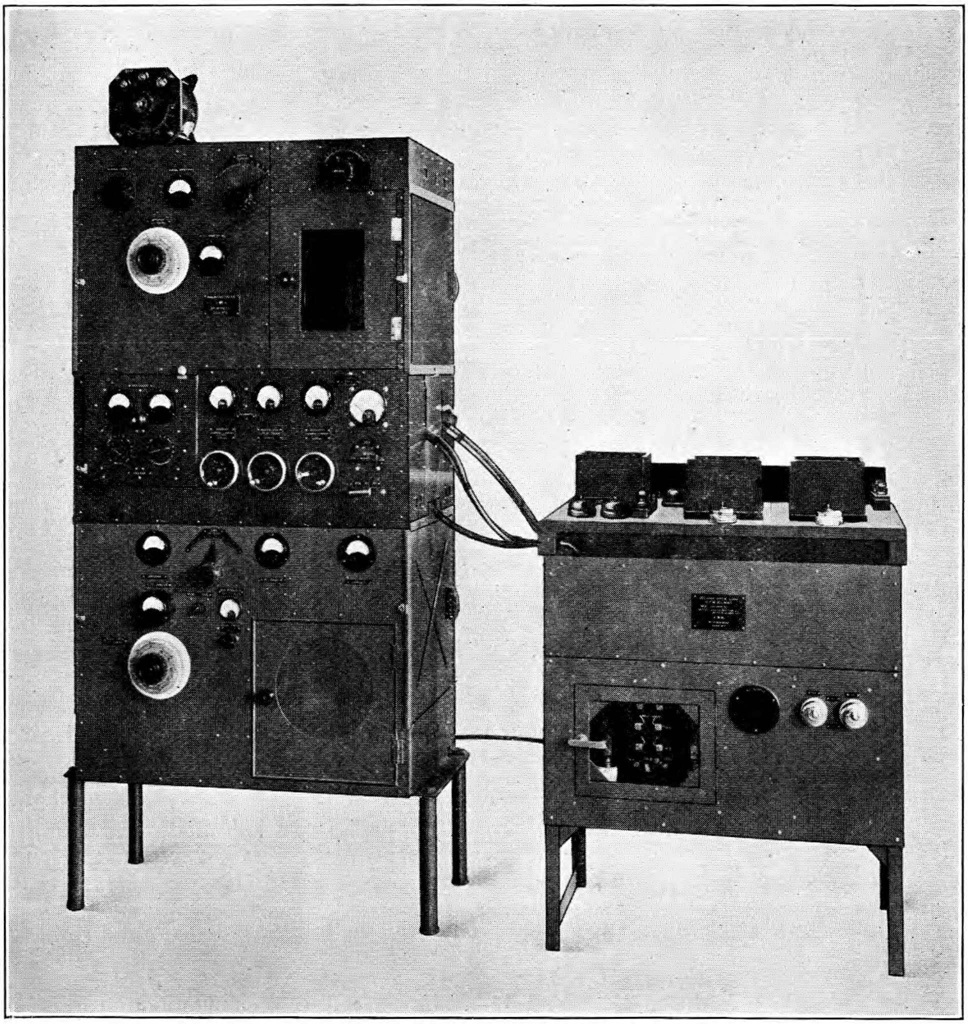

Fig. 1. Transmitter T.70 and rectifier, type B.

3. To minimize frequency variations when C.W. is being radiated, provision is made in the wiring for the use of an entirely separate H.T. supply to the master-oscillator, the latter being constantly energized whilst the amplifier supply is keyed. Where the bulk of the work of the transmitter is R/T, supply is by means of a special self-contained unit known as Rectifier, type B (Stores Ref. 10A/8067) operating from the standard A.C. mains and providing a rectified and smoothed 3,000 volt H.T. anode supply and a 20 volt A.C. filament supply. The transmitter is shown installed with such a unit in fig. 1. Where A.C. is not available the standard 2,000 volt generator is used for H.T. supply.

4. The transmitter is provided with a multiple contact selector switch which makes all the necessary changes when moved into any one of its three positions " R/T ", " C.W." or " I.C.W." It introduces the modulator and sub-modulator valves in the first position, cuts them out and introduces a keying circuit in the second position, and introduces an interrupter in the third position.

5. Radiation of telephony from a remote position over a land line is also provided for, the operation of changing from a local microphone to the line being performed by a conveniently placed switch.

6. The transmitter is built into an upright, three section, duralumin cabinet, approximately 6 ft. high by 2 ft. 8 in. by 1 ft. 8 in., with the controls and indicating instruments mounted on the front. The necessary grid bias arrangements are included in the cabinet and also the rotary interrupter for I.C.W. transmission. The weight of the transmitter alone is approximately 2¾ cwt.

GENERAL DESCRIPTION

7. The master-oscillator circuit oscillates at a frequency determined by the settings of its inductance and capacitance. Coupled to the anode inductance is a coil which is connected in the grid circuit of the amplifier valve. The frequency of the amplifier circuit is therefore governed by that of the master-oscillator circuit. The anode circuit of the amplifier valve is, in turn, coupled to the aerial coil to which the amplified oscillatory currents are transferred, causing radiation at the desired frequency. It is obviously desirable that the amplifier circuit shall have no tendency to self-oscillation but shall function only as an amplifier of the oscillatory current transferred to it from the master-oscillator. Feed-back in the anode-grid circuit of the amplifier valve is therefore guarded against by the provision of an adjustable neutralizing condenser connected between the grid and a tap on the anode inductance. By proper adjustment of this device the R/F voltages occurring as a result of the inter-electrode capacitance of the valve are opposed by equal and opposite voltages *via* the neutralizing condenser.

8. To facilitate setting of the neutralizing device a neon lamp is provided, together with a special switch. The operation of the switch breaks the filament circuit of the amplifier valve and places the neon lamp in the anode circuit. Minimum glow in the lamp indicates correct neutralizer setting.

9. When the selector switch is placed in the C.W. position, the master-oscillator and amplifier valves only are in operation, the filaments of the modulator and sub-modulator being open-circuited. The control choke in the anode circuit of the master-oscillator valve is short-circuited and the key is introduced (H.T. switch in " double " position and separate H.T. supplies connected) between the H.T. negative lead and the cathode of the amplifying valve. The operation of the key does not affect the master-oscillator, the amplifier valve circuit only being made and broken.

10. When the selector switch is placed in the I.C.W. position the modulator and sub-modulator valves are still cut out and the control choke in the anode circuit of the master-oscillator remains short-circuited. A contact is closed which starts up a motor-driven

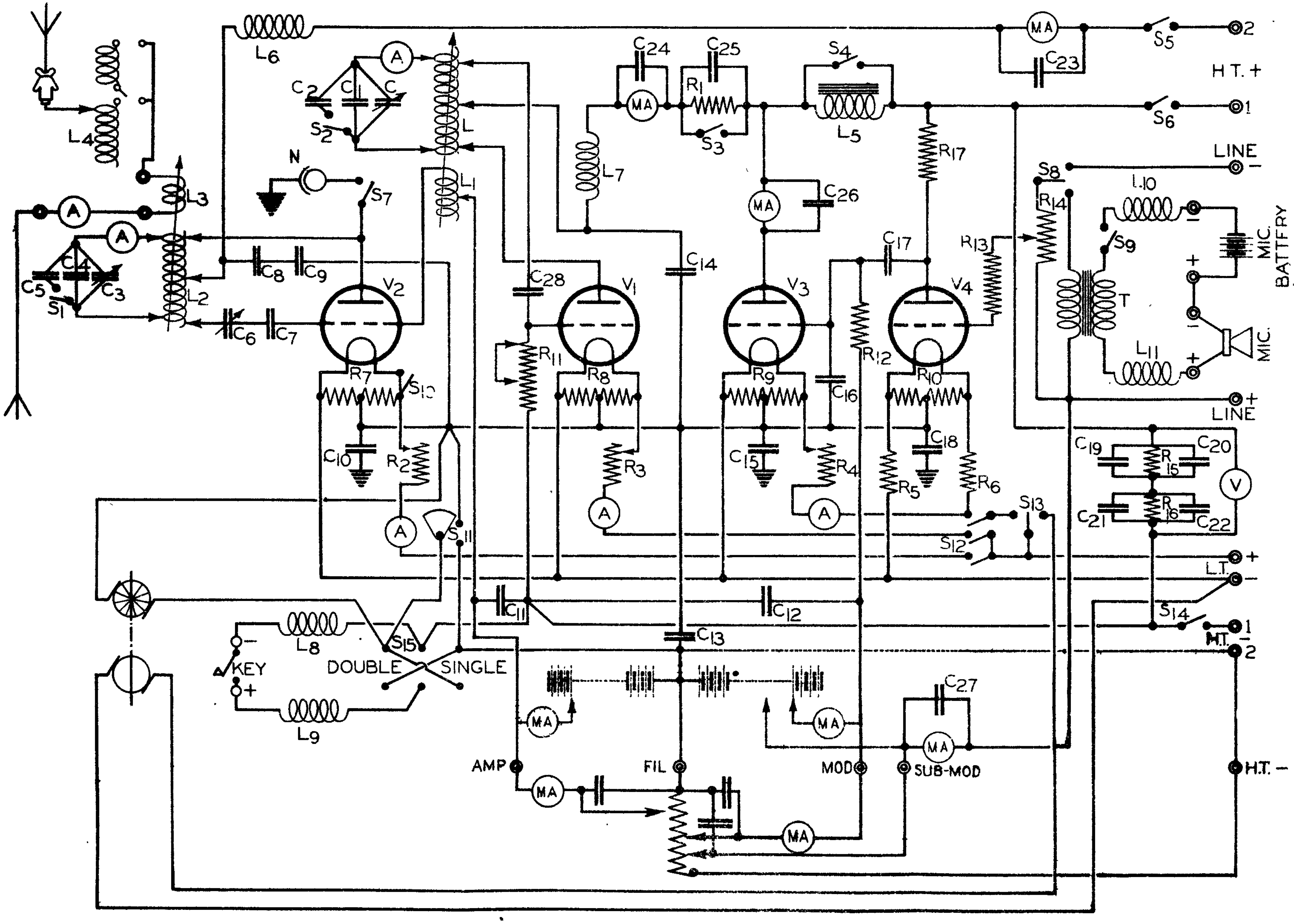

FIG. 2 THEORETICAL CIRCUIT DIAGRAM

CONDENSERS (μF)	
C	
C1	·00036 (max)
C2	·00023 (max)
C3	
C4	·00036
C5	·00023 (max.)
C6	·00004
C7	·0001
C8	·002
C9	·002
C10	·01
C11	·01
C12	·01
C13	·01
C14	·001
C15	·01
C16	·001
C17	·01
C18	·01
C19	1·0
C20	1·0
C21	1·0
C22	1·0
C23	1·0
C24	1·0
C25	·5
C26	1·0
C27	1·0
C28	·001
RESISTANCES (ohms)	
R1	10,000 or 30,000
R2	4
R3	4
R4	4
R5	7
R6	7
R7	80
R8	80
R9	80
R10	80
R11	60,000 (max.)
R12	50,000
R13	2 MΩ
R14	500,000
R15	5 MΩ
R16	5 MΩ
R17	500,000

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interrupter, and another contact opens and introduces the interrupter disc (which was previously short-circuited) in series with the key. The operation of the key now causes radiation of interrupted continuous waves.

11. When the selector switch is placed in the R/T position the filament circuits of the modulator and sub-modulator valves are closed, bringing these valves into operation. The short-circuit is removed from the control choke, the microphone circuit is completed, the motor interrupter is stopped and the key and interrupter disc short-circuited. The key is now inoperative and all four valves have their H.T. circuits complete. Speaking into the microphone now causes speech currents to be impressed on the sub-modulator valves and these are, in turn, passed on considerably amplified to the modulator valve. Owing to the well known " choke control " action, the anode potential of the oscillator valve is varied (hence the amplitude of the aerial oscillations) in accordance with the original sound vibrations at the microphone, causing radio-telephonic radiation.

12. A theoretical circuit diagram of the complete transmitter is given in fig. 2. V_1 is the master-oscillator valve, V_2 the amplifier valve and V_3 and V_4 the modulator and sub-modulator valves respectively.

13. The oscillatory circuit of the master-oscillator valve comprises an inductance L and condensers C and C_1, the condenser C being variable. A third condenser C_2 of fixed capacitance is provided and is placed in parallel with C and C_1, by means of a link, when working on the lower frequency band. The inductance L has three tappings, one of which is taken directly to the anode of the master-oscillator valve. Another is taken through a fixed condenser C_{28} to the grid of the master-oscillator valve, and the third tapping is the H.T. feed. In this feed is connected a milliammeter, R/F choke L_7, a resistance R_1 shunted by the condenser C_{25} and an iron-cored inductance L_5. Switches S_3 and S_4 are arranged on R_1 and L_5 respectively for the purpose of short-circuiting them for different transmission requirements.

14. The inductance L_1 in the grid circuit of the amplifier valve V_2 is inductively coupled to the inductance L, the coupling being variable. In the anode circuit of the amplifier valve is an inductance L_2 in parallel with which are two condensers C_3 and C_4, C_3 being variable. As in the master-oscillator circuit a third condenser C_5 of fixed capacitance is provided which can be placed in parallel for the lower frequency band by means of a link. Three tapping points are provided on the inductance L_2, the first being directly connected to the anode of the amplifier valve, the second being taken through the R/F choke L_6, and through a milliammeter to H.T. positive. The third lead is taken through the neutralizing condenser C_6 and fixed condenser C_7 to the grid of the valve. From the H.T. feed tapping two condensers C_8 and C_9 are connected in series to the filament line, and a neon lamp N is connected through the switch S_7 to earth for neutralizing purposes.

15. The aerial circuit comprises the inductance L_4 and L_3. The inductance L_4 is in two portions and a connecting link permits one portion or both to be included, depending upon the frequency requirements. The inductance L_3 which is in series with L_4 is inductively coupled to the amplifier inductance L_2, the coupling being variable.

16. Valves V_3 and V_4 are the modulator and the sub-modulator valves for radio-telephony. A microphone circuit including the transformer T, choke coils L_{10} and L_{11}, microphone and battery is connected to the grid circuit of the sub-modulator valve V_4, which is in turn resistance-capacitance coupled to the modulator valve V_3. The anode of the valve V_3 is fed through the iron-cored inductance L_5 from the H.T. line which simultaneously feeds the master-oscillator valve thus effecting modulation by the " choke control " method.

17. The switch S_8 permits either the local microphone circuit or the remote microphone circuit to be connected across the resistance R_{14}. This resistance is provided with a variable contact which is connected through the resistance R_{13} to the grid of the valve V_4, and speech voltage input to the grid-filament circuit of the valve may thus be varied from zero to maximum.

The anode of this valve is fed through a resistance R_{17}, in order to drop the voltage to the correct value and is coupled to the grid of the modulator valve through the condenser C_{17}, the lower end of the associated resistance R_{12} being taken through a milliammeter to a tapping on the grid-bias arrangement. A condenser C_{16} is connected across the grid-filament circuit of the modulator valve and a condenser C_{12} is connected from the tapping to H.T. negative.

18. A second tapping is taken from the grid-bias arrangement through a milliammeter, which is shunted by the condenser C_{27}, to provide the necessary bias for the valve V_4, the circuit being through the resistances R_{14} and R_{13}. The amplifier valve V_2 is biased from the same source, a milliammeter being similarly connected in the circuit. The grid base line of the master-oscillator is fixed by means of the adjustable resistance R_{11}. The value of the resistance included can be varied between zero and 60,000 ohms by means of a short-circuiting link. Condensers C_{11} and C_{13} act as by-pass shunts for the grid-bias circuits. The filaments of the valves are heated normally from a 20 volt A.C. circuit, and the filaments are shunted by the resistance R_7, R_8, R_9 and R_{10} respectively. The centre-points of the resistances are earthed separately through condensers C_{10}, C_{15} and C_{18}, with the exception of that on the oscillator valve.

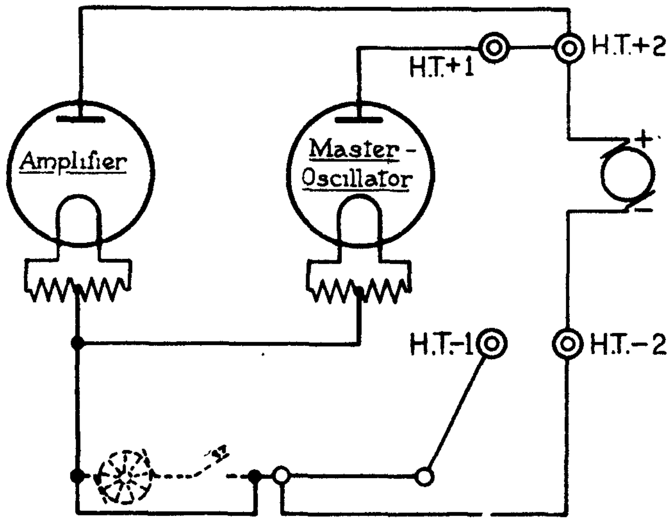
19. The filament circuits of the amplifier, oscillator and modulator valves all include ammeters, and rheostats R_2, R_3 and R_4 are provided for the purpose of setting the filament current. An additional switch is provided in the amplifier circuit to enable the circuit to be broken for neutralizing purposes. The current in the sub-modulator valve filament circuit is not variable, the resistances R_5 and R_6 being included in the circuit to maintain the current at the required value. The switch S_{13} enables the filament circuits of the sub-modulator valves to be broken when R/T is not required.

20. Referring to fig. 3 it will be observed that the H.T. connections are so arranged that the H.T. supply to the amplifier valve and oscillator valve may be entirely independent of one another. Two H.T. positive terminals marked H.T. + 1 and H.T. + 2 and two H.T. negative terminals marked H.T. —1 and H.T. —2 respectively, are provided. The switch S_{15}, located in the amplifier compartment, enables the necessary changes to be made in the connections of the amplifier and master-oscillator valves for common or separate H.T. supply. When R/T is being radiated the switch is placed in the " single " position, and when C.W. or I.C.W. is being radiated the switch is placed in the " double " position. In the " single " position both amplifier and oscillator anode circuits are fed from a common H.T. positive terminal, and the H.T. negative lead is connected to the cathodes of both amplifier and oscillator valves thereby energizing both valves. In the " double " position (when two separate H.T. supplies are connected to the appropriate terminals) the oscillator is continuously energized when the key is open, but the amplifier is energized (from an independent supply) only when the key is closed.

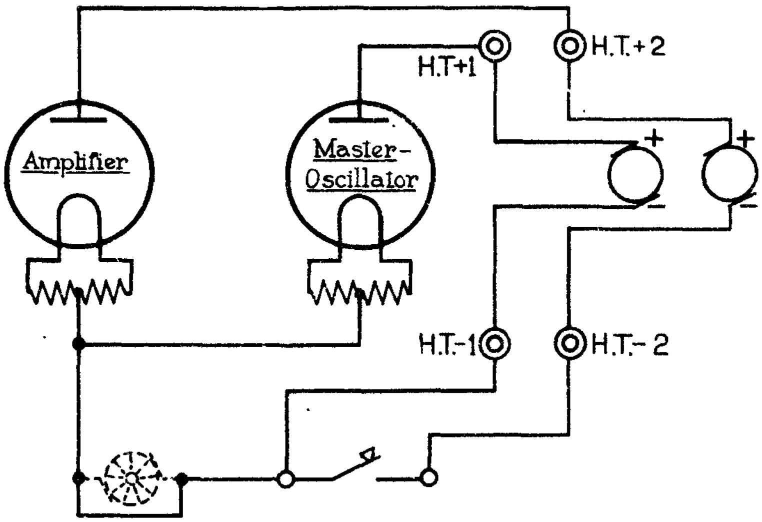
21. In fig. 2 a number of switches are shown separately at various points in the circuit. Actually several of these are arranged for simultaneous operation. For example, the H.T. switches S_{14}, S_5 and S_6 are operated by the movement of a single handle; similarly the switches S_7 and S_{10} are so coupled that when S_{10} is opened the filament circuit of the amplifier is broken, and movement of the switch handle through the remainder of its travel closes S_7, connecting the neon lamp in circuit.

22. The three-position selector switch, when moved into the C.W. position, closes S_4 thereby short-circuiting the control choke, opens the left-hand side of S_{13} thereby breaking the filament circuits of the modulator and sub-modulator valves, closes the first contact of S_{11} which short-circuits the interrupter (leaving the key in circuit), opens the right-hand side of S_{13} which opens the interrupter motor circuit, and opens S_9 which opens the microphone circuit.

23. In the I.C.W. position the switch S_4 is closed and S_{13} (left-hand side) is open as before, but the switch S_{11} is opened thus removing the short-circuit from the interrupter, and S_{13} (right-hand side) is closed thereby starting up the interrupter motor.



H.T. Switch in "Single" Position for R/T, Common H.T. Supply



H.T. Switch in "Double" Position for W/T, Separate H.T. Supply

FIG. 3 ALTERNATIVE H.T. SUPPLY

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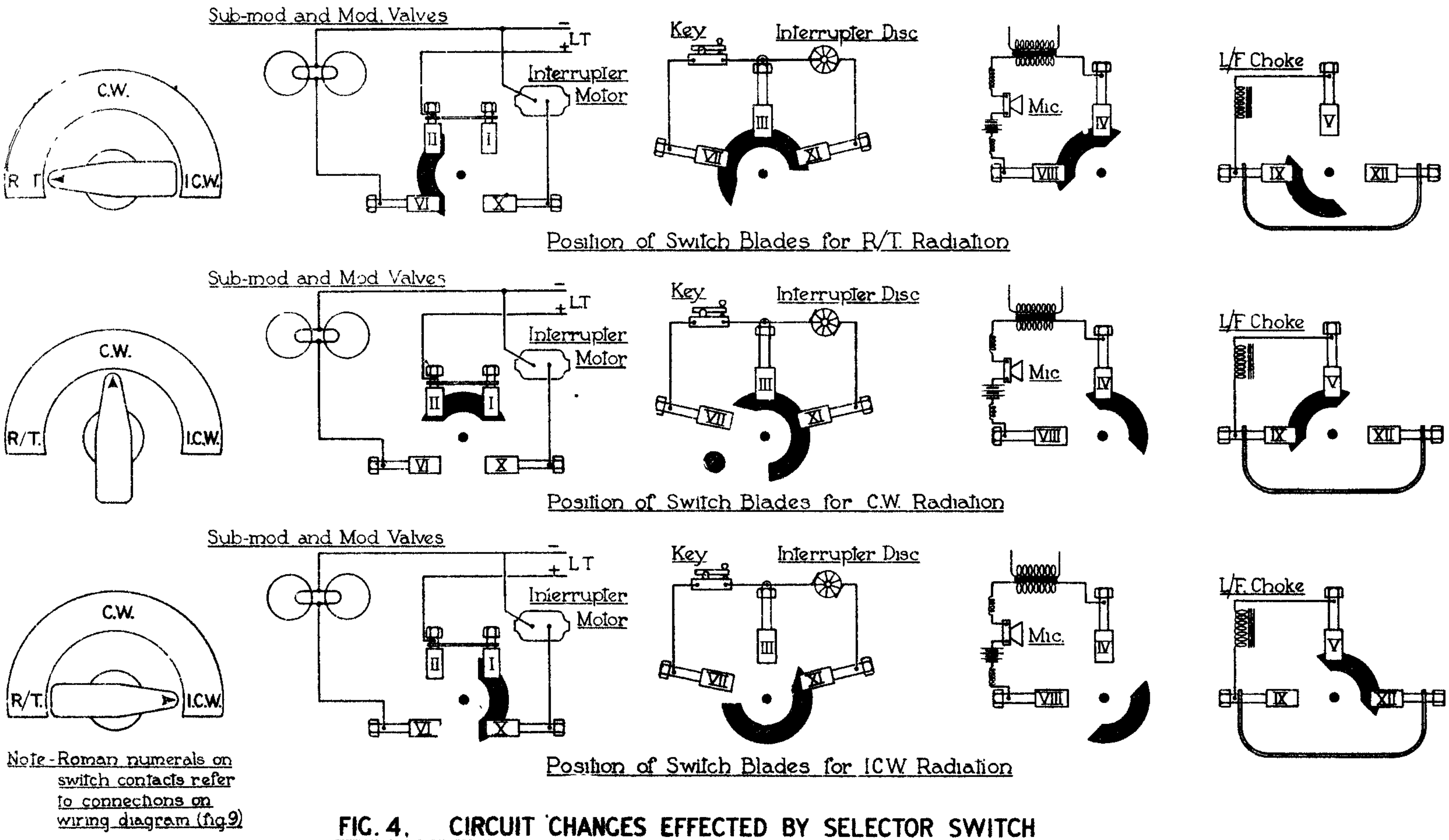


FIG. 4. CIRCUIT CHANGES EFFECTED BY SELECTOR SWITCH

24. In the R/T position switches S_{13} (left-hand side), S_{11} (second contact) and S_9 are closed and the following circuit changes are effected. The filament circuits of the modulator and sub-modulator valves are closed, the key and interrupter are short-circuited and the microphone circuit is closed. The switches S_4 and S_{13} (right-hand side) are opened thereby putting into circuit the control choke and opening the circuit of the motor interrupter. The circuit changes effected by the selector switch are clearly shown in the simplified diagram (fig. 4).

25. The resistance R_1 is interchangeable, 30,000 ohms being required for R/T and 10,000 for C.W. and I.C.W. transmission. In the bench wiring diagram (fig. 10) a 10,000 ohm resistance is in place. The resistance unit not in use is housed in a pair of clips fitted in the base of the bottom chamber just inside the door.

26. When the transmitter is required to operate on the higher frequency band with the standard 6-wire " T " type cage aerial, an aerial series condenser is required, and condenser type 7 (Stores Ref. 10A/2951) is suitable for this purpose. It is shown in position on the top of the transmitter in fig. 1. The condenser is of the glass enclosed variable type. It has a maximum capacitance of approximately ·0011 μF. and the scale with which it is equipped is engraved with two sets of graduations, one being in degrees (0–180) and the other in jars of capacitance (·05 to ·95).

CONSTRUCTIONAL DETAILS

27. The transmitter (*see* fig. 1) is built into a rectangular duralumin frame supported on four tabular feet, the overall height of the transmitter being approximately 6 ft. 3 in. It is divided horizontally into three compartments known as top, middle and bottom chambers respectively, the division between the middle and bottom chambers taking the form of a metal screen having terminals carried in insulating bushes.

28. The top and bottom chambers are provided with sliding side panels which can be completely removed, and hinged doors are provided on the front of these two compartments. The front door of the top chamber is provided with a glass window and the front door of the bottom chamber has a circular window fitted with gauze. The main terminal board (*see* fig. 7) is situated under a removable panel on the side of the middle chamber.

29. In the top chamber is housed the amplifier valve complete with its inductances and tuning apparatus. In the middle chamber are situated the switches, grid-bias arrangements, rheostats and a number of indicating instruments. The master-oscillator valve, modulator valve and sub-modulator valve with their associated apparatus are housed in the bottom chamber. Also in this chamber is the motor interrupter for I.C.W. transmission. Bench wiring diagrams of the three chambers are given in figs. 8, 9 and 10.

30. In fig. 5 is given a view of the front of the transmitter. In the top left-hand corner is the aerial tuning control (3). This consists of a moulded dial graduated from 0 to 100, which operates the variable tapping on the aerial inductance. The instrument (14) on the right of the aerial tuning condenser is the aerial ammeter. It is a thermo-ammeter reading 0 to 8 amps. and is connected in the aerial circuit. Next to this is the aerial coupling adjustment (4) which consists of a moulded knob carrying a pointer moving over a scale graduated from 0 to 90. The spindle is extended through the panel and carries the coupling coil (2, fig. 6). On the extreme right of the top of the panel is the neutralizing condenser adjustment (6), the dial of which is graduated from 0 to 120. The closed circuit ammeter (15) is situated near the centre of the upper panel, it is a thermo-ammeter reading 0 to 12 and is connected between the inductance and the condenser in the closed circuit. On the left of this is the amplifier closed circuit tuning adjustment (1), the moulded handle of which carries a transparent scale graduated from 0 to 200. Rotation of this handle operates the variable condenser through a bevel gearing.

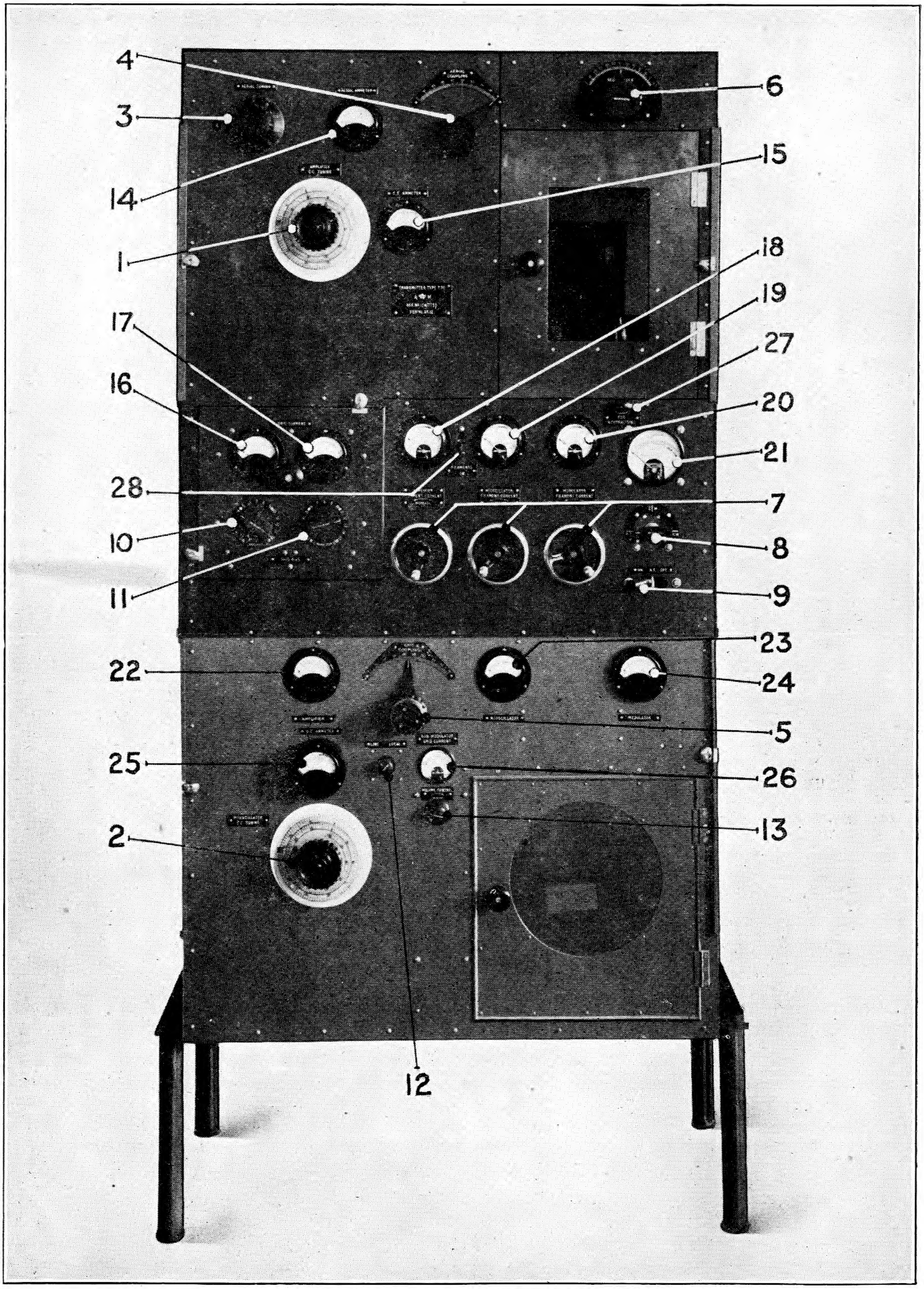


FIG. 5. Transmitter T.70, front of panel.

31. The middle section of the transmitter is provided with a front panel composed of synthetic-resin varnish-paper board on which are grouped six meters, six switches and three rheostat handles. The two meters on the left are milliammeters reading 0–100 and 0–30 respectively. The left-hand meter (16) is connected in the grid circuit of the amplifier valve and the other meter (17) is connected in the grid circuit of the modulator valve for the purpose of indicating when grid current is flowing. These two meters together with the switches seen immediately beneath them are mounted upon a rectangular panel which forms the front of a drawer containing two dry batteries for grid-bias on the amplifier and modulator valves. That for the amplifier is a 300-volt battery, the applied voltage being adjustable by means of a switch (10) in steps of 20 volts from 40 to 300. That for the modulator is a 130-volt battery, the voltage being adjustable by means of the switch (11) in steps of 6 volts, from 60 to 130.

32. A modification has been introduced whereby transmitters working on A.C. supply derive the necessary grid-bias voltages automatically from a tapped resistance connected in the common H.T. negative and grid circuits. The modified wiring is shown in the theoretical circuit diagram fig. 5, whereas the battery bias method is shown dotted. The automatic grid-bias unit improves the performance of the transmitter in that troubles due to gradual deterioration of the batteries are eliminated. Furthermore, battery maintenance and the possibility of failure due to high resistance is removed.

33. The modifications for automatic grid-bias are made in the following manner. After switching off the A.C. supply and withdrawing the existing battery bias draw, the upper rear cover of the transmitter is removed. The four bolts and four connections securing the contact panel are undone and the contact panel with which the draw engaged is removed. A new 5-pole contact panel is secured in place using the same bolts and fixing holes. The terminals marked AMP., MOD. and SUB.-MOD. are connected up as before. A.P. 1186/A.64 gives information on possible modifications to the 5-pole contact panel before fitting.

34. The two leads marked H.T.—2 are removed from the terminal board and connected together and the free end of this lead is connected to FIL. on the new contact panel. The terminal marked H.T.—2 on the terminal board is connected to H.T.—2 on the new contact panel. After the new grid-bias unit is placed in position the rear cover of the transmitter is replaced. The terminals H.T.+1 and H.T.+2 on the terminal panel are connected together externally and joined to H.T. positive of the supply. The terminal H.T.—1 is disconnected and H.T.—2 is connected to H.T. negative of the supply.

35. To the right of this drawer are the three ammeters (18), (19) and (20) in the filament circuit of the amplifier, master-oscillator and modulator valves respectively. Between the first and second filament ammeters is the filament switch (28). Beneath the ammeters are the three filament rheostat handles (7). The larger meter (21) is the H.T. voltmeter reading 0 to 3,500 volts and above this is the neutralizing switch (27) for breaking the filament circuit of the amplifier when carrying out the operation of neutralizing. The selector switch (8) is marked for three positions R/T, C.W. and I.C.W. and effects the necessary circuit changes to enable the three different forms of transmission to be made. The switch beneath this is the main H.T. switch (9) which when placed in the off position breaks both sides of the H.T. supply.

36. The lower section of the transmitter carries, on the front panel, five meters, a switch, a grid-coupling coil control, a master-oscillator tuning control and a volume control. The amplifier milliammeter (22) reads 0–500, the master-oscillator milliammeter (23) reads 0–250 and the modulator milliammeter (24) reads 0–250. These milliammeters are connected in the anode circuits of the respective valves. The remaining two meters on the lower section are the ammeter (25) reading 0–12, connected in the oscillatory circuit, and the milliammeter (26) reading 0–5 connected in the grid circuit of the sub-modulator valve. The grid-coupling control (5) is capable of being turned through 90 degrees and varies the coupling between the amplifier and the master-oscillator. The switch (12) is for the purpose of changing over from local to remote microphone,

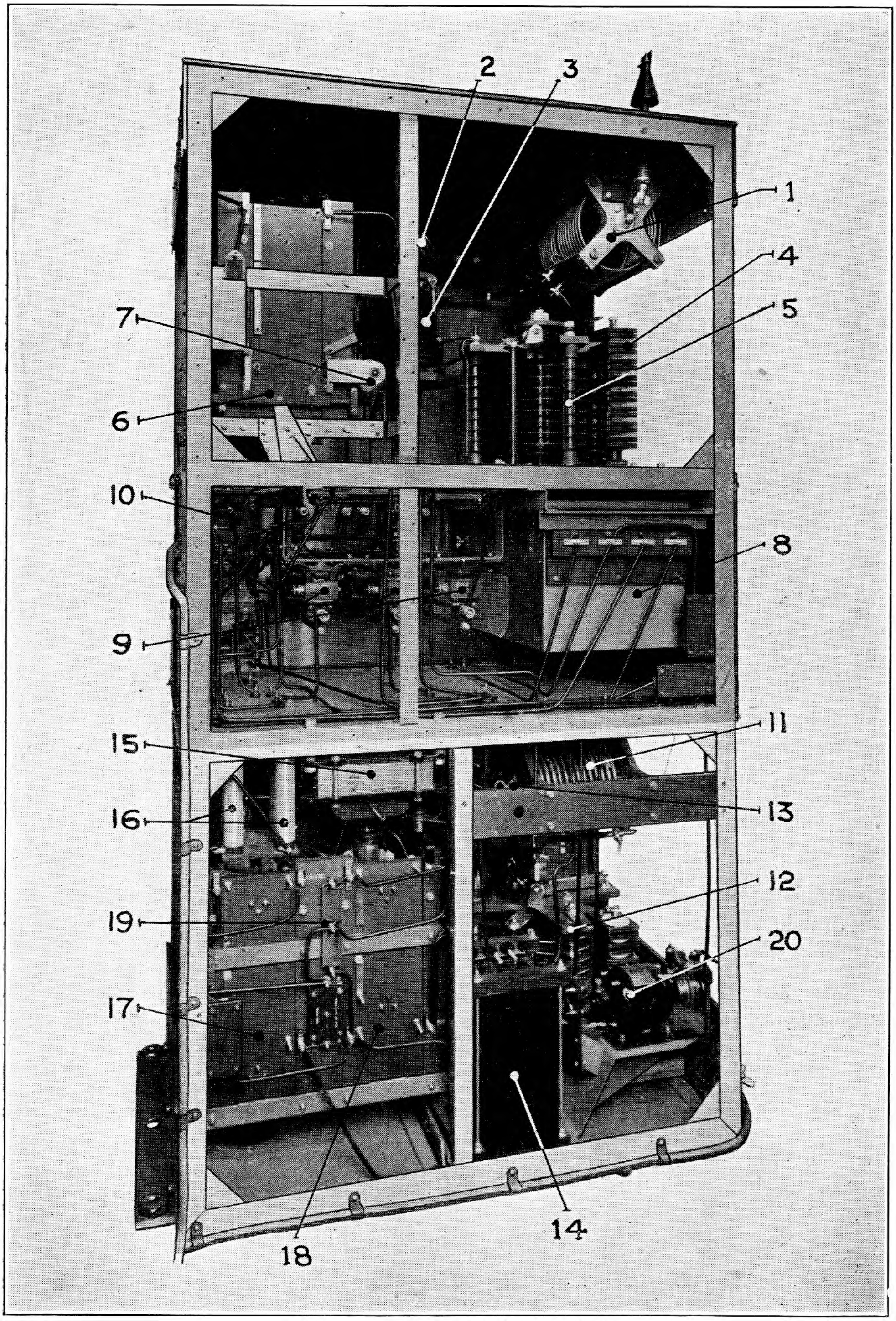


FIG. 6. Transmitter T.70, rear view.

and the volume control (13) is interposed between the microphone circuit and sub-modulator valve. The master-oscillator closed circuit tuning control (2) is similar to that fitted in the top section for the amplifier closed circuit tuning—rotating a condenser through a bevel drive in a similar manner.

37. Referring to fig. 6 the coil (1) is the aerial inductance coil which is constructed of copper tube on an insulating former. This coil has two sections one of which can be isolated by means of a link. In the illustration the link is shown in the open position. In the centre of the coil is a spindle which carries a contact operating around the turns of the coil, the spindle being actuated by the knob (3, fig. 5).

38. From the aerial inductance coil a copper strip is taken to the aerial coupling coil (2) the other end of which is connected through an ammeter (14, fig. 5) to the counterpoise terminal. The coupling coil which is also constructed of copper tube is capable of being rotated through 90 degrees by means of the control (4, fig. 5). Immediately beneath the aerial coupling coil is the amplifier closed circuit inductance coil (3), across which are connected the adjacent condensers, (4 and 5) in series with the closed circuit ammeter (15, fig. 5). The condenser (5) is specially constructed and consists partly of fixed and partly of movable vanes. The minimum capacitance is approximately ·00011 μF. and the maximum approximately ·00036 μF., adjustment being made through a bevel drive operated by the control handle (1, fig. 5) on the front of the panel.

39. The component (4) carried on the side of the adjustable condenser is a packing condenser consisting of 8 sections clamped together giving a total capacitance of approximately ·00023 μF. This is connected in parallel with the adjustable condenser for certain frequencies by means of the link which can be seen at the top of the adjustable condenser.

40. On the left of the top chamber is the amplifier valve panel. The valve itself can be clearly seen in fig. 4. Carried on the rear side of this panel is the switching device (6) which enables the amplifier filament circuit to be opened and a neon lamp (7) to be connected from the anode of the amplifier valve to earth, when carrying out the neutralizing operation.

41. The switch consists of a bar of insulating material on which are carried two contacts spaced approximately 6 in. apart. This bar is mounted in guides and is capable of being moved endways by means of a rack-and-pinion device operated from the front of the panel by the handle (27, fig. 5).

42. It will be observed that when the bar is in the extreme left-hand position, as shown, the left-hand contact closes the filament circuit. When the bar is moved to the right, the left-hand contact is opened. Further movement of the bar causes the right-hand contact to close, thereby connecting the anode of the valve to one side of the neon lamp, the other side of which is permanently connected to earth.

43. In the middle chamber can be seen the drawer (8) which contains the grid-bias batteries, or automatic grid-bias unit. The connections from the grid-bias batteries or from the unit are taken out through spring contacts, the back of the drawer being provided with knife contacts which engage with jaws mounted on an insulating contact bar against which the drawer stops when pushed into place. Terminals are provided on the contact bar to enable the necessary connections to be made to the spring jaws. The front of the drawer can be seen in fig. 5 and a diagram of the internal connections of the grid-bias switches (10 and 11, fig. 5) for both types of grid-bias is given in fig. 11. The three rheostats (9) are in the filament circuits of the amplifier, master-oscillators and modulator valves, and are wound on slate formers with a maximum resistance of 4 ohms. The sliding contacts are operated by handles (7, fig. 5) through worm drives. In the left-hand upper corner of the chamber can be seen the H.T. voltmeter (10). Beneath this is located the " R/T, C.W., I.C.W.", selector switch, and beaneath this is the H.T. on and off switch. A theoretical diagram of the selector switch is given in fig. 4. The H.T. change-over switch for separate or common supply is located on the cross member at the top of the middle chamber but is accessible only through the front door of the top chamber. A theoretical diagram showing the changes effected by this switch is given in fig. 3.

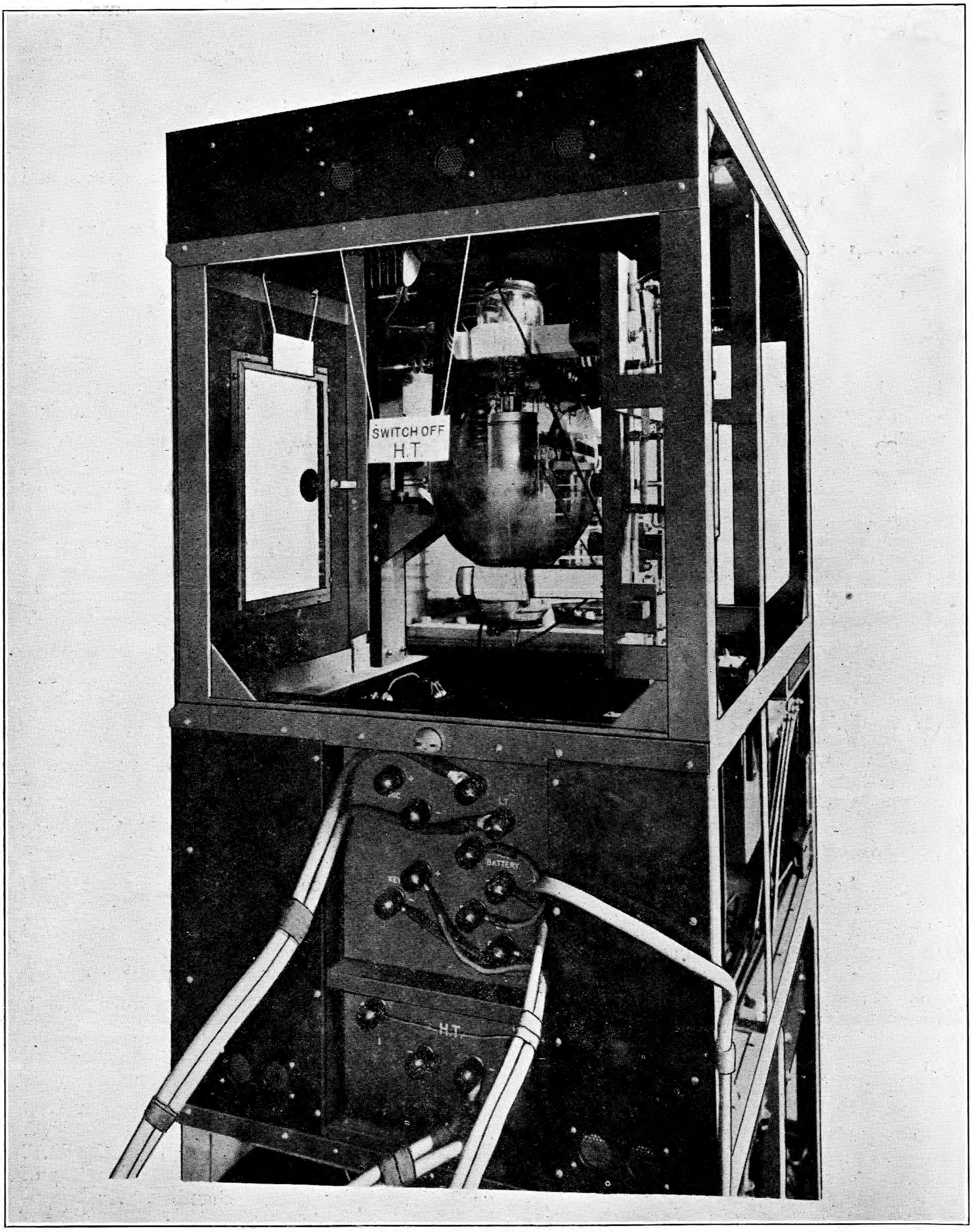
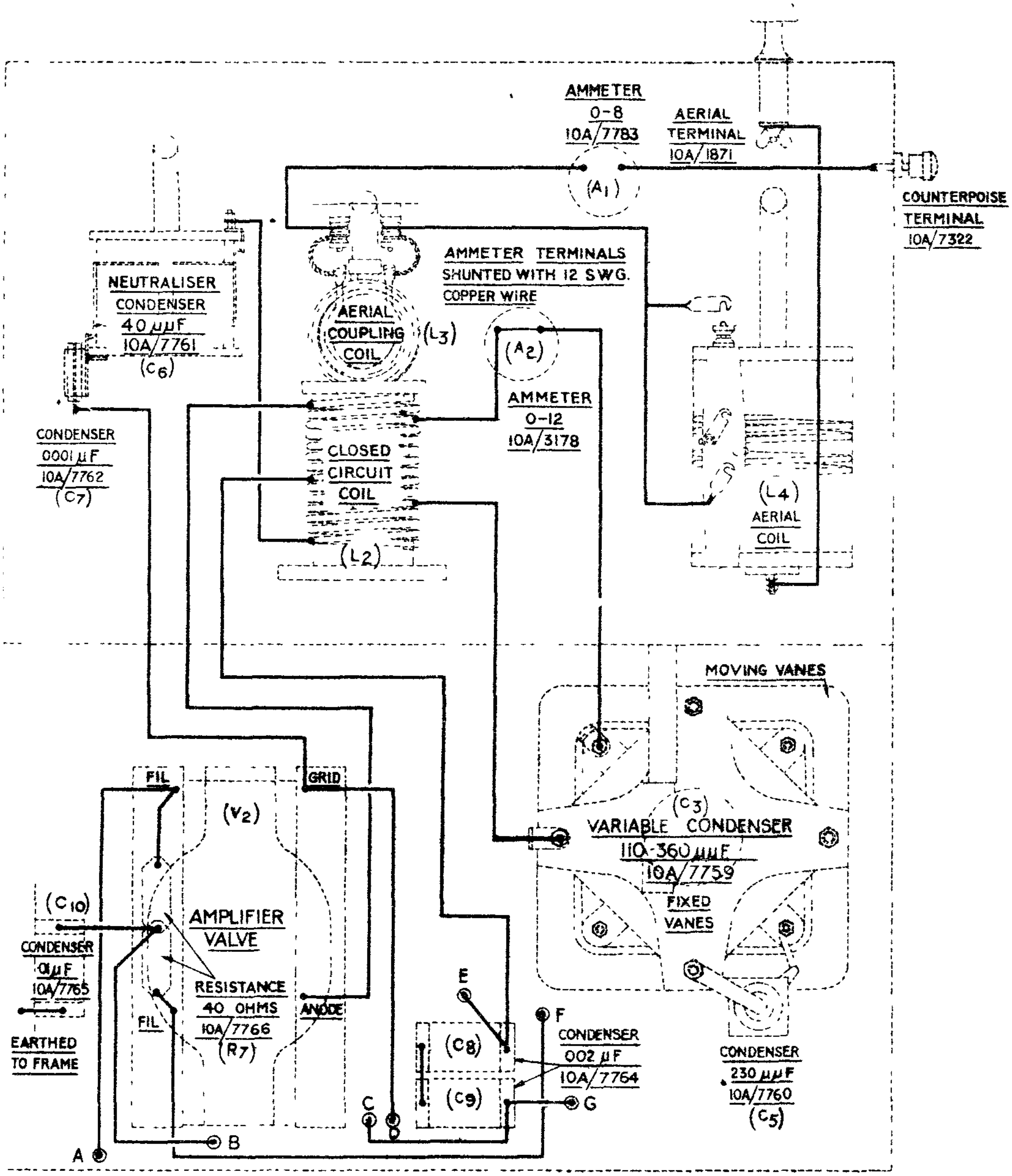


FIG. 7. Transmitter T.70, side view.



LEADS — A,B,C,D,E,F AND G ARE TAKEN INTO MIDDLE CHAMBER (SEE FIG.)

NOTE ANNOTATIONS THUS (L4) REFER TO THE CORRESPONDING ANNOTATIONS IN FIG. 2.

FIG. 8. BENCH WIRING DIAGRAM. TOP CHAMBER

44. In the bottom chamber can be seen the master-oscillator inductance coil (11) with its associated condensers (12). These are of similar construction to those used in the aerial closed circuit and installed in the top chamber. The grid coupling coil (13) is operated by the control handle (5, fig. 5), and an ammeter (25, fig. 5) is connected in the master oscillator closed circuit. The group (14) is a series-parallel group of 4 μF. condensers with two 5-megohm resistances and is connected between H.T. +1 and H.T. −1 on the dead side of the H.T. switch. The group corresponds to C_{19}, C_{20}, C_{21}, C_{22}, and R_{15} and R_{16} in fig. 2. On the left-hand side of the bottom compartment may be seen the L/F choke (15), next to which are the two microphone and two key R/F chokes (16) and the grid-bias by-pass condensers.

45. The master-oscillator, modulator and sub-modulator valves are all housed in the bottom chamber, the master-oscillator and modulator valves being carried on valve bases (17 and 18) which take the form of upright panels held in position by turn-buttons. Each panel is provided with valve clips and terminals for the electrodes, the latter being provided with spring contacts so that the whole panel may be easily plugged into place or withdrawn. The top of the modulator valve can be seen beyond the panel (18). The sub-modulator valve is carried on a separate base near the master-oscillator tuning condenser (12).

46. The resistance (19) is an 80-ohm centre-tapped resistance connected across the filament circuit of the modulator valve. All four valves have similar resistances across their filament circuits. The grid leak for the master-oscillator which consists of 12 sections each having resistances of 5,000 ohms, is installed just inside and above the front door of the bottom chamber. A short-circuiting link is provided on the leak to enable a suitable value of resistance to be obtained for any setting of the transmitter.

47. The interrupter motor (20) is designed to run on either A.C. or D.C. (20 volts). Two pairs of leads are provided, one pair being connected up for D.C. and the other pair for A.C. The shaft of the motor carries a ten-segment interrupter disc.

VALVES AND POWER SUPPLY

48. There are four valves used in the transmitter. A valve, type V.T. 5B is used as a master-oscillator. One V.T. 4B is used as an amplifier. The modulator is a valve, type D.E.T. 3 and the sub-modulator is a V.T. 25. The H.T. and L.T. voltages required for the valves are obtained from the rectifier, type B, (Stores Ref. 10A/8067). A rectifier and smoothing circuit is incorporated in the unit which is described elsewhere in this publication. The rectifier type B is generally placed near the transmitter, connections being made by means of flexible leads.

49. When the T.70 is adapted for operation by remote controls, the remote controls, type 5, are generally used and are mounted on the top of the rectifier unit. A reference to fig. 1 will show the manner in which the various components are usually arranged.

OPERATION

50. In fig. 12 is given a diagram and a table indicating master-oscillator and amplifier inductance settings. The three ranges are numbered 1, 2 and 3 and the sockets are coloured to facilitate rapid changes in the settings. The sockets in use on range 1 are coloured blue, those in use on range 2 are plain and those in use on range 3 are red. Where the same socket is used on two ranges the socket is given two colours, *e.g.*, a condenser connection is made to No. 3 turn for both range 1 and range 3. The socket is therefore coloured blue and red. The inductance coils illustrated in fig. 12 have the connections appropriate to range 1.

51. In Tables 1, 2 and 3 are given typical settings and instrument readings for the 6,000–4,286 kc/s. band (radiating radio telephony), the 4,286–3,000 kc/s. band (radiating C.W.), and

for the 3,000–2,500 kc/s. band (radiating R/T, I.C.W. and C.W.). From these tables can also be ascertained whether or not the packing condensers are required, whether full or half aerial coil is required, and what value of anode feed resistance is to be used for the master-oscillator.

Adjustments for C.W. operation

52. See that the H.T. switch is in the off position. Connect up the two H.T. sources to the appropriately labelled terminals. Place the H.T. supply switch, inside the amplifier compartment, in the " double " position. See that the grid-bias switches are at " 0 ".

53. From the information given in fig. 12 and in the tables, set the master-oscillator tuning condenser, grid coupling, amplifier tuning condenser and neutralizing condenser to the appropriate settings for the desired frequency. Place the packing condenser links in the appropriate positions, and if half aerial coil only is called for, the link should be opened and the strip connection removed from the outer end of the coil and connected at the end of the first half of the coil from which the link has been removed.

54. Set the aerial coupling to zero and the selector switch to the C.W. position. Now turn the filament rheostats as far as they will go in a clockwise direction. Next place the filament switch in the on position and adjust each filament rheostat to give the required current for the particular valve (Amplifier, up to 6 amps.; oscillator, 5·2 to 5·6 amps.; each adjusted for maximum aerial current) and set the amplifier grid-bias switch to stud 8. Switch on the H.T supply to the master-oscillator only, and set the transmitter main H.T. switch to on.

55. The main voltmeter, master-oscillator milliammeter, and closed circuit ammeter only should give readings when the correct state of oscillation of the master-oscillator circuit is obtained.

56. Operate the neutralizing switch which opens the amplifier filament circuit and connects the neon lamp to the anode circuit. Turn the neutralizing condenser to " 0 " and tune the amplifier by means of the glow in the lamp. Switch on the H.T. supply to the amplifier. Rotate the neutralizing condenser and note the scale readings at the extreme positions of the condenser for which there is no glow in the lamp. The mean of these values is the correct neutralizing position.

57. Return the neutralizing switch to its original position thereby closing the amplifier valve filament circuit and opening the neon lamp circuit. Depress the key to complete the amplifier circuit and tune the amplifier closed circuit until the current as indicated by the amplifier closed circuit ammeter is a maximum. Set the aerial coupling to, say 45 degrees and tune the aerial circuit. Re-adjust the grid coupling and aerial coupling until the maximum aerial current is obtained. The aerial coupling should be as loose as possible to avoid the " double hump " effect in tuning.

58. With the key closed, check the frequency. It may be found that a slight change of frequency has occurred. If a change has occurred, re-adjust the master-oscillator tuning and repeat the above operations.

59. Re-adjustment of the master-oscillator circuit tuning can be made quite simply in the following way. Suppose that the required frequency is 4,800 kc/s. and that as a result of first adjustment the frequency has changed to 4,762 kc/s. (a difference of 38 kc/s.). By reference to the tables it will be found that in this particular region of frequencies 255 kc/s. is equal to 20 divisions of the master-oscillator condenser scale, so that 38 kc/s. is equal to 3 divisions. It is only necessary therefore to set the master-oscillator tuning condenser back on the scale by this amount and re-tune throughout to reproduce a frequency of 4,800 kc/s. in the aerial circuit.

60. It may sometimes be found that at a certain frequency setting of the master-oscillator a harmonic resonance occurs in the grid coupling coil. This is mainly confined to the higher frequencies of the band covered by the transmitter and is due to the necessity for providing

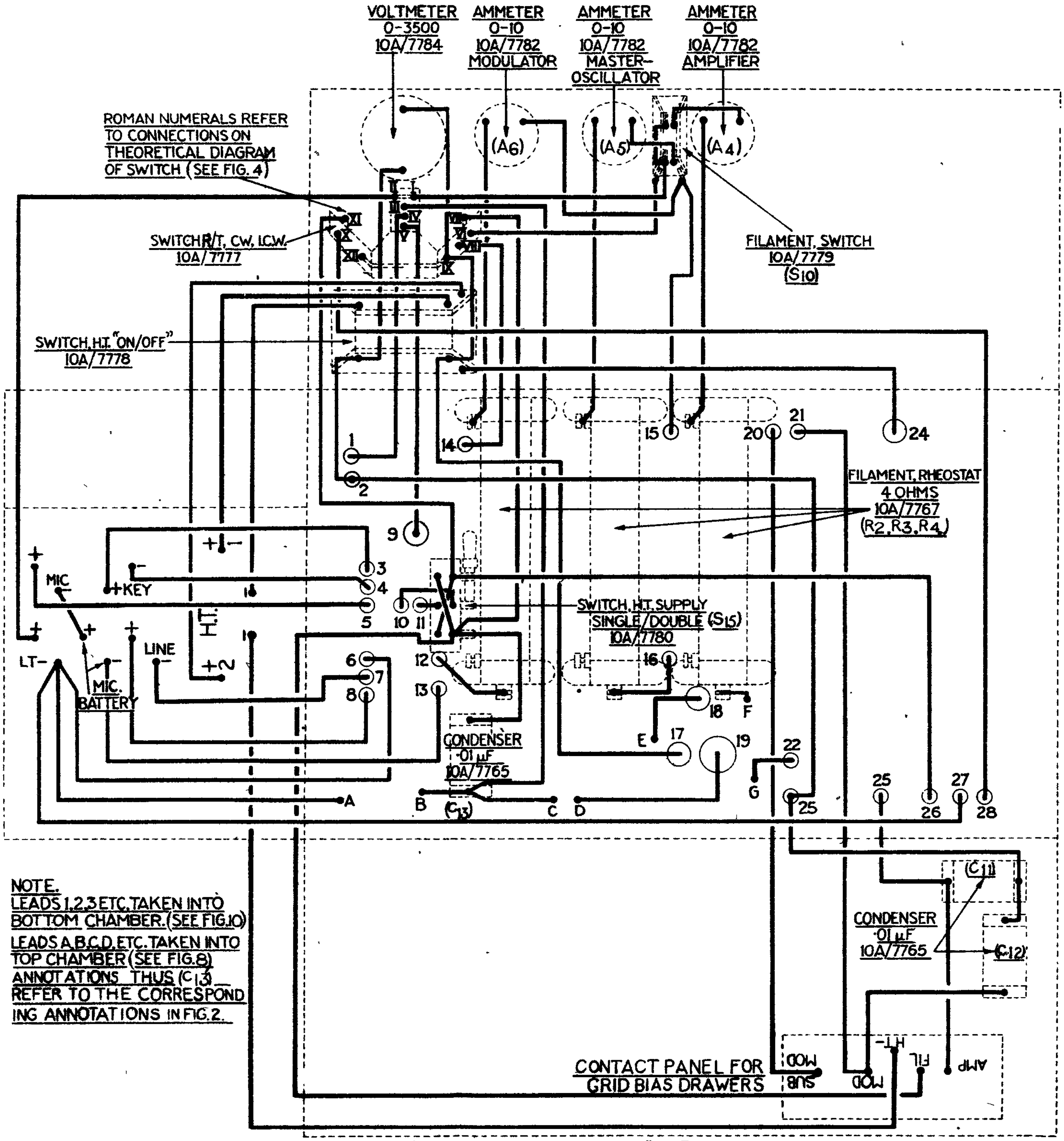
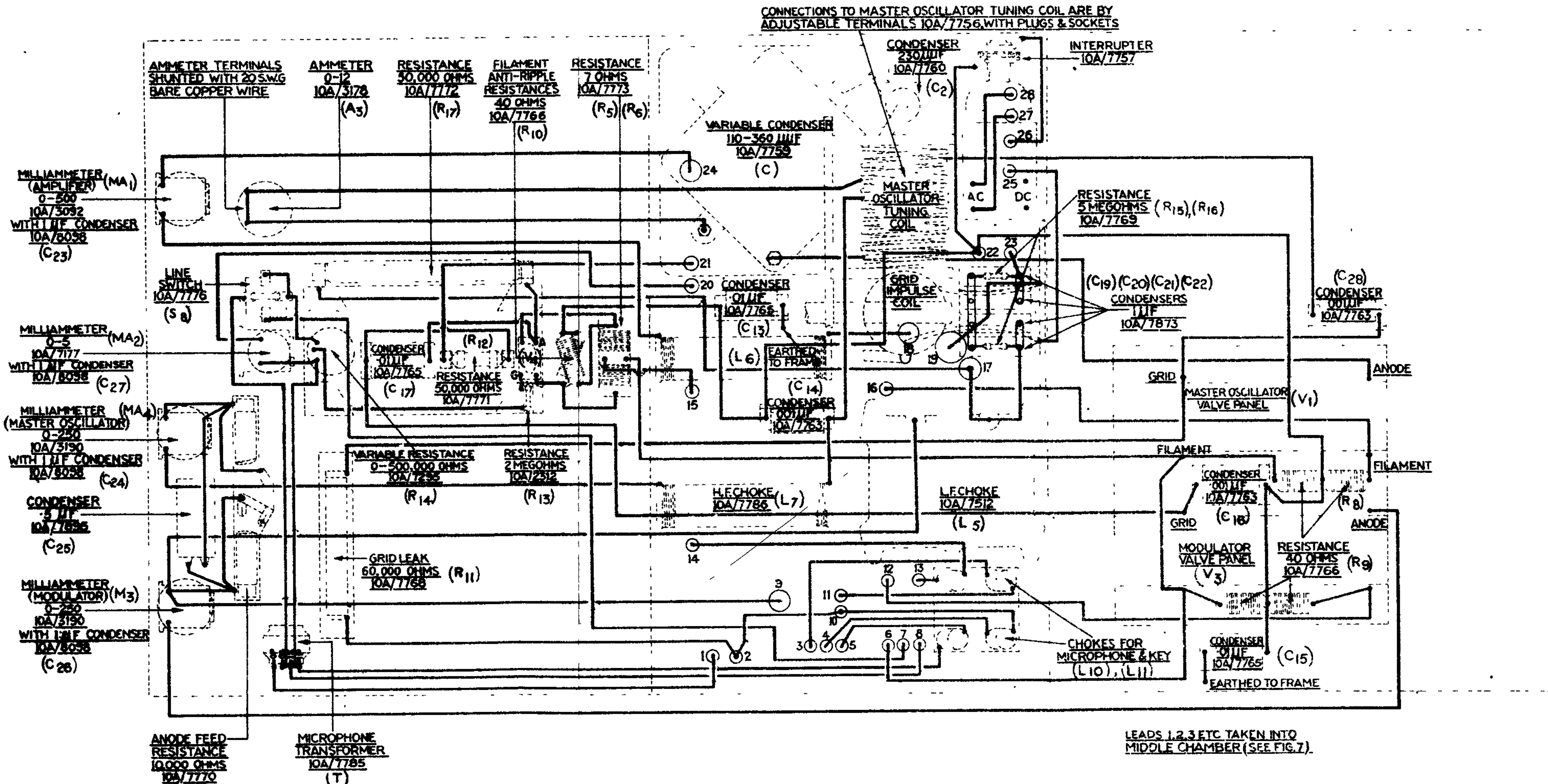


FIG.9. BENCH WIRING DIAGRAM, MIDDLE CHAMBER

(F.1799). F. & C. LTD



NOTE. ANNOTATIONS THUS (R_{17}) REFER TO THE CORRESPONDING ANNOTATIONS IN FIG. 2.

FIG. 10. BENCH WIRING DIAGRAM, BOTTOM CHAMBER

(F.1799). F. & C. LTD.

large inductance in the coupling coil for the lower frequency portion of the band. When, owing to this effect, difficulty is experienced in the process of tuning, or neutralizing, or both, a change of coupling tap will usually effect an improvement.

61. The master-oscillator valve should not take more than 130 milliamps. at 3,000 volts. If the anode current at 3,000 volts is much in excess of this value switch off and increase the resistance of the grid-leak.

62. The amplifier valve is capable of dissipating 450 watts continuously on the anode in which state the anode glows with a bright red colour. This is the normal working state of the valve and is in no way objectionable. In connection with the transmitter T.70 however, this state is sometimes associated with excessive grid current This latter must be avoided by increasing the amplifier bias or decreasing the grid coupling or both. When the grid coupling value is changed the neutralizing condenser may require to be reset.

Adjustments for I.C.W. operation

63. Adjust the transmitter for C.W. working as described above and set the selector switch to the " I.C.W." position. If more power is required than is obtainable with these adjustments, try the effect of increase of coupling (both grid and aerial). If the bulk of the work of the transmitter is to be on I.C.W. it may be advisable to lower the anode tap of the master-oscillator circuit, but this should never be done where there is likelihood of a quick change-over to R/T transmission being required.

Adjustments for R/T operation

64. In order to obtain proper modulating conditions the procedure outlined in the following paragraphs should be observed. Assuming that the transmitter has been properly adjusted for C.W. on the desired frequency, switch off and withdraw the master-oscillator anode feed resistance. Set the selector switch to R/T and the modulator bias switch to stud 16. Now switch on and adjust the amplifier bias until the amplifier anode current milliammeter reads 15–20 mA. with H.T. tap 2, or 30–40 mA. with H.T. tap 3. Switch off and insert the 30,000 ohm anode feed resistance.

65. Switch on and adjust the modulator filament current to 4 amperes (*see* para. 71, modulation of the carrier due to A.C. ripple). Adjust the grid and aerial coupling for maximum aerial current. (Re-tuning of both amplifier and aerial circuits will probably be necessary.)

66. Re-adjust the bias on the modulator valve until this valve is dissipating just less than 250 watts. For an anode voltage of 3,000 volts, for example, the anode current should be slightly less than 83 mA. ; for a voltage of 2,500 volts the anode current should be slightly less than 100 mA. and for a voltage of 2,000 volts the anode current should be slightly less than 125 mA. and so on.

67. The sub-modulator valve should normally require no adjustment. It is advisable, however, to check the sub-modulator bias occasionally with a voltmeter, and it is a good plan to glance at the sub-modulator valve after switching on. Any heating up of its anode is an indication that the bias is insufficient.

68. Read the value of aerial current carefully. Leaving all other adjustments untouched (except the modulator bias which must always be adjusted to limit the anode dissipation to 250 watts) reduce the grid coupling until the aerial current has fallen to half its former value. Proper conditions for modulation should now obtain.

69. When a common H.T. supply is to be used the switch must be put to the "single" position, the H.T. source connected to the H.T. +1 and H.T. —1 terminals, and the two H.T. positive terminals connected together. The terminals H.T. —1 and H.T. —2 must *not* be connected together otherwise arcing may take place when the H.T. switch is required to break a heavy current.

70. When all the adjustments described above have been satisfactorily made, the modulation should be checked by means of a Modulation Indicator. If a Modulation Indicator is not available the following method may be usefully employed. Speak into the microphone and note the readings on the aerial ammeter or on the amplifier closed circuit ammeter. For correct modulation these ammeter readings should rise with modulation (22 per cent. rise for 100 per cent. modulation, 6 per cent. rise for 50 per cent. modulation). At the same time there should be little or no movement of the pointers of the amplifier and the modulator anode current instruments. In the case of the amplifier anode current, an increase indicates that the grid coupling is insufficient or that the bias is too great, or both. Similarly a decrease of anode current indicates the converse. A small amount of movement of the pointer of the anode current instrument may be neglected. When checking the modulator anode current the adjustment to be aimed at is one that gives as little movement of the pointer as possible. A movement of 10 milliamps. should be regarded as the absolute maximum allowable.

71. If it is found, by observation of the Modulation Indicator, that more than 5 per cent. modulation of the carrier, is present owing to A.C. ripple, an increase or decrease of the filament current of the modulator valve may effect a considerable improvement. This is permissible up to a value not more than 20 per cent. or to such a value that the anode current of the modulator valve is not appreciably altered.

72. The amplitude of the speech voltage impressed on the grid of the sub-modulator valve can be controlled by means of the volume control. The volume is increased by rotating the handle of the control in a clockwise direction. The maximum volume allowable is that which produces the 10 milliamps. change mentioned above. Except for extreme ranges a low volume setting should be used.

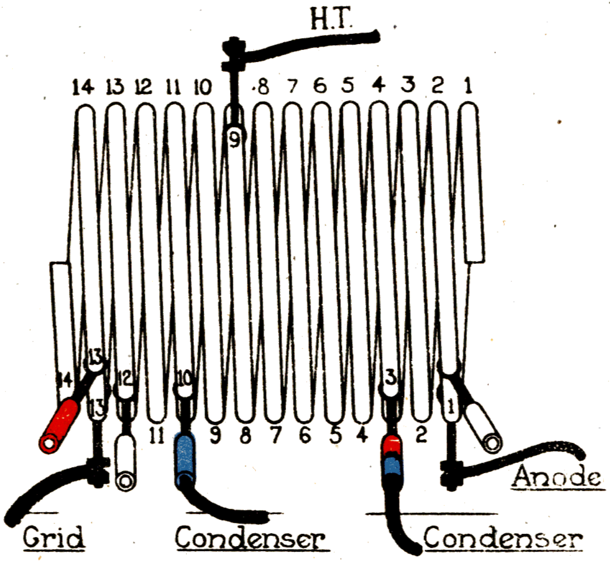
73. The upper limit of frequency of the transmitter is given as 6,000 kc/s. When necessary this upper limit may be raised to 6,666 kc/s. by making the following adjustments.

Master-oscillator coil.

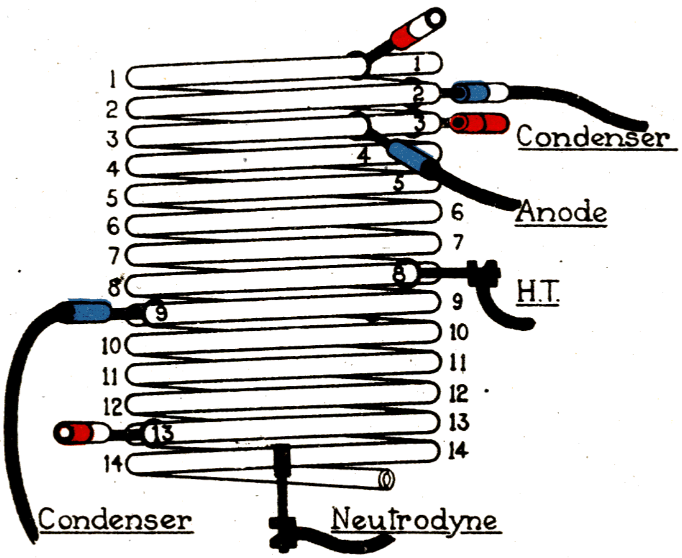
Connection.	Colour.	Turn.
Anode	Black	1
Condenser	Red-black	4
H.T. + ...	Black	9
Condenser	Blue	10
Grid	Black	13

Amplifier coil.

Connection.	Colour.	Turn.
Anode	Blue	3
Condenser	Blue-white	2
H.T. + ...	Black	7
Condenser	Blue	9
Neutrodyne ..	Black	14



Master-Oscillator Coil
(Set up for Range 1)



Amplifier Coil
(Set up for Range 1)

Range 1 (blue)

Master-Oscillator		Amplifier	
Anode on turn	1	Anode on turn	3
Condenser on turn	3	Condenser on turn	2
H.T. on turn	9	H.T. on turn	8
Condenser on turn	10	Condenser on turn	9
Grid on turn	13	Neutrodyne on turn	14

Range 2 (plain)

Master-Oscillator		Amplifier	
Anode on turn	1	Anode on turn	1
Condenser on turn	1	Condenser on turn	2
H.T. on turn	9	H.T. on turn	8
Condenser on turn	12	Condenser on turn	13
Grid on turn	13	Neutrodyne on turn	14

Range 3 (red)

Master-Oscillator		Amplifier	
Anode on turn	1	Anode on turn	1
Condenser on turn	3	Condenser on turn	3
H.T. on turn	9	H.T. on turn	8
Condenser on turn	13	Condenser on turn	13
Grid on turn	13	Neutrodyne on turn	14

FIG. 12 SETTING OF MASTER-OSCILLATOR AND AMPLIFIER INDUCTANCES

·cing paras 74–82

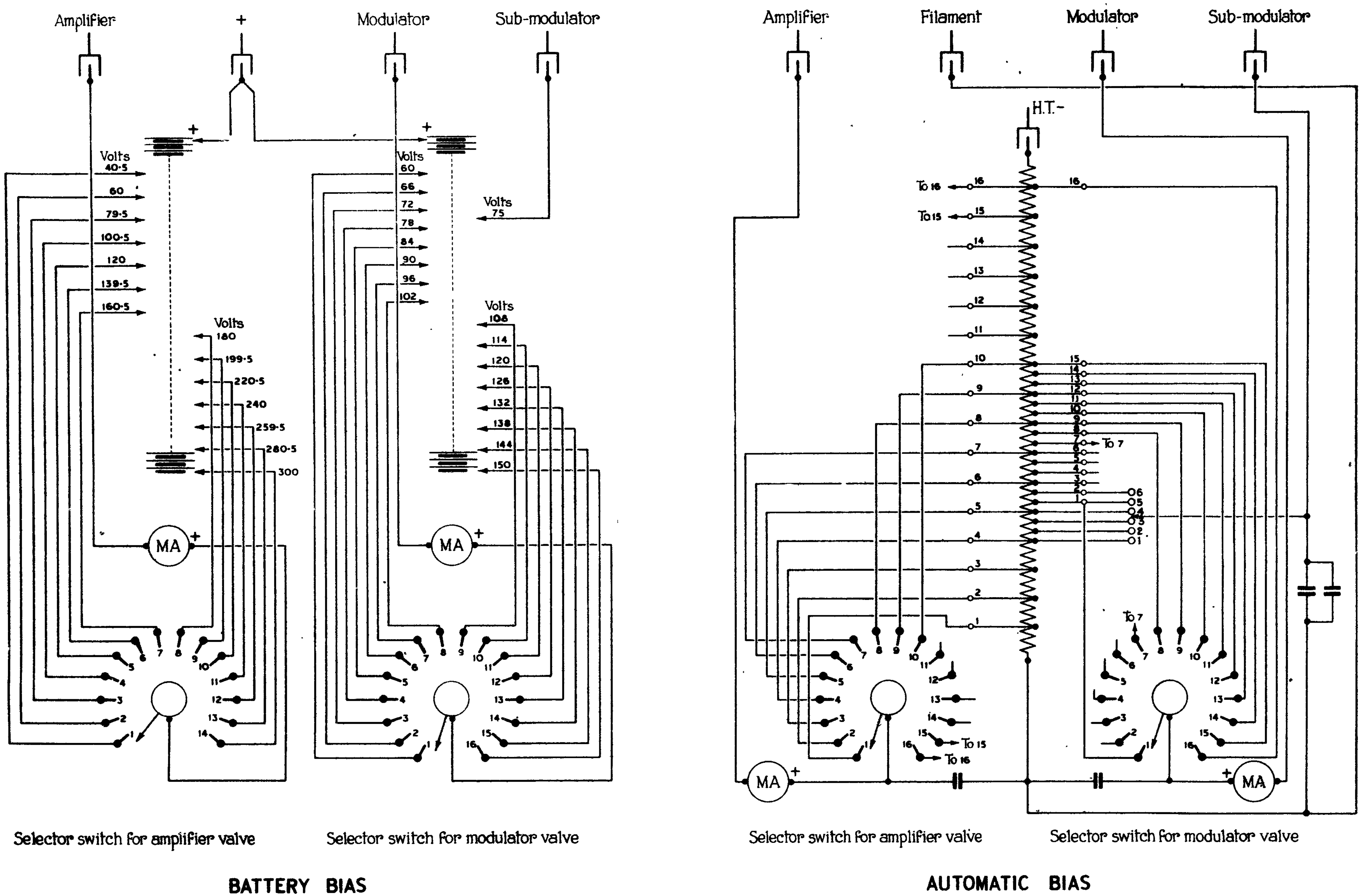


FIG. 11. GRID BIAS SWITCH CONNECTIONS.

74. When rapid changes of frequency are required between 4,300 and 6,000 kc/s. the operation is facilitated by the existence of a table which shows sets of adjustments for the frequencies to be used. Table 4 shows typical sets of adjustments for four frequencies between 4,300 and 6,000 kc/s. A similar table is to be prepared for each transmitter for the particular frequency on which it will be worked and is to be prominently displayed near the transmitter.

75. With practice it is possible to change to any frequency for which the adjustments are known in about 60 seconds. Whilst changing the frequency, the modulator grid-bias control should be set to a maximum. The aerial current, *i.e.*, the unmodulated carrier should not be less than 2 amps. for each frequency adjustment.

With remote control

76. When it is desired to operate the transmitter from some remote position, remote controls, type 5, (Stores Ref. 10A/9523) may be used. Both W/T and R/T remote control are possible with this unit, which is usually mounted on top of the rectifier, type B, near the transmitter.

77. Remote controls, type 5, consist of a board on which are mounted three relays, a repeating coil, a metal rectifier, a transformer, a key, two single tumbler switches and two coupled tumbler switches. The apparatus at the operating end is the same as is usually used for remote control operation and the whole system is described elsewhere in this publication.

78. Two terminal strips are provided on the remote control unit. The terminals on the right-hand strip are connected to the transmitter while the terminals on the left-hand strip are connected to the incoming A and B lines from the operating end and also to the rectifier. The simplified diagram, fig. 14, shows the manner in which the various units are connected up. When it is desired to operate the transmitter remotely, all that is necessary is to ensure that the switch (12, fig. 5) is in the " line " position and that the switch (8, fig. 5) is in the position which gives the type of radiation required, *e.g.*, R/T, C.W. or I.C.W. When R/T is being radiated, the coupled tumbler switches on the remote control unit should be in the R/T position. When C.W. or I.C.W. is being radiated, the coupled tumbler switches should be in the W/T position. The H.T. and L.T. to the transmitter are switched on and off by means of the two relays on the remote control unit, which are in turn controlled from the operating end.

PRECAUTIONS AND MAINTENANCE

79. While carrying out any adjustments to components inside the transmitter, every precaution must be taken to avoid contact with live parts. In no circumstances must a door or panel be opened unless the H.T. switch has first been placed in the off position. Labels bearing the words SWITCH OFF H.T. are hung at various places in the transmitter and these must never be removed.

80. When the transmitter is used for R/T, an anode resistance of 30,000 ohms is included in the H.T. feed to the master-oscillator valve. It has been found that, except when maximum efficiency is required, this value of resistance also suffices for C.W. and I.C.W. transmissions.

81. When the transmitter is in use for R/T, C.W. and I.C.W., this resistance is not to be changed with a change in the type of radiation unless maximum efficiency is required in the transmission of C.W. and I.C.W. Where the transmitter is never used for R/T, the alternative 10,000 ohm anode resistance (Stores Ref. 10A/7770) is to be used permanently for both C.W. and I.C.W.

82. Since the rectifier, type B, is used with this transmitter, the usual precautions peculiar to this unit should be observed. For example, the valves used are of the mercury vapour type and, should any mercury have come in contact with the filaments, the valves will be seriously damaged if the H.T. is switched on before this mercury is removed. To avoid this damage therefore the filaments should be switched on for not less than ten minutes before the H.T.

83. Care should be exercised that the correct fuses are fitted in the rectifier, and also that the relay type K is corectly adjusted. Details of the various precautions necessary for the rectifier unit will be found in the appropriate chapter which appears elsewhere in this publication.

84. If the grid-bias for the transmitter, as explained in para. 30 is obtained from dry batteries housed in a drawer, then in the event of irregularity of behaviour which cannot otherwise be traced, do not omit to check that the batteries are correctly connected and that the connections at the back of the drawer are making good contact.

85. If when adjusting the filament rheostats the correct current cannot be obtained, there is probably a high resistance connection somewhere in the filament circuit. This should be located and cleaned up.

86. It should be borne in mind that it is quite impossible, no matter what depth of modulation is used, to obtain good speech *if the aerial current is too large.* When making the grid coupling adjustments to reduce the maximum aerial current to half value as described in para. 68, it is preferable to *err on the side of small aerial current* rather than large.

87. Even on full power there should be little or no sparking at the key contacts. Excessive grid current will cause sparking and if the required power cannot be obtained without sparking at the key, a 1 µF. condenser in series with a resistance of about 40 ohms should be connected across the key contacts.

88. It is desirable whenever possible to switch on the master-oscillator and to allow the apparatus to attain a steady temperature before commencing to transmit. Generally 10 to 15 minutes will be sufficient and if this procedure is carried out variation of frequency during operation will be almost entirely prevented.

TABLE 1

Range 1. R/T. 6000–4286 kc/s.

Frequency kc/s.	Master-Oscillator.			Modulator		Amplifier.			Neutralizing condenser degrees.	Aerial.					Volts.
	Tuning condenser.	Grid coupling. Tap.	Grid coupling. Degree	Bias stud.	Anode current mA.	Tuning condenser.	Bias stud.	Anode current mA.		Coil setting (half-coil disconnected).	Series No. 7 condenser. Jars.	Series No. 7 condenser. Deg.	Coupling degrees.	Current amps.	
6,100	0	2	40	8	77	23	2	160	57	4·37	0·1	10	90	3·0	2,600
5,970	20	2	13	8	77	39	2	135	61	5·53	0·1	10	90	2·6	2,600
5,572	40	2	0	7	95	62·5	5	135	56	3·98	0·15	20	90	3·0	2,600
5,228	60	3	28	8	75	74·5	1	125	52	3·85	0·2	30	56	2·5	2,600
4,955	80	3	9	7	90	96·5	1	150	52	3·95	0·3	50	40	2·6	2,600
4,700	100	3	10	7	87	121·5	1	150	52	5·36	0·3	50	59	2·5	2,600
4,458	120	3	15	7	87	135	1	155	52	4·27	0·4	70	90	3·0	2,600
4,270	140	3	17	7	90	158	1	145	52	3·92	0·95	180	90	3·0	2,600
4,140	160	4	5	7	95	178	7	150	56	5·0	0·95	180	90	3·0	2,600
4,020	180	5	42	7	95	195	1	155	60	5·52	0·95	180	90	3·2	2,600

The links connecting the fixed " packing " condensers should be disconnected. The plugs on the master-oscillator and amplifier tuning coils should be in the sockets coloured blue. The anode feed resistance of the master-oscillator should be 30,000 ohms

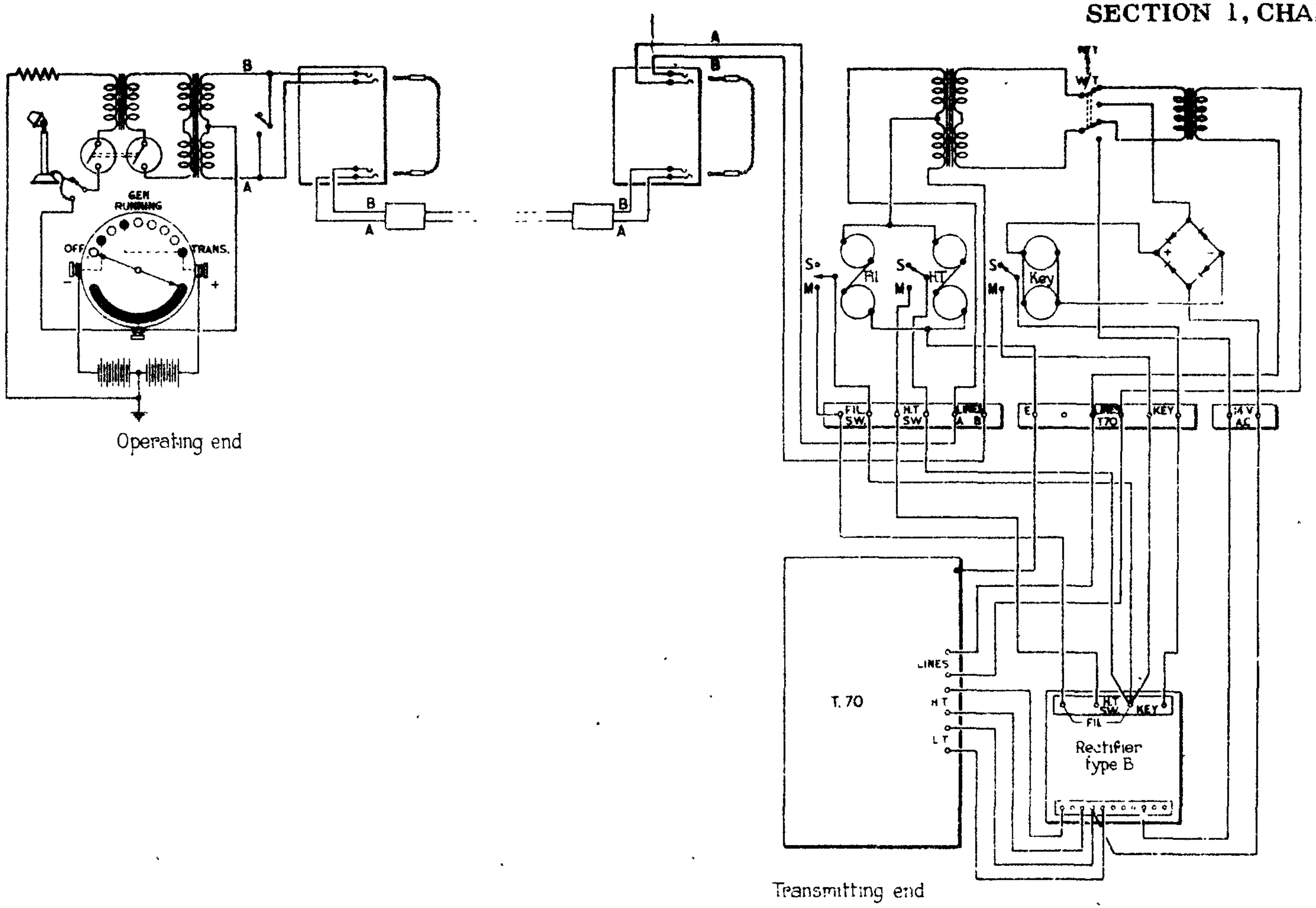


FIG. 13. T 70 AS OPERATED BY REMOTE CONTROLS, TYPE 5

TABLE 2

Range 2. C.W. only. 4286–3000 kc/s.

Frequency kc/s.	Master-Oscillator.			Amplifier.			Aerial.		
	Tuning con-denser.	Grid coupling.		Tuning con-denser.	Bias stud.	Anode current mA.	Coupling degrees.	Tuning coil setting.	Current amps.
		Tap.	Degrees.						
4,705	20	4	12	9·4	1	230	25	1·66*	5·0
4,355	40	3	15	27·7	1	250	29	3·24*	5·7
4,070	60	3	31	45	1	260	31	5·0*	5·9
3,840	80	4	3	67	1	260	33	6·93*	5·8
3,630	100	4	13	81	1	256	33	7·76*	5·7
3,440	120	4	17	99·6	1	235	33	2·29	5·3
3,300	140	4	26	117	1	240	33	3·62	5·3
3,170	160	5	5	135	1	280	33	4·82	6·0
3,040	180	5	13	152	1	33	33	6·0	6·2
2,940	200	5	18	168	1	300	33	6·97	6·0

Note :—
(1) Use separate H.T. supply to master-oscillator if possible.
(2) Use the least coupling both from master-oscillator to amplifier and amplifier to aerial that will transfer the necessary power to the aerial. For ranges up to 250 miles, 3 amps. in the above aerial system should be ample to work with appropriate service receiver. * Half coil disconnected.

The links connecting the fixed " packing " condensers should be disconnected. The plus on the master-oscillator and amplifier tuning coils should be in the uncoloured sockets. The anode feed resistance to the master-oscillator valve should be 10,000 ohms.

TABLE 3

Range 3. R/T. I.C.W. C.W. 3000–2500 kc/s.

Fre-quency kc/s.	Master-Oscillator.			Modulator.		Amplifier.			Neutralizing condenser degrees.	Aerial.			Volts.
	Tuning condenser	Grid coupling.		Bias stud.	Anode current mA.	Tuning condenser.	Bias stud.	Anode current mA.		Coupling degrees.	Tuning coil setting (full coil).	Current amps.	
		Tap.	Degrees.										
3,000	26	5	15	8	86	35	1	210	66	50	1·98	2·4	2,600
2,851	60	5	47	8	82	67	1	205	66	50	3·28	2·5	2,600
2,725	92	5	90	8	90	95	1	175	66	90	4·0	2·2	2,600
2,604	130	6	4	8	75	140	1	250	66	50	6·38	2·5	2,600
2,500	164	6	12	8	80	167	1	220	66	90	7·31	2·4	2,600

The links connecting the fixed " packing " condensers should be connected to the appropriate terminals. The plugs on the master-oscillator and amplifier tuning coils should be in the sockets coloured red. For R/T the master-oscillator anode feed resistance should be 30,000 ; for C.W. and I.C.W. it should be 10,000 ohms.

For C.W., use separate H.T. supply to the master-oscillator if possible.

TABLE 4

Settings of transmitter T.70 for rapid frequency change between 4,300 and 5,750 kc/s.

Frequency kc/s.	M/O Condenser degrees.	Grid coupling coil		AMP. tuning condenser degrees.	Aerial coupling condenser degrees.	Neutralizing condenser degrees.	Aerial tuning coil		Series aerial condenser degrees.
		Tap.	Degrees.				Turns.	Degrees.	
4,300	180	3	27	163	90	47	8	0	250
5,000	107	3	25	92	90	40	5	0	150
5,550	69	3	37	60	90	44	3	50	150
5,750	53	3	17	46	90	44	1	86	150

APPENDIX

NOMENCLATURE OF PARTS

The following list of parts is issued for information. In ordering spares for this transmitter, the appropriate section of AIR PUBLICATION 1086 must be used.

Ref. No.	Nomenclature.	Quantity.	Remarks.
10A/7755	Transmitter T.70 :—		Without valves, neon lamp and batteries.
	Principal components :—		
	Ammeter,		
10A/7782	Moving-iron, 0–10	3	
10A/7783	Thermo, 0–8	1	
10A/3178	Thermo, 0–12	2	
	Choke,		
10A/7786	H/F, type 9	2	
10A/7512	L/F, type C	1	
10A/7756	Clip, tuning coil	10	
	Condenser,		
10A/7759	Type 104	2	110–360$\mu\mu$F (variable).
10A/7760	Type 105	2	·00025μF bank of 8 units.
10A/7761	Type 106	1	40$\mu\mu$F neutralizer.
10A/7762	Type 107	1	·0001μF
10A/7763	Type 108	3	·001μF.
10A/7764	Type 109	2	·002μF.
10A/7765	Type 110	7	·01μF.
10A/7895	Type 118	1	0·5μF.
10A/8098	Type 146	4	1·0μF meter shunts.
10A/10920	Type 428	4	
10A/1871	Insulator, type 5	1	Aerial.
	Milliammeter,		
10A/7177	0–5	1	
10A/7123	0–30, type A	1	
10A/1504	0–100, type A	1	
10A/3190	0–250	2	
10A/3092	0–500, type A	1	
10A/7757	Motor, interrupter, 20-volt	1	
	Resistance,		
10A/2312	Type 26	1	2 MΩ.
10A/7295	Type 40	1	500,000 ohms, variable.
10A/7766	Type 82	8	40 ohms, wire-wound.
10A/7767	Type 83	3	4 ohms, variable.
10A/7768	Type 84	1	60,000 ohms.
10A/7769	Type 95	2	5 MΩ.
10A/7770	Type 86	1	10,000 ohms for C.W. and I.C.W.
10A/7771	Type 87	1	50,000 ohms.
10A/7772	Type 88	1	50,000 ohms.
10A/7773	Type 89	1	7 ohms.
10A/8141	Type 125	1	30,000 ohms for R/T alternative to 10A/7770.
	Switch,		
10A/7774	Type 56	1	14-contact, grid.bias.
10A/7775	Type 57	1	16-contact, grid-bias.
10A/7776	Type 58	1	2-position, line switch.
10A/7777	Type 59	1	R/T., C.W., I.C.W. switch.
10A/7778	Type 60	1	2-position, H.T. switch.
10A/7779	Type 61	1	2-position, L.T. switch.
10A/7780	Type 62	1	H.T. change-over switch.
10A/7781	Type 63	1	Neutralizer.

Ref. No.	Nomenclature.	Quantity.	Remarks.
	Transmitter, T.70—*continued*		
	Principal components—*continued*		
	Transformer, microphone,		
10A/7785	Type E	1	
10A/7322	Terminal	1	Counterpoise.
10A/7784	Voltmeter, moving coil .. .	1	0–3500.
	Accessories,		
5A/1338	Battery, dry, 15-volt	30	For battery grid-bias.
10A/7474	Lamp, indicating, neon, No. 1	1	
	Valves,		
10A/5203	Type V.T.4B.	1	Amplifier.
10A/1651	Type V.T.5B	1	Master-oscillator.
10A/7787	Type D.E.T.3	1	Modulator.
10A/1651	Type V.T.25	1	Sub-modulator.
10A/7104	Interrupter motor, brushes	2	
10A/7758	Interrupter disc, 10-segment	1	
10A/2951	Condenser, type 7 (1 jar)	1	Aerial, series, if required.
10A/9812	Panel contact, grid-bias unit	1	Alternative to battery grid-bias.
10A/9804	Unit, grid-bias	1	

FOR OFFICIAL USE ONLY

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SECTION 1, CHAPTER 2

TRANSMITTER T.77

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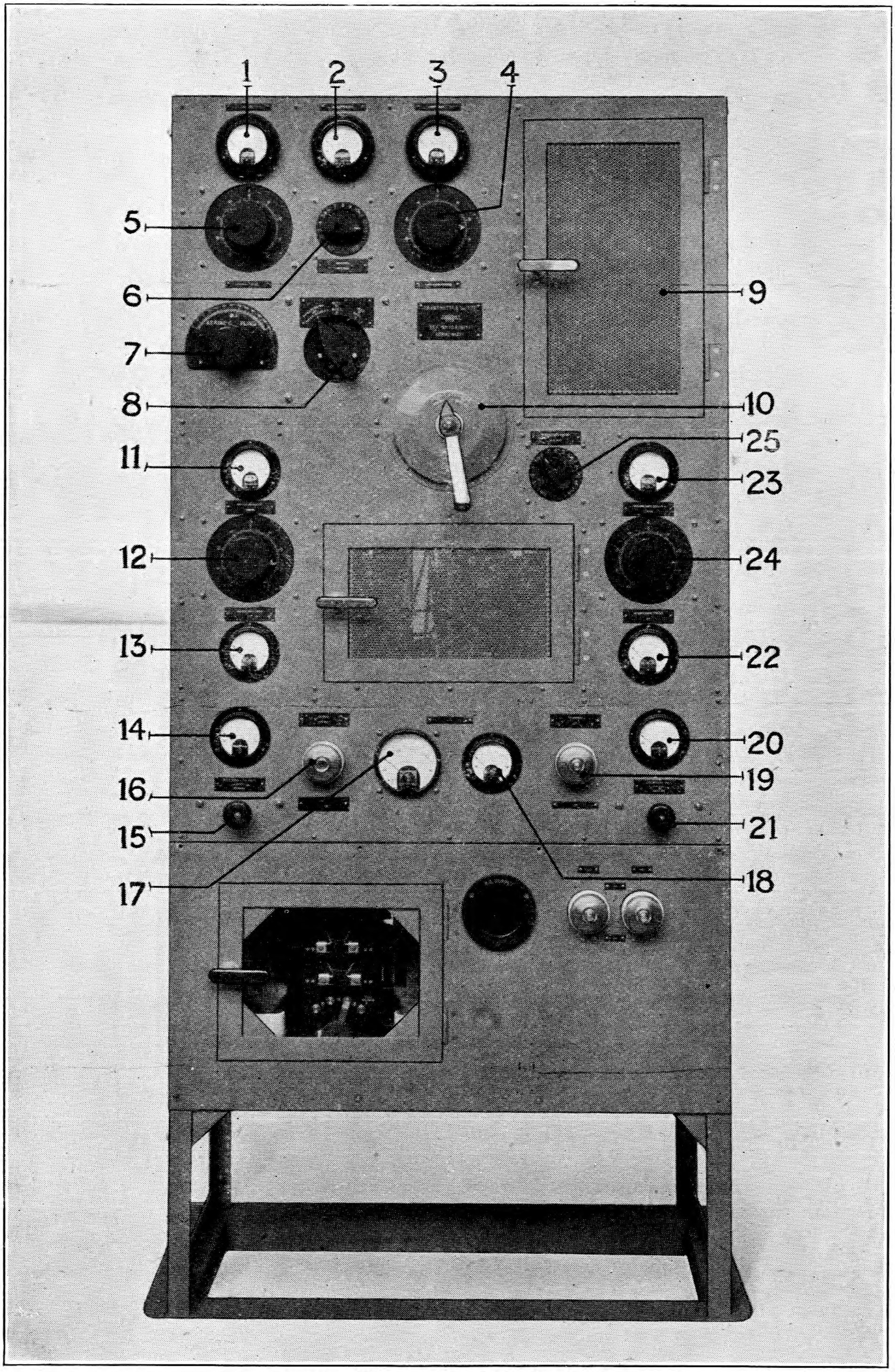

FIG. 1. Transmitter T.77 front view

TRANSMITTER T.77

(Stores Ref. 10A/8151)

INTRODUCTION

1. The transmitter T.77 is a master-oscillator controlled ground station transmitter designed for continuous wave transmission on the frequency bands 143 to 400 kc/s. and 1,500 to 2,256 kc/s. A socket is provided on the transmitter which enables a modulating amplifier to be used when R/T or M.C.W. is required.

2. The transmitter is so designed that it may be conveniently adapted for A.C. or D.C. supply. When used for D.C. the rectifier portion (panel, rectifying, type A, Stores Ref. 10A/8068) is removed and a dummy panel fitted in its place. The smoothing unit which is incorporated in the transmitter is not removed with the rectifier but remains in circuit for D.C. operation. The transmitter is adapted to be operated either directly or by remote control.

3. The transmitter comprises a master-oscillator circuit which controls, through an intermediate amplifier or buffer circuit, a power amplifier or output circuit. The aerial circuit is capacitance-coupled to the amplifier. The buffer circuit serves not only as an amplifying circuit but also as an isolating stage which, by preventing " feedback " between the output circuit and the M/O, serves to stabilize the frequency. This buffer circuit renders neutralization in the output circuit unnecessary.

4. In order to cover the two frequency bands without change of coils, etc., variometer tuning is employed, the windings of the variometers being connected in series for the lower frequencies and in parallel for the higher frequencies. The M/O and intermediate stage variometers are, on the lower frequencies shunted by variable condensers which are mechanically coupled to and simultaneously operated by the variometer spindles. Fixed capacitance coupling is employed between the M/O and the intermediate amplifier stage and between the latter and the output stage. The aerial coupling is effected by a variable condenser. Automatic grid-bias is provided for the valves in the intermediate and power amplifier circuits. Keying is effected by means of an electro-magnetically operated switch which makes and breaks the H.T. negative and grid-filament circuits of all three stages. A combined electro-magnetically operated " Send–Receive " and " H.T. on and off " switch is incorporated in the transmitter. By means of this switch the aerial is disconnected from the transmitter and connected to a receiver, the transmitter H.T. circuit being opened simultaneously.

5. The rectifying portion comprises two gas-filled rectifying valves and the necessary transformers and electro-magnetic switches. The rectifying panel is fully described in another chapter of this publication.

GENERAL DESCRIPTION

Transmitter

6. A theoretical circuit diagram of the transmitter is given in fig. 4. V is the master-oscillator valve, V_1 the intermediate amplifier valve (actually two valves in parallel) and V_2 is the power amplifier or output valve. The oscillatory circuit of the master-oscillator valve V, is of the Hartley type and consists of a variable inductance L across which is connected a variable condenser C. The variable inductance L is a variometer and the two windings are connected in series for the lower frequency band and in parallel for the higher frequency band. A filament centre-connection unit consisting of two condensers C_1 and C_2 and two resistances

R and R_1 is connected across the filament leads of V. The centre-point of the unit is connected to earth *via* the keying relay RL. Two further resistances R_2 and R_3 are included as filament resistances in the M/O filament circuit. R_4 is the grid-leak resistance and C_4 the grid coupling condenser. C_4 is the mains condenser.

7. The H.T. feed to the M/O oscillatory circuit is taken *via* the anode resistance R_5 and R/F choke L_1 through the range change switch to the centre-point of L. A milliammeter M, shunted by the condenser C_5, is in series with the anode resistance and choke. When working on the higher frequency band, instead of the variable condenser C, the inductance L_2 and fixed condenser C_9 are connected in parallel with the inductance L. The H.T. feed is then made to the tapping point of L_2, instead of the centre-point of the variometer. C_6 and C_7 are the coupling condensers between the M/O and the intermediate stage for the lower and higher frequencies respectively.

8. The filaments of the two intermediate amplifier valves V_1 have four resistances R_6, R_7, R_8 and R_9 included in the filament circuits, while the variable resistance R_{10} provides a means of controlling the filament voltage of both the M/O and intermediate stage valves. The variometer L_3, in conjunction with the variable condenser C_{10}, forms the tuned oscillatory circuit for V_1 The windings of L_3 can be connected in series for the lower frequency band and in parallel for the higher frequency band. The H.T. is fed through an anode resistance R_{11} and an R/F choke L_4. A milliammeter M_1 shunted by the condenser C_{11} is also included in the H.T. circuit. Coupling between the intermediate stage and the power output stage is effected by the condenser C_{12} for the higher frequencies, and C_{13} for the lower frequencies. When working on the higher frequency band the inductance L_5 and fixed condenser C_{12} are connected in parallel across the variometer in place of the variable condenser C_{10}.

9. Grid-bias for the valves V_1 is obtained from the resistances R_{12} which are connected between the grid of the valve and H.T.—. A movable arm selects a suitable tapping on the resistance. The R/F choke L_6 is connected in the grid circuit of the valves V_1. For R/T and M.C.W. a modulating amplifier is introduced into the grid circuit by means of the combined socket and switch S.

10. The power amplifying valve V_2 is provided with a filament centre-connection unit consisting of the resistances R_{13} and R_{14} and the condensers C_{15} and C_{16}. The centre-point of this unit is connected to earth *via* the keying relay RL. The filament voltage is controlled by means of the variable resistance R_{15}. Grid bias for the valve V_2 is obtained from the tapped resistance R_{19}, while the choke L_7 is included in the grid circuit of the valve. The R/F choke L_8 and milliammeter M_2, the latter shunted by the condenser C_{18}, are included in the H.T. circuit of V_2.

11. The windings of the variometer L_9 are connected in series for the lower frequencies and in parallel for the higher frequencies. The condenser C_{19} is connected across the variometer for lower frequencies, and the condenser C_{20} and inductance L_{10} in parallel, are connected across the variometer windings for the higher frequencies.

12. The pulse coil L_{11} is provided with several tapping points brought out to a terminal board. A flexible lead from the anode of V_2 terminates in a socket which can be engaged with one of the plugs on the pulse coil. Similarly the two ends of the oscillatory circuit of V_2 can be connected to any tapping point on L_{11}. In the lower frequency position the lower portion of L_{11} is used and in the higher frequency position, the upper portion of L_{11} is brought into circuit.

13. Variable capacitance coupling is employed between the output amplifier and the aerial circuit, C_{21} being used for this purpose. The aerial tuning inductance L_{12} is a variometer, the windings of which are connected in series for the low frequency band and in parallel for the high frequency band. In addition the aerial inductance L_{13} is connected across the variometer windings for the higher frequencies. C_{22} is the mains condenser. The aerial loading coil L_{14} is constructed in two portions and a three position switch S_1, connects the aerial directly to L_{12} in position 1,

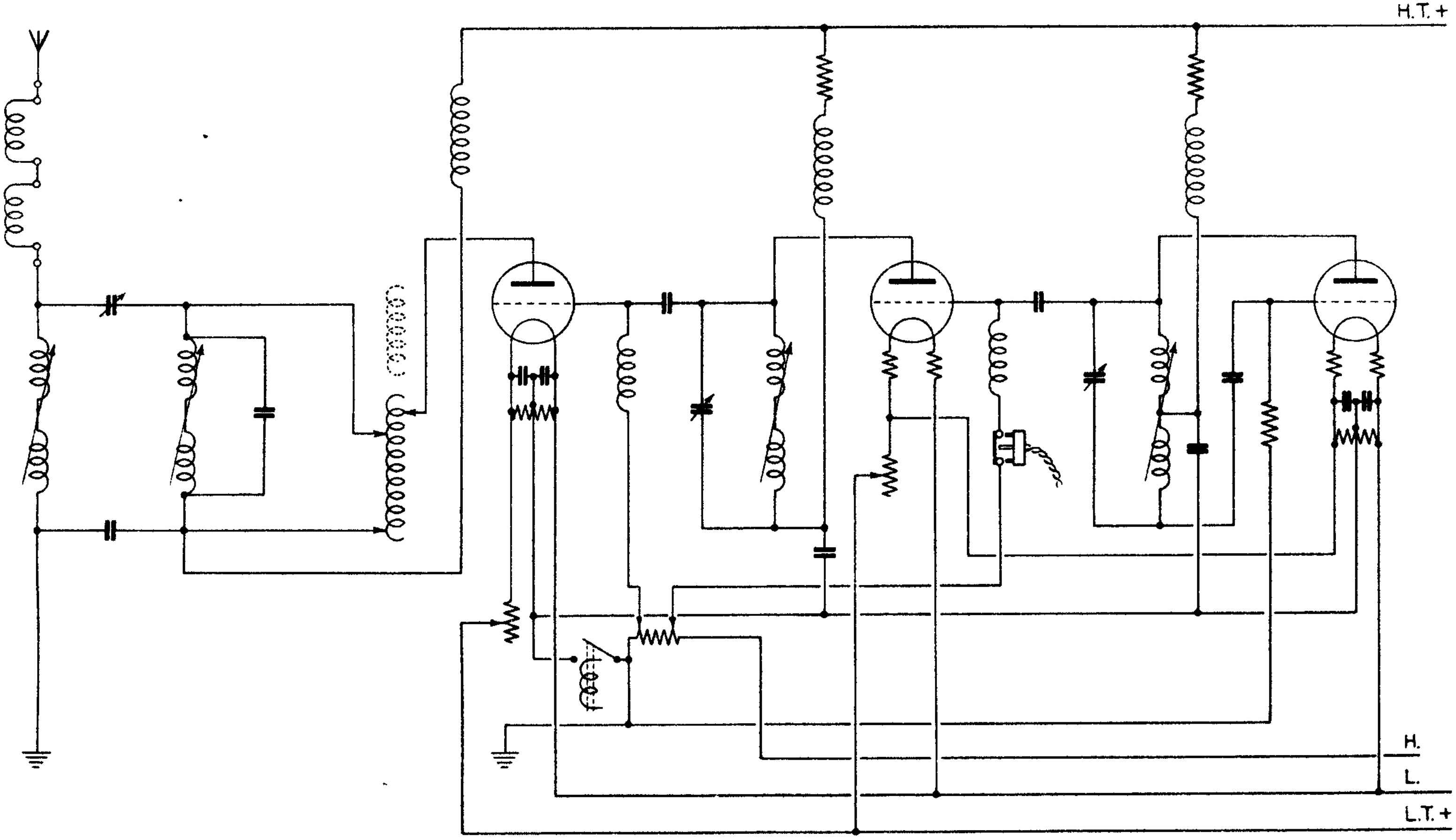

FIG. 2. SIMPLIFIED DIAGRAM (LOWER FREQUENCIES)

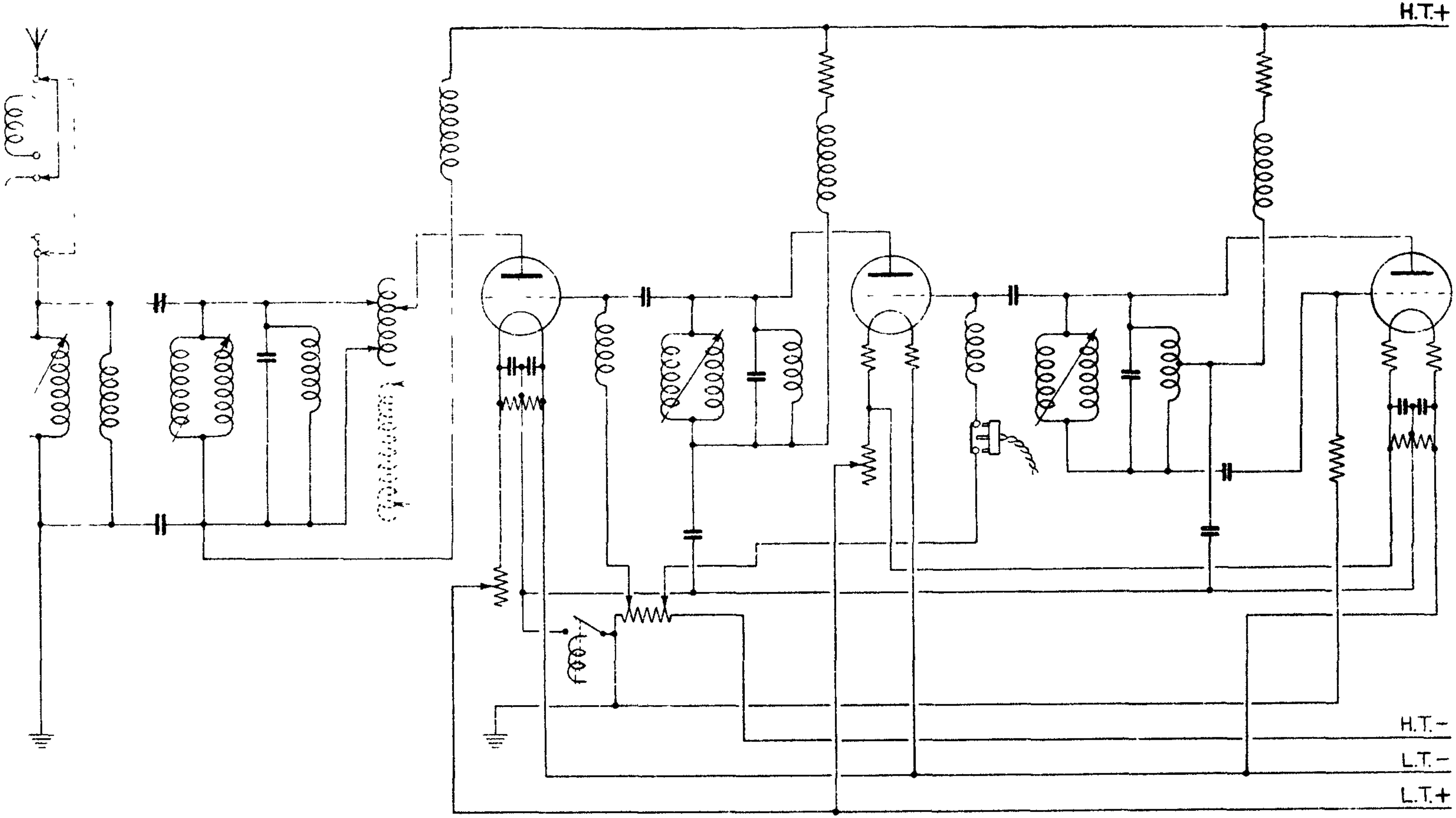

FIG. 3. SIMPLIFIED DIAGRAM (HIGHER FREQUENCIES)

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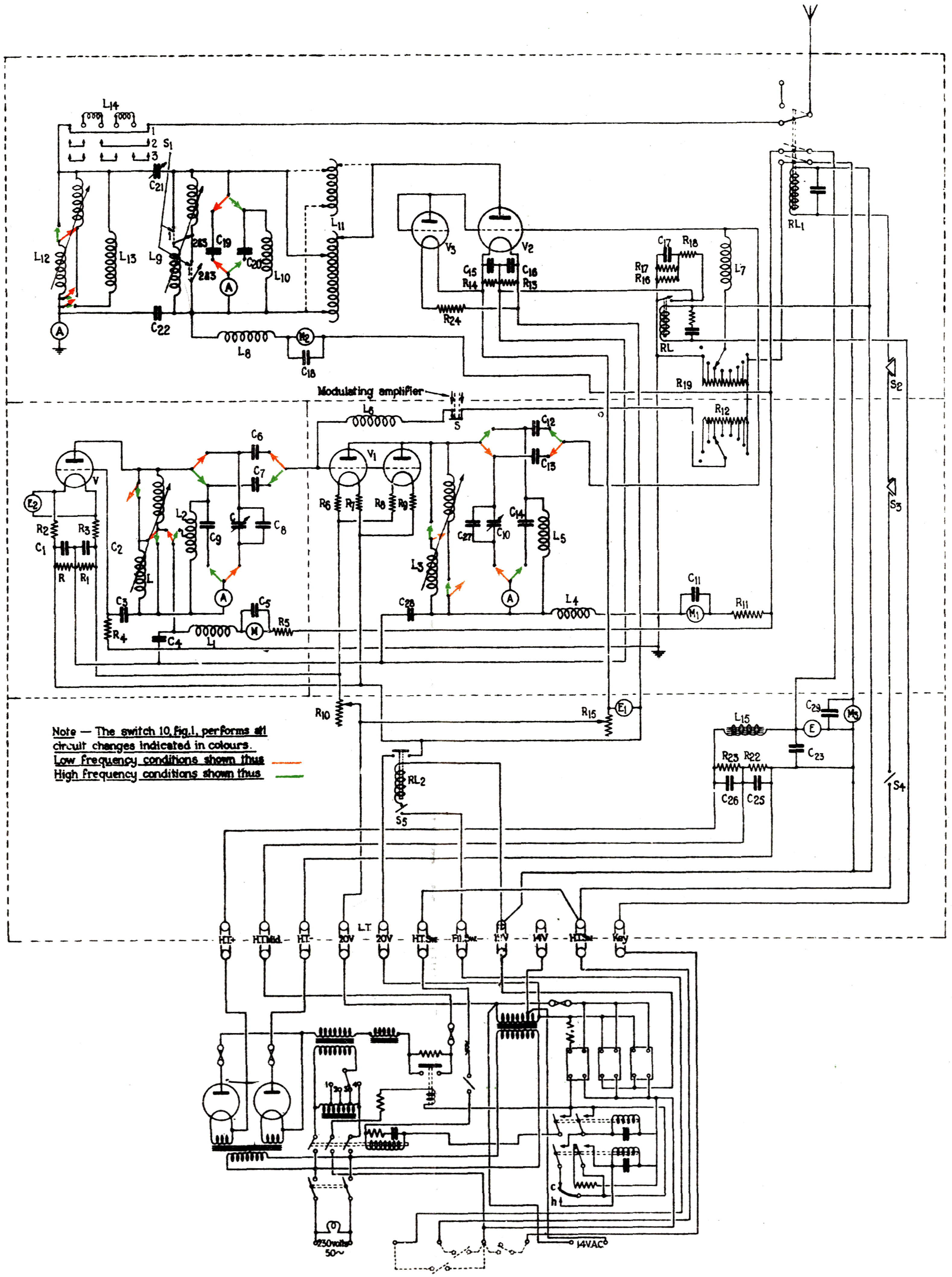


CONDENSERS - μF	
C	·00098 (variable)
C1	1·0
C2	1·0
C3	·01
C4	·01
C5	1·0
C6	·00005
C7	·00005
C8	·00103
C9	·000212
C10	·00098 (variable)
C11	1·0
C12	·00005
C13	·000106
C14	·0002
C15	1·0
C16	1·0
C17	·0003
C18	1·0
C19	·0026
C20	·000192
C21	·00008 (variable)
C22	1·5
C23	1·5 (2 off)
C24	Deleted
C25	1·5 (5 off)
C26	1·5 (5 off)
C27	·00103
C28	·01
C29	1·0
RESISTANCES - (ohms)	
R	40
R1	40
R2	1·5
R3	1·5
R4	20,000
R5	15,000
R6	1·5
R7	1·5
R8	1·5
R9	1·5
R10	0·85 (variable)
R11	10,000
R12	356 (5 off)
R13	40
R14	40
R15	0·85 (variable)
R16	100,000
R17	100,000
R18	500
R19	356 (5 off)
R20	Deleted
R21	Deleted
R22	50,000
R23	50,000
R24	1C

FIG. 4, THEORETICAL CIRCUIT DIAGRAM

connects a portion of the coil in the aerial circuit in position 2, and connects the whole coil in circuit in position 3. The switch S_1 also performs the connections (series and parallel) on the power amplifier variometer L_9. In position 1, the windings are connected in parallel, and in positions 2 and 3 the two windings are connected in series. The relay RL_1 makes and breaks the transmitter H.T. circuit, and also transfers the aerial from the transmit to the receive position.

14. The solenoid for the relay RL_1 and the solenoid for the keying relay RL are both operated from the same source. If A.C. is being used, the solenoids are energized from the rectifiers. If D.C. is used, then a 12-volt battery supplies the power for the solenoids. In circuit with the solenoid for RL_1 are the gate switches S_2 and S_3 and the tumbler switch S_4. This latter switch is represented by (16, fig. 1). The keying relay solenoid is operated by the key. Hence it will be seen that once the switch S_4 is closed, the H.T. is switched on and the aerial is connected in the transmit position. Operation of the key now results in the H.T. negative and filament circuits of the valves in all three stages being interrupted.

15. On closing the tumbler switch S_5, the relay RL_2 is energized and the filament circuits of all three stages are made. The switch (10, fig. 1), which changes the connections of the variometer coils L, L_3, and L_{12}, is represented diagrammatically in this figure by red lines and is shown in the lower frequency position. Movement of the switch handle effects all the changes from red lines to green lines establishing the higher frequency circuits.

16. The input milliammeter M_3 is shunted by the condenser C_{29} and is in the H.T.+ feed. The voltmeter E is across the H.T.+ and H.T.— lines, while the iron-cored choke L_{15} is in the H.T.+ line. The condensers C_{23}, C_{24}, C_{25} and C_{26}, together with the resistances R_{20}, R_{21}, R_{22} and R_{23} form the smoothing unit which is used on either A.C. or D.C. The voltmeter E_1 indicates the filament volts on the power amplifier valve, and E_2 indicates the filament volts for the M/O, and intermediate circuits.

17. Owing to the possibility of secondary grid emission with certain valves used in the power amplifying stage, a three-electrode valve V_3 connected as a diode has been introduced into the grid-filament circuit of the power amplifier to provide a permanent bias on the grid of the valve. To enable this to be fitted, a grid adaptor (Stores Ref. 10A/8297) consisting of a valve-holder and filament resistance is supplied. The adaptor is fitted behind the detachable panel which carries the power amplifying valve V.T.4B. Of the three lugs on the adaptor, the two filament lugs are connected to the filament terminals, and the remaining lug is connected to the grid terminal of the V.T. 4B. valve. The valve used in the adaptor is a V.T. 13C.

Remote controls

18. The transmitter may be used in conjunction with Ground Station Remote Controls type 2 or 4 (for C.W.) or Ground Station Remote Controls, type 3 (for C.W., M.C.W., and R/T). The manner in which the remote controls, type 2, are connected up to the transmitter is illustrated in fig. 5. The apparatus at the operating end comprises a microphone, microphone transformer, switch type 44, repeating coil, key and a 24-volt battery. The apparatus is grouped on a table and wired up as shown on the left of the figure. The ends of the secondary winding of the repeating coil at the operating end are connected through a distribution box, a junction box and through a pair of land lines to similar apparatus at the transmitting end. The pair of land lines carries the operating current for the FIL. and H.T. relays incorporated on the remote controls, type 2, at the transmitting end.

19. The terminal strip on the remote control unit is connected to the terminal strip at the bottom of the transmitter by short leads in the manner illustrated. The 14 volts A.C. required for operating the keying relay is obtained from the rectifier unit incorporated in the transmitter by connecting across the fourth and ninth terminals, reading from the left.

20. The transmitter is capable of being operated from either A.C. or D.C. mains and both methods are shown. The A.C. method is the normal one, but when D.C. mains are used an additional sounder relay is provided on the switch panel. The windings of this relay are connected in parallel with the windings of the filament relay on the remote control unit.

21. When the switch type 44 at the operating end is placed in the " generator running " position, the windings of the FIL. relay on the remote control unit are connected between the positive side of the battery and earth. Since these windings are connected in parallel with the windings of the relay on the switch panel, this relay also becomes energized. The tongue and mark terminals are connected to a relay which closes the D.C. mains circuit, and the motor-alternator may then be started up.

22. The schematic diagram shown in fig. 6 is very similar to fig. 5 except that remote controls, type 3, are used. The lines A and B are connected to the terminal strip at the bottom of the remote control unit. The various connections from FIL.SW., H.T., and KEY are taken to the transmitter as before. The terminals P.O. LINES are for use in connection with remote R/T modulation from a special line. The amplifier A.1104 forms part of remote controls, type 3, and provides the modulating voltage for M.C.W. and R/T transmission. A screened cable terminating at each end in a plug is used for connecting the output of the amplifier to the transmitter. Since 230 volts A.C. is required for A.1104, a pair of leads is taken from the 230 volt terminals on the T.77 to the amplifier. The 14 volts A.C. required for the rectifier in the circuit of the keying relay on remote controls, type 3, is obtained from the rectifier unit incorporated in the transmitter.

23. Provision is again made for operating the transmitter from either A.C. or D.C. mains, the system employed being the same as described previously. The transmitter may be operated or remotely controlled by type 4 remote controls, but as this type is somewhat similar to remote controls, type 2, no mention is made of it here. A full description of remote controls will be found elsewhere in this publication.

CONSTRUCTIONAL DETAILS

Transmitter

24. The transmitter T.77, a front view of which is given in fig. 1, and three bench wiring diagrams in figs. 8, 11 and 12, is built up of aluminium alloy sheets mounted on a duralumin frame work. The overall dimensions are about 5 ft. 6 in. high, by 2 ft. 6 in. wide, by 18 in. deep, and the approximate weight is 4½ cwt. The various components are housed in four compartments or cubicles, and access is given to the various valves by means of three doors. The upper or first cubicle contains the output valve and associated equipment. The second cubicle contains the master-oscillator and the intermediate amplifier components ; the M/O is on the left and suitably screened from the amplifiers which are on the right. The third cubicle houses the smoothing units and the fourth cubicle houses the rectifier unit.

25. The three doors provided on the front of the transmitter are each equipped with a safety switch which operates an electro-magnetic switch to break the power supply circuit. The doors in the first and second cubicles which give access to the power output valve and the M/O valve respectively are provided with perforated panels to allow for ventilation, but the door in the rectifier unit is provided with a glass panel. The rear and side portions of the transmitter are built up of perforated material so that adequate ventilation is available.

26. Referring to fig. 1, it will be seen that a number of instruments and control handles are mounted on the front of the transmitter. The 0 to 6 amp. aerial ammeter (1) can be seen in the top left hand corner and next to it is the power amplifier anode circuit milliammeter (2) reading 0 to 300 mA. The 0 to 12 amp. ammeter (3) is in the closed circuit of the power amplifier,

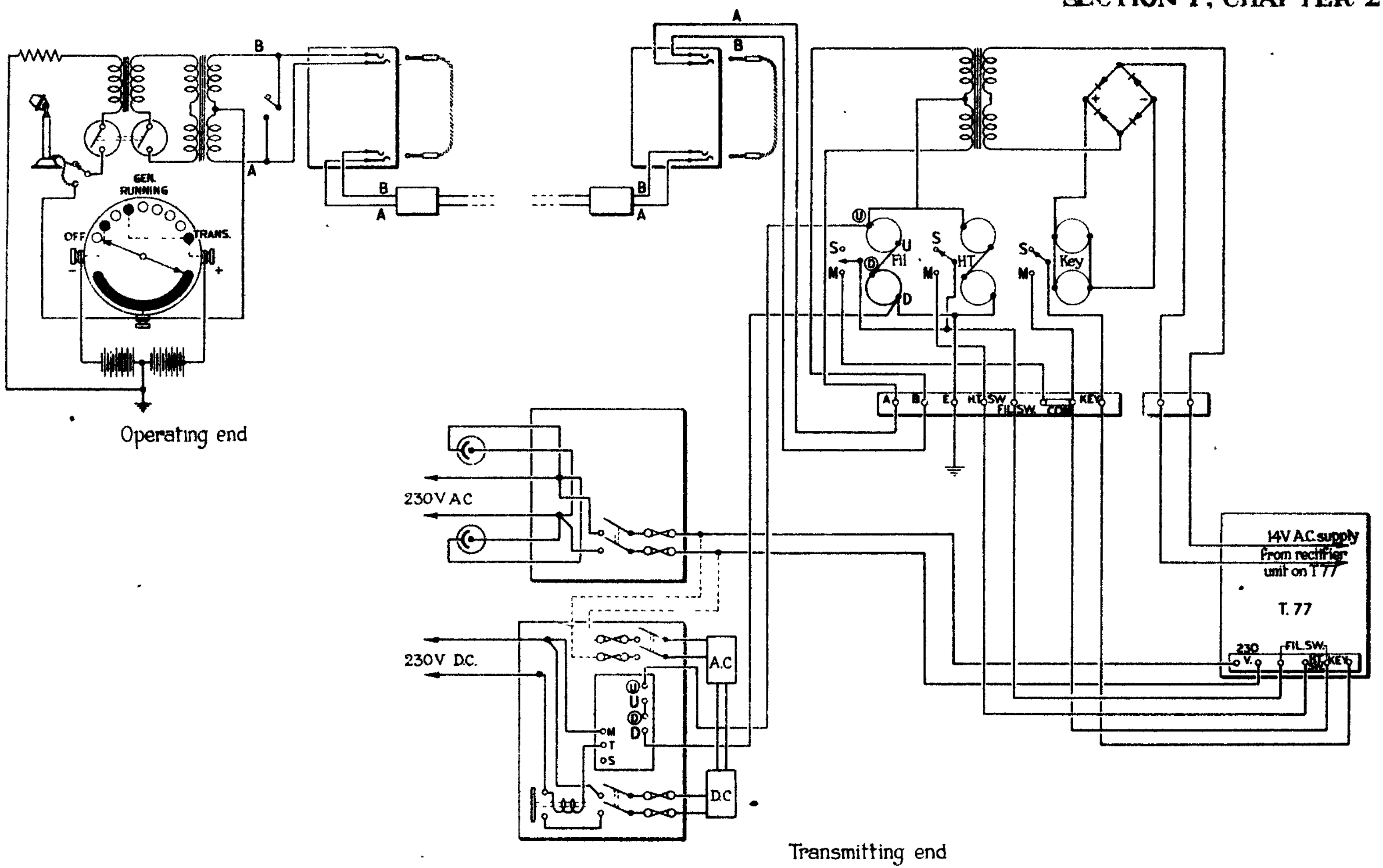


FIG. 5. T. 77 AS OPERATED BY REMOTE CONTROLS, TYPE 2

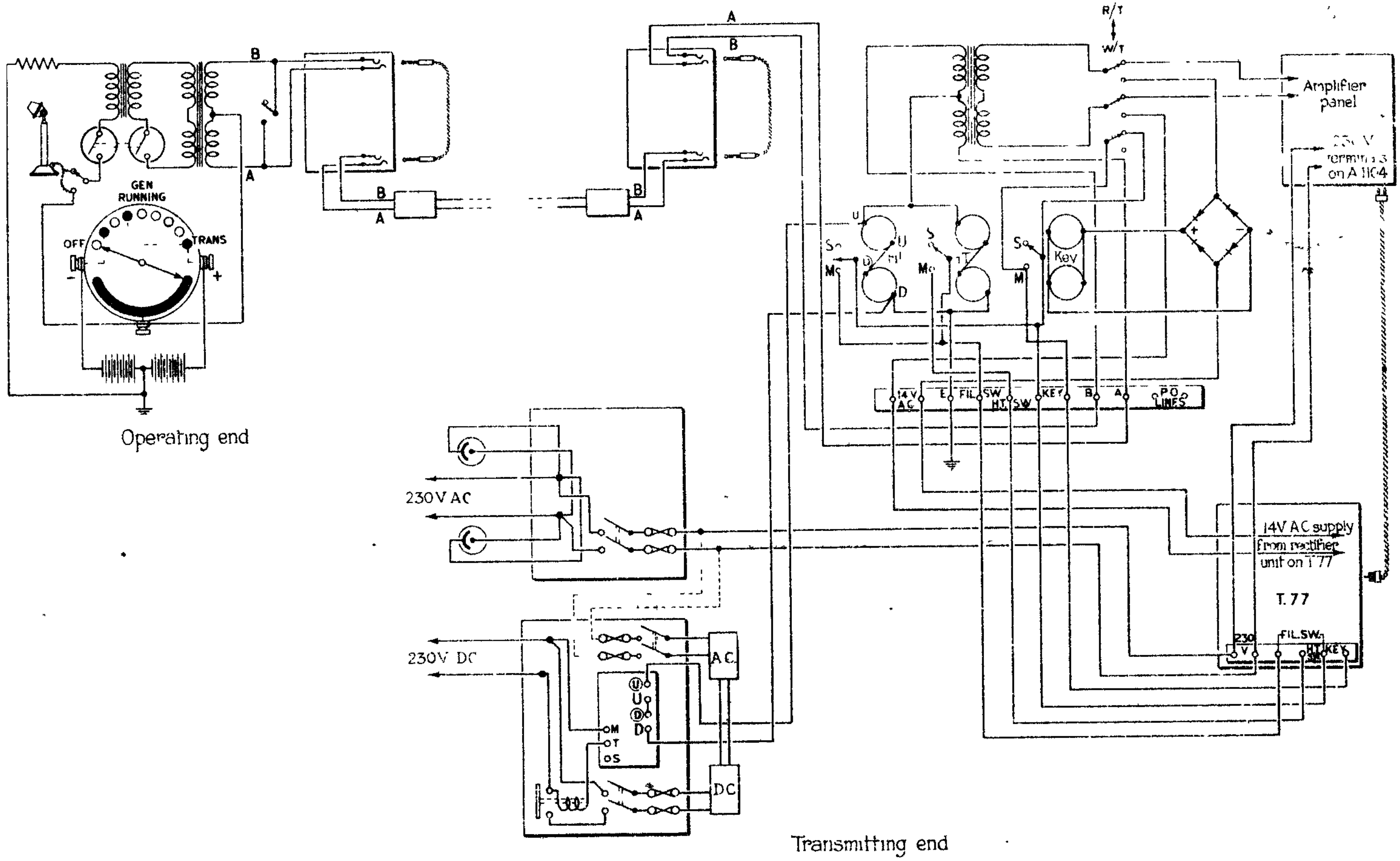


FIG.6. T.77 AS OPERATED BY REMOTE CONTROLS, TYPE 3

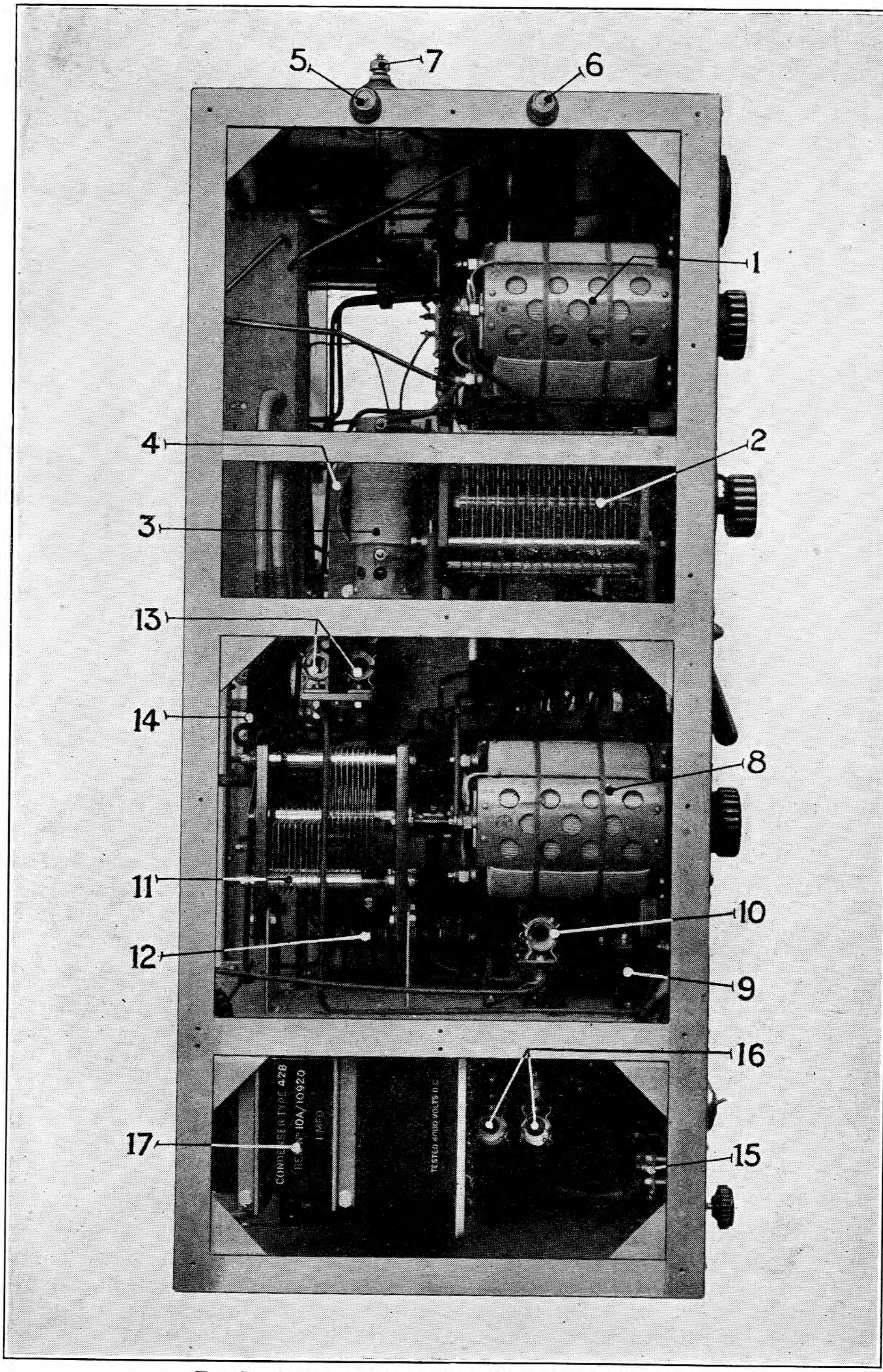


FIG. 7. Interior view of transmitter, left-hand side.

while the control knob (4) underneath it is the power amplifier tuning control. The aerial tuning control (5) is under the aerial ammeter, and to the right of it is the power amplifier grid-bias control knob (6). The aerial tuning knob and the amplifier tuning knob are each provided with an indicator and a scale engraved with one hundred divisions. The number of complete turns made by the knob can be seen through a small window directly above the knob. The amplifier grid-bias has a scale engraved from 0 to 16, and an indicating line on the knob registers with one of these figures.

27. The aerial coupling control (7) is in the bottom left-hand corner of the first cubicle. It has a scale engraved from 0 to 120°. To the right is the aerial loading switch (8). It has three positions, 1, 2 and 3. The first position is engraved 260 to 400 kc/s and 1,500 to 2,256 kc/s, the second position is engraved 160 to 260 kc/s and the third position is engraved 143 to 160 kc/s. The hinged door (9) is provided in order to give access to the amplifier valve. The range change switch (10) in the centre of the transmitter has two positions engraved 143 to 400 kc/s and 1,500 to 2,256 kc/s.

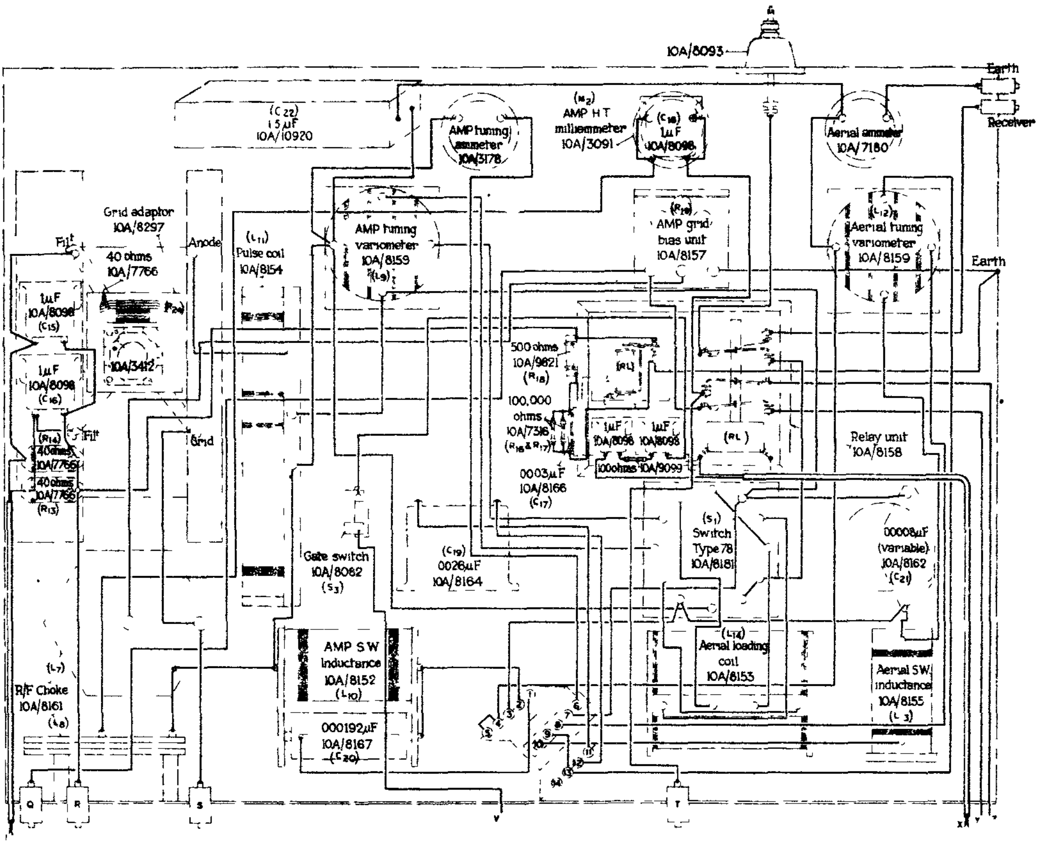
28. The 0 to 4 amps. master-oscillator oscillatory circuit ammeter (11) is in the top left-hand corner of the second cubicle, while just below it is the M/O tuning control (12). It has a scale engraved with one hundred divisions and an indicating window. The master-oscillator H.T. milliammeter (13), reading 0 to 100 mA, is below the tuning control, and below this is the 0 to 15 volts filament voltmeter (14) and control knob (15) for the M/O and intermediate circuit valve filaments. The send-receive switch (16) breaks the H.T. supply in the up or " receive " position and makes the H.T. in the down or " send " position. The 0 to 3,500 volt D.C. voltmeter (17) and the milliammeter (18) reading 0 to 500 mA. register the H.T. volts and the total input respectively. The tumbler switch (19) breaks the L.T. supply to the transmitter valve filaments in the up or off position and makes it in the down or on position.

29. In the right-hand bottom corner can be seen the 0 to 20 volt power amplifier filament voltmeter (20) and rheostat control knob (21). Above the filament voltmeter is the 0 to 200 mA. intermediate amplifier anode circuit milliammeter (22). The 0 to 4 amps. ammeter (23) and control knob (24) are in the tuned circuit of the intermediate amplifier while the grid-bias control (25) is on the left of the ammeter (23). It is engraved from 0 to 16 and a line engraved on the control handle indicates the bias setting. The door in the centre of the cubicle gives access to the M/O and intermediate amplifier valves. When the door is opened a contact switch breaks the H.T. circuit. The bottom cubicle houses all the rectifying equipment and is described elsewhere.

First cubicle

30. Referring to fig. 7 which is a view of the transmitter from the left-hand side, excluding the rectifier unit, some of the aerial and power amplifier components can be seen in the first cubicle. The aerial tuning variometer (1) can be seen on the right and below it the aerial coupling condenser (2) which is represented by C_{21} in the theoretical circuit diagram (fig. 4). The aerial inductance (3) can be seen to the left of the coupling condenser, while the aerial loading coil (4) can just be seen behind the aerial inductance. The wooden container on the left houses the aerial relay and the keying relay. The two terminals (5) and (6) seen at the top of the transmitter are engraved EARTH and RECEIVER respectively, whilst behind them is the aerial lead-in (7). The terminal (5) is connected to a suitable earth and the terminal (6) is provided to allow a receiver to be connected up in certain circumstances.

31. Fig. 9 is a rear view of the transmitter with the panels removed. In the top cubicle can be seen the relay panel. The relay (1) on the right is provided with three sets of contacts. The bottom set opens or closes the H.T.— circuits of the valves, the middle set opens or closes the H.T.+ circuits and the top set changes over the aerial from the " transmit " to the " receive " position and *vice versa*. The relay (2) is in the key circuit and is arranged to " key " the H.T.



NOTE (a) Annotations in parenthesis, for example (C_{19}), refer to the corresponding annotations in Fig 4
(b) Wires U, V X, Y and Z, and terminals Q, R, S and T are also illustrated and similarly annotated in Fig 12

FIG. 8. BENCH WIRING DIAGRAM (FIRST CUBICLE)

negative and filament circuits of all three stages. Future contracts for the T.77 will have the relay type 31 instead of the relay type N as shown in the illustration. The two 1μF condensers (3) and the 100-ohm resistance (4) are part of the relay unit.

32. The 500-ohm resistance (5) and ·0003μF condenser (6) are connected in series across the contacts of the keying relay. The amplifier lower frequency inductance (7) has a bank of six condensers mounted on its frame. Two of these condensers (8) can be seen in the centre foreground. Behind the inductance can be seen the pulse coil (9), which consists of two separate coils wound on the same former. Each coil is provided with several tapping points which are brought out to a numbered terminal board. The coil is connected in circuit by means of flexible leads terminating in sockets. It is represented by L_{11} in the theoretical circuit diagram (fig. 4). The R/F choke (10) on the left of the transmitter is connected in the grid circuit of the power amplifier valve, and the R/F choke (11), which is similar to (10), is connected in the power amplifier H.T. feed. The two resistances (12) seen on the left-hand side have a value of 40 ohms each and are connected in series across the power amplifier filament leads.

33. Referring to fig. 10 which is a view of the transmitter from the right-hand side, the power amplifier valve (1) can be seen on the left. Mounted on the valve-holder support are two condensers (2). They have a value of 1μF each and are connected in series across the valve filament leads. The grid adaptor valve (3) can be seen near the two condensers. The 1·5μF condenser (4) strapped to the top of the cubicle, forms the H.T. blocking condenser represented by C_{22} in the theoretical circuit diagram.

Second cubicle

34. The components associated with the M/O and the intermediate amplifier are housed in the second cubicle the interior of which can be seen in figs. 7, 9, and 10. The M/O components are clearly indicated in fig. 7 which is a view of the left-hand side of the transmitter. On the right is the M/O tuning variometer (8). The two windings of the coil are connected in series for low frequencies and in parallel for high frequencies. The range-change switch (10, fig. 1) effects the change of connections. The 1μF condenser (9) in the bottom right-hand corner is connected across the M/O, H.T. milliammeter. The resistance (10) to the left of the condenser has a value of 20,000 ohms and is the grid-leak resistance for the M/O valve. The variable condenser (11) seen on the left is the tuning condenser, the movable vanes being mechanically coupled to the same spindle by which the variometer (8) is actuated. Behind the condenser may be seen the M/O inductance (L_3, fig. 4). Carried on the frame of this inductance is a bank of ten condensers (12) which are connected across the variable tuning condenser and are represented by C_8 in fig. 4. The two 30,000-ohm resistances (13) connected in parallel form the 15,000-ohm anode resistance for the M/O valve. The R/F choke (14) which can just be seen in the background is represented by L_1 in fig. 4.

35. Both the M/O and the intermediate stage components can be seen in fig. 9. The M/O components are on the right and the intermediate stage components are on the left. The R/F choke (13) has already been referred to in the previous paragraph. To the left of this is the R/F choke (14) in the intermediate amplifier H.T. circuit. The condenser (15) has a value of ·00005μF and is the intermediate amplifier high frequency band coupling condenser, while the condenser (16) below it is the low frequency band coupling condenser and has a value of ·000106μF. The variable condenser (17), of which only the rear can be seen, is the tuning condenser C_{10}, fig. 4.

36. The components seen in the middle cubicle of fig. 10, which is a view of the transmitter from the right-hand side, are associated with the intermediate amplifier stage. The tuning condenser (5) is mechanically coupled to the variometer (6). As in the case of the M/O, this variometer also has its windings connected in series for the low frequency band and in parallel

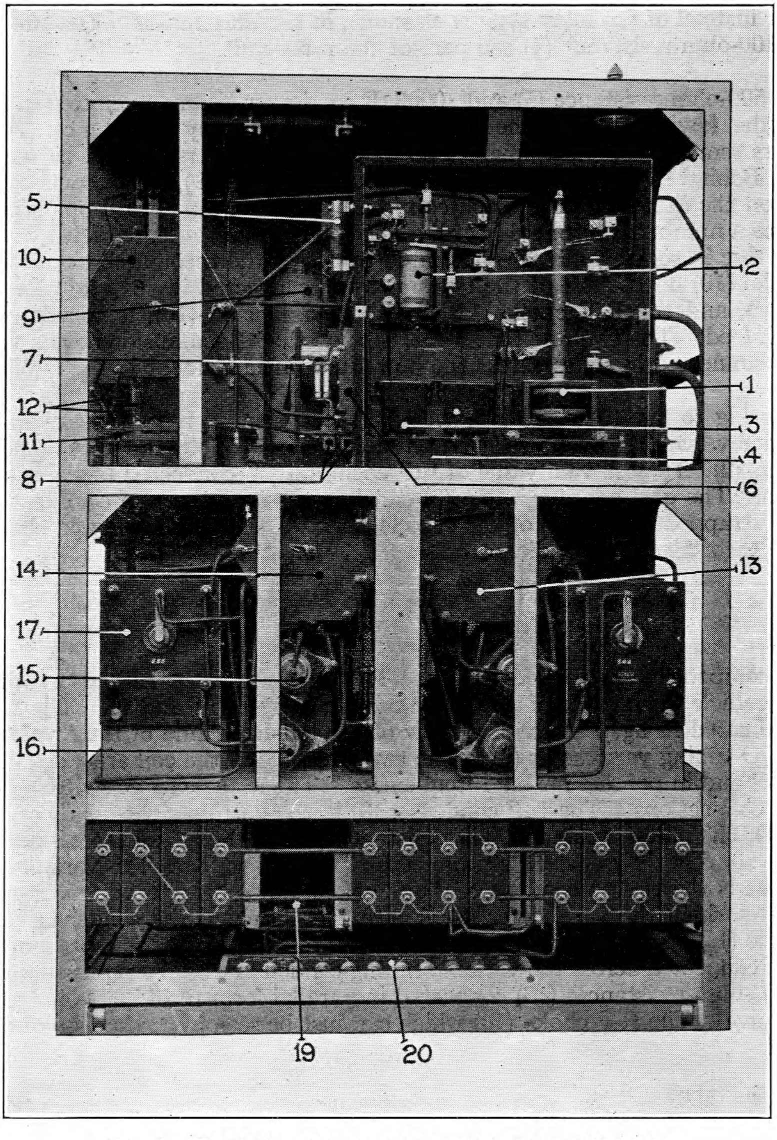


FIG. 9. Rear view of transmitter, without rectifier unit.

for the high frequency band. The modulating amplifier socket (7) is mounted above the variometer. The two 20,000-ohm resistances (8) in the top right-hand corner are connected in parallel to form the 10,000-ohm anode resistance R_{11}, fig. 4. One of the amplifier valve-holders (9) may be seen in the bottom left-hand corner. The 1μF condenser (10) in the left-hand corner is connected across the terminals of the H.T. milliammeter. The bank of ten condensers (11) below the variable condenser (5) are mounted in the frame of the tapped inductance coil (12), just showing behind the variable condenser. The bank of condensers (11) are represented by C_{14} in the theoretical circuit diagram ; they have a total value of ·00103μF and are connected across the variable condenser.

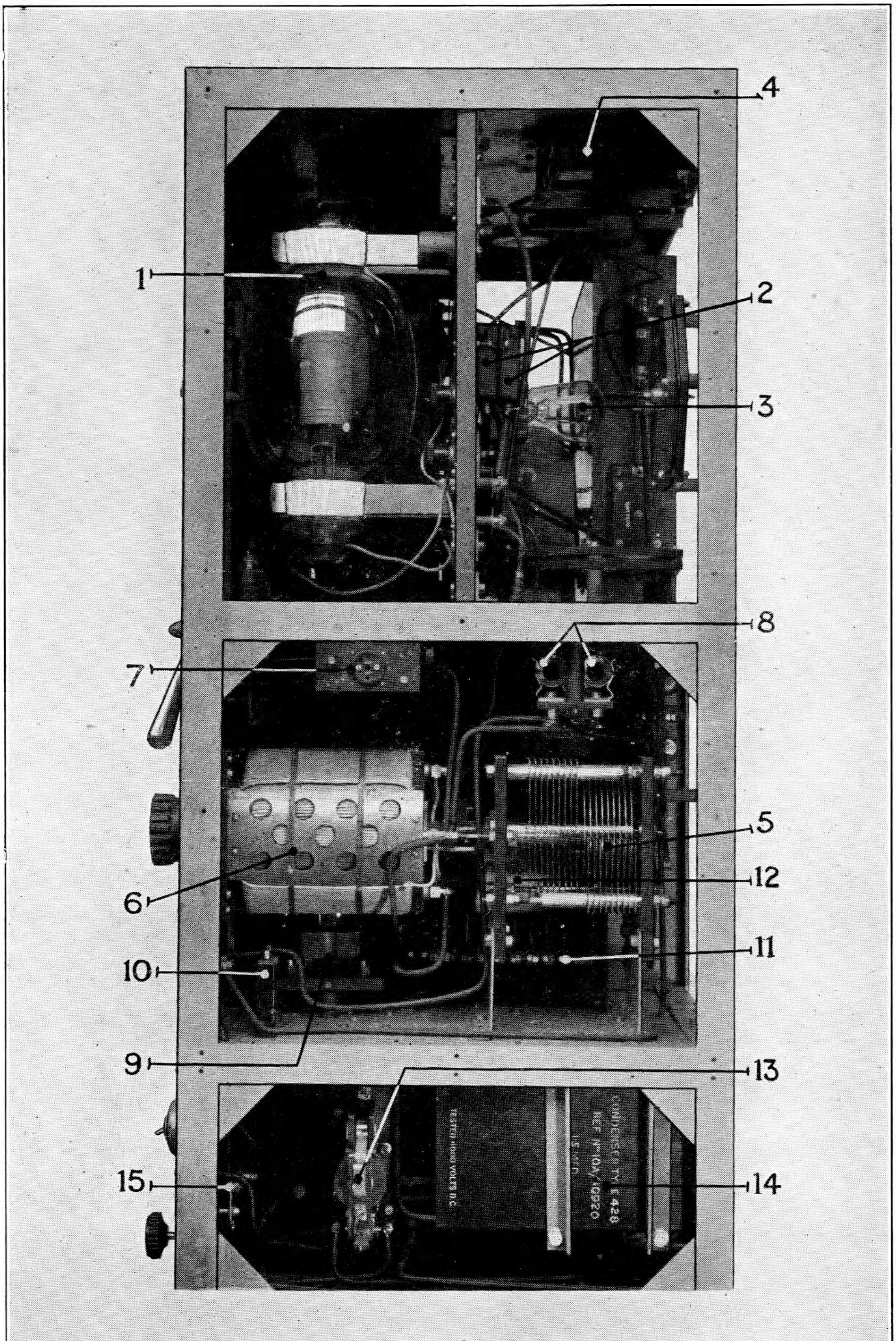
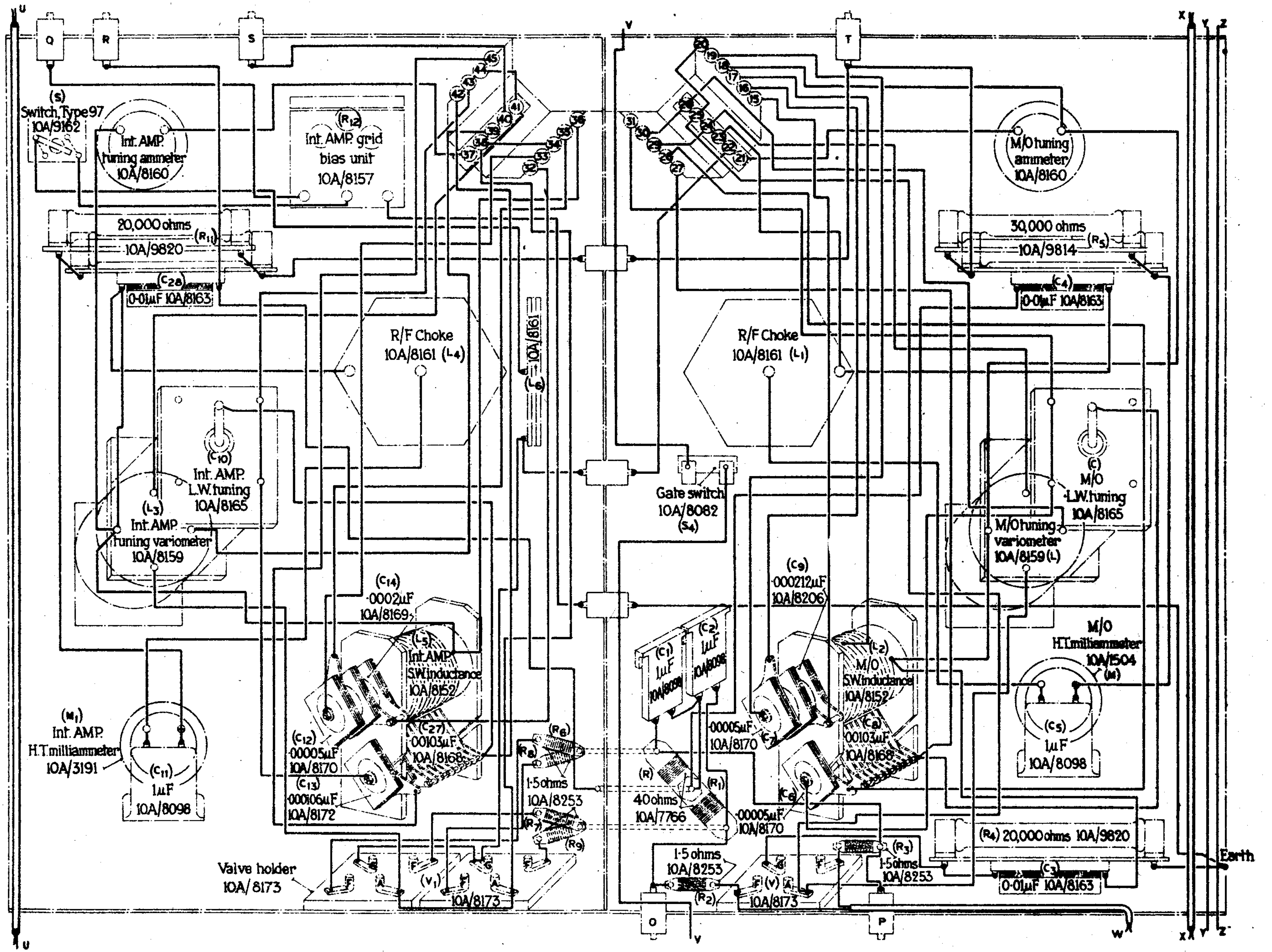


FIG. 10. Interior view of transmitter, right-hand side.



NOTE (a) Annotations in parenthesis, for example (R_9), refer to the corresponding annotations in Fig. 4

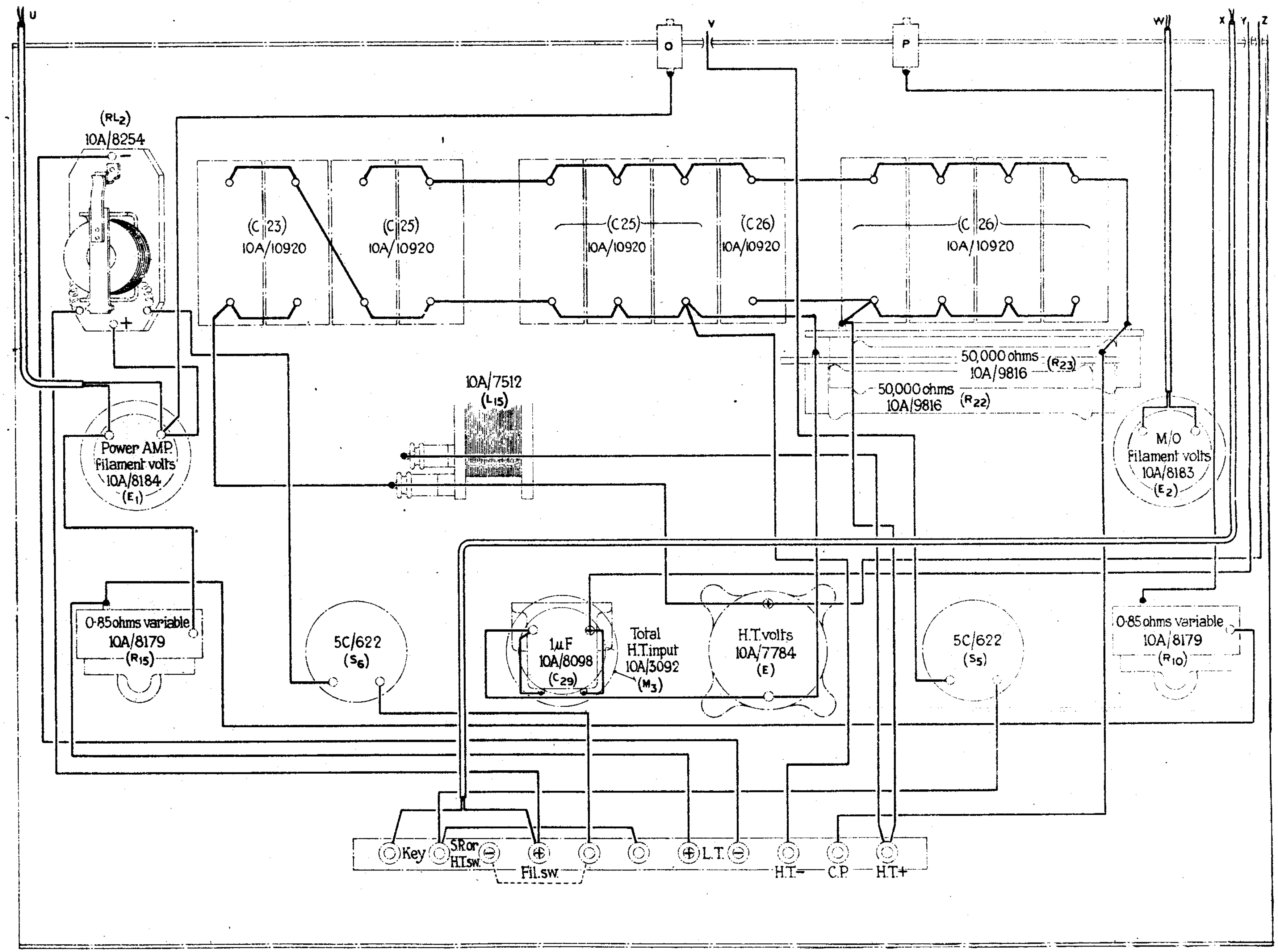
(b) Wires U, V, X, Y and Z, and terminals Q, R, S and T (top of figure) are also illustrated and similarly annotated in Fig. 9

(c) Wires U, V, W, X, Y and Z, and terminals O and P (bottom of figure) are also illustrated and similarly annotated in Fig. 13

FIG. 11. BENCH WIRING DIAGRAM (SECOND CUBICLE)

(F.1799). F. & C. LTD.

Facing fig. 13.



NOTE (a) Annotations in parenthesis, for example (C_{29}), refer to the corresponding annotations in Fig. 4

(b) Wires U, V, W, X, Y and Z, and terminals O and P are also illustrated and similarly annotated in Fig. 12

FIG. 12, BENCH WIRING DIAGRAM (THIRD CUBICLE)

(F.1799). F. & C. LTD.

Facing fig 13.

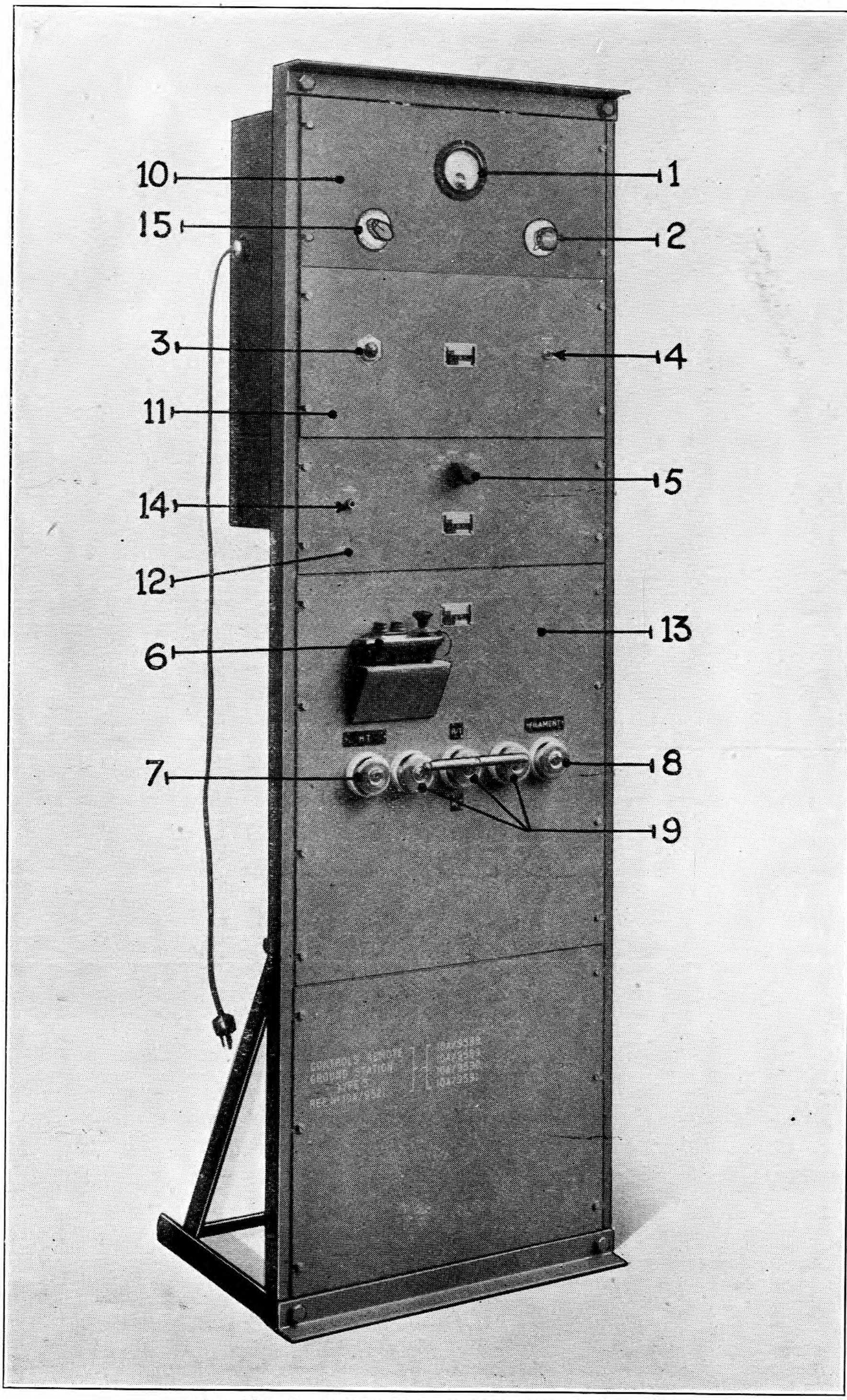


FIG. 13. Ground station remote controls, type 3.

Third cubicle

37. The lowest cubicle (rectifier cubicle not shown) seen in figs. 7, 9, and 10, houses the condensers and resistances forming the smoothing unit. In fig. 7, which shows the components from the left-hand side, the M/O and intermediate amplifier filament rheostat (15) is in the bottom right-hand corner. The two 50,000-ohm resistances (16) form part of the smoothing unit, and are represented by R_{22} and R_{23} in fig. 4. The $1 \cdot 5 \mu F$ condenser (17) on the left, is the end one of a bank of 12 such condensers which are strapped to the bottom of the M/O and intermediate amplifier cubicle.

38. In fig. 9 all 12 condensers are clearly indicated. The iron-cored choke (19) in the background, is in the H.T.+ lead and is represented by L_{15} in fig. 4. The terminal strip (20) seen in the bottom foreground is provided with eleven terminals which, if the supply is A.C., are connected by ten links to corresponding terminals on the rectifier unit. When D.C. is being used, apart from the usual H.T. and L.T. supply, a 12-volt battery is connected across the third and fourth terminals from the left and is used to operate the solenoids of the keying relay, the H.T. and aerial switch, and the L.T.— contactor.

39. Referring to fig. 10, a contactor (13) can be seen in the centre of the lowest cubicle. It is connected in the L.T.— line and its solenoid is controlled by the tumbler switch (19, fig. 1). The $1 \cdot 5 \mu F$ condenser (14) is the right-hand end condenser of the bank of 13 condensers forming the smoothing unit. The power amplifier filament rheostat (15) is visible in the bottom left-hand corner. It is controlled by the knob (21, fig. 1).

Remote controls.

40. Fig. 13 is a front view of ground station remote controls, type 3, as installed at the transmitter end. The top panel (10) carries the amplifier, which consists of an indirectly-heated triode, transformer-coupled to two triodes in push-pull, the latter forming the output stage. A milliammeter (1) reading 0–150 is connected in the H.T. feed to the output stage, and a potentiometer operated by the handle (2) is connected across the grid-filament of the first valve. A modification subsequently made in the amplifier panel introduced an attenuator. The knob (15) for controlling this may be seen to the left of the potentiometer handle.

41. The second panel (11) is the rectifier unit which incorporates a mains transformer, with five secondary windings, a double wave rectifying valve and a smoothing circuit. Of the five windings on the mains transformer, two 4-volt windings supply the filaments of the first and second stages of the amplifier, and the filament of the oscillator valve on the local control panel. Another winding supplies the anodes of the double wave rectifier (1,000 volts) and another the filament (4 volts) of the rectifier. The remaining winding gives a 10-volt supply to a metal rectifier situated in the local control panel (12). A tumbler switch (4) on the front of the panel switches the primary of the mains transformer across the supply, and a pilot lamp (3) connected across a 2-volt tapping on one of the secondaries gives a visual indication that the transformer is energized. A thermal relay is also incorporated in this panel which delays the connection of the output H.T. until the valve filaments have reached their working temperature.

42. The third panel (12) is the local control panel. This panel carries an indirectly heated triode coupled as a 1,000 c/s oscillator; this panel also carries two transformers, one for the local microphone and one for use when telephony is being carried out from a remote position on an incoming line. A metal rectifier is provided for the purpose of rectifying the 10-volt A.C. supply obtained from the winding on the mains transformer (previously referred to) and this is smoothed and provides the supply for operating the local microphone. On the front of the panel

is the jack (14) and the 4-position switch (5) ; the former receives the plug from the local microphone. The latter is engraved at its four positions, 600 OHM INPUT, DIRECT GRID, OSCILLATOR, LOCAL MICROPHONE. In the first-mentioned position the secondary of the " line transformer " is connected across the input to the amplifier to produce a suitable matching of the amplifier input to an incoming 600-ohm line. In the second position the transformer is cut out, and the input of the amplifier is connected directly to two terminals marked 50,000 OHMS, DIRECT GRID in order that the input may be matched to any incoming line. In the third position the oscillator is connected to the input of the amplifier. In the fourth position the secondary of the local microphone transformer is connected to the input of the amplifier. In this position, owing to the mechanical coupling of a D.P. switch, the microphone primary circuit is energized from the metal rectifier.

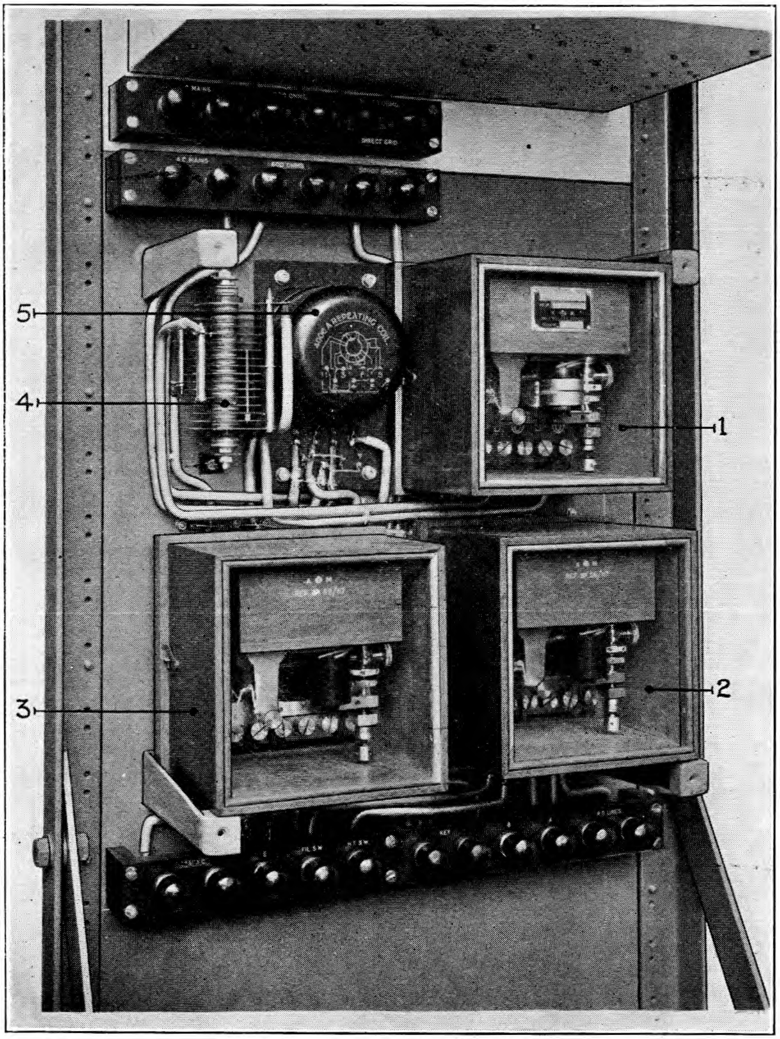


FIG. 14. Rear view of remote control panel.

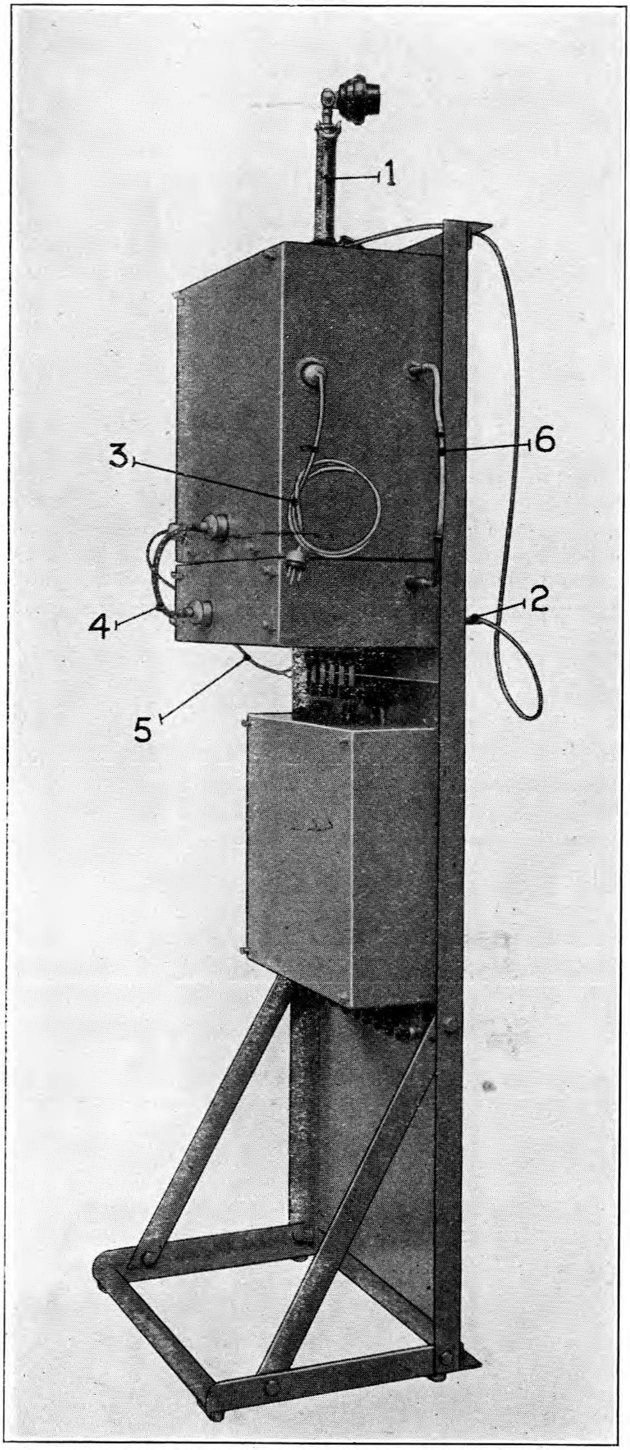


FIG. 15. Rear view of remote controls, type 3.

43. The fourth panel (13) is the remote control panel. On the front of this panel is mounted the morse key (6), the H.T. switch (7), the filament switch (8) and the three coupled switches (9). The rear of this panel can be seen in fig. 15 in which the relay (1) is the keying sounder relay which effects the keying of the transmitter. The relay (2) immediately below this is the H.T. sounder relay which switches the H.T. supply to the transmitter. The relay (3) on the left of this is the filament sounder relay which energizes the filament relay and so switches the filament circuits of the transmitter. To the left of the relay (1) can be seen the metal rectifier (4) and the repeating coil (5).

44. The switch (9, fig. 13) is a three pole two-position switch. Two of the poles change over the connections of the repeating coil secondary from the amplifier input to the 14-volt A.C. supply and rectifier. The former is the R/T position and the latter is the W/T position. The third pole merely short-circuits the tongue and mark terminals of the keying relay in the R/T position.

45. Connections between the various panels are made by means of plugs and sockets and links. Referring to fig. 14, the microphone (1) is connected by a screened lead terminating in a plug (2) which engages with the socket (14, fig. 13). The screened lead (3) effects the connections between the output of the amplifier and the appropriate circuit of the transmitter. The screened cable (4) terminates at each end in a six-point socket. These sockets engage with plugs one of which is situated on the amplifier and the other on the local control panel. This cable carries the filament A.C. supply for the oscillator valve, the A.C. supply to the microphone rectifier, and the smoothed H.T. supply for the oscillator anode supply. The screened cable (5) is connected at one end to the A.C. mains terminals, and terminates at the other end in a two-point socket which engages with a two-point plug connected to the primary winding of the rectifier transformer. The screened cable (6) terminates at each end in a plug. One plug is inserted into a jack on the amplifier and the other is inserted into a jack on the local control panel. This provides the connection between the input of the amplifier and the output of the local control panel. The form of the output may be either speech or a 1,000 c/s audio-modulating frequency for the production of M.C.W.

46. Referring to fig. 15, it will be seen that a row of six terminals is provided at the top of the remote control panel for convenient linking up with a corresponding row at the bottom of the local control panel. The first pair on the left is connected directly to the A.C. supply, and is engraved accordingly. The remaining two pairs are engraved 600 OHMS and 50,000 OHMS respectively.

VALVES AND POWER SUPPLY

47. The valve used in the master-oscillator stage is a valve type V.T.26, and it has a filament voltage of 12 volts. Two V.T.26 valves, connected in parallel, are used in the intermediate amplifier stage. The power amplifier stage uses a V.T.4B valve, the filament voltage of which is 18 volts. One V.T.13C valve, fitted in an adaptor, is connected across the grid-filament circuit of the power amplifier. The valves used in the rectifier are two type V.U.29. These are vapour-filled valves and should be carefully handled in order to avoid any mercury coming in contact with the filaments. The L.T. and H.T. supplies are obtained from any convenient mains power supply.

48. The transmitter may be operated from an A.C. or D.C. supply, the A.C. system being the more usual. A detachable rectifying unit (Panel, Rectifying, Type A, Stores Ref. 10A/8068 or Panel, Rectifying, Type B, Stores Ref. 10A/11156) is provided for this purpose. When operating on D.C. the panel is removed and a dummy panel inserted in its place. The smoothing unit, which is contained in a cubicle above the rectifying unit, remains in circuit for both A.C. and D.C. When working on A.C. the power required for operating the various electro-magnetic switches and relays is obtained from metal rectifiers incorporated in the rectifying unit. When operating on D.C. the power is obtained from a 12-volt battery connected to the appropriate terminals. The transmitter terminals are connected to the rectifier terminals by means of links.

OPERATION

Transmitter tuning

49. The following is a description of the method by which the transmitter may be adjusted and some of the precautions which must be taken. When making the adjustments reference should be made to the tables 1, 2, 3 and 4, and the curves given in figs. 16, 17, 18 and 19.

50. The transmitter filaments should be switched on ten minutes or so before the commencement of routine transmission to allow the master-oscillator to reach a steady temperature and thus obviate frequency creep. The curves in figs. 16, 17, 18, and 19 giving the M/O tunings are not true calibration curves, the frequencies being only approximately correct owing to the slight variations in inductance and capacitance on different models, as well as the effect of different output load conditions. They are given as an easy guide for setting up the transmitter to a given frequency.

51. The tables 1, 2, 3 and 4 give typical settings of the various tunings corresponding approximately to the frequencies quoted, and can be used for the initial setting up to the desired frequency. When the desired frequency is intermediate between two frequencies given in the tables, the curves provide the appropriate interpolation for the M/O setting, and the remaining settings, *i.e.*, grid-bias and aerial coupling, should be interpolated roughly from the tables. The input currents tabulated are quoted for guidance only.

52. When operating on A.C. the adjustments must be carried out in the following order: Switch on the A.C. mains and also the rectifier and transmitter filaments and adjust the filament voltages to 12 volts for the master-oscillator and intermediate amplifier valves and 18 volts for the power amplifier valve, by means of the two controls on the lower part of the panel.

53. Set the master-oscillator tuning to the appropriate setting as indicated on the curve. Set the aerial loading switch and the range change switch to the appropriate positions. Set the pulse coil taps to the positions indicated in the tables and set the aerial coupling to zero. The grid-bias switches should be set to maximum, *i.e.*, stop 16. When working on the 1,500 to 2,256 kc/s band, part of the 143 to 400 kc/s band pulse coil must be short-circuited, and the short-circuiting lead provided should be engaged with plugs 32 and 39. When working on the 143 to 400 kc/s band the short-circuiting lead should be stowed on the dummy plugs provided on the right-hand side.

54. Having set the intermediate amplifier and power amplifier to the approximate settings as shown in the tables, put the voltage switch on the rectifier to the first stud (low volts) and switch on H.T. to the rectifier. The voltage should be approximately 2,000 volts. If necessary, re-adjust the filament voltage of the M/O and intermediate amplifier valves to 12 volts and that of the power amplifier to 18 volts. Switch on H.T. to the transmitter and with the key closed tune the intermediate amplifier by obtaining a maximum ammeter reading. Now set the aerial coupling condenser to its appropriate value. Press the key and tune the aerial circuit by obtaining a maximum reading in the aerial ammeter. Carefully re-tune the power amplifier circuit. This tuning is facilitated by watching for a dip in the reading of the power amplifier input milliammeter. Observing the aerial ammeter carefully, re-tune the intermediate amplifier circuit, and finally re-tune the aerial and power amplifier circuits.

55. It is essential that all setting up should be done in accordance with the figures given in the tables. If any other procedure is adopted, there is a danger that a false tuning will be obtained as a result of harmonics.

56. A final re-adjustment of filament voltages may now be made. Each filament rheostat should be adjusted in turn in order to ascertain whether a small increase or decrease of filament voltage will increase the aerial current reading, and each rheostat should be left at the optimum setting. Check the frequency by means of a suitable wavemeter. Re-tune if necessary by reference to the curves and tables.

57. An increase of power may be obtained by putting up the voltage tap in the rectifier, but operators should find by trial the lowest power necessary for efficient communication and should use this setting for all normal traffic. After any such adjustment the frequency should be re-checked by a wavemeter. The approximate voltages obtainable on load are as follows :—

Tap 1 ..	..	1,800 volts.
Tap 2 ..	..	2,500 volts.
Tap 3 ..	..	3,000 volts.

An additional tap is provided, but when using the rectifier with the transmitter, type T.77, this tap must not be used in any circumstances.

58. The setting up of the transmitter for frequencies between 2,000 kc/s and 2,256 kc/s calls for considerable care if the best output is to be obtained, and a number of adjustments and re-adjustments of tuning between the intermediate amplifier, power amplifier and aerial are necessary. It must be noted that for these frequencies the power amplifier circuit cannot be tuned by the method of observing the dip in anode current unless the aerial coupling is at zero. It is also important to note that the aerial specified requires a series capacitance of 100μμF (a No. 7 condenser set at 0·10 is near enough) to give the best results on these higher frequencies.

Examples showing method of using tables and curves

59. Suppose it is required to set the transmitter to 150 kc/s the dial setting corresponding to this frequency (*see* fig. 18) is 8·81. Set the M/O coil to this reading and tune the transmitter as described above using Table 1. Ascertain the actual frequency radiated by means of a suitable wavemeter or syntonizer. Assume it is found to be 150·8 kc/s, which is 0·8 kc/s high. Now look up this frequency (150·8 kc/s) on the curve (fig. 16) and it will be found to correspond to a dial setting of 8·74. The difference between the first dial setting (8·74) and the setting actually obtained on the transmitter (8·81) is ·07. In this region of the curve, therefore, a difference of ·07 in the setting corresponds to 0·8 kc/s. Since it is required to lower the frequency by 0·8 kc/s the M/O inductance dial setting should be increased by ·07. That is, the transmitter must be set to 8·88 instead of 8·81.

60. In the higher frequency band assume it is required to set the transmitter to 1,800 kc/s. The dial setting corresponding to this frequency (*see* fig. 19) is 3·93. Set the M/O coil to this reading and tune the transmitter as previously described using Table 4. Determine the actual frequency radiated by means of a suitable wavemeter. Suppose the frequency obtained by the wavemeter is 1,790 kc/s, *i.e.*, 10 kc/s too low, on looking up this frequency (1,790 kc/s) on the curve, it will be found to correspond to a setting of 4·00. The difference between the dial setting read off (3·93) and the dial setting actually obtained on the transmitter (4·00) is ·07. In this region of the curve, therefore, 10 kc/s corresponds to a difference in the dial setting of ·07. Since it is desired to raise the frequency by 10 kc/s, the M/O inductance dial setting should be lowered by ·07, *i.e.*, the transmitter must be set to (3·93 — ·07) 3·86. The other curves (figs. 17 and 18) may be used in a similar manner, bearing in mind that the turns are increased to lower the frequency, and reduced to raise the frequency.

Adjustments for R/T and M.C.W.

61. The operations described above for setting up the transmitter for C.W. should first be carried out. The intermediate amplifier bias control should now be set to stud 16 and the bias of the power amplifier adjusted so as to reduce the aerial current by 50 per cent. The connector from the speech amplifier may now be plugged into the socket on the side of the transmitter and modulation checked by means of the Modulation Indicator, type 1. If a modulation indicator

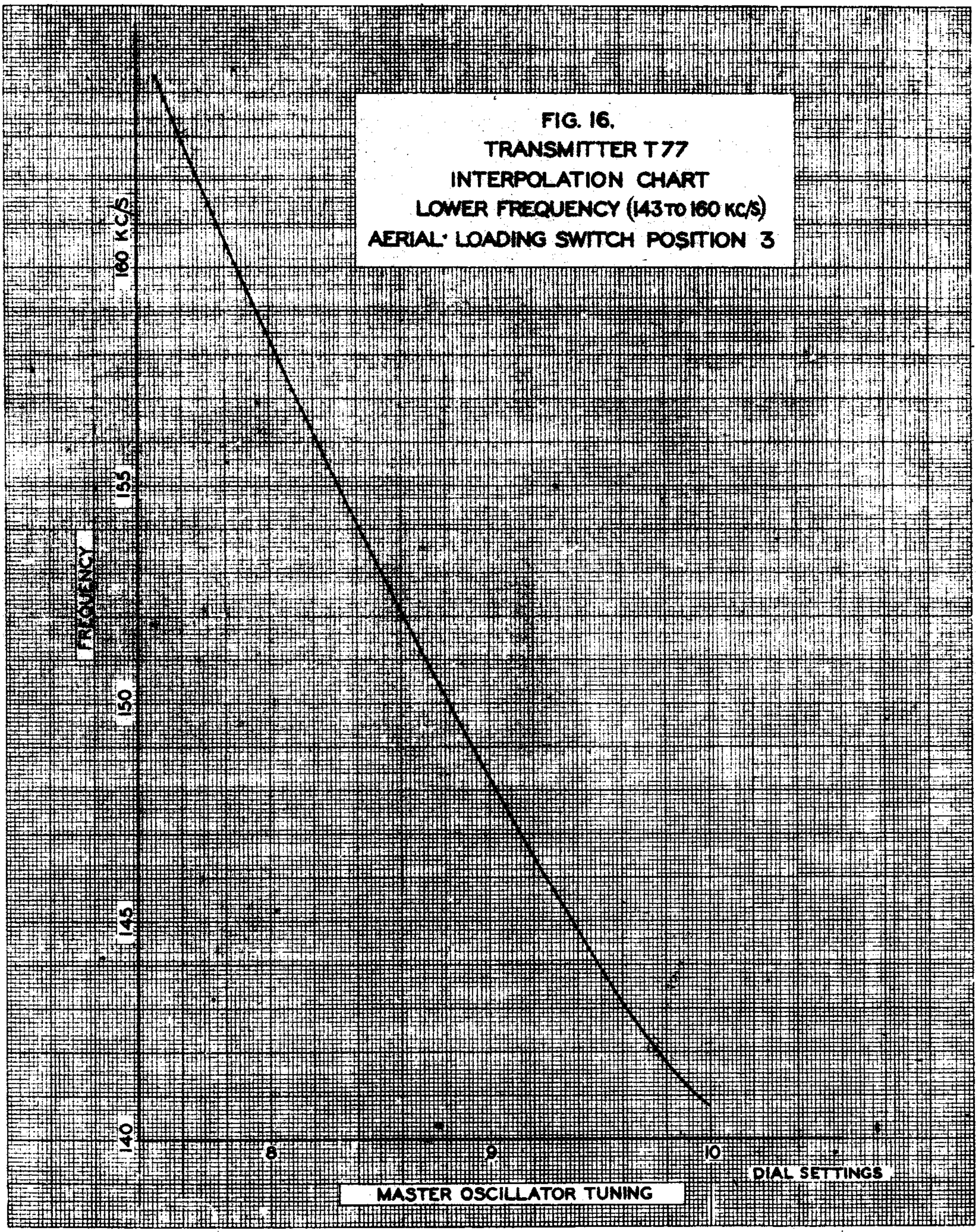


FIG. 16.
TRANSMITTER T 77
INTERPOLATION CHART
LOWER FREQUENCY (143 TO 160 KC/S)
AERIAL LOADING SWITCH POSITION 3
FREQUENCY
160 KC/S
155
150
145
140
8
9
10
DIAL SETTINGS
MASTER OSCILLATOR TUNING

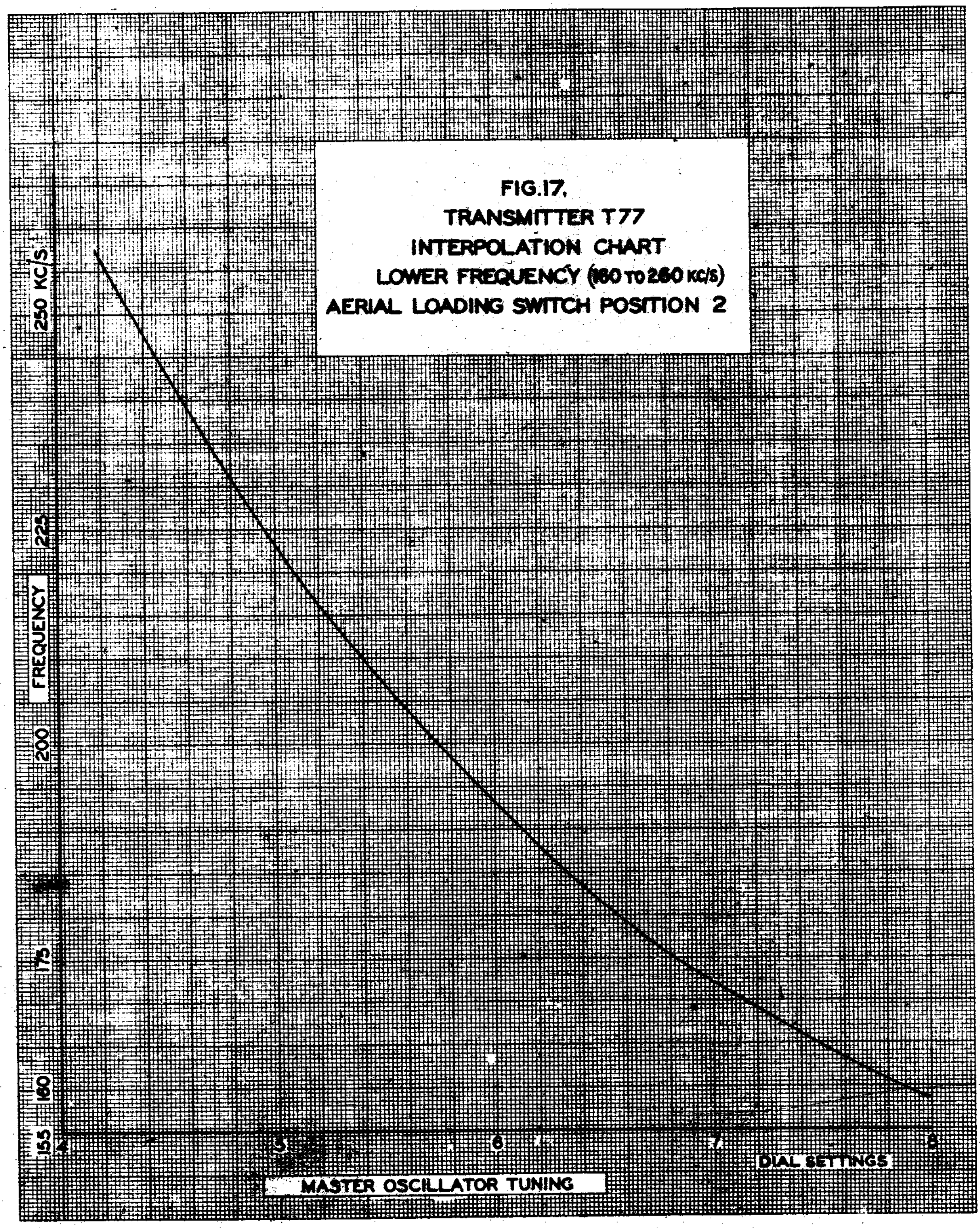


FIG.17.
TRANSMITTER T77
INTERPOLATION CHART
LOWER FREQUENCY (160 TO 260 KC/S)
AERIAL LOADING SWITCH POSITION 2
250 KC/S
225
FREQUENCY
200
175
160
155
4
5
6
7
8
DIAL SETTINGS
MASTER OSCILLATOR TUNING

is not available the aerial ammeter should be watched while speaking into the local microphone. There should be an increase in the reading of aerial current with no appreciable change of input to the amplifier valve. With 100 per cent. modulation the aerial current should rise 22 per cent. It should be borne in mind, however, that for normal speech no such increase will be observed on the aerial ammeter. With normal speech the modulation varies, even falling to zero during pauses. The average variation must therefore be considered and the average increase of the aerial ammeter reading may be no more than about 5 per cent. Since the aerial current for R/T will be of the order of 2·0 amperes this will be equivalent to an increase of 0·1 amperes.

62. If, however, a loud " hello-o-o " is sustained when testing, conditions more nearly approaching 100 per cent. modulation are obtained, and a rise of about 15 per cent. in aerial current may be effected. It should be borne in mind that it is quite impossible, no matter what depth of modulation is used, to obtain good speech if the aerial current is too high.

63. When using remote controls, type 3, the coupled switches on the remote control panel and the 2-way switch at the signals office end must be at R/T. The amplifier output connector must be plugged in and the switch on the local control panel (5, fig. 13) turned to 600 OHM INPUT. The grid-bias must be adjusted as stated in para. 61. If telephony is to be transmitted from an incoming line connected to the 50,000 OHMS terminals, the switch on the local control panel must be turned to the corresponding position. The main supply switch on the speech input amplifier must also be closed. The filament and H.T. supplies to the transmitter must then be switched on by closing the local tumbler switches. The circuit is arranged so that the H.T. cannot be switched on before the filaments.

64. When it is desired to transmit M.C.W. the connector from the remote control amplifier should be plugged into the side of the transmitter and the selector switch on the local control panel set to OSCILLATOR. The tumbler switch on the rectifier panel should be switched on, and the coupled tumbler switches placed in the W/T position. The input potentiometer should be adjusted to give the correct modulation.

PRECAUTIONS AND MAINTENANCE

65. Switch off the H.T. before making any adjustments to the transmitter. Safety switches are provided which cut off the H.T. supply when any of the transmitter doors are opened, but it is advisable not to depend entirely on these. For remote operation of the transmitter, all tumbler switches on the front panel of the transmitter must be in the " on " position, and of course all the doors must be closed.

66. The rectifier is similar to that described in another chapter of this publication, and similar precautions must be observed. The valves used in the rectifier are two type V.U.29 valves. These valves are of the mercury-vapour type and whenever there is any possibility of the mercury having come in contact with the filaments, the filament circuit should be switched on for not less than ten minutes prior to the H.T. being switched on, or the valves may be seriously damaged. This applies in any instance where a valve is shifted, or where the complete panel has been shifted and has been subjected to any inversion or heavy vibration.

67. The output voltage from the rectifier may be varied within limits. Four transformer taps are provided for this purpose as follows :—

Tap 1	1,800 volts.
Tap 2	2,500 volts.
Tap 3	3,000 volts.
Tap 4	3,500 volts.

68. Although four tapping points are provided, the fourth or highest tap must not be used with this transmitter. The R/F voltages generated with this high value of H.T. (3,500) are beyond the safe limit value of the insulation.

69. The valve used in the power amplifier stage is a V.T.4.B. valve. Some of these valves are prone to secondary grid emission. If any valve bearing one of the serial numbers from 2057 to 2684 is fitted, the power amplifier input milliammeter should be carefully watched as the H.T. is switched on. If a surge occurs, switch off immediately and increase the power amplifier filament volts a little. Switch on the H.T. again and watch the milliammeter. Increase the filament volts if necessary until there is no tendency to surge after switching on.

70. Care should be exercised that the correct fuses are fitted in the rectifier. There are four of these fuses each of which should carry two strands of 33 s.w.g. tin wire.

71. The relay, type K, which breaks the H.T. supply from the rectifier is situated in a glass-fronted box on the side of the unit. The contact arms should be adjusted so that when the relay is energized, the lower or L.T. contact arm makes first and the upper or H.T. contact arm makes a fraction of a second later. Each contact arm is provided with a carbon and a metal contact, and it should be adjusted so that the carbon contact makes before the metal contact.

TABLE 1

H.T. Voltage, Tap 2 (2,600 volts on load)

Range change switch position (143 to 400 kc/s)

Aerial loading switch, position 3

Aerial 1,100 $\mu\mu$ F (L-type, 6 wires, 2 ft. spacing, 200 ft. long, on 70-ft. masts)

Radial earth system.

kc/s.	Pulse Coil. Long Wave.			Tuning.				Bias Stud.		Aerial Coupling.	Inputs (mA).			Aerial Current (Amps.).
	Max.	Coupling.	H.T.	M/O.	INT. AMP.	POWER AMP.	AERIAL	INT. AMP.	POWER AMP.		M/O.	INT. AMP. Circuit.	POWER AMP.	
142·9	33	33	42	9·60	9·23	6·74	6·50	4	11	120	69	45	170	4·9
148·4	33	33	42	9·00	8·68	6·22	5·68	4	9	120	66	43	173	4·9
153·1	33	33	42	8·50	8·20	5·94	5·30	3	10	120	72	57	170	4·9
158·3	33	33	42	8·00	7·72	5·62	4·33	4	6	120	68	45	175	5·0
164·4	33	33	42	7·50	7·23	5·25	3·43	3	5	120	72	60	170	4·8

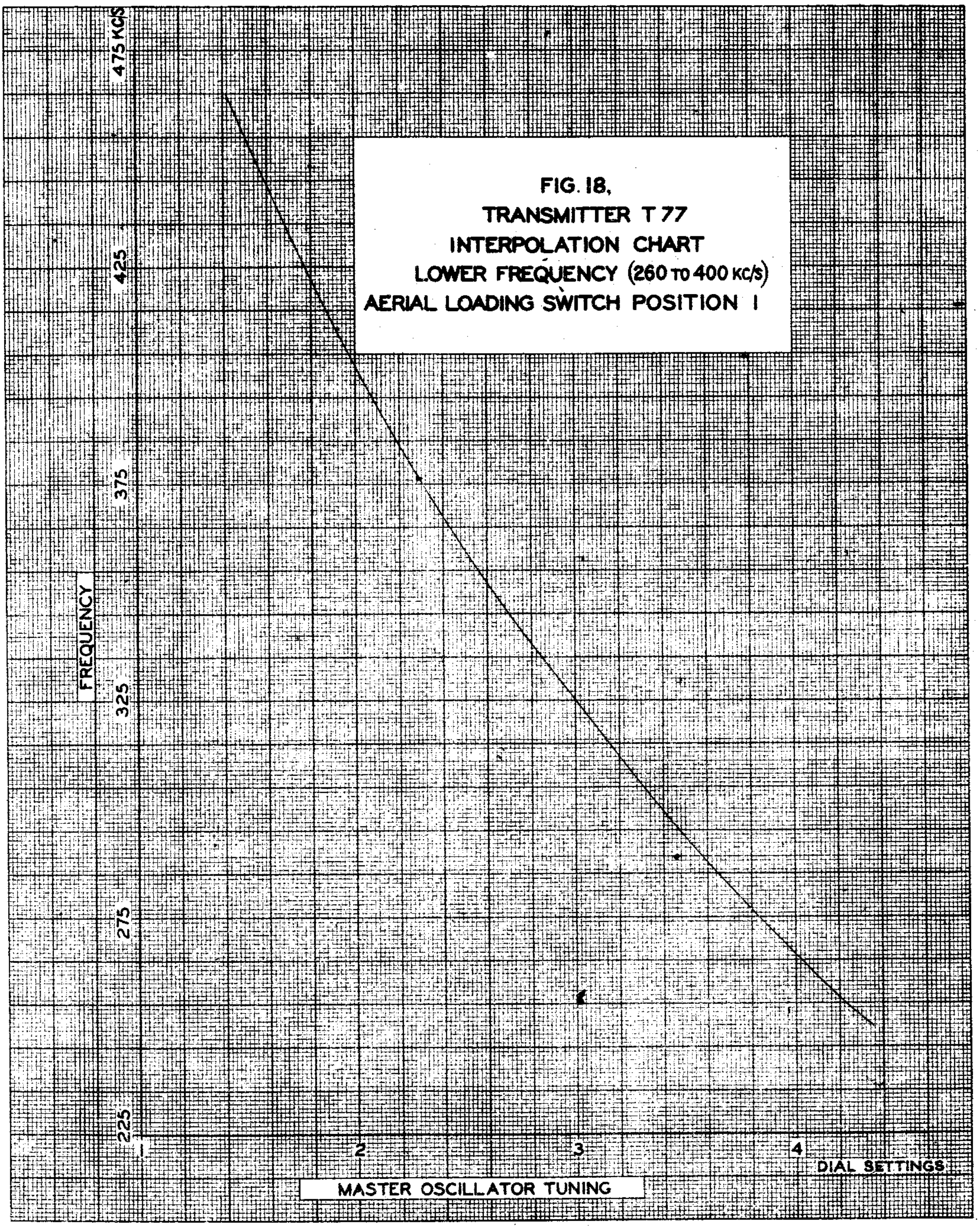


FIG. 18,
TRANSMITTER T 77
INTERPOLATION CHART
LOWER FREQUENCY (260 TO 400 KC/S)
AERIAL LOADING SWITCH POSITION 1
475 KC/S
425
375
325
275
225
FREQUENCY
1
2
3
4
DIAL SETTINGS
MASTER OSCILLATOR TUNING

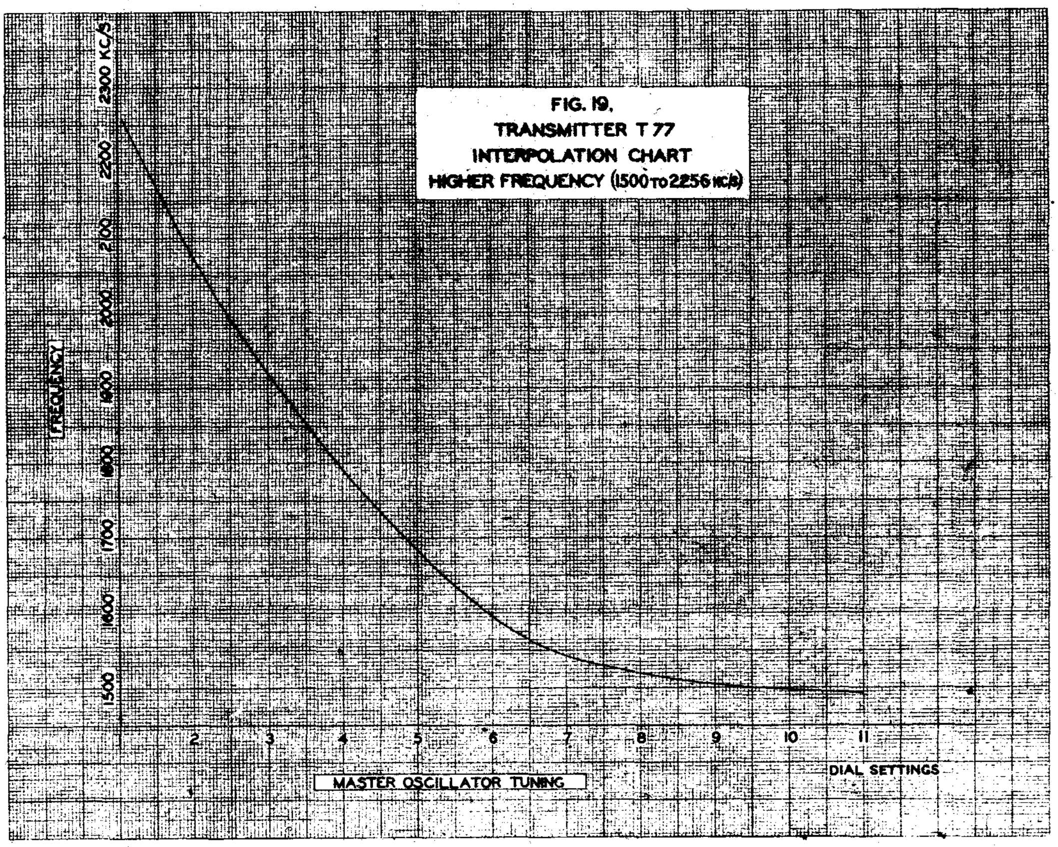


FIG. 19.
TRANSMITTER T 77
INTERPOLATION CHART
HIGHER FREQUENCY (1500 TO 2256 KC/S)
FREQUENCY
2300 KC/S
2200
2100
2000
1900
1800
1700
1600
1500
2
3
4
5
6
7
8
9
10
11
DIAL SETTINGS
MASTER OSCILLATOR TUNING

TABLE 2

H.T. Voltage, Tap 2 (2,600 volts on load)
Range-change switch position—(143 to 400 kc/s)
Aerial loading switch, position 2
Aerial 1,100 μμ F (L-type, 6 wires, 2 ft. spacing, 200 ft. long, on 70-ft. masts) Radial earth system.

kc/s.	Pulse Coil. Long Wave.			Tuning.				Bias Stud.		Aerial Coupling.	Inputs (mA).			Aerial Current (Amps.).
	Max.	Coupling.	H.T.	M/O.	INT. AMP.	POWER AMP.	AERIAL	INT. AMP.	POWER AMP.		M/O.	INT. AMP.	POWER AMP.	
158·3	33	33	42	8·00	7·74	5·56	9·43	4	14	120	66	40	175	4·7
168·5	33	33	42	7·20	7·00	5·00	7·52	3	13	85	68	50	170	5·0
176·5	33	33	42	6·77	6·58	4·83	6·73	3	13	90	64	45	170	4·8
185·7	33	33	42	6·20	6·04	4·36	5·73	3	11	57	68	50	170	4·9
199·6	33	33	42	5·74	5·62	4·00	5·03	3	11	63	64	47	170	4·9
215·8	33	33	42	5·20	5·17	3·50	4·10	3	10	57	68	50	170	4·9
230·8	33	33	42	4·78	4·67	3·06	3·18	3	6	60	66	48	170	4·9
256·4	33	33	42	4·20	4·19	2·45	1·62	3	4	120	72	55	170	4·6

TABLE 3

H.T. Voltage, Tap 2 (2,600 volts on load)
Range switch position—(143 to 400 kc/s)
Aerial loading switch, position 1
Aerial 1,100 μμF (L-type, 6 wires, 2 ft. spacing, 200 ft. long, on 70-ft. masts) Radial earth system.

kc/s.	Pulse Coil. Long Wave.			Tuning.				Bias Stud.		Aerial Coupling.	Inputs (mA).			Aerial Current (Amps.).
	Max.	Coupling.	H.T.	M/O.	INT. AMP.	POWER AMP.	AERIAL	INT. AMP.	POWER AMP.		M/O.	INT. AMP.	POWER AMP.	
245·9	33	33	42	4·40	4·30	9·97	4·80	3	9	80	70	50	170	4·6
266·2	33	33	42	4·00	3·87	8·01	4·29	2	6	65	74	55	170	4·9
291·8	33	33	42	3·50	3·35	6·28	3·64	2	6	45	74	50	170	4·7
326·8	33	33	42	2·95	2·79	5·32	2·89	2	3	35	74	66	170	4·6
366·0	33	33	42	2·40	2·28	4·46	2·10	1	2	45	74	50	170	4·2
409·8	33	33	42	1·90	1·80	3·78	1·46	1	1	65	80	82	200	4·0

TABLE 4

H.T. Voltage, Tap 2 (2,600 volts on load)

Range switch position—(1,500 to 2,256 kc/s)

Aerial loading switch, position 1

Aerial (vertical cage type, 6 wires spaced 12 in. diameter, top 50 ft.) Radial earth system.

kc/s.	Pulse Coil.		Tuning						Bias.		Aerial Coupling.	Inputs (mA).			Aerial Current (Amps.).
	Anode.	Coupling.	H.T.	M.O.	INT. AMP	POWER AMP.	AERIAL. Variometer.	AERIAL. Series Condenser	INT. AMP.	POWER AMP.		M.O.	INT. AMP.	POWER AMP.	
1,474	1	6	31	10·86	5·32	4·04	3·41	Nil	10	4	63	50	62	170	4·5
1,506	1	6	31	9·00	5·28	3·98	3·37	Nil	10	4	62	54	62	170	4·6
1,526	1	6	31	7·00	5·00	3·72	2·95	Nil	10	4	60	55	62	170	4·3
1,550	1	6	31	6·00	4·09	3·52	2·65	Nil	10	4	60	56	65	170	4·0
1,577	1	6	31	5·50	4·47	3·23	2·35	Nil	10	4	80	54	60	170	3·8
1,605	1	6	31	5·00	4·14	2·85	2·02	Nil	10	1	80	54	57	170	4·0
1,655	1	6	31	4·50	3·74	2·29	1·68	Nil	10	1	80	58	57	150	3·6
1,717	1	6	31	4·00	3·26	2·07	1·03	Nil	8	1	90	57	65	175	3·7
1,717	1	6	31	4·00	3·31	2·17	1·89	980	7	4	80	60	66	165	4·1
1,792	1	6	31	3·50	2·81	1·71	1·65	980	7	5	120	60	67	170	3·7
1,860	1	6	31	3·0	2·32	1·24	0·96	980	5	3	120	62	76	170	3·6
1,947	1	6	31	2·5	1·87	0·94	0·56	980	4	1	120	64	84	150	3·2
1,947	1	6	31	2·5	1·93	2·17	7·13	150	4	5	120	65	75	170	3·4
2,040	1	6	31	2·0	1·51	1·05	5·13	150	3	3	80	65	82	175	3·4
2,165	1	6	31	1·5	1·07	0·47	3·19	150	2	1	55	64	92	170	3·2
2,199	1	6	31	1·35	0·95	0·20	2·85	150	1	1	60	62	100	160	2·8

APPENDIX

NOMENCLATURE OF PARTS

The following list of parts is issued for information. In ordering spares for this transmitter, the appropriate section of AIR PUBLICATION 1086 must be used.

Ref. No.	Nomenclature.	Quantity.	Remarks.
10A/8151	Transmitter T.77		Complete without valves.
	Principal components :—		
10A/8297	Adaptor, grid, amplifier valve	1	Fitted with one valve-holder 10A/3412 and four resistances, type 82.
	Ammeter, thermo :—		
10A/8160	0 to 4 amps.	2	
10A/7180	0 to 6 amps.	1	
10A/3178	0 to 12 amps.	1	
	Choke, R/F. :—		
10A/8161	Type 15	1	
	Choke, A/F. :—		
10A/7512	Type C	1	
	Coil, inductance :—		
10A/8152	No. 1	3	Amplifier, intermediate circuit and M/O inductances with condenser mounting
10A/8153	No. 2	1	Aerial loading, L.W.
10A/8154	No. 3	1	Pulse coil.
10A/8155	No. 4	1	Aerial inductance.
	Condenser :—		
10A/8098	Type 146	8	1·0μF.
10A/8162	Type 150	1	Variable.
10A/8163	Type 151	3	·01μF.
10A/8164	Type 152	1	·0026μF.
10A/8165	Type 153	2	Variable.
10A/8166	Type 154	1	·0003μF.
10A/8167	Type 155	1	·000192μF. Bank of six units mounted on 10A/8152.
10A/8168	Type 156	2	·00103 μF. Bank of ten units each mounted on 10A/8152.
10A/8169	Type 157	1	·0002μF.
10A/8170	Type 158	3	·00005μF.
10A/8172	Type 160	1	·000106μF.
10A/8206	Type 162	1	·000212μF.
10A/9011	Type 256	26	1·0μF.
10A/8157	Grid-bias unit	2	Complete with 5 resistances, type 322.
	Holder, valve :—		
10A/8173	Type G	3	M/O and intermediate amplifiers.
10A/8174	Type H	1	Power amplifier.
	Insulator :—		
10A/8093	Type 16	1	Aerial lead-in.
	Milliammeter :—		
10A/1504	0 to 100 mA	1	M/O. H.T.
10A/3191	0 to 200 mA	1	Intermediate stage H.T.
10A/3091	0 to 300 mA	1	Amplifier H.T.
10A/3092	0 to 500 mA	1	Total input.

APPENDIX—*continued*

Ref. No.	Nomenclature.	Quantity.	Remarks.
	Transmitter T.77—*continued*		
	Principal components—*continued*		
10A/8068	Panel, rectifying, type A	1	For A.C. supply.
	or		
10A/11156	Panel, rectifying, type B	1	
10A/8207	Panel, dummy	1	Alternative to 10A/8068 when supply is D.C.
10A/8254	Relay, magnetic, type M	1	
10A/8158	Relay, unit	1	Complete with magnetic H.T. switch, one relay, magnetic, type N or 31, 2 condensers, type 146, and 1 resistance, type 127.
	Resistance :—		
10A/7316	Type 30	2	100,000 ohms, 1-watt, rod type.
10A/7766	Type 82	4	40 ohms.
10A/8179	Type 130	2	0·85 ohms, variable.
10A/8253	Type 138	6	1·5 ohms.
10A/8607	Type 153	2	5 MΩ 1-watt, rod type.
10A/9814	Type 300	2	30,000 ohms.
10A/9816	Type 302	2	50,000 ohms.
10A/9820	Type 306	3	20,000 ohms.
10A/9821	Type 307	1	500 ohms.
	Switch :—		
10A/8082	Type 75	2	Gate switch.
10A/8181	Type 78	1	Three-position switch.
10A/9162	Type 97	1	Plug operated. Fitted with socket, type 19.
5C/622	Tumbler	2	
10A/8159	Variometer	4	Aerial, power amplifier, intermediate amplifier, and master-oscillator.
	Voltmeter, A.C. :—		
10A/8183	0 to 15	1	M/O and intermediate amplifier filament.
10A/8184	0 to 20	1	Power amplifier filament.
	Voltmeter, moving coil :—		
10A/7784	0 to 3,500	1	D.C. volts.
	Accessories :—		
5A/1219	Lamp, filament, 230 V., 16 c.p... ..	1	Pilot lamp.
10A/7431	Plug, type 51	1	For 10A/9162.
10A/9167	Disc, indicating, type K	1	For 10A/7431
	Valves :—		
10A/5203	Type V.T.4B	1	Power amplifier.
10A/9122	Type V.T.26	3	M/O and two intermediate amplifiers.
10A/8087	Type V.U.29	2	For rectifying panel.
10A/7510	Type V.T.13C	1	For grid adaptor.
	Controls, remote, ground station :—		
10A/9009	Type 2	1	
	or		
10A/9521	Type 3	1	
	or		
10A/9522	Type 4	1	

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SECTION 1, CHAPTER 3

TRANSMITTER T.1087

Contents

List of Illustrations

TRANSMITTER T.1087

(Stores Ref. 10A./8709)

INTRODUCTION

1. The T.1087 is a ground-station transmitter designed for the transmission of C.W., M.C.W., or R/T on the frequency band 1,500 to 20,000 kc/s. Modulation is obtained from a separate amplifier such as the amplifier portion of Remote Controls, type 3 (*see* appropriate Section of this publication). The output from the amplifier is connected to the transmitter by means of a flexible cable and a plug which is inserted in the jack 6 (fig. 8). The transmitter may be operated either direct or by remote control over land lines. The power is normally obtained from a 230-volt 50 cycle A.C. supply, but D.C. may also be used in conjunction with a motor alternator or suitable convertor.

2. The circuit comprises a master-oscillator stage coupled to an amplifier stage comprising two screen-grid valves connected in push-pull. The output circuit consists of an auto-transformer capacitance-coupled to the amplifier circuit. The auto-transformer is provided with several taps whereby various types of aerial systems may be connected to the transmitter and by means of which the transformer ratio may be varied for matching purposes. A separate valve connected up as a rectifier is used to provide the bias for the amplifier valves.

3. A set of three plug-in coils is provided for the master-oscillator tuning inductance. A set of ten sockets is provided on the transmitter, six of which are used at a time, the coils being provided with a suitable number of lugs. The ranges covered are approximately as follows :—

Number 1 Coil	..	16,666 to 20,000 kc/s (18 to 15 metres).
Number 2 Coil	..	3,000 to 18,750 kc/s (100 to 16 metres).
Number 3 Coil	..	1,500 to 3,000 kc/s (200 to 100 metres).

The number 2 coil is adapted to be plugged into any one of four different positions. The plugs are engraved B, C, D and E to correspond to each of the positions and the corresponding ranges covered are :—

Position B	..	15,789 to 18,750 kc/s (19 to 16 metres).
Position C	..	11,110 to 15,789 kc/s (27 to 19 metres).
Position D	..	7,500 to 11,540 kc/s (40 to 26 metres).
Position E	..	3,000 to 7,500 kc/s (100 to 40 metres).

4. Provision is made for alternative values of master-oscillator anode feed resistances. When coil Number 3 is being used, two 20,000-ohm resistances are available. When the other two coils (Numbers 1 and 2) are used, two 10,000-ohm resistances are used. The resistances are of the vitreous embedded type and may be clipped into position as and when desired. When in circuit, the resistances are connected in parallel. The amplifier coil is built in and is tuned by means of taps, the frequency band being covered by various positions of these taps.

5. When transmitting W/T, the key makes and breaks the H.T., thus interrupting oscillations at the space position of the key so as to facilitate listening-through, but during stand-by periods the oscillations are automatically set up again, so as to maintain the temperature of the components of the tuned circuit of the master-oscillator. This stand-by, or space-tuning frequency is adjustable and will not, in general, be the same as the signalling frequency.

6. The change-over to space-tuning frequency occurs automatically if a pause of more than 10 seconds is made in transmission, when a number of relays included in the circuit are energized and perform various switching operations. In addition to switching over the master-oscillator to the space-tuning frequency, the amplifier is rendered inoperative and the aerial and earth are disconnected.

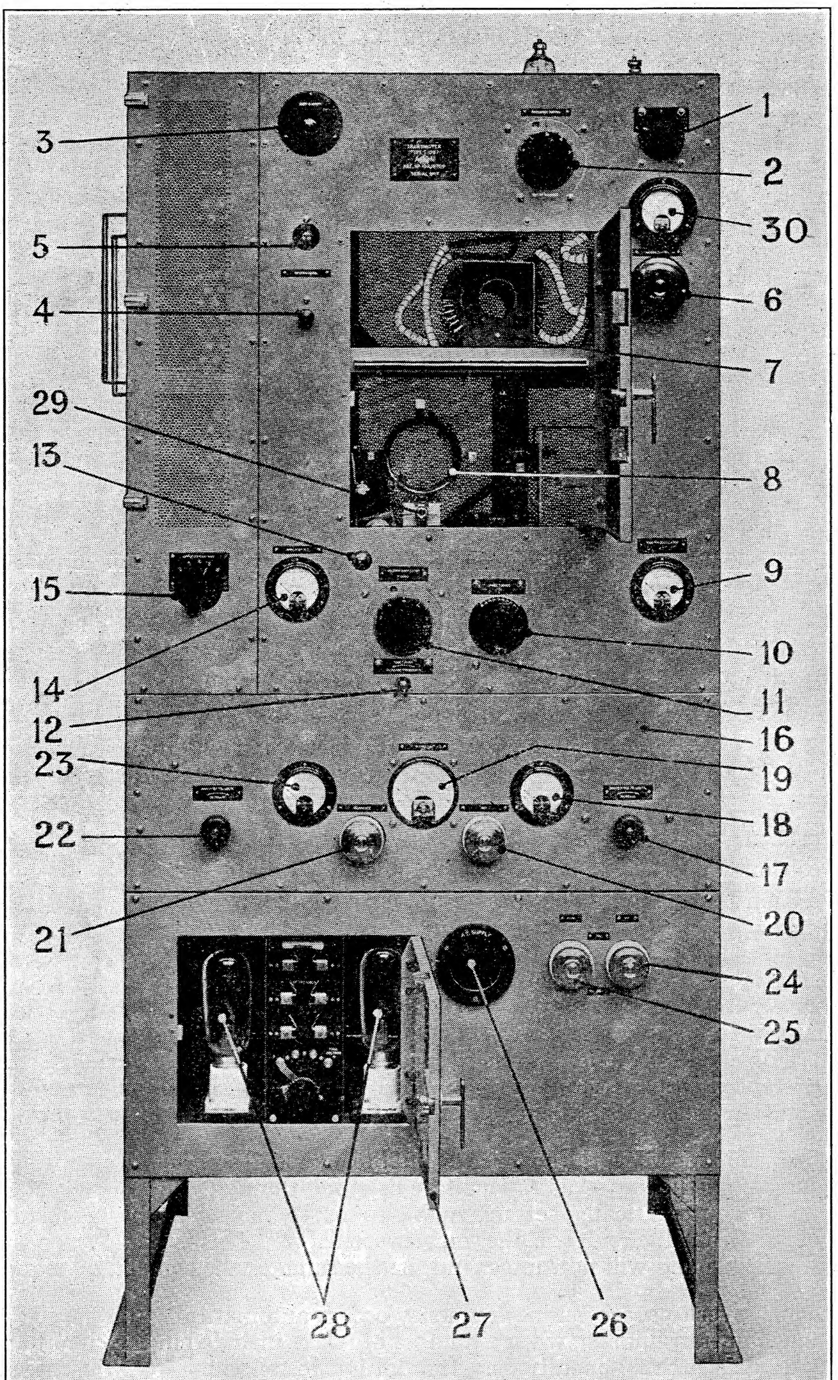
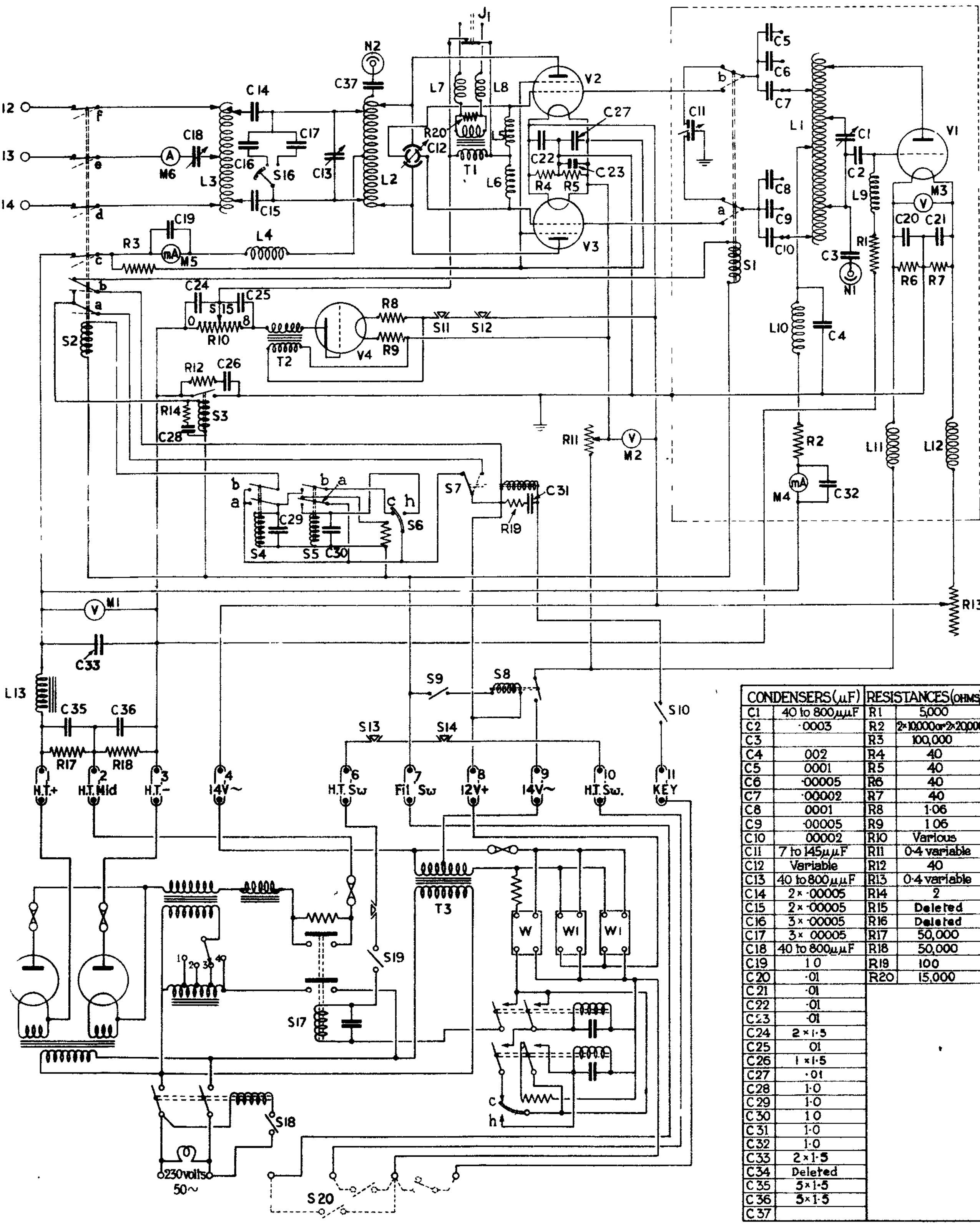


FIG. 1. Transmitter T1087.



CONDENSERS (μF)		RESISTANCES (OHMS)	
C1	40 to 800μμF	R1	5,000
C2	·0003	R2	2×10,000 or 2×20,000
C3		R3	100,000
C4	002	R4	40
C5	0001	R5	40
C6	·00005	R6	40
C7	·00002	R7	40
C8	0001	R8	1·06
C9	·00005	R9	1 06
C10	00002	R10	Various
C11	7 to 145μμF	R11	0·4 variable
C12	Variable	R12	40
C13	40 to 800μμF	R13	0·4 variable
C14	2× ·00005	R14	2
C15	2× ·00005	R15	Deleted
C16	3× ·00005	R16	Deleted
C17	3× 00005	R17	50,000
C18	40 to 800μμF	R18	50,000
C19	1 0	R19	100
C20	·01	R20	15,000
C21	·01		
C22	·01		
C23	·01		
C24	2×1·5		
C25	01		
C26	1×1·5		
C27	·01		
C28	1·0		
C29	1·0		
C30	1 0		
C31	1·0		
C32	1·0		
C33	2×1·5		
C34	Deleted		
C35	5×1·5		
C36	5×1·5		
C37			

FIG. 2. THEORETICAL CIRCUIT DIAGRAM

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GENERAL DESCRIPTION

7. A circuit diagram of the transmitter is given in fig. 2. It consists of a master-oscillator valve V_1 connected up as a Hartley circuit. The tuned inductance L_1 may consist of one of a set of three plug-in coils provided with six tapping points. C_1 is the tuning condenser and C_2 the grid blocking condenser. A neon lamp N_1 is coupled to L_1 by the condenser C_3 and serves to indicate when the master-oscillator is oscillating. The grid leak R_1 and choke L_9 are connected between the grid and H.T.— A connection is made directly from H.T.+ through the anode resistance R_2 and milliammeter M_4, the latter shunted by the condenser C_{32}, to a tap on the inductance L_1, an R/F choke L_{10} and by-pass condenser C_4 being also included in this circuit.

8. Two chokes L_{11} and L_{12} are included in the filament leads of the M/O, while the rheostat R_{13} varies the applied voltage. A filament equalizing unit consisting of the two condensers C_{20} and C_{21} and the resistances R_6 and R_7 is connected across the valve filaments. The voltmeter M_3 indicates the applied filament volts.

9. The M/O and amplifier are capacitance-coupled through the condensers C_5, C_6, C_7, C_8, C_9 and C_{10}, which are so arranged that the appropriate pair is selected by the coil L_1 when it is inserted in position. The relay S_1 has two positions such that when the key is down the relay is energized, and the output from the M/O is connected to the amplifier. If, however, the key is up for more than 10 seconds, S_1 is de-energized and the M/O circuit is connected to the condenser C_{11} and oscillation continues but at some pre-determined space-tuning frequency. Should this cause interference to the reception of weak signals in a near-by receiver, the space-tuning frequency may be adjusted by C_{11} to eliminate such interference.

10. Two screen grid valves V_2 and V_3 are used in the amplifier stage and are connected in push-pull. The filaments are in parallel and are fed from the rectifier unit at the bottom of the transmitter. The unit is Rectifier, type B (Stores Ref. 10A/8067) which is described elsewhere in this publication. A rheostat R_{11} controls the voltage applied to the amplifier valve filaments and also the voltage applied to the filament circuit of the rectifier valve V_4. The volt-meter M_2 measures this voltage. A filament equalizing unit consisting of the condensers C_{22} and C_{23} and the resistances R_4 and R_5 is connected across the filaments of the valves V_2 and V_3. The screen grids of the valves are connected to H.T.+ through the dropping resistance R_3 and are maintained at practically earth potential (R/F) by the condenser C_{27} connected between the screen grids and filament.

11. The socket J_1 provides the means of connecting the output of the external amplifier to the modulating transformer T_1. The two chokes L_7 and L_8 are in series in each side of the primary winding, and a 15,000-ohm. resistance R_{20} is connected across the primary winding to act as a speech improver. When the plug is withdrawn from the jack the secondary winding of the transformer is short-circuited. The amplifier circuit is tuned by means of taps on the coil L_2 and the variable tuning condenser C_{13}. A neon lamp N_2, coupled by the condenser C_{37}, indicates excitation of the tuned anode coil L_2. In addition to the variable condenser C_{13}, two fixed condensers C_{16} and C_{17} are provided. One or both of these may be connected in parallel with C_{13} by means of the switch S_{16}. The various circuit connections to L_2 are made through connecting links. In order to prevent feed-back on the higher frequency settings, a neutralizing arrangement consisting of the differential condenser C_{12} is connected between the anodes and grids of the valves V_2 and V_3.

12. The H.T.+ feed for the amplifier valves is connected to the centre-point of L_2. A milliammeter M_5, shunted by the condenser C_{19}, and a choke L_4 are included in this circuit. Also in this circuit is the contact *c* of the relay S_2. The H.T.— side of the valves V_1, V_2 and V_3 is connected back through the relay S_3, the contacts of which are shunted by the resistance R_{12} and condenser C_{26} in series.

13. Grid-bias for the valves V_2, V_3, is obtained from the rectifier valve V_4. The primary winding of T_2 is connected across the filament supply for V_4 which is obtained from the 50 cycle A.C. mains. The grid and anode of V_4 are strapped together so that the valve functions as a diode. The anode circuit includes the secondary winding of T_2, the grid-bias resistances R_{10} and condensers C_{24} and C_{25}. The end of R_{10} marked 8 is at negative potential with respect to the end marked 0, and the tapping point of R_{10} applies a negative bias to the grids of V_2 and V_3 *via* the chokes L_5 and L_6. When the key is pressed, however, the end of the resistance marked 0 is connected directly to the filament centre-point.

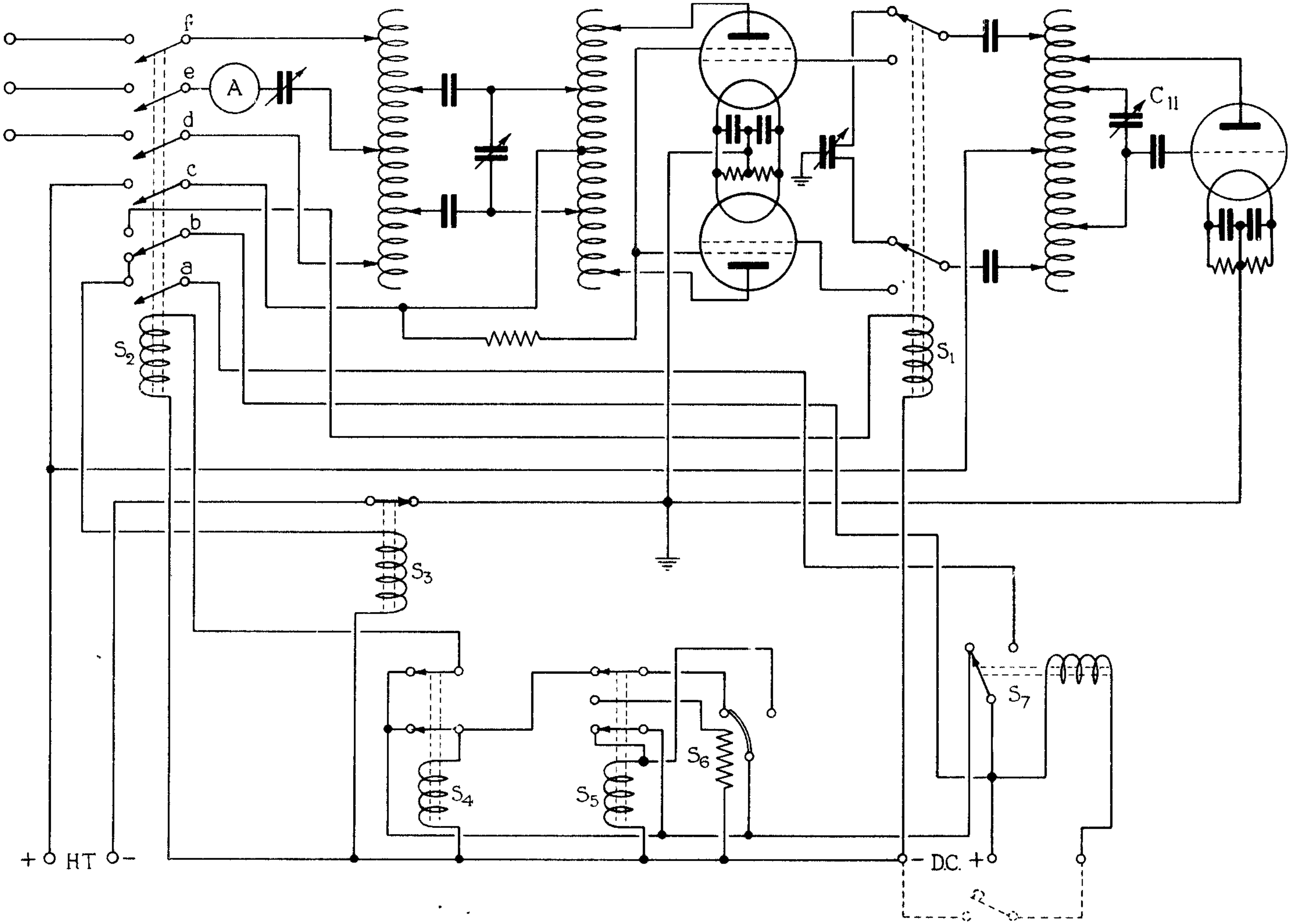
14. The output from the amplifier stage is connected through the blocking condensers C_{14} and C_{15} to the auto-transformer L_3 which consists of a coil, each turn of which is tapped and is provided to enable the transmitter to work into any type of load. The various connections are made by means of sockets, the transformer ratio being varied, for matching purposes, by changing the positions of the sockets on the input side and also those on the output side. Three aerial terminals are provided, two of which are connected by sockets to the output side of L_3 (12 and 14) and the third terminal 13 is connected to L_3 through an ammeter M_6 and variable condenser C_{18}.

15. The terminal 13 is provided to enable an aerial of the $\frac{1}{4}$ wavelength type to be used, for example when working on the higher frequencies. When the aerial is connected to terminal 13, the aerial circuit can be tuned by C_{18}, variation of coupling being effected by adjustment of the taps on the output transformer. If open wire transmission lines are used, they are connected to terminals 12 and 14. When connected thus, it is necessary to use matched ammeters in each of the lines, these being connected externally between the transmission lines and the transmitter.

16. The H.T. smoothing circuit consisting of the choke L_{13}, resistances R_{17}, R_{18} and condensers C_{33}, C_{35} and C_{36} is similar to the corresponding portion of the rectifier, type B. It should be noted that the lower portion of fig. 2 illustrates panel, rectifying, type A (Stores Ref. 10A/8068). Future contracts of the transmitter will have panel, rectifying, type B (Stores Ref. 10A/11156). Both types of panels are dealt with in the chapter on Rectifier, type B contained in this publication. The terminals marked 1 to 11 on the diagram represent the terminals on the transmitter which are connected up by means of links to the corresponding terminals on the rectifier unit. A 14-volt A.C. supply from the transformer T_3 is connected across the terminals 4 and 9. When the gate switches S_{13} and S_{14} are closed across terminals 6 and 10, and the H.T. switches are closed, it is possible for the H.T. relay S_{17} to become energized. A 12-volt rectified D.C. supply is connected across the terminals 7 and 8 in series with the filament switch on the remote control panel. The same 12-volt rectified supply from the metal rectifiers W_1 is connected *via* the terminal 8 through the relay of S_7 and the switch S_{10} to the terminal numbered 11. On closing the key, with S_{10} made, the terminal 11 is connected back to the negative side of the rectifiers W_1 and the relay S_7 operates.

17. When the main A.C. supply is connected to the 230-volt terminals on the rectifier unit, and the switches S_{18} and S_{19} are closed, after a period of about 20 seconds the H.T. supply to the transmitter becomes available. Two simplified circuit diagrams are given in figs. 3 and 4. Fig. 3 shows the condition of the various relays in the transmitter approximately 30 seconds after the switches S_{20} and S_{18} have been closed. The relays S_2, S_3, S_4 and S_5 are energized, the key is up, the M/O valve is oscillating but at some space-tuning frequency determined by C_{11}; the amplifiers are disconnected from the M/O; H.T.+ for the amplifiers is broken at *c* of S_2, and the output circuit is broken at *d*, *e*, and *f* of S_2.

18. A similar circuit is shown in fig. 4 but with the key down. The relays S_1, S_3 and S_7 are energized. The output from the M/O is coupled to the amplifiers, the H.T. circuit of the amplifier valves is made and also the output circuit to the aerial or transmission lines, depending upon what system is being used.



(F.1799). F. & C. LTD. **FIG. 3. SIMPLIFIED CIRCUIT DIAGRAM, TRANSMITTER WARMING UP**

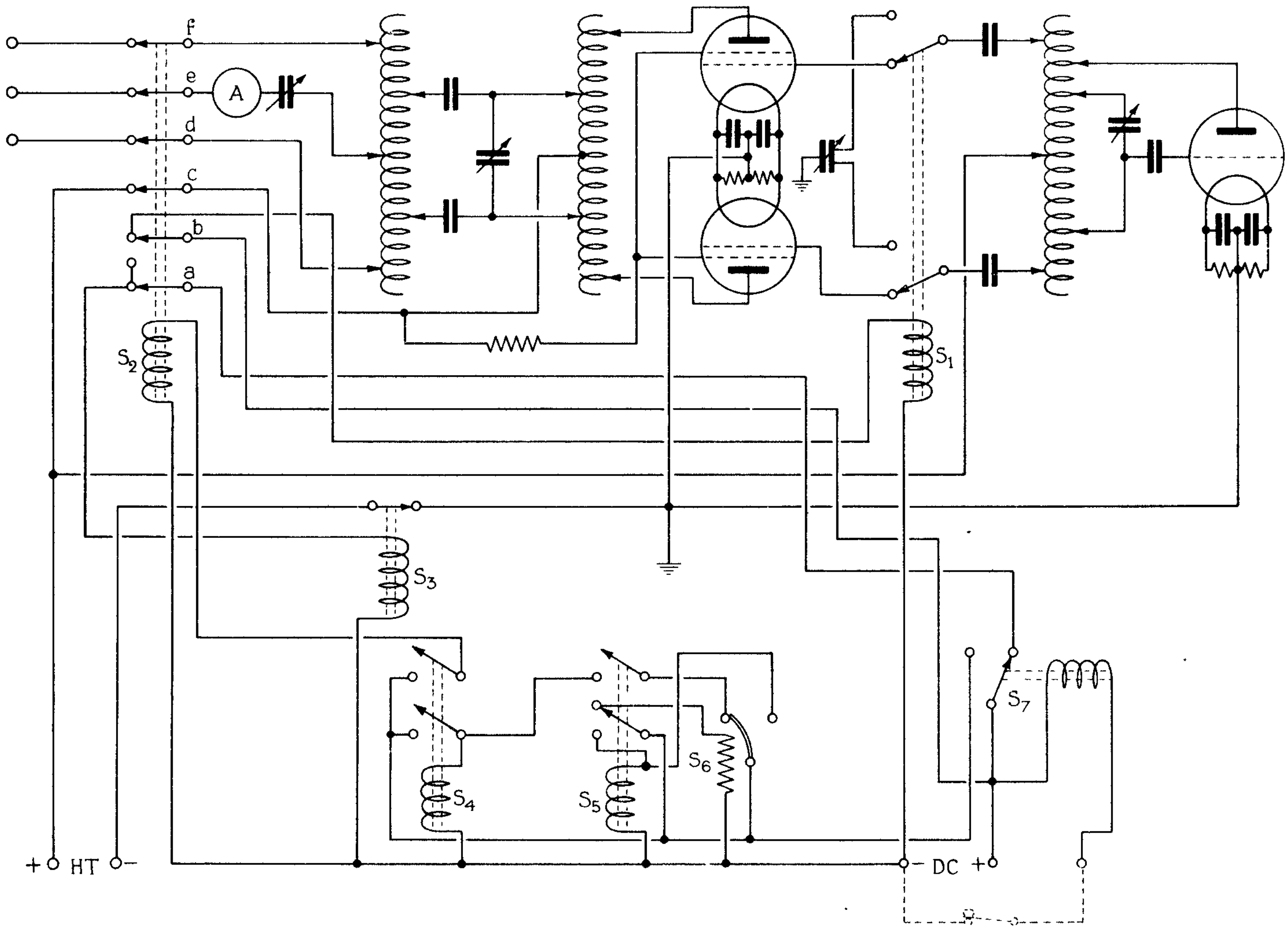


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FIG. 4. SIMPLIFIED CIRCUIT DIAGRAM. KEY DOWN

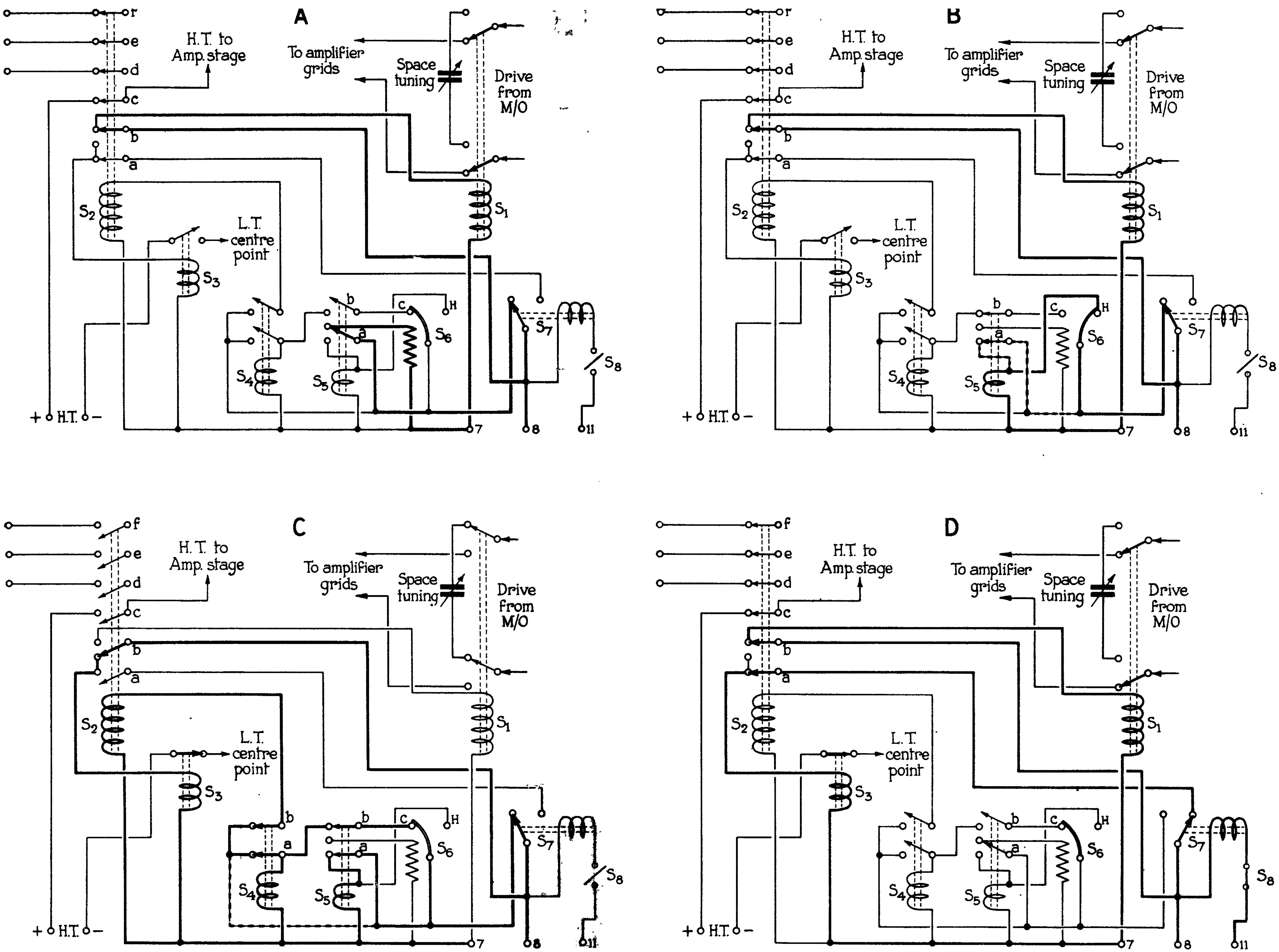

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FIG. 5, SEQUENCE OF OPERATIONS DUE TO THERMAL RELAY

19. Several relays have been introduced into the circuit in order that the M/O circuit components should be maintained at a constant temperature during a pause in transmission. Fig. 5 shows the sequence of operation. As soon as the power supplies are available from the rectifier unit, a 12-volt rectified supply is connected across the terminals (7 and 8, fig. 2), the relay S_1 becomes energized through contact *b* of S_2, the heating element of S_6 becomes energized through contact *a* of S_5 and the open-circuit contact of S_7, and the bi-metal strip starts moving over from the C (cold) to the H (hot) contact of S_6. These conditions are shown at A in fig. 5.

20. When the bi-metal strip reaches the H (hot) contact of S_6, the winding of S_5 becomes energized through this contact and S_7. S_1 remains as before, but the circuit for the heating element of S_6 is broken at *a* of S_5. The relay S_5 is self-locking. As soon as the relay is energized through H of S_6 and S_7, the circuit has two paths, one as shown in heavy lines and the other as shown dotted in B of fig. 5.

21. As soon as S_5 closes, the bi-metal strip starts returning from the H (hot) contact of S_6 to the C (cold) contact. A path is then completed for the winding of S_4 through *b* of S_5, *c* of S_6 and S_7. The relay is self-locking as in the case of S_5, an alternative path being shown dotted (C of fig. 5). When the relay S_4 closes, the winding of S_2 is energized through *b* of S_4 and S_7, the contacts of S_2 move over as shown and relay S_3 becomes energized through *b* of S_2 and the moving contact of S_7. The circuit for S_1 is broken at the same time, at *b* of S_2.

22. This sequence of operations, A, B and C, fig. 5, takes place as soon as the supplies from the rectifier are available and the key is up. When the key is down, however, the conditions will be as shown at D in fig. 5. If S_8 is closed, the 12-volt rectified supply will be connected in series with the key across the winding of S_7 which becomes energized thus breaking the circuits for the relays S_6, S_5, S_4 and S_2. Relay S_3 becomes energized through *a* of S_2 and the closed-circuit contact of S_7, while relay S_1 becomes energized through *b* of S_2 and the moving contact of S_7. The H.T.+ to the amplifiers is made through *c* of S_2 and the aerial system through *d*, *e*, and *f*.

23. The period of delay, that is from the time the supplies are available and the bi-metal strip moves from C to H and back again to C (A, B, C, fig. 5), takes about 10 seconds. It will be seen therefore that if during transmission the key is raised for more than 10 seconds, the M/O circuit will be switched over to the stand-by position (C, fig. 5), and immediately the key is pressed the M/O circuit is switched back to the radiating or transmitting position D, fig. 5. The sequence of operation starts during each space in the signal, but is never completed unless the space period is more than 10 seconds.

CONSTRUCTIONAL DETAILS

Transmitter

24. Several views of the transmitter are given in figs. 1, 6, 8, 9, 11 and 12 and three bench wiring diagrams in figs. 7, 10 and 13. Referring to fig. 1, which is a view of the transmitter from the front, the various controls and instruments may be seen. The transmitter is built up in a duralumin frame-work with perforated metal panels. The overall dimensions are about 5 ft. 10 in. high, 2 ft. 6 in. wide, and 1 ft. 10 in. deep and its approximate weight is 4½ cwt.

25. The switch (1) in the top right-hand corner has three positions engraved A, B and C. Its function is to include one or two condensers as desired in parallel with the amplifier tuning condenser, the control knob of which is at (2). The scale is divided into 100 divisions and a small window indicates the number of complete revolutions made. The neon lamp (3) indicates when the amplifier circuit is tuned. The neutralizing condenser control knob (4) with its scale (5) is mounted on the left.

26. Below the switch (1) is the aerial ammeter (30) reading 0 to 6 amps., and beneath it the aerial condenser tuning control (6). The output auto-transformer (L_3, fig. 2) is seen at (7) and the master-oscillator tuning inductance may be seen at (8). In the bottom right-hand corner of the top section is the master-oscillator H.T. milliammeter (9) reading 0 to 300 mA. To the

left of it is the control (10) for the space-tuning condenser. The master-oscillator tuning control (11) and fine tuning control (12) operate the variable condenser (C_1, fig. 2). The dial is divided into 100 divisions and a window indicates the number of complete revolutions made. The neon lamp (13) indicates when the M/O is oscillating. The amplifier H.T. milliammeter (14) reading 0 to 500 mA is adjacent to the amplifier grid-bias control knob (15). Eight positions are provided on the latter and the dial is engraved accordingly.

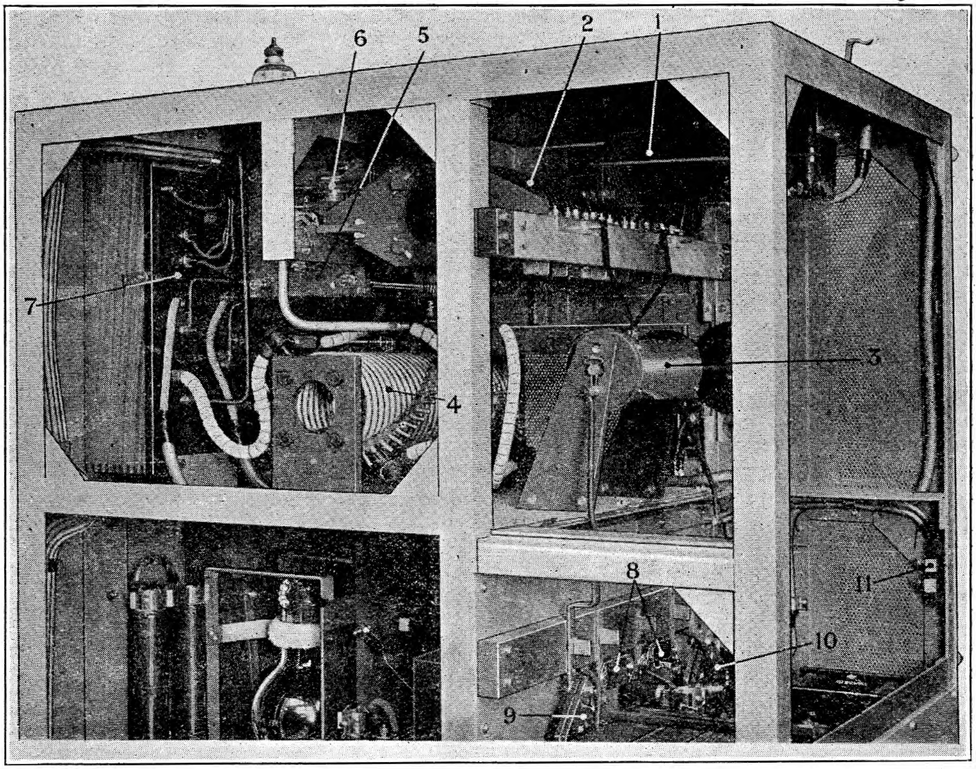
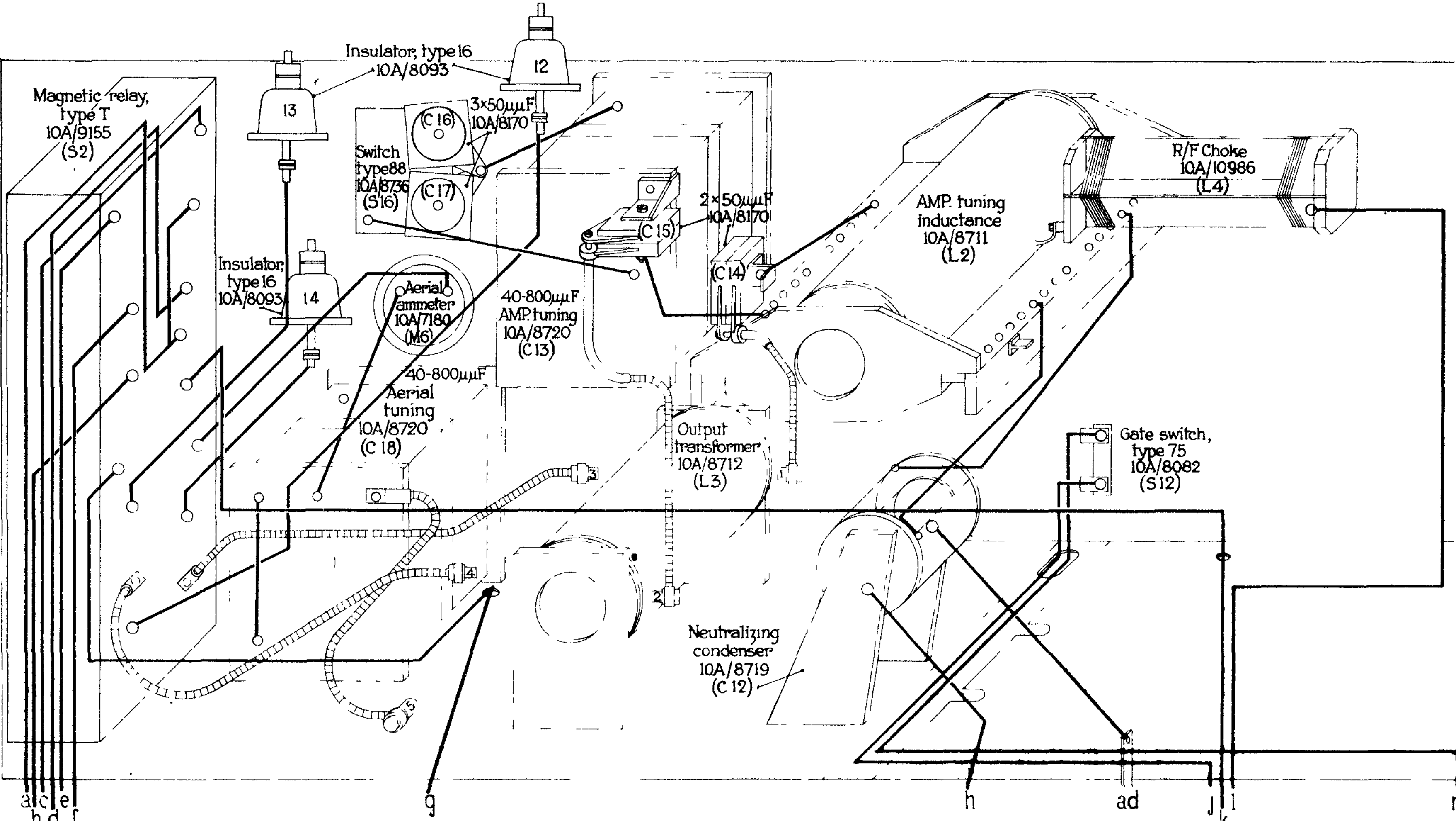


FIG. 6. Interior view of top section.

27. The smoothing unit components are housed behind the panel (16) on the front of which may be seen the M/O filament rheostat (17) and M/O filament voltmeter (18) reading 0 to 15 volts. The H.T. voltmeter (19) is in the centre of the panel and the tumbler switches (20) and (21) on either side of it are engraved KEY and FILAMENT respectively. Mounted on the left of the panel are the amplifier filament rheostat control (22) and the amplifier filament voltmeter (23) reading 0 to 15 volts.

28. The bottom section houses the rectifier components, the two switches (24) and (25) on the right are the H.T. and filament switch respectively. A pilot lamp shows through the window (26) when the main A.C. supply is switched on. Access to the rectifier valves is obtained through the door (27). The two valves (28) may be seen on the left.

29. An interior view of the top section of the transmitter is shown in fig. 6 and a bench wiring diagram of the same section in fig. 7. Referring to fig. 6, (1) is the R/F choke in the amplifier H.T. circuit. The amplifier tuning inductance (2) is on the left of the choke and the neutralizing condenser (3) is below it. The output auto-transformer (4) is mounted below the



NOTE : Annotations in parenthesis, for example (C 12), refer to the corresponding annotations in Fig 2

FIG. 7, WIRING DIAGRAM - TOP SECTION

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amplifier tuning condenser (5). The two 50 $\mu\mu$F condensers (6) are represented by C_{15} in fig. 2. On the left of the illustration is seen the back of the panel (7) on which the relay (S_2, fig. 2) is mounted. In the bottom right-hand corner can be seen the two 40-ohm resistances (8) connected across the amplifier filament circuit, and also the two R/F chokes (9) and (10) connected in the grid circuit of the amplifier valves. The gate switch (11) seen on the right is represented by S_{12} in fig. 2.

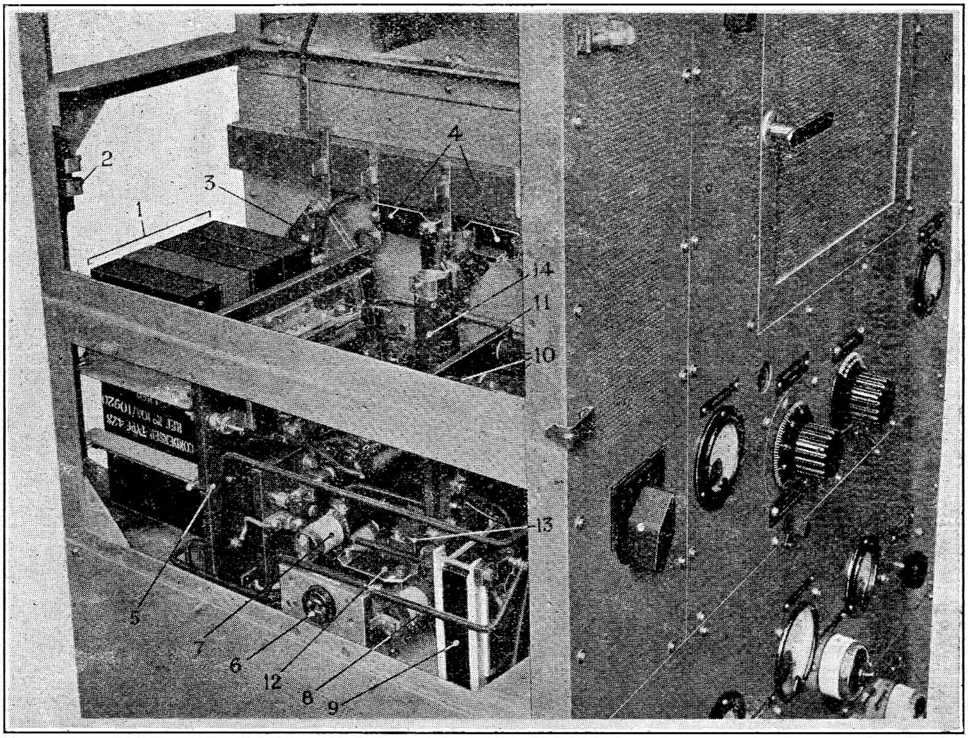


FIG. 8. Interior view of middle section, left-hand side.

30. Three interior views of the transmitter are given in figs. 8, 9 and 11, and a bench wiring diagram of the corresponding section in fig. 10. Referring to fig. 8, the three $1 \cdot 5\mu$F condensers (1) are connected up to form the condensers (C_{24} and C_{26}, fig. 2), the condenser nearest the frame being C_{26} and the other two being connected in parallel to form C_{24}. The type 428 condensers illustrated in these figures replace the existing type 256, and form the subject of a future modification. Above the condensers is another gate switch (2). One of the amplifier grid chokes (3) and the filament equalizing resistances (4) may be seen to the right of the condensers.

31. Mounted on the panel (5) are the relays, S_3, S_4, S_5, S_6 and S_7. To the right of the panel may be seen the 2-pole socket (6) into which the external amplifier is plugged. The two chokes (7) and (8) are connected in series with the primary of the input transformer (9). The panel (11) on which the resistances (10) for the amplifier grid-bias unit are mounted, can be seen above the transformer. One of the filament resistances (12) for the rectifier valve (V_4, fig. 2) is mounted on the valve-holder (13). The resistance (14) has a value of 100,000 ohms and is the dropping resistance in series with the H.T. supply to the screen grids of the amplifier valves.

32. In fig. 9, which is a rear view of the middle section, may be seen the two 20,000-ohm resistances (1) which are connected in parallel to form the anode feed resistance for the master-oscillator valve when coil No. 3 is being used. The resistance (2) has a value of 5,000 ohms and is connected with the choke (3) in the grid circuit of the M/O valve. The R/F choke (4) is in the H.T. feed of the M/O and is connected in series with the resistances (1). The M/O tuning inductance (5) is mounted above the M/O tuning condenser (6), and to the right of it is the relay (7) represented by S_1 in fig. 2.

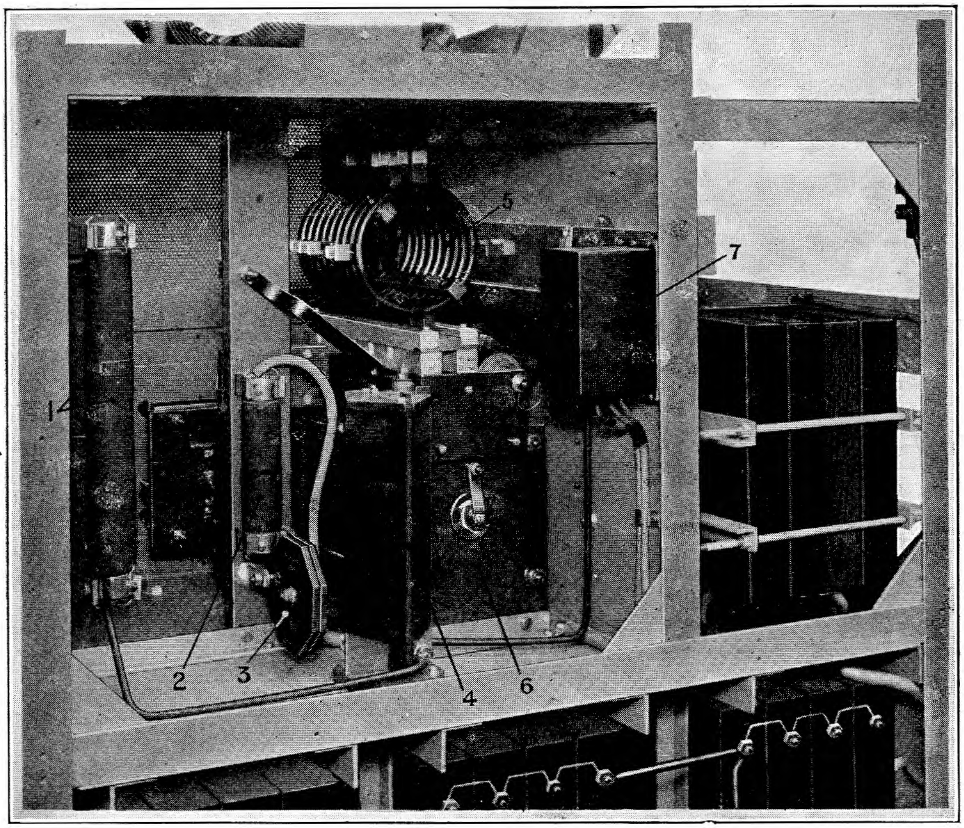
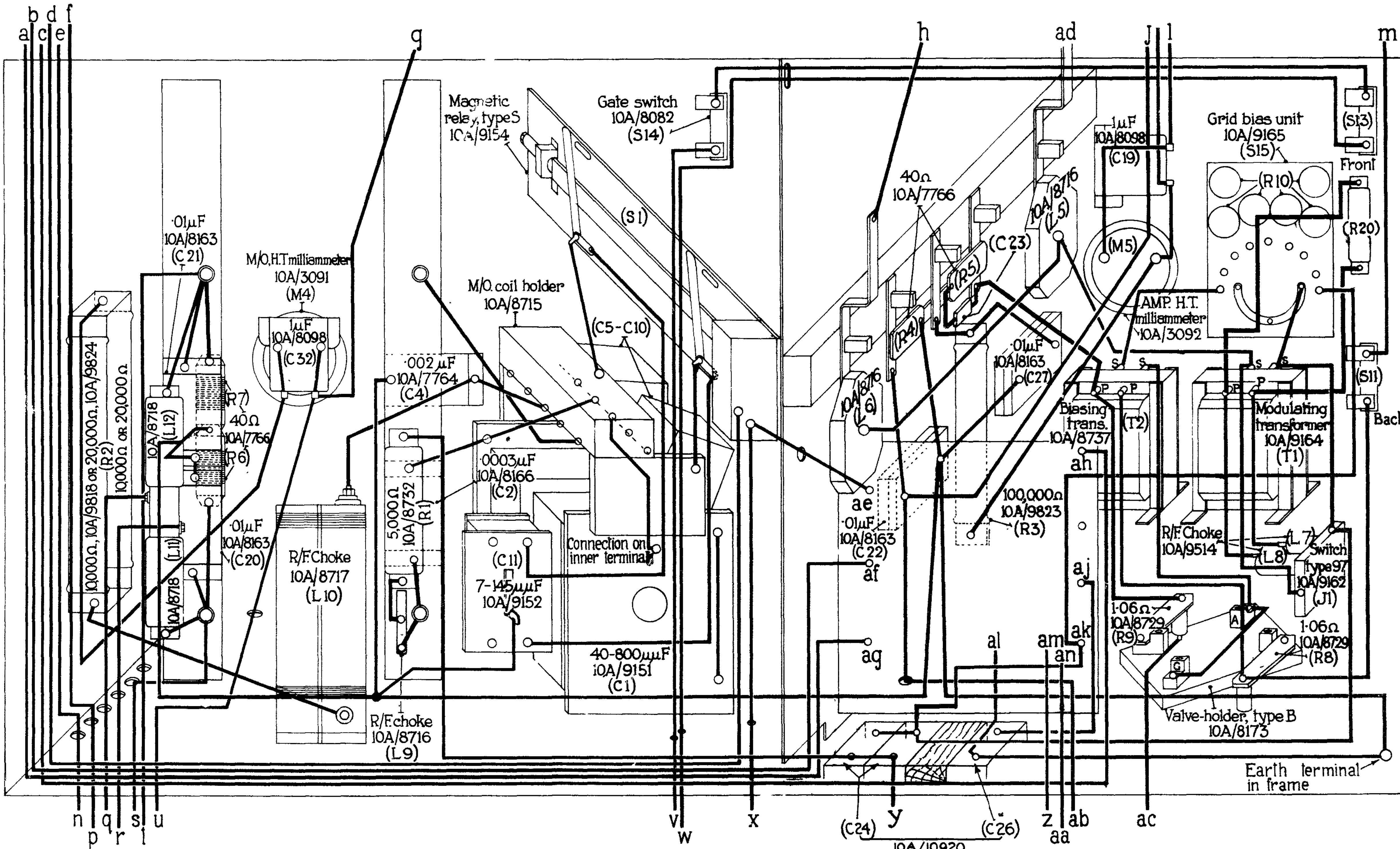


FIG. 9. Interior view of middle section from the rear.

33. Referring to fig. 11, which is an interior view of the transmitter from the right-hand side the filament equalizing unit for the M/O valve can be seen in the foreground. It consists of the two 0·01 μF condensers (1) and the two 40-ohm resistances (2). Mounted near the condensers are two chokes (3) which are connected, one in each leg of the M/O filament circuit. They serve, in conjunction with the by-pass condensers of the filament equalizing unit, to prevent H/F feed-back from the M/O valve. The space-tuning condenser (4) is mounted below the neon lamp (5). The M/O, H.T. milliammeter (6) shunted by the 1 μF condenser (7) may be seen on the left.

34. In the upper portion of the illustration may be seen the aerial tuning condenser (8), aerial ammeter (9) and the relay (10); this relay is represented by S_2 in fig. 2. The three 50 $\mu\mu$F condensers (11) and the three 50 $\mu\mu$F condensers (12) form the condensers C_{16} and C_{17} represented in fig. 2. They are mounted on the switch (13), the blade of which can just be seen. The three aerial terminals (14), (15) and (16) seen above the transmitter correspond to the terminals 12, 13 and 14 respectively in fig. 2.



NOTE: Annotations in parenthesis, for example (C 24), refer to the corresponding annotations in Fig. 2

FIG. 10. WIRING DIAGRAM - MIDDLE SECTION

(F.1799). Wt. 9053. 4,250. 5/43. Gp.959. FOSH & CROSS LTD.

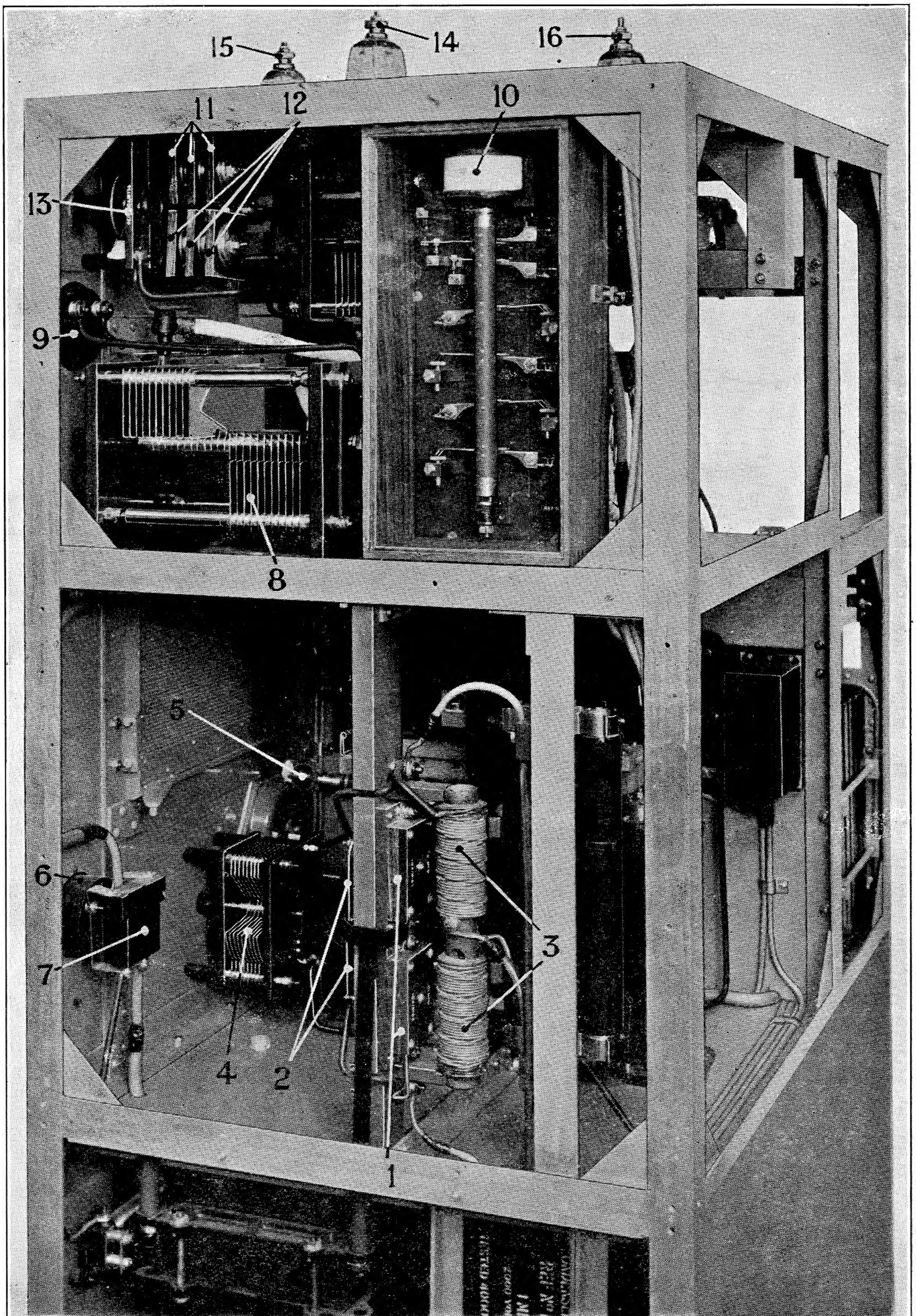


Fig. 11. Interior view of middle section, right-hand side.

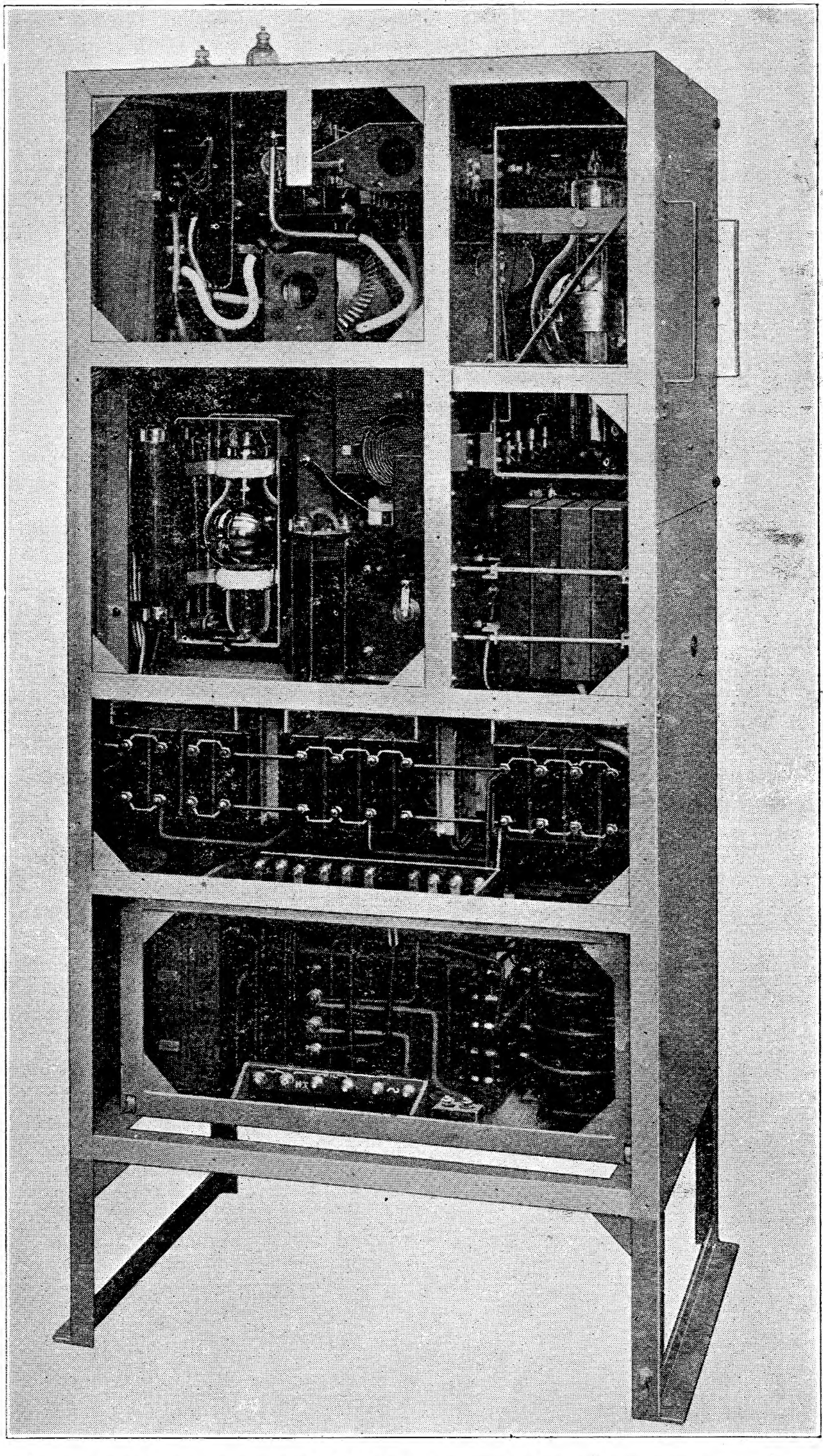
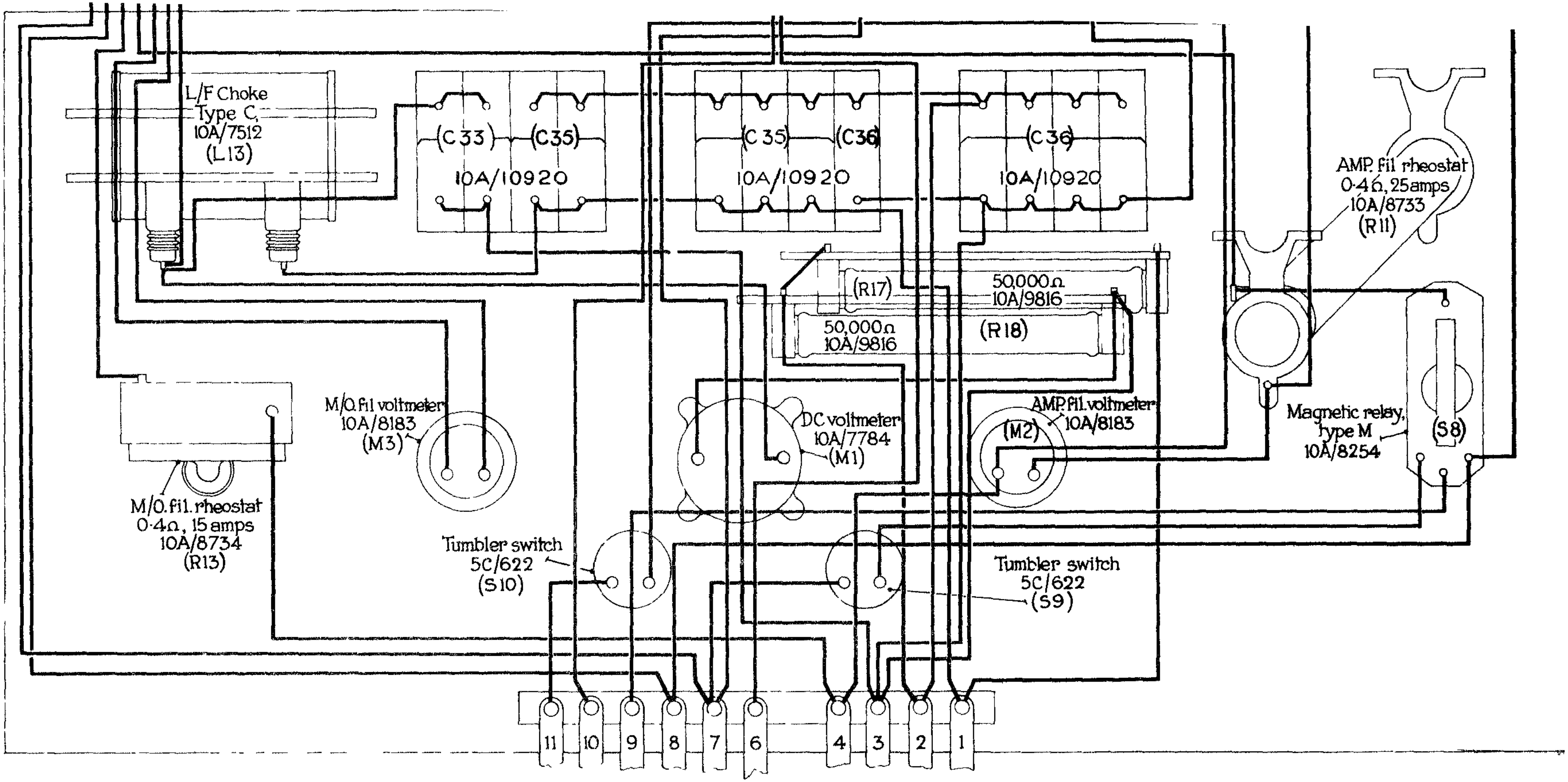


FIG. 12. Rear view of T.1087 with some of the panels removed.



NOTE : Annotations in parenthesis, for example (R 13), refer to the corresponding annotations in Fig. 2

FIG. 13, WIRING DIAGRAM - BOTTOM SECTION

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35. A rear view of the transmitter with some of the panels removed is given in fig. 12. The illustration shows the valves in position and also the condensers and resistances which form the smoothing unit. A bench wiring diagram of this unit is given in fig. 13. The rectifier unit is situated below the smoothing unit. It may be withdrawn from the transmitter when desired, the framework being mounted on rollers, two of which may be seen. The rectifier unit and smoothing unit are described elsewhere in this publication.

Coils

36. In order to cover the whole frequency band of the transmitter, the M/O inductance consists of a set of three coils known as No. 1, No. 2 and No. 3. Coils Nos. 1 and 3 are each provided with a set of six contacts, while coil No. 2 is provided with four sets of six contacts, the four sets being engraved B, C, D and E, the lettering corresponding to the various ranges for which the coil may be used.

37. Each coil is a helix, wound on insulating material stiffening pieces. No. 1 coil consists of six turns of 20 s.w.g. copper tube $\frac{3}{8}$ in. dia. and covers the range 16,666 to 20,000 kc/s, the contacts being engraved A. No. 2 coil is wound with nine turns of 20 s.w.g. copper tubing, $\frac{3}{8}$ in. dia., and covers the range 3,000 to 18,750 kc/s, the four sets of contacts being engraved B, C, D and E. No. 3 coil covers the range 1,500 to 3,000 kc/s and is wound with sixteen turns of 20 s.w.g. copper tube, $\frac{1}{4}$ in. dia., the contacts being engraved F.

38. The terminal strip (29, fig. 1) is provided with a set of " C " contacts with which the blade contacts on the M/O coils engage. Access to this terminal strip is obtained through the front door of the transmitter. The right-hand strip is engraved with three lines A–B, C–D and E–F. To insert a coil, first slacken back the thumb-screw, insert the coil in the appropriate set of contacts, i.e. if the No. 2 coil is being used in position D, then the blades engraved D must be inserted in the contacts opposite the line engraved C–D. See that the coil is upright and tighten up the thumb-screw again. When inserting or withdrawing the coil, care should be taken to see that the spacing pieces are not damaged. Always insert or withdraw the coil in a vertical direction and avoid sideways movement.

39. A special stowage case has been provided for the three M/O coils and their associated resistances. The case and coils are illustrated in fig. 14. When the coils are stowed, No. 1 coil is placed over the support (1) so that the stiffening members (2) lie in the grooves of the support. The coil No. 2 goes over the support (3), the same remarks applying to the stiffening members (4). This is arranged so that the blade contacts will not be damaged. Coil No. 3 is inserted in the space (5) with the blade contacts near the panel (6). On the front of the No. 3 coil instructions are engraved stating which resistances should be used. The two resistances (7), when not in use are clipped into the lid of the case.

40. The amplifier inductance, which is a non-interchangeable unit, consists of five separate coils wound with $\frac{1}{4}$ in. dia. 20 s.w.g. copper tube. All five coils are mounted on a suitable support and form one long coil. The arrangement is as follows. A coil of nine turns is followed by one of two turns, then one of eight turns, then one of two turns and lastly one of nine turns giving thirty turns all told.

41. Twenty-six tapping points are brought out to knife contacts which engage with " C " contacts as desired. Looking at the coil from the front of the transmitter there are sixteen knife contacts on the left engraved H, G, F, E, D, C, B, A, A, B, C, D, E, F, G and H. On the right there are ten contacts engraved N, M, L, K, J, J, K, L, M and N. The contacts on the left are the anode taps, and those on the right are the closed circuit taps. H.T.+ is fed to the centre of the eight-turn coil.

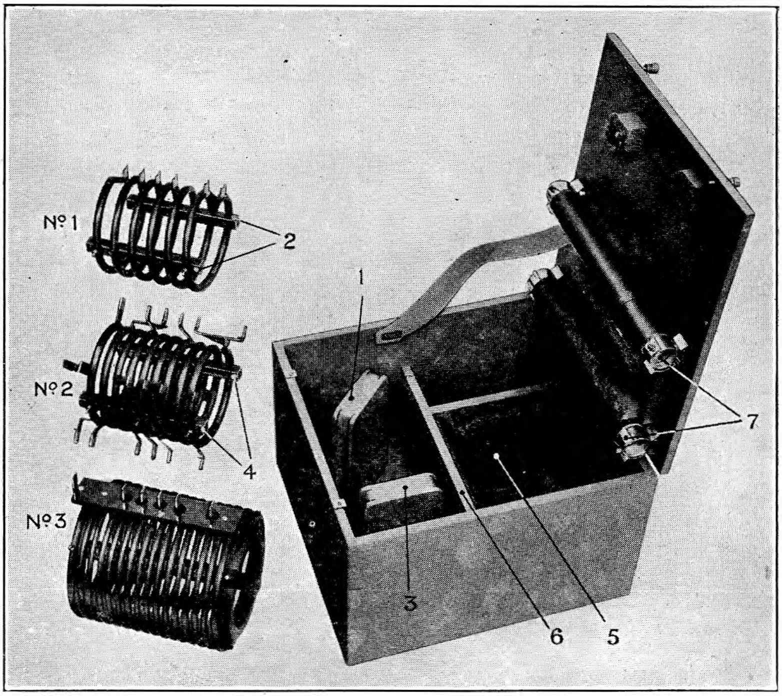


FIG. 14. Master-oscillator coils and case.

42. The auto-transformer output coil is wound with 30 turns of $\frac{3}{16}$ in. dia. 20 s.w.g. copper tube and every turn is tapped. A system of colouring and lettering is employed in order to facilitate connecting up. The taps are brought out to plugs with which sockets may be engaged. Viewing the coil from the front of the transmitter, on the right there are fourteen plugs on white bases, with the letters P to A engraved in black, followed by fourteen plugs on black bases with the letters A to O engraved in white. The sockets (Nos. 3 and 4, fig. 7) can be engaged with any of the white base or black base plugs respectively. On the left-hand side of the coil there are fifteen plugs with red bases engraved with the letters Q to A in white, followed by 15 plugs with yellow bases and the letters A to Q engraved in black. The sockets numbered 1 and 2 (fig. 7) may be engaged with the red and yellow base plugs respectively. One further plug on a green base with the letter X engraved in red is positioned at the centre of the coil.

43. The sockets 1 and 2 are the input sockets and the sockets 3 and 4 the output sockets, when transmission lines are being used. The socket number 5 is used when the usual aerial system is employed. The tables at the end of this chapter show where the various sockets, should be engaged for the various frequencies desired (*see* also para. 77).

VALVES AND POWER SUPPLIES

44. Four valves are used in the T.1087, one as a master-oscillator, two valves in push-pull as the amplifiers and one as a rectifier to supply the grid-bias for the amplifiers. The mercury vapour valves used in the rectifier unit form part of this unit which is described elsewhere. The anode and filament voltages for the four valves in the transmitter are obtained from the rectifier unit.

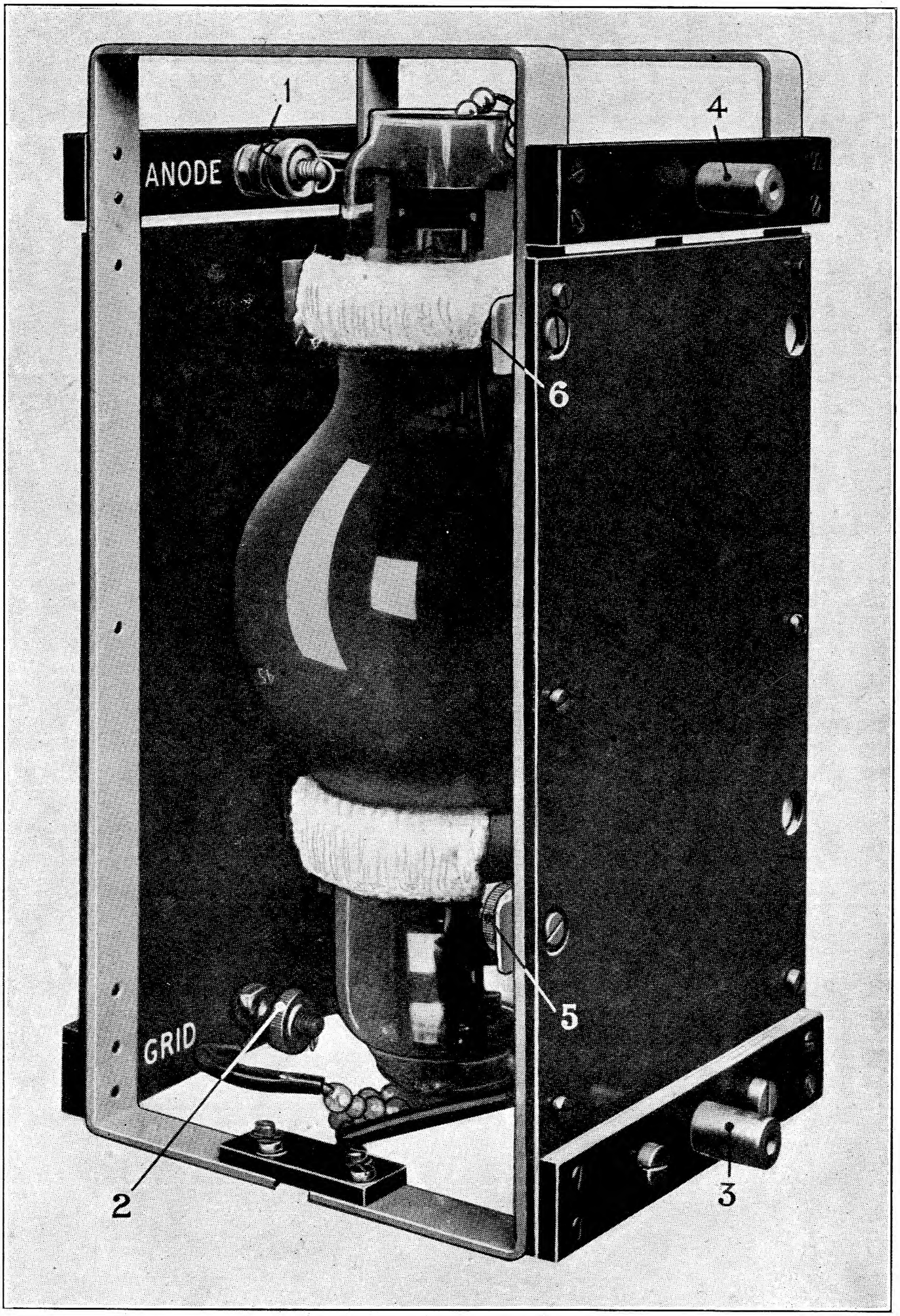


FIG. 15. Master-oscillator valve and valve-holder.

45. The master-oscillator is a valve, type V.T.30, mounted in a special valve-holder. The valve-holder is removable and consists of a box-like structure formed by two strips of metal bent to form a rectangle and provided with two sides. Fig. 15 shows the manner in which the valve is mounted in its holder. Four terminals of the thumb-screw type are provided by means of which the valve is connected in circuit. The anode terminal (1) is on the left, the grid terminal (2) is beneath and the two filament terminals are mounted near each other on the right. The terminals are connected to four cylindrical metal connecting pieces, two of which (3) and (4) may be seen on the right. These two are connected to the valve filament terminals by metal strips. Two similar connectors are provided for the anode and grid.

46. To insert the valve in position, loosen the thumb-screws (5) and (6) on the two movable clips on the frame and displace the clips sufficiently to enable the valve to be inserted. Replace the clips and tighten the screws. Connect the valve leads to the appropriate terminals, keeping the leads as short as possible. To insert the valve-holder in the transmitter rest the top cylindrical contacts of the frame on the top " C " contacts of the supporting pillars inside the transmitter, access being obtained through the door in the top compartment. Push downwards on the frame until these contacts are well home. Rotate the frame about these contacts until the two bottom cylindrical contacts on the valve-holder engage the two bottom " C " contacts on the supporting pillars and push them well home.

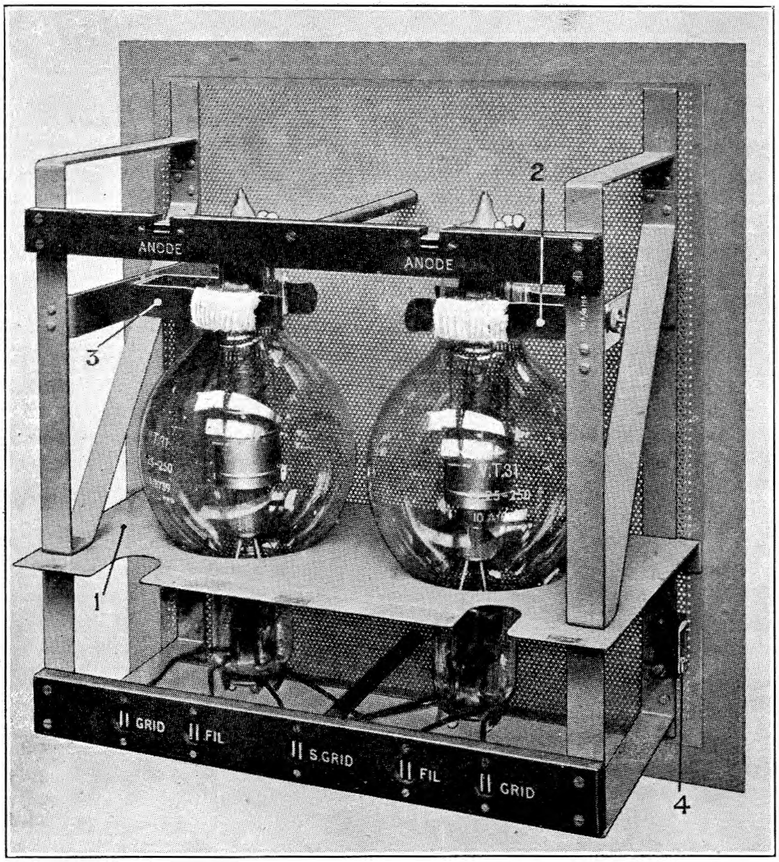
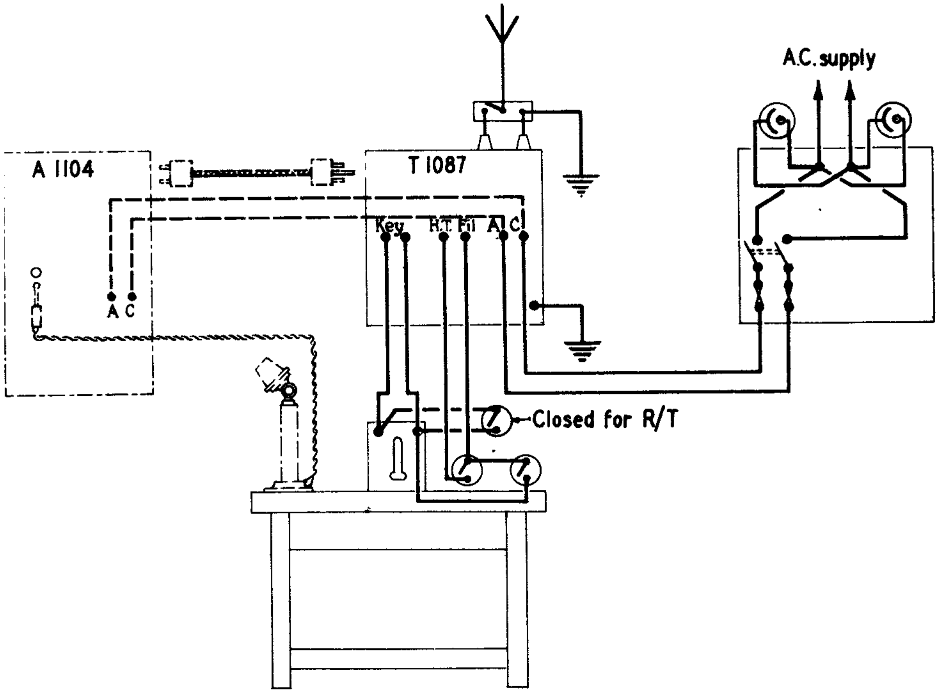
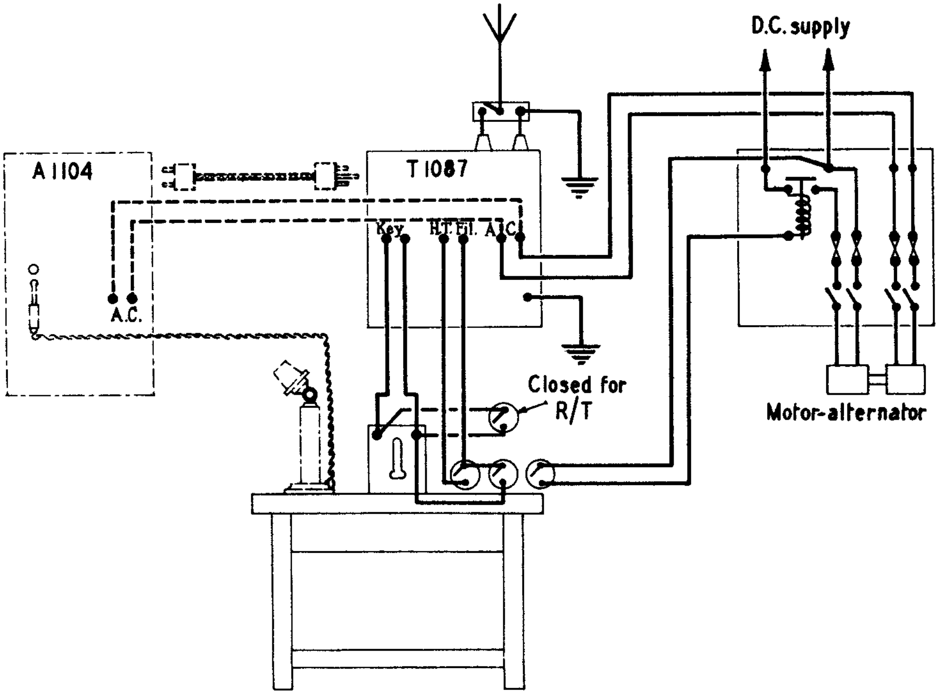


FIG. 16. Amplifier valves mounted on panel.

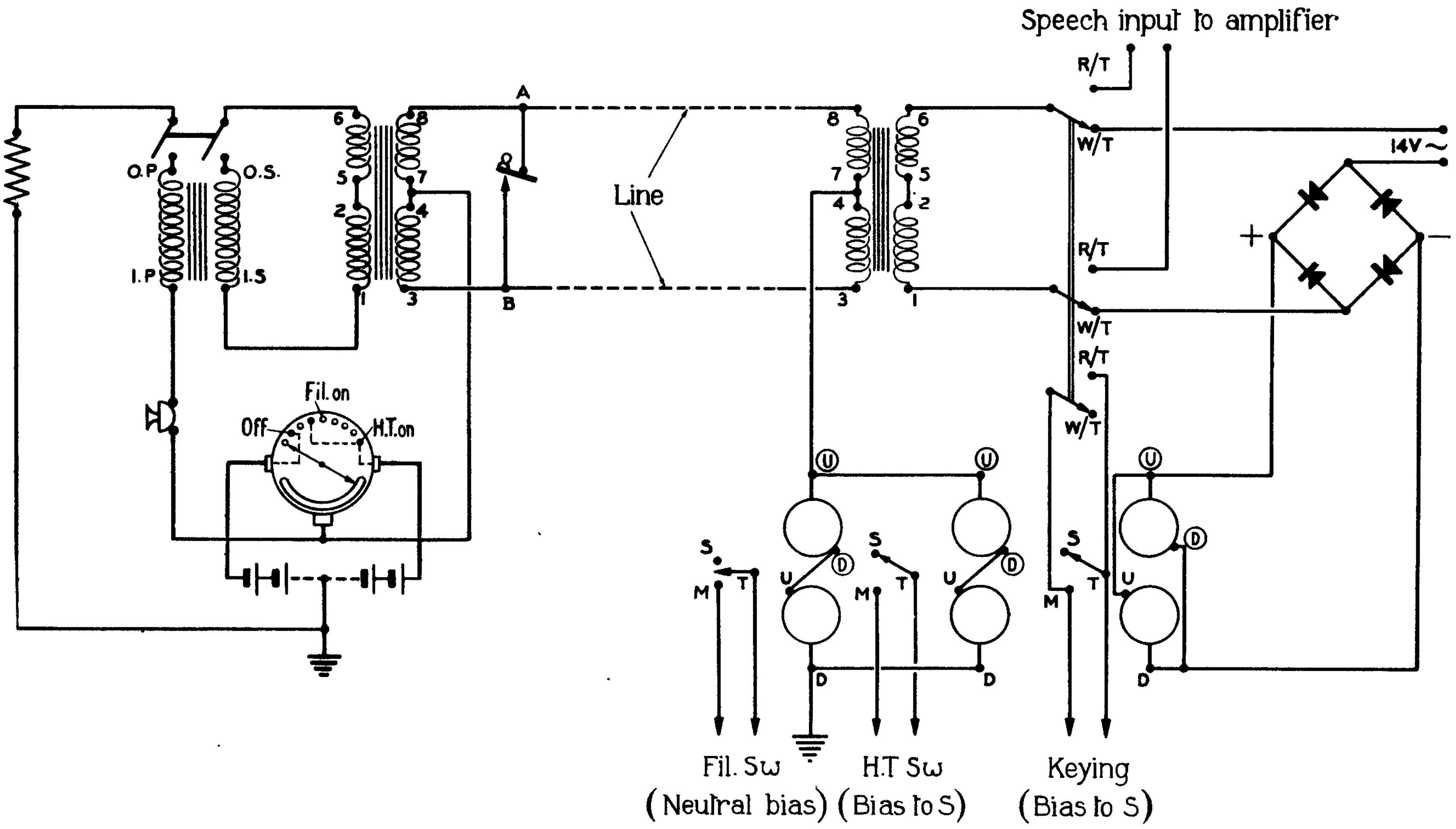


For A.C. supply 230 V. 50~



For D.C. supply

FIG. 17, TYPICAL INSTALLATION FOR LOCAL CONTROL



Operating end

Transmitter end

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FIG. 18. SCHEMATIC OF REMOTE CONTROL

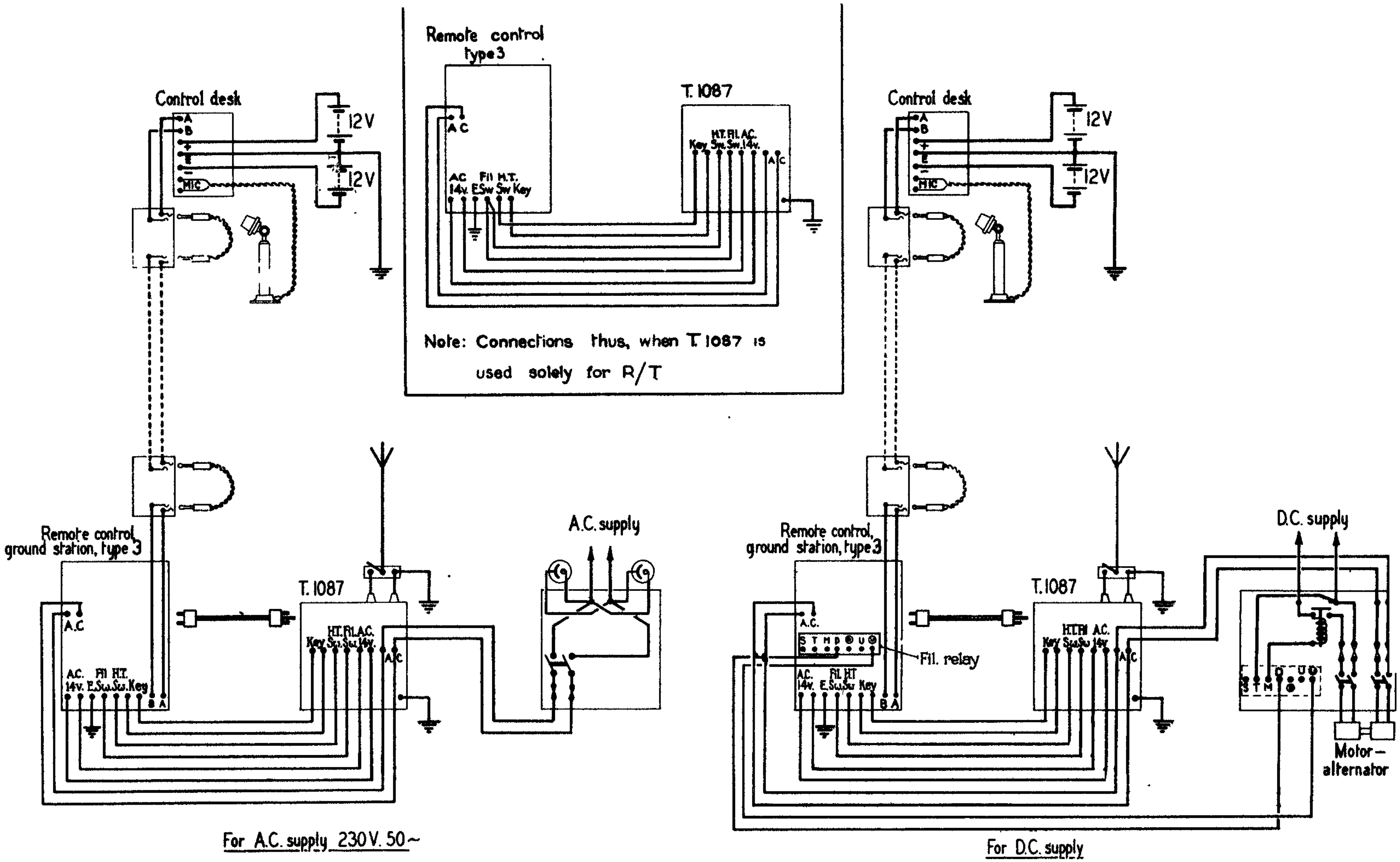

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FIG.19. TYPICAL INSTALLATION FOR REMOTE CONTROL

47. Two V.T.31 valves are used for the amplifiers. The valves are mounted in a removable frame, and the various electrodes are connected to " C " contacts which engage blade contacts on the transmitter when the frame is in position. The frame is secured to a perforated metal panel which is held in position on the transmitter by seven spring clips.

48. Referring to fig. 16, it will be seen that the anodes of the valves are brought out to two " C " contacts supported in a strip of insulating material and appropriately engraved. Since the screen-grids of the valves are connected together, one " C " contact is provided. The remaining four " C " contacts on the bottom strip are self-explanatory.

49. To insert the valves in position, slacken the thumb-screws on the valve clips. Insert the filament ends of the valves through the holes provided in the screening panel (1) and rest them on the pads provided. Place the clips (2) and (3) on the tops of the valves and secure them in position by means of the thumb-screws. Connect the valve leads to the appropriate terminals, keeping the leads as short as possible. Hold the frame by means of the two handles provided and push the panel well home so that the " C " contacts engage properly with the blade contacts on the transmitter. Make sure that the blade contact (4) engages with the " C " contacts (2, fig. 8).

50. The rectifier valve which is a type V.T.25 valve is inserted in an ordinary valve-holder type G, wired up in the usual manner. The filament voltage required for the M/O valve is 12·5 volts, the filament voltage for the amplifiers is 11·25 volts, and for the rectifier valve a filament voltage of 8 volts is required.

INSTALLATION

51. The transmitter can be operated locally or by means of remote controls. When remote operation is required, remote controls, types 2 or 3, are employed. The usual procedure is to operate the transmitter remotely, but should the remote cable break down, or for any reason remote operation become impossible, then the transmitter may be operated locally. For R T or M.C.W., the amplifier portion of remote controls, type 3, is essential. As the remote control unit is always installed near the transmitter, both local and/or remote operation is possible.

With local control

52. A typical diagram for local control is given in fig. 17. Both D.C. and A.C. systems are shown but when D.C. is used, the supply is connected to a motor-alternator to produce A.C. which is used to operate the transmitter. The D.C. mains must not be connected directly to the transmitter else the transformer for the biasing valve will be ruined. The portion shown dotted represents the amplifier A.1104 and its connections. The A.1104 is a portion of remote controls, type 3, and it is essential to this transmitter when R/T or M.C.W. is desired.

With remote control

53. When the transmitter is arranged for remote control, the method of wiring shown in the simplified circuit in fig. 18, will normally be used. In this method one pair of leads between the operating station and the transmitting station is used for each transmitter. Through this pair and an earth connection, the filament and H.T. relays are operated, the transmitter is keyed and R/T modulation is performed. For the latter purpose the pair is connected at each end to one winding of a repeating coil.

54. The relays controlling the filament and H.T. supply to the transmitter are operated by direct current derived from a battery at the operations end of the line. The battery is connected between the centre point of the line winding of the repeating coil at the operations end and earth, and the relays are connected in parallel between the centre point of the line winding of the repeating coil at the transmitter end and earth. The direct current to operate the relays thus divides equally in the two lines and there will be equal currents in opposite directions in the half windings of the repeating coil, and the core will not, therefore, be magnetized.

55. A typical installation for remote controls is shown in fig. 19. The circuit, shown in fig. 18 is incorporated in the controlling desk at the operations end, and a circuit diagram of this apparatus is given in fig. 20. A receiver will normally be fitted up on the same desk.

56. In an installation using a D.C. supply, a further relay with neutral bias, is connected in parallel with the filament relay at the transmitter end to operate the starter of the motor-alternator, as shown in fig. 19. Thus when the switch, type 44, at the operations end is placed in the central position (engraved GEN. RUNNING), the motor-alternator is started. When the switch is used in conjunction with A.C. mains, the engraving should be interpreted as " filaments on ". For a description of and the manner in which Remote Controls should be used, reference should be made to the appropriate section of this publication.

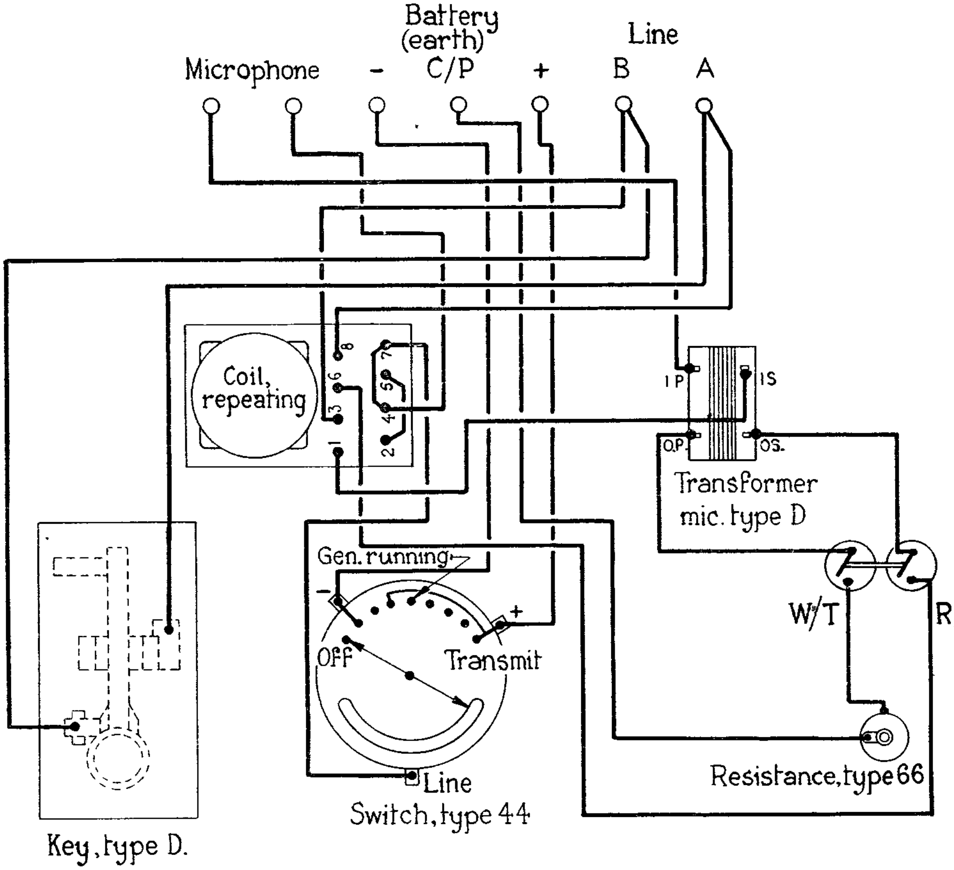


FIG. 20. Circuit diagram of apparatus on Control desk.

OPERATION

Preparation for tuning

57. Before the transmitter is ready for tuning, certain preliminary operations must be performed. Insert the M/O valve as described in para. 46 ; insert the amplifier valves as described in para. 49. Insert the neon lamps—a lamp has to be inserted in each of the positions (3) and (13) (fig. 1). Each lamp screws into a holder incorporating a cylindrical condenser and mounted by its single contact screw. The holder may be removed after loosening the nut on the contact screw, the neon lamp screwed in, and the holder replaced.

58. Insert the biasing rectifier valve in its holder insert the two V.U.29 power rectifying valves in their screwed sockets. Insert the pilot lamp and the fuses in the rectifier panel. There are four of these fuses and each one should carry two strands of 33 s.w.g. tin wire. Make sure that all switches are off, and that bias is on stud 8.

To set up the transmitter for C.W. (Local Control)

59. Connect a 230-V. 50 cycle A.C. supply to the two terminals engraved accordingly at the bottom of the transmitter. Connect the H.T. and filament switch terminals (i.e. the second, third and fourth terminals counting from the left) together by a piece of 16 s.w.g. tinned copper wire. Connect a morse key across the terminals engraved KEY, now close the main A.C. switch, and the pilot lamp in the rectifier should light up.

60. In the following paragraphs all annotational references refer to fig. 1. Close the rectifier filament switch (25) and the delay action referred to in para. 17 starts. Close the transmitter valve filament switch (21), and check the filament voltage on the M/O and Amplifier valves. The M/O filament volts may be read on (18) and should be adjusted by the control (17) to read 12·5 volts. The amplifier filament volts may be read on (23) and should be adjusted by the control (22) to read 11·25 volts.

61. Place the rectifier H.T. switch on stud 1, close the door (27) and switch on the rectifier H.T. by means of the switch (24). The H.T. volts read on (19) should be about 1,900. This is the " no-load " H.T. voltage. When the M/O is switched on to the space-tuning frequency, the voltage will drop to about 1,700 volts.

62. Switch on the key switch (20). This switch is in series with the key which should be up. Switch off H.T. at (24) and tap the key, now insert the appropriate M/O coil, set the various tappings, and adjust the controls by reference to the Tables. Close the rectifier H.T. switch (24) and, after the necessary time delay has occurred, the relays in the transmitter will operate to transfer the M/O circuit to the space-tuning frequency as described in para. 19 *et seq.* The neon lamp (13) should now glow and a reading of approximately 100 mA should be obtained on the M/O H.T. milliammeter (9). The master-oscillator should now be oscillating on the space-tuning frequency, which should be adjusted by the control (10) so as to give a frequency which will not cause local interference.

63. The amplifier stage will now have to be tuned. Off-set the neutralizing condenser to 0° or 180°, set the grid-bias to stud 8. Next the key should be locked in the down position which results in the M/O circuit being transferred immediately to the frequency at which radiation is desired. The neon lamp (3) should glow, due to a transference of R/F volts from the M/O *via* the condensers C_{5-10} (fig. 2), indicating that the amplifier is tuned to the M/O frequency but un-neutralized.

64. It will then be necessary to neutralize the amplifier. The correct neutralizing position may be obtained in the following manner. Assume that (5) is set at 180° as described in the previous paragraph. Rotate the control (4) until the lamp (3) goes out and note the reading on (5), say 110°. Carry on rotating (4) until 0° is reached when (3) will be glowing again. Now rotate (4) in the opposite direction and note the reading of (5) when the lamp (3) goes out again, say 70°. Then the correct neutralizing position is mid-way between 70° and 110°, which is 90°. Set (5) to this figure and the amplifier is now correctly tuned, neutralized and ready for operation.

65. The bias may now be reduced with safety to position O, and the input shown on the milliammeter (14) should be of the order of 170 mA with the H.T. on stud 1. The aerial ammeter should also show some reading. Finally the aerial should be tuned in conjunction with the amplifiers to give maximum output. Although the transmitter will now radiate C.W., it is not necessarily operating at its maximum efficiency. In order to obtain this condition it will be necessary to proceed as set out in paras. 77 *et seq.*

66. The frequency should be checked at this stage and the transmitter adjusted if necessary. The wavemeter W.1081 may be used for any frequency within its range, or wavemeter W.39 or W.39A may be used with harmonics. The frequency of the master-oscillator should be adjusted by means of the fine tuning knob (4), exactly to what is required. One complete turn of this knob corresponds to approximately two divisions of the main condenser. For the use of Crystal Monitor, type 1 (*see* paras. 90 *et seq.*).

To set up the transmitter for R/T or M.C.W. (Local Control)

67. For local R/T or M.C.W. a portion of Remote Controls, type 3, will have to be used. The necessary portions are Panel, Amplifier, (Stores Ref. 10A/9589) and Panel, Local Control, (Stores Ref. 10A/9590). Although Panel, Remote Control, type A (Stores Ref. 10A/9588) is part of Remote Controls, type 3, it is not essential for this purpose. Panel, amplifier is connected to the transmitter by a screened flexible cable terminating at each end in a three-pin plug. One plug is inserted in the output socket of A.1104 and the other plug is inserted in the socket (6, fig. 8) on the side of the transmitter. See that the oscillator panel and amplifier panel are connected together by the double-ended telephone plug lead on the side of the unit, and by means of the double-ended six-pole plug and lead at the back of the unit. The A.C. mains from the transmitter are connected to the terminals engraved A.C. MAINS on the remote control unit. A microphone is plugged into the appropriate socket on the local control panel. The terminals at the back of the transmitter remain connected as for local C.W.

R/T (Local control)

68. The transmitter is set up and tuned in exactly the same manner as for local C.W., except that the bias for the transmitter amplifier valves will require some further adjustment. To do this the reading of the aerial ammeter (30) should be noted and the amplifier bias switch should then be adjusted to the setting which will reduce the aerial current by approximately 50 per cent. This is the best setting for R/T. If the aerial current is too small to allow of accurate tuning, a thermo-ammeter (0 to 2·5 amp.) should be connected in series with the aerial.

69. Now switch on the A.C. switch on the amplifier panel and move the selector switch on the local control panel to the " local microphone " position. Speech may now be radiated, but the volume control on the remote control unit will have to be adjusted to give the necessary " audio volts " in order to modulate the transmitter. The best position for audio volts is a combined setting of the attenuator and volume controls, such that the reading of the milli-ammeter on the amplifier panel remains at about 120 mA without excessive fluctuation when speech is radiated. As an indication of the percentage modulation, an increase of $22\frac{1}{2}$ per cent. in the steady aerial current represents a modulation of 100 per cent.

M.C.W. (Local Control)

70. Set up and tune the transmitter as before, and set the bias as for R/T. Place the selector switch on the local control panel to the " oscillator position ", and connect the oscillator panel to the amplifier panel by means of the screening cable terminating at each end in a telephone plug. Adjust the volume control and attenuator to give the necessary audio volts for correct modulation and then key.

To set up the transmitter for C.W. (Remote Control)

71. For any remote control operation with this transmitter, Remote Controls, type 3 or type 2, may be used. The 230-V. 50 cycle A.C. mains should be connected to the A.C. terminals on the transmitter, and also to the left-hand pair of terminals on the upper terminal strip on the Remote Control unit. Connect the key, filament switch, and H.T. switch terminals on the transmitter to the corresponding terminals on the Remote Controls. Care should be taken to ensure that the correct key terminals are connected up. One key terminal on the transmitter is common to H.T. switch and filament switch and this terminal should be connected to the corresponding one of the Remote Control unit. Connect the 14-V. terminals on the transmitter

to the 14-V. terminals on the R/C unit. Units have been instructed to modify the T.1087 to incorporate these 14-V. terminals which should be connected to the terminals engraved 0 and 14 on the filament transformer in the transmitter rectifier unit (*see* figs. 2 and 12). The incoming lines A and B from the operations block must be connected to the terminals A and B on the R/C unit. The terminal engraved E should be connected to the transmitter earth.

72. It will now be possible to operate the transmitter both locally and remotely. For remote operation, however, it is first necessary to set up and tune the transmitter locally. The two filament, key and H.T. switches on the transmitter are put on. The transmitter may now be set up and tuned, using the switches and key on the R/C unit for the necessary operations, the procedure being exactly the same as for local C.W. When the transmitter has been set up and tuned all the switches, both on the transmitter and on the R/C unit are left on, with the exception of the H.T. switch on the R/C unit, because it is desirable, when using this transmitter, that the filaments should be left on continually. The ganged switches on the R/C unit are put to W/T and the transmitter may then be operated remotely on C.W., all the necessary switching and keying being done at the operations end.

To set up the transmitter for M.C.W. (Remote Control)

73. The transmitter and R/C unit are connected up as before and the transmitter is set up and tuned in the same manner as for remote C.W. Before M.C.W. can be radiated however, the amplifier portion of the R/C unit must be connected to the transmitter. The ganged switches must be in the W/T position, and the selector switch must be set to the " oscillator " position. The volume control must be adjusted as for local M.C.W.

To set up the transmitter for R/T (Remote Control)

74. In this case the connections between the R/C unit and the transmitter are somewhat different. Since the ganged switches on the R/C unit short-circuit the key in the R/T position, the M/O never transfers to the space-tuning frequency, because in effect the key is never up. To overcome this difficulty the transmitter should be connected up in the manner shown in the insert on fig. 19. Close the filament and H.T. switches on the transmitter. Set up and tune the transmitter as for local R/T using the filament and H.T. switches on the R/C unit as desired.

75. When the transmitter is ready, plug in the screened cable, into the socket (6, fig. 8) and also into the R/C unit, switch on the A.C. switch on the amplifier panel, place the ganged switches in the R/T position, and the selector switch in the " Local microphone " position, plug in the local microphone, and adjust the volume control on the amplifier panel for normal speech at the transmitter; bias adjustment will be the same as for local R/T. Leave all switches on except the H.T. switch on the R/C unit. Owing to the resistance of the lines A and B and the consequent loss of speech input to the R/C unit, it may be necessary to make a further adjustment to the volume control when remote R/T is being used.

76. After the transmitter has been set up and adjusted satisfactorily by the local operator (bias adjustment and volume control), the selector switch should be moved to the " 600 ohm input " position. The remote operator should now speak into his microphone while the operator at the transmitter end should watch the milliammeter and adjust the volume control in order to give the necessary audio volts. This further adjustment is not necessary on remote M.C.W., since the oscillations are generated at the transmitter end and are therefore not influenced by the extra resistance of the lines A and B as in the case of remote R/T.

Method of improving transmitter output

77. It should be borne in mind, that if the transmitter has been set up to the Tables, the most favourable operating conditions may not necessarily be obtained. The transmitter will, however, radiate and may be used on these settings. When time permits, units should ascertain for themselves which settings give the best performance and they should make a note of these settings for future reference. The tables are merely given as a guide, and are correct for a particular transmitter, but since transmitters may vary slightly depending upon the source of manufacture and varying impedance of the aerial system, the figures may not apply to every transmitter

for the most efficient operation. In the following paragraphs a method is given of the manner in which a transmitter should be set up, first to the Tables and then adjusted if necessary to improve the output.

78. The reason for the difference between the settings shown in the Tables and those which may be obtained on a T.1087 in Service is due to the following points. The figures and settings shown in the Tables were obtained on a particular transmitter using the correct aerial, namely a 54 ft. 6 in. wire cage outside the building and 5 ft. of lead-in to the aerial terminal. The earth system used was a good radial earth with short connections to the transmitter and there were no other aerial systems in the vicinity.

79. The valve impedance of the two V.T.31 output valves used in the transmitter is of the order of 4,000 ohms and the impedance of a good aerial-earth system as set out in the previous paragraph is approximately 70 ohms. It should be noted here that any alteration in the total length of aerial, or the resistance of the "earth" due to corrosion or dry ground, etc., or the proximity of other aerial systems or power absorbing objects, or the alteration to the height of the aerial will seriously alter the impedance of the aerial circuit. In order to provide for slight variations in these impedances, the output transformer is provided with several tapping points. The combination that should be used will depend on the particular installation. It will be seen therefore, that, unless the conditions are identical with those stated above, the settings, in practice, will differ from those given in the Tables.

80. The following method of improving the transmitter output matching is given as a guide only, and Units should adopt a similar method to obtain the best matching conditions. The result to be aimed at is an increased working efficiency of the transmitter, i.e. the ratio between the output watts and the input watts expressed as a percentage. The output watts are C^2R, where C is the aerial current and R is the resistance of the aerial-earth circuit, the input watts being the product of the amplifier D.C. volts and D.C. milliamps.

81. The output transformer is provided with several tapping points and four plugs are provided to engage these points. When making these adjustments to obtain maximum efficiency, it is desirable to move the plugs one at a time so that any increase or decrease of efficiency may be observed. If two or more plugs are moved at the same time, it will not be clear which one is responsible for the increase or decrease as the case may be.

82. Insert a small 0 to 2·5 amp. thermo-ammeter between the aerial lead-in and the aerial terminal of the transmitter. Before making any alteration inside the transmitter, make a note of the amplifier D.C. volts, D.C. milliamps. and the R/F aerial current. Then, being careful to switch off the H.T. before opening the transmitter, move plug No. 1 one tap either backwards or forwards. It is important to remember in which direction the move has been made. Now switch on the H.T. and re-tune the amplifier for maximum output. The series aerial tuning condenser must be mentioned at this stage as it plays an important part in the tuning of the T.1087. The aerial circuit of this transmitter is fairly tightly coupled to the amplifier circuit, therefore any change of amplifier tuning may affect the aerial tuning. It is therefore desirable that the amplifier tuning condenser and the aerial tuning condenser should be adjusted *together* in order to give maximum aerial output.

83. Having moved plug 1 and re-tuned, it may be noticed that the input milliamps. have decreased while the R/F output has remained the same or even increased. This indicates a definite increase in efficiency and furthermore that the plug has been moved in the right direction. Now move plug No. 2 in a similar manner. The direction in which it should be moved is important. If plug No. 1 has been moved towards the centre of the coil, then plug No. 2 should be moved towards the centre of the coil. Continue moving plugs Nos. 1 and 2 until a position is found where the output efficiency is a maximum. Now leaving plugs 1 and 2 in their new positions, move plugs 3 and 5 separately till the maximum output efficiency is obtained. A further adjustment may be made at this stage. Move plugs 1 and 2 *together* either backwards or forwards, moving each plug the same number of turns and, after finding the best position, move plugs 3 and 5 *together* in a similar manner.

84. The point to bear in mind, while moving these plugs is that a balance is to be aimed at between the two V.T.31 valves. The amplifier stage is a push-pull circuit which has been designed for mechanical and electrical symmetry. Therefore, if an unbalanced aerial circuit is coupled to the amplifier stage, the symmetry is upset and it may be possible for one V.T.31 valve to be overrun. This overrunning may be indicated by the anode of the valve heating up and glowing red. This unbalance can come about as the result of the position of plugs 1, 2, 3 and 5, and it is therefore necessary when making adjustments to these plugs, to observe the effect on the valve anodes and to endeavour to keep them as nearly equal in colour as possible.

85. If the power radiated in these circumstances is adequate, there is no necessity to increase the H.T. tap. Stud 2 or 3 need only be used where greater range is desired, or where the signal to noise ratio may be improved, as for example overcoming local interference. To change the H.T. stud, switch off H.T., set the bias back to 8, move the H.T. switch to stud 2 or 3, switch on H.T. and then reduce bias to 0. It may be necessary to re-tune the amplifier and aerial slightly to give maximum aerial current reading. It may also be necessary to re-adjust the filament volts on the master-oscillator and amplifier: controls (18) and (23) respectively. A check on the frequency is again necessary.

86. Although this tap-changing may appear laborious, it is only necessary to do it once for the frequency or frequencies on which the transmitter is likely to operate. Once the correct settings have been obtained they should be noted, and the transmitter set up when desired to these settings and not to those of the Tables for the same frequency. If it is necessary at any time to set the transmitter to a frequency for which no tap-changing settings have been previously obtained, then the Tables should be followed. When time permits units should endeavour to obtain for themselves the settings which will give the best results for the new frequency.

Rapid tuning between 4·3 and 6·0 Mc/s

87. When rapid changes of frequency are required between 4·3 and 6·0 Mc/s, it will generally be inconvenient to make all the adjustments referred to in the preceding paragraphs. By sacrificing a little output the essential changes may be reduced to a maximum of five. With practice it is possible to change to any frequency, for which the adjustments are known, in about 15 seconds.

88. Table 5 shows typical sets of adjustments for five frequencies between 4·3 and 6·0 Mc/s. A similar table should be prepared for each transmitter for the particular frequencies on which it will be worked, and should be prominently displayed near the transmitter.

89. It will be noticed that the occasions on which it is necessary to switch off the H.T. in order to make adjustments inside the transmitter are limited. The amplifier bias tap, stud 4, is such that the frequency may be safely changed without altering either the bias tap or the H.T. tap which may be left on stud 2 whilst tuning. The aerial current, i.e. the unmodulated carrier, should not be less than 1·9 amp. for each frequency adjustment.

Crystal monitor

90. In order that a rapid and correct check can be made on the frequency radiated by the transmitter, a Crystal Monitor (Stores Ref. 10A/10941) has been developed. The monitor is provided with a set of six crystals which will give six spot frequencies. It will be necessary to calibrate the crystal monitor before making a check on the frequency and the following procedure must be adopted :—

Calibration

91. Place the crystal monitor near the transmitter and ensure that the mains switch on the front panel is off. Remove the perforated back cover and insert crystals corresponding to the frequencies required in the crystal-holder. Ascertain the position of the arrow head on the selector switch corresponding to the selected crystal positions and make a mark to provide a reference to these points. Replace the back cover. Connect the loud speaker to the two-pole socket on the side of the monitor and connect the A.C. mains plug to the two-pole socket on the back of the power source unit.

92. Set the selector switch to the desired frequency, and switch on the mains switch control. Adjust the master-oscillator control of the transmitter until an audible note is produced in the monitor loud-speaker. Adjust the capacitance of the condenser associated with the particular crystal until the note reaches a maximum. A small screwdriver may be used for this purpose, but it should be noted that the potentiometer control should also be adjusted during the operation to suit the relative position of the monitor and transmitter.

93. Adjust the various component controls on the transmitter to arrive at the frequency settings corresponding to the selected crystal in the monitor. The attainment of this frequency will be indicated by the " Dead Space " of the beat note produced in the loud speaker. Make a note of the transmitter settings corresponding to this particular frequency in tabular form. Repeat the transmitter settings for each of the selected crystal positions of the monitor. After the adjustments have been completed, two sets of readings will be available, one for the settings of the transmitter controls, and one for the corresponding positions of the selector switch on the monitor.

Frequency monitoring

94. In order to monitor the frequency radiated by the transmitter, switch on the crystal monitor, set the selector switch on the monitor to the position for the desired frequency and, if necessary, adjust the transmitter controls to the " Dead Space " of the beat note produced in the loud speaker.

Frequency changing

95. In order to effect a rapid change of frequency, switch on the crystal monitor, set the selector switch to the position corresponding to the desired frequency, and set the transmitter controls in accordance with the tables produced in the initial calibration as described in para. 92. Adjust the tuning of the transmitter to the " Dead Space " of the beat note produced in the loud speaker. With practice, a change of frequency can be effected in less than one minute, even in the extreme case where the number of adjustments to be made is a maximum.

96. It should be noted that a seventh or off position is provided on the selector switch. Hence by leaving the mains switch in the on position and placing the selector switch in the off position, the crystal monitor may be left in a virtually inactive state ready for instant use by adjustment of the selector switch. It should also be noted that as no engraving has been provided for the mains switch, the signal lamp should be observed to ensure that the power supply is disconnected when not required. If a crystal monitor is not available, a wavemeter, type W.39A, modified for crystal control may be set up and used as described in the chapter dealing with this wavemeter.

PRECAUTIONS AND MAINTENANCE

97. Before commencing to use the transmitter see that all external leads are correctly connected. Check over the leads (where used) from the valves to the valve-holders. See that the various taps are in the correct position. Check the link connections between the rectifier unit and the transmitter. The link connections should make good contact and the nuts on both inside and outside of the insulating bars should be tightened with a spanner. The conductor connecting the frame of the transmitter to earth should be as short as possible. Finally, check over the connections on the terminals at the base of the rectifier unit and the connections between the transmitter and the remote control unit, depending on which system is being used.

98. Switch off the H.T. before making any changes which necessitate opening the doors of the transmitter. Do not rely wholly on the safety door switches. These switches only isolate the power supply but a number of condensers of large capacitance exist in various circuits and these take a few seconds to discharge. A period of about 15 to 20 seconds should be allowed to elapse before making any adjustments inside the transmitter after opening the doors. On M.C.W. or C.W. the condensers may be discharged by tapping the key. See that the main switch is off before unscrewing any of the side or back panels.

99. See that the adjustment of the contacts of the H.T. switch (S_{17}, fig. 2) is such that the contacts in the primary circuit of the transformer, i.e. the lower contacts, close before the contacts which short-circuit the 1,000-ohm resistance, i.e. the upper contacts. Care must be taken to ensure that the lower contacts are not set so far in advance of the upper contacts that the operating force of the relay is insufficient to close the latter.

100. Always switch on the filament supply first and then the H.T. supply. When shutting down, the procedure should be reversed; H.T. first and then the filaments. The transmitter filament and H.T. supplies should be switched on for ten minutes or so before the commencement of routine transmission. In the case of this transmitter it is advisable to leave the filaments switched on during pauses in transmission in order to minimize the possibility of frequency creep as the master-oscillator warms up. This may be accomplished by leaving the local filament switch on the type 3 remote control unit in the on position.

101. The valves used in the rectifier are two type V.U.29 valves. These valves are of the mercury vapour type, and whenever there is any possibility of the mercury having come in contact with the filaments, the filament circuit should be switched on for at least 10 minutes before the H.T. is switched on, or the valves may be seriously damaged. These remarks apply in any instance where a valve is moved or where the complete rectifier panel has been moved and has been subjected to inversion or heavy vibration.

102. It is very important that the A.C. mains voltage at the transmitter terminals does not drop below 230 volts or several transformers in the transmitter will be affected. The filament supply for the V.U.29 valves in the rectifier should never drop below 4 volts, or the life of the valves will be impaired. The filament transformer in the rectifier has a tapped secondary-winding giving 14 volts and 20 volts A.C. The 14 volt A.C. is reduced to 12·5 volts for the M/O and 11·25 volts for the amplifier valves and the bias rectifying valve, rheostats being employed for this purpose.

103. The 20-volt tapping supplies the three metal rectifiers for operating the relays. One rectifier provides the D.C. voltage for operating the delay relays in the rectifier, the other two are connected in parallel and provide the D.C. voltage for operating the relays in the transmitter. Since the D.C. output from the rectifiers depends on the A.C. input, which in turn depends on the input of the filament transformer, the necessity for keeping the mains at 230 will be appreciated.

104. After the transmitter has been in use some time, the neon lamp (3, fig. 1) may become "hard" owing to ageing, which will be indicated by a blackening of the glass. In these circumstances the lamp may not strike up when the amplifiers are near tune because a greater voltage is required to strike the neon. If, when following the normal tuning procedure the lamp fails to light, reduce the bias until the amplifiers are taking some anode current. This should not exceed 100 mA with the amplifiers off tune. The lamp should strike up, and if the amplifier stage is tuned in the normal manner, the lamp will glow at its brightest at the tune position. Now set the bias back to 8 and the lamp should remain alight. Proceed with neutralizing. If during neutralizing, the lamp fails to strike again when the condenser control is moved in the opposite direction, reduce the bias till the lamp strikes, then move the bias back to 8 and carry on with neutralizing. If however the lamp fails to strike at all in these circumstances it is probably defective and should be replaced. Before finally deciding on the lamp, however, make a careful check on the transmitter and ensure that the coil sittings are correct, and that the relay S_1, fig. 2 has operated to transfer the M/O to the amplifier.

105. Some cases of failure have occurred of the condenser connected across the keying relay (C_{26}, fig. 2). This may be evident both visually and aurally. With the H.T. switched on and the bias at 8, if C_{26} has broken down completely, the transmitter will radiate continually as though the key were down, because in effect the contacts of S_3 are shorted through the resistance R_{12}. If the fault is partial, intermittent transmission will take place, because with the grid-bias at 8, the maximum bias volts from the valve V_4 are virtually across C_{26}. As this voltage may be of the order of 1,000 volts, it may be enough to break down the faulty condenser.

106. A partially defective condenser may be tested in the following manner. Switch off the H.T. and set the bias to 8. The transformer T_2 will still be energized since the primary

is connected across the amplifier filament supply, and the bias volts generated by V_4 are across C_{26}. If the condenser is faulty, it will make a clicking noise every time the condenser flashes over. This flash over may not be apparent in the form of arcing, because it will probably occur inside the condenser, but it will certainly be heard. If when the bias is moved to 0, thus reducing the volts across C_{26}, the noise ceases, the condenser is obviously defective and should be replaced.

107. The condenser (C_{27}, fig. 2) is connected between the screen grids of the amplifier valves and earth. Should it become defective and short-circuit, the fault will be apparent by one or both of the following symptoms. Arcing may occur on the relay type T (S_2, fig. 2), resulting in the burning of the movable copper arm associated with H.T. positive contact, and accompanied in extreme cases by corrosion of the exposed metal parts of the relay. This will be more noticeable when using the higher H.T. studs. With the H.T. switch on Stud 1, the amplifier valves should normally start taking anode current when the bias is moved from stud 8 to stud 7. If C_{27} is short-circuited, then it will be noticed that the anode current does not start until the bias has been reduced to stud 4 or even 3.

108. As soon as either or both the defects are suspected, units are to make an insulation test. Remove the amplifier valve panel and withdraw the 100,000 ohm resistance (14, fig. 8) from its holder. The insulation should then be tested between the top contact of the resistance holder and the frame of the transmitter. A tester bridge megger should be used for this purpose and, if a reading of appreciably less than infinity be obtained, the condenser should be replaced.

109. Some cases of failure have occurred in certain of the resistances incorporated in the transmitter. When any of the following resistances fail they should be replaced by the corresponding tropical grade as follows :—

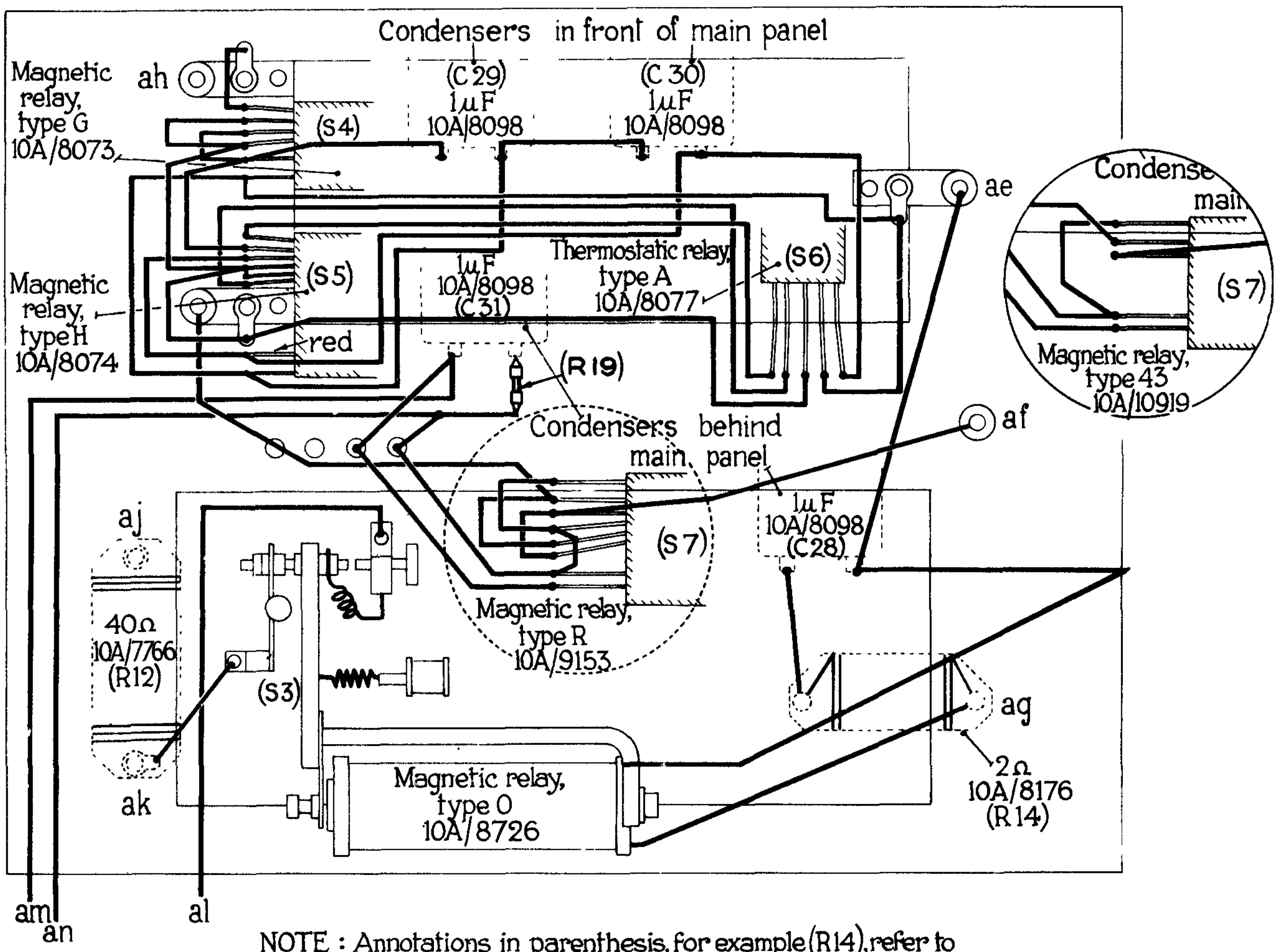
Original			Replacement	
Type 86	10A/7770		Type 304	10A/9818
,, 888	10A/7772		,, 302	10A/9816
,, 187	10A/8730		,, 309	10A/9823
,, 189	10A/8732		,, 308	10A/9822
,, 233	10A/9157		,, 310	10A/9824
,, 235	10A/9159	Part of 10A/9165	,, 323	10A/9862
,, 236	10A/9160		,, 324	10A/9863
,, 237	10A/9161		,, 325	10A/9864

Future contract issues of the transmitter will have these tropical grades incorporated.

110. The magnetic relay, type R is prone to failure, one of the symptoms being an inability to respond to the keying of dots at high speed. When this relay becomes unserviceable it is to be replaced by Relay, Magnetic, type 43 (Stores Ref. 10A/10919). The manner in which the new relay should be connected up is shown in the insert in fig. 21. The component shown in the dotted circle is relay, type R, whilst the component in the full circle is relay, type 43. In addition a 100-ohm resistance type 263 is connected in series with the condenser across the relay, to prevent arcing across the contacts of the sounder relay (Stores Ref. 5C/138) on remote controls types 3 or 4.

111. The transmitter may display instability when used on certain frequencies above 10 Mc/s. This becomes evident in the form of low frequency " motor-boating " and poor R/F efficiency as shown by a definite reduction of aerial current. It is partly due to the R/F choke in the H.T. supply to the amplifier valves being of such electrical dimensions as to cause this instability. A modification to overcome this defect is to reduce the number of turns on the choke to 51. The modified choke will adopt the new nomenclature Choke, H/F, type 43 (Stores Ref. 10A/10986).

112. The modified wiring referred to in para. 74 and shown in fig. 19 must only be applied to transmitters which are used solely for R/T, it must not be applied to transmitters which are required to make a rapid change from R/T to telegraphy. The following table shows how the transmitter is controlled by the switch, type 44, at the operations end. It should be noted that, during the intervals between R/T transmission, the switch, type 44, must be placed in the " Generator running " position ; furthermore, telegraphy cannot be transmitted with the modified connections.



NOTE : Annotations in parenthesis, for example (R14), refer to the corresponding annotations in Fig. 2

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FIG. 21, WIRING DIAGRAM - RELAY PANEL

Position of Switch, type 44.	Condition of Transmitter.
Off	Off
Generator running	H.T. and filaments on, after 10 seconds M/O is on (stand-by frequency) but amplifier is off.
Transmit	H.T. filaments and key are on. M/O and amplifiers are on desired frequency. Carrier wave is radiated ; ready to speak.
Generator running	H.T. and filaments on, key up. After 10 seconds M/O is on (stand-by frequency), but amplifier is off.
Off.	All off.

113. It is difficult to see the V.T.25 bias valve from the front of the transmitter and occasions have arisen where the filament of the valve had burnt out and, owing to its position, the defect was not apparent. On C.W. the bias switch should be set at stud 0 for maximum output. At this position of the switch the bias is zero, and the transmitter will operate normally even though the bias valve is defective. In these circumstances, the resistance connected across the valve becomes a grid leak and, as the grid current through it is small, insufficient volts are dropped to provide enough bias voltage to shut down the amplifier valves. The indication of a burnt out filament on the bias valve is that, with the bias switch on stud 8, the amplifier valves will be taking some anode current instead of nothing.

114. Some cases have occurred where the filament of the bias valve has sagged, when hot, and makes contact with the grid. This fault will be indicated by a normal ancde current reading when the bias switch is on stud 8 and the transmitter will radiate at the normal output. As the bias switch is reduced progressively from 8 to 0, the anode milliammeter will show a minimum reading at about stud 4 or 5. This dip in anode current is due to the charging and discharging of the condenser connected across the bias resistance.

TABLE 1

Settings of T.1087 for C/W signalling, with balanced load of 600 ohms, using terminals 12 and 14.

Freq. kc/s.	Master Oscillator.		Amplifier Anode Coil and Tuning.				Output Transformer.				Ampl Grid-Bias Stud.	Ampl. Anode Curr. mA.	Aerial Tuning Cond.	Load Curr. Amps.
	Coil.	Condenser.	Anode Taps.	Tuned Taps.	Condensers.		Input Sockets.		Output Sockets.					
					Fixed.	Variable.	1	2	3	4				
	(L1)	(C1)	(L2)	(L2)	(S16)	(C13)	(L3)	(L3)	(L3)	(L3)	(S15)	(M5)	(C18)	
3,800	E	5–50	CEH	M	B	1–41	E yel.	E red	G wh.	G Blk.	1	245	—	0·66
4,286	E	3–96	CEH	M	A	4–00	D ,,	D ,,	F ,,	F ,,	1	240	—	0·68
5,550	E	2–50	CEH	L	B	6–00	Q ,,	Q ,,	B ,,	B ,,	1	220	—	0·62
6,680	E	2–00	CEH	M	A	1–18	D ,,	D ,,	D ,,	D ,,	1	255	—	0·69
6,820	E	1–83	CEH	L	A	2–23	M ,,	M ,,	D ,,	D ,,	1	240	—	0·66
6,500	D	5–72	CEH	L	A	4–68	Q ,,	Q ,,	D ,,	D ,,	1	200	—	0:6
6,820	D	5–07	CEH	L	A	1–90	M ,,	M ,,	D ,,	D ,,	1	235	—	0·6
6,500	C	8–97	CEH	L	A	4–68	Q ,,	Q ,,	D ,,	D ,,	1	200	—	0·49
8,400	C	5–00	CEG	K	A	3–47	P ,,	P ,,	G ,,	G ,,	1	255	—	0·5
8,400	C	5–00	CF	K	A	8–68	Q ,,	Q ,,	D ,,	D ,,	2	230	—	0·48
10,700	C	3–00	CF	K	A	3–00	Q ,,	Q ,,	F ,,	F ,,	1	240	—	0·55
10,700	C	3–00	CF	J	B	4–29	H ,,	H ,,	E ,,	E ,,	2	230	—	0·52
11,400	C	2–60	CF	J	A	3–05	E ,,	E ,,	D ,,	D ,,	3	230	—	0·52
13,350	C	1–80	D	J	A	8–15	G ,,	G ,,	D ,,	D ,,	3	190	—	0·38
14,620	C	1–34	D	J	A	3–70	M ,,	L ,,	D ,,	D ,,	2	220	—	0·39
13,350	B	2–20	D	J	A	8–15	G ,,	G ,,	D ,,	D ,,	2	200	—	0·35
14,620	B	1–90	D	J	A	3–75	E ,,	E ,,	D ,,	D ,,	1	250	—	0·34
14,620	A	2–00	B	J	A	8–50	D ,,	D ,,	B ,,	B ,,	2	200	—	0·29
17,500	A	1–50	B	J	A	1–61	D ,,	D ,,	B ,,	B ,,	1	228	—	0·35
17,500	A	1–50	A	J	A	5–83	E ,,	K ,,	K ,,	H ,,	2	215	—	0·24
20,000	A	1–10	A	J	A	1–22	E ,,	K ,,	K ,,	H ,,	2	230	—	0·29

TABLE 2

Settings of T.1087 for R/T signalling with 4-wire cage aerial 7 ft. 6 in. top and counterpoise using terminal 12 for earth and 13 for aerial.

Frequency kc/s.	Master-Oscillator.		Amplifier.						Output Transformer.				Neutralizing.	Bias Stud.	Amplifier mA Output.	Aerial Tuning Condenser (Degrees)	Aerial Current.
	Coil.	Tuning.	Anode Tap.		Closed Circuit Tuning.				Input Sockets.		Output Sockets.						
					Coil Taps.		Condenser.										
			Back.	Front.	Back.	Front.	Fixed.	Variable.	1	2	3	5					
	(L1)	(C1)	(L2)	(L2)	(L2)	(L2)	(S16)	(C13)	Red. (L3)	Yellow. (L3)	White. (L3)	Black. (L3)	(C12)	(S15)	(M5)	(C18)	(M6)
8,400	E	1–45	CF	CF	K	K	A	5–10	D	D	D	D	87°	4	115	0°	0·85
8,000	E	1–58	CF	CF	K	K	A	6–73	D	D	D	D	87°	4	105	20°	1·0
7,500	E	1–78	CF	CF	L	L	A	2–90	D	D	D	D	87°	3	135	25°	1·15
7,000	E	2–0	CEG	CEG	L	L	A	2–43	G	G	D	D	87°	3	125	27°	1·25
6,700	E	2–15	CEG	CEG	L	L	A	3–52	G	G	D	D	87°	4	110	35°	1·15
6,000	E	2–62	CEG	CEG	L	L	A	6–40	J	J	D	D	87°	4	110	55°	1·4
5,400	E	3–14	CEG	CEG	L	L	B	2–12	L	L	D	D	87°	4	110	160°	1·5
5,000	E	3–58	CEG	CEG	M	M	A	2–87	K	K	D	D	87°	3	145	170°	2·0
4,600	E	3–79	CEG	CEG	M	M	A	3–74	K	K	D	D	87°	3	150	170°	2·0
4,250	E	4–73	CEG	CEG	M	M	A	5–92	K	K	F	F	87°	3	115	170°	2·0

H.T. Stud 2. Volts on load, 2,100.

TABLE 3

Settings of T.1087 for C.W. signalling with 54-ft. cage aerial and radial earth using terminal 12 for earth and 13 for aerial.

									Red.	Yellow.	White.	Black.					
5,100	E	3–60	CEG	CEG	L	L	B	3–10	G	G	A	A	87°	0	300	16°	1·3
4,800	E	3–38	CEG	CEG	L	L	B	4–90	G	G	A	A	87°	0	290	26°	1·3
4,635	E	4–08	CEG	CEG	L	L	B	7–38	G	G	A	A	87°	0	330	20°	1·62
4,482	E	4–33	CEH	CEH	M	M	A	3–24	D	D	B	B	87°	0	300	20°	1·95
4,368	E	4–54	CEH	CEH	M	M	A	3–70	D	D	B	B	87°	0	320	23°	2·05
4,195	E	4–90	CEH	CEH	M	M	A	4–59	D	D	B	B	87°	0	280	26°	2·25
3,900	E	5–55	CEH	CEH	M	M	A	5–87	E	E	B	B	87°	0	370	35°	2·75
3,700	E	6–08	CEH	CEH	M	M	A	7–00	E	E	B	B	87°	0	320	40°	2·3
3,500	E	6–73	CEH	CEH	M	M	A	8–45	E	E	B	B	87°	0	290	45°	2·3
3,300	E	7–50	CEH	CEH	M	M	B	3–45	E	E	B	B	87°	0	280	63°	2·6
3,150	E	8–15	CEH	CEH	M	M	B	4–72	F	F	B	B	87°	0	300	82°	2·7
2,900	E	9–53	CEH	CEH	M	M	B	7–70	G	G	B	B	87°	0	300	136°	3·0

H.T. Stud 2. Volts on load, 2,000.

TABLE 4

Settings of T.1087 for R/T, C.W. or M.C.W. signalling, with aerial 54 ft., 6-wire cage to 70 ft. mast and radial earth, using terminals 12 and 14.

Freq. kc/s.	Master Oscillator.		Amplifier Anode Coil and Tuning.				Output Transformer.				Ampl. Grid-Bias Stud.	Ampl. Anode Curr. mA.	Aerial Tuning Cond.	Load Curr. Amps.
	Coil.	Condenser.	Anode Taps.	Tuned Taps.	Condensers. Fixed.	Condensers. Variable.	Input Sockets. 1	Input Sockets. 2	Output Sockets. 3	Output Sockets. 4				
	(L1)	(C1)	(L2)	(L2)	(S16)	(C13)	(L3)	(L3)	(L3)	(L3)	(S15)	(M5)	(C18)	
1,500	F	6–50	CEH	N	C	7–07	Q red	A yel.	P wh.	P blk.	1*	255	—	3·6
1,605	F	5–75	CEH	N	C	4–72	L ,,	A ,,	P ,,	L ,,	1*	240	—	3·6
1,720	F	5–00	CEH	N	B	8–00	L ,,	C red	L ,,	J ,,	1*	215	—	3·4
1,920	F	4–10	CEH	N	B	4–90	L ,,	C ,,	L ,,	L ,,	1*	200	—	3·1
2,130	F	3–35	CEH	N	A	8–00	L ,,	C ,,	H ,,	H ,,	1*	200	—	3·1
2,375	F	2–75	CEH	N	A	5–83	L ,,	B ,,	F ,,	F ,,	1*	240	—	3·3
2,630	F	2–30	CEH	N	A	4–20	L ,,	C ,,	F ,,	A ,,	1*	220	—	2·82
3,050	F	1–83	CEH	N	A	2–32	L ,,	C ,,	F ,,	A ,,	1*	225	—	2·15

*For R/T and M.C.W. use bias stud 3.

TABLE 5

Settings of T.1087 for rapid frequency change made with a standard T type aerial, with 7 ft. 6 in. roof and counterpoise.

Frequency kc/s.	Master-Oscillator Condenser.		Amplifier Anode Coil and Tuning.				Bias Stud.	Output Transformer.		Aerial Tuning Condenser.
	Turns.	Degree.	Anode Taps.	Tuned Taps.	Condensers. Fixed.	Condensers. Variable.		Input Sockets.	Output Sockets.	
4,338	4	65	C.F.	L	C	5–46	4	D.D.	E.E.	180
4,500	4	33	C.F.	L	C	6–75	4	G.G.	E.E.	180
5,000	3	61	C.F.	L	B	7–62	4	G.G.	E.E.	180
5,500	3	05	C.F.	L	B	3–90	4	G.G.	E.E.	180
6,000	2	63	C.F.	L	A	8–05	4	G.G.	E.E.	180
								Switch off H.T. before adjusting.		

APPENDIX 1

NOMENCLATURE OF PARTS

The following list of parts is issued for information only. When ordering spares for this transmitter, the appropriate section of AIR PUBLICATION 1086 must be used.

Ref. No.	Nomenclature.	Qty.	Remarks.
10A/8709	Transmitter, type T.1087		Without valves or indicating lamps.
	Principal components :—		
10A/7180	Ammeter, thermo 0–6 amps	1	
10A/9166	Case, stowage	1	For M O coils and resistances.
	Choke, H/F		
10A/8716	Type 22	3	
10A/8717	Type 23	1	
10A/8718	Type 24	1	
10A/9514	Type 35	2	
10A/10986	Type 43	1	
10A/7512	Choke, L/F, type C	1	
	Coil, inductance ..		
10A/8713	No. 1	1	M/O range A, 20,000 to 17,000 kc/s.
10A/8710	No. 2	1	M/O ranges B, C, D and E, 18,750 to 3,000 kc/s.
10A/8728	No. 3	1	M/O range F, 3,000 to 1,500 kc/s.
10A/8711	No. 4	1	Amplifier, 20,000 to 1,500 kc/s.
10A/8712	No. 5	1	Output transformer 20,000 to 1,500 kc/s.
	Condenser		
10A/7764	Type 109	1	0·002 μF.
10A/8098	Type 146	6	1·0 μF.
10A/8163	Type 151	5	0·01 μF.
10A/8166	Type 154	1	300 μμF.
10A/8170	Type 158	12	50 μμF.
10A/8496	Type 188	1	0·01 μF.
10A/8719	Type 217	1	Variable, neutralizing.
10A/8720	Type 218	2	40 to 800 μμF. variable
10A/8721	Type 219	2	100 μμF. matched pair.
10A/8722	Type 220	2	20 μμF. matched pair.
10A/10920	Type 428	15	1·5 μF.
10A/9151	Type 263	1	40 to 800 μμF. variable.
10A/9152	Type 264	1	7 to 145 μμF. variable.
	Connector		
10A/8731	Type A	2	Fitted with sockets and lug ends.
10A/8735	Type B	2	Fitted with sockets and lug ends.
10A/8740	Type C	1	Fitted with sockets and lug ends.
10A/9163	Type D	1	Fitted with sockets and lug ends.
10A/9165	Grid-bias unit	1	Fitted with :— 1 condenser type 151, 4 resistances type 235*, 1 resistance type 236*, 1 resistance type 237*.
	Handle, condenser, vernier drive		
10A/7719	Type B	1	
10A/8723	Type E	2	
10A/8714	Holder, neon lamp	2	
	Holder, valve		
10A/8173	Type G	1	Rectifier (grid-bias).
10A/8724	Type N	1	Master-oscillator.
10A/8725	Type O	1	Amplifier.
10A/8093	Insulator, type 16	3	
	Milliammeter		
10A/3091	0 to 300, type A	1	Master-oscillator, H.T.
10A/3092	0 to 500, type A	1	Amplifier, H.T.

In the event of failure of items marked thus*, *see* para. 109.

APPENDIX—*contd.*

Ref. No.	Nomenclature.	Qty.	Remarks.
	Transmitter T.1087—(*contd.*)		
	Principal components—(*contd.*)		
	Mounting, anti-vibration		
10A/8803	Type 1	3	
10A/8715	Mounting, M/O coils	1	
10A/8068	Panel, rectifying, type A or ..	1	
10A/11156	Panel, rectifying, type B	1	
	Relay, magnetic		
10A/8073	Type G	1	
10A/8074	Type H	1	
10A/8254	Type M	1	
10A/8726	Type O	1	
10A/9153	Type R	1	In the event of failure, *see* para. 110.
10A/9154	Type S	1	
10A/9155	Type T	1	
10A/8077	Relay, thermostatic, type A	1	
	Resistance		
10A/7766	Type 82	7	40 Ω
10A/7770	Type 86*	2	10,000 Ω, when 10A/9157 is not in use.
10A/7772	Type 88*	2	50,000 Ω
10A/8176	Type 127	1	2·0 Ω
10A/8729	Type 186	1	1·06 Ω
10A/8730	Type 187*	1	100,000 Ω
10A/8732	Type 189*	1	5,000 Ω
10A/8733	Type 190	1	0·4 Ω, 25 amps. variable.
10A/8734	Type 191	1	0·4 Ω, 15 amps. variable.
10A/9157	Type 233*	2	20,000 Ω, when 10A/7770 is not in use.
10A/9099	Type 263	1	100 Ω.
10A/9863	Type 324	1	15,000 Ω, vitreous rod.
10A/7437	Socket, type 19	1	
5C/622	Switch, tumbler, 5 amp. S.P. ..	2	
10A/8082	Type 75	4	Gate switches.
10A/8736	Type 88	1	Three-position, radial contacts, fitted with 6 condensers, type 158.
10A/9162	Type 97	1	Fitted with socket, type 19, plug operated.
10A/8737	Transformer, biasing	1	
10A/9164	Transformer, modulating	1	
	Voltmeter		
10A/8183	0 to 15 volts	2	M/O and amplifier filaments.
10A/7784	0 to 3,500 volts	1	D.C. voltage.
	Accessories :—		
10A/7474	Lamp, indicating, neon, No. 1. ..	2	
	Valve		
10A/8738	Type V.T.30	1	Master-oscillator.
10A/8739	Type V.T.31	2	Amplifiers.
10A/7312	Type V.T.25	1	Biasing.

In the event of failure of items marked thus*, *see* para. 109.

APPENDIX 2

TRANSMITTER T.1087 WITH THE ADAPTOR, TYPE 9
(Stores Ref. 10D/1)

INTRODUCTION

1. The transmitter T.1087 with the Adaptor, type 9, is a modified form of the transmitter T.1087, described n this chapter. It has been introduced to provide a high degree of frequency stability with the elimination of frequency modulation and the initial warming-up period which was essential with the T.1087. The circuit comprises a crystal-controlled oscillator stage coupled to an amplifier stage, consisting of two valves in parallel, the output from which is capacitance-coupled to the aerial. The frequency range covered is from 6·6 Mc/s to 3·0 Mc/s.

2. The stabilization of frequency in the transmitter is effected by the use of a quartz crystal and to incorporate this element in the circuit of the transmitter T.1087 with the minimum of reconstruction, an adaptor has been designed. This apparatus is known as Adaptor, type 9, and its general appearance is shown in fig. 1 of this Appendix. It consists of a single valve unit mounted in the original master-oscillator valve

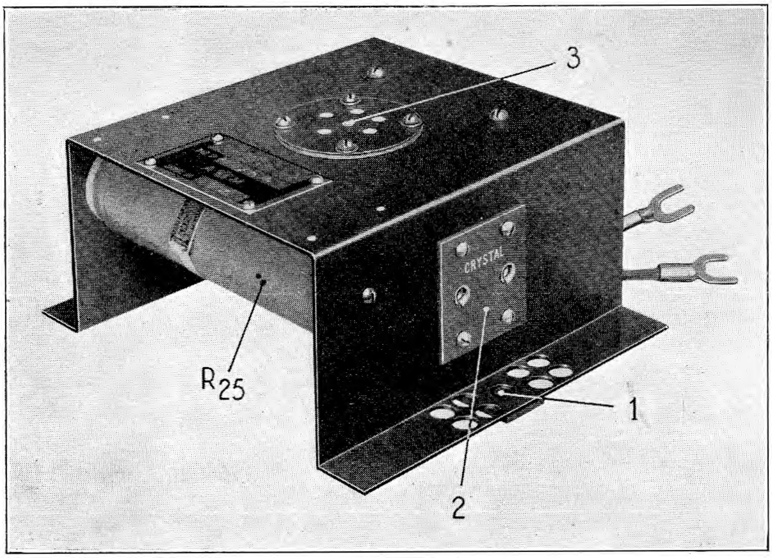


Fig 1.—App. 2. The Adaptor, type 9.

holder ; when this is done only two connexions from the adaptor, other than those made by the normal contacts of the valve-holder, are necessary. The whole assembly is, therefore, self-contained ; the overall dimensions being 5¾ in. by 5 in. by 2½ in. The general appearance of the transmitter is shown in fig. 2. It should be noted that all references to illustrations or tables herein are to those included in this Appendix.

3. Whilst the adaptor is self-contained the existing tuning circuits of the master-oscillator of the T.1087 are retained and provide the tuned anode circuit of the crystal-controlled valve. This valve is of the type V.T.81, a pentode requiring 7·5 volts on the filament. The filament supply utilized for this transmitter is substantially that of the T.1087, dropping resistances being incorporated in this modified stage.

4. The introduction of the Adaptor, type 9, renders necessary certain modifications in the original circuit of the T.1087. As apart from the adaptor circuit these changes involve the master-oscillator tuning coil with its associated condenser, the amplifier valves, which are now used in parallel and not, as formerly, in push-pull, the neutralizing arrangement, which is now rendered unnecessary, and the output circuit. The inclusion of a frequency-controlling element renders the space-tuning arrangements of the T.1087 unnecessary. In order to avoid useless repetition only such aspects of the transmitter wherein it differs materially from the T.1087 are dealt with in this Appendix.

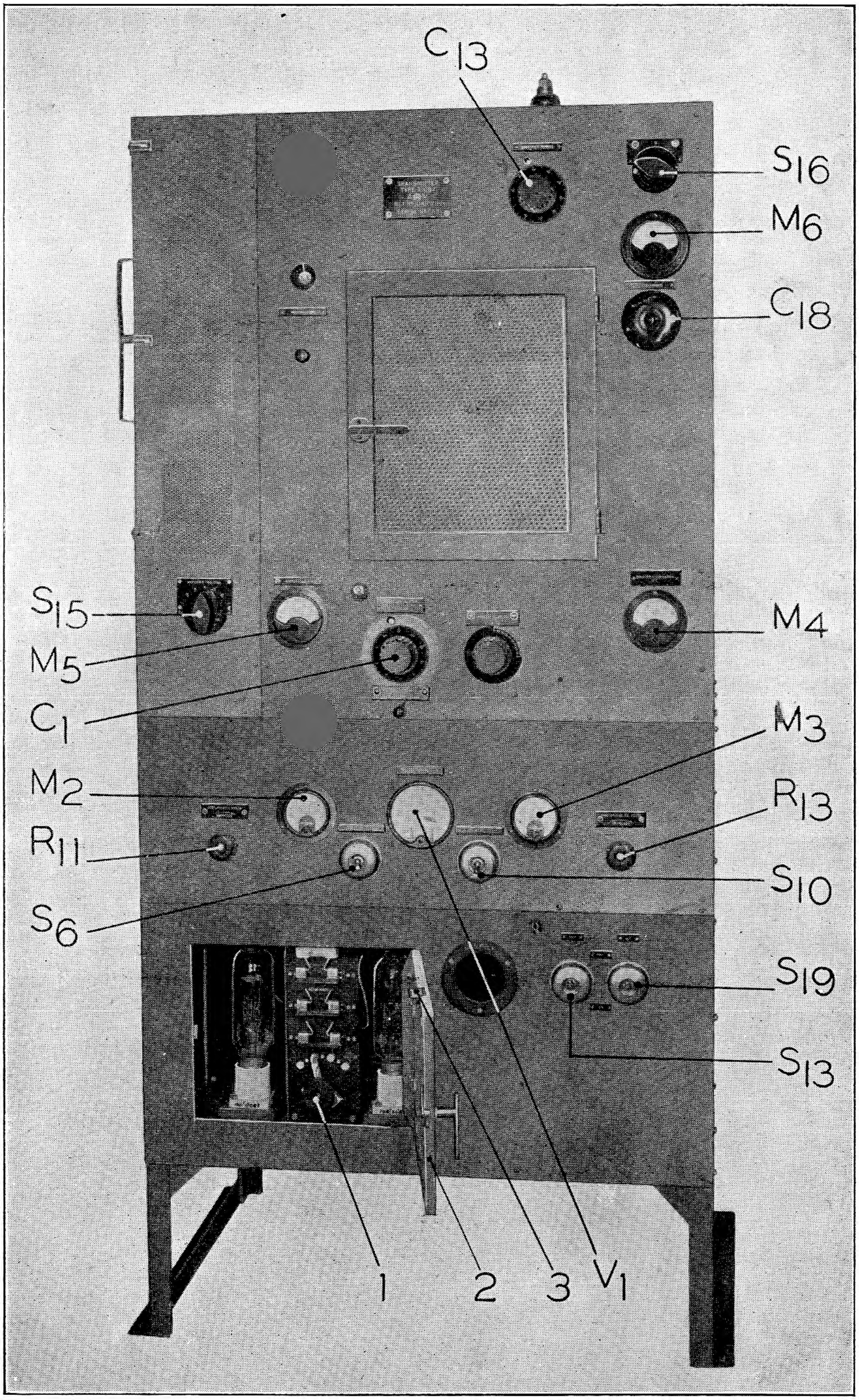


FIG. 2.—App. 2. The Transmitter.

CONDENSERS	C_{35} C_{33} C_{36} C_{19} C_{18} C_{28} C_{26} C_{43} C_{15} C_{24} C_{16} C_{14} C_{25} C_{17} C_{13} C_{42} C_{37} C_{12} C_{31} C_{22} C_{27} C_{23} C_{11} C_5 C_6 C_7 C_8 C_9 C_{10} C_4 C_{32} C_1 C_3 C_{20} C_{41} C_{38} C_{39} C_{21} C_{40}
RESISTANCES	R_{17} R_{18} R_{14} R_{12} R_3 R_{10} R_9 R_{19} R_8 R_{20} R_4 R_5 R_{11} R_2 R_{25} R_{27} R_6 R_{21} R_{13} R_{22} R_7 R_{26} R_{24} R_{23}
INDUCTANCES	L_{13} L_3 L_4 L_2 L_7 L_8 L_5 L_6 L_{10} L_1 L_{11} L_{12} L_9
MISCELLANEOUS	S_2 M_1 M_6 M_5 S_3 S_{16} S_{15} S_{13} T_2 S_9 S_{14} V_4 N_2 S_7 J_1 T_1 S_8 S_{11} S_{12} V_2 V_3 S_{10} M_2 S_1 M_4 N_1 V_X M_3 X

Condensers and Resistances Additional to, or replacing, those of T.1087	
In the Adaptor, Type 9.	
C_{38}	0·01 μF
C_{39}	0·01 μF
C_{40}	0·01 μF
C_{41}	0·0025 μF
R_{21}	40 ohms
R_{22}	40 ohms
R_{23}	50,000 ohms
R_{24}	50 ohms
R_{25}	50,000 ohms
R_{26}	0·93 ohms
R_{27}	0·93 ohms
In the Transmitter	
C_1	Half section only used
C_{18}	" " " "
C_{42}	0·01 μF
C_{43}	0·01 μF
R_2	1 of 10,000 ohms or 1 of 20,000 ohms

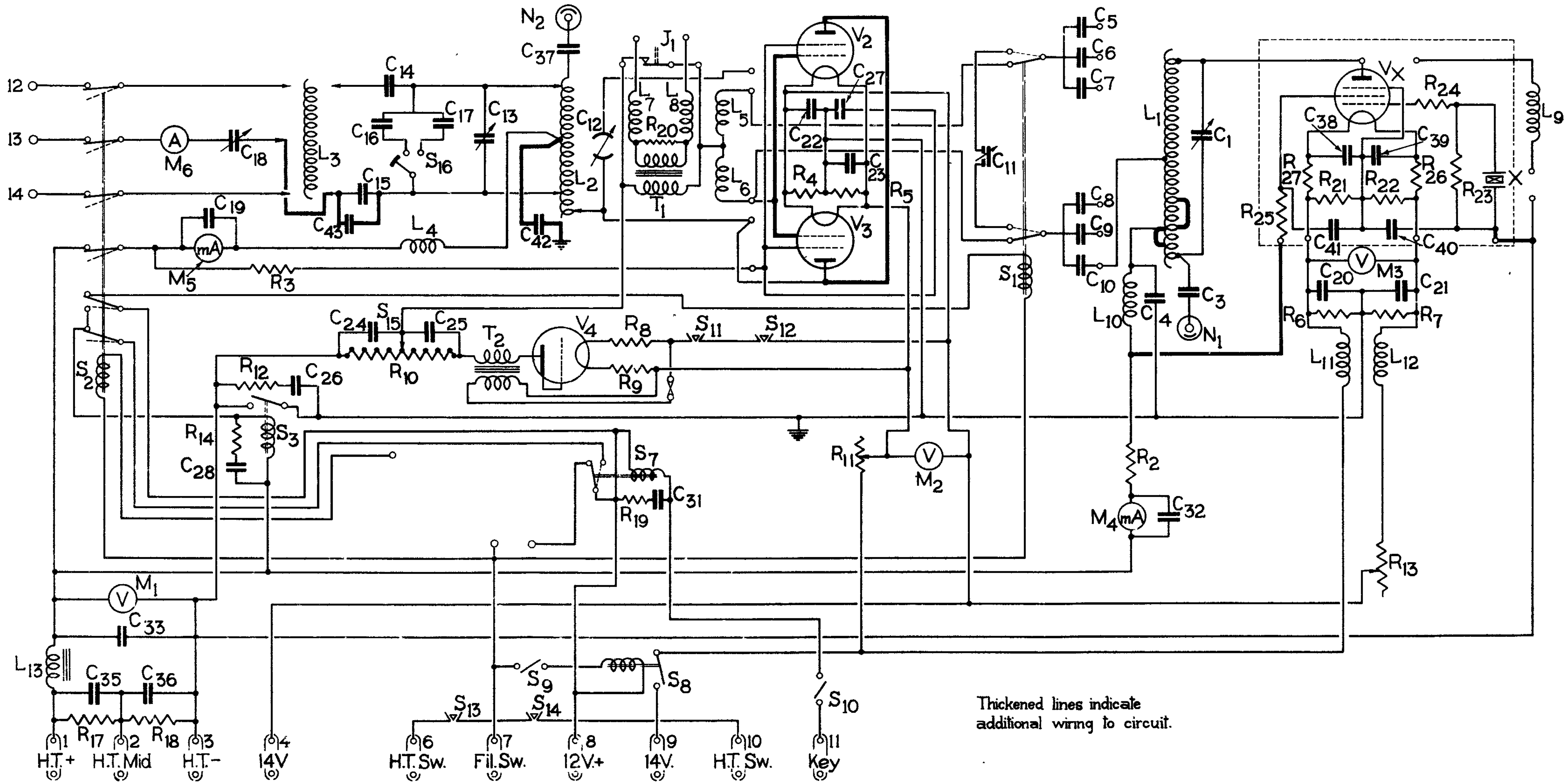


FIG. 3, APP. 2, THEORETICAL CIRCUIT DIAGRAM

GENERAL DESCRIPTION

5. A circuit diagram of the transmitter, omitting the power source, is given in fig. 3. The essential differences between this circuit and that of the T.1087 are emphasized by the thickened lines, specifying additions, and by the omission of certain components which featured in the T.1087. Wherever a component has been omitted from this circuit the omission is signified by a break in the sequence of annotational reference. To facilitate comparison, components additional to those of the parent transmitter have been allocated index numbers beyond any used in the original diagrams. A table of the constants of the new, or altered components is included in fig. 3. The components included in the Adaptor, type 9, are indicated within the dotted lines on fig. 3.

Circuit of the adaptor, type 9

6. The adaptor circuit consists of a crystal-controlled oscillator wherein the frequency-determining element is inserted in the grid circuit of a pentode valve. The crystal-oscillator valve V_x, together with its associated filament and grid circuits, is mounted on the adaptor together with a filament centre-pointing arrangement comprising two resistances R_{21} and R_{22} and the two condensers C_{38} and C_{39}. The suppressor grid of V_x is connected directly to the centre point of the filament circuit. To the grid of V_x a resistance R_{24} is joined. The resistance R_{24} prevents the development of parasitic oscillations and serves to limit the excitation of a fundamentally-operated quartz crystal X to a safe working condition. The crystal X, with which a grid-leak resistance R_{23} is in parallel, is joined between the resistance R_{24} and the GRID LEAK terminal of the adaptor. To this low-potential junction a connexion is made with the resistance R_{23} and a R/F by-pass (crystal current to filament) condenser C_{40}, the opposite side of which leads to the filament centre point. The connexion of the resistance R_{23}, at its low-potential end, to the H.T. negative side of the transmitter keying relay, assists in the prevention of sparking at the key contacts when operating on C.W. A condenser C_{41} is the screen-to-filament R/F by-pass condenser.

7. The screen voltage of the valve V_x is derived from the power supply source through a limiting resistance R_{25}. The anode of V_x is series fed from the supply line which includes a milliameter M_4, an interchangeable resistance R_2, a choke L_{10} and the anode tuning inductance L_1. To provide for the correct filament voltage to the valve V_x, dropping resistances R_{26} and R_{27} are incorporated in the leads from the 14-volt supply.

8. The anode tuning inductance L_1 is actually the coil F with its inductance reduced to cater for the range of frequency coverage desired. It provides for the transfer of an unbalanced input to the amplifier stage. Tuning of L_1 is effected by a condenser C_1 but the maximum capacitance of C_1 is not required and only one half of it is used.

Circuit of the amplifier

9. The unbalanced output from the crystal-oscillator stage is capacitance-coupled to the grid of a screened-grid tetrode valve V_3 through a condenser C_{10}. In order to give this R/F excitation the necessary amplification, the valve V_3 is connected in parallel with another tetrode V_2. This combination of a stable drive frequency with the use of tetrode output valves renders unnecessary any neutralizing device.

10. To effect a maximum transfer of power from the anodes of the valves V_2 and V_3 to the output circuit, an amplifier anode inductance L_2 is tuned by a condenser C_{13} in parallel with it. The H.T. positive voltage for the amplifier valves is derived from the supply source through a choke coil L_{13}, a milliameter M_5 shunted by a condenser C_{19}, a choke coil L_4 and the centre-point of the inductance L_2. An anode R/F by-pass condenser C_{42} is inserted between the anode end of the choke L_4 and earth and provides for the effective by-passing to earth of the centre point of L_2.

Circuit of the aerial system

11. The output from the amplifier is coupled to the aerial in accordance with the type of diffusion system to be employed. The normal output circuit consists of an auto-transformer L_3 having its input side capacitance-coupled by the condensers C_{14} and C_{15}. The circuit is available for working into a 600-ohm open line system.

12. When working into either a direct aerial system or concentric feeders the unbalanced output load is capacitance-coupled to the amplifier closed circuit through the condenser C_{15} and a variable condenser C_{18}, L_3 not being in circuit. The condenser C_{18} is in two sections but only one half of its maximum capacitance is used. At certain settings the condenser C_{15} is of too low a capacitance to enable optimum coupling to be attained and the additional capacitance of a condenser C_{43} is connected in parallel with it. When working into a 600-ohm open line system the condenser C_{43} is not required and must be disconnected from the circuit.

CONSTRUCTIONAL DETAILS

The Adaptor, type 9

13. The illustrations, figs. 1, 5 and 6 show the construction of the Adaptor, type 9, the arrangement of its components and its application to the valve holder, or crate, with the valve type V.T.81 in position. A bench wiring diagram of the adaptor is given in fig. 4. An interior view of the transmitter showing the valve-holder in position, is shown in fig. 7. Wherever applicable the annotational references of fig. 3 have been used in these illustrations.

14. The adaptor consists of an aluminium flanged channel section. The channel sides are 2½ in. deep and have right-angled flanges of ¾ in. The section is black-enamelled with a semi-gloss finish. Referring to fig. 1, the flanges are drilled (1) for mounting in the valve-holder. On one side of the channel a paxolin panel of 3½ in. by 1½ in. carries two terminals marked GRID LEAK and H.T. + SCREEN GRID respectively. On the opposite side the two crystal sockets (2) are mounted in paxolin. The valve-holder (3) is centred on the top panel.

15. Referring to fig. 5, it will be seen that the components are, for the most part, suspended between the sockets of the valve-holder (1) and a strip of paxolin (2) spacing the flanges. The 50,000-ohm screen resistance R_{25} also bridges the sides of the section and has both ends secured by screws and spaced by washers (3). The filament resistances R_{26} and R_{27} each of 0·93 ohms, are suspended from the top panel. The two 40-ohm resistances R_{22} and R_{21} are wired to R_{26} and R_{27}, two flexible leads terminating in spade terminals (4) and (5) being wired to the junction points.

16. The manner in which the adaptor is secured in the valve-holder is shown in fig. 6, the 4 B.A. screw (1) and the paxolin distance piece (2) being visible below the crystal holder. In this illustration the valve V_x is in

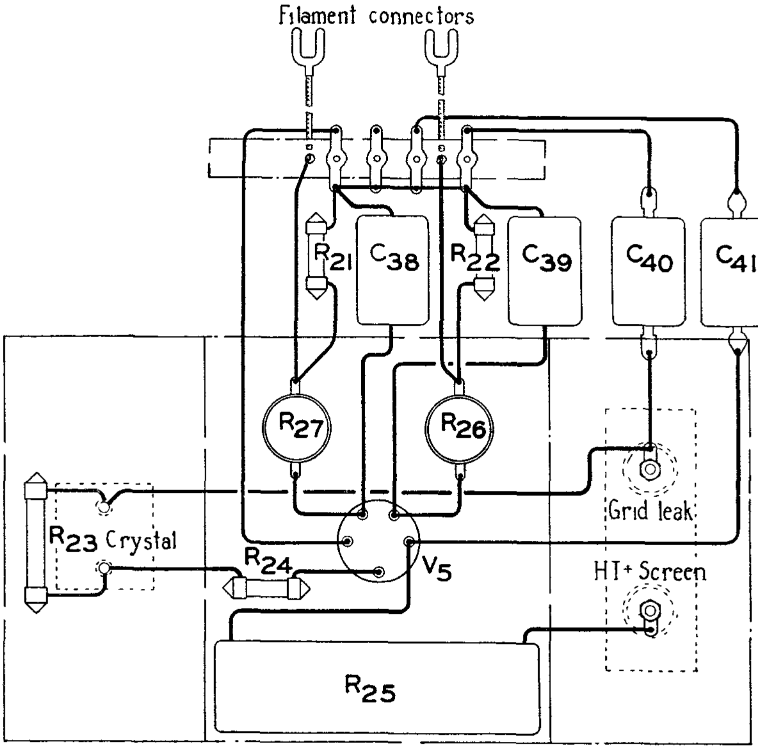


FIG. 4.—App. 2. The Adaptor, type 9—bench wiring diagram.

position and is secured by two clips (4) which are held in position by thumb-screws (5). The valve-holder, or crate, is composed of two strips of metal (6) bent to form a rectangle. Spacer pieces (7) carry the terminals for the anode (8) and the filament connectors (9) and (10). The fourth terminal (11) is not used in this instance.

VALVES AND POWER SUPPLY

17. The crystal-oscillator valve V_x is of the type V.T.81, a pentode with a high ratio of anode to input power and it requires 7·5 volts on the filament, this being indicated by 13·5 volts on the voltmeter M_3. The screen current of V_x is approximately 20 mA and the screen voltage approximately 300 volts. The anode feed resistance R_2 should be one of 20,000 ohms for H.T. voltages of 2,000 and above, and should be changed for one of 10,000 ohms when the H.T. supply is lowered to 1,500 volts. The remaining valves of the transmitter and the associated power supply are the same as those of the T.1087 and are described elsewhere in this publication. A rear view of the instrument with panels removed is given in fig. 7 which shows the V.T.81 valve V_x and the crystal adaptor (1) in position.

INSTALLATION

18. The transmitter can be operated locally or by means of remote controls. The method of installation has been detailed in connexion with the transmitter T.1087 and need not be recapitulated.

19. The installation of the crystal adaptor in the transmitter T.1087 and the modification necessary to effect the change of that instrument to the present transmitter are detailed in this and subsequent paragraphs. The master-oscillator valve-holder must be removed from the transmitter T.1087 and the valve V.T.30 taken out and stored. The adaptor is mounted on the valve-holder by drilling two 4 B.A. clearance holes in the paxolin distance pieces (2, fig. 6) to suit the holes, one of which is annotated on fig. 1. The adaptor is secured to the valve-holder by means of $\frac{1}{2}$ in. 4 B.A. screws and nuts, but care must be taken to ensure that clearance is maintained between the screws fixing the paxolin distance pieces and the metal chassis of the adaptor. The correct position of the adaptor in the holder is shown in fig. 6, that is, with the crystal sockets to the front and with the anode and grid terminals of the valve-holder to the left.

20. Referring to fig. 5, the two flexible leads (4) and (5) attached to the resistances R_{26} and R_{27} are connected to the adjacent filament terminals of the valve-holder. A valve, type V.T.81, is inserted in the five-pin socket and the anode of this valve is joined to the anode terminal of the valve-holder by means of the cap connector

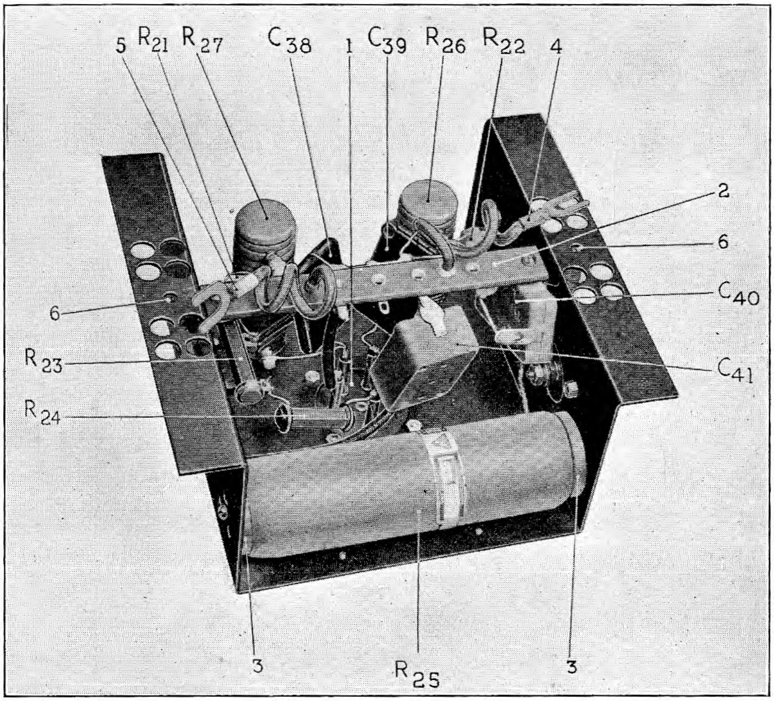


FIG. 5.—App. 2. The Adaptor, type 9—underside view.

and lead (12, fig. 6). The valve-holder is then replaced in the transmitter. Access to the interior of the transmitter is obtained through the door in the top compartment. To insert the holder, rest the top cylindrical contacts of the frame on the top " C " contacts of the supporting pillars. Push downwards on the frame until these contacts are properly engaged and rotate the frame about the contacts until the bottom two cylindrical contacts of the holder engage the bottom " C " contacts, pushing them into complete engagement. The adaptor terminal engraved H.T. + SCREEN is connected to the lower clip (2, fig. 7) of the master-oscillator grid leak of T.1087. It will be necessary to treat with Dope Solvent any screws or nuts which are locked due to the bakelite varnish fixer.

21. Having installed the adaptor it is necessary to effect certain internal modifications of the transmitter T.1087. The master-oscillator grid leak must be removed and retained in store. The two leads connecting the neutralizing condenser C_{12} to the amplifier grid contacts should be disconnected and stored. The space-tuning arrangements of the transmitter T.1087 not being necessary, the top portion of the relay panel is detached from the main panel and retained in store.

22. The parallel connector situated at the rear of the anode tuning condenser C_1 must be removed and the adjustment of C_1 checked. When the dial is set to read 0·00 the moving plates of C_1 should be out of mesh and set parallel to the fixed plates. If not in this position, the condenser drive should be slackened off and the rotor moved to the correct position.

23. Two additional 0·01 μF condensers, type 151, are mounted on the underside of the top panel and spaced from it by 6 B.A. nuts. The position of the condenser C_{42} (fig. 7) should be mid-way between the choke L_4 and the back of the transmitter. To fix C_{42}, take out the second screw securing the top panel to the back of the frame, remove the paint and clean around the screw hole on both sides, then screw a 4 B.A. terminal into position. The external portion of the terminal may be used as an additional earthing point for the transmitter.

24. The other condenser, type 151, is C_{43}, and it is mounted in parallel with C_{15}. It is fixed in a manner similar to that mentioned in para. 23, but is positioned above L_2 and as near to C_{15} as is convenient to facilitate wiring.

25. The direct aerial and the co-axial lines are terminated in a junction box, type 4. To mount this box on the top panel of the T.1087 remove the base plate and mark off and drill a $\frac{5}{16}$ in. fixing hole positioned 6 in.

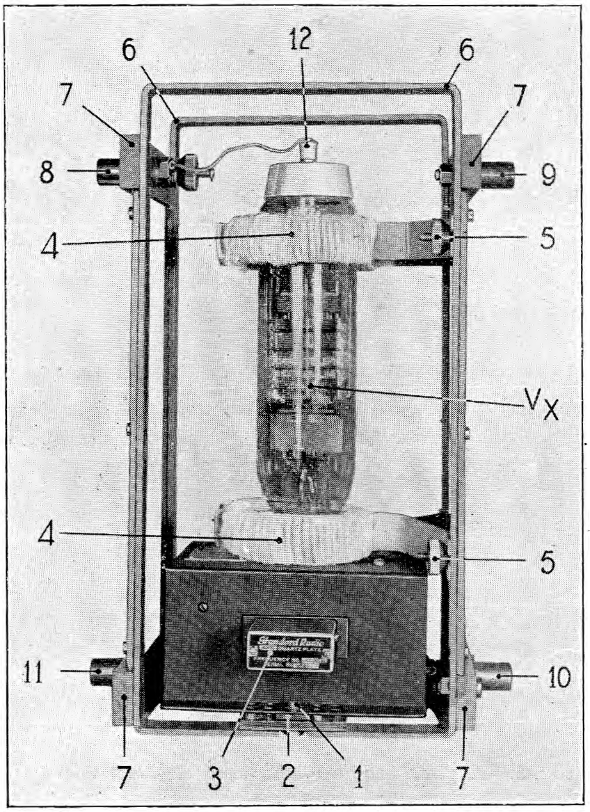


FIG. 6.—App. 2. Valve holder with crystal adaptor in position.

from the front and $\frac{3}{8}$ in. from the right-hand top edge of the T.1087. Using the junction box base plate as a template, mark off and drill a second fixing hole so that the box when mounted is parallel to the front edge of the T.1087. Ensure good electrical connexion between the box and the transmitter frame by removing the paint and then cleaning round the fixing holes. The junction box should be secured to the top panel by $\frac{3}{8}$ in. × $\frac{5}{16}$ in. Whitworth screws and washers. The method of internal wiring of the junction box is outlined on the box itself and reference should be made to this when connecting either coaxial cable or direct aerial.

26. The oscillator inductance coil F needs modification to provide for the two frequency bands. For frequencies between 5·5 Mc/s and 3·0 Mc/s, the prongs 2 and 3 (counting from the engraved end of the coil) are short-circuited. For frequencies between 6·6 Mc/s and 5·5 Mc/s, two turns, counting from prong 3 (fifth

to seventh turn from the engraved end) must be short-circuited in addition to those mentioned above. The figure 5·5 Mc/s is approximate and the tuning on the first-named band should be maintained to its highest limit frequency.

27. The output valve crate (4, fig. 7) should be removed and the anode lead disconnected from the front valve V_2 (nearer the panel) and joined to the anode terminal of the rear valve V_3. The grid lead of V_2 should be disconnected and joined to the grid terminal of V_3. If any extension of these leads is necessary, a length of R 4 wire enclosed in insulating tubing H.T. grade D 2·5 mm. should be used.

28. When working into a direct aerial system or concentric feeders the connexions to the output coil L_3 should be changed in order to omit the auto-transformer from the circuit. Remove socket No. 1 from the output coil and plug it into stowage for socket No. 5. Plug sockets Nos. 3 and 4 into the back plugs on the output coil. Join the sockets Nos. 2 and 5 together by means of a 1½ in. length of $\frac{3}{16}$ in. copper or brass rod. Both sections of the aerial series condenser C_{18} are not required and the parallel connector must be removed.

29. When working into a balanced open wire feeder system the condenser C_{43} referred to in para 24 should be disconnected from the circuit. In other respects the normal output circuit is maintained.

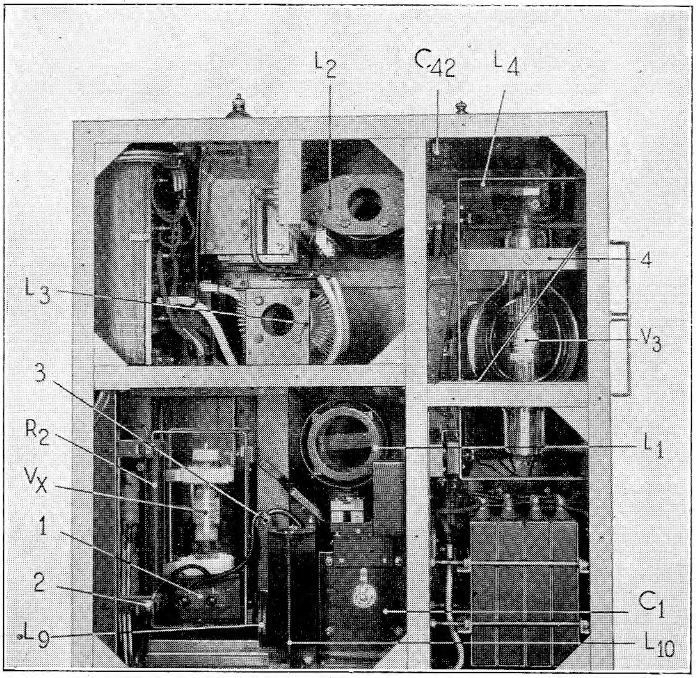


FIG. 7.—App. 2. Interior view of the transmitter.

OPERATION

30. The incorporation of the frequency-controlling element in this transmitter obviates the necessity for any stabilization of frequency by an initial " warming up " period. As apart from this, however, and the absence of any visual indication of oscillation in the oscillator stage, the operational notes applicable to the T.1087 apply equally to this transmitter. Reference to the appropriate section of the chapter upon the T.1087 should be made for the preliminary operations involved, in so far as they refer to the insertion of the amplifier valves, the rectifying valves, H.T. pilot lamp and fuses. The method of setting up the transmitter for C.W., and the incorporation of the appropriate modulator when used for M.C.W. or R/T can also be found in that chapter. The notes herein are additional to or in variation of the steps set out under T.1087. A general view of the transmitter showing the front panel controls is given in fig. 2.

Direct aerial or concentric feeder system

31. Before the transmitter is ready for operation into a direct aerial or concentric feeder system the modification detailed in paras. 21 to 29 must have been effected and the adaptor, carrying a crystal of the desired frequency, inserted in position. A final check should be carried out to ensure that these preliminary steps have been taken. The resistance R_2 (either 20,000 ohms or 10,000 ohms, whichever may apply) is placed in its clips and the modified coil F (para. 26) plugged into the oscillator coil sockets and locked into position.

32. The amplifier output circuit having been modified in accordance with the instructions contained in para. 27 the amplifier anode coil switches, the variable condenser C_{13} and the switch S_{16} should be adjusted as specified in the operational Tables 1, 2, 4 or 5. Set the condenser C_{18} to zero and adjust the oscillator condenser C_1 to a reading of say, 50 degrees less than that indicated in Table 1. The panel controls and instruments are annotated in fig. 2 and the references of fig. 3 are maintained in this diagram. The rectifier is switched on at S_{13}.

33. Switch ON the filament supply at S_6, adjusting the oscillator filament resistance R_{13} so that the filament voltmeter M_3 reads 13·5 volts. The amplifier filament voltmeter M_2 is adjusted by means of R_{11} to read 11·25 volts. Set the rectifier H.T. switch (1) which can be seen inside the door (2) at the bottom left-hand corner of fig. 1 to Stud 1 and the bias switch S_{15} to 8. On the top edge of this door can be seen a safety gate switch contact (3). Close the keying circuit switch S_{10} and put the H.T. switch, which is annotated S_{19} on fig. 2, but does not appear on fig. 3, to the ON position.

34. Increase the oscillator tuning condenser C_1 slowly until the milliameter M_4 shows a sudden dip. Adjust the tuning to the point of lowest input. Then set the H.T. switch to Stud 2, adjusting S_{15} to a position at which the amplifier is drawing 100 mA, as indicated by the milliameter M_5. The condenser C_{13} is then adjusted for resonance as indicated by a minimum reading on M_5.

35. Increase the aerial series condenser C_{17} slowly, at the same time keeping C_{13} in step to preserve resonance, until there is optimum coupling between the amplifier anode circuit and the output load. This condition is obtained when the output current, as indicated by the ammeter M_6, remains stationary or begins to fall while the input to the amplifier, as indicated by M_5, rises.

C.W. operation (local control)

36. For C.W. operation reduce the amplifier grid bias by means of S_{15} to give full output and adjust the oscillator tuning condenser C_1 very slowly and carefully to give minimum input as read on the milliameter M_4. Finally, carefully reduce the oscillator tuning condenser to a point at which M_4 reads approximately 5 mA in excess of the previously obtained minimum. This ensures that the crystal commences to oscillate readily and that, when working on C.W., the transmitted morse will not be clipped.

R/T operation (local control)

37. The transmitter is set up and tuned in exactly the same manner as for local C.W., but when the maximum C.W. output has been attained, the amplifier bias must be adjusted in order to reduce the aerial current by approximately 50 per cent. of that maximum. In most cases this adjustment can be done by moving the bias switch to tap 3. Then carefully adjust the oscillator tuning to minimum input as indicated on M_4, finally reducing the condenser until the input reads approximately 5 mA in excess of the minimum previously obtained as outlined in the preceding paragraphs. This adjustment may slightly reduce the output, as it may also do on C.W., but it is preferable to have certainty of switching and keying rather than a slightly increased output.

R/T operation (remote control)

38. Having set up and tuned the transmitter as for local R/T the selector switch of the remote controls, type 3, should be moved to LOCAL MICROPHONE and the volume control adjusted so that with normal speech output the current from the transmitter will rise 20 per cent. (equivalent to 100 per cent. modulation). Whilst deep modulation is essential for R/T, over-modulation should be avoided, as distorted speech will not only impair communication but will reduce the effective operating range. Mark the position of the volume control. Check the modulation with aeroplanes at effective range.

Balanced output, open-wire feeder system

39. The previous paragraphs relating to the setting up of the crystal-oscillator apply equally when working into a balanced output load. The amplifier anode circuit and the output coil taps should be adjusted in accordance with Table 3. The output load is, in this instance, connected across the terminals 12 and 14 (fig. 3).

PRECAUTIONS AND MAINTENANCE

40. The normal precautions associated with the transmitter T.1087 apply to this modification of it. The adaptor requires little or no maintenance and there are no special precautionary measures to be taken beyond the usual care to be exercised in the handling of apparatus. The crystal contained in the holder, by virtue of its physical dimensions, and the frail nature of its metallic "splutter" demands careful handling and, because of this fact, stations are not permitted to take down or to repair the holder. The percentage of failures in this element are, however, remarkably low and, provided no unauthorized attempt has been made to dismantle the apparatus, operators may have every confidence in it both for ease of starting and in its maintenance of oscillation at the specified frequency.

41. The valve V.T.81 should remain effective for a period much longer than that normally associated with transmitting valves. Low input to the crystal-oscillator valve V_x, coupled with the absence of tuning, will indicate that either the screen condenser C_{41} has broken down, thus earthing the screen-grid, or that there is no anode connexion.

MODIFICATION TO PERMIT USE OF CRYSTAL OSCILLATOR VALVE AS A MASTER-OSCILLATOR

42. To convert the transmitter to master-oscillator control, using the crystal-oscillator valve V_x as the M/O, reference should be made to Leaflet A.113 of A.P. 1186, Vol. II. The crystal-holder is removed and a specially constructed condenser is inserted between the left-hand (viewed from the front of the transmitter) crystal socket of the adaptor and the condenser C_1. On frequencies above 4 Mc/s the coil E replaces the modified coil F (para. 26) and on frequencies below 4 Mc/s an unmodified coil F is used or, alternatively, the parallel connector of C_1 is replaced and a coil E used. The following table shows typical settings of the transmitter so modified :—

Frequency Mc/s	Condenser C_1 Dial Readings		
	C_1 modified as in para. 22		*Alternative* C_1 Connector replaced
	E Coil	F Coil (unmodified)	E Coil
3·00	—	3–16	8–81
3·25	—	2–67	7–56
3·50	—	2–26	6–57
3·75	—	1–96	5–79
4·00	9–50	1–69	5–14
4·25	8–35	1–44	4–61
4·50	7–44	1–23	4–15
4·75	6–70	0–98	3–78
5·00	6–00	—	3–44
5·25	5–45	—	3–12
5·50	4–96	—	2–90
5·75	4–55	—	2–70
6·00	4–16	—	2–51
6·25	3–66	—	2–33
6·50	3–53	—	2–18
6·75	3–27	—	2–05
7·00	3–02	—	1–93

TABLE 1 (APPENDIX 2)

Typical settings of T.1087 with the adaptor, type 9, working into coaxial cable.

Coaxial cable connected to terminal 13 *via* junction box and earth.

Frequency Mc/s	Oscillator		Input mA (M_4)	Amplifier Anode Coil and Tuning				Series Aerial Condenser (C_{18})	Amplifier Grid Bias Stud (S_{15})	Amplifier Input (M_5)	Output Amps. to Line (M_6)	H T Volts Stud 2
	Coil F	Condenser (C_1)		Anode Taps	Tuned Taps	Condensers						
						Variable (C_{13})	Fixed (S_{16})					
6·66	See para. 27	1/10	60	C.E.G.	L	5/73	A	38	0	230	1·65	2,050
6·00	See para. 27	1/65	59	C.E.G.	L	9/50	A	38	0	235	1·65	2,040
5·30	See para. 27	1/10	58	C.E.G.	M	3/16	A	32	0	235	1·70	2,020
4·75	See para. 27	1/63	58	C.E.G.	M	4/92	A	36	0	250	1·70	2,030
4·25	See para. 27	2/22	56	C.E.G.	M	6/74	A	38	0	245	1·70	2,030
4·00	See para. 27	2/61	54	C.E.G.	M	7/90	A	40	0	260	1·70	2,030
3·50	See para. 27	3/63	54	C.E.G.	M	2/80	B	44	0	250	1·65	2,020
3·25	See para. 27	4/30	54	C.E.G.	M	4/97	B	46	0	250	1·65	2,020
3·00	See para. 27	5/18	53	C.E.G.	M	7/95	B	48	0	250	1·65	2,000

Note.—The annotational references are to fig. 2.

TABLE 2 (APPENDIX 2)

Typical settings of T.1087 with the adaptor, type 9, working into 54-ft. wire cage aerial and earth. Aerial to be connected to terminal 13 *via* junction box.

Fre-quency Mc/s	Oscillator		Input mA (M_4)	Amplifier Anode Coil and Tuning				Series Aerial Condenser (C_{18})	Amplifier Grid Bias Stud (S_{15})	Amplifier Input mA (M_5)	Load Current in Amps. (M_6)	H.T. Volts Stud 2
	Coil F	Condenser (C_1)		Anode Taps	Tuned Taps	Condensers						
						Variable (C_{13})	Fixed (S_{16})					
4·25	See para. 27	2/46	60	C.E.G.	M	6/17	A	27	0	250	1·48	2,100
4·00	See para. 27	2/88	60	C.E.G.	M	7/18	A	31	0	255	1·54	2,100
3·50	See para. 27	3/92	58	C.E.G.	M	3/09	B	47	0	290	1·87	2,100
3·25	See para. 27	4/62	58	C.E.G.	M	5/00	B	46	0	278	2·00	2,100

Note.—The annotational references are to fig. 2.

TABLE 3 (APPENDIX 2)

Typical settings of T.1087 with the adaptor, type 9, working into 600-ohm open wire feeders. Lines connected to terminals 12 and 14.

Fre-quency Mc/s	Oscillator		Input mA (M_4)	Amplifier Anode Coil and Tuning				Output Transformer				Ampli-fier Grid Bias Stud (S_{15})	Ampli-fier Input mA (M_5)	Load Current Amps. (M_6)	H.T. Volts Stud 2
	Coil F	Con-denser (C_1)		Anode Tap	Tuned Taps	Condenser		Input Sockets		Output Sockets					
						Vari-able (C_{13})	Fixed (S_{16})	1	2	3	4				
6·50	See para. 27	1/15	68	C.E.G.	L	4/63	A	C	C	E	E	0	258	0·64	2,000
5·30	See para. 27	1/11	62	C.E.G.	L	9/03	A	E	E	C	C	0	280	0·66	2,000
4·75	See para. 27	1/65	60	C.E.G.	M	3/05	A	D	D	F	F	0	305	0·70	2,000
4·25	See para. 27	2/24	60	C.E.G.	M	5/19	A	D	D	F	F	0	290	0·67	2,000
4·00	See para. 27	2/62	60	C.E.G.	M	6/46	A	D	D	F	F	0	270	0·66	2,010
3·25	See para. 27	4/33	56	C.E.H.	M	4/50	B	F	F	G	G	0	238	0·64	2,030

Note.—The condenser C_{43} must be removed from circuit.
The annotational references are to fig. 2.

TABLE 4 (APPENDIX 2)

Typical settings of T.1087 with the adaptor, type 9, working into 40-ft. vertical wire aerial and earth. Aerial to be connected to terminal 13 *via* junction box.

Aerial length measured from transmitter.

Frequency Mc/s	Oscillator		Input mA (M_4)	Amplifier Anode Coil and Tuning				Series Aerial Condenser (C_{18})	Amplifier Grid Bias Stud (S_{15})	Amplifier Input mA (M_5)	Load Current in Amps. (M_6)	H.T. Volts Stud 2
	Coil F	Condenser (C_1)		Anode Taps	Tuned Taps	Condensers						
						Variable (C_{13})	Fixed (S_{16})					
6·60	See para. 27	1/00	60	C.E.G.	M	5/20	A	33	0	225	1·16	2,120
6·00	See para. 27	1/60	58	C.E.G.	M	7/64	A	39	0	245	1·40	2,120
5·50	See para. 27	2/04	58	C.E.G.	M	2/08	A	37	0	240	1·60	2,100
5·50	See para. 27	1/02	61	C.E G.	M	2/08	A	38	0	255	1·85	2,100
4·75	See para. 27	1/85	61	C.E.G.	M	3/56	A	64	0	250	2·25	2,120
4·25	See para. 27	2/46	60	C.E.G.	M	5/16	A	95	0	245	2·30	2,130

Note.—The annotational references are to fig. 2.

TABLE 5 (APPENDIX 2)

Typical settings of T.1087 with the adaptor, type 9, working into 70-ft. vertical single wire aerial and earth. Aerial to be connected to terminal 13 *via* junction box. Aerial length measured from transmitter.

Frequency Mc/s	Oscillator		Input mA (M_4)	Amplifier Anode Coil and Tuning				Series Aerial Condenser (C_{18})	Amplifier Grid Bias Stud (S_{15})	Amplifier Input mA (M_5)	Load Current in Amps. (M_6)	H.T. Volts Stud 2
	Coil F	Condenser (C_1)		Anode Taps	Tuned Taps	Condensers						
						Variable (C_{13})	Fixed (S_{16})					
4·25	See para. 27	2/46	50	C.E.G.	M	6/15	A	26	0	280	1·57	2,120
4·00	See para. 27	2/84	58	C.E.G.	M	7/00	A	35	0	282	1·85	2,100
3·50	See para. 27	3/90	56	C.E.G.	M	3/40	B	42	0	265	1·66	2,120
3·25	See para. 27	4/61	55	C.E.G.	M	5/05	B	60	0	290	1·85	2,100
3·25	See para. 27	4/61	58	C.E.H.	M	4/51	B	68	0	255	1·90	2,100
3·00	See para. 27	5/47	58	C.E.G.	M	7/37	B	80	0	275	2·10	2,120
3·00	See para. 27	5/47	58	C.E.H.	M	6/55	B	104	0	270	2·20	2,220

Note.—The annotational references are to fig. 2.

NOMENCLATURE OF PARTS

The following list of parts is issued for information only. When ordering spares for this transmitter, the appropriate section of AIR PUBLICATION 1086 must be used.

Ref. No.	Nomenclature.	Qty.	Ref. in Fig. 3.	Remarks.
10D/1	Transmitter, type T.1087, with the adaptor, type 9.	—	—	Without valves or lamps.
	Comprising :—			
10D/8709	Transmitter, type T.1087	1	—	Modified.
10A/11890	Adaptor, type 9	1	—	For details, see below.
10A/11819	Box, junction, type 4	1	—	—
10C/8163	Condenser, type 151	2	C_{42}, C_{43}	0·01 μF.
10E/3	Valve, type 81	1	V_x	Oscillator.
	Adaptor, type 9 :—			
	Principal components :—			
	Condenser,			
10C/7906	Type 125	2	C_{38}, C_{39}	0·01 μF.
10C/10511	Type 378	1	C_{41}	0·01 μF.
10C/336	Type 663	1	C_{40}	0·0025 μF.
	Holder,			
10H/203	Crystal, type 3	1	—	—
10H/202	Valve, type 45	1	—	—
	Resistance,			
10C/9634	Type 272	1	R_{24}	50,000 ohms.
10C/11685	Type 519	1	R_{23}	50 ohms.
10C/66	Type 566	2	R_{21}, R_{22}	40 ohms.
10C/336	Type 752	1	R_{25}	50,000 ohms.
10C/338	Type 766	2	R_{26}, R_{27}	0·93 ohm.
10H/7227	Terminal	2	—	—
	Accessories :—			
	Connector,			
10H/204	Type 167	1	—	—
10H/205	Type 168	1	—	—
10H/206	Type 169	1	—	—
10X/ as required.	Crystal unit, type A	—	X	With plug-in holder.

FOR OFFICIAL USE ONLY

December, 1938

AIR PUBLICATION 1186
Volume I

SECTION 1, CHAPTER 4

TRANSMITTER T.1078

Contents

List of Illustrations

TRANSMITTER T.1078

(Stores Ref. 10A/8292)

INTRODUCTION

1. The transmitter T.1078 is a self-contained ground station transmitter of the master-oscillator type operating on the frequency band 3 to 15 megacycles, and capable of radiating C.W. or modulated C.W. Nine valves are employed, one of which is for the sole purpose of producing a 1,000 cycle modulating frequency. The transmitter is capable of radiating at any frequency within the above-mentioned limits, and all the circuit adjustments necessary to change from

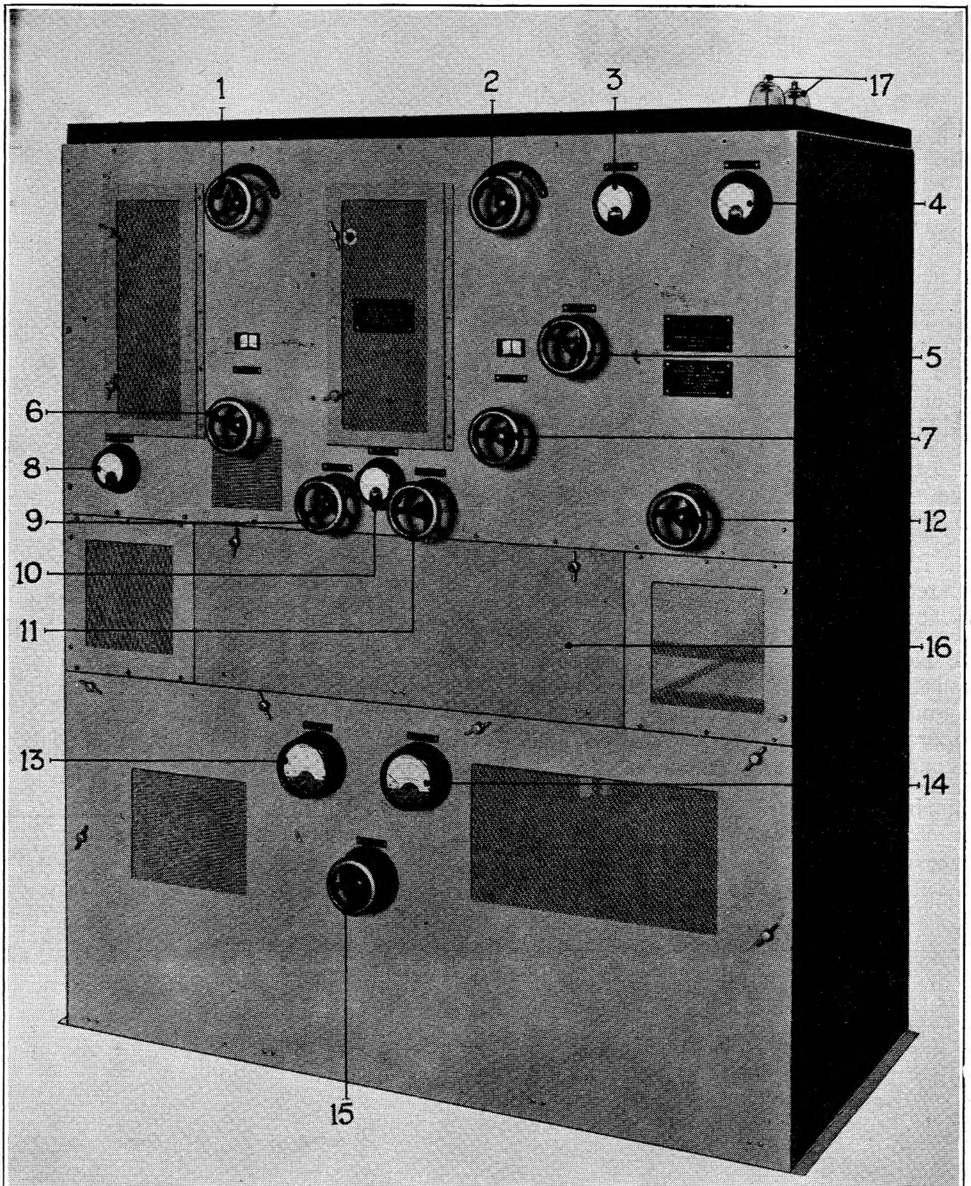


FIG. 1. Front view of transmitter.

any one frequency to another may be effected in less than ten minutes. The design of the transmitter is such as to provide for connection to a transmission line or for direct connection to an aerial.

2. Accommodation is provided on the transmitter for a standard control panel complete with the necessary sounder relays for remote switching and keying, and the tumbler switches for local operation. The equipment is arranged for 230 volt 50 cycle A.C. single phase supply, the necessary transformers and rectifying apparatus being housed within the cubicles. Safety switches are fitted to all doors of the transmitter. These ensure that the H.T. circuit is broken when any door is opened.

GENERAL DESCRIPTION

3. A theoretical circuit diagram of the transmitter is given in fig. 2. V_1 is the master-oscillator valve, and V_2 the amplifier valve. Coupling between the two is effected entirely by the low impedance link L_K.

4. The inductance coil L_1 in the anode circuit of the master-oscillator is tuned by means of the variable condenser C_{19}, and a portion is tapped off and coupled back through a condenser to the grid to maintain the valve in a state of oscillation.

5. The inductance coil L_2 in the grid circuit of the amplifier is tuned by means of the variable condenser C_{23}, and the inductance coil L_3 in the anode circuit is tuned by means of the variable condenser C_{20} and inductively coupled to the aerial or transmission line through the coil L_4. The amplifier is neutralized by means of the variable condenser C_{22}.

6. The rectifier V_8V_9 supplies H.T. to the amplifier valve, and the rectifier V_6V_7 supplies H.T. to the master-oscillator valve. A third rectifier V_5 provides bias for the amplifier valve and the necessary rectified supply for operating the relays. It also provides the anode supply for the valve V_3.

7. The valve V_3 functions as a 1,000 cycle oscillator to supply the modulating frequency for modulated continuous wave transmission. It is coupled to the grid circuit of the grid-leak modulator valve V_4.

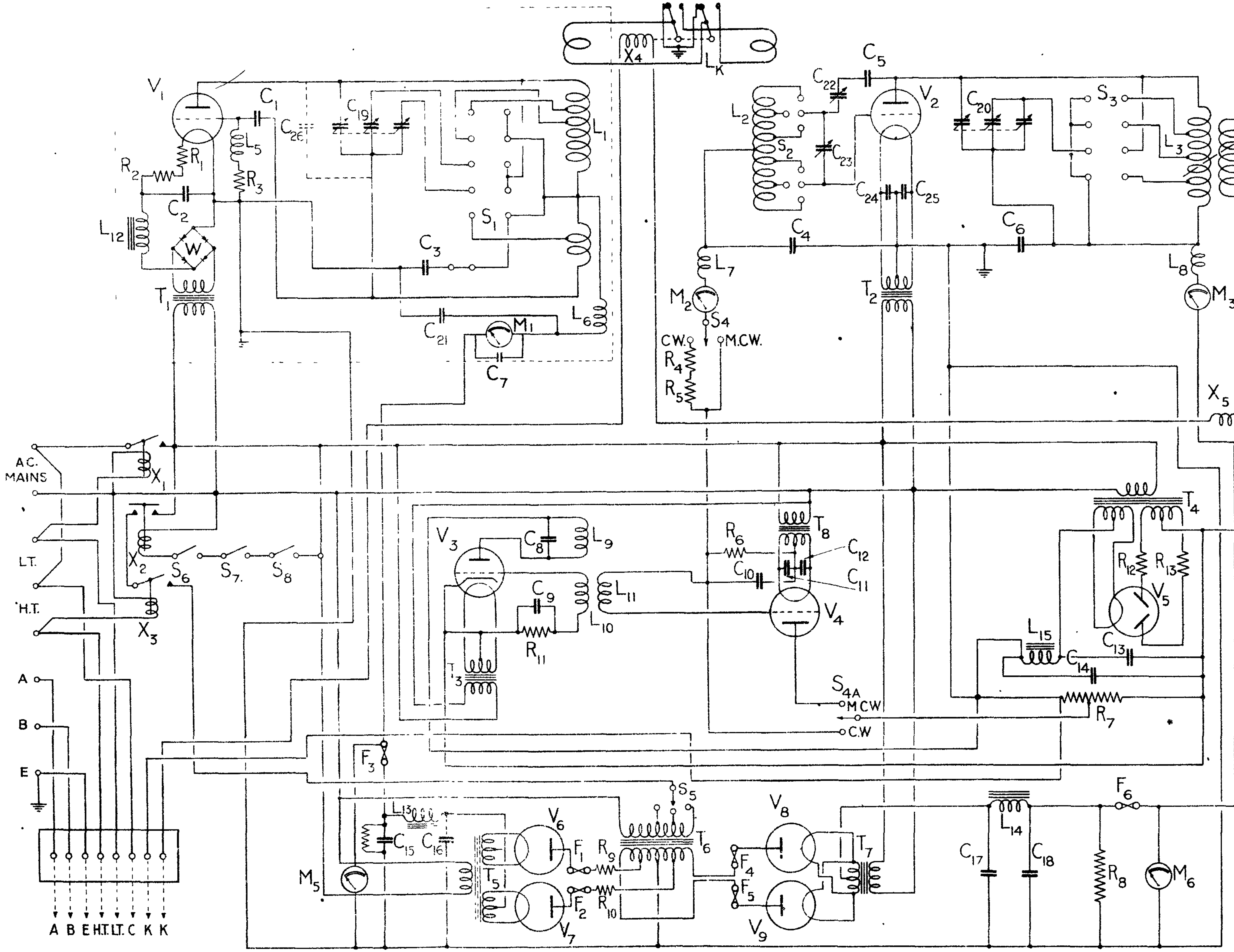
8. Keying is performed by making and breaking the link between the master-oscillator and amplifier, the master-oscillator valve circuit being maintained continuously in an oscillatory condition. To prevent any possibility of radiation the aerial circuit is also made and broken. The operating windings of the two relays X_4 and X_5 which key the link circuit and the aerial circuit, are in series and are energized simultaneously.

9. No temperature control is fitted, but the master-oscillator incorporates a compensating device consisting of a small shunt capacitance C_{26} shown dotted in fig. 2, the value of which decreases with temperature rise. The device is located close to the master-oscillator valve and is controlled by the temperature rise of the latter.

10. All valve filaments, with the exception of that of the master-oscillator, are supplied with A.C., each valve having a separate transformer. The supply to the master-oscillator filament is rectified by means of a copper-oxide rectifier W and smoothed by the choke L_{12} and condenser C_2. This rectifying and smoothing equipment is housed in the master-oscillator compartment.

Oscillator

11. The transformer T_1 which supplies the current for heating the oscillator filament has an output voltage of 30. In the secondary circuit is a metal rectifier W, an iron-cored smoothing choke L_{12}, and a condenser C_2. Two 0·125 ohm vitreous embedded resistances R_1 and R_2 are also included in series with the filament. The voltage across the filament is 12. Connected



CONDSRS.		RESISCES.	
	μFDS		OHMS
C1	·002	R1	·125
C2	4000	R2	·125
C3	·0005	R3	8000
C4	0005	R4	2500
C5	00003	R5	2500
C6	·002	R6	2500
C7	01	R7	12000
C8	·15	R8	1,000,000
C9	2	R9	1400
C10	2	R10	1400
C11	1	R11	300
C12	1	R12	2000
C13	2	R13	2000
C14	2		
C15	4		
C16	4		
C17	4		
C18	4		
C19	Ganged variable		
C20	Ganged variable		
C21	002		
C22	Neutralising		
C23	·0002 Variable		
C24	·01		
C25	·01		
C26	Compensating		

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FIG. 2, THEORETICAL CIRCUIT DIAGRAM

Facing paras. 2-11.

between grid and filament are the inductance coil L_5 and the resistance R_3, the latter consisting of eight 1,000 ohm rod-type resistances. The condenser C_1 which effects the coupling between the grid and anode circuits of the oscillator is a special porcelain-encased type condenser having a capacitance of 0·002μF. The fixed condenser C_{21} which also has a value of 0·002μF is connected between the earthed filament and the H.T. feed to the anode inductance of the oscillator. The fixed condenser C_7 which has a value of 0·01 μF is connected across the milliammeter M_1 (reading 0 to 250 milliamps.) in series with the H.T. feed. A choke coil L_6 is also included in this H.T. feed. The condenser C_3 which has a value of 0·0005 μF is connected between earth and anode inductance for certain frequencies by means of a link.

12. The variable condenser C_{19} is in three sections ganged together and operated by a common spindle. One of the sections is permanently connected across the anode inductance L_1, but the other two sections are connected to the switch S_1 and are connected across the inductance for certain positions of the switch. The switch simultaneously makes changes in the inductance values. The actual changes effected in the oscillator anode circuit by the switch are shown in fig. 5.

13. The link L_K consists of a twisted pair of leads terminated at one end by a turn around the anode inductance of the oscillator and at the other end by a turn around the grid inductance of the amplifier. The twisted pair is made and broken by means of the relay X_4. The relay incorporates two moving contacts, each of which moves between two fixed contacts. In one position of the contacts the link circuit is completed and in the other position both legs of the link are broken and the portion which terminates at the oscillator inductance is earthed.

Amplifier

14. The grid inductance coil L_2 with its tuning condenser C_{23} and range switch S_2 is housed in a metal box, and a centre tapping is taken out through the choke L_7 and the milliammeter M_2 (0 to 50 milliamps.) to the switch S_4. A condenser C_4 is connected between the tapping and earthed filament. One end of the grid inductance is connected to the grid and the other end is connected through the neutralizing condenser C_{22} and fixed condenser C_5 to the anode of the amplifying valve. The filament of the valve V_2 is heated from the transformer T_2, the voltage across the secondary of which is 17·5 volts. Two condensers C_{24} and C_{25} are connected in series across the filament with their junction point earthed. The connections of the anode inductance L_3, switch S_3 and condenser C_{20} are similar to those employed for the inductance, switch and condenser in the anode circuit of the oscillator valve. The actual changes effected in the amplifier anode circuit by the switch are shown in fig. 5.

15. The H.T. feed to the amplifier anode inductance is through the choke L_8 and milliammeter M_3 (0 to 300 milliamps.), the condenser C_6 being connected from this point to earth. The inductance L_4 which is coupled to the inductance L_3 is connected through the contacts of a relay X_5 which is similar to that in the link circuit, and through a thermo-ammeter M_4 (0 to 1 amp.) to the aerial terminals.

Small rectifier

16. The rectifying valve V_5 is a double-wave thermionic rectifier and supplies, rectified H.T. for the keying relay coils, H.T. for the M.C.W. oscillator valve, and grid bias for the amplifier. The transformer T_4 supplies this valve. It has two secondary windings, one of which applies four volts across the filament, whilst the other applies approximately 600 volts between the anodes. Two 2,000 ohm resistances R_{12} and R_{13} are included in the anode circuits. Smoothing is effected by the condensers C_{13} and C_{14} and the choke L_{15}. Across the output is connected the resistance R_7 which consists of twelve 1,000 ohm rod-type resistances. The keying relay coils

are connected in series (and in series with the operating key) across this resistance. A connection is taken from the positive end of the resistance to the anode circuit of the valve V_3, and a tapping is taken from the resistance to the switch S_{4A}. The positive end of the resistance is connected to the filament of the valve V_2 and, the tapping being negative with respect to this, negative bias is thus provided for the amplifier.

Grid-leak modulator valve

17. The grid-leak modulator valve V_4 has its filament heated by the transformer T_8, the secondary of which has a voltage of 6. Two condensers C_{11} and C_{12} are connected in series across the filament, and the centre point is connected through the resistance R_6 to the C.W.—M.C.W. switch.

18. This switch has two positions, one marked C.W. and the other marked M.C.W. It is shown in two portions (S_4 and S_{4A}) both being operated by the same movement. As will be seen from the diagram, when the switch is in the C.W. position, the negative bias tapping from the valve V_5 is taken *via* the lower contact of the switch S_{4A} to the filament of the valve V_4 and through the two resistances R_4 and R_5 *via* the left-hand connection of the switch S_4 to the centre tapping of the grid inductance of the valve V_2. When the switch is in the M.C.W. position, the negative grid-bias tapping from the valve V_5 is connected directly to the anode of the valve V_4. The path may be traced through the filament of the valve, and the right-hand side of the switch S_4 to the grid of valve V_2. The inductance L_{11}, which is connected between the grid of the valve and filament, is for the purpose of coupling up the M.C.W. oscillator valve.

M.C.W. oscillator valve

19. The valve V_3 is an indirectly heated valve and receives its heating current from the transformer T_3, the secondary of which has a voltage of 4. The centre-point of the secondary is connected to the cathode. The grid circuit includes the inductance L_{10}, and the condenser C_9 shunted by the resistance R_{11}. The anode circuit includes the inductance L_9 shunted by the condenser C_8. The circuit characteristics of this valve are such as to produce oscillations at a frequency of approximately one thousand cycles per second. These are impressed upon the valve V_4 by the coupling inductances L_{10} and L_{11}. The M.C.W. oscillator remains in a state of oscillation irrespective of the position of the switches S_4 and S_{4A}.

Rectified supply for oscillator

20. The valves V_6 and V_7 are ~~gas-filled~~ rectifying valves, the filament supply for which is obtained from the transformer T_5. This transformer has two secondaries, one for each valve filament. The centre-points of the secondaries are connected together and from this point the positive H.T. supply is taken. The anodes are connected to tappings on the secondary of the transformer T_6, and in the anode circuit are included the fuses F_1 and F_2 (350 milliamp.) and the resistances R_9 and R_{10}, the latter having values of 1,000 ohms each. The output is smoothed by means of the choke L_{13} and the two condensers C_{15} and C_{16}. A fuse F_3 (350 milliamp.) is included in the positive H.T. supply lead, and across the output is connected the voltmeter M_5 (0 to 2·5 kilo-volts).

Rectified supply for amplifier

21. The valves V_8 and V_9 are large thermionic rectifying valves, the filament current of which is supplied from the transformer T_7, the secondary voltage being 13·5. The anodes are connected through 500 milliamp. fuses F_4 and F_5 to the secondary of the transformer T_6. The output is smoothed by means of choke L_{14} and condensers C_{17} and C_{18}. Across the smoothed output is connected the resistance R_8 which consists of ten 100,000 ohm rod-type resistances.

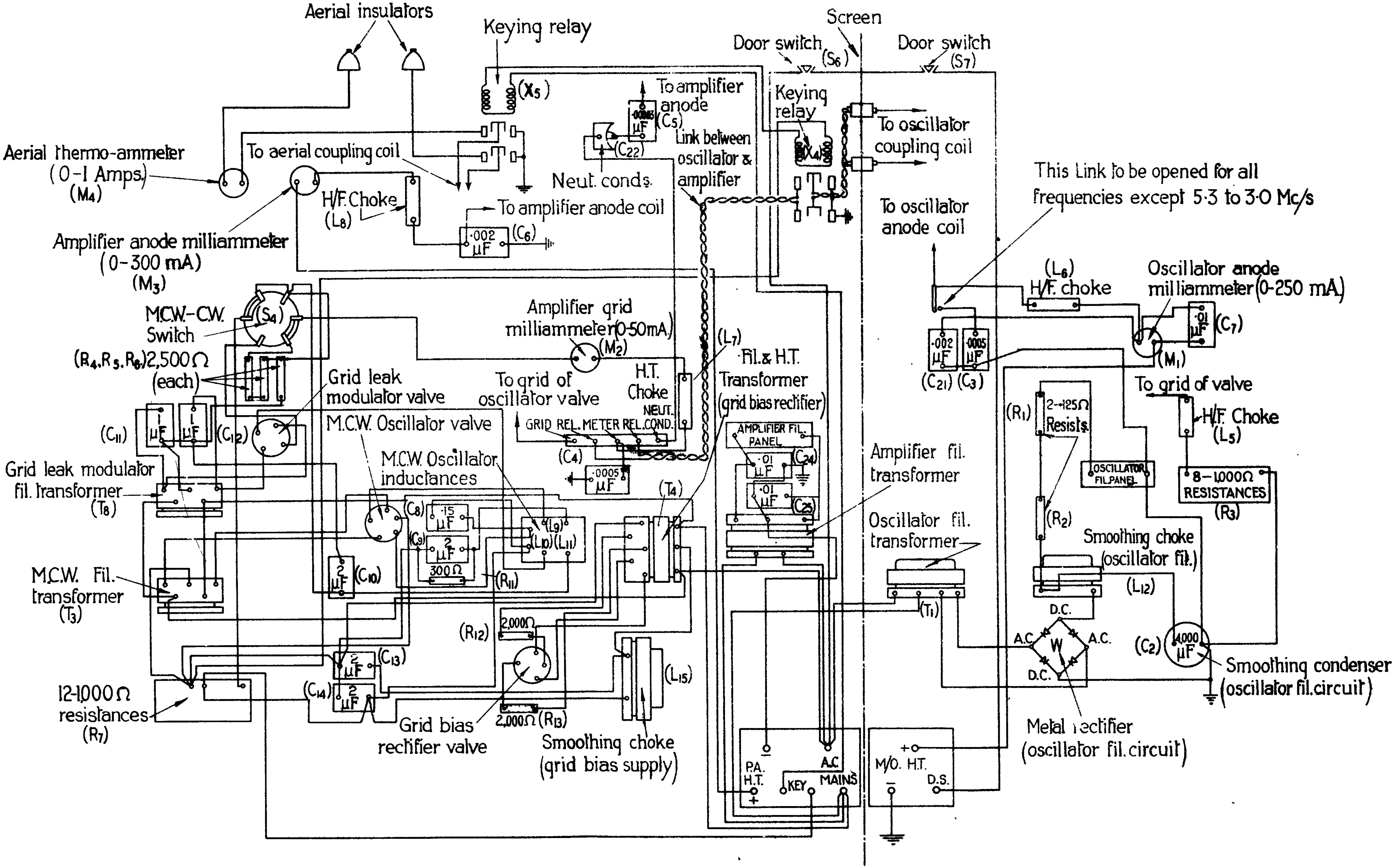

FIG. 3, BENCH WIRING DIAGRAM— UPPER CUBICLE

A 500 milliamp. fuse F_6 is included in the positive H.T. supply and a voltmeter M_6 (0 to 4 kilovolts) is connected across the output. The switch S_5 enables the ratio of the transformer T_6 to be varied, thus providing control of power.

Switching relays

22. As will be seen from fig. 2 there are three switching relays X_1, X_2, X_3. These relays are of the S.P., A.C. contactor type, X_1 and X_3 being exactly similar whilst X_2 has an escapement delay action. The winding of relay X_1 has one end permanently connected to one side of the A.C. line. The other end of the relay winding is connected to the terminal engraved L.T. on the terminal board, and when a connection is made between this terminal and the adjacent terminal engraved C, through a local or remote switch, the winding of the relay is connected across the A.C. line. The contacts of the relay which are in series with the A.C. supply to the primaries of the filament transformers now close and all valves of the transmitter have their filaments heated.

23. The relay X_3 has one side of its winding permanently connected to one side of the A.C. line The other end of the winding is connected to the terminal engraved H.T. on the terminal board, and when a connection is made between this terminal and the terminal engraved C, through a local or remote switch, the winding of the relay is connected across the A.C. line. The contacts of this relay, which are in series with the contacts of the relay X_2 in the A.C. supply leads to the primary of the H.T. transformer, now close. The supply to the primary is not completed, however, unless the contacts of the relay X_2 are also closed. The winding of the relay X_2 is permanently connected at one end to the A.C. mains. The other end is connected through the gate switches S_6, S_7, and S_8 to the other side of the A.C. mains. It is, therefore, necessary to have X_1, X_2, and X_3 all closed before the H.T. transformer can be energized. As previously mentioned there is an escapement delay action incorporated in the relay X_2 to provide a 30 seconds delay between the energizing of its winding and the closing of its contacts. The arrangement ensures that if either the circuit of the winding of the relay X_1 is broken (by means of the L.T. switch), or the circuit of the winding of the relay X_2 is broken (by opening one of the gate switches) the H.T. supply will be cut off and cannot be re-established until 30 seconds after both windings have been energized. If the windings of X_1 and X_2 are maintained energized, the H.T. may be broken independently by means of the relay X_3 without any delay action taking place.

24. The object of this arrangement is to prevent H.T. being applied to the valves before the filaments are heated, this being particularly important in respect of the gas-filled rectifying valves. When transmission is in progress, however, the operator frequently finds it necessary, during periods of reception, to shut down the oscillator and it would be undesirable to have a 30 seconds delay before transmission could be resumed. The H.T. relay X_3 overcomes this difficulty by placing in the hands of the operator an independent control (through the medium of the H.T. switch in the operating winding of the relay) of the H.T. supply. The filaments remain heated.

Terminal boards

25. As can be seen in fig. 8, there are five terminal boards on the transmitter. Three of these (7), (8) and (9), are conveniently placed at the back of the transmitter to facilitate the interconnection of the cubicles. The two other terminal boards (11) and (10) are situated in the centre and the lower portions of the transmitter respectively. The lower terminal board (10) is provided with eight terminals. Two of these, marked LINES A AND B are for connecting up the incoming control lines. Two are marked A.C. and are for connecting up the incoming 230 volt A.C. supply. Of the remaining four, one is for an earth connection, and the other three, which are marked 1, 2 and 3, are internally connected to the filament relay and to the H.T. relay. No external connections other than the A.C. supply and the incoming control lines

are made to this board. Internal connections are made between the A.C. supply terminals and the transformers, etc., in the cubicles, and internal connections are taken from the line terminals to two similarly marked terminals on the central terminal board (11). The four remote control terminals, marked 1, 2, 3 AND EARTH, are also internally connected to the central board (11), being marked there as Fil S/W, COMMON, H.T. S/W and EARTH respectively.

26. The three interconnection terminal boards (7), (8) and (9) are connected by means of lead-covered cables after the two cubicles have been placed in position and bolted together. The terminal board (7) carries six terminals. The left-hand two are marked + P.A. H.T.—, and internal connections are taken from these to the circuits of the amplifier valve. The two right-hand terminals are marked A.C. MAINS, and internal connections are taken from these to the transformers, etc., in the upper cubicle. The other two terminals, which are not marked, have internal connections to the keying relay coils. The terminal board (8) carries three terminals. Two are marked +M.O. H.T.—, and internal connections are taken from them to the circuits of the oscillator valve. The third terminal, which is unmarked, is the door switch connection. The terminal board (9) in the lower cubicle carries seven terminals, two marked +P.A. H.T.—, two marked +M.O. H.T.— and two marked A.C. MAINS. The seventh terminal, which is for a door switch connection, is unmarked. The " P.A. H.T." terminals are internally connected to the amplifier rectifier output, and the " M.O. H.T." terminals are connected to the oscillator rectifier output. The " A.C. mains " terminals are connected up to the A.C. supply, one lead being taken through the filament relay.

27. A loom of lead-covered cables is provided for making the inter-cubicle connections. These connections are shown in fig. 12. The loom (shown in the upper part of the illustration) consists of nine lead-covered cables, terminating at each end in thimbles. The thimbles are unmarked and care should be exercised when making or remaking the connections that they are made correctly as shown in fig. 12. It will be seen that at the upper end of the loom nine connections are made, six on the terminal board in the amplifier section of the upper cubicle and three on the terminal board in the oscillator section of the upper cubicle. At the lower end of the loom two of the nine cables, longer than the others, are taken to the key terminals on the centre terminal board (11, fig. 8) and the remaining seven to the terminal board (9, fig. 8) in the lower cubicle.

28. In addition to ensuring that terminals marked with similar polarity are connected together, it is important to make quite certain that the A.C. terminals on the two boards are connected in the correct way. The upper A.C. terminal on one board must be connected to the upper A.C. terminal on the other, and the lower one to the lower one on the other board. *If these connections are reversed the door switches and the H.T. relay coils will be short-circuited.*

Remote control

29. The remote control unit, type 2, which is accommodated in a space between the two cubicles of the transmitter consists of a rectangular metal base approximately 18 × 27 in. At the back of the unit are eight equally-spaced terminals which link up with a terminal strip on the transmitter having a similar number of terminals. At the front of the unit are arranged a push switch and two tumbler switches and the rest of the unit is occupied by a repeating coil and three sounder relays.

30. Referring to fig. 11, the primary of the repeating coil is connected, when the unit is connected up to the transmitter, across the incoming line (terminals A and B) from the operating station. The secondary of the repeating coil is connected on the unit to the windings of the sounder relay which accomplishes the keying of the transmitter. This relay is adjusted to the neutral position and the tongue moves to " mark " or " space " in accordance with the movement of the key at the operating station. Connections are taken from the tongue and mark terminals of the sounder relay to the transmitter key relays, so that when the tongue moves to mark, these relays are energized and when the tongue moves to space they are de-energized.

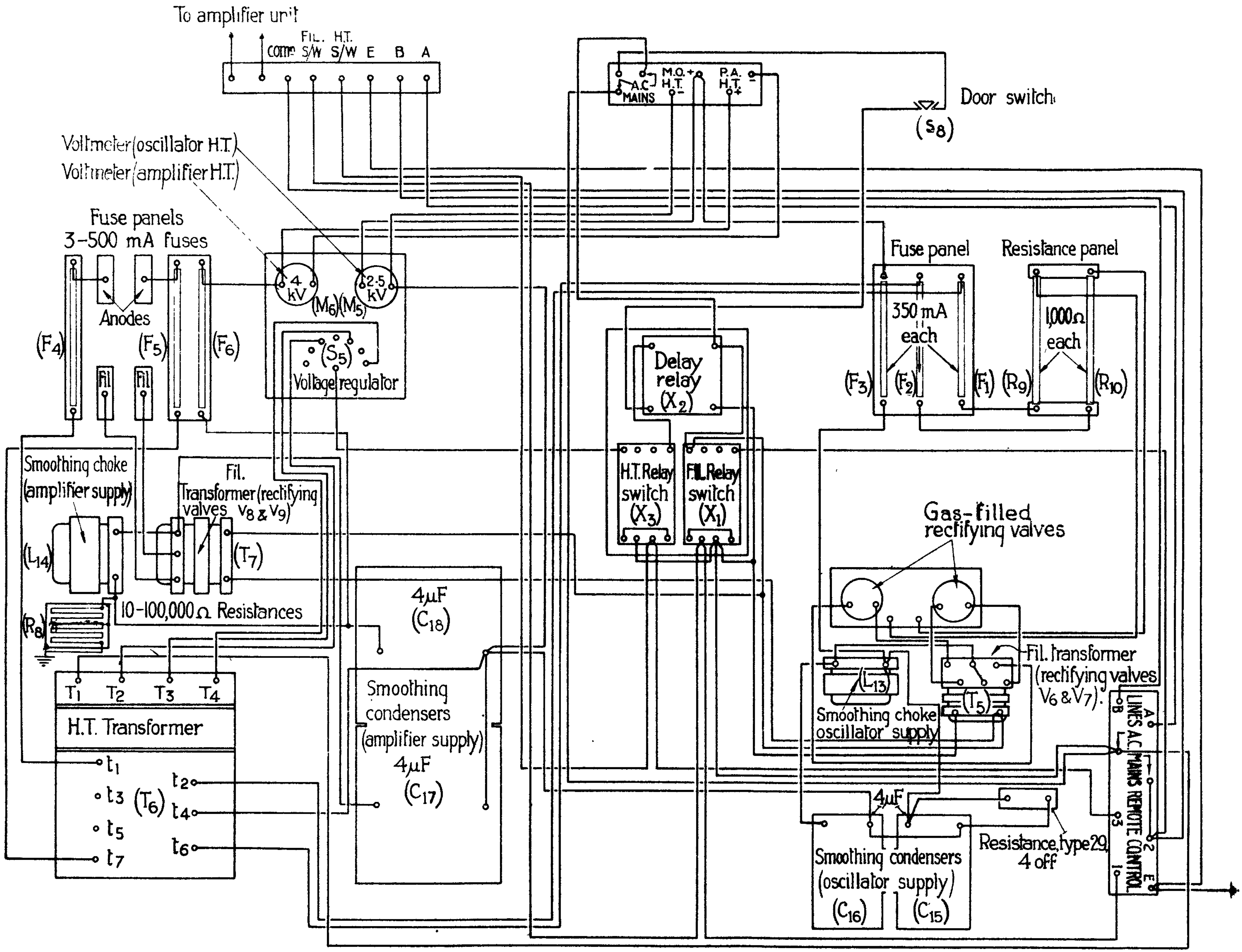

FIG. 4. BENCH WIRING DIAGRAM – LOWER CUBICLE

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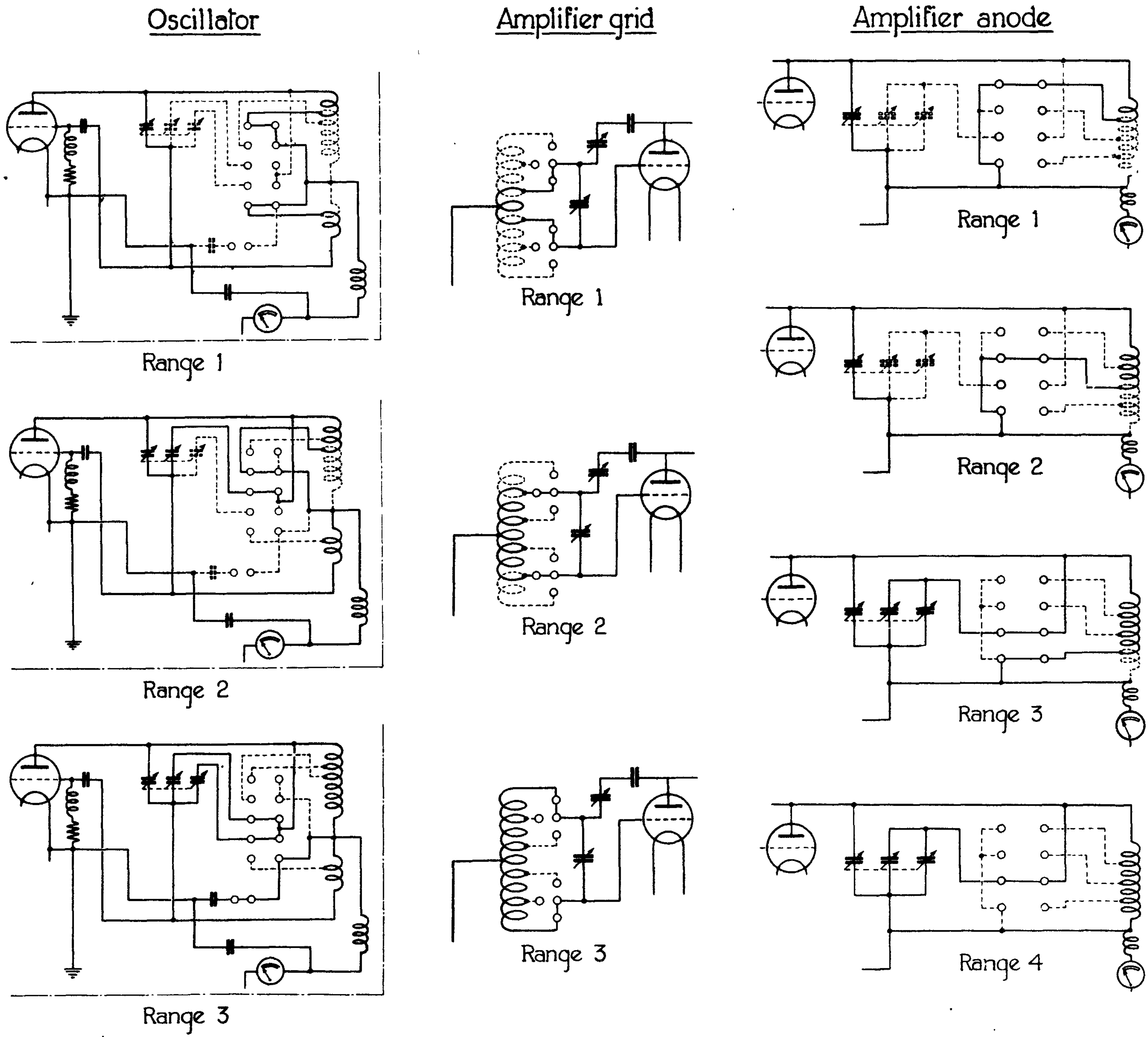

FIG.5. CIRCUIT CHANGES EFFECTED BY RANGE SWITCHES

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Facing paras. 31-37.

31. The other two sounder relays are for the purpose of switching on and off the H.T. and L.T. circuits of the transmitter from the operating station. The method by which switching is accomplished can be seen from an examination of fig. 11. From a centre tap (6) on the primary of the repeating coil, a connection is taken to the (U) terminals of both H.T. and L.T. relays. The D terminals are joined together and earthed. Both relays thus have their windings connected in parallel between the centre of the repeating coil primary and earth. It will be seen, therefore, that if the battery on the operating station is connected between one side of the line and earth, both sounder relays will be energized.

32. The H.T. sounder relay is adjusted to have a space bias, but the L.T. sounder relay is adjusted to the neutral position. The effect of this is that the H.T. relay will normally remain at space and will move to mark only when a current is made to flow in the appropriate direction. When no current flows the tongue will return to space.

33. The tongue of the L.T. relay is adjusted to the neutral position so that it moves to mark when current flows through the relay in one direction or to space when current flows in the reverse direction. It is an important requirement of this relay that the tongue will remain in position at either mark or space after the current which caused the movement has ceased. It will be seen that with this arrangement of the switching relays, the "marking" current may be caused to flow through both relays, and the tongues of both relays will move over to the mark position. So long as this current is maintained, both relays will hold their respective circuits closed. On the cessation of the current, the H.T. relay will open but the L.T. relay will remain closed. If the current is now reversed both relays will be opened.

34. Connections are taken from the tongue and mark terminals of the H.T. relay to the high tension switch on the transmitter. Connections are taken from the L.T. sounder relay to the low tension switch on the transmitter. The distant operator may thus have control of both H.T. and L.T. supply to the transmitter. He may, for example, by merely breaking the switch during a pause in transmission, break the H.T. supply whilst leaving the L.T. on the valve filaments. To shut down the transmitter completely, he merely reverses the current on the line.

CONSTRUCTIONAL DETAILS

35. The transmitter, a front view of which is given in fig. 1, consists of two cubicles, one above the other. The lower cubicle contains the H.T. rectifiers and smoothing equipment, and the upper contains the radio-frequency and modulating circuit equipment.

36. The cubicles consist of rectangular frameworks of angle iron with removable aluminium sides and ends. The two cubicles are separated by distance pieces approximately 9 in. long and in the space thus provided is housed the control unit. The necessary connections between the two cubicles are made by means of lead-covered cables connected between conveniently placed terminal blocks. In fig. 3 is given a bench wiring diagram of the upper cubicle, and in fig. 4 is given a bench wiring diagram of the lower cubicle. The appropriate overall dimensions of the transmitter are 5 ft. 1 in. × 4 ft. 1 in. × 2 ft. 3 in., and the approximate weight is 6 cwt. 4 lb.

37. Referring to fig. 1 which shows a view of the front of the panel, the range switch (1) on the extreme left is for the purpose of varying the anode inductance of the master-oscillator, and the range switch (2) to the right of this varies the amplifier anode inductance. To the right of this is the milliammeter (3), reading 0 to 300 milliamperes, in the anode circuit of the amplifier, and to the right of this again is the thermo-ammeter (4), reading 0 to 1 amperes, in the aerial circuit. Beneath this is the handle (5) which controls the aerial coupling. This is provided with a scale engraved 0 to 10 degrees. The oscillator tuning handle (6) and the amplifier tuning handle (7) which rotate the variable condensers connected across the oscillator and amplifier anode inductances respectively, are situated beneath. Both of these are provided with tuning scales rotating behind windows with engraved datum lines. The oscillator scale is calibrated in megacycles but the amplifier scale is engraved in degrees from 0 to 180.

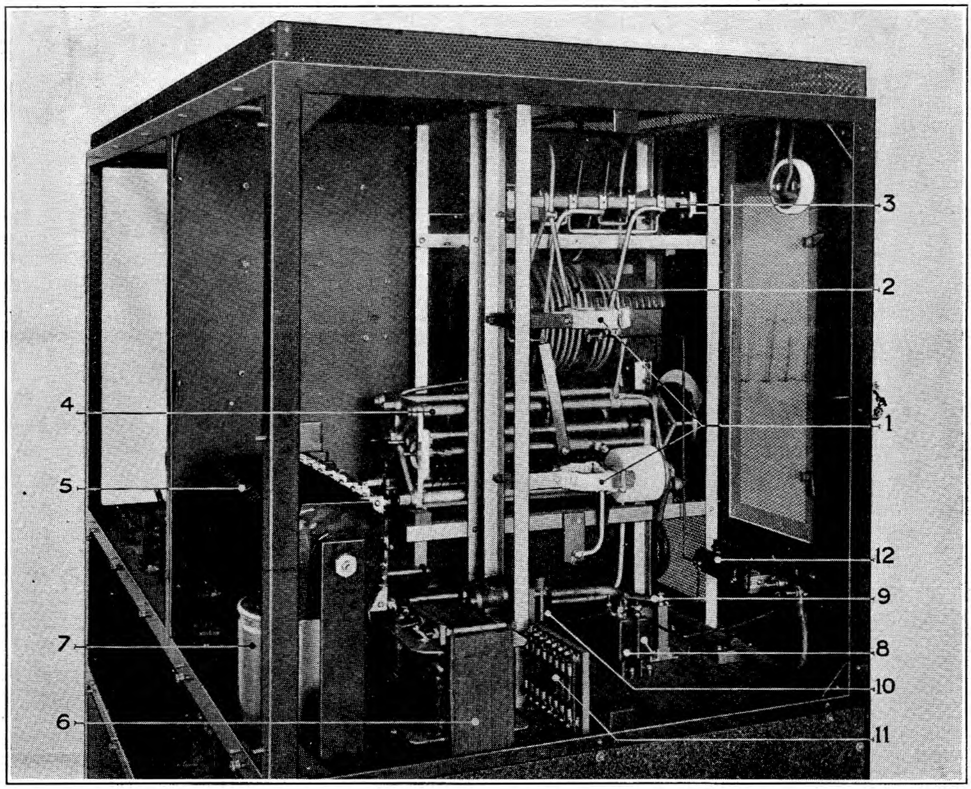

FIG. 6. Oscillator cubicle.

38. In a row beneath these handles are two milliammeters and three control handles. The milliammeter (8) on the extreme left reads from 0 to 250 milliamps. and is connected in the oscillator anode circuit. The range switch handle (9) varies the inductance in the grid circuit of the amplifier. The milliammeter (10), reading 0 to 50 milliamperes, is connected in the amplifier grid circuit. The handle (11) rotates the variable condenser across the amplifier grid inductance, and is provided with a scale reading 0 to 100 degrees. On the right of this can be seen the handle (12) which controls the modulator switch. In one position pure C.W. is radiated and in the other position modulated C.W. is radiated.

39. Below the removable panel (16) which gives access to the remote control unit, there are two meters and one control handle. The left-hand meter (13) reads from 0 to 2·5 kilo-volts and is connected across the output of the rectifier supplying the H.T. to the oscillator valve. The right-hand meter (14) reads 0 to 4 kilo-volts and is connected across the output of the rectifier supplying the amplifier. The control handle (15) has three positions marked 1, 2 and 3 and varies the tap on the primary of the main H.T. transformer.

Upper cubicle

40. In fig. 6 can be seen the interior of the master-oscillator cubicle. The valve is held in the holder (1) mounted upon aluminium uprights. Behind the valve-holder can be seen the anode inductance (2) on which is also wound the reaction and coupling windings. Above this

is the oscillator range switch (3) consisting of a rod of insulating material on which are mounted metal plates, which in the various positions of the switch make the necessary connections to bring into circuit the appropriate amount of the oscillator inductance for the required frequency band. Beneath the inductance is the oscillator tuning condenser (4) which consists of three air-dielectric condensers on a common spindle. The three sections of the condenser are connected up to the range switch (3) and either one, two, or three sections may be connected across the oscillator inductance, depending upon the position of the range switch.

41. The apparatus for the filament supply to the oscillator valve can be seen on the left. It consists of the metal rectifier (5), the choke (6) and the electrolytic condenser (7). On the floor of the cubicle are the two condensers (8) (C_3 and C_{21}, fig. 2) one of which may be disconnected for certain frequencies (*see* para. 56) by uncoupling the link (9). The inductance (10) and the eight 1,000 ohm resistances (11) are in the grid circuit. On the front panel of the cubicle beneath the lower edge of the door is the H/F choke (12) connected in the H.T. feed to the oscillator.

Amplifier cubicle

42. In fig. 7 is given a rear view of the amplifier cubicle. The amplifier valve is carried in the holder (10) mounted upon aluminium uprights. Near the centre of the cubicle can be seen the amplifier anode inductance (1) inside of which is the aerial coupling coil operated by the handle (5, fig. 1) on the front of the panel. Above this is the amplifier anode range switch (2)

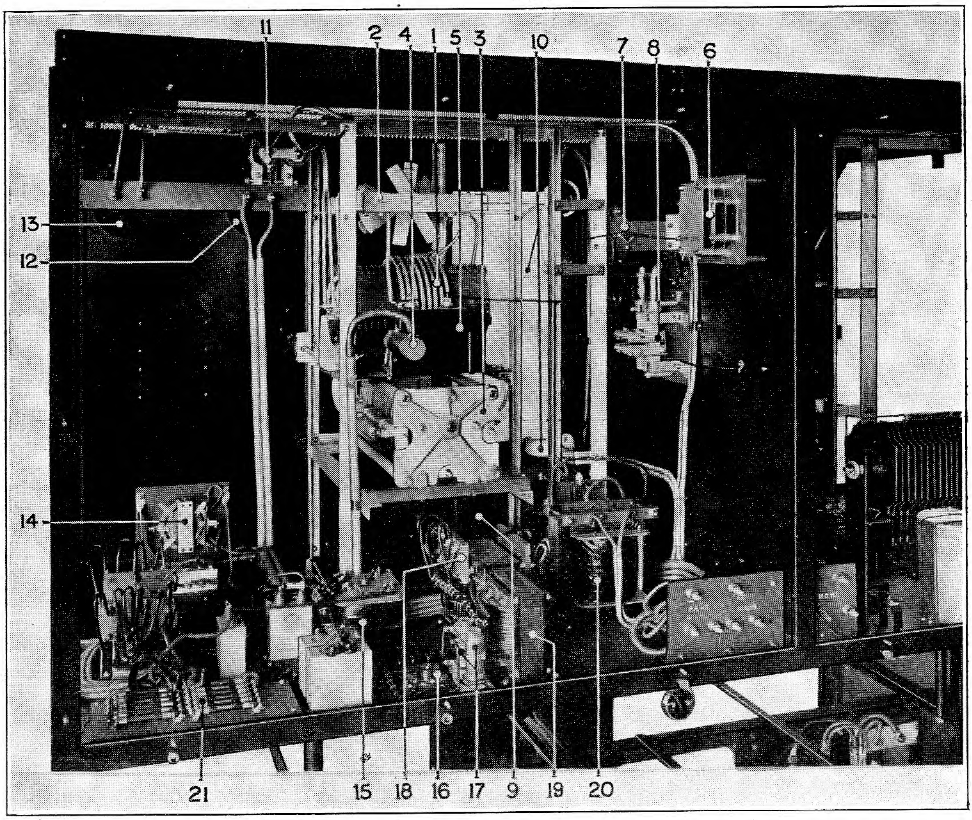

FIG. 7. Amplifier cubicle.

which is similar in construction to the oscillator range switch previously described. Beneath the inductance is the condenser (3) which tunes the anode inductance of the amplifier. This condenser, like the oscillator condenser, is in three sections, one or more sections being connected across the inductance by the amplifier range switch. Mounted near the inductance is the H/F choke (4) in series with the H.T. supply to the amplifier, and near this is the fixed condenser (5) which corresponds to C_6, (fig. 2) and is connected between earth and the end of the inductance remote from the anode. The air-dielectric condenser (6) mounted on the side of the cubicle is in series in the anode connection to the neutralizing condenser (7). Near this and mounted on the same wall of the cubicle, is the relay (8) which keys the coupling link between the oscillator and amplifier circuits. A pair of wires twisted together makes connection between this and a metal compartment (9) in which is housed the amplifier grid inductance and its tuning condenser. The relay (11) which keys the aerial circuit is situated at the top of the cubicle to the left. The rear of the amplifier milliammeter (12) and the aerial thermo-ammeter (13) can be seen on the left On the lower part of this panel is mounted the C.W.—M.C.W. switch (14) and on the floor of the cubicle near by are the valve-holders for the grid-leak modulator and M.C.W. oscillator with their associated equipment. The coupling coil unit (15) has three windings (L_9, L_{10} and L_{11}, fig. 2) one of which is in the anode circuit of the M.C.W. valve, one in the grid circuit of this valve and one in the grid circuit of the grid modulator valve.

43. The double wave rectifying valve which supplies the D.C. for operating the keying relays, the necessary grid bias for the amplifying valve and the H.T. supply for the M.C.W. valve is held in the holder (16), the choke (17), being connected in the anode leads. The filament and H.T. supplies for this valve are obtained from the transformer (18), and a bank consisting of twelve 1,000 ohm resistances (21) in series is connected across the rectified output from the valve. The positive side of this supply is earthed and a tapping is taken from the resistance bank for the grid bias supply to the amplifier valve. The two keying relay windings are connected in series with one another, and in series with the manual key right across the resistance bank.

Lower cubicle

44. The interior of the lower cubicle can be seen in figs. 8 and 9. Referring to fig. 9 the Edison-screw valve-holders (1) and (2) accommodate the gas-filled rectifying valves which supply the rectified H.T. to the oscillator valve. The fuseboard (5) carries three 350 milliampere fuses. One of these is connected in the positive H.T. supply lead to the oscillator and one in each anode circuit of the rectifier. Two 1,000 ohm resistances (6) to the left of this board are also connected, one in each anode circuit of the rectifier. The transformer (7) which supplies the filament current to the rectifying valves, and the H.T. output smoothing choke (8) are mounted on the floor of the cubicle.

45. At the right of the lower cubicle are the holders (3) and (4) in which are carried the two rectifying valves which supply the H.T. to the amplifier, and on the floor of the cubicle beneath are mounted the transformer (11), which supplies the filament current for these valves, and the H.T. smoothing choke (10). In the centre of the floor of the cubicle is a board carrying ten 100,000 ohms resistances wired in series and connected across the output of the rectifiers. Three 500 milliampere fuses, one of which (12) can be seen to the right of the valve-holder, are included in the rectifier circuits. One is connected in each of the anode circuits of the valves and one in the H.T. supply lead to the amplifier. The gate switch (13), which is closed only when the front panel is in position, can also be seen in this illustration. In fig. 8 can be seen the transformer (1) which provides the supply to the anodes of the rectifiers. The full voltage of the secondary is applied to the rectifiers supplying the amplifier, whilst the gas-filled rectifiers which supply the oscillator are supplied with a lower voltage from tappings on the secondary. The two 4μF condensers (3) are in the smoothing circuit of the gas-filled rectifiers and the two condensers (2) to the left of these are of the same value and are in the smoothing circuit of the amplifier rectifiers.

The three mains relay switches can be seen mounted on an inner panel to the right. The upper relay (4) is the delay action relay (X_2, fig. 2) and contains an escapement mechanism which delays the closing of the contacts for 30 seconds after the operating winding is energized from the A.C. mains. The winding of this relay is in series with the three gate switches (13, 15 and 16,

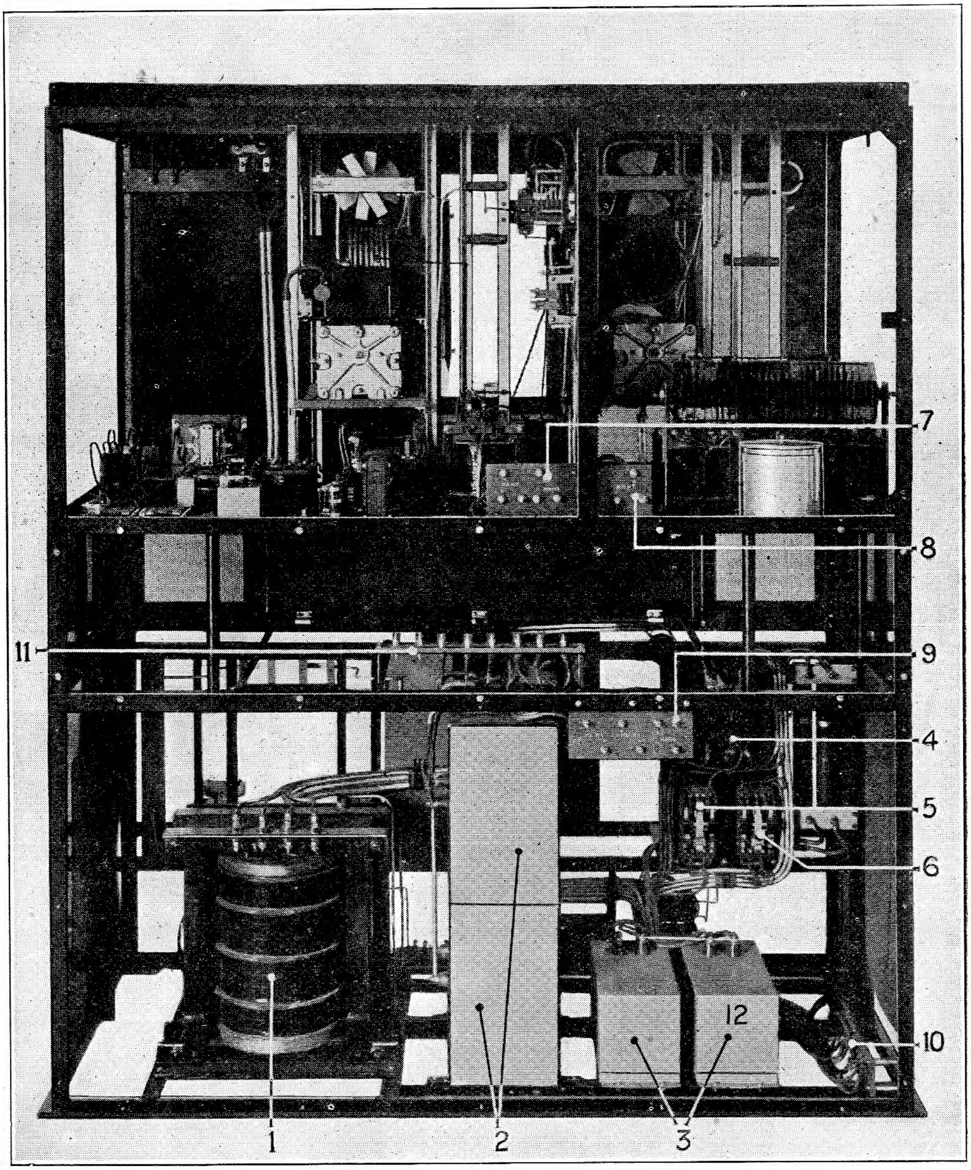

FIG. 8. Rear view, back removed.

fig. 9) so that it becomes de-energized and trips the contacts if a gate is opened. It will be energized again on closing the gates, but a further 30 seconds delay takes place before the operating contacts close. The operating contacts are in series with the A.C. supply to the primary of the H.T. transformer. Also in series with this supply are the operating contacts of the H.T. relay (5) so that it is necessary to have these contacts closed in addition to the gate switches, in order to complete the A.C. supply circuit to the primary of the H.T. transformer. The L.T. relay (6) has its contacts connected in series with the main A.C. line. The windings of the L.T. relay (6)

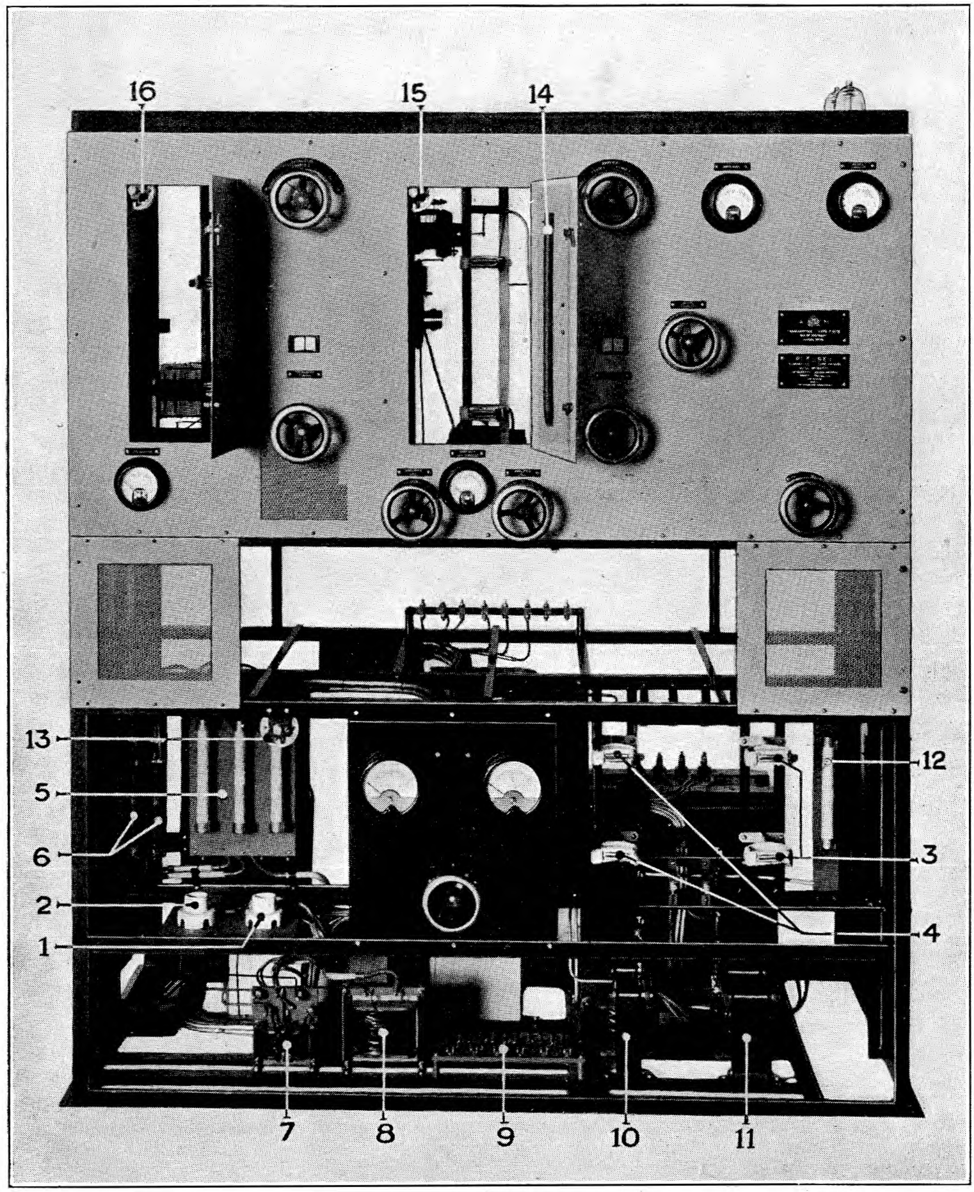

FIG. 9. Front view, lower cubicle uncovered.

and the H.T. relay (5) are connected across the A.C. supply only when the appropriate remote control switches are closed. The winding of the delay relay (4) is connected across the A.C. supply when all the gate switches are closed. There is no other control on this relay.

46. In fig. 10 is given a plan view of the lower cubicle. The upper cubicle, which is normally carried on four angle irons at the corners and six distance pieces (1), has been removed for this view. The four terminals on the top of the H.T. transformer (2) are the primary tappings which are connected by lead-covered cable to the voltage regulating switch (15, fig. 1) on the front

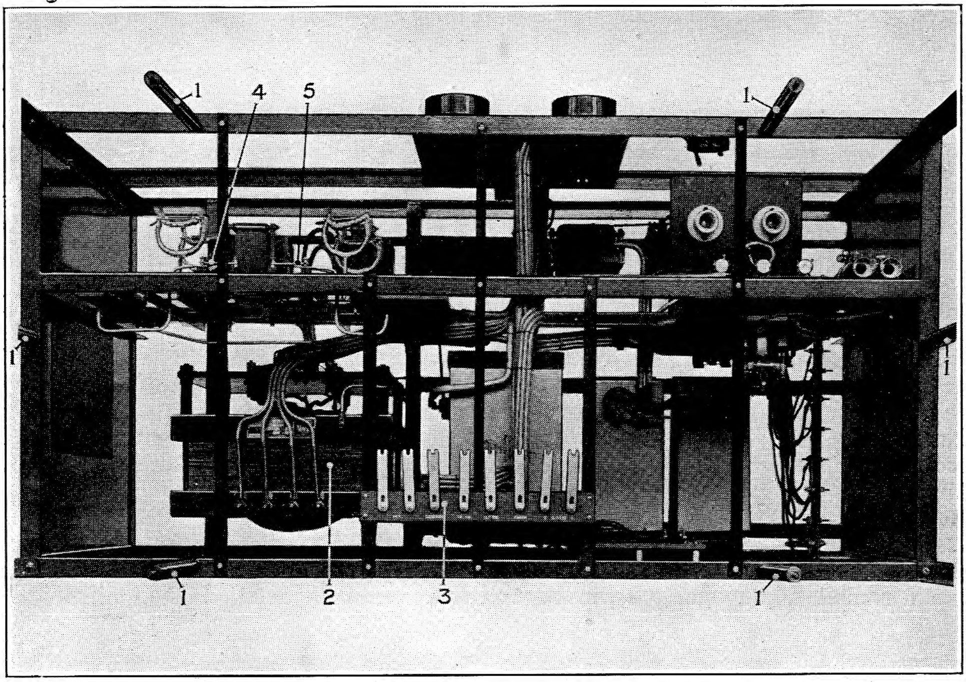

FIG. 10. Lower cubicle viewed from above.

of the panel. The terminal strip (3) is provided with eight links to enable convenient connections to be made to the remote control unit which is slid into position upon the upper framework of this cubicle. The remote control unit is provided with a similar terminal strip carrying eight terminals and similarly engraved.

VALVES

47. The valve used in the master-oscillator circuit is a T.X.3–200 with a filament voltage of 12. The valve used in the amplifier is a T.X.5–400 with a filament voltage of 17·5. The 1,000 cycle oscillator circuit employs an indirectly heated 164V. valve having a heater voltage of 4. The grid-leak modulator valve which is coupled to the 1,000 cycle oscillator circuit is an M.Z.05–20 valve. It has a filament voltage of 6.

48. The rectifying valves for the oscillator are gas-filled RG1–125 valves having filament voltages of 2, and the rectifying valves for the amplifier are R.X.3–120 valves, the filament voltage of which is 13·5. A D.W.4 double wave rectifying valve (4 volt filament) is used for supplying the H.T. for the 1,000 cycle oscillator, for the supply to the keying circuit, and for the amplifier grid bias.

OPERATION

49. See that the 230 volt 50 cycle A.C. supply is connected up to the terminal board on the left-hand side of the lower cubicle, that the jumper connections between the two cubicles are properly connected and that the control line is connected up to the terminals marked A and B. The remote control unit, type 2, is provided with eight terminals which should be connected across by the eight strips provided to the remote control panel on the transmitter.

50. Connect up the transmission line or aerial to the appropriate insulators on the top of the transmitter. Place all valves in position. See that the anode circuits of the two thermionic rectifier valves (H.T. supply to amplifier) are broken by means of the straps (4 and 5, fig. 10) provided.

51. Close the L.T. switch on the remote control unit. This will complete the A.C. supply circuit to the filament transformers, and the valve filaments will heat up. Thirty seconds after the closing of the L.T. switch the delay relay will operate automatically. The gate switches are in series with the winding of the delay relay. The delay relay cannot, therefore, operate if any gate on the transmitter is left open. The H.T. circuit will not yet be completed as it is still broken at the H.T. relay, which can be closed only by operating the H.T. switch on the control unit. Before closing the H.T. switch, set the "power control switch" to position 3 (lowest voltage) and the C.W.—M.C.W. switch to the C.W. position. Set the aerial coupling to zero. Set the range switches (*see* Table 1) to give similar inductance ranges, *e.g.*, master-oscillator to 1. amplifier grid to 1 and amplifier anode to 2. Now close the H.T. switch on the control unit. Observe the milliammeter in the oscillator anode circuit. There should be a reading of 50 to 80 milliamperes.

52. Press the test key and tune the amplifier grid circuit. The amplifier grid milliammeter should show a reading of 20 to 35 milliamperes. Whilst observing the grid milliammeter, vary the amplifier anode tuning condenser and ascertain the resonant setting.

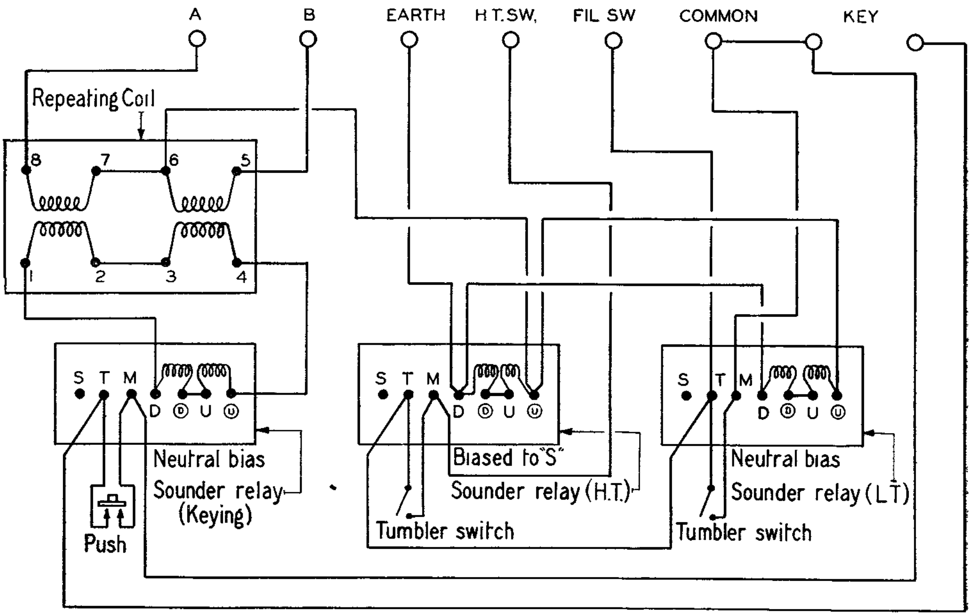

FIG. 11. Remote Control unit (type 2) circuit diagram.

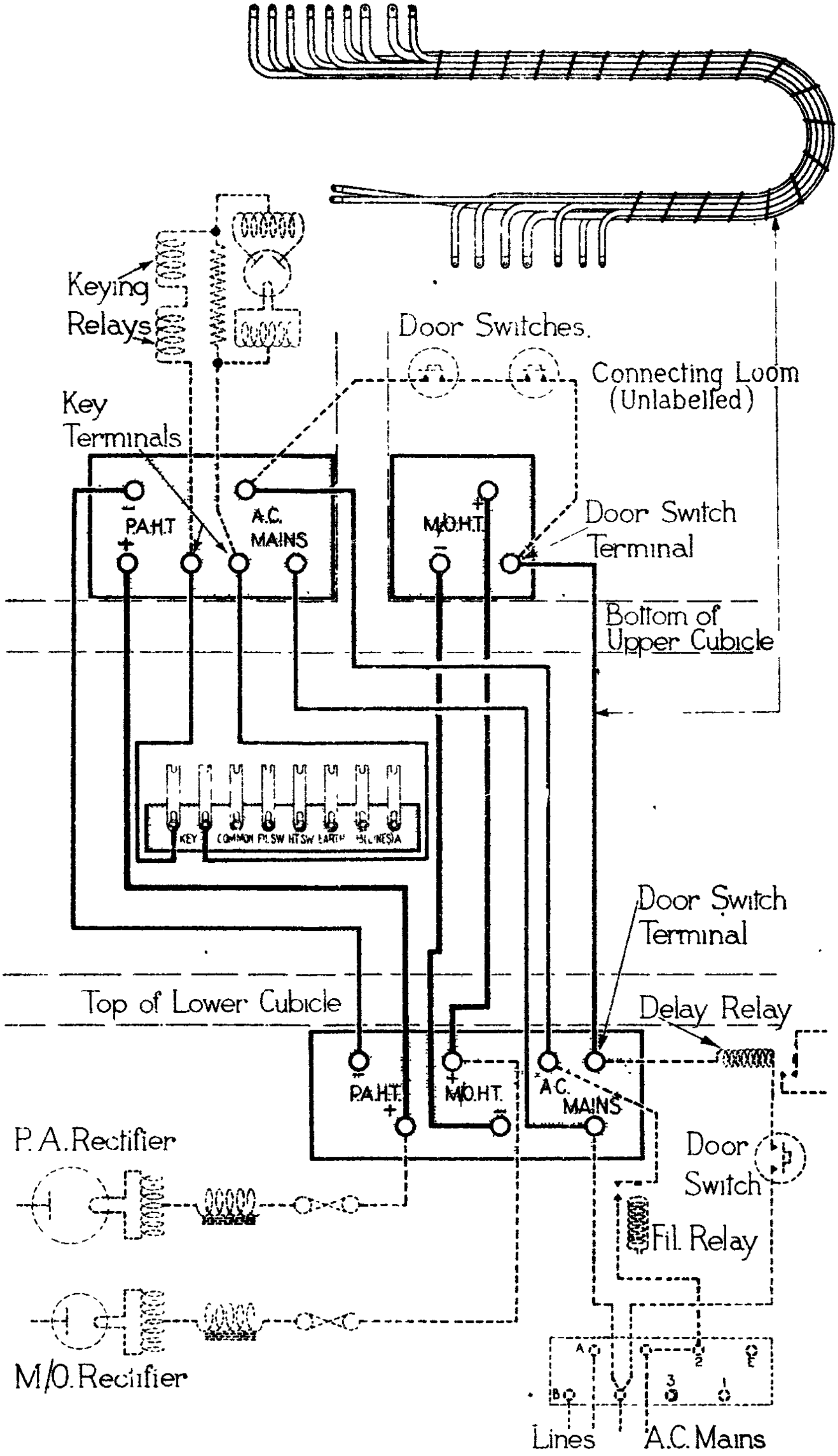

FIG. 12. INTER-CUBICLE CONNECTIONS

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53. The amplifier should now be neutralized by inserting the special insulated tool (14, fig. 9) through the hole in the door of the amplifier section and engaging it with the neutralizing condenser spindle. Whilst varying the amplifier anode tuning control about the resonant point, adjust the neutralizing condenser until the " kick " on the grid milliammeter produced by the amplifier anode control is gradually reduced. The neutralizing condenser should be left at the adjustment which gives the minimum " kick."

54. Break the H.T. circuit by means of the switch on the control unit and re-connect the two links in the anode circuits of the thermionic rectifiers which supply the H.T. to the amplifier. Close the H.T. switch and check the neutralization, making any slight adjustment that may be necessary. Increase the aerial coupling and re-tune the amplifier anode circuit. The voltage may now be increased by moving the power control to position 2 and then to position 1.

55. The oscillator tuning condenser scale is calibrated directly in megacycles and if this is set to the frequency required the succeeding tuned circuit can be brought into resonance with it. In Table 2 is given a typical set of readings for several frequencies. For accurate setting of the frequency, however, a wavemeter such as W.1081 should be used or, failing this, a wavemeter W.66 may be used as a preliminary adjustment subsequently checking the frequency by reference to the monitoring station. The transmitter should be allowed to reach a steady temperature before finally setting the frequency, a warming-up period of at least 15 minutes being necessary.

PRECAUTIONS AND MAINTENANCE

56. When setting the transmitter to frequencies within the 5·3 to 3·0 megacycles band (range 3 of the master-oscillator) the 0·0005μF condenser in the master-oscillator cubicle must be brought into circuit by means of the link provided. The link must be opened for all other ranges. When connecting or disconnecting this link it should be remembered that although the H.T. circuit will be broken (the opening of the cubicle gate will trip the delay relay) the condenser and that adjacent to it will be holding a charge. The condenser should be short-circuited by means of a screwdriver or similar tool with an insulated handle before handling.

57. The rectifying valves (RG1–125) used for the oscillator supply are of the gas-filled type. If it should be necessary to insert a new one or one that has been out of use for some time, the filament should be heated for at least 15 minutes before H.T. is applied to the anode.

58. When inserting or withdrawing the master-oscillator valve, care should be taken to ensure that the compensating capacity device beside it is not interfered with. The two strips which comprise this device are bowed outward from one another and it is important that no change in the shape should be made.

59. All relays should be periodically inspected to see that they are free on their bearings, this applies particularly to the keying relays, a very small amount of clock oil being applied, if necessary. The relay contacts should be inspected at the same time and cleaned if necessary. Should any pitting be found the contacts should be faced up carefully with a magneto file. The relays which key the aerial circuit and the coupling link (11 and 8, fig. 7) are mounted on metal partitions of rather large area. If any trouble is experienced in the operation of the relays examine the mountings and partition bolts and take all precautions to ensure that all causes of excessive vibrations are removed. The time delay relay should have the escapement mechanism oiled with clock oil occasionally. All switch blades, contacts, valve-holder sockets, etc., should be inspected periodically and cleaned where necessary.

60. A resistance (R_8, fig. 2) is provided across the reservoir condenser C_{18} in the amplifier rectifier supply. No such discharge resistance is provided on the M/O rectifier, and one should be fitted in order to protect personnel from shocks. This should be made up by soldering four

resistances type 29 (Stores Ref. 10A 7267) in series, making short connections between the resistances to keep the assembly rigid. When fitting this the A.C. main switch should first be switched off and the lower rear cover of the transmitter removed. The two condensers (3, fig. 8) should now be discharged by means of a screwdriver with an insulated handle. The resistance assembly may then be connected across one of these condensers, making sure that the resistances are clear of all other conductors. The condenser in question is represented by 12, fig. 8. It will be seen that a connection is taken from this to the fuse F.3, and that the condenser is on the load side of the choke.

61. The usual form of remote control employed with ground station transmitters is of the A.C. keying type, and not the type described in paras. 29 *et seq.* The system of keying transmitters by means of A.C. is described in this publication in the chapter on remote controls and in order to adapt the T.1078 to this form of keying, a modification will be necessary. At the present time (1938) no such change is visualized.

TABLE 1

Frequency Megacycles.	Master-Oscillator Range.	Amplifier Grid Range.	Amplifier Anode Range.
15·0–12·0	1	1	1
12·2– 9·0	1	1	2
9·5– 5·25	2	2	3
5·3– 3·0	3*	3	4

* 0·005 μF connected in M/O circuit for this range.

TABLE 2

kc/s.	Tunings.						Aerial Coupling.	M/O Input.		Amplifier Input.		Output C.W.	Power Tap.
	M/O.		Amplifier Grid.		Amplifier Anode.								
	Range.	Mc/s.	Range.	Condsr.	Range.	Condsr.		mA.	Volts.	mA.	Volts.	Amps.	
10,032	1	10·04	1	79	2	78	3·0	71	1,505	130	3,150	·52	1
10,032	1	10·04	1	79	2	78	3·0	60	1,340	106	2,790	·42	2
10,032	1	10·04	1	79	2	78	3·0	50	1,110	82	2,340	·32	3
10,032	1	10·04	1	72	2	78	3·0	77	1,600	74	3,500	·33	1
15,400	1	15·4	1	18	1	144	3·0	75	1,500	176	3,100	·60	1
12,000	1	12·0	1	57	1	2	1·5	76	1,540	156	3,190	·52	1
12,200	1	12·2	1	56	2	165	1·5	78	1,520	164	3,150	·66	1
8,900	1	8·9	1	92	2	15	1·5	75	1,570	130	3,300	·5	1
9,100	2	9·1	2	24	3	180	1·5	110	1,390	190	3,000	·64	1
5,100	2	5·1	2	87	3	3	1·5	135	1,310	200	2,800	·54	1
5,250	3	5·25	3	35	4	179	1·5	63	1,525	156	3,190	·64	1

APPENDIX

NOMENCLATURE OF PARTS

The following list of parts is issued for information. In ordering spares for this transmitter, the appropriate section of AIR PUBLICATION 1086 must be used.

Ref. No.	Nomenclature.	Quantity.	Remarks.
10A/8292	Transmitter, type T.1078		Complete, without valves.
	Principal components :—		
10A/9406	Ammeter, Thermo 0–1 amp.	1	2½ in. dial, projecting type.
10A/9390	Choke L/F.	1	Iron core 5 in. × 5 in. × 5½ in. overall (approx.).
10A/9391	Choke L/F.	2	Iron core. 4 in. × 5 in. × 5 in. overall (approx.).
10A/9392	Choke L/F.	1	Iron core 3½ in. × 4 in. × 3 in. overall (approx.).
10A/9375	Condenser	1	·002μF, 2,500 V.D.C. with porcelain cover.
10A/9376	Condenser	1	4,000μF, electrolytic, 12V. working.
10A/9377	Condenser	2	·0005μF, in moulded case.
10A/9378	Condenser	1	·00003μF, fixed air dielectric.
10A/9379	Condenser	1	·002μF, in moulded case.
10A 9380	Condenser	2	2·0μF, 500 V. paper dielectric, metal case.
10A/9381	Condenser	1	·15μF, 250 V. paper dielectric, metal case.
10A/9382	Condenser	2	2·0μF, 250 V. paper dielectric, metal case.
10A/9383	Condenser	2	1·0μF, 250 V. paper dielectric, metal case.
10A/9384	Condenser	2	4·0μF, 2,500 V. paper dielectric, metal case.
10A/9385	Condenser	2	4·0μF, 4,000 V. paper dielectric, metal case.
10A/9386	Condenser	2	Variable, ganged air dielectric.
10A/9387	Condenser	1	·002μF, moulded case.
10A/9388	Condenser	1	Adjustable air condenser.
10A/9389	Condenser	1	·0002μF, variable, air dielectric.
10A/9185	Condenser, type 286	3	·01μF.
10A/9393	Fuse, 350 mA., 2,000 V.	3	
10A/9394	Fuse, 500 mA., 3,000 V.	3	
10A/9395	Inductance	1	Oscillator anode.
10A/9396	Inductance	1	Amplifier grid.
10A/9397	Inductance	1	Amplifier anode.
10A/9398	Inductance	1	Aerial.
10A/9399	Inductance	3	Oscillator grid choke. Amplifier grid choke. Amplifier anode choke.
10A/9400	Inductance	1	
10A/9401	Inductance	1	1,000 cycle oscillator.
10A/9402	Inductance	1	Combined unit.
10A/8093	Insulator, Type 16	2	
10A/9404	Milliammeter 0–50 mA.	1	2½ in. dial, projecting type.
10A/9403	Milliammeter 0–250 mA.	1	2½ in. dial, projecting type.
10A/9405	Milliammeter 0–300 mA.	1	2½ in. dial, projecting type.
10A/8409	Rectifier, metal	1	
10A/9410	Relay, magnetic	2	S.P. make and break, A.C. operated.

APPENDIX—*continued*

Ref. No.	Nomenclature.	Quantity.	Remarks.
10A/8292	Transmitter, Type T.1078—*continued*		
	Principal components—*continued*		
10A/9411	Relay, magnetic	1	H.T. relay with time lag mechanism. A.C. operated.
10A/9412	Relay, magnetic	2	Keying relay 600 V. D.C. operated.
10A/9413	Resistance	2	·125 ohm, 30 watt, vitreous em bedded.
10A/9414	Resistance	8	1,000 ohms, rod type 43 × 6 mm.
10A/9415	Resistance	3	2,500 ohms, rod type 43 × 6 mm.
10A/9418	Resistance	12	1,000 ohms, rod type 43 × 6 mm.
10A/9419	Resistance	10	100,000 ohms, 1 watt, rod type.
10A/9420	Resistance	2	1,400 ohms, 150 watts, vitreous embedded, with two taps.
10A/9421	Resistance	1	300 ohms, ½ watt, rod type.
10A/9416	Resistance	2	2,000 ohms, 30 watts, vitreous embedded.
10A/9422	Switch	1	Oscillator range switch.
10A/9423	Switch	1	Amplifier grid switch.
10A/9424	Switch	1	Amplifier range switch
10A/9425	Switch	1	C.W. and M.C.W. switch.
10A/9426	Switch	1	Power control switch.
10A/9417	Terminal panel, remote control ..	1	
10A/9427	Transformer	1	M/O Fil. R.M.T.33.
10A/9428	Transformer	1	Amplifier Fil. R.M.T.24.
10A/9429	Transformer	1	Oscil. "Mod" Fil. R.M.T.34.
10A/9430	Transformer	1	Bias Rectr. Fil. R..M.T.13.
10A/9431	Transformer	1	Mercury Rectr. Fil. R.M.T.28.
10A/9432	Transformer	1	H.T. Foster 71/S.202.
10A/9433	Transformer	1	Thermionic Rect. Fil. R.M.T.26.
10A/9434	Transformer	1	G.L. Modr. Fil. R.M.T.10.
10A/9407	Voltmeter 0–2·5 kilo-volts	1	3¼ in. dial, projecting type.
10A/9408	Voltmeter 0–4·0 kilo-volts	1	3¼ in. dial, projecting type.
	Accessories		
10A/9009	Controls, remote, ground station, Type 2 ..	1	
10A/9435	Valve T.X.3–200	1	M/O Mullard.
10A/9436	Valve T.X.5–400	1	Apmr. Mullard.
10A/9437	Valve 164 V	1	M.C.W. Oscillator Mullard.
10A/9438	Valve M.Z.05–20	1	G.L. Modr. Mullard.
10A/9439	Valve D.W.4	1	Bias Rectr. Mullard.
10A/9440	Valve R.G.1–125	2	Mercury Rectr. Mullard.
10A/9411	Valve R.X.3–120	2	Thermionic Rectr. Mullard.

December, 1938

AIR PUBLICATION 1186
Volume I

SECTION 1, CHAPTER 5

TRANSMITTER T.1083

Contents

List of Illustrations

TRANSMITTER T.1083

(Stores Ref. 10A/8456)

INTRODUCTION

1. This transmitter is a General Purpose Aircraft Transmitter covering the following frequency bands 136 to 500 kc/s and 3 to 15 Mc/s. It is capable of C.W., I.C.W. and R/T transmission. The send-receive switch of the transmitter may be remote controlled.

2. The transmitter comprises a master-oscillator valve and an amplifier valve, the frequency bands being covered in four ranges by means of four pairs of plug-in coils. The ranges are as follows: 136 to 500 kc/s, 3 to 6 Mc/s, 6 to 10 Mc/s and 10 to 15 Mc/s. C.W., I.C.W. or R/T

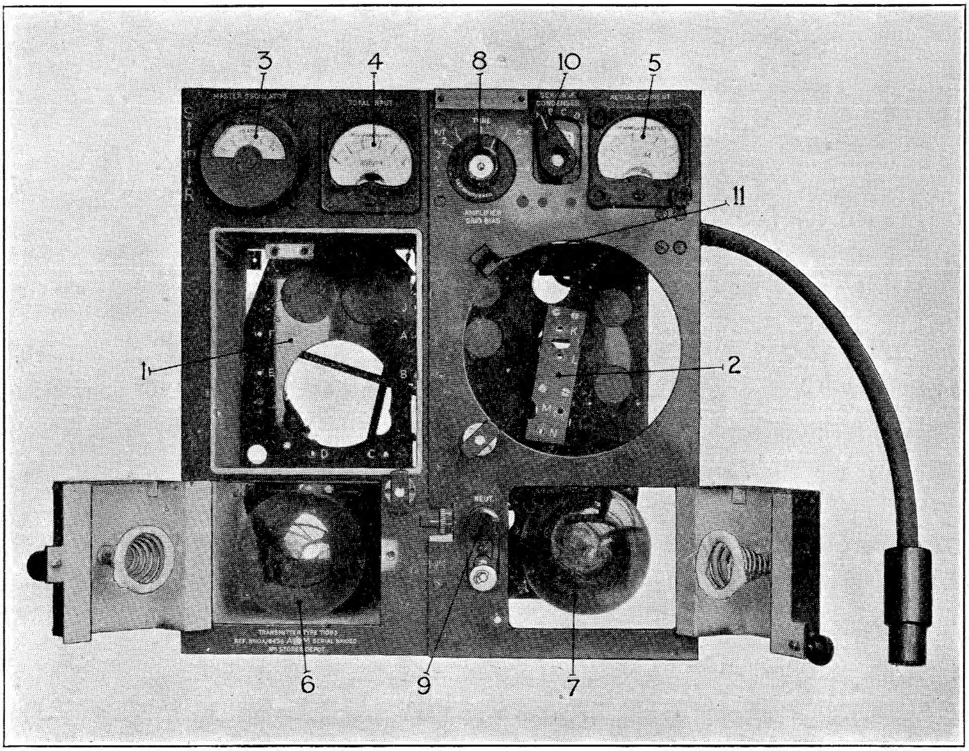
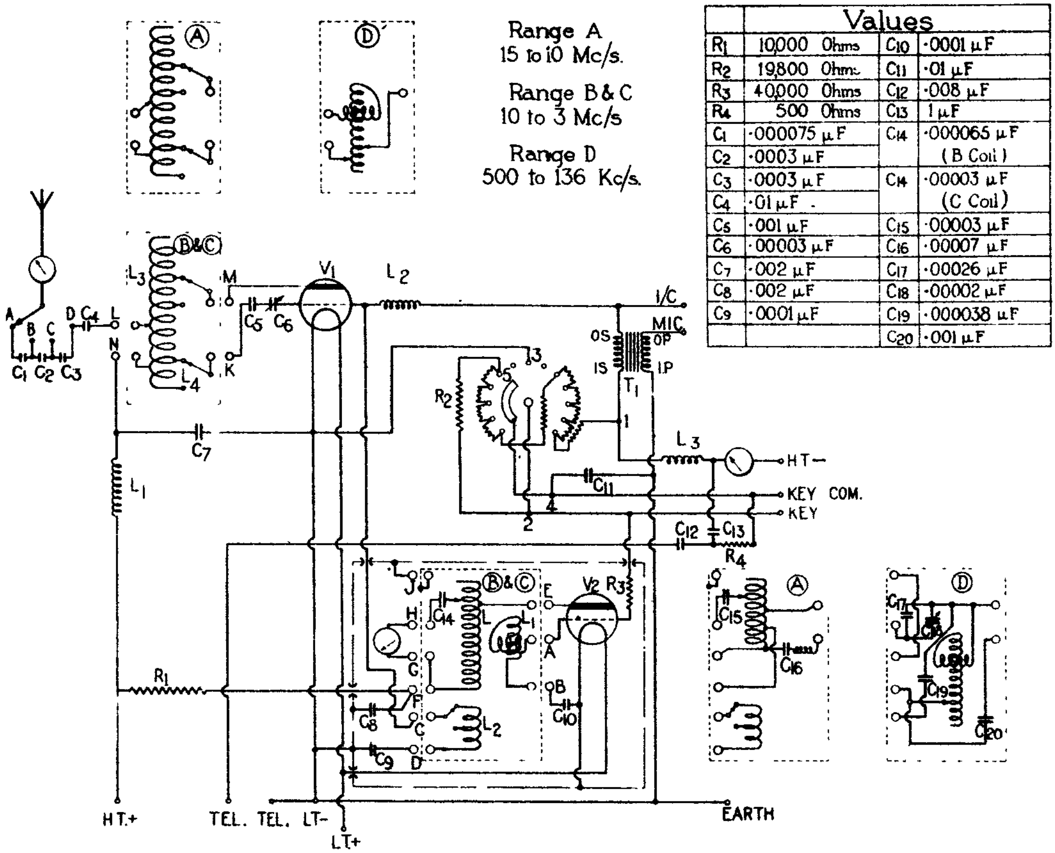


FIG. 1. Front view of transmitter, T.1083.

transmission may be made on any of these ranges, except the first mentioned range, where R/T is not practicable. The transmitter is intended to be used in conjunction with the receiver R.1082 and arrangements are provided to enable the transmitter and receiver to be used for intercommunication in the aeroplane. Provision is also made for "listening-through".



Values			
R1	10,000 Ohms	C10	·0001 µF
R2	19,800 Ohms	C11	·01 µF
R3	40,000 Ohms	C12	·008 µF
R4	500 Ohms	C13	1 µF
C1	·000075 µF	C14	·000065 µF (B Coil)
C2	·0003 µF		
C3	·0003 µF	C14	·00003 µF (C Coil)
C4	·01 µF		
C5	·001 µF	C15	·00003 µF
C6	·00003 µF	C16	·00007 µF
C7	·002 µF	C17	·00026 µF
C8	·002 µF	C18	·00002 µF
C9	·0001 µF	C19	·000038 µF
		C20	·001 µF

FIG. 2, THEORETICAL CIRCUIT DIAGRAM

GENERAL DESCRIPTION

Transmitter

3. In fig. 2 is given a theoretical circuit diagram of the transmitter. V_1 is an amplifier valve and V_2 an oscillator valve. The plug-in units for both amplifier and oscillator may be changed to cover the frequency bands required. There are four of these units for the oscillator and four for the amplifier, marked as follows :—

Range A	.. ..	10–15 Mc/s
,, B	.. ..	6–10 Mc/s
,, C	.. ..	3–6 Mc/s
,, D	.. ..	136–500 kc/s

4. In the diagram of fig. 2 the circuit is shown for the 3–10 Mc/s band (ranges B and C). The circuit changes effected when coil units A or D are plugged into position are shown in the dotted rectangles near the oscillator and amplifier valves, and the resistance and capacitance values are given in the table in the upper right-hand corner of the illustration.

5. A switch is provided on the transmitter by means of which one, two or three small condensers may be included in the aerial circuit to raise its natural frequency. Position A gives the highest, and position D the lowest, natural frequency.

6. External to the transmitter a further condenser may be connected in the earth lead when, in a large aircraft, difficulty is experienced in reaching the highest frequencies. This condenser is shunted by an inductive resistance so that no steady charge can accumulate. Such a charge would raise the chassis of the transmitter to a potential other than earth potential. An aerial blocking condenser is provided.

7. The neutralizing winding L_4 in the amplifier circuit is provided to prevent feed-back in the amplifier circuit. If this provision were not made the value of the master-oscillator drive would be lost. The winding is connected back to the grid of the amplifier through the fixed condenser C_5 and the variable condenser C_6, and neutralization is effected by adjustment of the condenser C_6. The fixed condenser C_5 is connected in series to prevent damage in the event of an accidental short-circuit in the variable condenser.

8. Keying is effected by joining H.T. negative to L.T. negative through the bias as shown in fig. 7. It will be seen that the oscillator is keyed as well as the amplifier.

9. For R/T, modulation is effected by connecting the secondary of a microphone transformer in series with the amplifier grid-bias arrangement. There is thus imposed on the steady grid bias a component which alternates at speech frequency.

10. In fig. 3, simplified diagrams are given showing the changes in the circuit of the transmitter for the frequency bands 15–10 Mc/s (range A), 10–3 Mc/s (ranges B and C) and 500–136 kc/s (range D). Referring first to range D it will be seen that on the lower frequencies the master-oscillator circuit is a Colpitts oscillator in which reaction is obtained by applying the R/F. p.d's of the mains condenser between grid and filament. The inductance is tapped and a fine tuning variometer is included. The amplifier circuit incorporates a tapped coil and fine tuning variometer. The coupling between amplifier and master-oscillator is through a coupling condenser. A neutralizing arrangement is not provided on this frequency band.

11. For ranges B and C it will be seen that the oscillator becomes a tuned-anode-tuned-grid circuit in which reaction is obtained through the anode-grid capacitance of the valve. The anode inductance is shunted by a condenser through a variable tapping point. The grid circuit is tuned by a variometer. The amplifier circuit incorporates an inductance with a variable aerial tap and a neutralizing winding. The coupling between amplifier and master oscillator is provided by the coupling coil.

12. For range A the amplifying circuit remains the same as for B and C (an inductance with a variable aerial tap and a neutralizing winding) but the master oscillator circuit is now changed to a form of Hartley circuit, the anode inductance being shunted by a condenser through a variable tapping point, and the grid circuit being coupled to the end of the inductance through a choke and condenser.

13. The way in which grid bias is controlled is shown in fig. 7. A suitable fraction of the resistance $R+R_2+R_1$ is connected between H.T. negative and filament, and the IR drop across this resistance is used as grid bias. The resistance R is always in circuit; it ensures that the bias will never fall below a safe minimum value. The arm selects a tapping on resistance R_2 and includes a suitable fraction of R_2 in series with R. When the arm is moved into the position " TUNE " the resistance R_1 is put in series with R and R_2. In this position the bias is so great that the amplifier valve is inoperative.

14. The arm has ten positions on R_2, marked C.W. 1, 2, 3, 4 and 5 and R/T 1, 2, 3, 4 and 5 respectively. As the arm is moved from stud 1 to stud 5 in either the C.W. or the R/T quadrant the bias is progressively decreased, and the input and output of the amplifier are correspondingly increased. When the arm is moved into any of the five R/T positions it not only selects a suitable steady bias but also short-circuits the key. The bias for the oscillator valve is fixed by means of a separate resistance.

15. In fig. 2 can be seen the arrangements for obtaining side tone. A portion of the audio-frequency component of the amplifier grid voltage is applied *via* a condenser C_{13} to a resistance R_4 to which the telephones are connected in series with a small condenser C_{12}. The telephones are switched from this circuit to the receiver by means of the send-receive switch, when reception is taking place. Also in fig. 2 can be seen the R/F. chokes in the transmitter H.T.+ and H.T.— connections, and in the lead from the grid of the amplifier valve to the microphone transformer. The chokes in the H.T. leads are for the purpose of preventing R/F. energy from reaching the generator, and also to prevent any tendency for this circuit to resonate. The choke in the grid circuit ensures that the R/F. drive from the oscillator is not short-circuited *via* the microphone transformer and the bias circuit.

16. The chokes exterior to the transmitter can be seen in fig. 7. They are in the following circuits: H.T.+ and H.T.—, key and microphone, and are grouped in one unit.

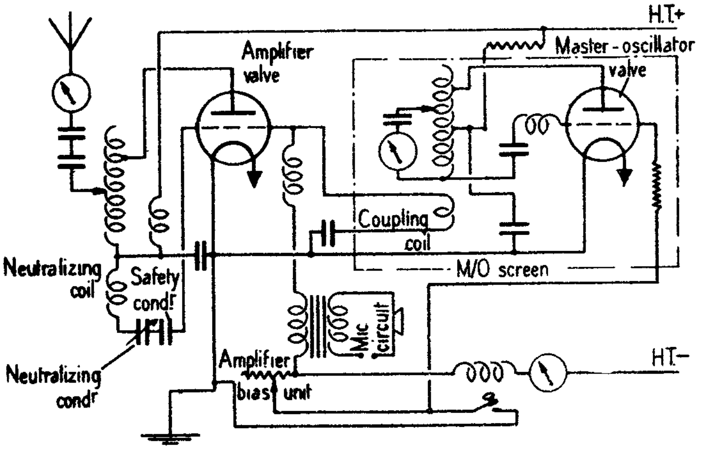
17. Transmitter filament chokes (Stores Ref. 10A/8463) are provided for use in flying boats, where the filaments are heated from a 12-volt battery; the D.C. drop in the chokes is 4 volts. If the battery is on charge (14 volts), the choke terminals marked L.BATT. should be used. The standard arrangement is shown in fig. 15, however, and no departure should be made from this without authority.

Coils

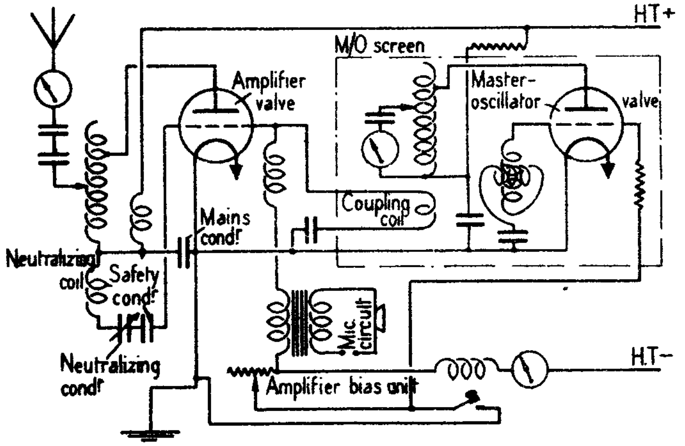
18. Six of the eight coil units with which the transmitter is provided are shown in fig. 4. The coil units in the front row are the M/O. units for ranges B, C and D covering the ranges 10,000 to 6,000 kc/s, 6,000 to 3,000 kc/s, and 500 to 136 kc/s respectively. The units in the rear row are the units for the corresponding ranges of the amplifier. Coil units range A (not shown) for both M/O. and amplifier are of similar appearance and cover the band 15,000 to 10,000 kc/s. All coil units are engraved with their frequency band. A diagram of the internal connections of the coils is given in fig. 13.

Listening-through

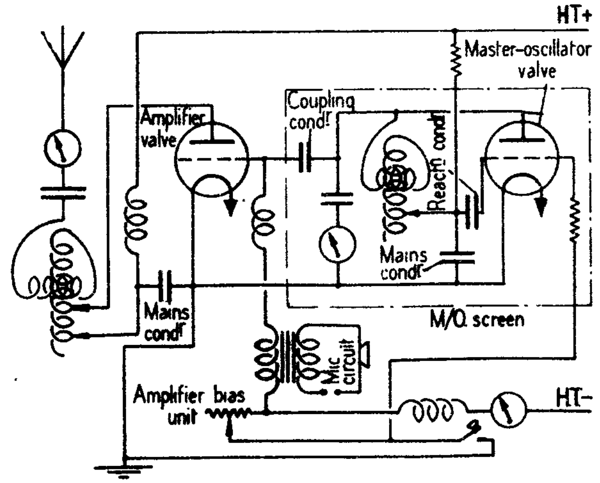
19. The installation is provided with a listening-through arrangement. This consists of a small unit of moulded material provided with three connections. Two of these connections are taken to the transmitter, and one to the receiver. When they are connected in this way a fixed



15–10 Mc/s (RANGE A)



10–3 Mc/s. (RANGES B & C)



500–136 kc/s. (RANGE D)

FIG. 3. SIMPLIFIED CIRCUIT DIAGRAMS T.1083

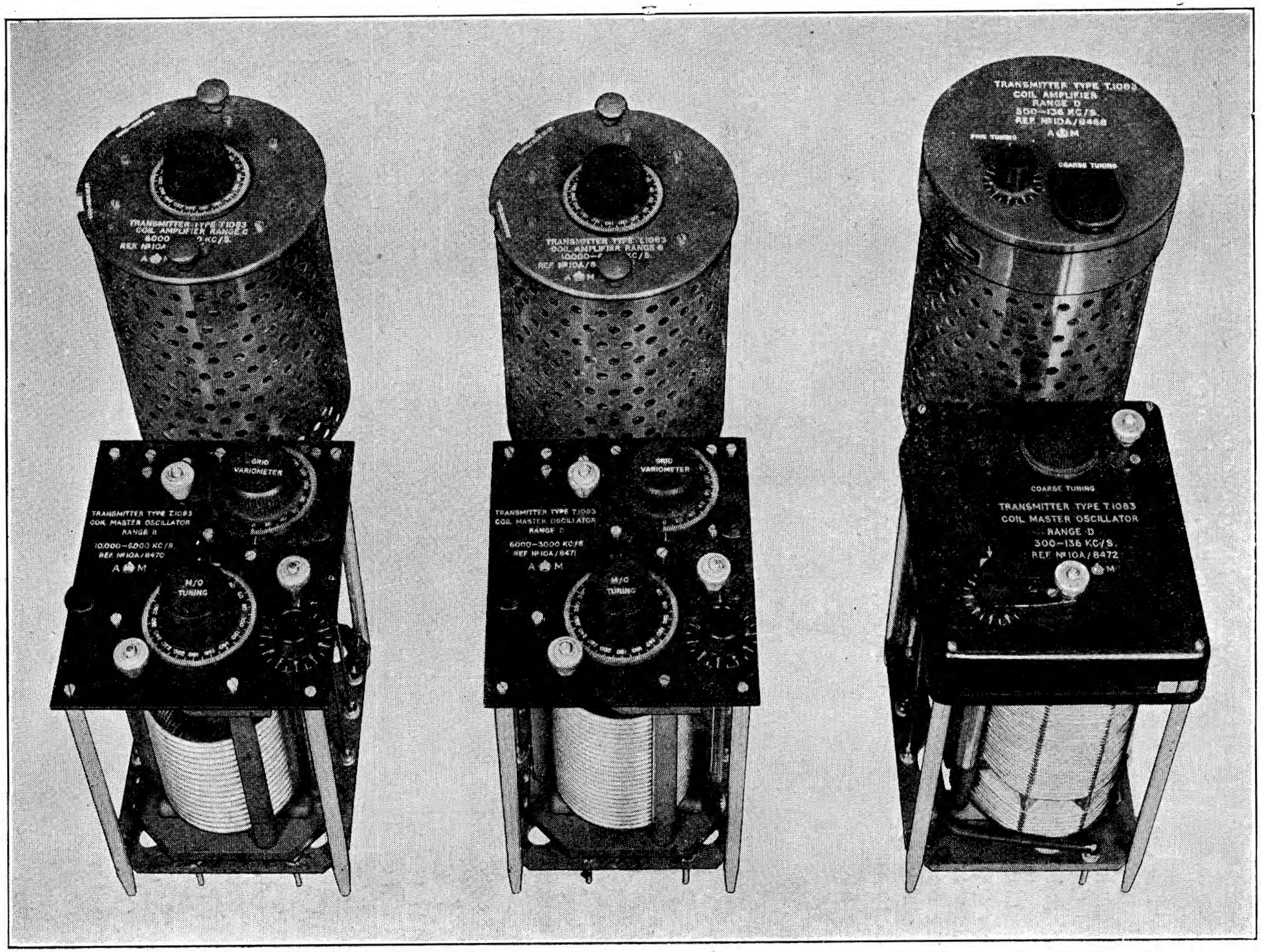


FIG. 4. Transmitter coils, B, C & D.

condenser incorporated in the unit is connected between the receiver and transmitter inductances, and the aerial is connected to one side of the condenser. As will be seen from the diagram of fig. 5, when transmission is in progress, the operator will be able to listen-in during pauses in his transmission owing to the permanent connection of the receiver through the listening-through condenser to the aerial. There is a further important effect arising from this listening-through arrangement. During reception, the transmitter aerial inductance (tuned to the same frequency) is coupled to the receiver aerial inductance, resulting in an increase of sensitivity and selectivity beyond those normal to the receiver. It will be apparent from the foregoing that background noises during reception would nullify any advantages derived from this and, therefore, it is essential that the generator should be as noise-free as possible. The smoothing unit shown in figs. 15 and 16 is, therefore, employed.

20. Listening-through is not possible when transmitting R/T. On telegraphic transmission it is only applicable when transmission and reception are being carried out on the same frequency. Searching is not practicable when listening-through. If it is desired to make use of the advantages accruing from the use of the transmitter aerial coil, and neither transmission nor searching is contemplated, it is important to ensure that the send-receive switch is in the " receive " position in order to avoid waste of L.T. current on the transmitter valve filaments.

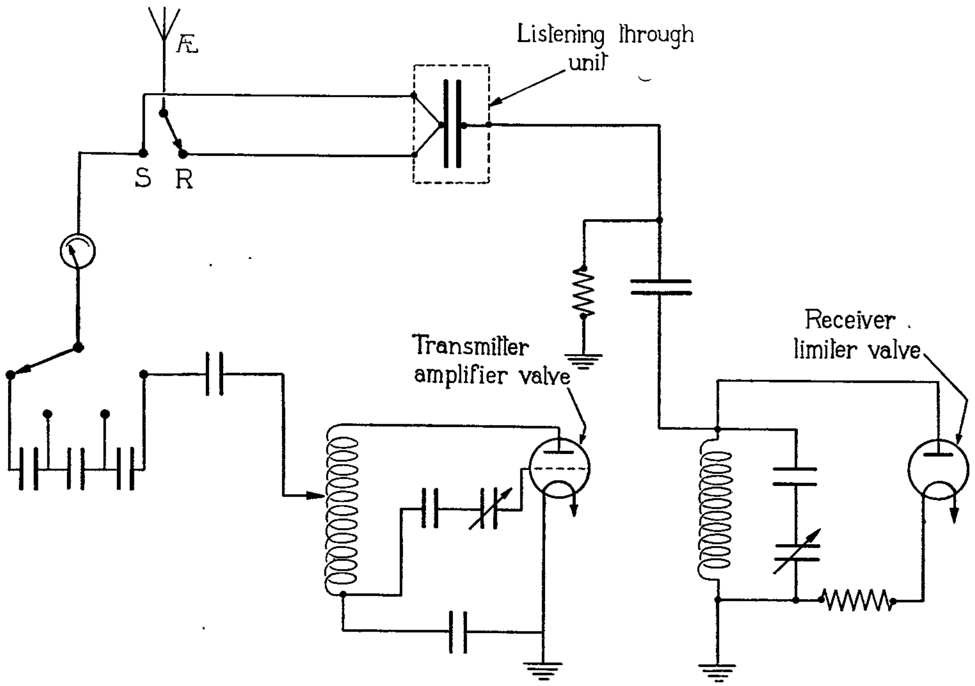


FIG. 5. Simplified listening-through circuit.

21. Owing to the use of plug-in connections on the listening-through unit, it is possible to re-arrange the connections to give " free receiver ". By removing the receiver aerial connection (milled plug) from the unit and mating it with the milled socket (*see* fig. 7), the receiver is connected directly to the send-receive switch, and operation of the switch now merely changes the aerial from transmitter to receiver or *vice versa*.

22. When the receiver is connected up *via* the listening-through unit, and transmission is in progress, R/F. voltages will be developed across the transmitter aerial coil and applied *via* the listening-through condenser to the receiver input circuit. To avoid damage to the receiver

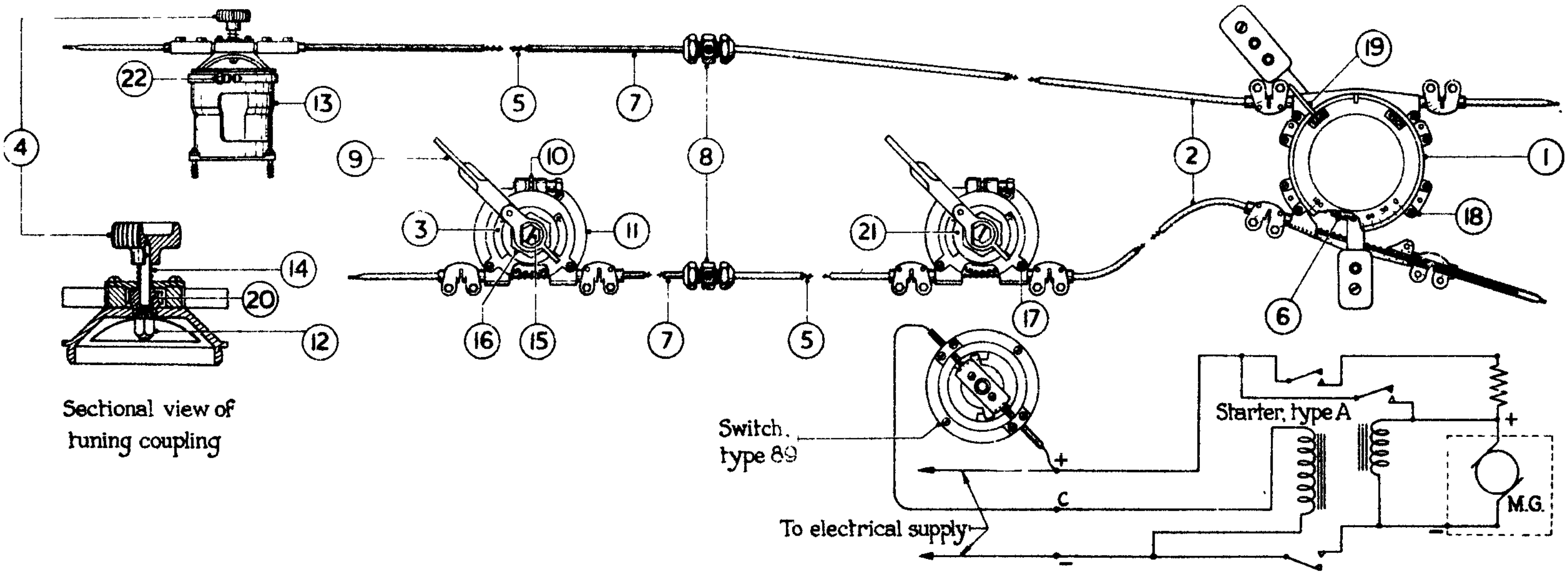


FIG. 6, REMOTE CONTROLS

a limiting valve is employed. This is a diode connected across the receiver input circuit. During alternate half cycles it acts as a low resistance across the receiver input, and any energy which the latter has accepted from the transmitter is harmlessly dissipated at the limiter valve anode. This protection is afforded only when the receiver switch is on. In order to ensure that the valve does not damp the receiver during normal reception, a small negative bias is applied to the limiter valve.

Remote controls

23. The arrangement of the remote controls for the T.1083–R.1082 installation is shown in fig. 6. The " control, switch and tuning " (1) has two handles, the upper one being engraved SEND-RECEIVE and the lower one being engraved TUNING. Movement of these handles is transmitted, through flexible shafts sliding in casings (2), to the send-receive switch (3) on the transmitter and the tuning control (4) on the receiver respectively. The internal flexible shafts (5) comprise a core of stranded steel wire on which is wound a spiral " tooth " wire, making approximately 10 turns to the inch.

24. In the controller is a " gear wheel " (6) which engages with the spiral tooth winding so that rotation of the gear wheel moves the shaft backwards or forwards in the casing. On the send-receive switch and tuning control of the instrument are coupling units similarly provided with gear wheels which are engaged with the spiral windings on the flexible shafts. The movement of the flexible shafts thus rotates these gear wheels operating the send-receive switch and tuning controls. The remote controls are permanently installed in the aeroplane and means are provided for easily releasing them from the instruments when the latter are removed from the aeroplane.

25. The outer casing is of solid drawn light aluminium alloy for the greater part of its length, but the portion (7) near the instrument is flexible, being constructed from a spiral brass strip, over which are two windings, one of steel wires and one of phosphor-bronze or spring steel, with an outer weatherproof covering of cotton braid treated with transparent varnish. The junctions between the rigid and flexible casing are made by unions (8).

26. The switch coupling consists of an aluminium body in which is a gear wheel, the spindle of which projects and carries an exterior handle (9). On the underside of the gear wheel is a dog coupling which engages with the fitting on the end of the send-receive switch spindle. The body of the switch coupling is provided with a split-ring and clamping bolt (10), and when fitting the switch coupling to the transmitter, the dog is engaged with the fitting on the send-receive switch spindle and the body is secured to an adaptor ring (11) on the transmitter by means of the split-ring and clamping bolt. Provision is made for different positions of the switch coupling to suit possible different angles at which the remote control shafts may enter. It is positioned by a projection on the underside of the switch coupling body which may be engaged in any one of 8 slots around the periphery of the adaptor ring. The handle may also be fitted in any one of 8 positions by undoing a slotted screw, removing the handle from the squared spindle and re-fitting.

27. Remote control of the tuning on the R.1082 is accomplished by varying the permeability of the anode inductance coil S.50. A square hole is provided in the movable element of the coil. In this is engaged a square spindle (12) carried in the coupling tuning which is, in turn, fitted on the pedestal coupling (13) fitted to the receiver. The coupling tuning is secured to the pedestal coupling by a split-ring and clamping bolt (22). A gear wheel (20) in this coupling is rotated by the to-and-fro motion of the flexible shaft causing the core to be inserted or withdrawn according to the direction of rotation. A spring plunger device (14) on the top of the coupling provides a means of disengagement. Disengagement is effected by pressing in the plunger after which the knob is rotated to obtain the correct tuning and then released. Operation of the remote tuning control, which has previously been set in a central position, now varies the tuning either side of a given point.

28. At one or more intermediate points on the send-receive shafting provision may be made, by means of additional switch couplings, to operate the send-receive switch. One of these (21) is provided with a remote switch (switch type 89) which is a simple " on and off " switch connected up to the motor-generator starting switch to ensure that the motor-generator starts up whenever the send-receive switch is placed in the send position and is stopped when the switch is placed in the receive or off position.

29. It is essential that the remote control mechanism be so adjusted that the controls on the instrument always occupy their correct positions when moved by, and as indicated on, the remote controller. The method of adjusting the controls is described in the following paragraphs.

30. At the instrument end, the dog of the switch coupling is engaged with the send-receive switch fitting and the body of the switch is secured to the adaptor ring by tightening up the clamping bolt. The switch is placed in the send position and the handle correctly positioned with respect to the indicating plate. The handle may be removed from the spindle by undoing the screw (15) and may be refitted in any one of eight positions. By undoing the nut (16) the indicating plate may be removed and refitted in any one of sixteen positions.

31. The intermediate switch coupling should now be disengaged from the internal shafting by undoing one of the screws (17) and swinging away the body of the switch coupling. Leaving this disengaged the controller end should now be set by undoing one of the screws (18) and swinging away the body of the controller so that the internal shafting is disengaged from the gear wheel. The control send-receive handle is now moved into the send position, but before re-engaging the wheel with the internal shafting, the latter should be tensioned by grasping the projecting end in the hand and pulling. Whilst maintaining the shafting in tension the body of the controller should be swung back again into position so that the gear wheel is again engaged with the flexible shafting and the screw (18) re-inserted. The intermediate switch coupling may now be placed in the send position, the wheel engaged with the shafting and the screw (17) re-inserted. Rotation of the controller handle should now result in the rotation of the send-receive switch and the intermediate switch coupling. To obtain correct synchronism a further slight adjustment may be necessary on the intermediate switch coupling. This may be made by locking the controller handle in the intermediate or off position with the catch (19) in the slot provided. If it is found on examination that the intermediate coupling switch is not exactly central, it should be disengaged and the wheel rotated a tooth or so either way to bring it exactly to off, and then re-engaged. It is important to check that the position of the switch type 89, coupled to the underside of the intermediate switch coupling is correct. In the send position it should be closed and in the off and receive positions it should be open. Two leads are taken from this switch to the starter type A, which is a relay starting switch for the motor-generator.

32. The relay starting switch consists of two electro-magnetic switches, one being double-pole and the other single-pole, and a resistance element of 0·22 ohm. When the switch type 89 is closed the solenoid operating the double-pole switch is energized from the 12 volt aircraft supply. Both contacts close, and the supply is connected across the motor-generator (the resistance being in series with the L.T. armature), and the motor-generator starts up. The solenoid of the single-pole switch is connected across the L.T. armature of the motor-generator and as the motor-generator speeds up, the voltage across the armature increases. When it reaches about 8 volts the single-pole switch closes and short-circuits the series resistance element thus allowing the motor-generator to run up to full speed. To stop the motor-generator the switch type 89 is opened. This de-energizes the solenoid of the double-pole switch breaking both sides of the supply to the motor-generator.

33. The tuning handle on the controller is provided with disengaging devices similar to those on the send-receive handle. The adjustment is facilitated by the provision of the spring plunger device on the receiver coupling tuning. It is only necessary to fit the pedestal coupling on the

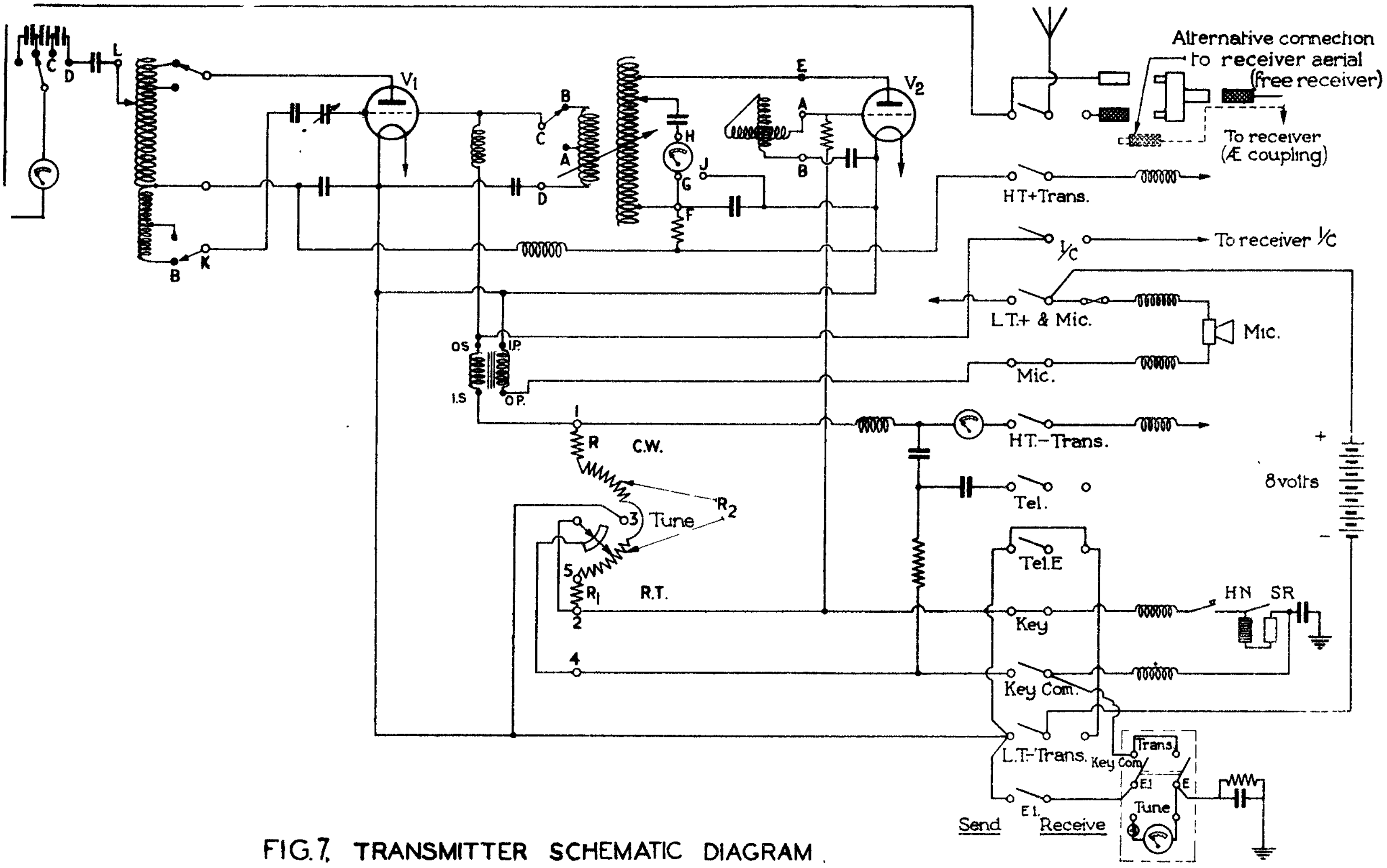


FIG. 7. TRANSMITTER SCHEMATIC DIAGRAM.

receiver and the coupling tuning on this with the square spindle on the latter engaged in the square hole in the movable element of the coil and ensure that the internal shafting is positioned so as to allow for rotation of the gear wheel on the coupling tuning over the full travel of the tuning handle.

34. Final adjustments of the tuning control are made with the receiver in operation. The tuning handle on the controller is set to the central position. The spring plunger is depressed, disengaging the spindle from the gear wheel, allowing the spindle to be turned freely. The movable element of the coil may thus be rotated until the correct tuning is obtained. The plunger is now released, allowing the spindle to be re-engaged with the gear wheel. Movement of the controller tuning handle now gives variation of the tuning on either side of a given frequency. It is important when installing the shafting to ensure that the flexible portion is cleated up as near the instrument as possible. If this is not done movement of the outer flexible casing takes place and unnecessary friction is produced when the controls are moved.

Artificial aerial, type 1

35. When a new transmitter is drawn from stores and installed in an aircraft one of the important things to be done is to set up the transmitter on all the operational frequencies which are likely to be used. When using a fixed aerial for transmission, *i.e.* for frequencies above 3,000 kc/s, the initial setting-up can be done conveniently in the aircraft on the ground, but when a long trailing aerial is used for transmission, *i.e.* for medium frequencies, the initial setting-up on operational frequencies cannot be done conveniently in this way, but it may be done by using the artificial aerial as a load.

36. The artificial aerial consists of a resistance and a variable capacitance and simulates the aircraft aerial. The capacitance of a trailing aerial varies with its length and with the type of aircraft and, possibly within small limits, with different aircraft of the same type. With a 250 ft. length of aerial, the capacitance may be expected to vary between 200 and 300$\mu\mu$F, depending on the size of the aircraft and the method of construction. The artificial aerial may be set to some intermediate value as a compromise, for the initial bench setting-up of the transmitter. Since the amplifier settings in the air may differ quite considerably from those obtained on the bench, a method is employed whereby the artificial aerial may be matched to the trailing aerial of a particular aircraft for a particular frequency.

37. This method may be described in the following way. The M/O settings and the final amplifier setting obtained in the air, for a particular frequency, are ascertained. On the ground these readings are set on the transmitter, which is then operated into the load of the artificial aerial, the latter having first been adjusted to an approximate setting. The artificial aerial is then tuned until minimum input (corresponding to maximum aerial current) is shown on the transmitter milliammeter. The tuning point is well defined.

38. The setting of the artificial aerial for this particular frequency is noted and the procedure repeated for any other frequency required. The settings of the artificial aerial thus recorded may then be used for initial setting-up of a transmitter intended to be used on a similar aerial system, and at similar frequencies. Bench testing of the transmitter will be greatly facilitated by the use of the artificial aerial since the value of capacitance (matched to the aircraft for a particular frequency) is now known and may be used for this purpose.

CONSTRUCTIONAL DETAILS

Transmitter

39. Four views of the transmitter are given in figs. 1, 8, 9 and 11, and a bench wiring diagram in fig. 10. All the components of the transmitter with the exception of the send-receive switch are carried on a removable panel. The panel is carried in a case, the sides of which are perforated

for ventilation, and the transmitter may be lifted out of the case after loosening three screws in hinged clamps. The master-oscillator unit is screened by a metal case having a removable bottom. On the panel above the valves (6 and 7, fig. 1) are hinged perforated caps for protection. The weight of the transmitter alone, without coils, is 16 lb. 4 oz., and the approximate dimensions are $12\frac{1}{2}$ in. × $11\frac{1}{2}$ in. × 10 in.

40. Referring to fig. 1, the series aerial condenser switch (10) can be seen between the aerial ammeter (5) and the amplifier grid-bias switch (8). Next to this switch is a milliammeter (4) reading from 0 to 150 which is connected in the H.T. circuit through a choke and indicates the total input. The thermo-ammeter (3) on the top left-hand corner is in the anode circuit of the M/O valve. It reads from 0 to 3 amps and indicates the oscillatory current in the M/O circuit.

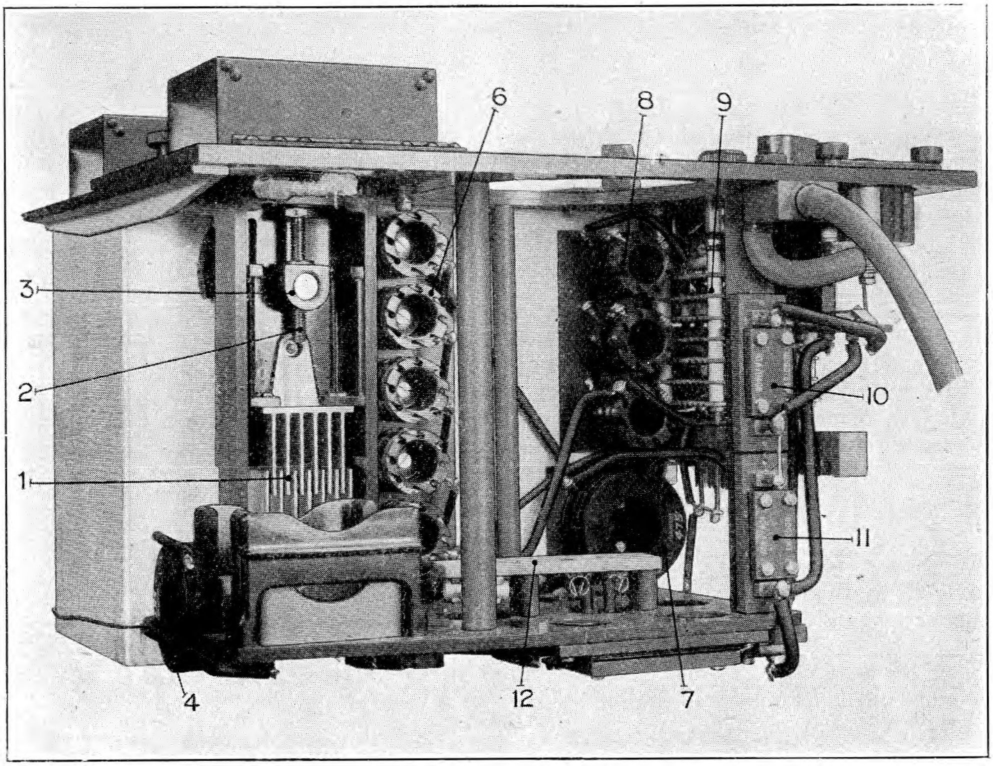


FIG. 8. Interior view of transmitter, amplifier components.

Below these two instruments can be seen the coil-holder (1) for the master-oscillator coil and to the right of it the coil-holder (2) for the amplifier coil. To the left of the amplifier valve (7) can be seen the handle (9) of the neutralizing condenser. The small knurled metal nut below this forms a locking device for the condenser. The amount of movement of the condenser is indicated on a scale which can be seen to the left of this unit.

41. Fig. 8 is an interior view of the transmitter, showing the components in the amplifier section, the valve having been removed. In the left foreground can be seen the amplifier valve-holder and behind this the neutralizing condenser (1). As can be seen, this is a variable air-dielectric condenser, the bottom set of plates being fixed and the upper set of plates being movable. Movement is obtained by the screw (2), secured to the handle (9, fig. 1), engaging the nut (3).

To the left of this condenser can be seen a choke (4), one end of which is connected in the grid circuit of the amplifier valve, the other end of which is connected to the fixed plates of the neutralizing condenser. To the right of the neutralizing condenser can be seen a bank of five resistances (6), each of 2,000 ohms, connected in series. One end of the bank is connected to the choke (7) and the other end is connected to the terminal engraved F on the M/O coil socket (*see* fig. 2). The three resistances (8) seen above the choke (7) have a value of 6,600 ohms each

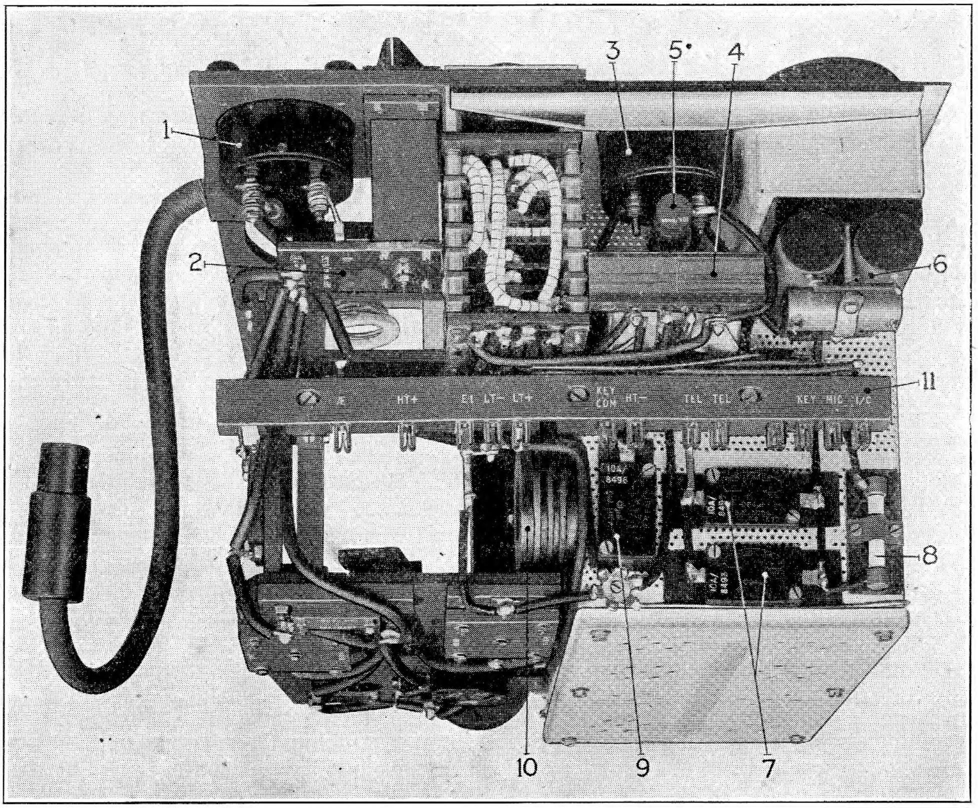


Fig. 9. Interior view of transmitter, M/O components.

and form with the resistance unit (9) the grid-bias resistance for the amplifier valve. In the right-hand foreground can be seen two condensers (10) and (11) having values of ·000075μF and ·0003μF respectively. These condensers are connected to the series aerial condenser switch (10, fig. 1). In the centre foreground can be seen the amplifier coil-holder (12), the sockets of which are engraved K, L, M and N. They are connected up as shown in the bench wiring diagram (fig. 10).

42. Fig. 9 is an interior view of the transmitter showing the aerial ammeter (1) in the top left-hand corner and beneath this the series aerial condenser switch (2). Adjacent to this switch on the right-hand side is the grid-bias resistance unit (9, fig. 8). To the right of this unit can be seen the input milliammeter (3) and below this the microphone transformer (4). The primary winding is earthed at one end and the other end is connected to the microphone. The secondary winding is connected at one end to the grid-bias resistance and at the other end,

through a choke, to the grid of the amplifier valve. Above the transformer (4) is a choke (5) connected between the H.T. circuit and the secondary winding of the transformer. To the right of the choke is a group of condensers (6). Although three condensers may be seen in the illustration, the bottom one is left disconnected, while the other two which have a value of 0·5μF each, are connected in parallel and are indicated as C_{13} in the theoretical circuit diagram fig. 2. The two condensers (7) seen on the bottom right-hand side of fig. 9, have values of ·004μF each and are connected in parallel, giving a value of ·008μF. These two condensers are represented by C_{12} in fig. 2. To the right of these two condensers is a resistance (8) having a value of 500 ohms. It is connected on one side to the condensers (6) and (7) and on the other side to KEY COM. The condenser (9) has a value of ·01μF and is connected between KEY COM and earth. The choke (10) to the left of this condenser may also be seen in fig. 8 and has been referred to previously.

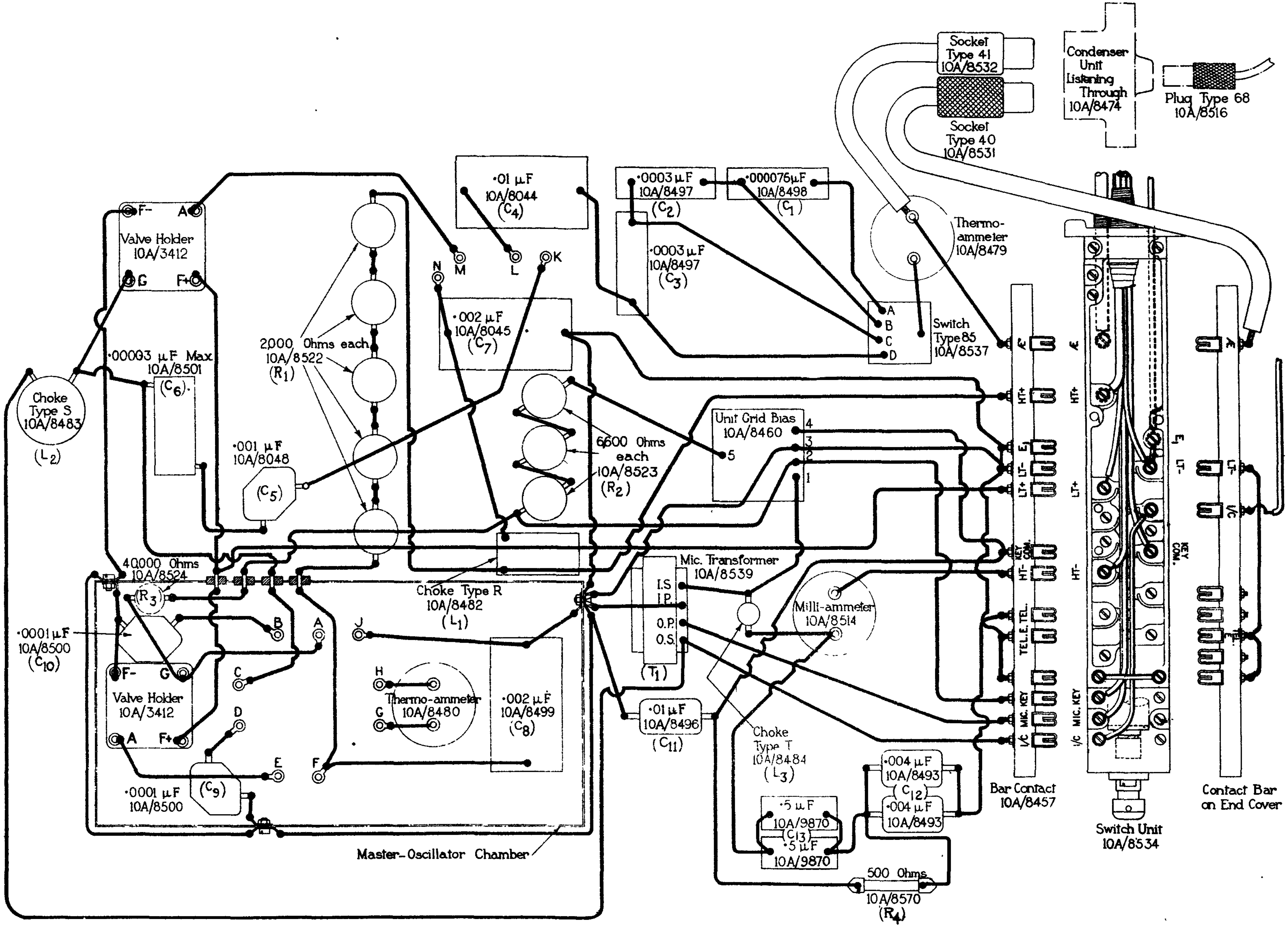
43. The contact bar (11) which can be seen across the centre of the illustration lies alongside the switch unit when the transmitter is placed in the case. The blades on the switch rotor make contact at the various points when the switch is in the send position. Starting from the left-hand side, the contact engraved AE. is connected to one side of the aerial ammeter. H.T.+ is connected to one side of the choke, E. and L.T.— are connected by a strip of metal behind the contacts and are connected to the metal screen. The contact L.T.+ is connected to the filaments of the valves. The contact KEY COM is connected to the top of the condenser (9), and H.T.— is connected to one side of the milliammeter (3). Of the two contacts engraved TEL, the left-hand one is connected to the condensers (7) and the other is connected, at the back of the bar, to the fourth contact from the right. The contact engraved KEY is connected to the grid-bias resistance unit. The contact engraved MIC is connected to the transformer primary and the contact engraved I/C is connected to the transformer secondary.

44. Fig. 11 is another interior view of the transmitter showing the components from the underside. The cover on the metal screen surrounding the M/O valve, which can be seen in the right-hand bottom corner of fig. 9, has been removed. The two condensers (1) and (2) seen in the top right-hand corner, are two of the series aerial condensers. The smaller one (2) on the right has a value of ·0003μF, and the larger one a value of ·01μF. The condenser (3) seen below these two aerial condensers has a value of ·002μF and is connected between the socket engraved N on the amplifier coil-holder, and earth. The ·001μF condenser (4) seen in the middle of the panel is connected on one side to the amplifier coil socket engraved K and on the other side, in series with the neutralizing condenser, to the grid of the amplifier valve. These condensers are represented by C_5 and C_6 respectively in the theoretical circuit diagram, fig. 2.

45. The group of components located in the lower half of the figure are associated with the M/O valve. In the centre of the group can be seen the underside of the M/O coil-holder with the various sockets engraved A, B, C, D, E, F and J. The ·002μF condenser (5) seen on the right is connected across the socket J and F, the socket J being bonded to the metal screen. The ·0001μF condenser (6) is connected between the socket D and the metal screen. In the bottom left-hand corner is the M/O valve-holder (7). The grid terminal is connected to the coil socket A, the anode terminal to the socket E, and, of the two filament terminals, the top left-hand one is earthed to the metal screen and the bottom right-hand one is connected to L.T. +. The ·0001μF condenser (8) above the valve-holder, is earthed to the screen on one side and connected to the coil socket B on the other side.

Case

46. Fig. 12 is a view of the transmitter case showing the send-receive switch (3) in the background. The contact bar (1) can be removed from the case along with the perforated side to which it is secured. The send-receive switch consists of a barrel (3) carrying blades, and rotation of the barrel engages the blades with the fixed contacts on the bar (1), or with the fixed contacts (11, fig. 9) on the transmitter when the latter is in position. The base (2) of the send-receive switch has a number of fixed contacts in which the blades engage. The contacts are connected



NOTE: Annotations in parenthesis, for example (C5), refer to the corresponding annotations in Fig. 2

FIG 10 BENCH WIRING DIAGRAM T 1083

by a group of leads, which can be seen on the right of the case, to various components outside the transmitter, for example, the H.T. and L.T. supply, key, microphone, etc. The blades on the switch rotor (3) make contact with the fixed contacts on the base and the contacts on the transmitter and case in the send and receive positions respectively and thus connect the external

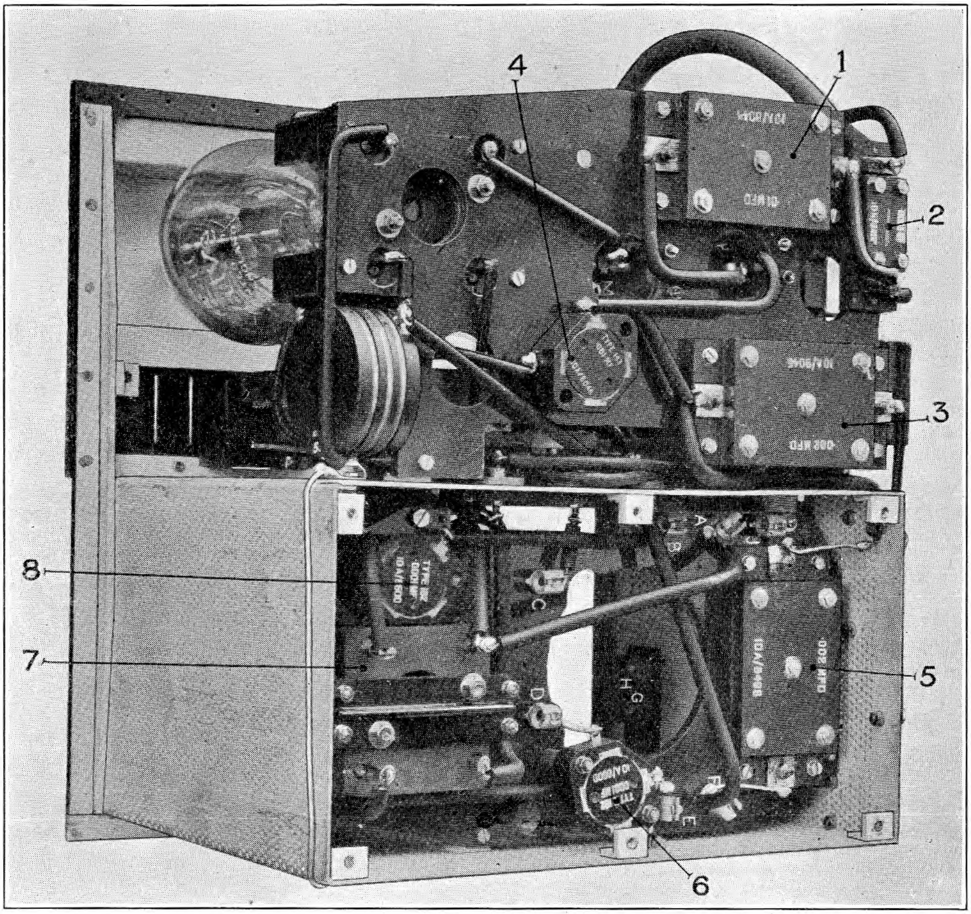


FIG. 11. Interior view of transmitter, underside.

apparatus in circuit as required. The case itself is a canvas covered wooden structure with perforated paxolin sides and bottom. The side carrying the receive contact bar can be removed by undoing four screws. It is necessary to remove this side before the switch unit (barrel (3) and base (2)) can be inserted. Dowel pins are provided at convenient points on the case to facilitate correct assembly and alignment.

47. The contact bar secured to the removable side of the case has eight contacts engraved (from the right) AE, L.T.—, I/C, L.T.+Rec, TEL, TEL/E, H.T.+ REC. The aerial plug-in lead (4) is connected to the contact AE, and another lead (5) terminating in a plug, type 86, is secured to the I/C contact. The contacts L.T.— and TEL/E are connected together inside the case. Another piece of wire connects the contact TEL/E to the last contact on the bar. This

contact engages a fixed blade contact on the base (2). The switch base (2) is provided with thirteen spring jaw contacts and six fixed blades. The two fixed blades on the right are not used in this transmitter. Six of the spring jaw contacts, reading from the right, are engraved AERIAL, H.T.+ TRANS, L.T.+ TRANS and MIC, H.T.— TRANS, TEL, H.T.+ REC. Of the fixed

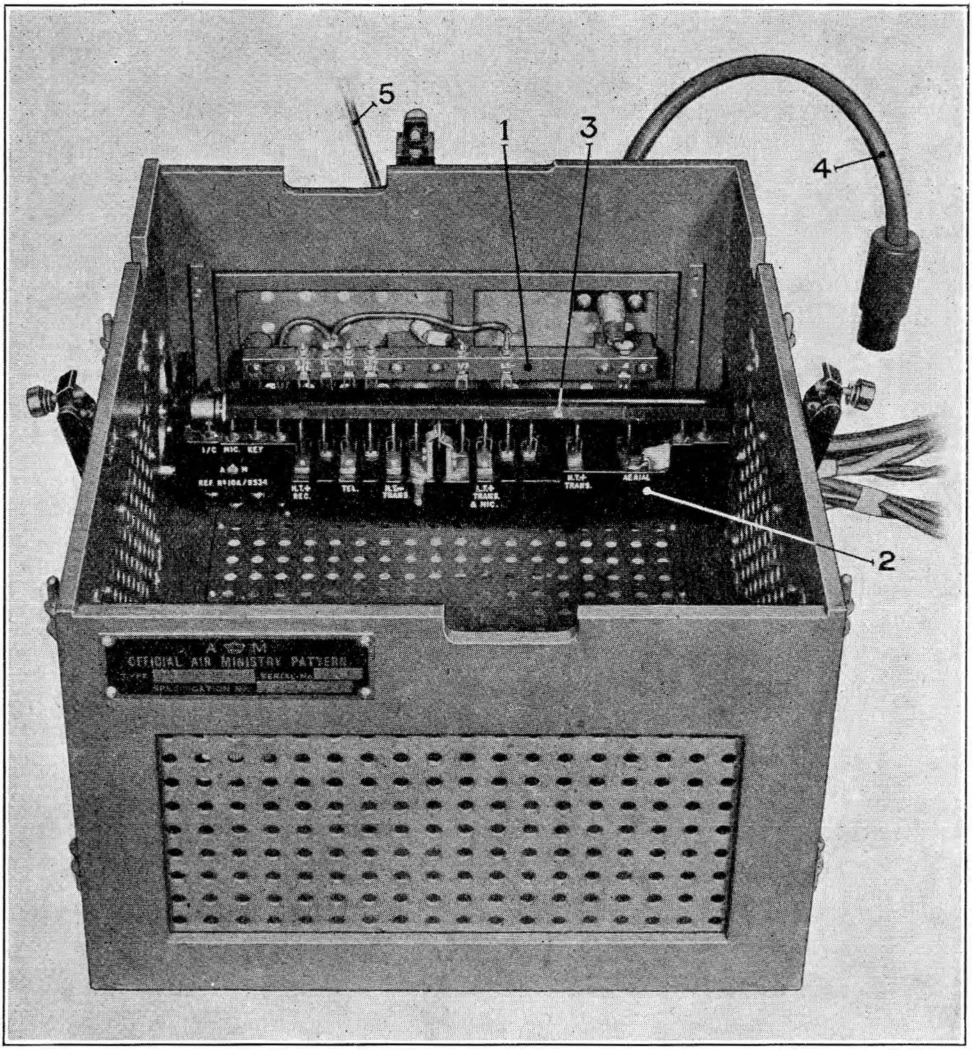


FIG. 12. Case and contact bar.

blades on the left, one is not engraved and is connected under the base to the corresponding blade contact on the receive side. The next three fixed blades are engraved, KEY, MIC, and I/C. These blades are always in engagement with the corresponding contacts on the transmitter contact bar (11, fig. 9) when the transmitter is in the case.

48. On the other side of the switch base (2) which may be seen by removing the side carrying the receive contact bar, the contacts are engraved (from the right) TEL E, L.T. + REC,

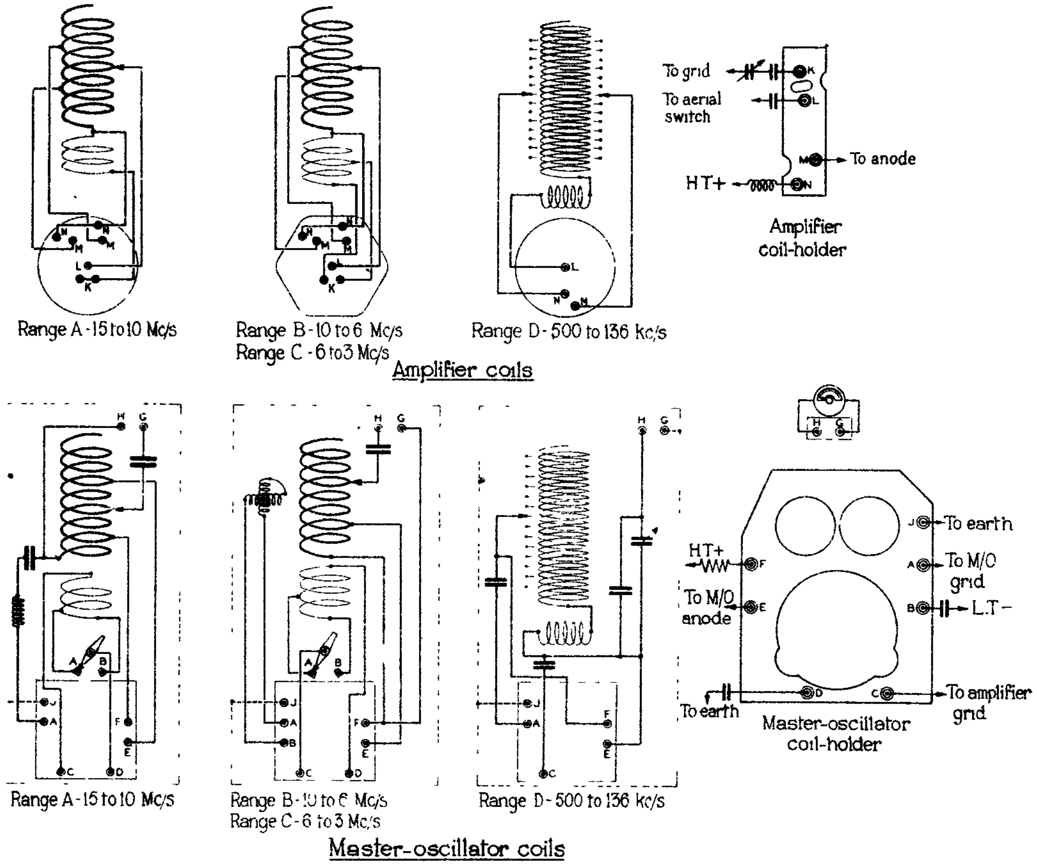


FIG. 13. M/O AND AMPLIFIER COILS, CIRCUIT DIAGRAM

KEY COM, L.T.—TRANS, and E_1; also on the extreme right are four blade contacts, of which only the fourth one from the right is used. When the switch barrel (3) is in the receive position the blades make contact with the various contacts on the base as well as with the appropriate contacts on the bar (1). The barrel of the switch is provided with a coupling so that the switching over from send to receive and *vice versa* may be remote controlled. When the switch is in the intermediate position the circuits to the transmitter and receiver are broken as the blades are not engaged with either contact bar. The top left-hand corner of the front panel (fig. 1) is engraved S-OFF-R, and this engraving refers to the positions of the switch coupling. In the send position the blades on the barrel connect the external apparatus to the transmitter contact bar, and in the " R " position the blades connect the external apparatus to the " receive " contact bar (1).

Coils

49. The amplifier coil unit range A, consists of a former, built up from composite insulating material, carrying two coils and a top cover of synthetic-resin varnish-paper board. The connections from the coils are taken to plugs secured in the former base. A variable tap is provided on the inductance coil, which is controlled by a knob engraved in degrees (0°–360°). An indicator device is also provided by means of which the number of complete turns made by the tap brush is registered. Two lifting knobs are also provided on the top cover. The base and top of the former are held together by three pillars of composite insulating material. The main inductance consists of a coil, formed of $\frac{1}{8}$ inch o/d, 22 s.w.g. silver-plated copper tube having $10\frac{1}{2}$ turns approximately. Two fixed anode taps are provided, one $3\frac{1}{2}$ turns and the other $4\frac{1}{2}$ turns from the top of the coil. Each anode tap is brought to a separate plug. The neutralizing winding is wound on the same former and in the same direction as the inductance coil and consists of $2\frac{1}{4}$ turns of 20 s.w.g. double cotton-covered copper wire. The finish of the neutralizing winding is connected to the start of the inductance coil and the junction brought to two plugs. Similarly the start of the neutralizing winding is also brought to two plugs in the base. From the disposition of the plugs it is possible to insert the coil unit in two different positions in the coil-holder. Two slots are provided on the top of the coil, one engraved 15,000 to 12,500 kc/s and the other engraved 13,000 to 10,000 kc/s, and when either slot is engaged with the projection (11, fig. 1) the anode tapping for that particular frequency band is engaged in the appropriate coil socket. The variable tap is brought to a central plug in the base of the coil. The various connections are shown in fig. 13.

50. The M/O coil unit range A consists of a tubular coil with a variable tap and two fixed taps, a tapped rotatable coupling coil, two fixed condensers and a choke all mounted within a framework consisting of a base plate of composite insulating material and a top plate of duralumin assembled together by four duralumin columns mounted one at each corner. The necessary operating knobs are mounted on the top plate. The control knob for the variable inductance is provided with an indicating device which registers each complete turn of the movable contact on the coil. In addition the knob is engraved in degrees from 0 to 360. A similar indicating device is provided for the coupling coil.

51. There are six pins or plugs secured to the base plate and engraved J, A, C, D, E, F, and two further plugs fixed in a bracket secured to the top plate and engraved H, and G. The variable inductance consists of a helical coil of 14 turns of $\frac{1}{8}$ inch o/d silver-plated 22 s.w.g. copper tube. Two fixed taps are provided, one at 3 turns from the bottom and one at 9 turns from the bottom, the former is connected to the plug F and the latter to the plug E. The movable contact is connected to one side of a $\cdot 00003\mu F$ fixed air dielectric condenser, the other side of the condenser being connected to the plug G. The bottom turn of the variable inductance is connected through a $\cdot 00007\mu F$ condenser and choke to the plug A. The plug J is connected to one of the duralumin columns. The plug H is connected to the start of the inductance.

52. The coupling coil is wound on a former of composite insulating material and is constructed so as to be variable with respect to the inductance coil. It is wound with $4\frac{3}{4}$ turns of 26 s.w.g. double cotton-covered copper wire and tapped at $3\frac{1}{2}$ turns. The start of the coil is connected to the plug C by a flexible copper connection, while the plug D is connected to a movable arm on the coil former. This arm can be set to one of two positions engraved A and B. The finish of the winding is connected to B and the tap to A.

53. The amplifier coil unit range B (10,000 to 6,000 kc/s) consists of a former, built up from composite insulating material carrying two coils, enclosed in a perforated tube. A top cover of synthetic-resin varnish-paper board carries a control knob engraved in degrees from 0 to 360 and an indicating device. The knob controls the movable contact on the variable inductance, and the indicating device registers the number of complete turns made by the brush on the coil. The top cover is provided with two slots engraved 4,400 to 3,000 kc/s and 6,000 to 4,300 kc/s. One or the other of these two slots register with the projection (11, fig. 1), when the coil is in position, thus giving two positions in which the coil may be plugged into its socket. A suitable number of pins are provided on the coil base for this purpose, only four of the seven pins being in use for each frequency band.

54. The inductance coil consists of a helix of silver-plated 22 s.w.g. copper tubing of $\frac{1}{8}$ inch o/d having 19 turns. Two fixed taps are taken off the coil, one at $8\frac{1}{3}$ turns from the top of the coil, and one at $9\frac{1}{3}$ turns from the top of the coil, each tap being connected to a separate pin in the base. The neutralizing winding is wound with $3\frac{1}{2}$ turns of 20 s.w.g. double cotton-covered copper wire in the same direction as the main coil and a tapping is taken off at one turn and connected to one of the pins, the start of the neutralizing winding being connected to an adjacent pin. Thus $3\frac{1}{2}$ or $2\frac{1}{2}$ turns of the neutralizing winding may be used, depending on which way the coil is inserted in its socket. The movable contact is connected to a central pin which is common to both positions of the coil. The end of the neutralizing winding is connected to the start of the main winding and the junction taken to two separate pins so that one or the other will be in use, depending on the position of the coil in its socket.

55. The M/O coil unit range B (10,000 to 6,000 kc/s) consists of a tubular coil with a variable tap, a tapped coupling coil, a variometer and a fixed condenser mounted within a framework consisting of a base plate of composite insulating material and a top plate of duralumin assembled together by four duralumin columns mounted one at each corner. The necessary operating knobs fitted with locking devices are mounted on the top plate. The variable inductance has an indicating device showing the number of turns made by the movable tap and a scale engraved in degrees from 0 to 360. The grid variometer scale is engraved from 0° to 180° and the coupling coil control has a scale engraved from 0 to 9. Two lifting knobs are also provided on the top plate. The base of the coil is provided with seven pins, engraved J, A, B, C, D, E and F. Two further pins are mounted in a bracket secured to the underside of the top plate and engraved G and H.

56. The variable inductance consists of a helical coil wound with 18 turns of $\frac{1}{8}$ inch o/d silver-plated 22 s.w.g. copper tube, tapped at the seventh turn from the top of the coil. This tap is connected to the pin engraved E. The start of the coil is connected to the pin F and another connection is made from here to the pin G. The movable tap of the coil is connected to one side of a ·000065μF fixed air dielectric condenser, the other side of the condenser being connected to the pin H. The grid variometer is connected between the pins A and B. The stator and rotor are each wound in two parts on ebonite formers. The stator has $11\frac{3}{4}$ turns ($5\frac{7}{8}$ turns on each part) of 24 s.w.g. double cotton-covered copper wire, wound in a clockwise direction. The rotor has 13 turns ($6\frac{1}{4}$ and $6\frac{3}{4}$ turns) of 24 s.w.g. double cotton-covered wire wound in a clockwise direction. The coupling coil, which is wound on a movable former of composite insulating material, consists of a winding of $7\frac{5}{7}$ turns of 26 s.w.g. double cotton-covered copper wire, tapped at $4\frac{1}{12}$ turns from the start and wound in the same direction as the main coil. The finish of the coil is brought to a contact engraved B on the coil former and the tap is

brought to a contact engraved A. A movable arm on the former can be placed on either contact, thus all, or a part of the coupling coil, can be used as desired. The start of the coil is connected to the pin D and the tapping arm is connected to the pin C.

57. The amplifier coil unit range C (6,000 to 3,000 kc/s) is similar to the coil unit range B as regards construction and internal connections. The two slots in the top cover are engraved 6,000 to 4,300 kc/s and 4,400 to 3,000 kc/s. The main inductance is wound with $22\frac{1}{2}$ turns of 22 s.w.g. silver-plated copper tubes, $\frac{1}{8}$ inch o/d. One tap is taken at $6\frac{1}{3}$ turns from the top of the coil and another tap is taken at $10\frac{1}{3}$ turns from the top of the coil. The neutralizing winding is wound with $8\frac{1}{2}$ turns of 22 s.w.g. double cotton-covered copper wire in the same direction as the main coil and tapped at 2 turns from the start. The disposition of the pins and the way in which they are connected to the various windings can be seen in fig. 13.

58. The M/O coil unit range C (6,000 to 3,000 kc/s) is constructed in a similar manner to the coil unit range B, the connections also being similar. The main inductance is wound with 24 turns of $\frac{1}{8}$ inch o/d silver-plated 22 s.w.g. copper tube, tapped at the sixth turn from the top of the coil. The coupling winding is wound in the same direction as the main coil and consists of $14\frac{5}{7}$ turns of 34 s.w.g. double cotton-covered copper wire, tapped at $8\frac{1}{12}$ turns from the start. The grid variometer and fixed condenser are of similar construction to those fitted in the range B unit, but are of different values. The condenser is a ·000115μF fixed air-dielectric condenser, the variometer rotor is wound with 26 turns ($13\frac{1}{4}$ and $12\frac{3}{4}$ turns) of 28 s.w.g. double cotton-covered copper wire, and the stator is wound with $22\frac{3}{4}$ turns ($10\frac{7}{8}$ and $11\frac{7}{8}$ turns) of 28 s.w.g. double cotton-covered copper wire. All the windings on the grid variometer are in a clockwise direction from the start. The disposition of the pins and the connections to the various windings are illustrated in fig. 13.

59. The amplifier coil unit range D (500 to 136 kc/s) comprises a variable inductance consisting of rotor and stator, having 28 tapping points brought out to 14 pairs of contacts on a coarse tuning switch, the coil and switch being mounted between end plates of synthetic-resin varnish-paper board and enclosed within a perforated tube and cover of the same material. The operating knobs project through the top cover and are each provided with a device to indicate the positions of the switch and rotor respectively. Both stator and rotor are wound with 27/40 Litz wire. Each strand is single silk-covered and the 27 strands are covered overall with a double silk covering. There are 14 aerial and 14 anode taps taken from the stator, which is wound counter-clockwise looking at the coil from the rotor end, each section having 9 turns. The 14 aerial tappings 1, 2, 3, etc., are taken at the following sections, 6, 8, 11, 15, 19, 23, 27, 31, 35, 39, 43, 47, 51 and 55, the 14 anode taps 1, 2, 3, etc., are taken at the sections 1, 3, 4, 8, 11, 14, 17, 20, 23, 26, 29, 32, 35 and 38 respectively. The coarse tuning switch controls both the aerial and anode taps. The fine tuning is accomplished with the rotor, which is wound in halves, each half comprising five sections of eight turns per section. Three pins are secured to the base of the coil engraved L, M, and N. The pin L is connected to the start of the rotor winding, the pin M is connected to the movable anode tap, and the pin N is connected to the movable aerial tap. The finish of the rotor winding and the start of the stator winding are joined together inside the coil.

60. The M/O coil unit range D (500 to 236 kc/s) consists of a variable inductance comprising a rotor and a stator having 14 tapping points brought out to the contacts of a coarse tuning switch, three fixed condensers and one adjustable condenser mounted on a panel. All these components are mounted within a framework consisting of a base and top plate of synthetic-resin varnish paper board assembled together by four supports of duralumin mounted one at each corner. The top of the unit is enclosed by a cover of duralumin through which the knobs operating the switch and rotor project. The knobs are each provided with a device to indicate the positions of the switch and rotor respectively. The rotor is wound in halves having 5 sections each and 8 turns per section of 27/42 Litz wire. The stator is wound in sections, each

section having 9 turns of 27/40 Litz wire. There are 14 taps provided in the following order from the bottom of the coil: sections 6, 8, 11, 15, 19, 23, 27, 31, 35, 39, 43, 47, 51 and 55. The start of the stator winding is connected to the end of the rotor winding.

61. The base of the coil is provided with five pins engraved J, A, C, E, F; two further pins carried in a bracket on the condenser panel are engraved H and G. The pin J is connected to one of the duralumin columns and the pin G is also connected to one of these columns. The pin E is connected through a ·000038μF condenser to the pin C. The pin F is connected through a ·001μF condenser to the pin A. The pin H is connected through an adjustable condenser ·00002μF max. to the pin E in parallel with a ·00026μF condenser. The finish of the rotor winding is also connected to the pin E. The disposition of the pins and the various connections can be seen in fig. 13.

Artificial aerial

62. The artificial aerial, an illustration of which is given in fig. 14, comprises a variable condenser, a fixed condenser and a tapped resistance, all mounted on a panel with the necessary aerial and earth terminals, and fitted into a wooden case. As can be seen from the diagram, two aerial and two earth connections are employed. When it is required to employ the instrument on frequencies above 1,000 kc/s, the earth terminal marked 15,000–1,000 kc/s is used, and the resistance R_1 (8 ohms) only is in circuit with the capacitance. For the frequencies below 1,000 kc/s the earth terminal marked 1,000–136 kc/s is used, and the resistance R_2 (7 ohms) is added in series. In a similar way the series capacitance is altered for the different frequency bands by selecting the appropriate aerial terminal. For frequencies below 10,000 kc/s the aerial terminal marked 10,000–136 kc/s is used, and the variable condenser C_1 (·0003μF) only is in circuit with the resistance. For frequencies above 10,000 kc/s the aerial terminal marked 15,000–10,000 kc/s is used, and the fixed condenser C_2 (·00003μF) is connected in series.

63. The dial of the condenser is provided with a scale engraved from 0–120 degrees. In addition, two other scales are engraved on the dial giving values of capacitance in micro-microfarads. One of these is used for settings on the 15,000–10,000 kc/s range and the other is used on the 10,000–136 kc/s range. The actual calibrations of capacitance are made with the 15,000–1,000 kc/s earth terminal and 15,000–10,000 aerial terminal in use for the former scale and with the 1,000–136 kc/s earth terminal and 10,000–136 kc/s aerial terminal in use for the latter scale. Three indicator blocks, each of which is engraved with a datum line, are carried on the panel, equidistant around the periphery of the dial. Each scale is set or read against the appropriate datum line.

64. As will be seen from the circuit diagram in the upper part of fig. 14 the effect of connecting up the instrument is to place across the aerial and earth terminals of the transmitter a capacitance and resistance in series. The values used are a compromise of those actually required for the various aerial systems used on aircraft and consequently when the aircraft aerial system is again connected to the transmitter, re-tuning of the aerial circuit of the latter will in general be necessary. Where master-oscillator transmitters are used, it will generally be found that re-tuning of the master-oscillator stage is not necessary although it is still necessary for the aerial circuit.

65. The lengths of the leads between the transmitter and artificial aerial should be as short as possible, especially on the higher frequencies and should be spaced well apart. Further, the type of wire used for the leads should be similar to that normally used between the transmitter and aerial reel, i.e. cable, electric, uniplug 12, red braided (Stores Ref. 5A/917).

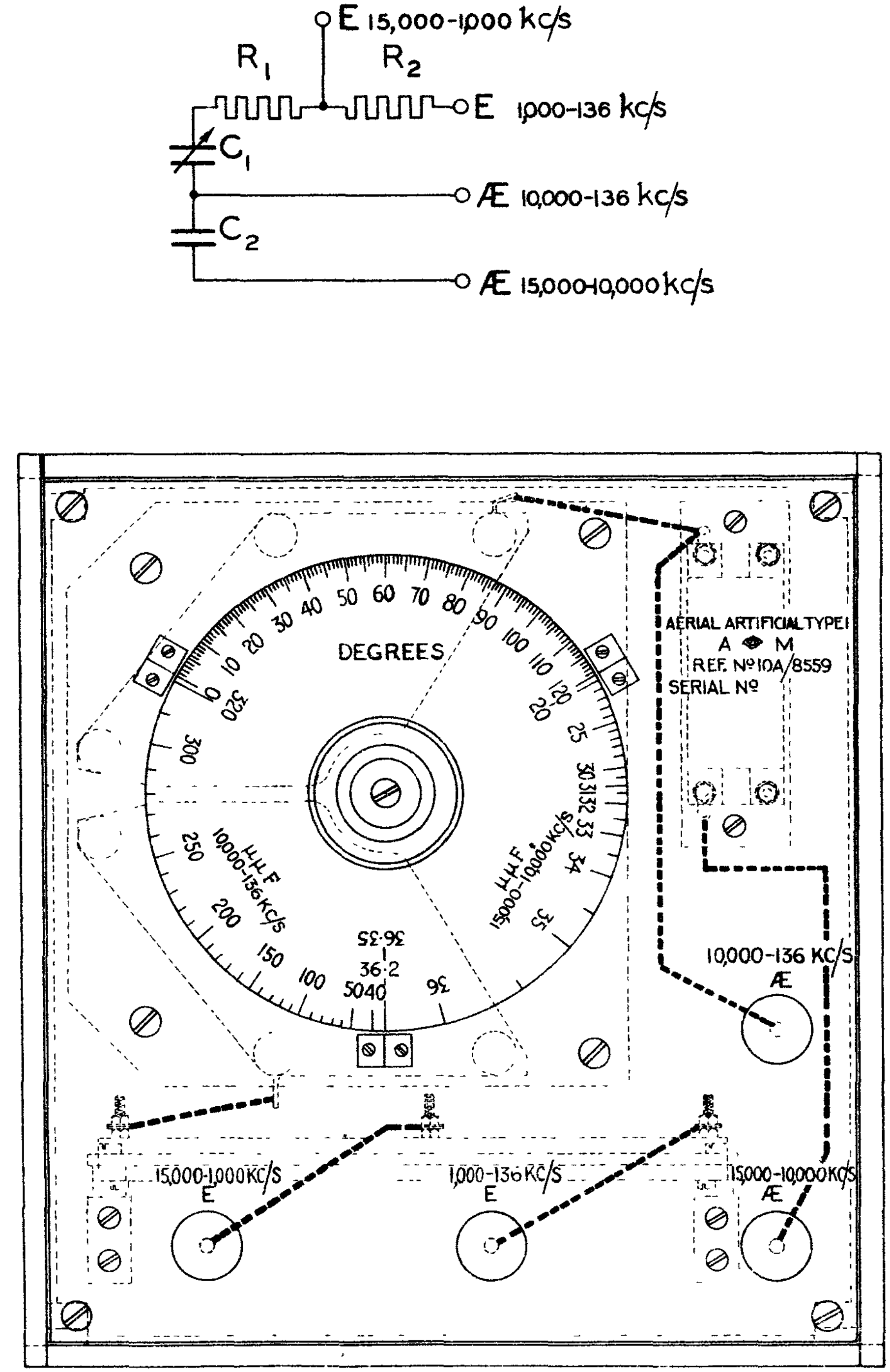


FIG. 14, ARTIFICIAL AERIAL TYPE 1

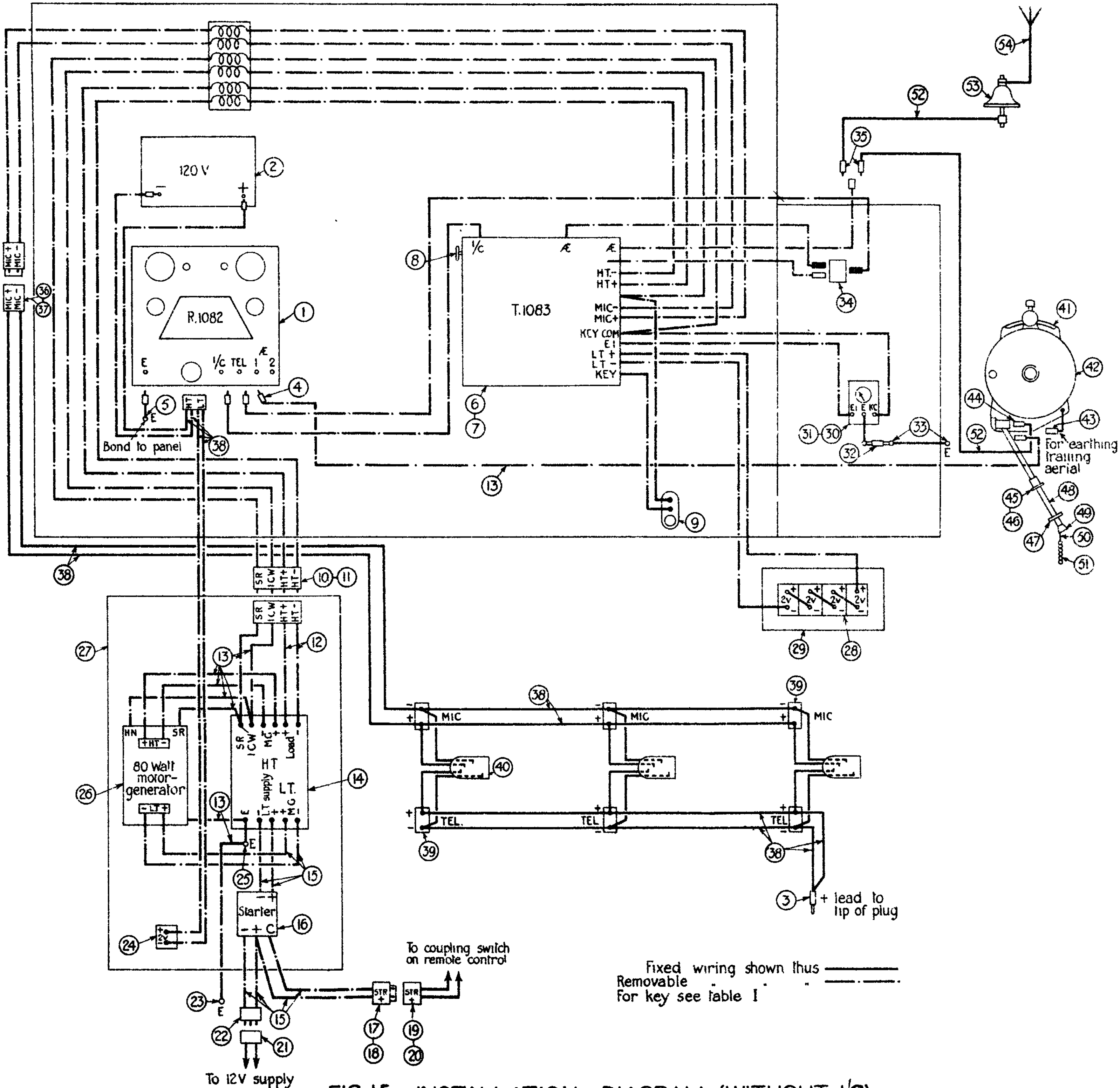


FIG. 15. INSTALLATION DIAGRAM (WITHOUT I/C)

Facing table I

TABLE 1

(Key to installation diagram, fig. 15)

Item No.	Stores Ref.	Nomenclature.	Quantity.	Remarks.
1	10A/8415	Receiver R.1082		Without valves, coils or lamps. Complete with plugs, leads and sockets.
2	5A/1333	Battery, dry, 120 volts, type A	1	
3	10A/488	Plug, type 1, telephone	1	
4	10A/8516	Plug, type 68	1	
5	10A/3387	Terminal, 2 B.A., type A..	1	
6	10A/8456	Transmitter T.1083	1	Without valves and coils. Complete with plugs, sockets and leads.
7	10A/9871	Switch unit, type D, wired for Battle aeroplane.	1	Complete with plugs, sockets, leads and choke unit (10A/8464).
8	10A/8580	Adaptor, ring, switch coupling	1	
9	10A/7741	Key, Morse, type F	1	
10	10A/8533	Socket, type 42, 4-point, H.T. type ..	1	
11	10A/8551	Disc, indicating, type D	1	For 10A/8533.
12	5A/81	Cable, H.T., uniplug, unbraided ..		As required.
13	5A/916	Cable, L.T., unisheath 4, red unbraided		As required.
14	10A/8525	Smoothing unit, H.F., type A	1	
15	5A/91	Cable, L.T., duflex 19, yellow braided ..		As required.
16	10A/7997	Starter, type A	1	For T.1083.
17	10A/8118	Plug, type 62, 2-point	1	
18	10A/8051	Disc, indicating, type E	1	For 10A/8118.
19	10A/7437	Socket, type 19, 2-point	1	
20	10A/8120	Disc, indicating, type E	1	For 10A/7437.
21	N.I.V.	Socket, jacelite, 3-pin, 5 amp.	1	Cat. No. 7170.
22	N.I.V.	Plug, jacelite, 3-pin, 5 amp.	1	Cat. No. 7110.
23	10A/3387	Terminal, 2 B.A., type A, spring type ..	1	Bonded to longeron.
24	5A/1387	Accumulator, 2-V, 20Ah., type B ..	1	For R.1082.
25	10A/3387	Terminal, 2 B.A., type A, spring type ..	1	
26	10A/7532	Generator-motor, 80-watt, type C ..	1	
27	N.I.V.	Crate, power supply	1	
28	5A/1387	Accumulator, 2-V, 20-Ah., type B ..	4	For T.1083.
29	N.I.V.	Crate, accumulator	1	For 5A/1387.
30	10A/8475	Neutralizing unit	1	
31	5A/1385	Lamp, filament, 4-V, 1·2 watts.. ..	1	For 10A/8475.
32	10A/8473	Condenser unit, earth	1	
33	10A/3387	Terminal, 2 B.A., type A..	2	Bonded to panel.
34	10A/8474	Condenser unit, listening-through ..	1	
35	10A/9000	Plug, type 72, S.P. unispark cable ..	2	
36	10A/7437	Socket, type 19, 2-point	1	
37	10A/7962	Disc, indicating type D	1	For 10A/7437.
38	5A/919	Cable, L.T., uniflex 4, red-braided ..		As required.
39	5C/430	Block terminal, type B, two-way, No. 1	6	
40	10A/7971	Socket, type 29, Tel-Mic, parallel type ..	3	
41	10A/9005	Aerial winch, type 5 (frame)	1	For trailing aerial.
42	10A/9123	Aerial winch reel, type B..	1	For aerial trailing
43	10A/8531	Socket, type 40, S.P. unispark cable ..	1	Trailing aerial to R.1082.
44	10A/8531	Socket, type 40	1	For aerial winch.
45	N.I.V.	Aerial fairlead clamp	1	
46	10A/7986	Aerial fairlead bush, insulating ..	1	
47	N.I.V.	Aerial fairlead bush, steady	1	
48	10A/216	Aerial fairlead, tube, Dexine, 1 in. ..	1	
49	10A/8913	Aerial fairlead bush, steel 1 in., type 3, flared.	1	
50	10A/8235	Aerial wire, stainless steel		As required.
51	10A/7298	Aerial weight, bead type, No. 1		As required.
52	5A/82	Cable, H.T., unispark 7, unbraided ..		As required.
53	10A/8093	Aerial insulator, type 16, lead-in ..	1	For fixed aerial.
54	10A/4589	Aerial wire R.4		As required.

VALVES, BATTERY AND H.T. SUPPLY

66. The transmitter employs two type V.T.25 valves (8 volts, 2·2 amps). One valve is used as an oscillator and one as an amplifier. The H.T. supply is obtained from an 80-watt motor-generator, type C, driven by the 12-volt aeroplane supply, while the L.T. is obtained from four 2-volt accumulators 5A/1387 stored in the same crate as the receiver L.T. and H.T. supply.

INSTALLATION

67. Figs. 15 and 16 are typical installation diagrams for transmitter T.1083 and receiver R.1082. It will be seen that a plug and socket connection enables either a fixed or trailing aerial to be selected. The H.T. supply to the transmitter is obtained from an 80-watt motor-generator. The L.T. supply for the filaments is obtained from four 2-volt accumulators. A plug and socket connection is provided between the transmitter and the accumulators.

68. When a motor-generator, type B or C, is used a smoothing unit is necessary for listening-through. This smoothing unit (Stores Ref. 10A/8525) consists of a system of chokes and condensers connected in the L.T. and H.T. circuits, of the motor-generator. The unit has two terminal blocks. One is engraved E ; L.T. supply, + and — ; and M.G. + and — ; and another is engraved S.R. ; I.C.W. ; M.G. — and + ; and Load, + and —. On the L.T. side the terminal engraved E is connected to a suitable earth. A choke is connected internally between the terminals marked supply + and M.G. +, and another choke is connected between the terminals marked supply — and M.G. —. Two condensers, with their junction-point earthed, are connected in series across the terminals marked M.G. + and —. On the H.T. side of the smoothing unit, a choke is connected between the terminals marked Load — and M.G. —, and another choke is connected between the terminals marked M.G. + and Load +. Two condensers in series have their junction-point earthed and are connected between the terminals marked M.G. + and —. The terminal marked S.R. is connected externally to the S.R. terminal on the motor-generator, and the terminal I.C.W. is connected to the terminal H.N. on the motor-generator. A small ·01μF condenser inside the smoothing unit is connected between the terminal marked S.R. and earth. A switch is provided to short-circuit the terminals S.R. and I.C.W. If it is desired to change from I.C.W. to C.W. at a remote position, a pair of leads is taken from these two terminals to a tumbler switch (Stores Ref. 5C/621), and in this case the switch on the unit is locked in the off position. The L.T. to the smoothing unit and hence to the motor-generator is obtained from the aeroplane 12-volt supply. Two leads are brought to an automatic starter, type A (Stores Ref. 10A/7997), which is wired up in series with the switch, type 89, on the remote controls (*see* fig. 6). From the starter two leads are taken to the L.T. side of the smoothing unit and from there to the L.T. or motor side of the motor-generator. An alternative starting arrangement is sometimes employed. The 12-volt supply is taken to a switch, type 49, which is manually operated and has three positions : "start," "run", "off". In the "start" position a resistance is included in the armature circuit and in the "run" position it is cut out. It should be noted that motor-generators, types A, B and C, should receive their L.T. supply from the 12-volt battery and not from the "lighting load" connections (*see* A.P. 1095/G.12). If a motor-generator, type E, is used the L.T. supply is taken from the "lighting load" circuit. The smoothing unit (Stores Ref. 10A/8525) will probably be dispensed with when type E motor-generators are brought into service.

69. There are fourteen connections from the transmitter, six of which, namely, the H.T. supply, the microphone and key, are taken through a choke unit (Stores Ref. 10A/8464). Of the other eight, one is the I/C connection which is taken to the receiver, and two other connections terminate in sockets and are taken to the listening-through unit. The earth connection is taken through a neutralizing unit (Stores Ref. 10A/8473) external to the transmitter. This unit comprises a sensitive thermo-ammeter in series with a pea-lamp and a D.P.D.T. switch. The pea-lamp serves both as a visual indicator and as a fuse. In one position the switch connects

the filament circuit directly to the earth condenser unit, and in the other position it connects the filament circuit to earth through the pea-lamp and ammeter in series. The aerial lead to the transmitter terminates at a plug and socket connection which enables either the fixed aerial or the trailing aerial to be used. The remaining two connections are the L.T. leads to the accumulators.

70. An examination of the connections to the listening through unit will show that, in addition to the two connections from the transmitter, another plug-in connection is taken to the aerial socket on the receiver. This connection of the listening-through unit ensures that the receiver is always connected to the transmitter inductance through a small condenser. The receiver being connected up through a condenser whilst the transmitter is actually in operation, the operator is enabled to listen between pauses in transmission without having to operate the change-over switch. To obtain " free receiver " (independent connection of the receiver to the aerial) sockets, type 41 and 40 (*see* fig. 15 or 16), should be removed from the listening-through unit and plug, type 68, should be mated with socket, type 40.

71. The I/C connection between the transmitter and receiver enables the audio-frequency amplifying portion of the receiver to be utilized for telephonic communication between the occupants of the aeroplane. This is accomplished by providing a 4-point jack at each position in the aircraft, one pair of contacts of each jack being wired in parallel to a telephone plug engaging with a socket on the receiver. The 4-way cord connected to the telephone and microphone worn by each occupant terminates in a 4-way plug. When this plug is inserted into the above-mentioned jack, the microphones are connected to the microphone transformer in the transmitter and the telephones are connected in the output circuit of the receiver. Thus, during transmission any one of the occupants, by speaking into his microphone, may transmit R/T, and during reception he may speak through the receiver to the other occupants.

72. Remote control may be provided on the send-receive switch and also on the tuning of the receiver. Incorporated in the send-receive remote control is a switch which gives remote operation on the motor-generator, starting the motor-generator when in the send position and stopping the motor-generator in the receive and " off " positions.

TABLE 2

(Key to Installation Diagram, fig. 16)

Item No.	Ref. No.	Nomenclature.	Quantity.	Remarks.
1	10A/8415	Receiver, type R.1082	1	Without valves, coils or dial lamps
2	N.I.V.	Crate receiver	1	Complete with plugs, lead and sockets.
3	10A/3387	Terminal, 2 B.A., type A, spring type ..	1	For receiver, earth.
4	10A/8516	Plug, type 68 (S.P.)	1	
5	5A/1333	Battery, dry, 120-V. type A	1	For R.1082
6	10A/7437	Socket, type 19 (2-point)	1	
7	10A/8602	Disc indicating, type H	1	For 10A/7437.
8	5A/1387	Accumulator, 2-V, 20-A.H., type A ..	5	One for R.1082, four for T.1083. Type B for tropical use.
9	N.I.V.	Crate battery	1	
10	10A/7437	Socket, type 19 (2-point)	1	
11	10A/8603	Disc indicating, type J	1	For 10A/7437.
12	10A/8456	Transmitter, type T.1083	1	Without valves and coils, complete with plugs, sockets and leads.
13	10A/9871	Switch unit, type D, wired for Wellington aeroplane.	1	Complete with plugs, sockets, leads and choke unit.

TABLE 2—*contd.*

Item No.	Ref. No.	Nomenclature.	Quantity.	Remarks.
14	N.I.V.	Crate transmitter	1	
15	10A/8050	Handle, operating, switch unit, type 2 ..	1	
16	10A/8474	Condenser unit, listening-through ..	1	
17	5A/916	Cable, L.T., unisheath 4, red-braided ..		As required.
18	10A/8118	Plug, type 62 (2-point, shielded) ..	2	
19	10A/8525	Smoothing unit H.F., type A	1	
20	5C/622	Switch, tumbler, 5 amp.	1	
21	5A/89	Cable, L.T., duflex 4, red-braided ..		As required.
22	5A/91	Cable, L.T., duflex 19, red-braided ..		As required.
23	10A/7997	Starter, type A	1	
24	N.I.V.	Plug, jacelite, 3-point, 5-amp.	1	Cat. No. 7110, Crabtree.
25	N.I.V.	Socket, jacelite, 3-point, 5-amp. ..	1	Cat. No. 7170, Crabtree
26	10A/3387	Terminal, 2 B.A., type A, spring type ..	1	
27	10A/7532	Generator, motor, 80-watt, type C. ..	1	
28	10A/8533	Socket, type 42 (4-point)	1	
29	10A/8551	Disc indicating, type D	1	For 10A/8533.
30	N.I.V.	Crate, smoothing unit	1	
31	5A/81	Cable, H.T., uniplug 12, unbraided ..		As required.
32	10A/8475	Neutralizing unit	1	
33	5A/1385	Lamp filament, 4-V, 1·2 watts	1	For neutralizing unit.
34	10A/3387	Terminal, 2 B.A., type A, spring type ..	1	
35	10A/8473	Condenser unit, earth	1	
36	10A/4589	Aerial wire R.4		As required.
37	10A/8093	Aerial insulator, type 16, lead-in ..	1	
38	5A/82	Cable, H.T., unispark 7, unbraided ..		As required.
39	10A/9005	Aerial winch, type 5, frame	1	
40	10A/9123	Aerial winch reel, type B..	1	
41	10A/8531	Socket, type 40 (S.P., H.T.)	2	
42	N.I.V.	Aerial fairlead tube clamp, floor.. ..	1	
43	10A/7986	Aerial fairlead tube bush, insulating ..	1	
44	10A/216	Aerial fairlead tube, Dexine		Length as required.
45	10A/8913	Aerial fairlead bush, flared steel, type 3	1	
46	10A/8235	Aerial wire, stainless steel 7/28 ..		For trailing aerial.
47	10A/7298	Aerial weight, bead type, No. 1 ..		
48	10A/7741	Key, Morse, type F	1	
49	10A/7437	Socket, type 19 (2-point)	1	
50	10A/7962	Disc indicating, type D.	1	For 10A/7437.
51	10A/8118	Plug, type 62 (2-point, shielded) ..	1	
52	10A/7961	Disc indicating, type D	1	For 10A/8118
53	10A/7837	Socket 28 (Tel-Mic), series	9	
54	5C/430	Block terminal, type B 2-way, No. 1 ..	18	
55	5A/1353	Cable, L.T., unicel 4, black-braided ..		As required.
56	10A/488	Plug, type 1, Tel.	1	
57	5A/919	Cable, L.T., uniflex, red 4		As required.
58	10A/7275	Switch, type 25, I/C	1	
59	10A/7282	Switch, type 25, I/C base	1	
60	5C/432	Block terminal, type B, 3-way, No. 1 ..	1	
61	5A/1362	Cable, L.T., ducel 4, black-braided ..		As required.
62	10A/7283	Socket, type 12 (4-point)	1	
63	10A/7280	Plug, type 33 (4-point)	1	
64	10A/7265	Disc indicating, type A	1	For 10A/7280.
65	10A/8517	Plug, type 69	1	
66	10A/8908	Disc indicating, type F	1	For 10A/8517.
67	10A/8533	Socket, type 42	1	
68	10A/8909	Disc indicating, type F	1	For 10A/8533.
69	N.I.V.	Crate, I/C amp., batteries	1	
70	10A/8261	Plug, type 64 (S.P. battery)	1	
71	10A/8262	Plug, type 65 (S.P. battery)	1	
72	5A/1333	Battery, dry, 120-V, type A	1	For I/C amplifier.
73	10A/9130	Amplifier, I/C, type B	1	
74	5A/1548	Battery, dry, 3-V	3	For I/C amplifier grid bias.
75	N.I.V.	Crate, I/C amplifier	1	

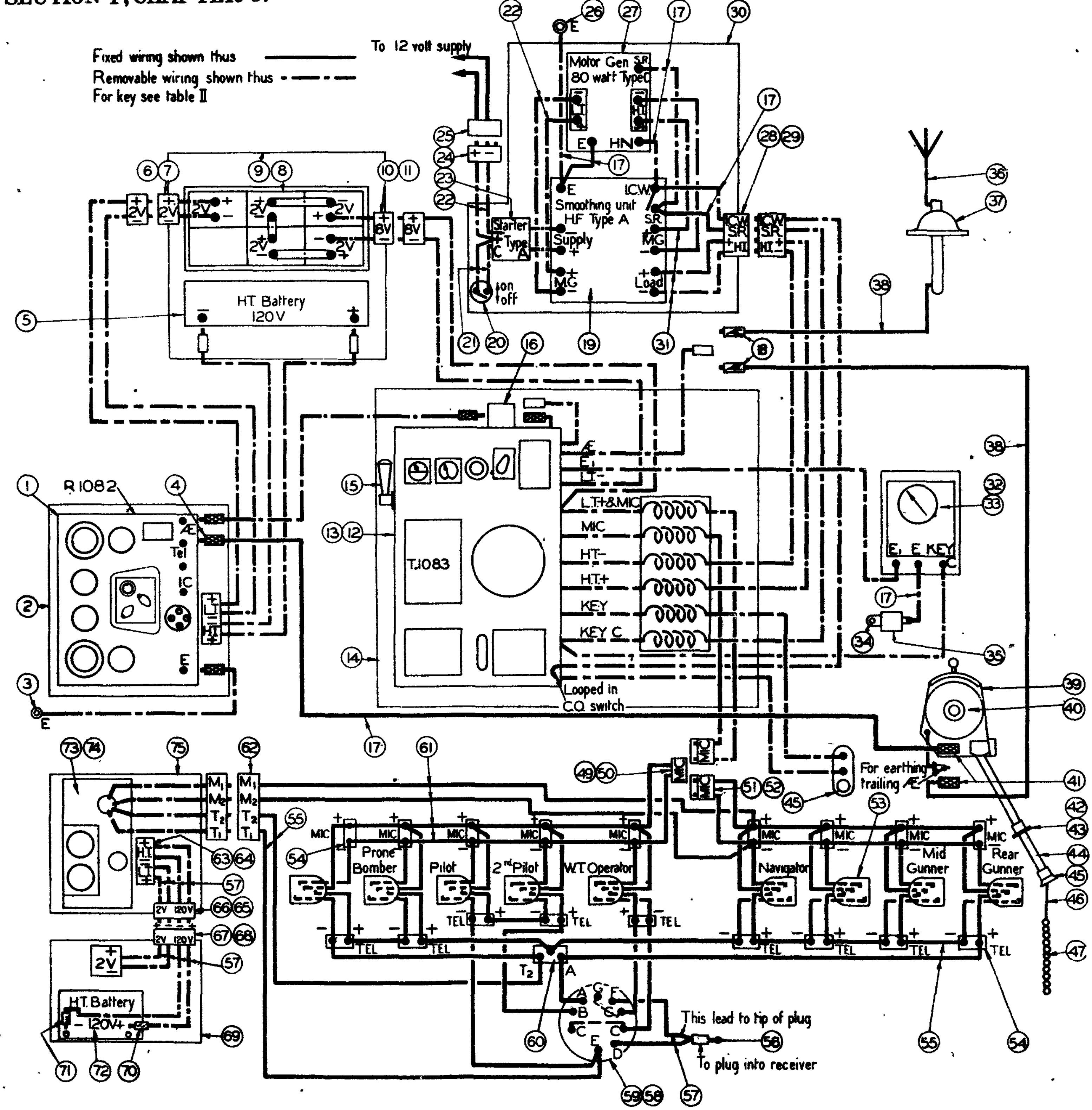


FIG. 16, INSTALLATION DIAGRAM (WITH I/C)

73. Referring to fig. 16 it will be seen that the main difference between this installation and that shown in fig. 15 is in the intercommunication arrangements. No connection is made from the transmitter side-tone system to the I/C socket on the receiver. The audio-frequency portion of the receiver is not, therefore, used for intercommunication but a separate amplifier, known as amplifier I/C, type B, is employed together with a 4-way switch ; Switch, I/C Control, type 25. Nine positions are shown, each of which is provided with a microphone and telephone jack. Each of the occupants is provided with a flexible lead and plug connected to his microphone and telephone receivers, the plug being inserted in the appropriate jack. The I/C switch is provided with a two-way plug which is engaged with the telephone jack on the receiver, and the four positions of the switch are engraved I/C; I/C and W/T; W/T; I/C, W/T and PILOT. The amplifier, complete with the necessary transformers, switches and resistances, is contained in a canvas-covered wooden case and employs two valves (V.R.32 and V.R.19). One of the resistances is variable and serves as a volume control. A 120-volt dry battery is used for H.T., a 2-volt accumulator for L.T. and three 3-volt dry batteries are provided for grid bias. The L.T. and H.T. connections are made to the amplifier by means of one 4-way socket, and the connections between the amplifier and inter-communication system are made through another. An examination of the diagram will show that the microphone circuit may be broken at a plug and socket connection (49 and 51). When the plug and socket connection is made all the microphone circuits are in parallel on the intercommunication system but are not connected to the transmitter. By breaking this connection and connecting the socket (49) to the microphone plug on the transmitter, five of the occupants have their microphones connected to the transmitter and may thus transmit R/T. The remaining four who are not connected to the transmitter are, however, still left on the intercommunication system. The switch controls the telephone circuits only and operates in the following way. When the switch is in the I/C position all the telephone receivers are connected in series to the last stage of the amplifier, and there is no W/T reception. When the switch is moved to the I/C and W/T position, the telephones of the W/T operator are connected to the wireless receiver, while the telephones of the other occupants are all connected, in series with the I/C amplifier, across them. In the W/T position the W/T operator alone is on W/T reception, and all the other occupants are connected on the intercommunication system. In the fourth position of the switch the telephones of the W/T operator and the two pilots are connected in series across the wireless receiver, and the telephones of the other occupants are all connected, in series with the I/C amplifier, across the same circuit.

OPERATION

74. There are three methods of tuning the transmitter. Wavemeter W.1081 may be used, or the master-oscillator may be used as a standard, or receiver R.1082 may be used. When familiarity with the apparatus has been achieved the normal method will be by use of the master-oscillator as described in the following paragraphs.

136–500 kc/s

75. Connect the transmitter to a suitable aerial and set the ABCD switch to D. Set the grid-bias switch to TUNE, remove from the earth circuit the series earth condenser and plug in oscillator and amplifier coils (Range D). Set oscillator by calibration chart or by experience (*see* Tables 3, 4, 5 and 6), and set amplifier tuning, both rough and fine, to zero. Switch on receiver and transmitter L.T. and H.T. The M/O input should be about 20 mA. The M/O oscillatory current should be just readable.

76. If a standard trailing aerial is in use the rough tuning settings of oscillator and amplifier will be about the same. If this is remembered, the presence of harmonics need cause no confusion. It is not sufficient to use the coarse amplifier tuning, since this is merely a tapping switch. The fine tuning must also be used after selecting the nearest tapping.

77. The neutralizing unit should now be set to TRANSMIT and the grid-bias switch set to C.W.1 or R/T.1. Check that total input is normal, not more than 70 mA. and check that aerial current is about 1 amp. Lock the controls and check I/C.

3–15 Mc/s

78. Connect the transmitter to a suitable aerial and set ABCD switch by calibration chart or experience (*see* Tables 3, 4, 5 and 6). Insert the series earth condenser (if necessary). Set the grid-bias switch to TUNE, the neutralizing unit to TUNE and the neutralizing condenser to zero. Insert the appropriate amplifier coil, choosing the anode tap A or B appropriate to the frequency. Set the amplifier coil to zero and set the AB switch on the base of the appropriate oscillator coil to correspond with the A or B anode tap. Now set the oscillator tuning and variometer, and the coupling coil by calibration chart or by experience. As a rough guide it may be said that if working near the highest frequency for which the selected anode tap is correct, a loose coupling is required; towards the bottom of the frequency range (of the selected anode tap) a tight coupling is required.

79. Switch on the receiver and switch on transmitter L.T. and H.T. The M/O input should be about 30 mA. and the oscillatory current about 1·5–2 amps. Tune the amplifier coil for maximum reading in the neutralizing ammeter. Harmonics may give false readings. Ensure that a true maximum is being used. Increase the setting of the neutralizing condenser until the neutralizing ammeter reads zero. Now set the neutralizing unit to TRANSMIT, and the bias switch to C.W.1. Press the key and slightly re-tune the amplifier coil for maximum aerial current. The total input should not exceed 70 mA. The aerial current should be about 2 amps. Slight adjustment of the coupling and slight retuning of the amplifier may increase the output. If using R/T, observe aerial ammeter for modulation. Lock the controls and check side tone and I/C.

80. To tune the transmitter by the wavemeter method, proceed as described in para. 78, and measure the transmitted frequency on W.1081. If in error, estimate the change required in oscillator setting, and repeat tuning from the beginning. This method should rarely be necessary.

81. To tune the transmitter to the frequency of a received signal making use of the receiver, tune the R.1082 to the "dead space" of the incoming signal (*see* appropriate chapter on R.1082). Reduce the volume considerably. Noting the approximate frequency, insert suitable coils in the transmitter. Set the ABCD switch, and put the bias switch to TUNE, switch on the transmitter H.T. and L.T. and tune the master-oscillator until its heterodyne note is heard in the receiver. Adjust the master-oscillator to the "dead space". Tune the amplifier to the master-oscillator in the usual way. The transmitter frequency should now be very close to that of the incoming signal. To cover any small error, make the first call on I.C.W. At the lower radio frequencies this method of tuning is very satisfactory, but above 5,000 kc/s the tuning of the master-oscillator becomes increasingly difficult due to frequency pulling, and care must be taken to keep the receiver gain down to the lowest practical value during these adjustments.

82. The amplifier grid-bias switch must be finally adjusted to give the necessary power. Never use more power than the circumstances require. On R/T, do not attempt to use studs 3, 4 or 5; in these positions a strong current with negligible modulation is transmitted, and the range is less than that obtainable on studs 1 or 2. The depth of modulation may be increased, and the range usually increased, by reducing the coupling between the oscillator and the amplifier.

PRECAUTIONS AND MAINTENANCE

83. Troubles in the transmitter are often quickly found by studying the indications on the four meters. For example, if in the tune position on range B an oscillator feed current of 45 mA. is observed and there is no oscillatory current, there is probably a break in the master-oscillator oscillatory circuit. Check pins and sockets F, G and H, or if there is no master-oscillator feed current, check that the H.T. is on to the transmitter, check H.T. contacts of S/R switch; check pins and sockets A, B, E and F.

84. If the master-oscillator is oscillating, but no aerial current is observed when tuning the amplifier, make sure that :—

(i) the correct aerial is connected,
(ii) the aerial and earth series capacitances are correct,
(iii) the amplifier is not neutralized ; the neutralizing condenser should be in the zero position.
(iv) the fuse in the neutralizing unit is not blown,
(v) the coupling coil tap is correctly set,
(vi) the transmitter chassis is not earthed (*via* the front panel, perhaps).

85. If the amplifier appears to tune naturally, but the aerial current is low, the amplifier is probably tuned to a harmonic of the M/O. If the amplifier tunes at two adjacent points (" double hump ") then the coupling is too tight. This may be reported by a receiving operator as a bad note, or as transmission on two frequencies. When the coupling coil setting is changed, the M/O. will usually require slight retuning.

86. The optimum setting of the ABCD switch and the use of the earth condenser are matters for experience on a particular aircraft and frequency. Earthing of the transmitter chassis will short-circuit the earth condenser.

87. Faults in the grid-bias switch might account for—

(i) No anode current.
(ii) Excessive anode current.
(iii) Key short-circuited.
(iv) No carrier when switched to R/T.
(v) Intermittent failure of amplifier.

88. In cases of emergency when one good V.T.25 valve is available, two methods of using this valve for transmission may be employed on ranges A, B and C. With either of these two methods it is imperative that, in order to obtain transmission on the required frequency, the receiver R.1082 should be used as a check, and the anode condenser of the receiver should be calibrated in frequency and the settings recorded.

89. In the first method, the serviceable V.T.25 valve should be inserted in the master oscillator stage. If another V.T.25 valve with a defective filament is available, it may be inserted in the power amplifier stage, but a valve with short-circuited electrodes should not be used. As a first measure, use the normal settings for the desired frequency on the master oscillator and power amplifier coils, but adjust the neutralizing condenser to zero. Switch on the R.1082, adjust its volume control almost to minimum and set the tuning to the required frequency. Put the grid-bias switch on the transmitter to C.W.1 and switch on. Adjust the master oscillator tuning to give a note in the receiver telephones. Adjust the power amplifier stage to give a maximum reading in the aerial ammeter. This may be as high as 0·5 amperes. Re-adjust the master oscillator and power amplifier coil settings so that a note can be heard in the telephones. The instrument is then ready for transmission. The radiated frequency will be reasonably stable, but the power will be considerably reduced. In general the settings of both the master oscillator and power amplifier will not be different from those used when the transmitter is functioning normally. In the second method, transmission may be obtained, in an emergency, with one V.T.25 valve as follows :—put the serviceable valve in the power amplifier stage, adjust the neutralizing condenser to maximum. Switch on the receiver R.1082 and adjust it as in the previous method. Put the transmitter grid-bias switch to C.W.1, switch on and key. If oscillation commences, adjust the power amplifier coil setting to give a note in the receiver telephones. The transmitter is then ready for operation. It should be noted that the amplifier coil may not function as a self oscillator at the desired frequency. If it does oscillate, frequency stability will be poor as it will be influenced by changes in aerial constants, but the power should be normal.

90. If the L.T. voltage is badly down, both power and frequency stability will be reduced. If the M.G. input voltage is badly down, starter, type A will run the M.G. at half speed only. If the input voltage to the M.G. is much above 14 volts, there is a slight risk on range D of a breakdown of aerial circuit insulation. Set transmitter to C.W.1. Beware of reversed polarity at M.G. input terminals.

91. It should be remembered that the neutralizing unit is in the lead between the earth terminal of the transmitter and the earth connection of the installation. An accidental earth on the transmitter will, therefore, short-circuit the neutralizing unit. Such a short-circuit may occur if the suspension of the transmitter is allowed to sag and cause the metalwork of the master-oscillator chamber to touch an " earthed " part of the installation. As a consequence, tuning with the neutralizing switch in the tune position will be rendered difficult if not impossible.

92. The microphone transformer (4) shown in fig. 9 has four soldering tags punched into the terminal strip. Some transmitters (serial Nos. 1260–1630) have, in addition, four 8 B.A. nuts and bolts through the strip. The presence of these nuts and bolts constitutes a potential source of insulation failure. The transmitter should be inspected and if these nuts and bolts are present they should be removed from the terminal strip. Difficulty may occur in starting the thread, and it is essential for the whole instrument and nut to be firmly held while bearing on the bolt, and also to ensure that the soldering tags in the terminal strip are not loosened.

93. The microphone transformer has been found to fail under sea-going conditions, for example when the transmitter is used with the Fleet Air Arm. Since R/T is not required in these circumstances, the transformer may be put out of action by short-circuiting the secondary winding with a piece of 16 s.w.g. copper wire. Before the transmitter is returned to stores, the short-circuit should be removed.

94. Owing to certain insulation failures, a number of modifications have been made to the coils and general transmitter wiring. These modifications are in all cases in the nature of constructional details. Except for these changes, the transmitter is exactly as described in the earlier paragraphs. To provide against the eventuality of an earth occurring on the MIC-TEL circuit, a fuse is now inserted in the positive L.T. lead between the switch terminal engraved LT + & MIC and choke unit, as shown in fig. 7.

TABLE 3

Typical Calibrations of T.1083

Taken on a Swordfish Aeroplane

Range D. Aerial : 200 feet trailing.

" ABCD " Switch : D.

Earth Condenser Unit not in circuit.

Frequency kc/s.	Master-Oscillator.		Amplifier.		Input (mA.).	Output (I_{AE}).
	Coarse.	Fine.	Coarse.	Fine.	G.B. switch at C.W.5.	
132	14	5·5	14	3·4	58	0·9
137	13	5·5	13	4·5	60	1·0
144	12	5·5	12	5·2	60	1·0
149	11	5·5	11	5·5	60	1·0
160	10	5·5	10	5·8	60	1·0
170	9	5·5	9	5·8	57	1·05
184	8	5·5	8	5·9	57	1·1
200	7	5·5	7	5·9	55	1·1
223	6	5·5	6	5·8	57	1·2
252	5	5·5	5	5·6	57	1·2
295	4	5·5	4	5·6	57	1·25
358	3	5·5	3	5·4	50	1·2
412	2	5·5	2	5·3	60	1·25
475	1	5·5	1	5·2	55	1·2

TABLE 4

Range C. Aerial : Fixed. Three-limbed umbrella

Frequency Mc/s.	Master-Oscillator		Coupling and Anode Tap.		Neut. Cond.	Bias C.W.	ABCD.	Amplifier Turns.	Earth Cond.	Input mA.	Output Amps.
	Turns.	Vario.									
2·98	17·240		B	9	36	4	D	16·200	Dis.	65	1·7
3·16	15·180		B	8	36	4	D	15·200	Dis.	65	2·0
3·25	14·180		B	7	34	4	D	14·140	Dis.	65	2·0
3·35	13·180		B	6·5	32	4	D	13·210	Dis.	65	2·0
3·44	12·180		B	6	32	4	D	12·310	Dis.	65	2·0
3·55	11·180		B	5·5	30	4	D	12·400	Dis.	65	2·1
3·67	10·180		B	5	30	5	D	11·120	Dis.	65	2·2
3·83	9·180		B	4	28	5	D	10·200	Dis.	65	2·2
3·98	8·180		B	2·5	28	5	D	9·220	Dis.	65	2·2
4·15	7·180		A	9	30	4	D	9·120	Dis.	65	2·1
4·35	6·180		A	8	30	4	D	8·500	Dis.	65	2·1
4·62	5·180		A	7	30	4	D	7·800	Dis.	65	2·2
4·86	4·180		A	6	26	4	D	6·120	Dis.	65	2·2
5·20	3·180		A	5	26	4	D	5·160	Dis.	65	2·2
5·54	2·180		A	4	26	3	D	4·196	Dis.	65	2·0
5·92	1·180		A	3	22	4	C	5·500	Dis.	65	1·9
6·12	1·000		A	2	22	4	C	4·180	Dis.	65	1·6

TABLE 5

Range B. Aerial : Fixed. Three-limbed umbrella

Frequency Mc/s.	Master-Oscillator.		Coupling and Anode Tap.		Neut. Cond.	Bias C.W.	ABCD.	Amplifier Turns.	Earth Cond.	Input mA.	Output Amps.
	Turns.	Vario.									
5·7	15·000		B	9	62	4	C	8·320	In	65	1·75
5·95	13·180		B	7·5	60	4	C	7·330	In	65	1·6
6·13	12·180		B	7	60	4	C	7·160	In	65	1·6
6·30	11·180		B	6	58	4	C	6·320	In	65	1·55
6·55	10·180		B	5	56	3	C	6·110	In	65	1·5
6·80	9·180		B	4	56	3	C	5·360	In	65	1·5
7·20	8·180		B	2	56	4	C	5·300	In	65	1·5
7·5	7·180		A	9	66	4	C	4·200	In	65	1·5
7·94	6·180		A	8	68	4	C	3·260	In	65	1·5
8·42	5·180		A	7	68	4	C	2·240	In	65	1·5
9·00	4·180		A	6	68	4	C	2·000	In	65	1·5
9·72	3·180		A	4	68	4	B	1·120	In	65	1·4
10·30	2·180		A	2	68	3	B	0·140	In	70	1·0

TABLE 6

Range A. Aerial : Fixed. Inverted L ; transmitter to fin, 12 feet.
Aerial series condenser : A.
Earth condenser unit in circuit.
Bias : C.W.5.

Frequency Mc/s.	M.O. Turns.	Coupling and Anode Tap.	Neutralizing Condenser.	Amplifier Turns.	Input mA.	Output Amps.
9·88	12·80	B 10	50	6·340	55	1·3
10·09	11·180	B 9	50	6·200	55	1·4
10·40	10·180	B 8	48	6·30	56	1·4
10·83	9·180	B 7	48	5·20	56	1·4
11·24	8·180	B 6	46	5·0	56	1·4
11·67	7·180	B 5	46	4·140	56	1·4
*12·24	6·180	*B 4	44	3·280	60	1·3
*12·59	6·180	*A 8	42	3·240	60	1·2
13·20	5·180	A 7	42	3·50	60	1·2
13·98	4·180	A 5	42	2·130	60	1·2
14·50	3·340	A 4	44	1·320	60	1·2
15·10	3·70	A 3	44	1·80	65	1·0

* Note change of M/O frequency with change of coupling coil tap.

APPENDIX

NOMENCLATURE OF PARTS

The following list of parts is issued for information only. In ordering spares for this transmitter, the appropriate Section of AIR PUBLICATION 1086 must be used.

Ref. No.	Nomenclature.	Quantity.	Remarks.
10A/8456	Transmitter T.1083		Without valves, coils or switch unit.
	Principal components :—		
	Ammeter, thermo :—		
10A/8479	0–2·5, type B	1	Aerial.
10A/8480	0–3, type B	1	Master-oscillator.
10A/8457	Bar, contact	1	With 13 contacts.
10A/8458	Case	1	
	Choke, H.F. :—		
10A/8482	Type R	1	
10A/8483	Type S	1	
10A/8484	Type T	1	
	Condenser :—		
10A/8044	Type 139	1	·01μF.
10A/8045	Type 140	1	·022μF.
10A/8048	Type 143	1	·001μF.
10A/8493	Type 185	2	·004μF.
10A/8496	Type 188	1	·01μF.
10A/8497	Type 189	2	·0003μF.
10A/8498	Type 190	1	·000075μF.
10A/8499	Type 191	1	·002μF.
10A/8500	Type 192	2	·0001μF.
10A/8501	Type 193	1	·00003μF. (max.)
10A/9870	Type 344	2	0·5μF.
10A/8459	Cover, end	1	With contact bar.
10A/3412	Holder, valve, V.T.13	2	
10A/8514	Milliammeter :—		
	0–150, type B	1	
	Resistance :—		
10A/8522	Type 148	5	2,000 ohms each.
10A/8523	Type 149..	3	6,600 ohms each.
10A/8524	Type 150..	1	40,000 ohms.
10A/8570	Type 152..	1	500 ohms.
10A/8537	Switch, type 85	1	Series aerial condenser.
10A/8539	Transformer, microphone, type H ..	1	
10A/8460	Unit, grid-bias	1	
	Accessories :—		
10A/8571	Case, stowage, coils	8	One case takes one M/O or one amplifier coil.
	Case, transit :—		
10A/8461	Coil	1	
10A/8462	Transmitter	1	
	Coil :—		
	Amplifier :—		
10A/8465	Range A	1	15,000 to 10,000 kc/s
10A/8466	Range B	1	10,000 to 6,000 kc/s.
10A/8467	Range C	1	6,000 to 3,000 kc/s.
10A/8468	Range D	1	500 to 136 kc/s.
	Master oscillator :—		
10A/8469	Range A	1	15,000 to 10,000 kc/s. Fitted with coupling coil and one each types 196 and 200 condensers.

APPENDIX—*continued*

Ref. No.	Nomenclature.	Quantity.	Remarks.
	Transmitter T.1083—*continued*		
	Accessories—*continued.*		
	Master-oscillator—*continued.*		
10A/8470	Range B	1	10,000 to 6,000 kc/s. Fitted with one each range B variometer and type 195 condenser.
10A/8471	Range C	1	6,000 to 3,000 kc/s. Fitted with coupling coil and one each range C variometer and type 194 condenser.
10A/8472	Range D	1	500 to 136 kc/s. Fitted with one each types 142, 197, 198 and 199 condensers.
10A/8534	Switch unit (unwired)	1	Send-receive.
	Valve :—		
10A/7312	Type V.T.25	2	One M/O and one amplifier.
	Accessories, installation :—		For use when T.1083 is used together with R.1082.
10A/8559	Aerial, artificial	1	For ground setting-up of T.1083.
10A/8487	Aerial, screened loop	1	For D/F with R.1082.
	Choke unit :—		
10A/8463	Filament	1	For use with 12-V filament supply.
	Controls, remote, comprising :—		
10A/8580	Adaptor, ring, change-over switch ..		On which a switch coupling, type E, is mounted.
10A/8189	Casing, flexible, type C		
10A/8190	Casing, rigid, type C		
10A/8585	Cleat, type C		For securing casing rigid to aeroplane structure.
10A/8187	Control switch and tuning, type C ..		
10A/8592	Coupling, pedestal	}	For remote control of coil, anode, S.50, on R.1082.
10A/8590	Coupling, tuning	}	
10A/4178	Gun, lubricator, type B		For use with 10A/9119.
10A/9515	Pin, key, type C		For use with union, casing, type B.
10A/8192	Shafting, flexible, type C		
10A/8745	Switch, type 89		Mounted on underside of switch, coupling.
10A/8746	Switch, coupling, type E	2	For " send-receive ".
10A/8193	Union, casing, type B		Quantity as required.
10A/9119	Union, lubricating, type C		Quantity as required.

APPENDIX—*continued*

CONCISE DETAILS OF TRANSMITTER T.1083

PURPOSE OF EQUIPMENT	Air-borne transmitter
TYPE OF WAVE	C.W., I.C.W. and R/T
FREQUENCY RANGE	136 kc/s to 500 kc/s ; 3 Mc/s to 15 Mc/s
FREQUENCY STABILITY	Master-oscillator
CRYSTAL MULT. FACTOR	Not applicable
PERCENTAGE MODULATION	Min. 60 per cent. with 0·8 amp. carrier in aerial system
MAXIMUM SENSITIVITY	Not applicable
SELECTIVITY	Not applicable
OUTPUT IMPEDANCE	Variable
AMPLIFIER CLASS	Class C
MICROPHONE TYPE	Carbon granule
VALVES	Oscillator V.T.25 (Stores Ref. 10E/7312) Amplifier V.T.25 (Stores Ref. 10E/7312)
POWER INPUT	Motor generator :— 80 watt, 11–12 volts, 7–14 amps to 1,100 volts, 0·072 amp.
POWER OUTPUT	0·8 amp. into aerial for R.T. 0·6 amp. for C.W. for average aircraft fixed aerial.
STORES REF. NO.	10D/8456
APPROXIMATE OVERALL DIMENSIONS	LENGTH 12½ in. WIDTH 11½ in. HEIGHT 10 in.
WEIGHT	16 lb. 4 oz. without coils
ASSOCIATED EQUIPMENT	Motor generator, type C, for H.T. (Stores Ref. 10K/7532) Four 2 volt accumulators for L.T. (Stores Ref. 5A/1387) Receiver R.1082 (Stores Ref. 10D/8415) Wavemeter W.1081 (Stores Ref. 10T/8405) Amplifier, I/C, type B (Stores Ref. 10U/9130) Artificial aerials (Stores Ref. 10B/8559) Aerial, screen loop (Stores Ref. 10B/8487)

FOR OFFICIAL USE ONLY

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SECTION 1, CHAPTER 6

TRANSMITTER T.1090

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List of Illustrations

TRANSMITTER T.1090

(Stores Ref. 10A/9337)

INTRODUCTION

1. The transmitter T.1090 is a mobile ground station transmitter, designed to meet the requirements of Army Co-operation work and is intended more particularly for use in tenders. The transmitter is capable of radiating C.W., I.C.W. and R/T. The frequency bands covered are 6,667 to 1,222 and 857 to 545 kc/s, these bands sub-divided into five ranges by means of plug-in coils as follows :—

Range A	..	..	4,286 to 6,667 kc/s.
Range B	..	..	3,000 to 4,615 kc/s.
Range C	..	..	2,000 to 3,409 kc/s.
Range D	..	..	1,222 to 2,069 kc/s.
Range E	..	..	545 to 857 kc/s.

2. The transmitter employs a master-oscillator circuit of the Hartley type, capacitance-coupled to an amplifier circuit with tuned anode. The aerial circuit is inductively coupled to the amplifier circuit. Neutralizing is employed in order to avoid "feed-back" into the

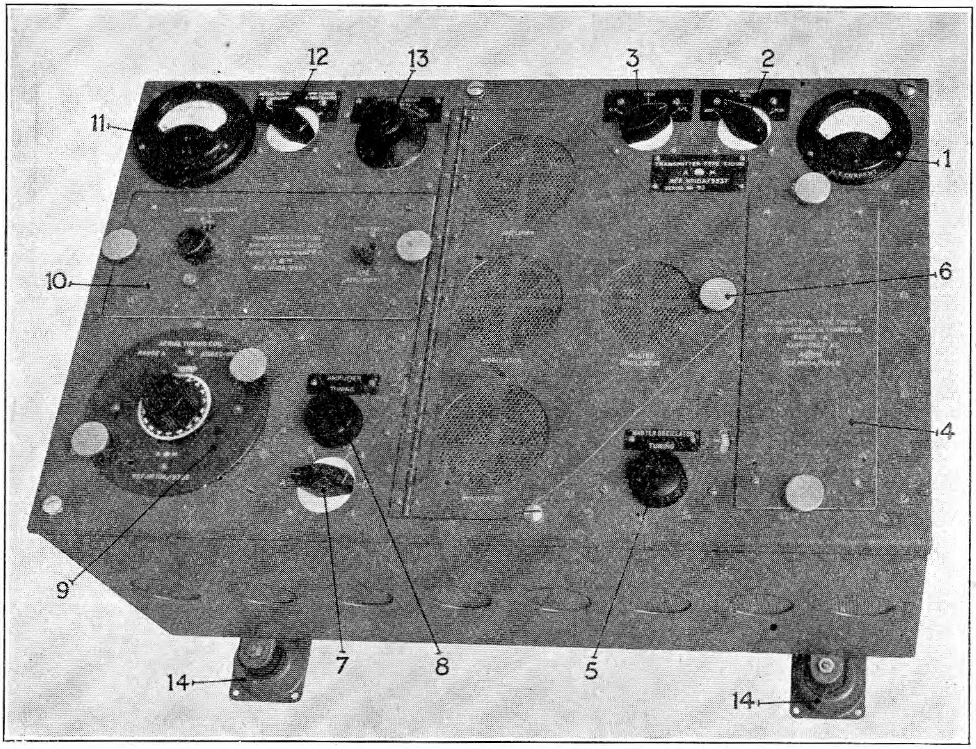


FIG. 1. Transmitter T. 1090.

master-oscillator circuit. Modulation is obtained by choke control. Four type V.T.25 valves are used, one as a master-oscillator, one as an amplifier, and two in parallel serve as modulator valves on R/T.

3. The transmitter has been designed so that the grid biasing equipment is external to the instrument itself, thus any form of biasing may be employed such as grid-bias battery or " automatic " bias. The weight of the transmitter including valves and one set of coils is about 41 lb. and the overall dimensions are approximately $23\frac{5}{8}$ in. × $11\frac{1}{8}$ in. × 16 in.

4. In order to provide for different aerial systems two positions are provided for the aerial plug. One enables the aerial circuit to be tuned on fairly small aerials at the lower frequency end of the band, and the other enables tuning to be performed on larger aerials at the higher frequency end of the band. In order to extend the scale of the amplifier tuning condenser, three fixed condensers can be added by means of a four-position switch. Each of these condensers has a capacitance slightly less than the tuning condenser.

5. A selector switch is provided which enables C.W., I.C.W., or R/T to be used. Another selector switch enables the valve anode currents to be read on the same milliammeter. The switch is engraved AMP, MOD, and M/O, and when moved into one or other of these positions it switches the milliammeter into the anode circuit of the corresponding valve.

6. The L.T. supply required is 8 volts and the H.T. voltage depends upon the power required. If the transmitter is working on full load (approximately 200 watts), the H.T. supply will have to be of the order of 1,500 volts. When a lower power output is employed the H.T. voltage must be reduced.

GENERAL DESCRIPTION

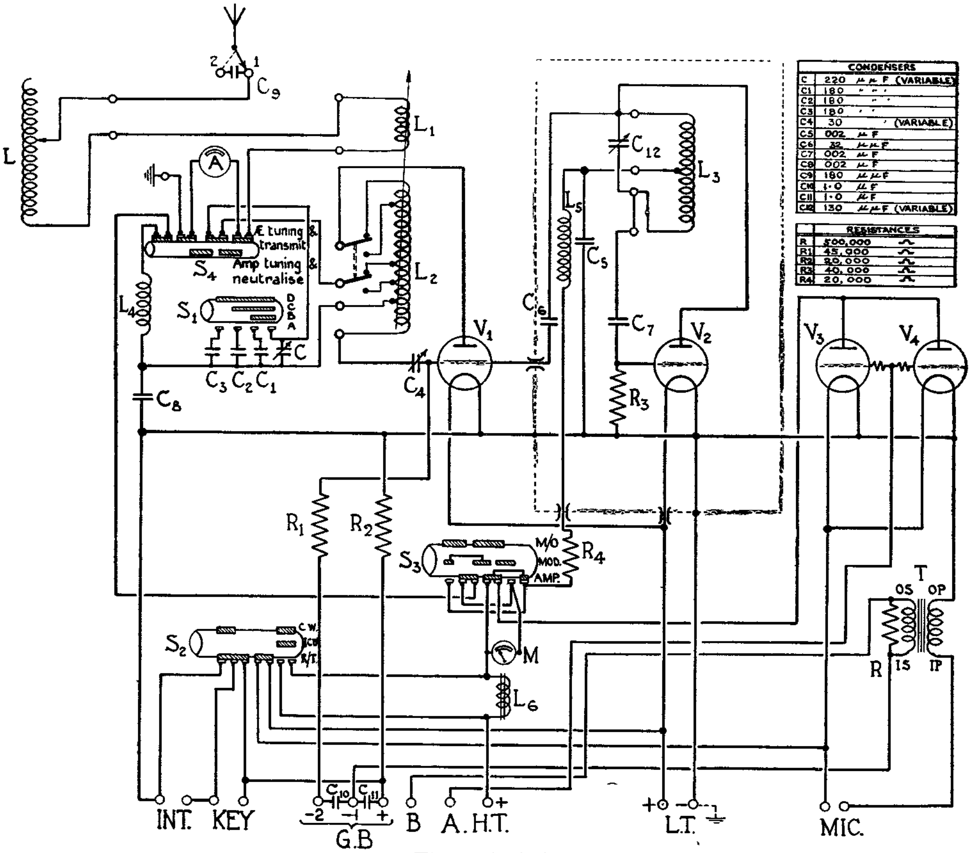
Transmitter

7. A theoretical circuit diagram of the transmitter, with the coils for range A in position is given in fig. 2. V_2 is the master-oscillator valve, V_1 the amplifier valve and V_3 and V_4 the modulator valves. The master-oscillator inductance L_3 is tuned by means of the condenser C_{12}, and the H.T. feed is made through the R/F choke L_5 and the resistance R_4. The master-oscillator is capacitance-coupled to the amplifier through the condenser C_6.

8. The anode inductance L_2 of the amplifier circuit receives its H.T. feed through the iron-cored choke L_6 and the R/F choke L_4, and a portion of the inductance is tuned by means of the variable condenser C. The lower portion of the inductance is a neutralizing winding and is connected through the variable condenser C_4 to the grid of the amplifier valve. The aerial coil L which is tuned by varying its inductance, is connected in series with a coupling coil L_1 situated in the amplifier unit. The coupling of the coil L_1 to the amplifier anode coil is capable of variation.

9. The modulator valves V_3 and V_4 are in parallel and the anodes are fed with H.T. through the iron-cored choke L_6. The primary of the transformer T is connected in series with the microphone across the filament supply. One end of the secondary is connected to the socket engraved B, while the grids of the modulator valves are connected to the socket engraved A. It is thus possible to employ the transformer T by short-circuiting A and B, or to use an external matching impedance by connecting it across A and B.

10. There are four drum-type switches in the transmitter. The switch S_1, is for the purpose of extending the tuning range of the amplifier. This switch has four positions engraved A, B, C and D. In position A (shown in the diagram), the variable condenser C only is connected across the amplifier inductance. In position B the fixed condenser C_1 is added. In position C condensers C_1 and C_2 are added and in position D condensers C_1, C_2 and C_3 are added.



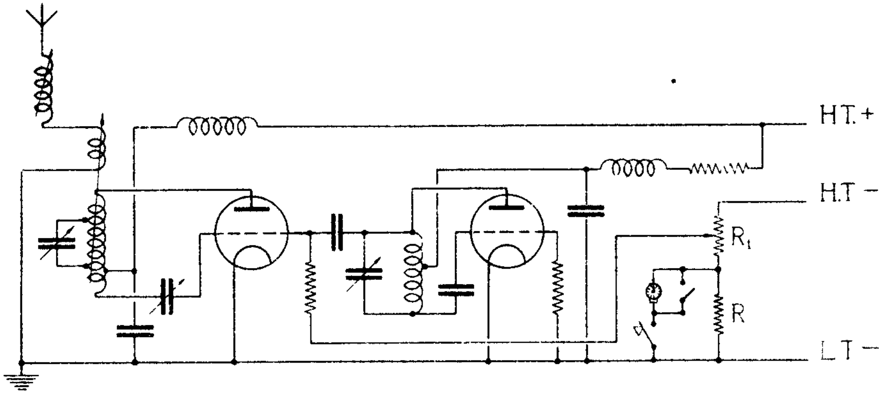
CONDENSERS		
C	220	$\mu\mu$F (VARIABLE)
C1	180	" "
C2	180	" "
C3	180	" "
C4	30	" (VARIABLE)
C5	002	μF
C6	32	$\mu\mu$F
C7	002	μF
C8	002	μF
C9	180	$\mu\mu$F
C10	1·0	μF
C11	1·0	μF
C12	130	$\mu\mu$F (VARIABLE)

	RESISTANCES	
R	500,000	Ω
R1	45,000	Ω
R2	20,000	Ω
R3	40,000	Ω
R4	20,000	Ω

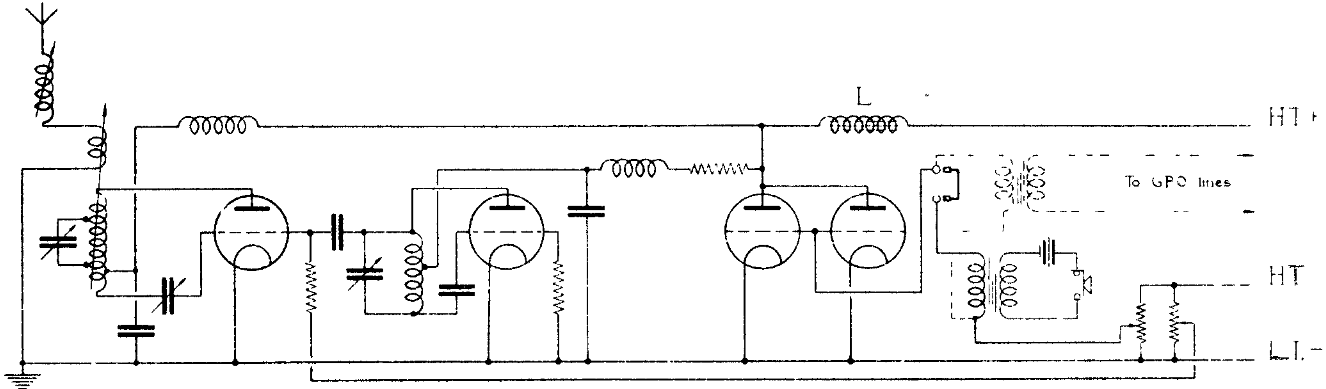
FIG. 2. Theoretical circuit diagram.

11. The switch S_2 is for the purpose of changing over from C.W. to I.C.W. or R/T. The switch is shown in the R/T position and it will be seen that the three left-hand contacts are bridged, short-circuiting the key and interrupter. The next two contacts are also bridged closing the filament circuit of the modulator valves, across which is connected the primary of the microphone transformer. When the switch is moved into the I.C.W. position the bridging connection is removed from the three left-hand contacts and the key and interruptor are put into circuit. The bridging connection is also removed from the modulator valve filament circuit, thus opening this circuit. At the same time the two right-hand contacts are closed, short-circuiting the modulator choke. In the C.W. position the two left-hand contacts and the two right-hand contacts are bridged. As a result the interrupter is short-circuited but the key is left in circuit. The modulator filament circuit is opened and the modulator choke short-circuited.

12. The switch S_3 is provided to enable a single milliammeter to read the anode current in the master-oscillator, the modulator or the amplifier circuits. It has three positions engraved M/O, MOD and AMP. In the diagram it is shown in the " AMP " position, and it will be seen that the H.T. supply has a common path through the modulator choke, after which the amplifier branch passes through the milliammeter M, whilst the supplies to the master-oscillator and modulators are taken direct from the choke. When the switch is moved into the MOD position the amplifier and master-oscillator H.T. supplies are taken direct from the choke, and the modulator H.T. current only passes through the milliammeter. Similarly when the switch is moved into the M/O position the master-oscillator H.T. current passes through the milliammeter and the modulator and amplifier H.T. currents do not.



A



B

FIG 3. SCHEMATIC DIAGRAM. T.1090

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13. The switch S_4 has two positions engraved AE TUNING AND TRANSMIT and AMP TUNING AND NEUTRALIZE. It is shown in the first-mentioned position, and it will be seen that the two left-hand contacts are in the amplifier H.T. feed circuit and that this circuit is completed only when the switch is in the position shown. An examination of the connections of the next two contacts will show that one is earthed and the other is connected to the ammeter. One side of the ammeter is thus earthed in this position of the switch. If the circuit of the ammeter is traced through, it will be seen that it is connected (at the right-hand pair of contacts) to the aerial coupling coil and therefore measures the aerial current. The remaining pair of contacts on the switch is also bridged in this position, and it will be seen that the effect is to connect the variable condenser C across the tunable portion of the amplifier inductance. When the switch is moved into its alternative position the left-hand pair of contacts is opened, breaking the H.T. supply to the amplifier. The second pair and the right-hand pair are broken, disconnecting the ammeter from the aerial circuit. The bridge is removed from the remaining pair and the ammeter substituted. The ammeter is thus connected in series in the tuned circuit of the amplifier.

14. A schematic diagram of the transmitter employing the automatic grid-bias is given in fig. 3. The upper part of the illustration (fig. 3A) shows the circuit arrangements for C.W. or I.C.W., while the lower portion (fig. 3B) shows the circuit arrangements for R/T. It will be seen that the R/F portion of the circuit is the same for both arrangements. A master-oscillator circuit of the Hartley type is employed and is capacitance-coupled to an amplifier circuit. The variable aerial inductance is provided with a series coil which is coupled to the amplifier inductance. Frequency instability due to feed-back is obviated by the provision of a neutralizing winding on the amplifier inductance. A resistance is included in the anode circuit of the master-oscillator valve to reduce the supply voltage to the required value. The anode circuit of the M/O and amplifier valves are provided with R/F chokes.

15. Referring to the upper portion (fig. 3A) which shows the arrangements for C.W. or I.C.W., it will be seen that the modulator valves, and the choke (L, fig. 3B) are not used. For keying

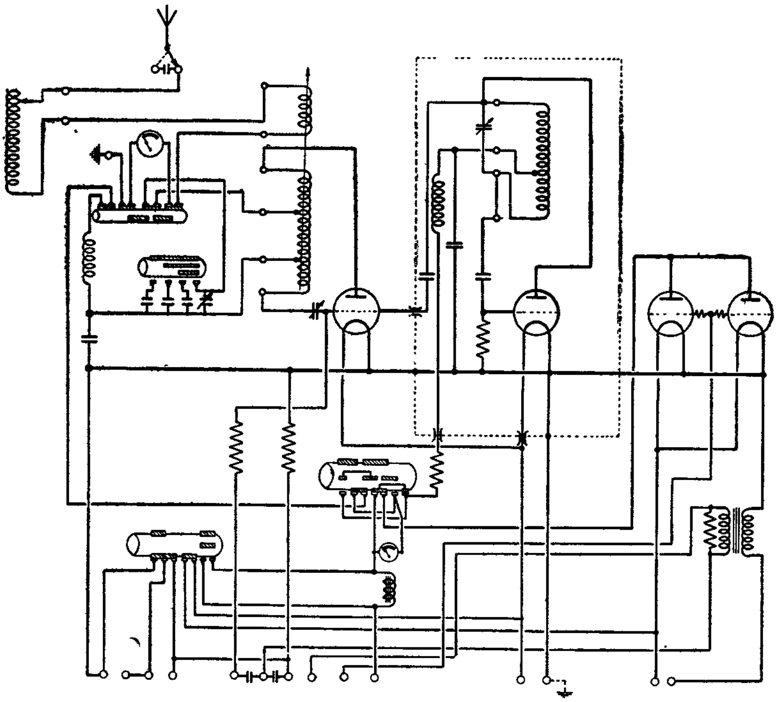


FIG. 4. Theoretical circuit diagram (Range B).

purposes a resistance R is included in series with the automatic bias resistance between H.T.— and L.T.—. The key circuit including the interrupter, is connected across the resistance. When the key is depressed the resistance is short-circuited. When the key is raised heavy negative bias is applied to the amplifier valve and at the same time the anode voltage is reduced. It will therefore be seen that the effect of the resistance, when in circuit, is to " shut down " the amplifier valve.

16. The lower part of the illustration (fig. 3B) shows the circuit employed on R/T. It will be seen that the two modulator valves are connected in parallel, the choke control method of modulation being used. For this purpose the iron-cored choke L is provided in the anode circuit of the modulator valves. It will be observed that, unlike other service transmitters, the H.T. feed to both oscillator and amplifier is taken *via* the modulator choke. The grid-bias for the amplifier and both modulators is obtained from the automatic grid-bias unit. This consists of two resistances connected in parallel between H.T.— and L.T.—, bias for the amplifier being obtained from one of the resistances and bias for the modulators being obtained from the other. A grid-leak resistance is provided in the amplifier grid circuit. As shown in the diagram the common grid circuit of the modulator valves is brought to one of a pair of sockets. The other socket is connected through the secondary of a microphone transformer to the appropriate resistance on the automatic grid-bias unit. In order to connect the transmitter to a line for remote modulation, arrangements have been made to enable the circuit to be changed as shown by the dotted lines. In this event a special matching impedance unit is used. Connections to this impedance unit are made by means of plugs and sockets. When the unit is not being used, the two ends of the transformer secondary winding are disconnected, and the two sockets are then short-circuited.

Coils

17. The diagram in fig. 2 gives the transmitter circuit with the range A coils (4,286 to 6,667 kc/s) in position. The circuits for ranges B (3,000 to 4,615 kc/s), C (2,000 to 3,409 kc/s), D (1,222 to 2,069 kc/s) and E (545 to 857 kc/s), are given in figs. 4, 5, 6 and 7.

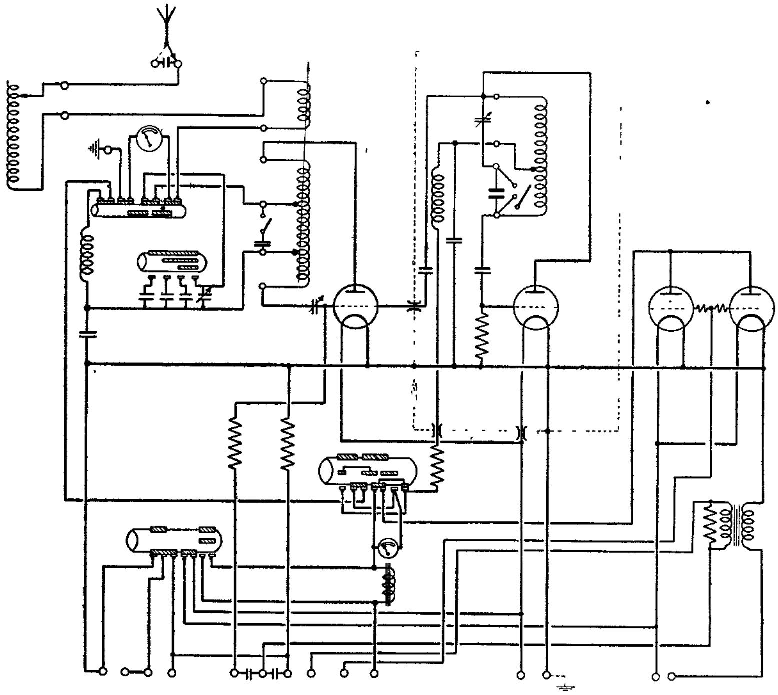


FIG. 5. Theoretical circuit diagram (Range C).

18. Referring to fig. 4 it will be seen that the substituted aerial coil for the range B is of the same form (variable tapping) but it has a different maximum inductance value. The amplifier anode circuit differs from that used in range A in that no switch is provided for changing the tapping point, the required frequency cover being obtained entirely by means of the variable condenser. The master-oscillator unit is of similar construction, except that the tapping point is changed.

19. As shown in fig. 5, the range C aerial circuit is similar but the amplifier unit, in addition to having a different value of inductance, has a fixed condenser which may be switched into circuit across the tuned portion of the winding in addition to the existing variable condenser. The master-oscillator coil has an additional condenser which may be switched in series with the tuning condenser.

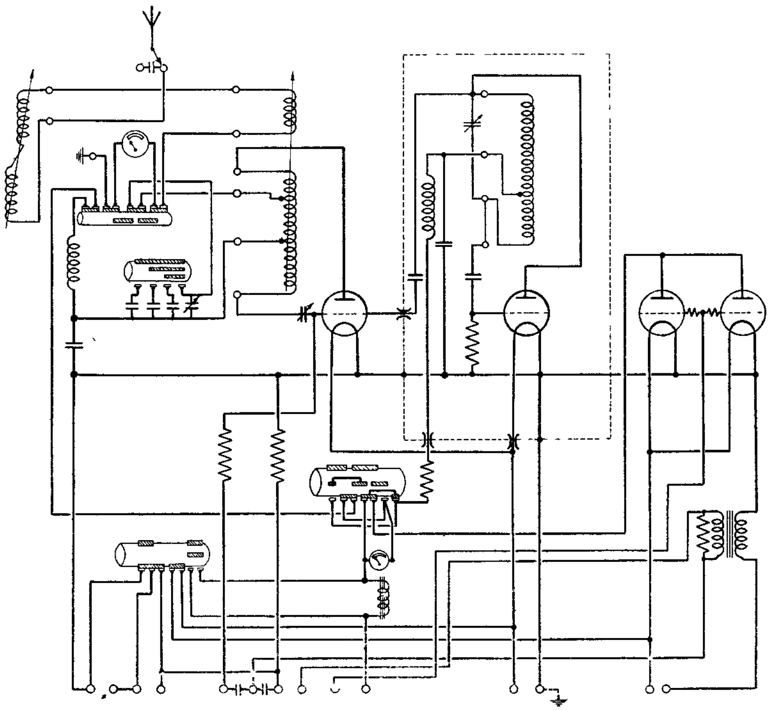


FIG. 6. Theoretical circuit diagram (Range D).

20. On range D (fig. 6) the aerial coil differs from the previous form of construction in that instead of a tapped inductance, the variometer principle is employed. The amplifier coil differs only as regards inductance value, while the master-oscillator coil is of the same form as the A and B ranges but has a different value of inductance.

21. Referring to fig. 7, the aerial and amplifier units for the range E coils are of the same form as for the previous range. The master-oscillator coil in addition to having a different value of inductance has two fixed condensers in series connected across the winding.

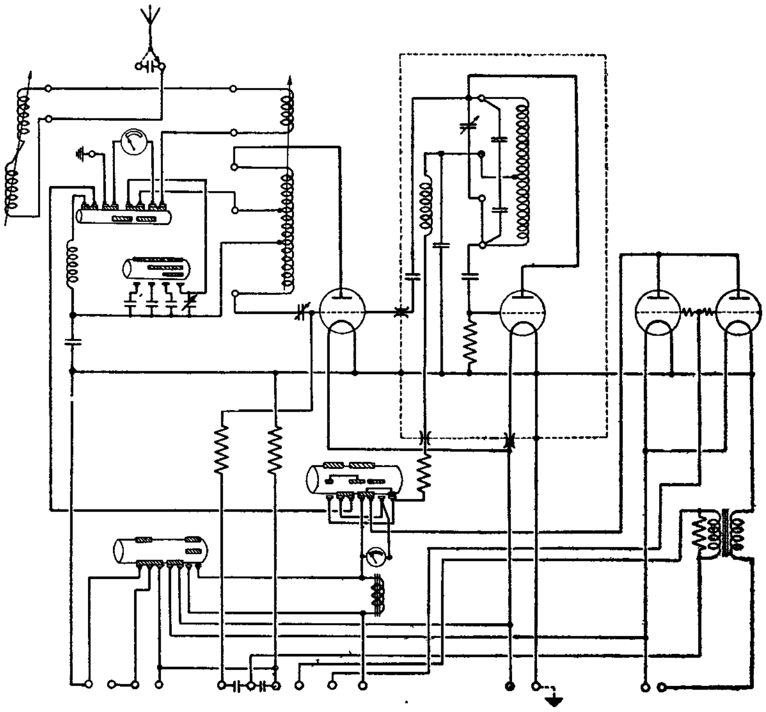


FIG. 7. Theoretical circuit diagram (Range E)

Automatic grid-bias unit

22. This unit has been designed for use with the transmitter as an alternative to bias batteries. It provides bias for both modulator and amplifier valves. The negative voltages required for this purpose are obtained from the H.T. generator by the use of resistances in series with the H.T. negative connection to the filaments. Variable taps on these resistances select suitable voltages (negative with respect to the filaments) for application to the grids of the valves.

23. Referring to fig. 8, in order to give separate and continuously variable values of grid-bias for the two sets of valves, two resistances are arranged in parallel, one common connection going to the terminal engraved H.T.—, the other to the terminal engraved G.B.+. The variable tappings are taken to the grids of the modulator and amplifier valves, *via* the terminals engraved G.B. — 1 and G.B. — 2 respectively.

24. Each resistance has a nominal value of 3,500 ohms giving a maximum bias of 250 volts when the transmitter is on full load. The bias for either the modulators or amplifier is selected by setting the appropriate dial according to the figures given in the Tables.

25. The power absorbed by the bias resistances from the H.T. generator is approximately 35 watts when 1,500 volts is applied to the transmitter. The unit is capable of giving finer adjustments than the battery bias and has the further advantage that no maintenance is required.

Side-tone unit type D

26. A circuit diagram of the side-tone unit is given in fig. 9. The three condensers C, C_1 and C_2 are in series and are connected between aerial and earth of the transmitter. The total capacitance is small enough to prevent appreciable energy being taken from the transmitter.

Across one of these condensers (C_2) is connected a copper-oxide rectifier of the " Westector " type, and audible response is obtained in a pair of telephones connected across the latter when modulation at audio-frequencies is taking place.

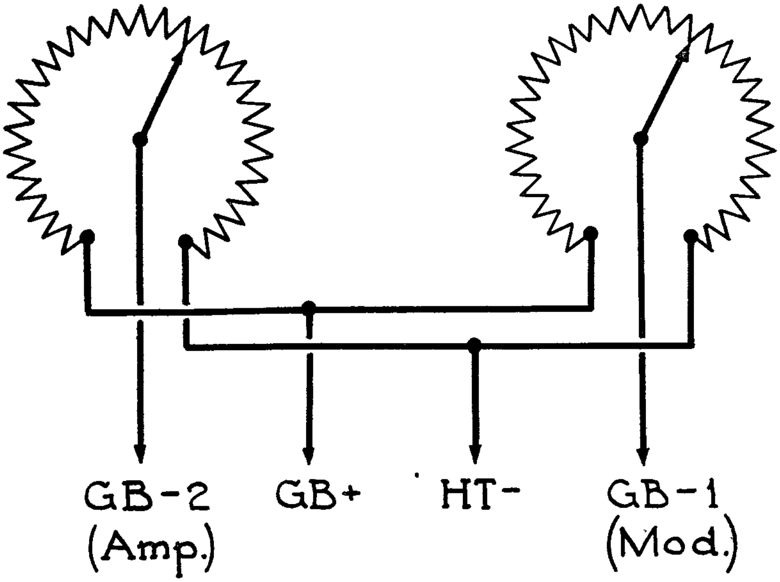


FIG. 8. Theoretical circuit diagram. (Automatic grid-bias unit.)

27. The unit has been so designed that the telephone receivers, while in use with the unit, remain connected to the output of the receiver at the same time. This is accomplished by providing two telephone jacks (J and J_1). The jack J_1 is connected to the receiver output by means of a length of cable terminating at each end in a plug. One of these plugs is engaged in the jack J_1 and the other in the jack of the receiver. The telephones in use are plugged into jack J. Since the rectifier circuit forms a permanent shunt path across the telephones during reception, a resistance R is connected in series to prevent reduction of signal strength.

28. A second resistance R_1 also in series in this circuit is provided with a switch S to enable two different degrees of loudness of side-tone signals to be obtained. When the switch S is closed the total resistance in series with the telephones is ·25 megohm, and when the switch

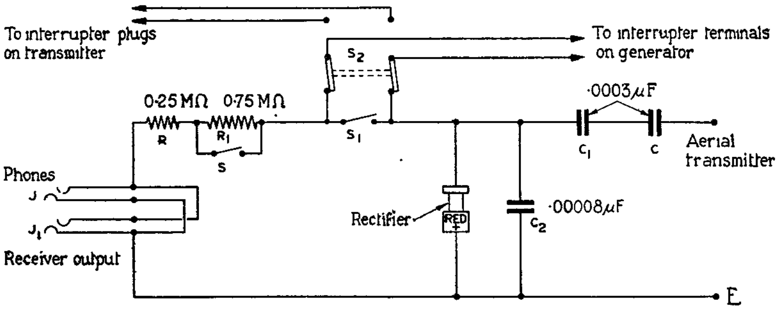


FIG. 9. Theoretical circuit diagram. (Side-tone unit.)

is open the value is 1 megohm. Thus one or other side-tone signal strength may be selected to suit the varying conditions met with owing to change of frequency and power. For R/T on I.C.W., side-tone signals will be obtained in the telephones whenever the microphone is spoken into or the transmitter keyed. For C.W., however (no modulation), unless provision is made, there will be no response. The method adopted to obtain a side-tone for C.W. is to switch an interrupter into the side-tone circuit. The interrupter of the transmitter, not being required during C.W. transmission, is utilized for this purpose and a switching arrangement is provided to enable it to be switched from the transmitter to the side-tone unit and *vice versa.*

29. The switching arrangement can be seen in the diagram (fig. 9). Switches S_1 and S_2 are operated simultaneously by the movement of a single handle moving between two positions engraved C.W. and I.C.W. and R/T . In the diagram the switch is in the C.W. position. It will be seen that S_1 is open and S_2 is in the position which brings the interrupter on the generator in series with the rectifier and telephones. When the switch is placed in the I.C.W. and R/T position, S_1 is closed, completing a side-tone circuit which consists of the telephones, the resistances R and R_1 and the rectifier. The switch S_2 is now in the position in which it connects the interrupter back into the transmitter circuit. It will be observed that I.C.W. cannot be transmitted until the switch on the side-tone unit has been returned to its correct position (*i.e.*, with the interrupter in the transmitter circuit).

CONSTRUCTIONAL DETAILS

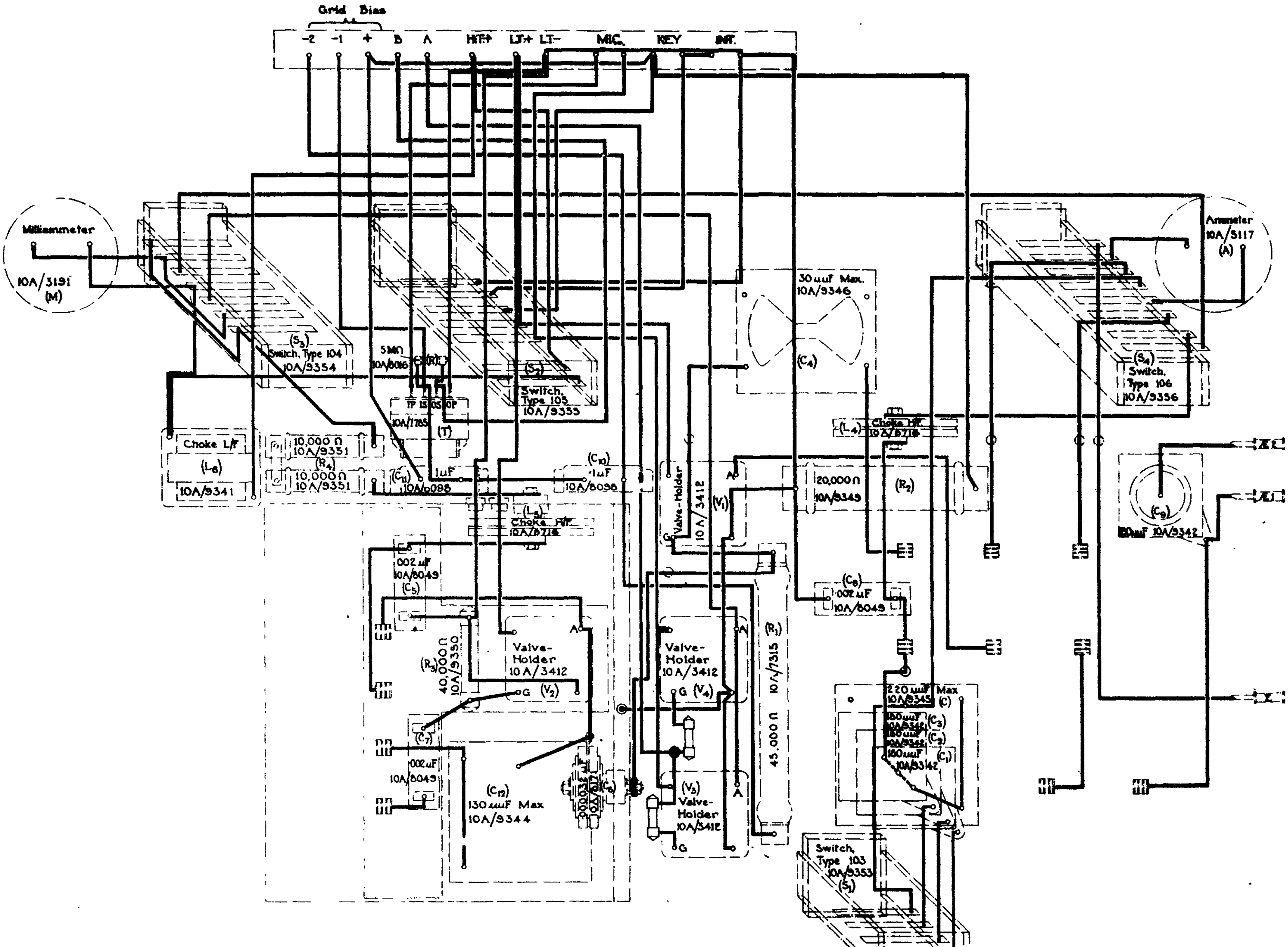
Transmitter

30. Four views of the transmitter are given in figs. 1, 11, 12, 13, and a bench wiring diagram in fig. 10. Referring to fig. 1 which is a view of the transmitter with a set of range A coils in position, the anode current milliammeter (1) is in the top right-hand corner, and adjacent to it the selector switch (2). This switch is engraved M/O, MOD and AMP and when the handle is placed in any of the three positions, the anode current of the appropriate valve will be indicated on (1). Next to the switch (2) is the selector switch (3) which determines the type of radiation. Either C.W., I.C.W., or R/T may be used depending on the position of the switch which is suitably engraved.

31. Below the milliammeter (1) can be seen the master-oscillator tuning coil (4). This coil is for the range A (6,667 to 4,286 kc/s). Next to the coil is the master-oscillator tuning control (5). Movement of this control operates the variable condenser C_{12}, fig. 2. Near the control is a small window indicating the amount of movement of the condenser vanes, a scale graduated in degrees from 0° to 180° being secured to the moving vanes. The hinged valve cover can be seen in the centre of the panel, and access to any of the valves is obtained by undoing the screw (6) and raising the cover. It is suitably perforated for ventilation.

32. To the left of the valve-cover are the components associated with the amplifier valve and the aerial and in the bottom right-hand corner can be seen the amplifier condenser switch (7). This switch has four positions A, B, C and D, and serves to introduce one or more small condensers in the amplifier circuit. Above the switch (7) can be seen the amplifier tuning control knob (8). It is provided with an indicating disc which is visible through a small window. The disc is engraved in degrees from 0° to 180° and is secured to the moving vanes of the condenser C in fig. 2. In the bottom left-hand corner is the range A aerial tuning coil (9) and above it the amplifier tuning coil (10) for the same range. In the top left-hand corner is mounted the aerial ammeter (11), and adjacent to it, the switch (12). This switch has two positions engraved AERIAL TUNING AND TRANSMIT, and AMPLIFIER TUNING AND NEUTRALIZE. To the right of this switch lies the neutralizing condenser control knob (13). The whole instrument is mounted on four anti-vibration mountings, two of which (14) can be seen in the illustration.

33. In fig. 11, which is an interior view of the transmitter, the anode milliammeter (1) is seen in the bottom right-hand corner, and above it the A/F choke (2) which is represented by L_6 in the theoretical circuit diagram, fig. 2. The two resistances (3) above the choke, each have a value of 10,000 ohms and are connected in series in the anode circuit of the M/O valve. The



NOTE: Annotations thus, (C_{12}) refer to corresponding annotations in Fig 2

FIG. 10, BENCH WIRING DIAGRAM, T. 1090

contact bar (4) is provided with 14 sockets suitably engraved. The leads from the various batteries, key, microphone and interrupter, terminate in plugs which engage with these sockets. Below the contact bar can be seen the microphone transformer (5). Below the transformer is the selector switch (6). This switch enables the anode current of any valve to be read on the milliammeter (1). To the left of this switch is the selector switch (7) which determines the type of radiation, for example, C.W., I.C.W., or R/T.

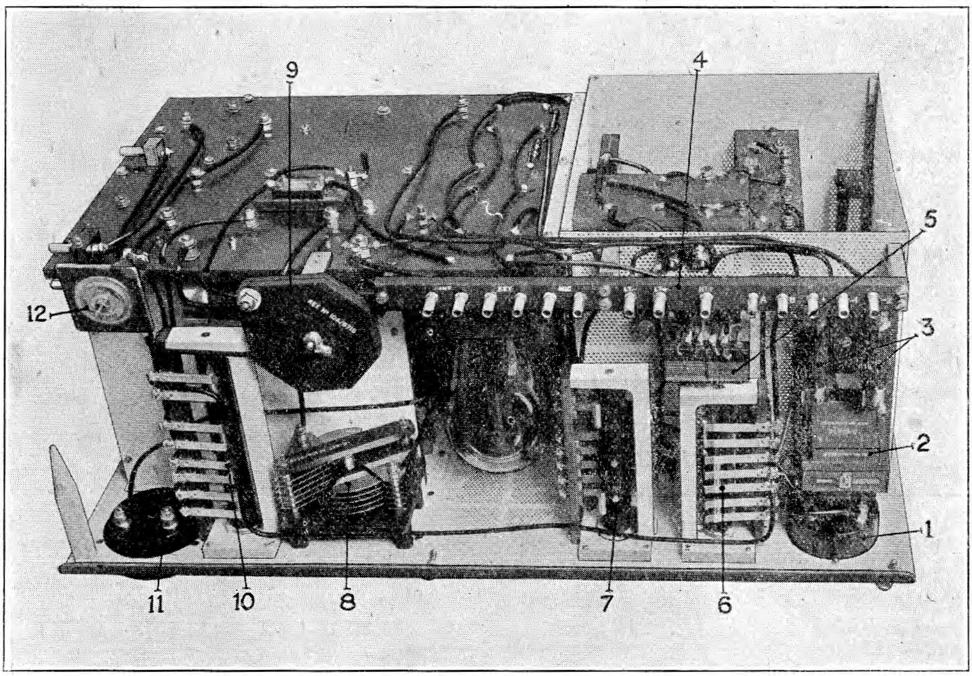


FIG. 11. Interior view.

34. The valve seen in the centre of the illustration is the amplifier valve. The two modulator valves are behind the amplifier. The condenser (8) seen in the foreground is the neutralizing condenser. The R/F choke (9) above the neutralizing condenser is represented by L_4 in the theoretical circuit diagram fig. 2. The transmit-neutralize switch (10) can be seen to the left of the neutralizing condenser while the aerial ammeter (11) is in the bottom left-hand corner. The condenser (12) in the top left-hand corner has a value of ·00018μF and is the aerial condenser C_9, fig. 2.

35. An underside view of the transmitter is given in fig. 12. The aerial and earth plugs (1) and (2) respectively are seen on the right, the ·002μF condenser (3) being the mains condenser C_8, fig. 2. The components on the left of the illustration are associated with the M/O valve. In the centre is seen the base of the valve-holder (4), while immediately below it lies the M/O tuning condenser (5). To the right is another condenser (6). It has a value of ·00032μF and is the coupling condenser between the M/O and amplifier valves. The condenser (7) has a value of ·002μF and is connected between the inductance and grid of the M/O valve. The ·002μF condenser (8) to the left of the valve-holder is the mains condenser C_5 in the theoretical circuit diagram, fig. 2.

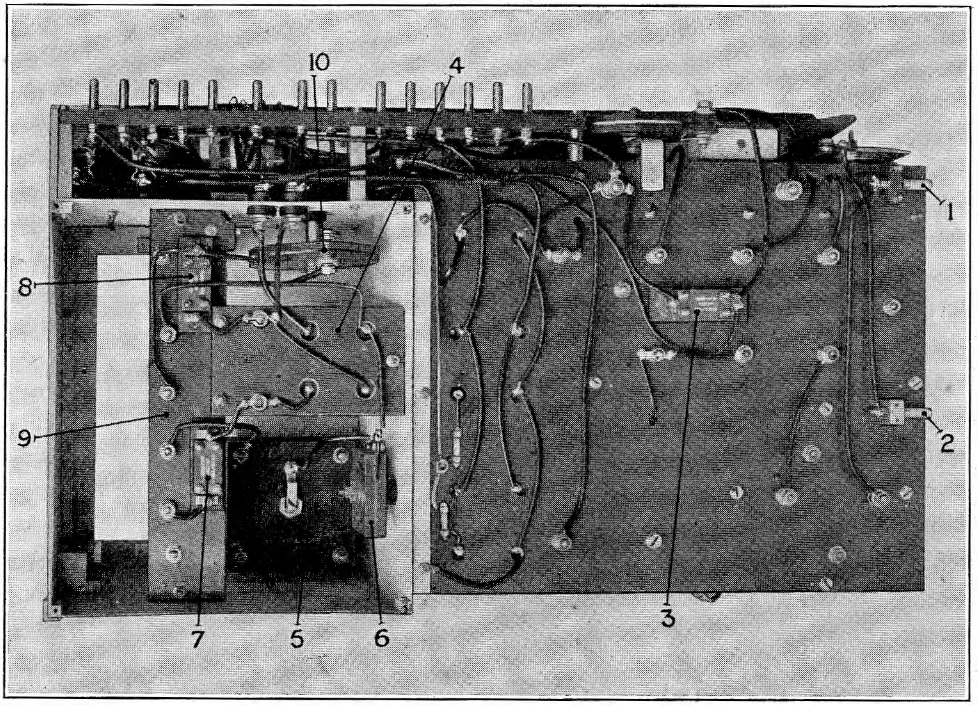


FIG. 12. Underside view.

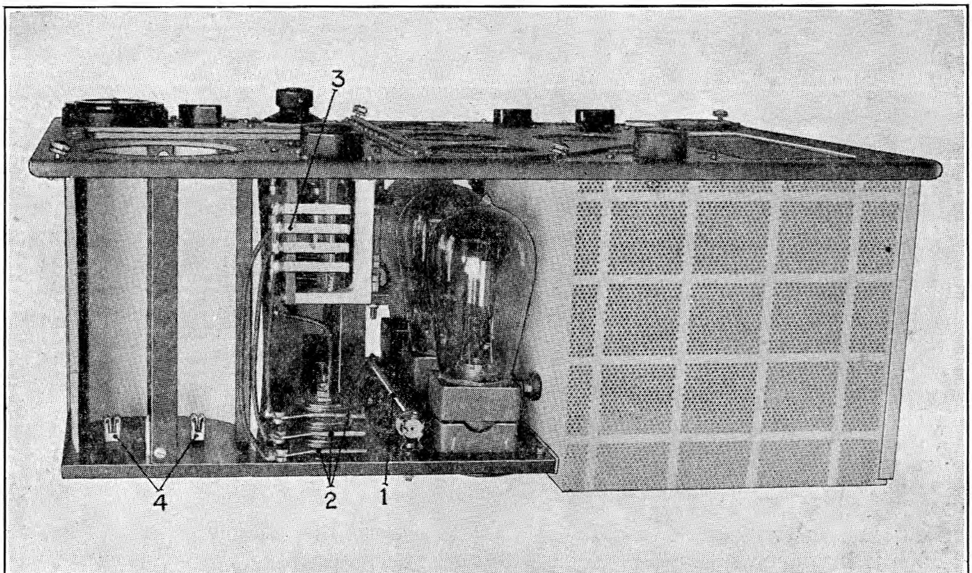


FIG. 13. Side view.

36. The base (9) of the master-oscillator tuning coil forms the support for the two condensers (7) and (8). The R/F choke (10) seen to the right of the coil-holder is connected in the anode circuit of the M/O valve and is represented by L_5 in fig. 2. The contact bar seen at the top of the figure has been referred to previously (*see* 4, fig. 11).

37. Referring to fig. 13, which is a side view of the transmitter, it will be seen that the master-oscillator chamber is entirely screened, perforated metal being employed for ventilation. Of the three valves seen in the foreground, the first two are the modulators and the rear one is the amplifier. The resistance (1) seen near the valves is the grid-leak resistance R_1 in fig. 2 and has a value of 45,000 ohms. The three condensers (2) each have a value of ·00018μF. They are represented by C_1, C_2 and C_3 in fig. 2, and may be included in the amplifier circuit by operating the switch (3) immediately above them. The space on the left-hand side of the transmitter is normally occupied by the aerial tuning coil. The two contacts (4) on the base of the coil-holder are clearly visible.

Coils

38. The frequency bands of the transmitter are covered by sets of plug-in coils. One set of three coils is provided for each of the ranges A, D and E, while ranges B and C have a common aerial coil engraved accordingly. Each set of coils consists of an aerial tuning coil, an amplifier tuning coil and a master-oscillator tuning coil. The set for range C is shown in fig. 14. The aerial coil for the range A and the coil provided for B and C have a similar general appearance, while the aerial coils for the ranges D and E are similar to each other but differ slightly from those of the first three ranges. All the M/O tuning coils are similar in appearance except for range C which has a switch handle passing through the top plate. The amplifier coils for the ranges B, D and E are similar, while those for the ranges A and C have a switch in addition.

39. The amplifier coils for all five ranges are similar in appearance and are built up on rectangular formers of composite insulating material. The top of each coil is provided with an aluminium alloy plate, and two screws pass through the plate and secure the coil in position. The various tapping points are brought out to six knife contacts secured to the base. The inductance is varied by means of a variometer built into the coil. A knob is provided on the top plate by which the variometer may be controlled. On the ranges A and C, in addition to the

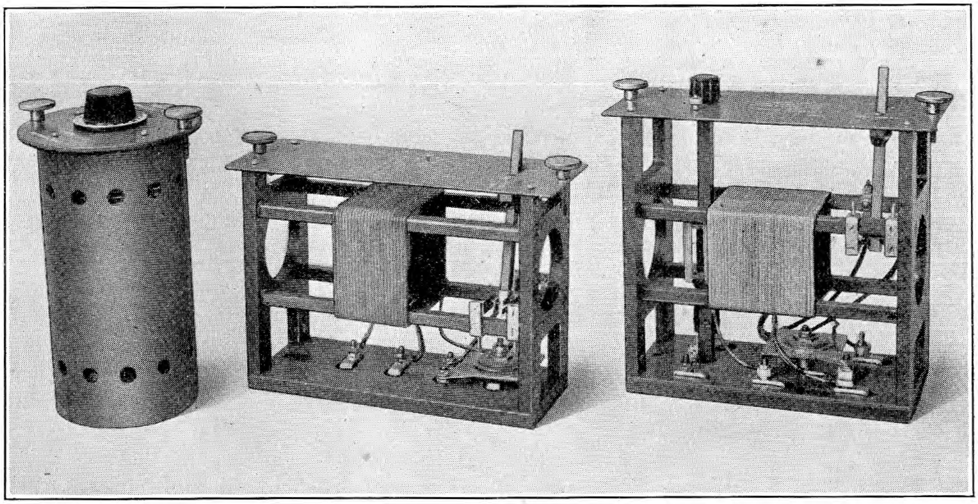


FIG. 14. Aerial, Master-oscillator, and Amplifier coils (Range C).

variometer, a switch is provided which splits up the frequency band covered by the coil. Thus in the case of the amplifier coil range A (6,667 to 4,286 kc/s), the switch divides this band into two frequencies: 6,667 to 5,455 kc/s and 5,455 to 4,286 kc/s. In the case of the coil range C (3,409 to 2,000 kc/s), the switch divides this band into two frequencies 3,409 to 2,500 kc/s and 2,500 to 2,000 kc/s.

40. All the master-oscillator coils are similar in appearance, the range C coil only being provided with a switch. The constructional features are the same as those of the amplifier coils, except that the M/O coils are somewhat smaller and only four knife contacts are provided in the base.

41. The aerial tuning coils differ from the M/O and amplifier coils in that they are cylindrical coils. The windings and coil former are encased in a shield of insulating material. The top of the coil is formed from composite insulating material and the base is provided with two knife contacts. The range A coil and coil for range B and C are each provided with a central control knob by means of which the inductance of the coil may be varied. An indicating window shows the amount of movement of the variable tap. The coils for the ranges D and E differ from the others in that the control knob instead of being central, is disposed somewhat near the edge of the top plate. Furthermore instead of the inductance being tapped, as in the case of the coils A, or B and C, the variometer principle is employed.

42. The aerial tuning coils for the ranges A, B and C (*see* fig. 15) are wound with $\frac{1}{8}$ in. dia. 22 s.w.g. plated copper tube. A rotatable brush makes contact with the inside of the coil, the number of turns being recorded on an indicating device at the top of the coil. In addition to the coil of copper tubing, the coil for range B and C has a winding of 5 turns of 16 s.w.g. double-covered copper wire in series with the main winding. The finish of the winding is brought to one contact on the coil base and the variable tap to the other contact. The main winding for coil A range (6,667 to 4,286 kc/s) has $18\frac{1}{2}$ turns, while the main winding for the B and C range coil (4,615 to 2,000 kc/s) has $30\frac{1}{2}$ turns.

43. The aerial coils range D and E (2,069 to 1,222 kc/s) and (857 to 545 kc/s) respectively consist of a rotor and a stator. Each winding employs 27/39 single silk-covered stranded copper wire, double silk-covered overall. Each coil is provided with two knife contacts secured in the base to which the windings are connected. The rotor and stator of the range D coil have 14 turns each (7 per slot). The rotor of range E coil has 50 turns (25 per slot) and the stator has 38 turns (19 per slot).

44. The amplifier tuning coil range A (6,667 to 4,286 kc/s) is provided with two windings, one stator and one rotor. The rotor is wound with 6 turns of 27/39 stranded copper wire, each strand is single silk-covered and all the strands are double silk-covered. The stator is wound in three sections. The first section has $6\frac{3}{4}$ turns of 20 s.w.g. double cotton-covered copper wire. The second section is wound with $3\frac{3}{4}$ turns of 81/40 stranded copper wire enamelled and braided cotton-covered. The third section is wound with $6\frac{1}{4}$ turns of 20 s.w.g. double cotton-covered copper wire. The rotor is connected across the first two contacts. Various tappings are taken from the stator as follows; section one, 2 turns from the start, section two at $\frac{3}{4}$ turns from the start. Section three is connected across the last two contacts on the coil base. A diagram of connections is given in fig. 16.

45. The amplifier coil range B (4,615 to 3,000 kc/s) is provided with a rotor and a stator. The rotor is wound with 6 turns of 27/39 single silk-covered stranded copper wire, double silk-covered overall. The winding is connected across the first two contacts on the coil base. The stator is wound in two sections, the first section has 17 turns of 81/40 stranded enamelled copper wire braided-cotton-covered. The second section has $9\frac{1}{4}$ turns of 20 s.w.g. double cotton covered copper wire. A tapping is taken at $12\frac{1}{4}$ turns from the start of the first section. This tapping and the start of the winding are connected across the second pair of contacts on the coil base.

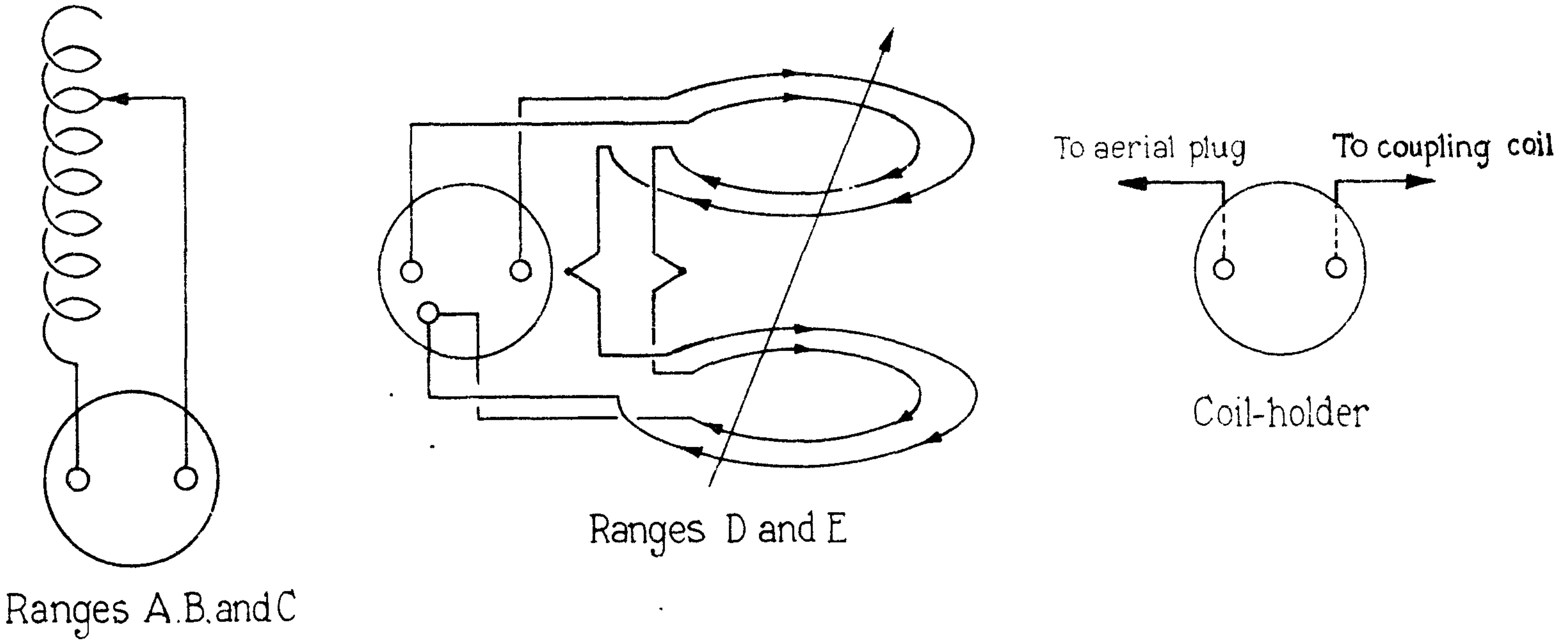


FIG.15, COIL DIAGRAMS (AERIAL)

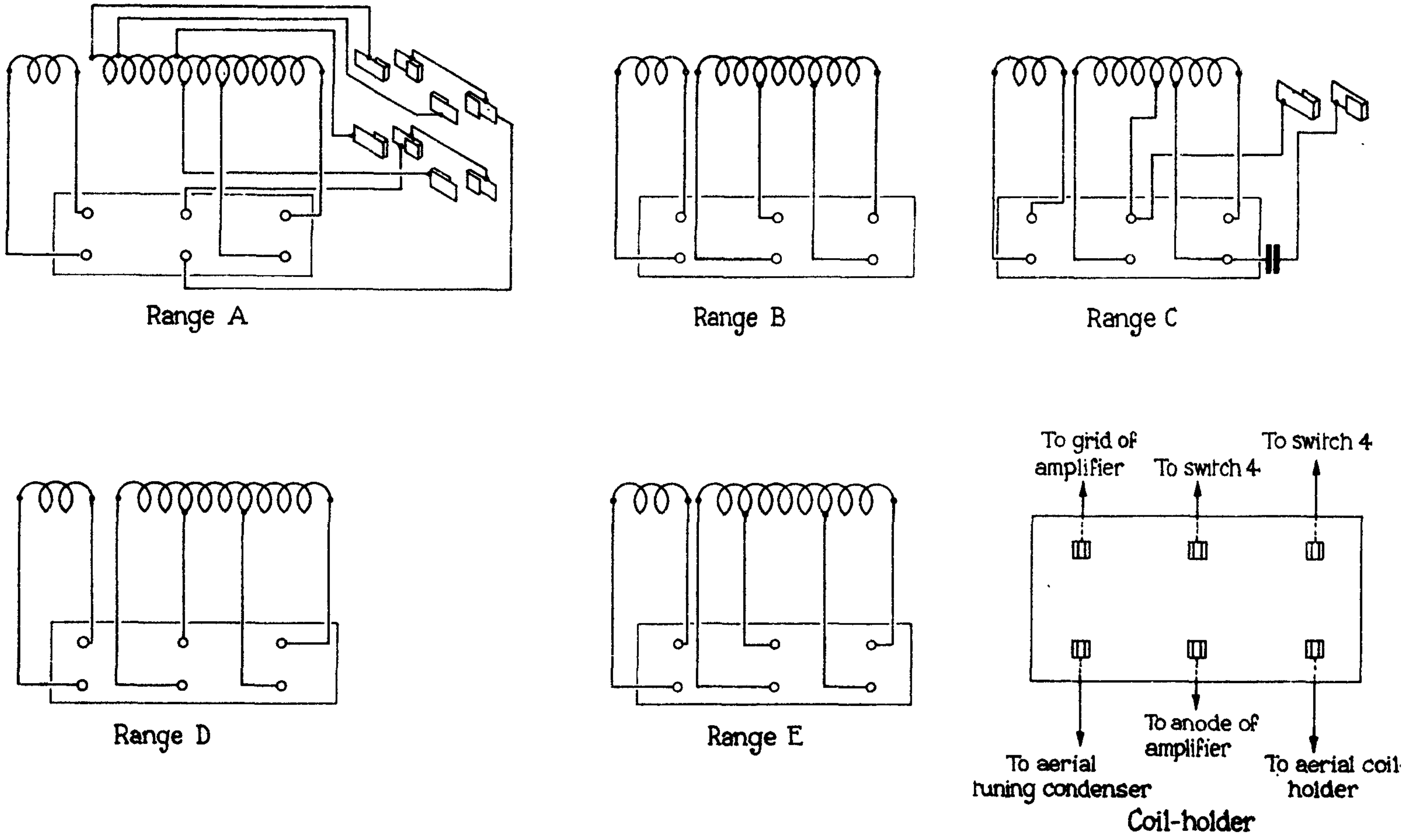


FIG. 16. COIL DIAGRAMS (AMPLIFIER)

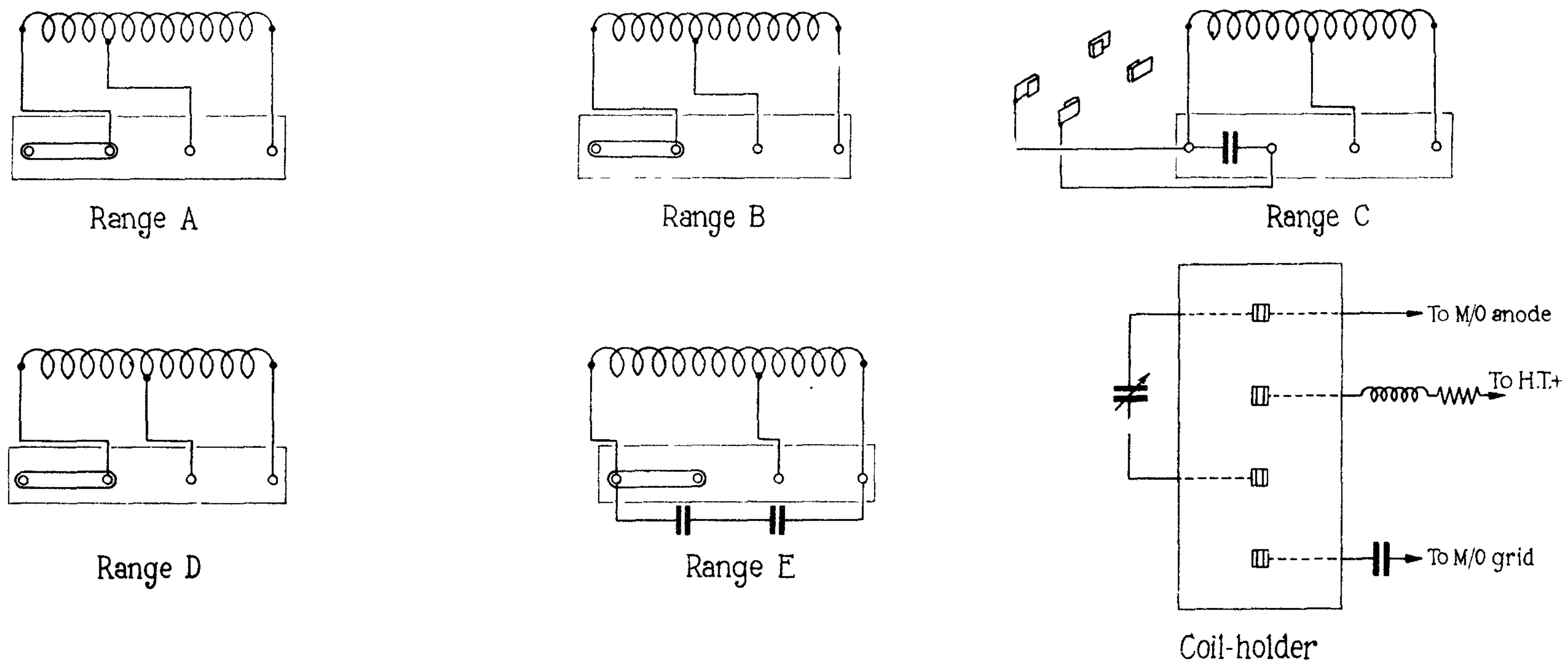


FIG.17, COIL DIAGRAMS (MASTER-OSCILLATOR)

The end of the first section and the start of the second section are connected together and joined to one of the last pair of contacts, while the end of the second section is joined to the other contact of the last pair (*see* fig. 16).

46. The amplifier coil range C (3,409 to 2,000 kc/s) is provided with a rotor and a stator. The rotor is wound with 8 turns of 27/39 single silk-covered stranded copper wire, double silk-covered overall. The winding is connected across the first pair of contacts on the coil base. The stator is wound with 33 turns of 81/40 stranded enamel copper wire, braided-cotton-covered. Tappings are taken at 15¼ and 21 turns from the start. The start of the winding and the first tap are connected across the second pair of contacts, and the second tap and end of the winding are connected across the third pair of contacts. A ·0004μF condenser is connected in series with a switch between the tapping points on the coil (*see* fig. 16).

47. The rotor winding on the amplifier coil range D (2,069 to 1,222 kc/s) is wound with 11 turns of 27/39 single silk-covered stranded copper wire, double silk-covered overall, and connected across the first pair of contacts on the coil base. The stator is wound with 51¼ turns of 81/40 stranded enamel braided-cotton-covered copper wire ; tappings are taken off at 12¼ and 26 turns from the start. The start of the winding and the first tap are connected across the second pair of contacts, while the second tap and end of the winding are connected across the third pair of contacts (*see* fig. 16).

48. The rotor of the amplifier coil range E (827 to 545 kc/s) is wound with 27/39 single silk-covered copper wire, double silk-covered overall. The winding is connected across the first pair of contacts on the coil base. The stator is divided into three sections and connected up as shown in fig. 16. The first section is wound with 35¼ turns of 24 s.w.g. double cotton-covered copper wire. The second section is wound with 31¾ turns of 18 s.w.g. double cotton-covered copper wire, and the third section is wound with 50¼ turns of 24 s.w.g. double-cotton-covered copper wire.

49. The M/O tuning coil range A (6,667 to 4,286 kc/s) has one winding wound with 11 turns of 81/40 stranded enamelled copper wire, braided-cotton-covered, tapped at the third turn from the start. The first and second contacts on the coil base are short-circuited. The start of the winding is connected to the second contact, the tapped portion to the third contact and the finish of the coil to the last contact. A diagram of connections is given in fig. 17.

50. The M/O coil for range B (4,615 to 3,000 kc/s) and the coil for range D (2,069 to 1,222 kc/s) have the same circuit diagram, as can be seen in fig. 17, but the windings of each coil are different. The coil for range B is wound with 17 turns of 81/40 stranded enamelled braided-cotton-covered copper wire, and tapped at six turns from the start. The coil for range D is wound with 36 turns of 18 s.w.g. double cotton-covered copper wire, tapped at 11 turns from the start.

51. The M/O coil for range C (3,409 to 2,000 kc/s) is wound with 23 turns of 14 s.w.g. double cotton-covered wire tapped at seven turns from the start. The start of the winding is connected to the first knife contact on the coil base, the tap is connected to the third contact, and the finish of the coil is connected to the fourth contact. Between the first and second contacts, a ·00018μF condenser is connected. A switch incorporated in the coil is capable of short-circuiting this condenser if required (*see* fig. 17).

52. The M/O coil for range E (857 to 545 kc/s) is wound with 126 turns of 18 s.w.g. double-cotton-covered copper wire, tapped at 56 turns. The start of the winding is connected to the first contact on the coil base. The tap is connected to the third contact, and the end of the winding is connected to the last contact. The first and second contacts are short-circuited) Two ·00018μF condensers are connected in series across the first and fourth contacts (*see* fig. ·17.

Automatic grid-bias unit

53. The automatic grid-bias unit is shown in fig. 18. It consists of an aluminium case (1) approximately 8 in. × 6 in. × 4 in., inside which are mounted two wire wound potentiometers (*see* fig. 8). The potentiometers incorporate toroidal wound resistances on cylindrical formers with self-lubricating copper-graphite contacts operated by handles, each element having a resistance of 3,500 ohms. The case has been designed with the object of making the unit both sand and moisture proof, special sealing means being provided for the operating spindles of the potentiometers. Since the air enclosed within the case is liable to contract and expand under the influence of temperature change, a pressure stabilizing device has been provided in the base. This consists of a chrome-leather diaphragm which will readily expand with increased pressure. The diaphragm is covered by a fine mesh screen for protection.

54. Three of the four plugs on the right of the instrument are engraved GB—2, GB—1 and GB+ respectively. The plugs GB—2 and GB—1 are connected to the movable contacts on the amplifier and modulator resistance element respectively. The plug GB+ is connected to the start of both resistances and the un-engraved plug is connected to the finish of both resistances (*see* fig. 8). The plugs are similar to those on the grid-bias battery box described elsewhere. The two units are interchangeable.

55. The front of the case is provided with two operating handles (2) and two scales engraved from 0–100. The one on the left is for the amplifier valve and the one on the right for the modulator valves. An indicating line is engraved on each handle to facilitate setting and reading. The scales are suitably engraved with an arrow to indicate in which direction the handles should be rotated to increase the bias.

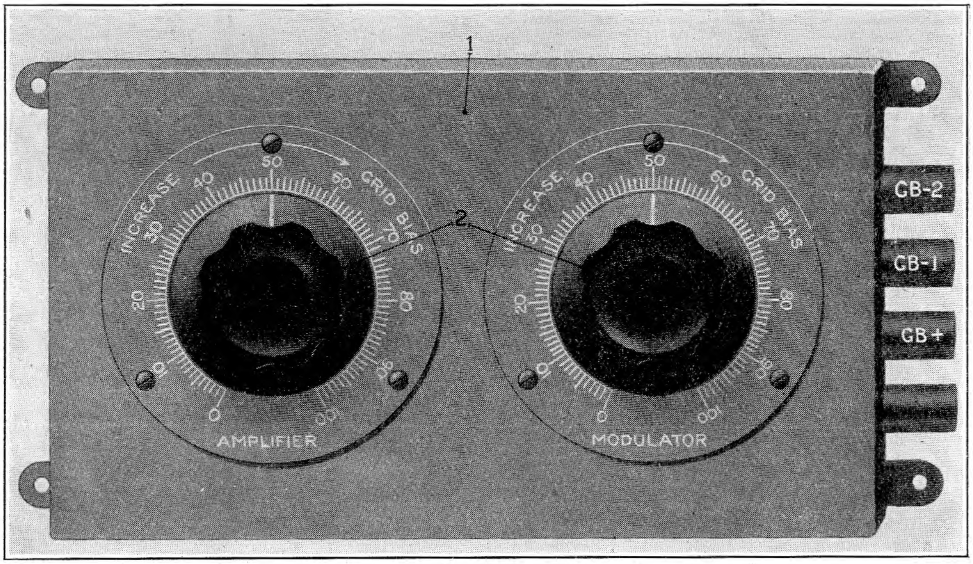


FIG. 18. Automatic grid-bias unit.

Grid-bias battery and box

56. As an alternative to the automatic grid-bias unit, the necessary bias for the valves may be obtained from a battery. This unit which is illustrated in fig. 19 consists of twelve 15-volt units contained in a wooden case. The case (1) is built up of teak and painted inside with an anti-corrosive paint. The lid is retained in the closed position by means of the two spring catches (2).

Along one side of the case is a fixed strip of wood (3). This strip is arranged so that its lower edge is just high enough to allow the batteries to pass under it. Along the opposite side is a movable piece of wood (4). As can be seen in the illustration this strip is longer than the total width of all the batteries and is equal in depth to the box. If it is necessary to remove one or more of the 15-volt units, the screw (5) is slackened back allowing the strip (4) to move towards the side of the case. The defective unit can then be moved so as to be free of the fixed strip (3) and removed from the case. After replacement the screw (5) is tightened up again. Eleven battery connectors (6) are provided. Each connector consists of a piece of flexible insulated wire terminating at each end in a spring plug. The 15-volt units are arranged so that the + and — ends are adjacent to each other and the plugs are inserted in position.

57. A terminal strip (7) having four sockets is provided at the left of the case. As can be seen, three of these sockets are engraved —2, —1 and +. The last two sockets are short-circuited by a link (8). Four plugs engage these sockets externally. The plugs are the same as those used on the automatic grid-bias unit (*see* fig. 18). The socket engraved + is connected by a flexible

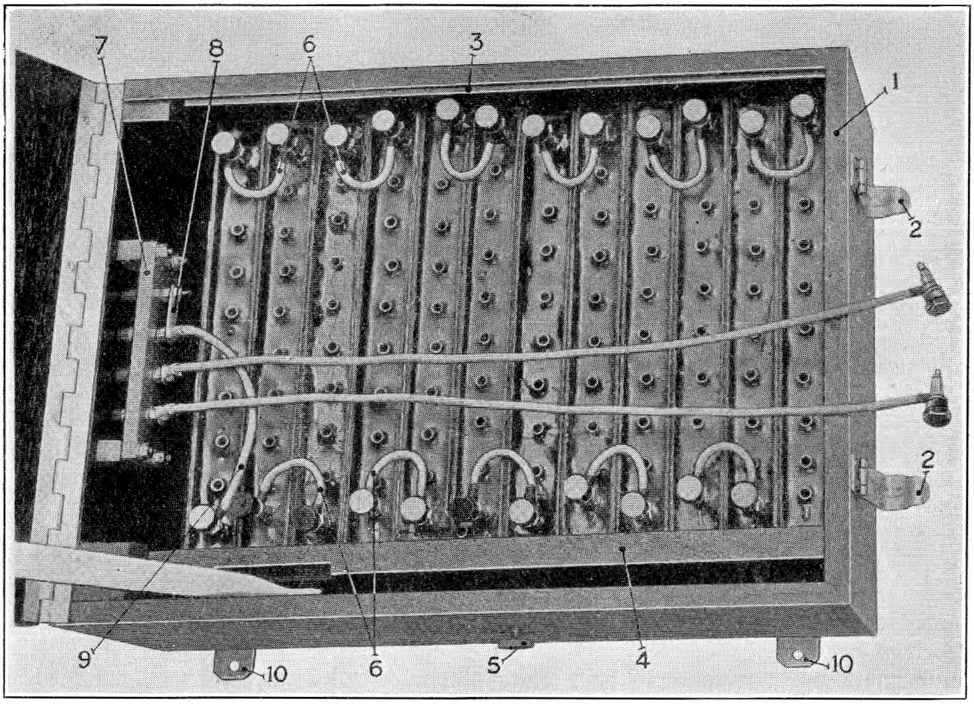


FIG. 19. Grid-bias battery unit.

lead (9) to the positive contact of the first 15-volt unit. The sockets engraved —2 and —1 are each provided with a flexible lead terminating in a spring plug and long enough to engage any of the sockets of the last 15-volt unit. It is thus possible to obtain a bias up to 180 volts between the socket engraved + and either of the two sockets engraved —1 or —2. Four securing lugs are provided on the base of the case, two of which (10) can be seen in the foregound.

Side-tone unit

58. An illustration of the side-tone unit is given in fig. 20. It consists of a metal case (1) in which are housed three condensers, a metal rectifier and two resistances. On the front panel

of the case are mounted two telephone jacks (2) and two switches (3). The two jacks are wired in parallel, the one on the right for the receiver output and the one on the left for the telephones. The switch handle on the left simultaneously operates a D.P.D.T. switch and an " on and off " switch. The former changes over the connections of the interrupter, allowing it to interrupt the side-tone circuit or the transmitter circuit. The " on and off "

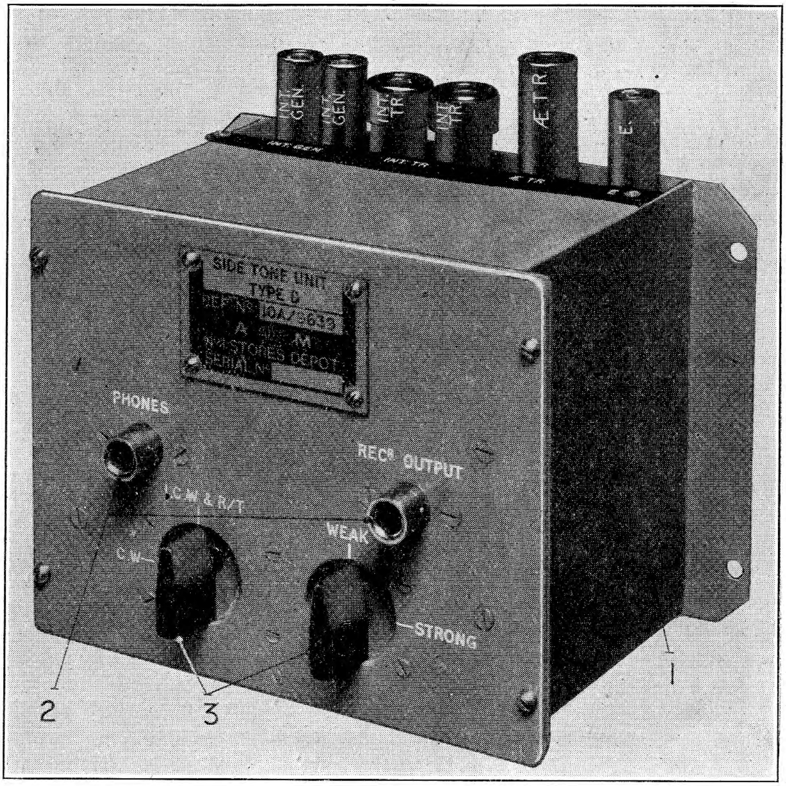


FIG. 20. Side-tone Unit. Type D.

switch completes the side-tone circuit when the interrupter is removed. The right-hand switch which is marked WEAK and STRONG, short-circuits, in the " strong " position, one of the series resistances. The six plugs at the rear of the side-tone unit are engraved INT. GEN. INT. GEN. INT. TR. INT. TR. AE.TR. and E. Flexible connections are taken from these plugs to the interrupter terminals on the generator, the interrupter terminals on the transmitter, and the aerial and earth terminals respectively. The circuit diagram of the unit is given in fig. 9.

VALVES, GENERATORS AND BATTERIES

59. Four type V.T.25 valves are used, one as a master-oscillator, one as an amplifier and two in parallel, as modulators. The L.T. supply is obtained from accumulators. In a tender, alkaline accumulators will normally be used, and the requisite number of cells to provide 8-volts will be required. The H.T. is obtained from either an 80-watt motor-generator, type E, or a 255-watt motor-generator. The 80-watt M/G is driven from a 14-volt battery and the 255-watt M/G is driven from a 24-volt battery.

60. The transmitter is capable of dealing with input power of about 200 watts. If, in order to obtain a larger output, it is necessary to overload the 80-watt generator, suitable ventilation must be arranged and prolonged runs must be avoided. When using the 80-watt M/G the automatic grid-bias unit in not employed. Grid bias is then obtained from a 180-volt battery consisting of twelve 15-volt units contained in a wooden box with the necessary plug-in connections.

OPERATION

61. The following paragraphs describe the way in which the transmitter may be adjusted for operation. When making these adjustments reference should be made to Tables 1 to 7. Before commencing to use the transmitter, make sure than all external leads are correctly connected. Particularly, see that there is a connection from the negative terminal of the L.T. battery to earth. The appropriate coils should now be plugged in and the modulator bias (G.B.—1) set to the maximum bias position. The amplifier valve grid-bias (G.B.—2) is also set initially to maximum.

62. Set the selector switch to R/T, the anode current milliammeter switch to MOD and the "Transmitter-neutralize" switch to AMP TUNING AND NEUTRALIZE. Set the aerial coupling coil (on the amplifier tuning coil) to 0, and the master-oscillator tuning to the setting given in the appropriate table nearest the desired frequency, and switch on the L.T. supply.

63. If an H.T. generator provided with a field control is used, adjust the field to give an H.T. voltage of 1,000 volts. Since no such control is normally available on the 80-watt generator, the voltage will be of the order of 1,200 volts. Switch on the H.T. and read the anode current taken by the modulator valves. A small current reading should be obtained by adjusting the modulator bias. If, when using the 80-watt motor-generator the anode current is greater than 60 mA some fault is indicated either in the bias arrangement, or in the valves, or in the H.T. supply. Switch off the H.T. and set the milliammeter switch to M/O. On switching on the H.T. again, the M/O current should be about 20 mA. (The anode current varies between 15 and 25 mA dependent on variations of frequency and H.T. supply.)

64. Set the neutralizing condenser to zero and tune the amplifier closed circuit by observing the thermo-ammeter ; an optimum reading should be obtained. As the reading in the ammeter increases, the value of the current should be reduced step by step by means of the neutralizing condenser so that when the amplifier circuit is tuned, the ammeter should indicate a minimum (quarter scale reading or less). This is the correct neutralizing position.

65. Switch off the H.T., put the "Transmit-neutralize" switch to AERIAL TUNING AND TRANSMIT and introduce a little aerial coupling, say 10 degrees, *i.e.* move the aerial coupling knob on the amplifier coil to the position engraved 1. Switch on the H.T., adjust the amplifier bias and tune the aerial circuit, retuning the amplifier and aerial circuits alternately until a maximum aerial current reading is obtained. The amplifier circuit can best be tuned by setting the milliammeter switch to AMP and tuning to a minimum anode current. Increase the aerial coupling by degrees, re-tuning the amplifier and aerial circuits each time, until a maximum aerial current is obtained without the "double hump" tuning effect in the aerial circuit.

66. It will now be necessary to adjust the anode currents in the amplifier and modulator valves. The total power is shared by the three circuits M/O, AMP and MOD. Assuming the generator will give 80 watts at 1,000 volts, there is a current of 80 mA available for these three circuits. If the M/O takes 20 mA, the remaining 60 mA will be shared between the amplifier and modulators roughly in the proportion of 25 mA for the amplifier and 35 mA for the modulators. If a 255-watt M/G is used and the H.T. voltage can be adjusted, the current in the three circuits should be increased proportionally, though the total current should not exceed 150 mA since the modulator choke is rated at 150 mA maximum. If 200 watts is available, a voltage of 1,300

approximately is all that is necessary in order to provide a total current of 150 mA. In these circumstances since 25 to 30 mA are taken by the M/O, 120 to 125 mA must be shared between the amplifier and modulators, a suitable allocation being 50 to 55 mA for the amplifier and 65–70 mA for the modulator. These values depend upon the H.T. voltage available, but they should be approximately in this ratio. The V.T.25 valves used in the modulator stage have a rated maximum anode dissipation of 60 watts, hence the power used by the two valves should not exceed 120 watts. Using a voltage of 1,300 volts the maximum permissible current in the modulator is 90 mA approximately.

67. Adjust the bias of the amplifier and modulator valves and if necessary adjust the aerial coupling until the anode currents are in the ratios given in the previous paragraph. Check the frequency. Wavemeter W.1081 may be used if the transmitter is being operated on range A or B (6,667 to 3,000 kc/s). Wavemeter W.1095, if available, may be used for Range C (2,000 to 3,409 kc/s) and part of range D. On the other frequencies a wavemeter W.39 may be used. If the frequency is incorrect determine the M/O setting to give the required frequency by interpolation from the table (*see* para. 76) and after having set up the M/O, tune the amplifier and aerial circuits.

68. Check the depth of modulation by means of a Modulation Indicator, type 1 (Stores Ref. 10A/8219) if available. Using the handpress microphone (Stores Ref. 10A/7849) provided for local working, a loud " Hulloo " spoken into the microphone should give 75 per cent. modulation. Where the modulation indicator is not available, some idea of the modulation may be gained by observing the rise in aerial current with modulation. A rise of 15 to 20 per cent. should be obtainable by shouting. Check the speech quality by using either the modulation indicator or by listening on the side-tone unit ; separate individuals should do the speaking and listening. The percentage modulation and quality of speech may be varied by adjustment of the grid-bias of the modulator valves.

69. For C.W. or I.C.W. operation it is only necessary to set the selector switch and the side-tone switch to the appropriate positions. It should be observed that, owing to the removal of the modulator valve load from the generator, the values of anode and aerial current are higher for C.W. than for R/T. If, when operating on the 857 to 545 kc/s band an increase in working range is desired, this can be obtained by using a 150-ft. single wire aerial on 30-ft. masts with earth mats.

Adjustment of transmitter for various frequencies

3,800 to 6,940 kc/s

70. Assume it is desired to set the transmitter to a frequency of 5,000 kc/s. The coils required are the range A coils and the table of reference is Table 1. By interpolation from the table it will be seen that the desired frequency can be obtained with the amplifier coil switch at position 1 or 2. Position 1 is selected as being more appropriate. The frequency required falls between 5,295 and 4,795, and roughly half way. Set the M/O tuning to 75 as a first approximation. Tuning up the transmitter and checking on a wavemeter W.1081, the radiated frequency is found to be 5,033 kc/s or 33 kc/s too high. It will be seen that the difference in frequency is 5,295 — 4,795 or 500 kc/s, and the difference in the M/O setting for these frequencies is 90 — 60 or 30 scale divisions. In this region of the scale therefore one division is equal to $\frac{500}{30}$ or $16 \cdot 6$ kc/s. The M/O is therefore increased two divisions or $33 \cdot 2$ kc/s $(16 \cdot 6 + 16 \cdot 6)$ and the transmitter re-tuned when the radiated frequency will be found to be 5,000 kc/s.

1,970 to 3,500 kc/s

71. Assume it is desired to set the transmitter to 3,000 kc/s. Coils required, range C, table of reference, Table 3. The required frequency falls between 3,130 and 2,850 kc/s, and is again roughly half way between them. Set the M/O tuning at 45, with the coil range switch in

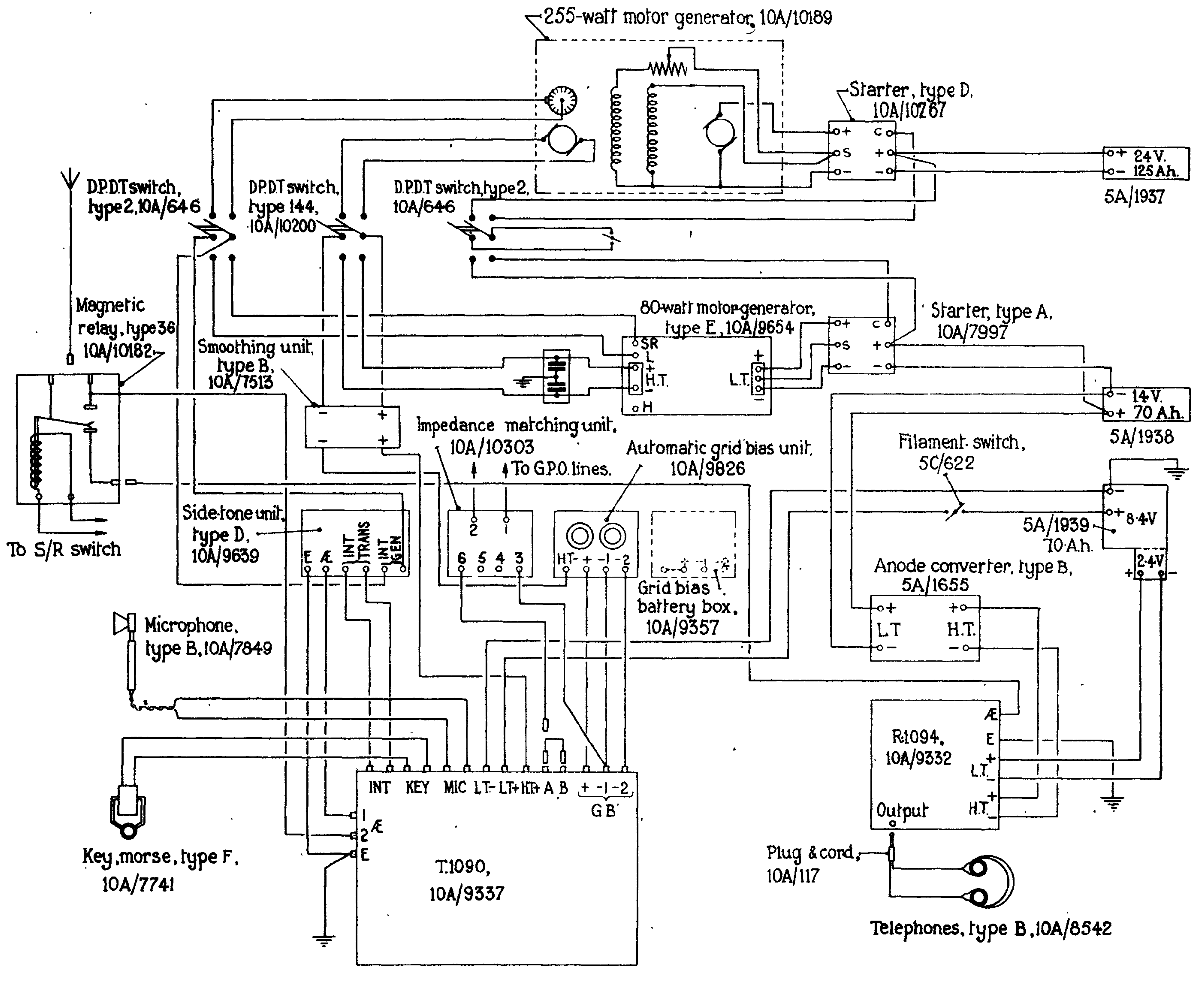


FIG. 21. INSTALLATION DIAGRAM. T.1090

(F.1799). F. & C. LTD

position 2. On tuning the transmitter, the radiated frequency, measured by the wavemeter, is found to be 2,950 kc/s or 50 kc/s low. At this position of the tuning scale 280 kc/s (3,130—2,850) is equivalent to 30 (90—60) scale divisions, or each scale division equals $\frac{280}{30}$, or 9·3 kc/s. It is, therefore, necessary to set the master-oscillator tuning $\frac{50}{9\cdot3}$ or 5·4 scale divisions lower than 45, *i.e.*, to 39·6, say 40. Setting-up to this value and re-tuning, the frequency is found to be 3,000 kc/s $\pm$2 kc/s.

1,207 to 2,120 kc/s

72. The desired frequency is 1,250 kc/s. The coils required are range D, and the table of reference is Table 4. The required frequency in this case is only 34 kc/s different from 1,284. The difference between 1,284 and 1,207 is 77 kc/s. This difference corresponds to a difference of 180—150 or 30 scale divisions, which is roughly 2·5 kc/s per scale division. Now 34 kc/s correspond to 13 scale divisions, so as a first approximation set the M/O tuning to 150 + 13 or 163 scale divisions. On tuning the transmitter, the radiated frequency, as measured by the wavemeter, is found to be 1,240 kc/s and this is 10 kc/s low, so that the proper M/O setting should be $\frac{10}{2\cdot5}$ or 4 divisions less, *i.e.* 159. On re-setting the M/O to this value and tuning the transmitter the radiated frequency is found to be 1,250 kc/s.

INSTALLATION

73. Fig. 21 is an installation diagram of transmitter T.1090 used in conjunction with receiver R.1094, the latter being similar to R.1093 described elsewhere in this publication, but fitted in a box. The diagram is a simplified one showing the method of connecting up the automatic bias, side-tone unit, etc. When housed in a W/T tender, auxiliary equipment such as remote control devices, relays, extra receivers, etc., are required. The installation of the complete station with its auxiliary apparatus will be dealt with elsewhere.

74. Referring to fig. 21, it will be seen that the transmitter and the receiver are connected up in such a way that the aerial is changed over from one to the other by means of an electrically operated change-over switch. Alternative H.T. supplies are shown in the diagram. One of these consists of an 80-watt motor-generator, type E, and the other a 255-watt generator. Each motor is equipped with its own automatic starting device, and a change-over switch enables either H.T. supply to be connected to the transmitter. A smoothing unit is connected in the H.T. supply line.

75. In the diagram it will be seen that the automatic grid-bias is in use. The battery grid-bias is shown to the right of this, the two units being interchangeable. To the left of the automatic grid-bias can be seen the special matching impedance unit which is required when the transmitter is modulated on a line from a remote position. Normally the connections A and B on the transmitter, are connected together by means of a jumper terminating in two plugs. When remote modulation of the transmitter is required plug A is removed, and the plug on the special matching impedance unit is inserted in its place ; the secondary of the matching impedance transformer is thereby connected in the grid circuit of the modulator.

76. To the left of the matching impedance unit can be seen the side-tone unit. This is provided with six terminals. The two terminals on the left are connected to Æ and E respectively. The two terminals at the right marked INT., GEN. are connected to a change-over switch and movement of the latter connects the interrupter of the 80-watt generator or the interrupter of the 255-watt generator into circuit in the side-tone unit. The two terminals in the centre are connected up to the INT. terminals on the transmitter. A change-over switch (not shown) is

operated to change from " send " to " receive." This switch operates a number of relays which close various circuits, for example, the aerial change-over switch solenoid, the H.T. supply to the transmitter and the H.T. supply to the receivers.

77. On the right of the diagram can be seen the batteries which supply the L.T. to the transmitter and receiver, and also the anode converter which provides the H.T. supply to the receiver. Two separate batteries are provided one (14-volt) for the 80-watt M/G and one (24-volt) for the 255-watt M/G.

PRECAUTIONS AND MAINTENANCE

78. The tables of adjustments which follow have been prepared on a load representing the aerial system likely to be fitted on a W/T tender. When the transmitter is used with another type of aerial, the aerial tuning and aerial current figures will, of course, not apply. The amplifier tuning figures may also be different.

79. Where the major portion of the traffic is W/T, and particularly where extreme ranges are required, special C.W. or I.C.W. settings (*see* Table 6) may be used. In these circumstances it is recommended that the aerial ammeter be short-circuited by a straight piece of R_4 aerial wire. This is to avoid possible damage consequential upon large aerial currents.

80. Poor quality of speech may be caused by inaccurate adjustment of the anode current ratio of amplifier and modulator valves. The trouble is more likely to occur with insufficient modulator anode current. Over-modulation may also produce distortion. This will be indicated by violent changes of modulator anode current when modulating. To correct this, reduce the loudness of the voice until the modulator anode current milliammeter ceases to kick violently. The possibility of a bad microphone being in use should also be checked. Try tapping the microphone. If this fails to improve the quality, change the microphone.

81. With C.W. there is an increase in aerial current over that obtained on R/T. This is because the load is less on C.W. and the voltage available from the generator is therefore higher. It should be noted that when automatic bias is used this effect is exaggerated owing to the fact that the reduced current through the bias resistances reduces the effective bias. When using the 255-watt generator at maximum power, the current produced in the standard tender aerial will be considerably greater than the aerial ammeter is capable of carrying without damage. If C.W. is to be used therefore, before switching over from R/T to C.W., reduce the aerial coupling or increase the amplifier bias until the aerial current is limited to a value which will not damage the ammeter. If maximum power on C.W. must be used, the ammeter should be shunted as mentioned in para. 62.

82. If, when listening to the C.W. note in the side-tone unit, roughness is detected, the amplifier bias should be increased until a pure note is obtained. It is important to note that if I.C.W. is required the switch on the side-tone unit must be in the " I.C.W. and R/T " position.

83. The voltage of the L.T. battery should be checked periodically on load. Where battery grid-bias is employed the voltage of this should also be checked frequently and any defective 15-volt units renewed. Ensure that all grid-bias battery jumper connections and plugs make proper connection.

84. When the grid-bias battery is used and the H.T. voltage exceeds 1,100 volts, parasitic oscillations are liable to occur in the circuit associated with the modulator valves. In order to prevent these oscillations, two resistances type 263 (100 ohms each) are connected in series between the grids of the modulator valves. The junction-point of the two resistances is taken to the socket engraved A. This modified arrangement is shown in figs. 2, 10, 11 and 12.

TABLES OF ADJUSTMENTS FOR TRANSMITTER TYPE T.1090

Standard Tender Aerial System. H.T. 1,500 volts on load. 200 watts input (approx.)

Table 1.—Range A (4,286 to 6,667 kcs)

kc/s.	M/O.		Amplifier.						Neutralizing condenser.	Modulator.			Total anode current mA.	Total input (watts).	Aerial.			
			Tuning.				Grid bias.				Grid bias,							
	Tuning.	Anode current mA.	Range 1.	Range 2.	Fixed condenser switch	Anode current mA.	Volts.	Dial setting.		Anode current mA.	Volts.	Dial setting.			Plug position.	Tuning.	Coupling (degrees).	Current (amps.).
6,940	0	33	—	36·0	A	48	236	93	48	65	110	43	146	219	2	1–118	7	1·1
6,080	30	35	—	114·5	A	43	228	92	48	65	112	45	143	214	2	4–204	14	0·55
5,300	60	35	—	58·0	B	44	233	93	48	65	111	44	144	216	2	7–158	16	0·82
4,800	90	35	—	130·0	B	43	226	94	52	60	112	46	138	207	2	9–344	24	0·72
6,075	30	35	54·0	—	A	43	216	91	60	57	112	47	135	203	2	5–45	25	1·03
5,295	60	36	118·5	—	A	38	206	92	62	54	115	51	128	192	2	7–263	12	0·8
4,795	90	36	39·5	—	B	39	210	92	65	56	114	50	131	197	2	10–15	18	0·9
4,360	120	37	103·5	—	B	40	212	92	66	56	114	49	133	200	2	12–202	21	0·8
4,050	150	37	29·0	—	C	44	224	92	64	59	110	45	140	210	2	14–335	28	0·88
3,800	180	38	85·0	—	C	42	226	92	66	62	109	44	142	213	2	17–150	27	0·75

TABLE 2

Range B (3,000 to 4,615 kc/s)

kc/s.	M/O.		Amplifier.					Neutralizing condenser.	Modulator.			Total anode current mA.	Total input (watts).	Aerial.			
			Tuning.			Grid bias				Grid bias							
	Tuning.	Anode current mA.	Variable condenser.	Fixed condenser switch	Anode current mA.	Volts.	Dial setting.		Anode current mA.	Volts.	Dial setting.			Plug position.	Tuning.	Coupling (degrees).	Current (amps.).
4,945	0	33	82	A	43	219	92	51	60	112	47	136	204	2	1–304	5	1·28
4,240	30	35	34	B	44	223	94	53	61	110	47	135	203	2	5-292	10	1·2
3,680	60	35	114	B	47	225	90	54	60	109	44	142	213	1	3–35	18	1·27
3,300	90	35	103	C	47	225	90	56	60	110	44	142	213	1	6–33	6	1·0
3,010	120	35	41	D	50	232	92	56	60	113	44	145	218	1	9–3	7	0·95
2,795	150	36	143	D	50	234	92	58	60	109	43	146	219	1	11–277	32	1·0
2,700	165	37	179	D	50	233	90	55	60	109	42	147	221	1	12–360	58	0·95

TABLE 3

Range C (2,000 to 3,409 kc/s)

kc/s.	M/O.			Amplifier.						Neutralizing condenser.	Modulator.			Total anode current mA.	Total input (watts).	Aerial.			
	Tuning.			Tuning.				Grid bias.				Grid bias.							
	Range 1.	Range 2.	Anode current mA.	Range 1.	Range 2.	Fixed con- denser switch	Anode current mA.	Volts.	Dial setting.		Anode current mA.	Volts.	Dial setting.			Plug position.	Tuning.	Coupling (degrees).	Current (amps.).
3,500	—	0	28	—	149	A	41	206	92	66	59	115	51	128	192	1	2–264	10	1·38
3,130	—	30	27	—	93	B	45	210	91	69	60	110	48	132	198	1	5–320	20	1·4
2,850	—	60	27	—	43	C	47	217	91	68	62	112	47	136	204	1	9–74	20	1·3
2,675	—	90	27	—	103	C	49	220	90	69	64	110	45	140	210	1	11–335	0	1·2
2,540	—	120	27	—	173	C	51	226	91	70	64	109	44	142	213	1	14–99	0	1·2
2,440	—	150	27	—	59	D	51	226	91	69	64	109	44	142	213	1	16–106	0	1·2
2,360	—	180	27	—	101	D	50	229	92	69	65	110	44	142	213	1	17–314	0	1·17
2,980	30	—	28	4	—	A	44	211	91	64	60	113	49	132	198	1	7–237	0	1·3
2,625	60	—	27	147	—	A	49	224	91	64	64	110	45	140	210	1	12–284	0	1·25
2,355	90	—	27	153	—	B	49	226	92	67	64	111	45	140	210	1	18–31	10	1·2
2,145	120	—	28	152	—	C	50	230	92	69	65	113	45	143	215	1	23–98	0	1·15
2,000	150	—	29	123	—	D	50	230	91	70	65	113	45	144	216	1	28–271	0	1·07
1,970	158	—	29	162	—	D	50	229	91	69	65	113	45	144	216	1	30–103	0	1·05

TABLE 4

Range D (1,222 to 2,069 kc/s)

kc/s.	M/O		Amplifier.					Neutralizing condenser.	Modulator.			Total anode current mA.	Total input (watts).	Aerial.			
			Tuning.			Grid bias.				Grid bias.							
	Tuning.	Anode current mA.	Variable condenser.	Fixed con- denser switch	Anode current mA.	Volts.	Dial setting.		Anode current mA.	Volts.	Dial setting.			Plug position.	Tuning.	Coupling (degrees)	Current (amps.)
2,120	11	24	78	A	47	214	90	54	65	111	47	136	204	1	2	6	1·3
1,900	30	23	124	A	45	195	84	58	65	113	49	133	200	1	19	0	1·2
1,690	60	23	58	B	50	207	86	62	65	113	47	138	207	1	45	0	1·4
1,506	90	22	133	B	50	233	90	64	75	105	41	147	221	1	71	0	1·3
1,388	120	23	65	C	55	236	91	66	70	112	43	148	222	1	104	0	1·4
1,284	150	23	136	C	54	247	97	68	68	113	45	145	218	1	132	0	1·35
1,207	180	24	50	D	52	240	94	71	70	112	44	146	219	1	157	0	1·25

TABLE 5

Range E (545 to 857 kc/s)

kc/s.	M/O. Tuning.	M/O. Anode current mA.	Amplifier. Tuning. Variable condenser.	Amplifier. Tuning. Fixed con-denser switch	Amplifier. Anode current mA.	Amplifier. Grid bias. Volts.	Amplifier. Grid bias. Dial setting.	Neutralizing condenser.	Modulator. Anode current mA.	Modulator. Grid bias. Volts.	Modulator. Grid bias. Dial setting.	Total anode current mA.	Total input (watts).	Aerial. Plug position	Aerial. Tuning.	Aerial. Coupling (degrees).	Aerial. Current (amps.).
896	0	30	123	A	41	216	91	60	65	113	47	136	204	1	22	10	0·9
805	30	29	50	B	47	221	89	66	65	112	45	142	213	1	40	7	1·05
717	60	31	133	B	40	215	90	66	65	113	47	136	204	1	61	4	1·0
650	90	32	104	C	42	222	91	64	65	112	46	139	209	1	78	2	0·95
600	120	34	18	D	42	222	90	69	65	112	45	141	212	1	90	3	0·9
560	150	33	103	D	41	221	91	61	65	113	46	139	209	1	102	5	0·86
540	170	34	169	D	42	224	91	58	65	113	46	141	212	1	112	8	0·75

TABLE 6

Examples of C.W. settings showing high current output

The aerial ammeter has been short-circuited by a piece of R.4 aerial wire

Actual aerial current is shown in brackets.

Frequency kc/s.	M/O. Tuning. Range 1.	M/O. Tuning. Range 2.	M/O. Anode current mA.	Amplifier. Tuning. Range 1.	Amplifier. Tuning. Range 2.	Amplifier. Tuning. Fixed con-denser switch	Amplifier. Anode current mA.	Amplifier. Grid bias. Volts.	Amplifier. Grid bias. Dial setting.	Neutralizing condenser.	Modulator. Grid bias volts.	Modulator. Anode current mA.	Total anode current mA.	Total input (watts).	Aerial. Plug position.	Aerial. Tuning.	Aerial. Coupling. (degrees).	Aerial. Current.
3,350	—	13·5	28	—	35	B	88	176	87	69	—	—	116	174	1	2–266	25	1 (2·3 amp.).
2,000	150	—	29	123	—	D	90	190	90	70	—	—	120	180	1	28–271	20	0·8 (1·9).

TABLE 7

Ranges C and D (1,222 to 2,069 kc/s)

H.T. supplied by standard 80-watt motor-generator. Battery bias

kc/s.	M/O. Tuning. Range 1.	M/O. Tuning. Range 2.	M/O. Anode current mA.	Amplifier. Tuning. Range 2.	Amplifier. Tuning. Range 2.	Amplifier. Tuning. Fixed condenser switch	Amplifier. Anode current mA.	Amplifier. Grid bias volts.	Neutralizing condenser.	Modulator. Grid bias volts.	Modulator. Anode current mA.	Aerial. Plug position.	Aerial. Tuning.	Aerial. Coupling (degrees).	Aerial. Current (amps.).
3,500	—	0	16	—	149	A	25	120	66	52	50	1	2–264	22	0·7
3,130	—	30	16	—	93	B	26	120	69	52	52	1	5–320	14	0·7
2,850	—	60	16	—	43	C	28	120	68	52	51	1	9–74	18	0·7
2,675	—	90	16	—	103	C	27	120	69	50	55	1	11–335	20	0·65
2,540	—	120	16	—	173	C	28	120	70	50	54	1	14–99	20	0·62
2,440	—	150	16	—	59	D	28	120	69	50	55	1	16–106	20	0·6
2,360	—	180	16	—	101	D	28	120	69	50	54	1	17–314	20	0·56
2,980	30	—	16	4	—	A	27	120	64	50	54	1	7–237	20	0·62
2,625	60	—	16	147	—	A	28	120	64	50	54	1	12–284	20	0·62
2,355	90	—	16	153	—	B	28	120	67	50	54	1	18–31	22	0·56
2,145	120	—	16	152	—	C	28	120	69	50	52	1	23–98	24	0·52
2,000	150	—	16	123	—	D	30	120	70	46	56	1	28–271	30	0·5
1,970	158	—	16	162	—	D	30	120	69	46	56	1	30–103	30	0·5

APPENDIX

NOMENCLATURE OF PARTS

The following list of parts is issued for information. In ordering spares for this transmitter, the appropriate section of AIR PUBLICATION 1086 must be used.

Ref. No.	Nomenclature.	Quantity.	Remarks.
10A/9337	Transmitter T.1090		Complete, without coils or valves.
	Principal components :—		
10A/5117	Ammeter, thermo, 0 to 1·5 ..	1	
10A/9339	Case	1	Fitted with four mountings, anti-vibration, type 9 (10A/10950).
	Choke, H/F. :—		
10A/8716	Type 22	2	
	Choke, L/F. :—		
10A/9341	Type M	1	Iron core.
	Condenser :—		
10A/8049	Type 144	3	·002 μF.
10A/8098	Type 146	2	1·0 μF.
10A/8171	Type 159	1	·000032 μF.
10A/9342	Type 293	4	·00018 μF, mica dielectric.
10A/9344	Type 295	1	15 to 130 $\mu\mu$F, variable, with slow motion handle.
10A/9345	Type 296	1	20 to 220 $\mu\mu$F, variable, with slow motion handle.
10A/9346	Type 297	1	6 to 30 $\mu\mu$F, variable, with handle.
10A/9348	Contact, coil	12	
	Holder, valve :—		
10A/3412	Type V.T.13	4	
	Milliammeter :—		
10A/3191	0 to 200, type A	1	
	Plug :—		
10A/7153	Type 29	14	Single pole, circular body.
10A/7328	Type 43	3	Single pole, circular body.
	Resistance :—		
10A/7315	Type 41	1	40,000 to 45,000 ohms, rod type.
10A/8016	Type 108	1	·5 MΩ rod type.
10A/9349	Type 249	1	20,000 ohms, rod type.
10A/9350	Type 250	1	40,000 ohms, 3-watt, rod type.
10A/9351	Type 251	2	10,000 ohms, 30-watt, rod type.
10A/9099	Type 263	2	100 ohms.
	Socket :—		
10A/9352	Type 47	17	Single pole.
	Switch :—		
10A/9353	Type 103	1	4-way, barrel type.
10A/9354	Type 104	1	3-way, barrel type.
10A/9355	Type 105	1	3-way, barrel type.
10A/9356	Type 106	1	2-way, barrel type.
	Transformer, microphone :—		
10A/7785	Type E	1	
	Accessories :—		
	Case, transit :—		
10A/9358	Coils	5	To hold one each aerial, amplifier, and M/O coils.
10A/9359	Transmitter	1	

APPENDIX—*contd.*

Ref. No.	Nomenclature.	Quantity.	Remarks.
	Transmitter T.1090—*continued*		
	Accessories—*continued.*		
	Coil, aerial :—		
10A/9338	Range A	1	4,286 to 6,667 kc/s, variable, with counting mechanism.
10A/9360	Ranges B and C	2	2,000 to 4,615 kc/s, variable, with counting mechanism. One coil in range B and one in range C transit case.
10A/9361	Range D	1	1,222 to 2,069 kc/s, variometer.
10A/9362	Range E	1	545 to 857 kc/s, variometer.
	Coil, amplifier :—		
10A/9363	Range A	1	4,286 to 6,667 kc/s, fitted with switch and variable coupling coil.
10A/9364	Range B	1	4,615 to 3,000 kc/s, fitted with variable coupling coil.
10A/9365	Range C	1	2,000 to 3,409 kc/s, fitted with switch, variable coupling coil and one condenser, type 300.
10A/9366	Range D	1	1,222 to 2,069 kc/s, fitted with variable coupling coil.
10A/9367	Range E	1	545 to 857 kc/s, fitted with variable coupling coil.
	Coil, master-oscillator :—		
10A/9368	Range A	1	4,286 to 6,667 kc/s.
10A/9369	Range B	1	4,615 to 3,000 kc/s.
10A/9370	Range C	1	2,000 to 3,409 kc/s, fitted with switch and one condenser, type 293.
10A/9371	Range D	1	1,222 to 2,069 kc/s.
10A/9372	Range E	1	545 to 857 kc/s, fitted with two condensers, type 159.
10A/7312	Valve, type V.T.25	4	

SECTION 1—CHAPTER 7

TRANSMITTERS, TYPES T.1154, T.1154A, T.1154B, T.1154C, T.1154D AND T.1154E

..60. with appendix on T.1154 F, G, H, J, K, L, M, N, and P.

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List of Illustrations

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TRANSMITTERS, TYPES T.1154, T.1154A, T.1154B, T.1154C, T.1154D AND T.1154E

INTRODUCTION

1. The transmitters of the T.1154 group are, primarily, intended for use in aircraft to provide two-way communication, air-to-air and air-to-ground. They are normally, but not invariably, used in conjunction with the communications and D/F receivers of the R.1155 group and provision is made for switching interlock between the installed instruments. There is little difference between the T.1154 (Stores Ref. 10D/97) and T.1154B (Stores Ref. 10D/196) which may be used for R/T, C.W. and M.C.W. The T.1154C (Stores Ref. 10D/198) gives similar facilities but with an extended frequency coverage. The T.1154A (Stores Ref. 10D/99) provides for C.W. and M.C.W. operation only. A mobile application uses the T.1154D (Stores Ref. 10D/730) for R/T, C.W. and M.C.W. and the T.1154E (Stores Ref. 10D/731) for C.W. and M.C.W. only. These two types have a modified frequency coverage and are wired for operation independently of the receiver.

2. Frequency selection in all versions of this transmitter can be effected by the use of a pre-selector "click-stop" mechanism giving a total of eight "spot" frequencies for each range and of any value within the particular range. The term RANGE is used in this chapter as a convenient means of describing the individual bands of frequencies but is not actually engraved upon the instrument, the controls of which are colour-coded in accordance with the accompanying schedule. This colour code is applied, for facility of operation, to the receivers of the R.1155 group.

T.1154, T.1154A, T.1154B
- RANGE 1 (H.F.), BLUE, 10 Mc/s. to 5·5 Mc/s.
- RANGE 2 (H.F.), RED, 5·5 Mc/s. to 3·0 Mc/s.
- RANGE 3 (M.F.), YELLOW, 500 kc/s. to 200 kc/s.

T.1154C
- RANGE 1 (H.F.), BLUE, 16·7 Mc/s. to 8·7 Mc/s.
- RANGE 2 (H.F.), BLUE, 8·7 Mc/s. to 4·5 Mc/s.
- RANGE 3 (H.F.), RED, 4·5 Mc/s. to 2·35 Mc/s.
- RANGE 4 (M.F.), YELLOW, 500 kc/s. to 200 kc/s.

T.1154D, T.1154E
- RANGE 1 (H.F.), BLUE, 8 Mc/s. to 4·5 Mc/s.
- RANGE 2 (H.F.), RED, 4·5 Mc/s. to 2·5 Mc/s.
- RANGE 3 (M.F.), YELLOW, 500 kc/s. to 200 kc/s.

3. On airborne equipment switching provision is made for operation into either fixed or trailing aerials by means of an independent aerial selector switch, type J, which also controls the interlocking of the H.T. supplies. Alternatively, an aerial plug board is used. Fixed aerials may be of any length between 25 ft. and 65 ft. including the lead in, 45 ft. being approximately an optimum length for single wire aerials. Trailing aerials are of the standard service type of 200 ft. For mobile use the T.1154D and T.1154E are fed into vertical aerials for remote working and into triatic suspended arrays for local working.

4. The circuit of the transmitter is based upon a master oscillator (M.O.) triode stage driving a power amplifier comprising two pentode valves in parallel. An additional triode valve is used for R/T modulation or as a tone oscillator of approximately 1,200 c/s on C.W. and M.C.W. providing keying side-tone and tone modulation. Output loading is effected by means of tapped coils on the H.F. ranges with an additional anode tap for the M.F. range.

5. With the exception of the BLUE RANGES 1 and 2 of T.1154C, which are obtained on the same oscillator and output controls, each RANGE throughout the group of transmitters is covered by a separate L/C circuit in both oscillator and amplifier stages. Any range can be obtained by the operation of a switch which selects the oscillator and the corresponding output circuit. Pre-selection of "spot" frequencies is arranged through a special "click-stop" mechanism to which vernier adjustment may be applied on the H.F. RANGES.

6. Either carbon granule or electro-magnetic type microphones may be used for R/T with the transmitters equipped for telephony transmission but when electro-magnetic microphones are used it is necessary to incorporate a suitable sub-modulating device such as the intercommunication (I/C) amplifier A.1134 (Stores Ref. 10U/11500) to provide the necessary microphone gain. The change from carbon to electro-magnetic operation entails a minor internal modification to the transmitter (*see* para. 47). A detailed description of the amplifier A.1134 is given in Sect. 4, Chap. 2 of this publication. When using the A.1134, I/C is available and side-tone is provided from the amplifier.

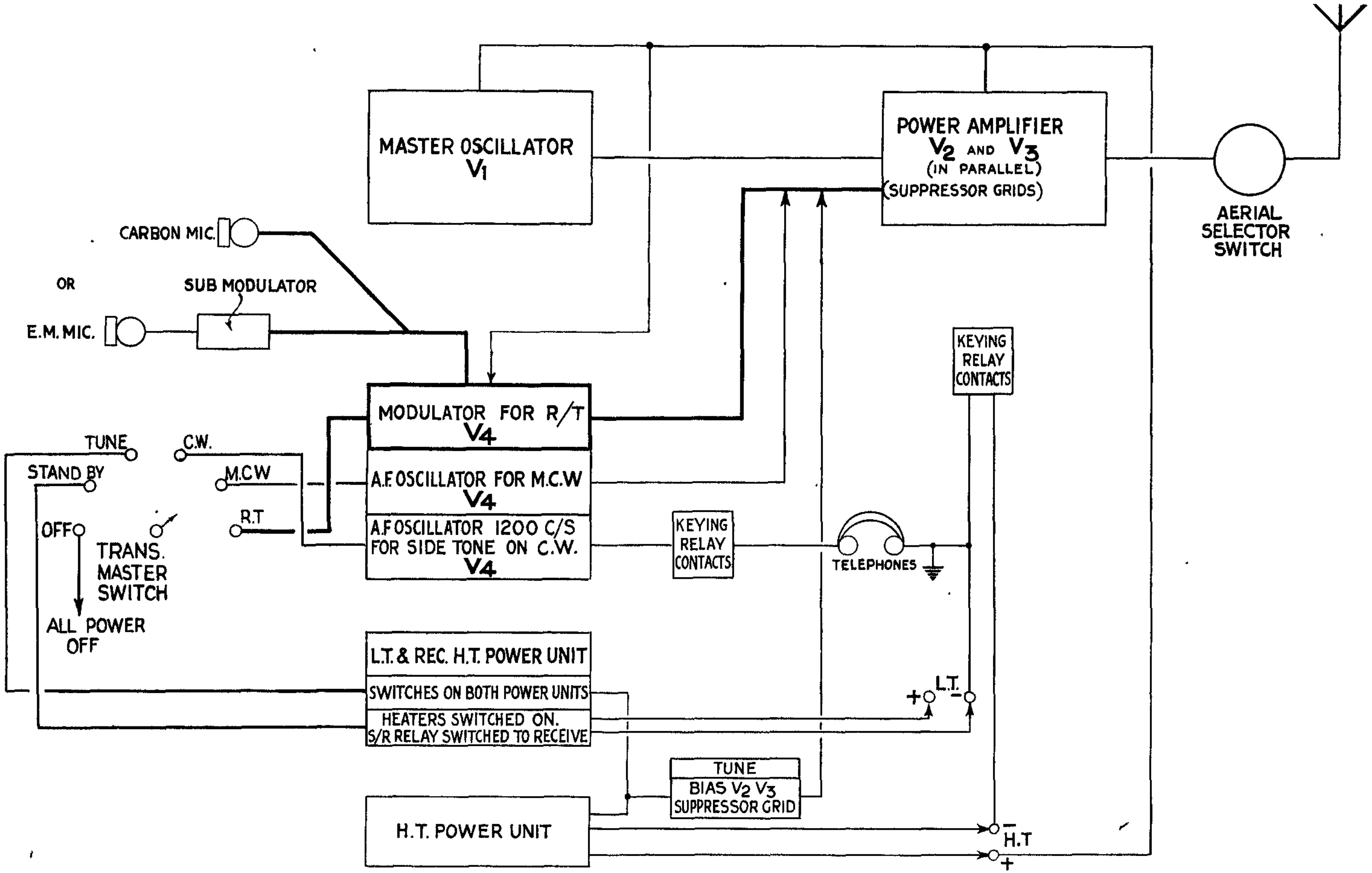


Fig. 2.—Schematic diagram of transmitter

7. Power supplies for the airborne equipment are derived from the general aircraft electrical supply system of nominal 12-volt or 24-volt rating, through two power units which include rotary transformers and the necessary smoothing and filtering circuits. One of these units (referred to as the H.T. power unit) supplies the H.T., and the other (the L.T. power unit) provides the L.T. The L.T. power unit is used in common with the receiver installation, supplying both H.T. and L.T. for the receiver. The T.1154D and T.1154E are operated from a 230 volts, A.C. single-phase, 50 c/s supply through suitable rectifier power units. For training purposes the equipment is normally supplied with direct current from these rectifier power units, such as the power unit, type 114 (Stores Ref. 10K/350), from the A.C. mains or from the standard airborne rotary transformer power units actuated through a 24–28 volts rectifier unit, such as the power unit, type 115 (Stores Ref. 10K/351) connected to the A.C. mains.

8. The overall dimensions of a transmitter, in its case, are approximately 17½ in. by 16⅜ in. by 11¼ in. The weight of the instrument, complete with its suspension units and valves, is approximately 46 lb. 10 oz. The general appearance of a transmitter T.1154 is shown in fig. 1 and this illustration is representative of the remaining types except for the additional socket required for the R/T versions.

GENERAL DESCRIPTION

9. A schematic diagram of the transmitter, including R/T, is given in fig. 2. A complete circuit diagram of the T.1154A, that is, for C.W. and M.C.W. operation only, is shown in fig. 3. A simplified circuit for C.W. on RANGE 1 of R.1154A is given in fig 4. A complete circuit diagram of the R.1154, for R/T, C.W. and M.C.W. operation is shown in fig. 5 and a simplified circuit of the keying and switching arrangements in RANGE 1 is shown in fig. 6.

10. Variations in the types of this transmitter arise from the inclusion of R/T facilities or through differences in frequency coverage. The basic circuit is unchanged and this consists of a master-oscillator control stage arranged as a series-feed Hartley-type oscillator in which the tuned circuit is connected between the anode and grid of an indirectly-heated triode valve V_1.

11. Oscillation set up across the whole of the tuned circuit coil produces an oscillatory voltage across that portion of the coil connected between the grid and cathode. The cathode tap is also the H.T. tapping point, that is, the point on the coil through which the H.T. positive is supplied to the anode of V_1. This common tap is at earth potential to R.F. and adjusts the portion of the oscillatory circuit which is fed back between grid and cathode. The optimum condition for self-oscillation is, however, obtained because the oscillatory voltage between grid and cathode is always in anti-phase to the anode (top end) and cathode oscillatory potential difference.

12. The common tapping point is connected to the cathode through two condensers C_{18} and C_{19} (in parallel) which have a low impedance to R.F. while isolating the H.T. supply. Thus this point is maintained at cathode potential to R.F. It should be pointed out, however, that in this circuit, the cathode is connected to chassis which is at a positive potential to the negative H.T. supply terminal due to the voltage drop through R_{10}, R_9 and the keying relay contacts through which the whole of the H.T. current for the transmitter flows.

13. Grid bias is obtained by grid leak and condenser C_5, R_{11}. When the key is up, this grid bias is increased by the voltage dropped across R_9, which becomes shorted by means of contacts in the keying relay when the key is pressed. A resistance R_3 in the H.T. positive line serves to reduce the anode voltage of the oscillator valve. When the key is up, the increased bias reduces the anode current, giving less voltage drop in R_3 and a higher anode voltage to V_1 which helps this valve to commence to oscillate when the key is pressed. The increase of anode current then gives more drop in R_3 and reduces the anode current to the normal working value.

14. The output from the tuned circuit is coupled, through a condenser C_6, to the control grids of a power-amplifier stage consisting of two directly-heated pentodes V_2 and V_3 connected in parallel. The grid current flowing in the power amplifier valves causes the input to have a low impedance which is matched in the oscillator circuit by means of a tapping on the coil.

15. On RANGES 1 and 2 of all transmitters the output circuit is parallel consisting of a coil tuned by a variable condenser. The loading is effected by tapping the aerial to a suitable point on the coil through a tap selector switch. On RANGE 3 (H.F.) of the T.1154C the coil is disconnected from earth to act as an aerial loading coil, the circuit being completed through the aerial capacitance. The circuit is completed by the aerial capacitance.

16. On RANGE 3 (M.F.) of transmitters, other than the T.1154C, and on RANGE 4 of the T.1154C, a parallel fed circuit is retained. The aerial provides a tank circuit capacitance, the tuning being obtained by a switch which taps the amount of inductance in circuit and short-circuits the unwanted portion of the coil. A fine tuning control adjusts the value of inductance between the tapping points by varying the permeability of the core. Loading of the output stage is adjusted by tapping the anodes of the output valves *via* a tap selector switch to the aerial coil.

Note:—To

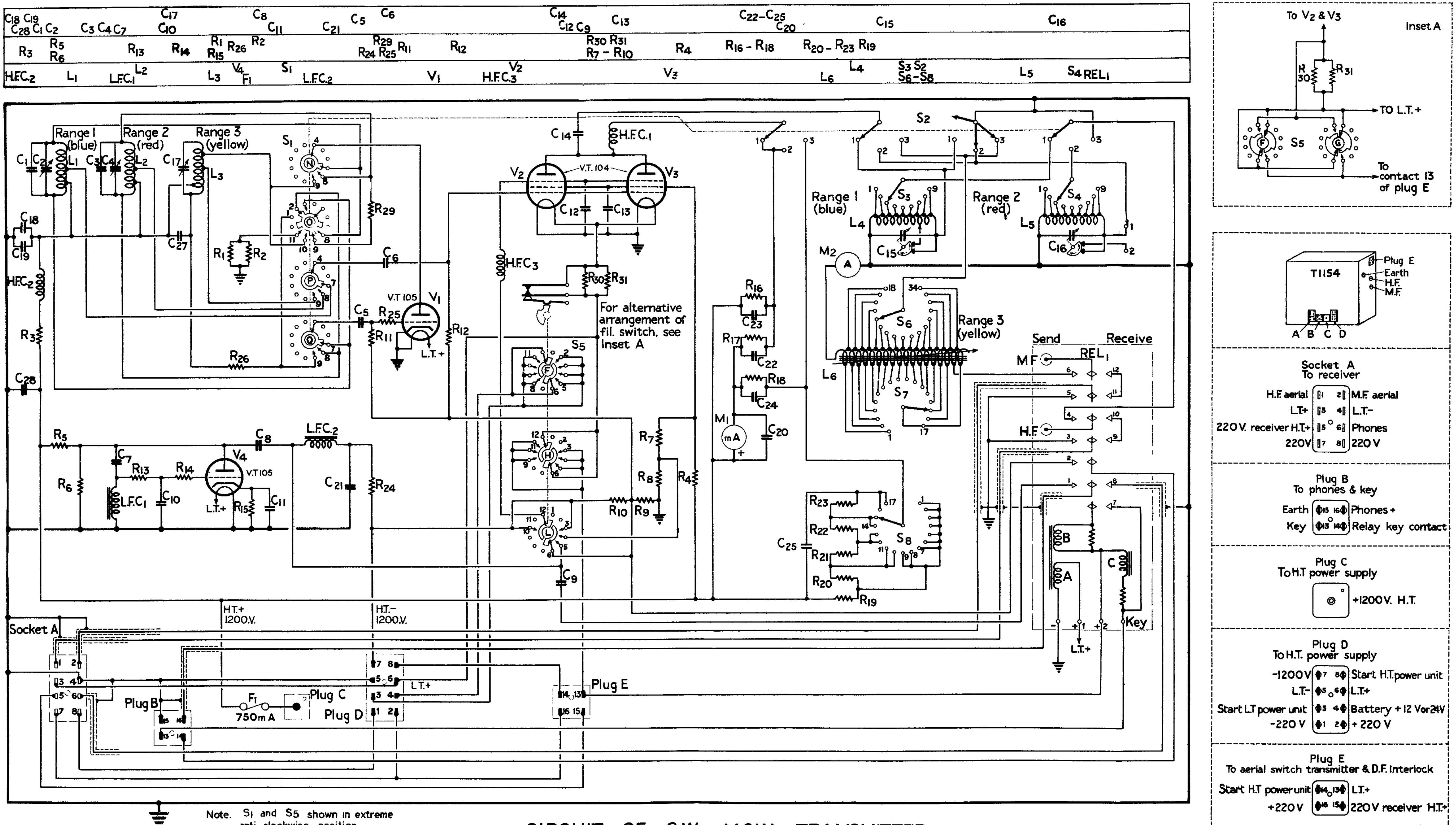
C.W. AND M.C.W. TRANSMITTER
COMPONENT LIST

CONDENSERS

Annotation	Value	Type	Stores Ref. No.
C_1	10 $\mu\mu$F	942	10C/2018
C_2	11–150 $\mu\mu$F		
C_3	6 $\mu\mu$F	976	10C/2086
C_4	11–150 $\mu\mu$F		
C_5	·0002 μF	943	10C/2038
C_6	·0002 μF	943	10C/2038
C_7	50 $\mu\mu$F	944	10C/2039
C_8	·25 μF	955	10C/2053
C_9	·001 μF	897 or 1647	10C/965 or 10C/3381
C_{10}	·0002 μF	946 or 1593	10C/2041 or 10C/3279
C_{11}	·01 μF	188 or 1503	10C/8496 or 10C/3103
C_{12}	·004 μF	947	10C/2043
C_{13}	·01 μF	188 or 1503	10C/8496 or 10C/3103
C_{14}	·004 μF	948	10C/2043
C_{15}	7–205 $\mu\mu$F } Part	of magnifier unit, type 2	(10D/107)
C_{16}	7–205 $\mu\mu$F }		
C_{17}	22·5–379 $\mu\mu$F }		
C_{18}	·005 μF	949	10C/2044
C_{19}	·005 μF	949	10C/2044
C_{20}	·004 μF	956 or 1502	10C/2055 or 10C/3102
C_{21}	·5 μF	955	10C/2053
C_{22}	·0003 μF }	950 or	{ 10C/2045 or
C_{23}	·0003 μF }	1501	{ 10C/3101
C_{24}	·0003 μF }		
C_{25}	·001 μF	1647	10C/3381
C_{27}	40 $\mu\mu$F	1648	10C/3383
C_{28}	·004 μF	1505	10C/3105

RESISTANCES

Annotation	Value Ohms	Type	Stores Ref. No.
R_1, R_2	51,000 or 24,000 (1 offs or 27,000 (1 offs	868 or 6119	10C/677 or 10C/6119
R_3	50,000	1043	10C/1043
R_4	20,000	1044	10C/1044
R_5, R_6	75,000	1045	10C/1045
R_7, R_8	12,000 + 2,000	1046	10C/1046
R_9	5,000	1047	10C/1047
R_{10}	350	1048	10C/1048
R_{11}	15,000	1049	10C/1049
R_{12}	20,000	1050	10C/1050
R_{13}	680	1053	10C/1053
R_{14}	7,500	1051	10C/1051
R_{15}	820	1052	10C/1052
R_{16}–R_{18}	10 + 19·5 + 19·5	1056	10C/1056
R_{19}–R_{23}	10 + 2·9 + 5·3 + 12·6 + 69·2	1055	10C/1055
R_{24}	5,100 or 4,700	942 or 917	10C/877 or 10C/1872
R_{25}	51	934	10C/851
R_{26}	510	868	10C/677
R_{27}, R_{28}	10 + 6	1054 or 6833	10C/1054 or 10C/6833
R_{29}	150	1931	10C/1931
R_{30} and R_{31}	1·5	8208	10C/8208



Note. S1 and S5 shown in extreme anti-clockwise position. Socket & plugs as viewed from front of transmitter.

CIRCUIT OF C.W., M.C.W. TRANSMITTER (T1154A & T1154E)

FIG. 3

FIG. 3

PP1949 M23920/700 12/42 13000 C & P Gp. 959(4)

17. An indirectly-heated triode valve V_4 has a triple function. On C.W. transmission it is used as an A.F. oscillator tone source of approximately 1200 c/s. to provide monitorial side-tone to the telephones as a check upon accurate keying. On M.C.W. transmission the oscillations from V_4 are fed to the negatively-biased suppressor grids of the power amplifiers V_2 and V_3. The output from V_2 and V_3 is, thus, modulated approximately 70 per cent. at 1200 c/s. and, simultaneously, side tone is provided as in the case of C.W. On R/T transmission the valve V_4 acts as a modulator, variations in its anode voltage, due to speech, being imposed upon the suppressor grids of V_2 and V_3. Speech side tone is, then, available in the telephones.

C.W. and M.C.W. circuit (T.1154A and T.1154E)

18. For a detailed examination of the circuits of the types providing C.W. and M.C.W. only, reference should be made to the diagram of fig. 3. A simplified switching schematic, fig. 7, should assist in the study of the circuits. It is essential that the switching arrangements should be closely studied and priority has been given in this chapter to a description of the switching. The main and secondary switching components are, so far as is possible, given in their operational sequence. The aerial switching arrangements, represented by the aerial switching unit, type J, or by its alternative, the aerial selector plug board, are, however, dealt with later in the chapter. These instruments are, physically, extraneous to the transmitter proper.

The master switch, S_5

19. A master, or operational switch, controls the power supplies to the transmitter and, in the purely C.W. and M.C.W. versions, has five positions:—OFF, STAND-BI, TUNE, C.W. and M.C.W. These positions control three sections which are referred to in this chapter as L, H and F and annotated as S_{5l}, S_{5h} and S_{5f}.

20. In the OFF position the equipment is completely switched off and both the rotary transformer power units are idle. The transmitter, and the associated receiver, are, therefore, inoperative.

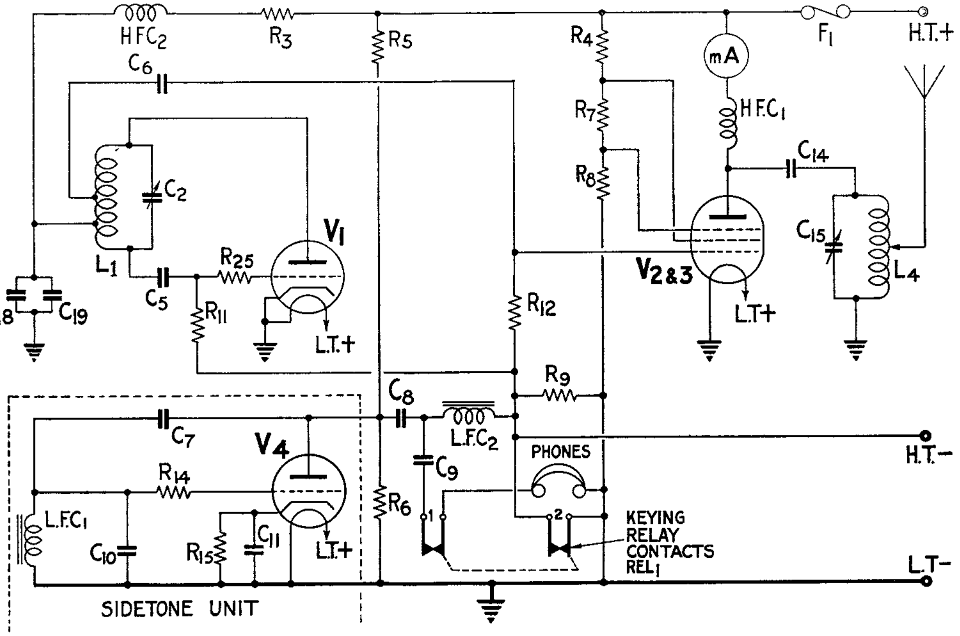


FIG. 4.—SIMPLIFIED CIRCUIT C.W. ON RANGE 1

21. In the STAND–BI position the L.T. power unit, which provides the 6-volt heater supply for the transmitter and receiver (with H.T. to the receiver) is energized through the closing of the circuit at S_{5f} and through points 3 and 4 of an eight-way Jones plug, type D, to the accumulator input circuit of the L.T. power unit, with consequent application of its L.T. output, *via* points 5 and 6 of plug D to a magnetic relay, type 85, which is the SEND–RECEIVE relay REL_1. This is a multi-contact relay operated from the 6-volt supply. One coil A of the relay is energized and this causes a switching action to the RECEIVE position at which it is held.

22. The 6-volt supply is always made as there is no switching of the heater circuits. In the STAND–BI position, however, two limiting resistances R_{30} and R_{31} are brought into the heater circuit of the power amplifiers V_2 and V_3 and reduce the current whilst the transmitter is inoperative

23. In the TUNE position of the switch S_5 the energization of the L.T. power unit is maintained, the circuit being completed as before. Through the point 8 of plug D, the interlock plug E, point 14, and the aerial selector switch, type J or aerial plug board, the H.T. power unit is started. This extraneous switching should be in any position with the exception of D/F and EARTH.

24. In the TUNE position, also, the circuits of the remaining two windings B and C of the relay REL_1 are also completed through the key K_1, connected between the points 13 and 14 of a four-point plug B, so that when the key is pressed, the relay snaps over to the SEND position, completing the H.T. positive circuit through a one-hole plug C, a 750 mA fuse F_1 and, dividing, through:—

(i) A milliammeter M_1 with its associated circuits, one section of a four-section frequency range switch S_2 and a R.F. choke coil HFC_1, to the joined anodes of V_2 and V_3;

(ii) the resistance R_3 (*see* para. 13), a R.F. choke coil HFC_2 which prevents short-circuiting of R.F. through the H.T. supply, and a portion of the appropriate RANGE coil, through a section N of the frequency range switch S_1 to the anode of the oscillator valve V_1;

(iii) a potentiometer R_4–R_7 and R_8 which maintains the screen voltage of the power amplifier valves V_2 and V_3 at approximately 200 volts;

(iv) a potentiometer R_5–R_6 which maintains the anode voltage of the valve V_4, the side tone, modulator or A.F. oscillator valve (*see* para. 29) at approximately 200 volts.

25. Grid bias for the P.A. valves is obtained by the voltage drop across the resistances R_9 R_{10} through which the total H.T. supply passes when the key is up on TUNE, M.C.W. or R/T. When the key is pressed, the relay REL_1 short-circuits the resistance R_9, the control grids of V_2 and V_3 being connected to earth, grid bias being obtained from the voltage dropped across their grid resistances. The suppressor grids of these valves are, however, connected through the switch section S_{5l} to H.T. negative and are thus biased by the voltage across R_{10}. This negative bias is applied to the suppressor grids of V_2 V_3 to limit the anode feed due to mal-adjustment during the tuning operation. Simultaneously, the grid of the M.O. valve V_1 is keyed to earth through an anti-parasitic resistance R_{25} and the grid leak R_{11}.

26. In the TUNE position of the master switch S_5 the negative biasing of the suppressor grids of the valves V_2 and V_3 puts them in a condition in which low power transmission is possible. Short-distance communications and any setting-up adjustment of the transmitter should be made with S_5 at this position. As an example of the effect obtained, working, for instance, on 10 Mc/s, the anode current would be in the region of 60 mA with an aerial current of 0·25 amp. The suppressor grid voltage is of the order of 45 negative.

27. In the C.W. position of S_5 the L.T. energizing circuits of both power units are maintained so that H.T. and L.T. continue to be supplied to the transmitter and receiver. The suppressor grid is connected through the switch section S_{5l} to the junction of resistances R_7, R_8, which are part of the potentiometer R_4, R_7, R_8 which maintains the screening grids at the correct positive potential. The suppressor grids are therefore also maintained at a positive potential in the C.W. position, increasing the power output. In this position no grid bias is required from R_{10} which is shorted out to prevent loss of H.T. voltage to the valves. For the purpose of comparison with the readings given in para. 26, on 10 Mc/s operation the anode current is of the order of 92 mA, the aerial current, approximately, 0·4 amp. and the suppressor grid voltage, approximately, 20 volts positive with grid current of 7·5 mA. The side-tone circuits remain unaltered at C.W.

28. When the switch S_5 is at M.C.W. position, the short-circuit is removed from R_{10} and a negative bias is again imposed upon the suppressor grids of V_2 and V_3, and the readings for anode current, aerial current and suppressor grid voltage are closely approximate to those of the TUNE position. The anode current is slightly less but the aerial current is higher, due to the modulation, about 20 per cent. increase should be obtained for 70 per cent. modulation. The suppressor grids of the power amplifiers are connected to H.T. negative through the output load of the A.F. oscillator valve V_4, which is an A.F. choke LFC_2.

29. The anode circuit of the valve V_4 is coupled, *via* a condenser C_7, to the oscillatory circuit constituted by an A.F. choke coil LFC_1 and a condenser C_{10}. This circuit has a frequency of oscillation of 1200 c/s, approximately. The amplitude of the oscillatory current is limited by a resistance R_{13}, an anti-parasitic resistance R_{14} being connected in the grid lead. Grid bias is obtained by the cathode resistance R_{15} which is by-passed by the condenser C_{11}, which is further increased should grid current flow in R_{13} R_{14} on the peaks of the oscillations.

30. The output from V_4 is developed across R_6, across which is a resonant circuit composed of the choke coil LFC_2 of maximum inductance value 1·21H (minimum 0·99H), a condenser C_8 and a by-pass condenser C_{21}. To broaden the response sufficiently to accommodate variations of A.F. note between 800 and 1200 c/s a resistance R_{24} is included between LFC_2 and H.T. negative.

31. The A.F. modulating voltages are applied to the suppressor grids of V_2 and V_3 in series with the negative bias. A condenser C_{12} serves to keep the suppressor grids and filaments at the same R.F. potential and C_{13} serves a similar purpose for the screen and filament. In the M.C.W. position the side-tone circuits are unaffected. Whilst V_4 is in an oscillating condition all the time, the side-tone circuit is only made when the key is pressed. The A.F. oscillations are made available through a condenser C_9, the relay REL_1, which makes and breaks the telephone circuit, and the points 15 and 16 of a four-pole key and telephone plug B. Through the action of REL_1, when the key is released, listening through is available.

32. It should be noted that the A.F. oscillatory circuit of the valve V_4 is quite independent of the M.O. circuit which governs the transmission. In consequence, strength or quality of side tone gives no indication of the strength or quality of the emitted signals. The action of the side tone in this transmitter should not be confused with that existing in aircraft installations wherein the side-tone circuits are directly associated with the transmitter output in which case weak transmission results in weak side tone. Both the milliammeter M_1 and the aerial ammeter M_2 (on RANGE 3) or the external ammeter (on RANGES 1 and 2) should deflect during transmission. If the receiver is tuned to the transmission frequency its tuning indicator ("magic eye") will flicker to the dots and dashes. Rough indications of transmission are, thus, available.

The frequency range switch (S_1 *and* S_2)

33. A frequency range switch, consisting of two ganged switches S_1 and S_2, is included in the circuit, its function being to accomplish all the necessary circuit changes associated with the three frequency RANGES. The switch S_1 has four sections or sets of contacts which are lettered N, O, P and Q. These contacts effect all necessary M.O. circuit changes as described in ensuing paragraphs.

34. Each of the three frequency RANGES has its own coil and tuning condenser as indicated in the accompanying TABLE A.

TABLE A

M.O. COILS AND CONDENSERS

Range	Frequency	Coil	Inductance	CONDENSERS			
				Variable	Capacitance	Fixed	Capacitance
1. BLUE	10–5·5 Mc/s	L_1	5·32 μH	C_2	11–150 $\mu\mu$F	C_1	10 $\mu\mu$F
2. RED	5·5–3·0 Mc/s	L_2	17·27 μH	C_4	11–150 $\mu\mu$F	C_3	6 $\mu\mu$F
3. YELLOW	500–200 kc/s	L_3	2285 μH End to Tap 1 1925 μH End to Tap 2 1220 μH End to Tap 3 590 μH	C_{17}	22·5–379 $\mu\mu$F	C_{27}	40 $\mu\mu$F

35. In the circuit for the RANGE 1, the coil L_1 with its tuning condenser C_2 and the parallel fixed condenser C_1 are connected, through the sections N and Q of S_1, across the anode and grid of the M.O. indirectly-heated triode valve V_1. A condenser C_5 and an anti-parasitic resistance R_{25} complete the circuit of L_1 to the grid of the valve V_1. The grid-leak resistance for the stage is R_{11} and this leads to earth through either the resistance R_9 or, directly, *via* the keying contacts of REL_1 when S_5 is at TUNE (*see* para. 25). The section P of the switch S_1 couples the coil L_1 to the control grids of the parallel connected power-amplifier pentodes V_2 and V_3 through a condenser C_6. The section O of the switch S_1 short-circuits the RANGE 2 coil L_2.

36. In the circuit of RANGE 2, ondenser C_4 having the fixed condenser C_3 in parallel. The tuned circuit is connected to the valve V_1 by the sections N and Q of the switch S_1. The section P of S_1 couples the coil L_2 to the amplifier valves V_2 and V_3 through the condenser C_6. The section O of S_1 short-circuits the coil L_1 of RANGE 1. The circuit associated with RANGE 3 consists of the coil L_3 tuned by the variable condenser C_{17} and connected by the sections N and Q of the switch S_1 and a resistance R_{26} to the valve V_1. The section P couples the coil L_3 through the condenser C_6 to the valves V_2 and V_3. The section O of S_1 short-circuits the RANGE 2 coil L_2.

37. The M.O. stage has essentially a higher efficiency factor when used for the band of frequencies covered by RANGE 3 (M.F.) than when employed for the frequencies of either RANGE 1 or RANGE 2. It is therefore necessary to incorporate some limiting arrangement in the nature of a bank of resistances R_1 and R_2 between the H.T. positive line and earth. These resistances are brought into circuit *via* the section O of the switch S_1 and the coil L_7. They act as a parallel H.T. load and so limit the voltage rise. A resistance R_{26} prevents the generation of parasitic oscillations which might also occur in this range. The capacitance of a 40 $\mu\mu$ F condenser C_{27} is also included between the H.T. feed tapping point of L_3 and the grid end of that coil.

38. The section S_2 of the frequency range switch combination consists of four sets of contacts, and these accomplish all the necessary circuit changes between the output of the power amplifier valves V_2 and V_3 and the aerial circuits when switching from one RANGE to another.

39. In the circuits of the RANGES 1 and 2, the positive H.T. supply is fed through a milliammeter M_1 across a section of the switch S_2, and a R.F. choke coil HFC_1 to the anodes of the parallel amplifier pentodes V_2 and V_3. The milliammeter is calibrated on these ranges by R_{16} and R_{17}, which are disconnected on RANGE 3, when the resistance combination R_{18} to R_{23} shunt the meter so that on the different frequencies of this range, the same apparent anode current is obtained when actually this is limited to suit the frequency in use (*see* para. 44).

40. The anode load impedance of V_2 V_3 is coupled by the condenser C_{14} and a section of the switch S_2. In the RANGE 1 position a tapped coil L_4 is tuned by a variable condenser C_{15} which is fitted with a commutator device which enables the inductance of the coil L_4 to be varied. This additional facility enables a greatly increased tuning range to be achieved, affording a wide margin for coupling to the differing aerial systems. The aerial is connected across the keying relay REL_1 and the switch S_2 to a switch S_3 by which the tappings on the coil L_4 are selected. A tuning coil L_5 of RANGE 2 is short-circuited and earthed by the action of the switch S_2. An external aerial ammeter is provided to give an *approximate* indication of radiation at the transmitted frequencies.

41. In the circuit of RANGE 2 the H.T. positive is supplied *via* the milliammeter M_1 through a section of the switch S_2 and the R.F. choke HFC_1 to the anodes of the valves V_2 and V_3. The output from the anodes of V_2 and V_3 is coupled through a condenser C_{14} to the RANGE 2 tuning coil L_5 and a section of the switch S_2. The coil L_5 is tuned by a, condenser C_{16} which is fitted with a commutator device similar to that of C_{15}. The aerial is connected across the keying relay REL_1 and the switch S_2 to a switch S_4 which selects the appropriate tappings on the coil L_5. Any portion of a tuning coil L_6, which is the RANGE 3 coil, brought into circuit by the tapping switch, is earthed by the action of S_2. An external ammeter is in circuit as for RANGE 1.

42. In the position of RANGE 3 the aerial forms the tank circuit capacitance, tuned by the tapped coil L_6. Coarse tuning is provided by the switch S_7 which shunts out the portion of the coil not in use. Fine tuning is obtained by the permeability method, a sliding dust iron core being adjusted inside the coil L_6. The valve impedance is matched to the aerial by means of a switch S_6 which adjusts the point at which the anodes of V_2 V_3 are tapped on to the aerial coil. Ganged to S_7 is the switch contact S_8 which varies the resistances in shunt with the milliammeter M_1.

43. The Q value of the total inductance of L_6 is a minimum of 225 at 200 kc/s and the R.F. resistance of the coil is 12 ohms. The accompanying TABLE B shows the approximate inductance between the tapping points of the coil.

TABLE B

RANGE 3—OUTPUT CIRCUIT COIL TAPPINGS

Tap No.	Inductance μH	Aerial Tap	Anode Tap
1	38	—	1
2	46	—	2
3	59	—	3
4	70	—	4

C.W. M.C.W. AND R/T TRANSMITTER

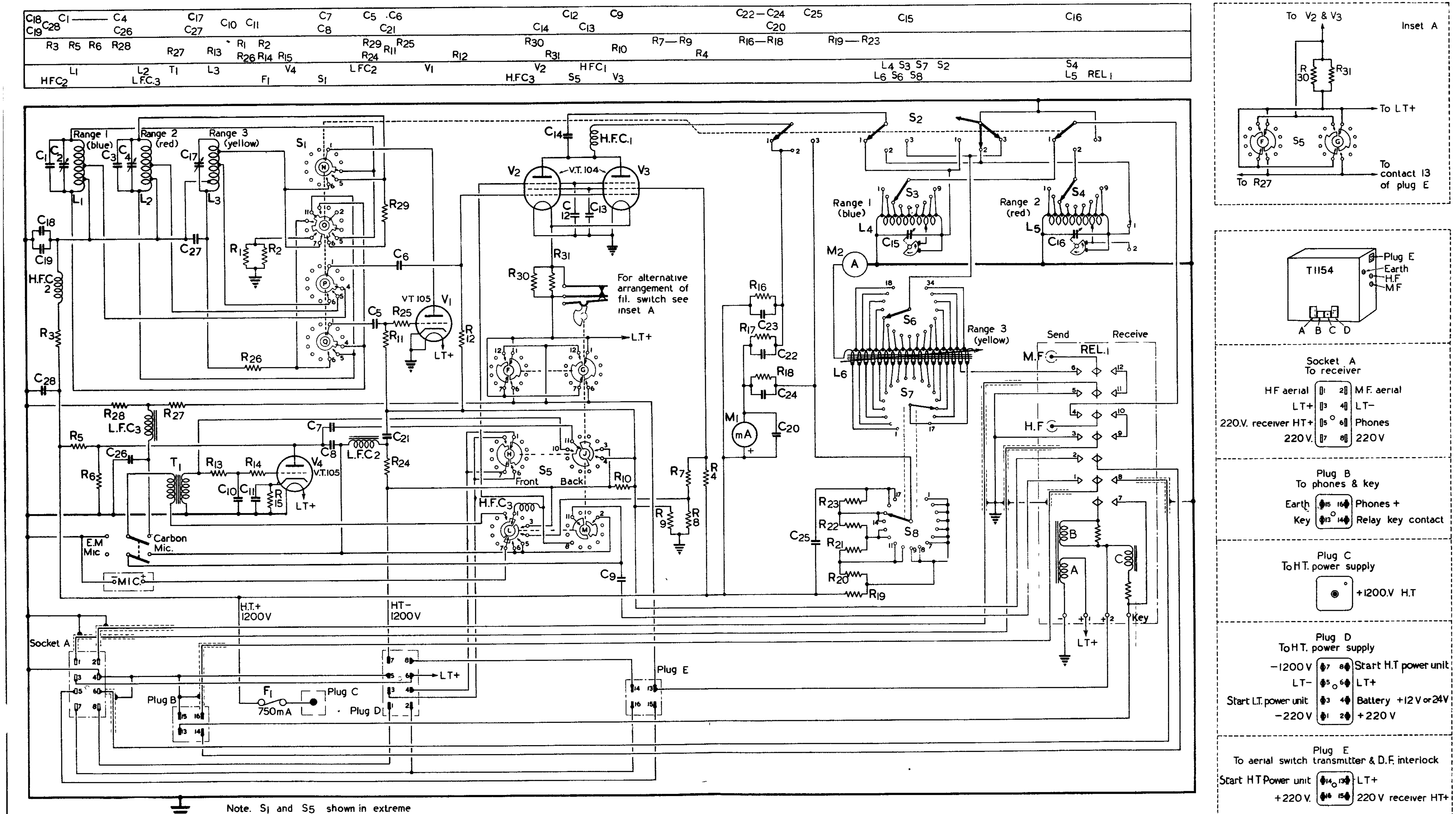
COMPONENT LIST

CONDENSERS

Annotation	Value	Type	Stores Ref. No.
C_1	10 $\mu\mu F$	942	10C/2018
C_2	11–150 $\mu\mu F$		
C_3	6 $\mu\mu F$	976	10C/2086
C_4	11–150 $\mu\mu F$		
C_5	·0002 μF	943	10C/2038
C_6	·0002 μF	943	10C/2038
C_7	50 $\mu\mu F$	944	10C/2039
C_8	·25 μF	955	10C/2053
C_9	·001 μF	897 or 1647	10C/965 or 10C/3381
C_{10}	·0002 μF	946 or 1593	10C/2041 or 10C/3279
C_{11}	·01 μF	188 or 1503	10C/8496 or 10C/3103
C_{12}	·004 μF	947	10C/2043
C_{13}	·01 μF	188 or 1503	10C/8496 or 10C/3103
C_{14}	·004 μF	948	10C/2043
C_{15}	7–205 $\mu\mu F$ } Part	of magnifier unit, type 2	(10D/107)
C_{16}	7–205 $\mu\mu F$		
C_{17}	22·5–379 $\mu\mu F$		
C_{18}	·005 μF	949	10C/2044
C_{19}	·005 μF	949	10C/2044
C_{20}	·004 μF	956 or 1502	10C/2055 or 10C/3102
C_{21}	·5 μF	955	10C/2053
C_{22}	·0003 μF }	950 or 1501	} 10C/2045 or 10C/3101
C_{23}	·0003 μF		
C_{24}	·0003 μF		
C_{25}	·001 μF	1647	10C/3381
C_{26}	2 μF	1031	10C/2220
C_{27}	40 $\mu\mu F$	1648	10C/3383
C_{28}	·004 μF	1505	10C/3105

RESISTANCES

Annotation	Value Ohms	Type	Stores Ref. No.
R_1, R_2	51,000 or 24,000 (1 offs or 27,000 (1 offs	868 or 6119	10C/677 or 10C/6119
R_3	50,000	1043	10C/1043
R_4	20,000	1044	10C/1044
R_5, R_6	75,000	1045	10C/1045
R_7, R_8	12,000 + 2,000	1046	10C/1046
R_9	5,000	1047	10C/1047
R_{10}	350	1048	10C/1048
R_{11}	15,000	1049	10C/1049
R_{12}	20,000	1050	10C/1050
R_{13}	680	1053	10C/1053
R_{14}	7,500	1051	10C/1051
R_{15}	820	1052	10C/1052
R_{16}–R_{18}	10 + 19·5 + 19·5	1056	10C/1056
R_{19}–R_{23}	10 + 2·9 + 5·3 + 12·6 + 69·2	1055	10C/1055
R_{24}	5,100 or 4,700	942 or 917	10C/877 or 10C/1872
R_{25}	51	934	10C/851
R_{26}	510	868	10C/677
R_{27}, R_{28}	10 + 6	1054 or 6833	10C/1054 or 10C/6833
R_{29}	150	1931	10C/1931
R_{30} and R_{31}	1·5	8208	10C/8208



Note. S1 and S5 shown in extreme anti-clockwise position
Socket & plugs as viewed from front of transmitter.

FIG. 5 CIRCUIT OF R.T., C.W. AND M.C.W. TRANSMITTER (T1154, T1154B & T.1154D) FIG. 5

PP1949 M23920/700 12/42 13000 C & P Gp. 959(4)

TABLE B—*Sheet 2*

Tap No.	Inductance μH	Aerial Tap	Anode Tap
5	82	—	5
6	96	—	6
7	107	—	7
8	122	—	8
9	130	1	—
10	142	—	9
11	147	2	—
12	165	3	—
13	166	—	10
14	180	—	11
15	187	4	—
16	195	—	12
17	208	5	—
18	212	—	13
19	228	6	—
20	232	—	14
21	272	7	—
22	340	8	—
23	345	—	15
24	382	9	—
25	482	—	16
26	486	10	—
27	638	—	17
28	642	11	—
29	700	12	—
30	812	13	—
31	975	14	—
32	1,175	15	—
33	1,562	16	—
34	1,985	Aerial connexion	—
35	1,990	17	—

44. The switch S_8 places a varying value of shunt resistance in circuit with the feed milliammeter M_1. The resistances R_{19} to R_{23} therefore constitute a tapped potentiometer and the effect is to increase the sensitivity of the milliammeter with an increase in aerial tapping. This provides an indirect means for limiting the voltage to the aerial circuit for, as the aerial inductance is increased progressively higher, values of shunt resistance are corrected across M_1. Loading can, by this visual indication, be adjusted by keeping the meter reading at a given indication on the scale. The R.F. thermo-ammeter M_2 reading from 0 to 3·5 amp. is connected in the earthed end of the coil L_6. This meter is used for the M.F. RANGE only and serves to indicate that the transmitter is radiating. An external aerial ammeter is provided for the H.F. RANGES.

45. The effect of the anode feed meter shunt resistances R_{19} to R_{23} is shown by the following details. On RANGES 1 and 2 full scale deflection on the meter M_1 represents from 0–300 mA; on RANGE 3, with switch contacts B and B_1 closed (aerial tapping switch positions 1 to 9), 0–300 mA; contacts A and A_1 closed (taps 10–11), 0–255 mA; contacts A and A_2 closed (taps 12–13) 0–210 mA; contacts A and A_3 closed (taps 14–15), 0–165 mA and with contacts A and A_4 closed (taps 16–17), 0–120 mA.

Filament resistance unit

46. At STAND–BI, the output from the L.T. power unit rises, and would cause failure of the filaments of the VT104 valves, were not two resistances R_{30} R_{31} included in the filament circuit of these valves to reduce this voltage. These resistances were not included in the earlier versions of the transmitter. Instructions have been issued, in leaflet form, for the necessary modification to incorporate these resistances. This modification necessitated the disconnexion of a lead between point 6 of plug D from the positive heater pin of the power amplifier, and its reconnexion to the switch S_5 and the incorporation of the two parallel resistances.

Transmitters with R/T facilities

47. A complete circuit diagram, in fig. 5, shows the transmitter circuit incorporating R/T facilities. Carbon-granule type microphones are used normally and if it is desired to modulate by the use of the electro-magnetic type, a suitable sub-modulator, such as the A.1134, is connected. The basic transmission circuit is unchanged.

48. Dealing, in the first instance, with the master switch S_5, this now consists of six sections lettered F, G, H, J, L, and M and annotated, for the purposes of this chapter, as S_{5f} to S_{5m}. When a carbon type microphone is used it is connected, in the R.T. position of S_5, in series with the primary winding of a 25 : 1 ratio microphone transformer T_1, an audio frequency choke LFC_3 and a resistance R_{28} which is part of a potentiometer R_{27} and R_{28}, across the L.T. supply and gives 2 volts across the microphone. The potentiometer and R_{28} form, in effect, one 16-ohm resistance tapped to form two sections of 10 and 6 ohms. In the case of electro-magnetic microphones the output of the pre-amplifier (A.1134 or suitable instrument) is connected across the primary of T_1. In both cases the modulating voltage is applied through resistances R_{13} and R_{17} to the grid of V_4 and, to the suppressor grids of V_2 and V_3, through C_8, S_{5l} and HFC_3.

49. For A.F. oscillating purposes the coupling, between the grid and anode of the modulator valve, which went direct to the choke LFC_1 of the purely C.W. and M.C.W. version, is now connected to switch section S_{5j}. It will be appreciated that, in this version of the transmitter, the function of the choke LFC_1 is covered by the transformer, T_1, secondary winding. In the additional (R/T) position of the switch S_5 the coupling between grid and anode *via* C_7 is removed and the valve V_4 is used as a modulator.

50. At R/T the resistance R_{10} (*see* para. 28) remains in circuit thus negatively biasing the suppressor grids of V_2 and V_3. The key K_1 and a switch connected in parallel with it, remain in circuit. To transmit speech, therefore, it is necessary to press the key or operate the switch which is situated conveniently for the pilot. The resistance R_9 is short-circuited through the relay REL_1. After speech transmission it is necessary to release the key or to put the parallel switch to OFF in order to receive. This action releases the relay REL_1 which moves over to RECEIVE.

Modulation

51. The utilization of suppressor grid modulation implies Class C operation in the output, or power amplifier stage, that is, a biasing of beyond cut-off. This brings about a reduction in the output power of V_2 and V_3 to a value which is, approximately, one third of the power obtained with C.W. and half that which needs to be developed at the time of complete modulation. The anode peak voltage does not exceed the value obtained during C.W. working and, in consequence, there is a safety factor which permits a much higher anode voltage to be used. On the modulation peaks the negatively-biased suppressor grids swing positive and at this time suppressor-grid current flows. The power required to drive this current is furnished by the valve V_4.

52. Typical figures for R/T transmission at 10 Mc/s are total input current 135 mA, anode current 60 mA, and aerial current 0·45 amp. The modulation should not exceed 70 per cent. At the lowest frequencies, where the power is automatically reduced, the suppressor grid bias is reduced with the lower feed current. High percentage modulation cannot, as a consequence, be obtained.

The magnetic relay, type 85

53. The magnetic relay, type 85, referred to in this chapter as REL_1, is a multi-contact relay operated by the 6-volt radio supply and is common to all versions of the transmitter. When the key K_1 is depressed, the relay energizing coil circuits are completed thus breaking all necessary receiver circuits and completing all necessary transmitter circuits. The relay therefore performs the functions of a send-receive switch operated by the morse key K_1. In the intervals of keying, the receiver becomes operative for "listening through". The relay REL_1 can operate at a speed which is the equivalent of more than 25 words per minute.

54. The relay REL_1 incorporates three coils A, B and C. The coil A is in circuit so long as the transmitter is switched on, that is, with the master-switch S_5 at any of the positions STAND–BI, TUNE, C.W., M.C.W. or R/T. With S_5 in the STAND–BI position the coil A only is energized and holds the relay in the RECEIVE position. The key K_1 is not in circuit.

55. When the switch S_5 is in the TUNE, C.W., M.C.W., or R/T position the key K_1 is switched into circuit. Depression of K_1 energizes both B and C coils of REL_1, the connexion of the winding B being so arranged that its field neutralises the field due to the holding coil A. The resistance and the inductance of the coil B is made very small in order to effect the demagnetizing process very rapidly. Were the circuit to remain closed for any length of time, undue high current dissipation would result in the coil B and, in consequence, this coil B is energized through an auxiliary pair of contacts on the relay only long enough for coil C to operate.

56. A rapid rise of current through the coil B ensues when K_1 is pressed. At the instant when the nett field resulting from both coil A and coil B is zero the relay commences to move under the combined action of the spring contacts. The auxiliary relay contacts open, thus cutting off the current through the coil B. This sudden cessation of current in coil B causes a transient condition in the coil A which instantly reduces its current to zero. Thereafter the field of the coil A is re-established at a rate determined by the high inductance of this winding. In effect, the coil B demagnetises the holding or RECEIVE magnet (coil A).

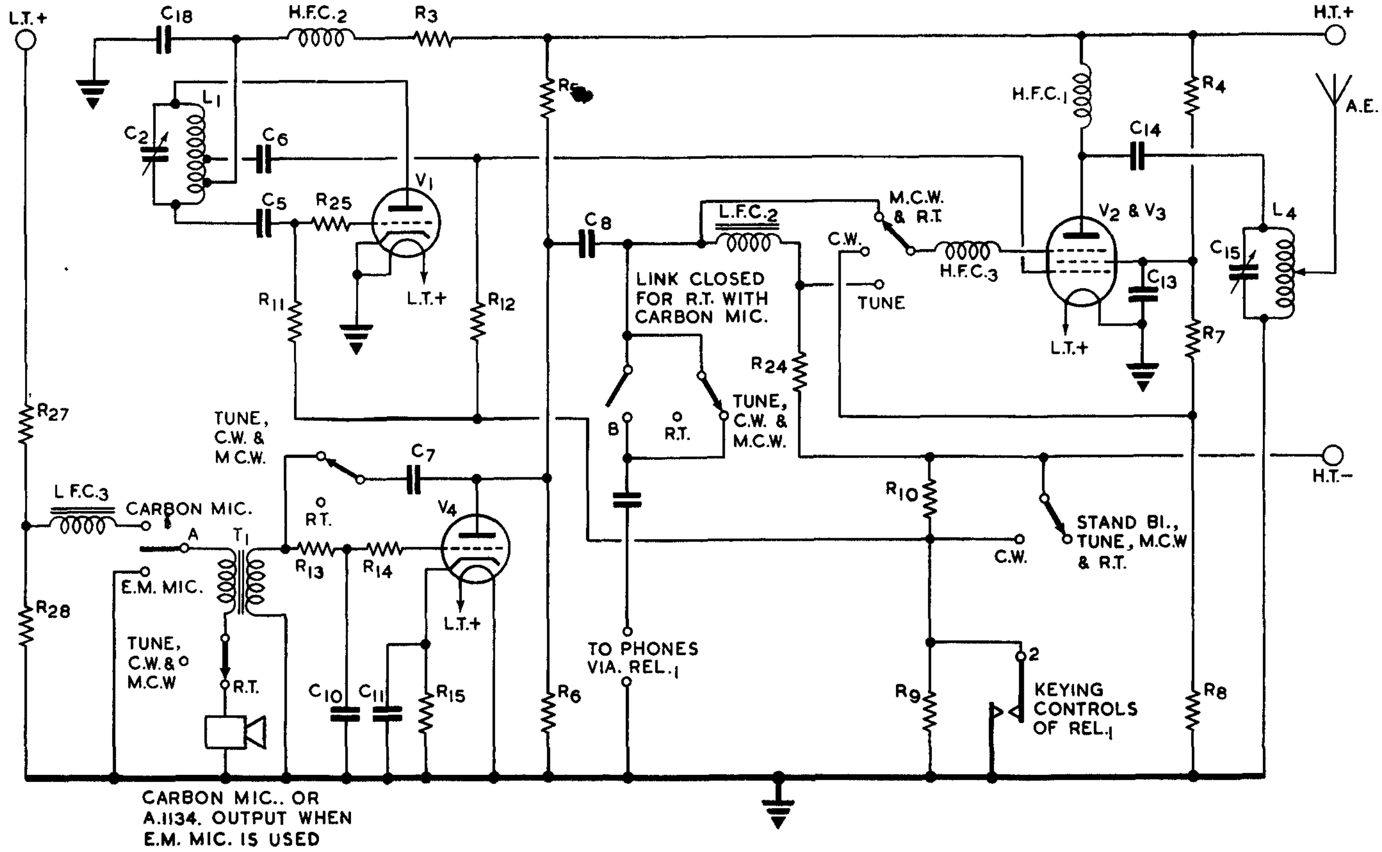


Fig. 6.—Simplified circuit, switching in range 1

57. Although the demagnetizing coil is then disconnected, the field due to the coil A is not fully re-established until after a period of time considerably longer than the transit time of the relay. As the energizing of the coil C takes place simultaneously with that of the coil B, that is when K_1 is pressed, it follows that the relay motion by coil B will be completed by the attraction due to the coil C.

58. The re-establishment of the field of the coil A does not sensibly affect the hold-on power of the coil C due to the variation in air gap of the two coils. When K_1 is released the relay must rapidly return to the RECEIVE position, since the field of the coil A is already established, and the field due to the coil C will collapse immediately the current is cut-off by the breaking of the key circuit.

59. The functions performed by the various contacts of REL_1 may be summarized as follows:—

(i) The two aerials, fixed and trailing, are switched from the transmitter to the receiver.
(ii) In the transmit position the receiver aerial leads are earthed.
(iii) The telephones are switched from the receiver to the transmitter.
(iv) The keying circuit proper is made on the TRANSMIT side.
(v) An auxiliary contact is provided which is associated with the relay coil B circuit.

Listening-through

60. Although the STAND–BI position is provided on the master switch S_5 for RECEIVE, it is not necessary to operate this switch during a series of transmissions. This position is provided so that if it is probable that no transmission will be made for some time, the H.T. power unit can be switched OFF and so reduce the drain on the aircraft general electrical system. When the switch is placed to TUNE, C.W., M.C.W. or R/T, the transmitter H.T. power unit is started up, but the equipment is still in a state of RECEIVE until the key K_1 is pressed. The operator can transmit and receive messages without any operations other than sending his message on the key. Whilst sending a message the receiver is operative when the key is raised. The distant station can, thus, call the operator's attention during his transmission if required.

Transmitter T.1154C

61. A complete circuit diagram of the transmitter T.1154C is shown in fig. 8. The basic circuit is similar to that already described. Four bands are, however, provided as given in para. 2, and the upper frequency limit, accordingly, becomes 16·7 Mc/s as compared with 10 Mc/s of the transmitters already dealt with in this chapter. To provide for the additional H.F. BLUE RANGE circuits the frequency range switch S_2, which is ganged to the master switch S_5, has been changed. Both RANGES 1 and 2 are obtained on the same oscillator and output controls.

62. The RANGES 1 and 2 (BLUE) oscillator coil has an inductance of 8·52 μH. The RANGE 3 (RED) coil is 28·7 μH. The RANGE 4 (YELLOW) has a total inductance 2266 μH with, from end of winding to tap 1, 1925 μH, from end to tap 2, 1212 μH and from end to tap 3, 590 μH.

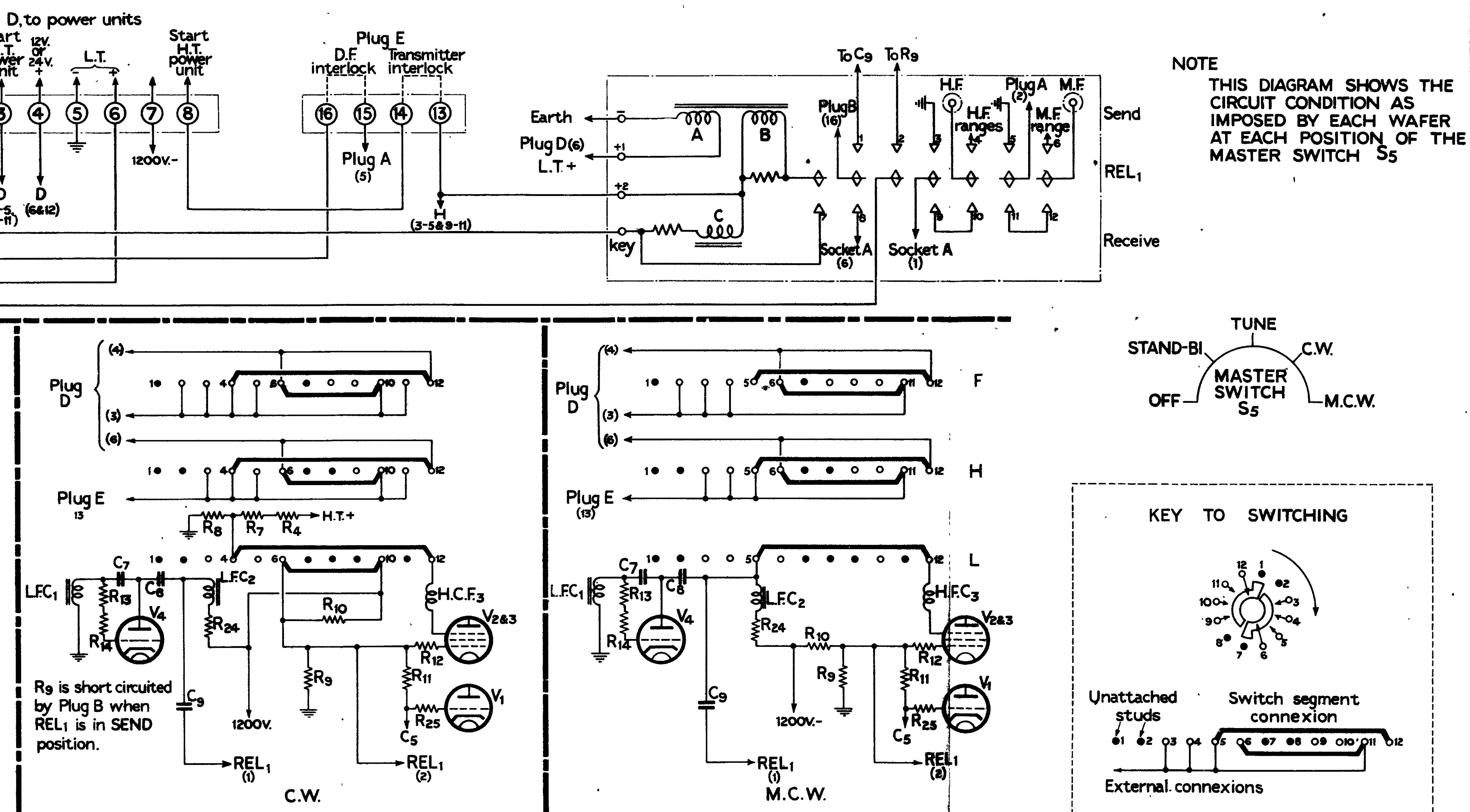
63. Between the output circuit coil for RANGE 3 and earth a three-point reversible socket X–N is interpolated. Its purpose is to enable highly resistive or reactive aerials to be satisfactorily loaded. The normal position of the socket is with the arrow (on the panel) pointing to N. In the reverse position a condenser of 0·0003 μF (that is $C_{30} + C_{31}$) is connected between the aerial end of the circuit to earth.

64. On RANGE 3 (RED) the variable condenser C_{16} operates a switch through a cam on the condenser spindle. This switch is connected in series with the relay REL_1 and serves to back bias the transmitter H.T. at a point where the commutator switch makes or breaks. This prevents arcing at the commutator switch contacts α and β shown in fig. 8. A pair of contacts ganged with the frequency range switch S_1 opens on RANGE 4 but is closed on the other ranges. This prevents absorption effects by the RANGE 4 coil in certain frequencies.

Transmitters T.1154D and T.1154E

65. The transmitters T.1154D (R/T, C.W. and M.C.W.) and T.1154E (C.W. and M.C.W.) differ from the T.1154 and T.1154A only in respect of the modified frequency coverage on RANGES 1 and 2 and in the matter of application. They are used in multiple-channel transmitter mobile ground stations and are supplied with power from single-phase, 50 c/s mains through a power unit. As the transmitters are not interlocked with a receiver as in airborne practice, arrangements are made whereby the relay REL_1 is held permanently to TRANSMIT.

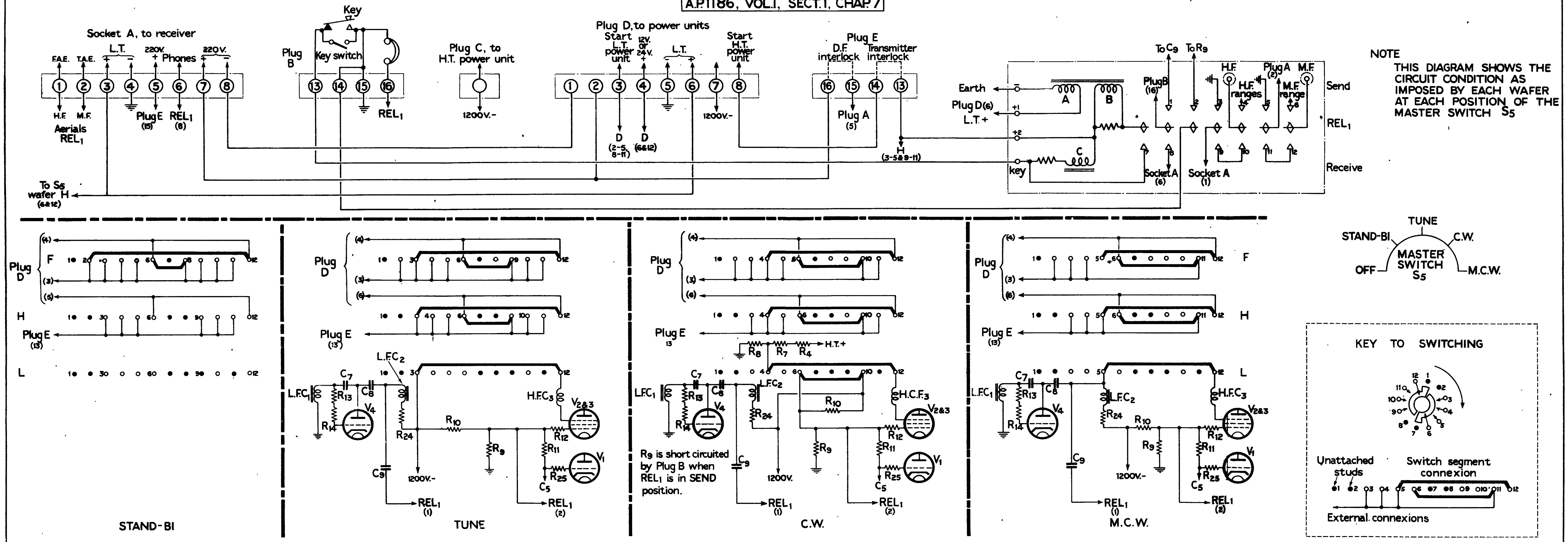
66. The output from these transmitters is worked into either local or remote aerial systems. The remote system consists of a $\frac{\lambda}{4}$ inclined vertical aerial. The local system is, normally, a triatic supported array the arrangement of which provides for anchoring eight possible aerials. This mobile system will, ultimately, be described elsewhere in this publication.



HEMATIC OF SWITCHING ARRANGEMENTS

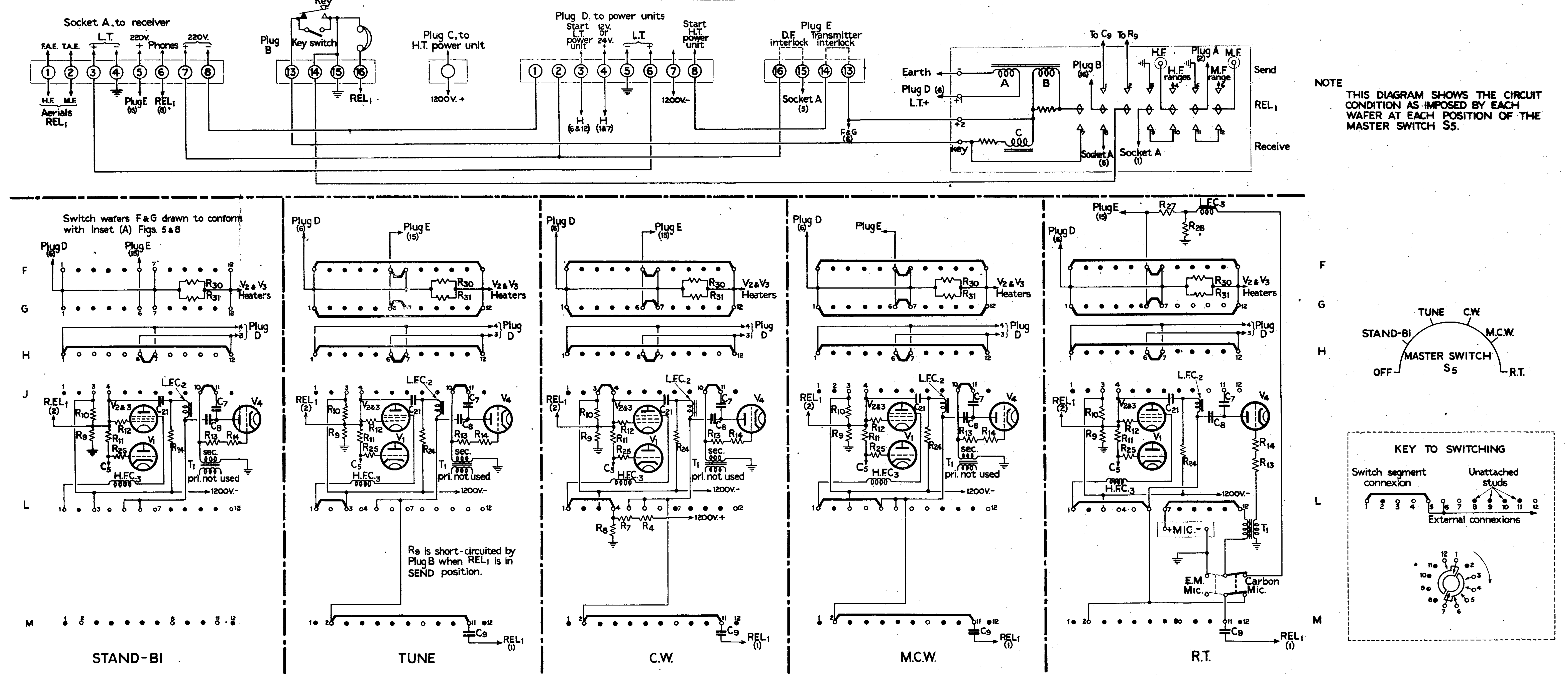
FIG.7

PP1949 M23920/700 12/42 13700 C & P Gp. 959 (4)



SCHEMATIC OF SWITCHING ARRANGEMENTS

FIG. 7



SCHEMATIC OF SWITCHING ARRANGEMENTS (R.T. VERSION)

FIG. 7a

Note:—To be

TRANSMITTER T.1154C

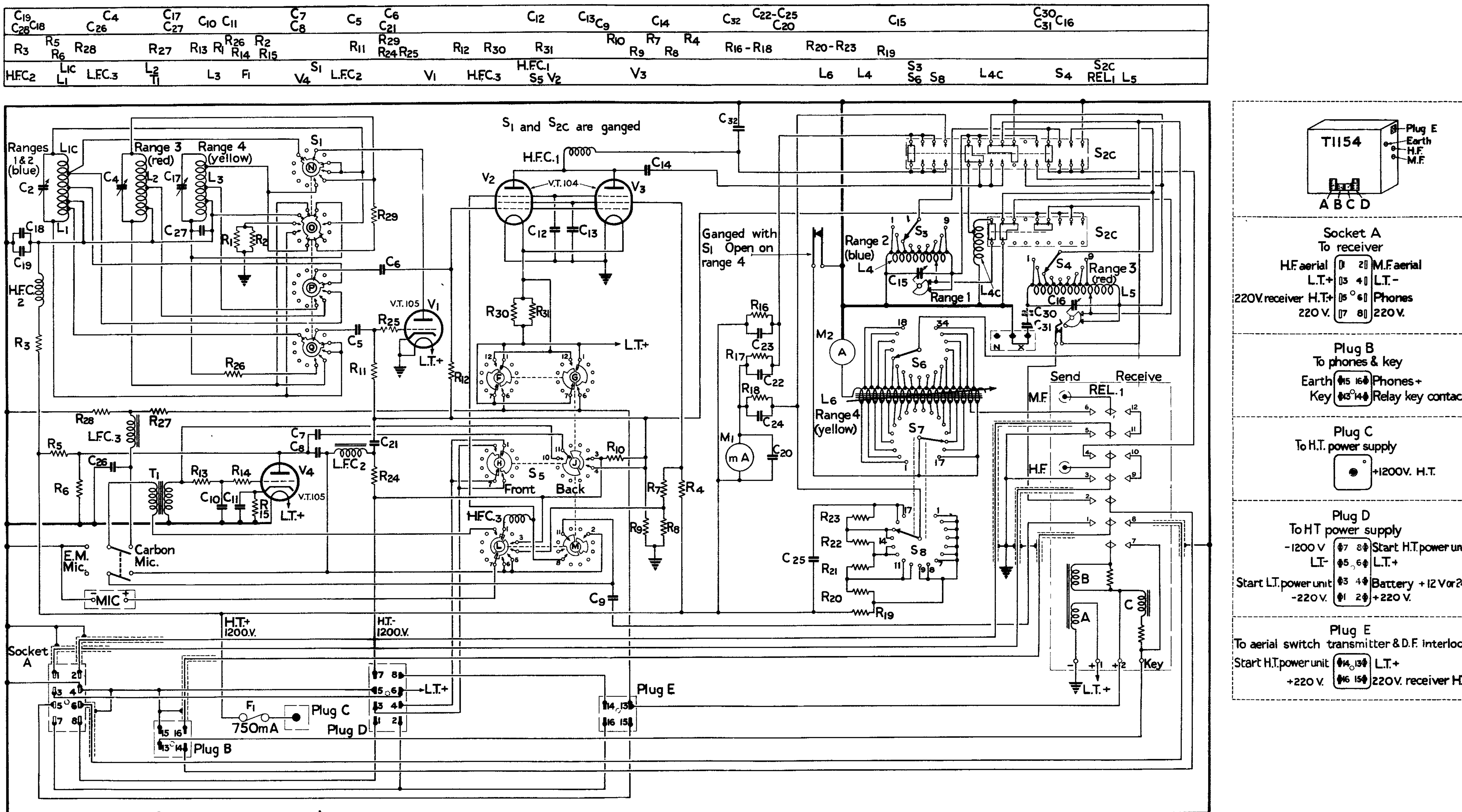
COMPONENT LIST

CONDENSERS

Annotation	Value	Type	Stores Ref. No.
C_2	11–150 μμF		
C_4	11–150 μμF		
C_5	·0002 μF	943	10C/2038
C_6	·0002 μF	943	10C/2038
C_7	50 μμF	944	10C/2039
C_8	·25 μF	955	10C/2053
C_9	·001 μF	897 or 1647	10C/965 or 10C/3381
C_{10}	·0002 μF	946 or 1593	10C/2041 or 10C/3279
C_{11}	·01 μF	188 or 1503	10C/8496 or 10C/3103
C_{12}	·004 μF	947	10C/2043
C_{13}	·01 μF	188 or 1503	10C/8496 or 10C/3103
C_{14}	·004 μF	948	10C/2043
C_{15}	7–205 μμF } Part	of magnifier unit, type 3	(10D/107)
C_{16}	7–205 μμF } Part	of magnifier unit, type 3	(10D/107)
C_{17}	22·5–379 μμF } Part	of magnifier unit, type 3	(10D/107)
C_{18}	·005 μF	949	10C/2044
C_{19}	·005 μF	949	10C/2044
C_{20}	·004 μF	956 or 1502	10C/2055 or 10C/3102
C_{21}	·5 μF	955	10C/2053
C_{22}	·0003 μF }	950 or 1501	10C/2045 or 10C/3101
C_{23}	·0003 μF }	950 or 1501	10C/2045 or 10C/3101
C_{24}	·0003 μF }	950 or 1501	10C/2045 or 10C/3101
C_{25}	·001 μF	1647	10C/3381
C_{26}	2 μF	1031	10C/2220
C_{27}	40 μμF	1648	10C/3383
C_{30}	·0006 μF	1676	10C/3415
C_{31}	·0006 μF	1676	10C/3415
C_{32}	·004 μF	1505	10C/3105

RESISTANCES

Annotation	Value Ohms	Type	Stores Ref. No.
R_1, R_2	51,000 or 24,000 (1 offs or 27,000 (1 offs	868 or 6119	10C/677 or 10C/6119
R_3	50,000	1043	10C/1043
R_4	20,000	1044	10C/1044
R_5, R_6	75,000	1045	10C/1045
R_7, R_8	12,000 + 2,000	1046	10C/1046
R_9	5,000	1047	10C/1047
R_{10}	350	1048	10C/1048
R_{11}	15,000	1049	10C/1049
R_{12}	20,000	1050	10C/1050
R_{13}	680	1053	10C/1053
R_{14}	7,500	1051	10C/1051
R_{15}	820	1052	10C/1052
R_{16}–R_{18}	10 + 19·5 + 19·5	1056	10C/1056
R_{19}–R_{23}	10 + 2·9 + 5·3 + 12·6 + 69·2	1055	10C/1055
R_{24}	5,100 or 4,700	942 or 917	10C/877 or 10C/1872
R_{26}	510	868	10C/677
R_{27}, R_{28}	10 + 6	1054 or 6833	10C/1054 or 10C/6833
R_{29}	150	1931	10C/1931
R_{30} and R_{31}	1·5	8208	10C/8208
R_{40}	100	1903	10C/1903
R_{41}	1 M	95	10C/7908



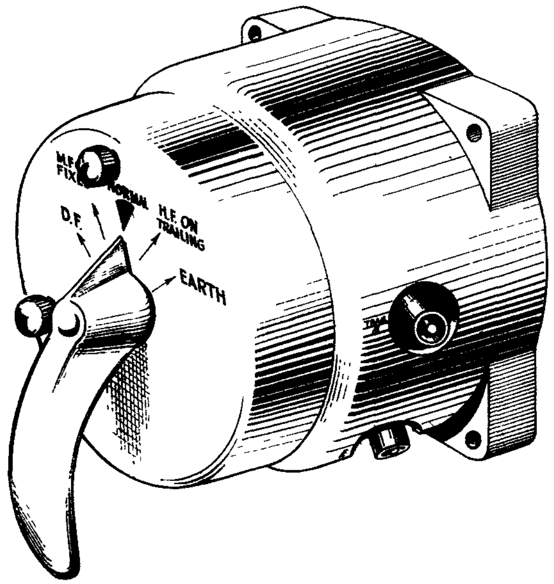
Note: S1 and S5 shown in extreme anti-clockwise position.
Socket & plugs as viewed from front of transmitter.

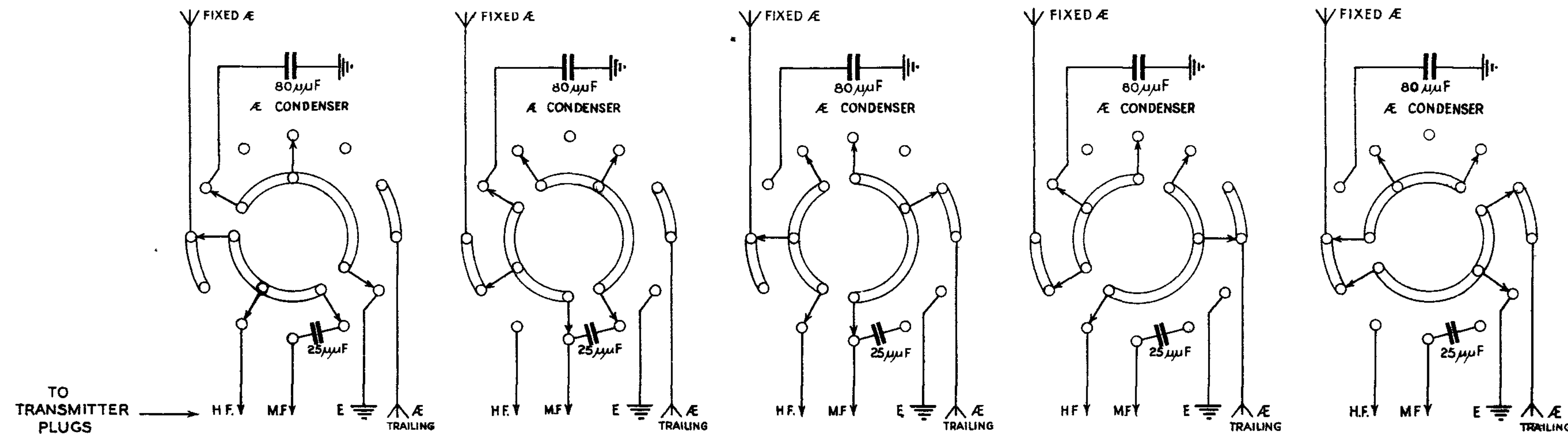
CIRCUIT OF T. 1154 C

FIG. 8

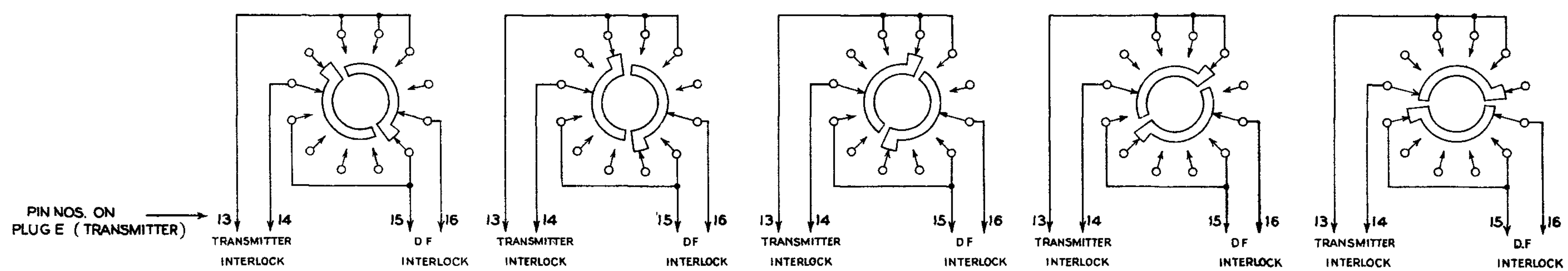
FIG. 8

PP1949 M23920/700 12/42 13000 C & P Gp. 959 (4)





POSITION OF MAIN SWITCH



AERIAL SWITCHING UNIT, Type J
THEORETICAL CONNEXIONS

POSITION OF AUXILIARY SWITCH GANGED TO MAIN SWITCH

D.F. POSITION 1	M.F ON FIXED POSITION 2	NORMAL POSITION 3	H.F. ON TRAILING POSITION 4	EARTH POSITION 5
MAIN SWITCH	MAIN SWITCH	MAIN SWITCH	MAIN SWITCH	MAIN SWITCH
FIXED Æ TO H F & M.F.	FIXED Æ TO M F & Æ LOADING CONDENSER	FIXED Æ TO H.F. TRAILING Æ TO M.F	TRAILING Æ TO H.F	FIXED & TRAILING Æ'S TO EARTH
AUXILIARY SWITCH	AUXILIARY SWITCH	AUXILIARY SWITCH	AUXILIARY SWITCH	AUXILIARY SWITCH
TRANSMITTER INTERLOCK OPEN CIRCUIT	TRANSMITTER INTERLOCK CLOSED CIRCUIT	TRANSMITTER INTERLOCK CLOSED CIRCUIT	TRANSMITTER INTERLOCK CLOSED CIRCUIT	TRANSMITTER INTERLOCK OPEN CIRCUIT
D.F. INTERLOCK CLOSED CIRCUIT	D.F. INTERLOCK OPEN CIRCUIT	D.F INTERLOCK OPEN CIRCUIT	D.F. INTERLOCK OPEN CIRCUIT	D F INTERLOCK CLOSED CIRCUIT

FIG. 9

FIG. 9

The aerial selector switching unit, type J

67. The airborne equipment is connected to the appropriate aerial through a five-position exterior switch which is connected to the aerial terminals on the transmitter. A trailing aerial is normally used for the M.F. RANGES and a fixed aerial for the H.F. From the aerial terminal the circuit is completed through contacts of the relay REL_1 and the output circuits. The correct aerial is selected through the operation of the frequency range switch S_1 and provision is made by switch adjustment, for the use of either fixed or trailing aerials in the event of a breakdown of either.

68. The fixed aerial is used for D/F purposes but the energizing circuit of the H.T. power unit is then broken by the secondary contacts of an auxiliary switch which is ganged to the main switch and transmission is prevented. When heavy static conditions prevail the EARTH position of the switching unit is used. Both fixed and trailing aerials are directly earthed at the switch; the H.T. power unit circuit is broken, thus preventing use of the transmitter. The diagram of fig. 9 shows the theoretical circuit connexions of the aerial switching unit in the five positions, with the conditions obtaining at an auxiliary switch.

The aerial selector plug board

69. On a limited number of installations, an aerial selector plug board is fitted instead of the aerial switching unit, type J. The connexions of the plug board are shown in fig. 10. Changing over the sockets on the centre pair of plugs makes it possible to obtain the following transmitter combinations of aerial connexion to the equipment: M.F. transmission on trailing aerial; H.F. transmission on fixed aerial. This constitutes the normal position and is used when both aerials are serviceable. Either aerial may be used should one become defective, the change-over being effected by re-arrangement of the plugs.

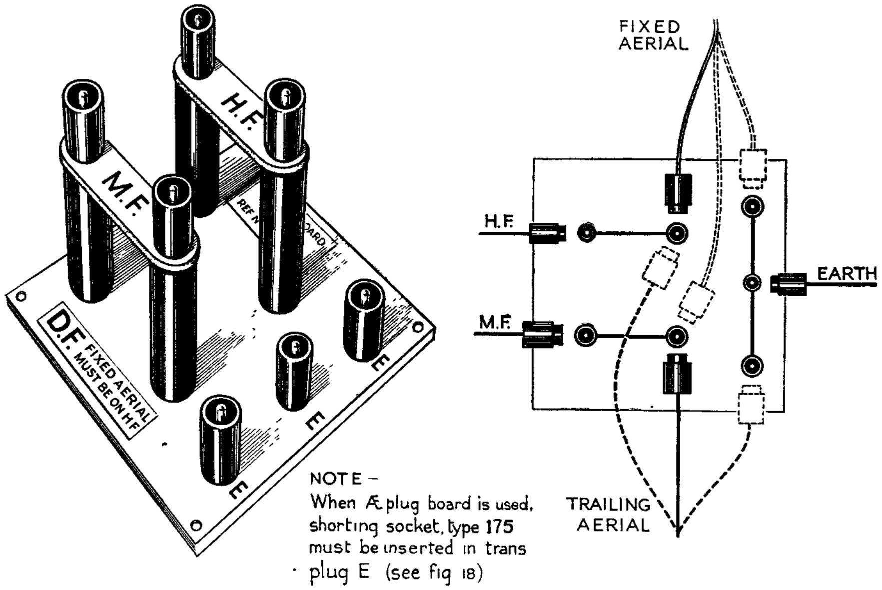


FIG. 10.—AERIAL PLUG BOARD CONNEXIONS

70. When the aerial plug board is used a socket, type 175 (Stores Ref. 10H/425) is required for plugging into the D/F interlock position, plug E, on the transmitter to make and break the input to the H.T. power unit. The internal connexions of this socket are shown in fig. 9. The pins 13 and 14 and pins 15 and 16 are short-circuited externally.

Socket and plugs

71. The connexions of the sockets A, F.Ae, T.Ae and Earth with the plugs B, C, D and E which are common to all transmitters when used as airborne equipment are set out, with the relevant connector sets, in para. 101. The MIC socket included in the R/T version is also given.

CONSTRUCTIONAL DETAILS

72. Illustrations of a typical transmitter are given in figs. 1, 11, 12, 13, 15 and 16. The general appearance is shown in fig. 1. A rear view with the case removed is shown in fig. 11. Side, top and bottom views of the instrument are given in figs. 12, 13, 15 and 16. A diagram of the click stop mechanism is shown in fig. 14 and a bench-wiring diagram of the C.W. and M.C.W. instrument in fig. 17. Certain structural alterations, notably the style of the sliding contact switch gauge with the frequency range switch in T.1154C have not been dealt with in this section.

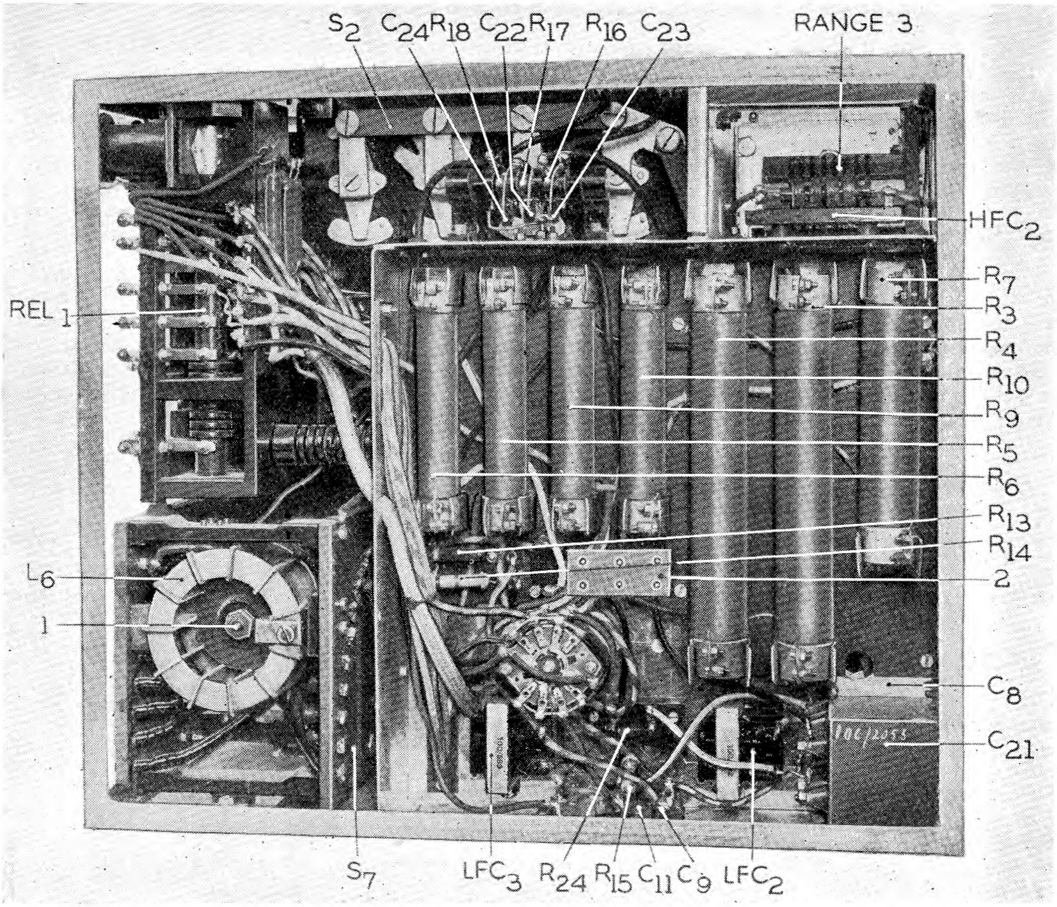


FIG. 11.—REAR VIEW OF THE TRANSMITTER WITH CASE REMOVED

73. The front panel controls of the instrument are shown in fig. 1. The master switch S_5 is located in the centre of the panel immediately below the LIFT TO RELEASE knob (1) which enables a small panel to be removed so that access to the valve compartment may be obtained. The switch S_5 has five positions on C.W. and M.C.W. versions with an additional position in R/T versions. The illustration on fig. 1 does not show the R/T position as it represents a T.1154A. The frequency range switch S_1 is located at the bottom left-hand corner of the panel and has three positions (four for the T.1154C) engraved with the frequency coverage.

74. There are three controls in the BLUE RANGES and these are colour coded accordingly. The M.O. tuning condenser for this RANGE, C_2 is provided with a "click-stop" mechanism giving eight different positions which may be pre-set to coincide with any eight "spot" frequencies within the limits of the RANGE. These eight click-stops are lettered from A to H and the frequencies can be recorded for reference on an ivorine panel (2).

75. The switch S_3 is used to connect the aerial to any of the nine tappings on the BLUE output coil L_4. The control of the output tuning condenser C_{15} is positioned at the top right-hand corner of the panel and is also provided with eight click-stops engraved similarly to those of the M.O. tuning condenser.

76. The three controls of RANGE 2 (RANGE 3 of T.1154C) are coloured RED. The control of the M.O. tuning condenser C_4 is located immediately above that of C_2. The click-stops are labelled J, K, L, M, N, P, Q, and R. A tap switch S_4 associated with this RANGE is located below S_3 and connects the aerial to any one of the tappings on the coil L_5. The condenser C_{16} is the output tuning condenser for this range and has click-stops engraved in accordance with the lettering of C_4.

77. There are four controls in the RANGE 3 (RANGE 4 of T.1154C), coloured YELLOW. The M.O. tuning control of C_{17} is at the top left-hand corner of the panel and is similar to those of the M.O. condensers for the other ranges. The eight click-stops are engraved S, T, U, V, W, X, Y and Z. The switch S_7 is the aerial coarse tuning switch and is situated to the right of the master switch S_5. The switch S_7 has seventeen positions numbered 1 to 17 and varies the amount of inductance in the aerial tuning coil L_6.

78. The output fine tuning control of the aerial coil L_6 is immediately below the output tuning of RANGE 2. It consists of a sliding core inside the coil. As the change in frequency between the tappings is small in comparison with that of other RANGES no click-stops are provided. The anode tap switch S_6 provides for seventeen positions numbered 18 to 34. The switch S_6 changes the position at which the output of the power amplifier is connected to L_6.

79. The M.O. controls C_2 and C_4 are provided with vernier adjustment controls (3) and (4). These allow for a variation of plus or minus 0·1 per cent. on any of the pre-set frequencies. A release mechanism is provided for the click-stops of C_2, C_4, C_{15}, C_{16} and C_{17}. These release controls enable the dials to be rotated without engaging the click-stops so that any frequency within the limits of the particular range can be selected. In the illustrations, these controls are identified as (5), (6), (7), (8) and (9). A friction drive is brought into use when the click-stops are released thus preventing the controls from vibrating off their setting.

80. At the top of the panel, immediately above the valve compartment, is the milliammeter M_1. This instrument reads from 0–300 milliamperes and indicates the current taken by the anodes of V_2 and V_3. The aerial ammeter M_2 is located to the right of M_1 and reads from 0–3·5 amp. when in circuit for the YELLOW RANGE. An external aerial ammeter is provided for the H.F. RANGES.

81. The socket A and the plugs B, C and D are below the master switch S_5. The socket A has eight contacts and caters for the receiver power supplies. B is the key and telephone plug, C the H.T. (1,200 volts) positive plug and D the main power supply plug. The openings in the transmitter case, through which connexions are made to plug E, to the fixed aerial, to the trailing aerial, and to earth, are also indicated. In the transmitter designed for R/T, microphone sockets are below the valve compartment; these are not shown in fig. 1. When used with electro-magnetic microphones the amplifier A.1134 is connected to the microphone socket. The H.T. fuse F_1 is immediately below the two meters. The fuse is of the glass tubular type and is rated at 750 milliamperes. It is protected and held in position by an insulated cap which screws on to the panel.

82. The transmitter is robustly constructed, being assembled on the separate unit principle to facilitate repair or replacement. The complete chassis is detachable from the containing box which is mounted on rubber suspension units (10) to prevent mechanical shocks and vibration. This minimizes the possibility of the frequency of the M.O. stage being rendered unstable. The cable connexions to the transmitter are equipped with non-reversible and non-interchangeable plugs and sockets. Wherever possible, supply cables are metal braided and have the braiding earthed to reduce electrical interference. The M.O. stage is carefully screened.

83. Two aspects of the keying relay REL_1 can be seen in figs. 11 and 12. The former illustration shows the construction of the coil L_6 with its associated core (1) for permeability tuning. The microphone link panel (2) is the contactor for the carbon-electro-magnetic microphone switches (not shown). The mechanism of the frequency change switch S_2 can be plainly seen in fig. 11. The plugs annotated as E and Earth and the terminals F.Ae and T.Ae appear in fig. 12. The semi-circular commutator device incorporated in the condensers C_{15} and C_{16} is attached to the spindles (1) and (2) seen in this illustration. One of the contacts of the device, that of C_{15}, appears as (1) in fig. 15. It should be noted that the annotations in brackets on this illustration refer to the contacts of the magnetic relay, type 85.

84. A semi-circular commutator having two brushes is fitted to the spindles of the condensers C_{15} and C_{16}. This commutator is so arranged that the condenser completes one-half revolution with the brush contacts open and the other half revolution with the brush contacts closed. When the brush contacts are closed, part of the inductance L_4 is short-circuited. The angular setting of the commutator permits the condenser to sweep from the maximum to minimum capacitance with the commutator brush contacts open. In the same manner the condenser sweeps from minimum to

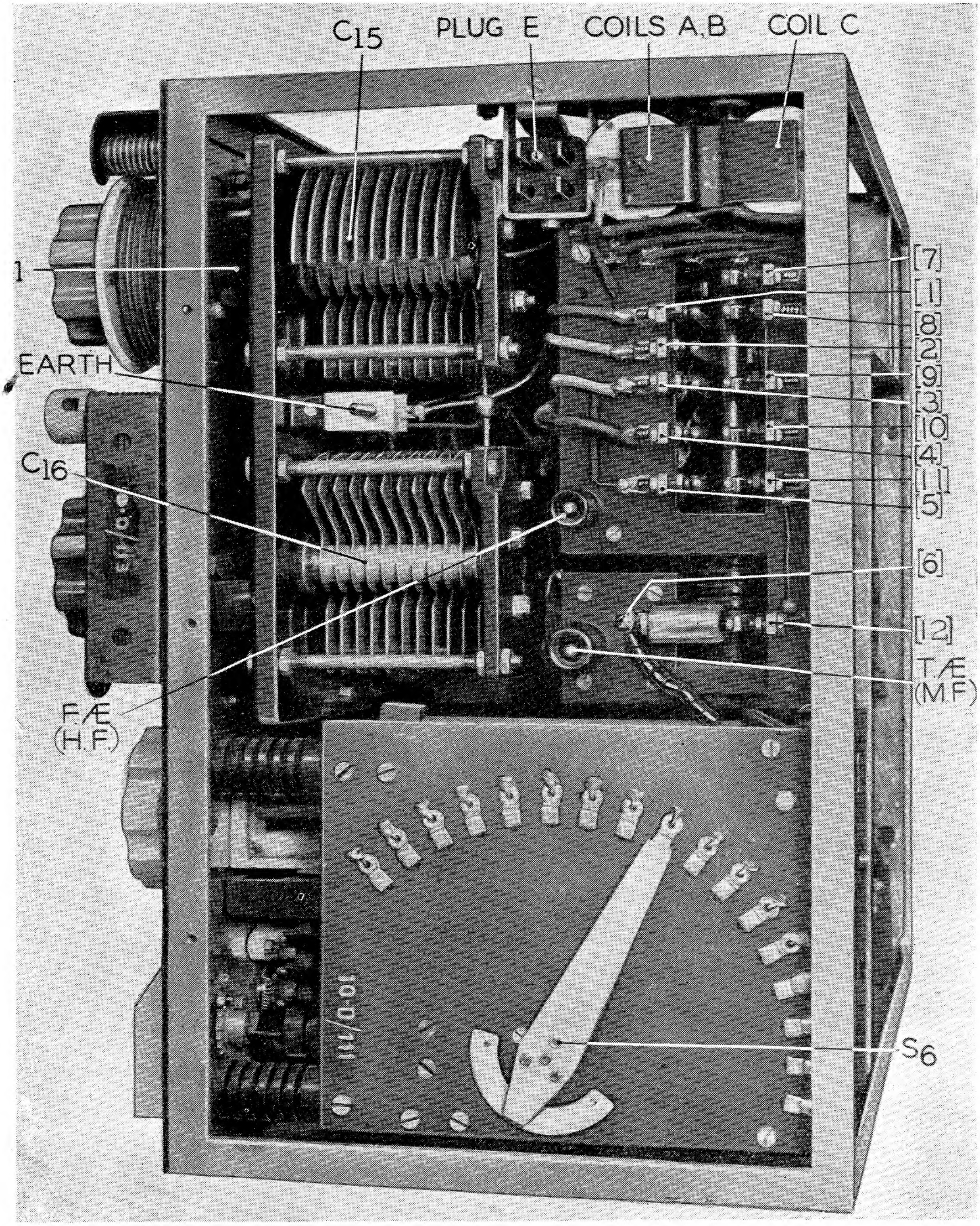


FIG. 12.—SIDE VIEW OF TRANSMITTER CHASSIS

maximum capacitance with the contacts closed. As the opening and closing of the commutator contacts alters the inductance value of L_4, a greater range of tuning is achieved. This affords the tuning margin for coupling to a diversity of aerials.

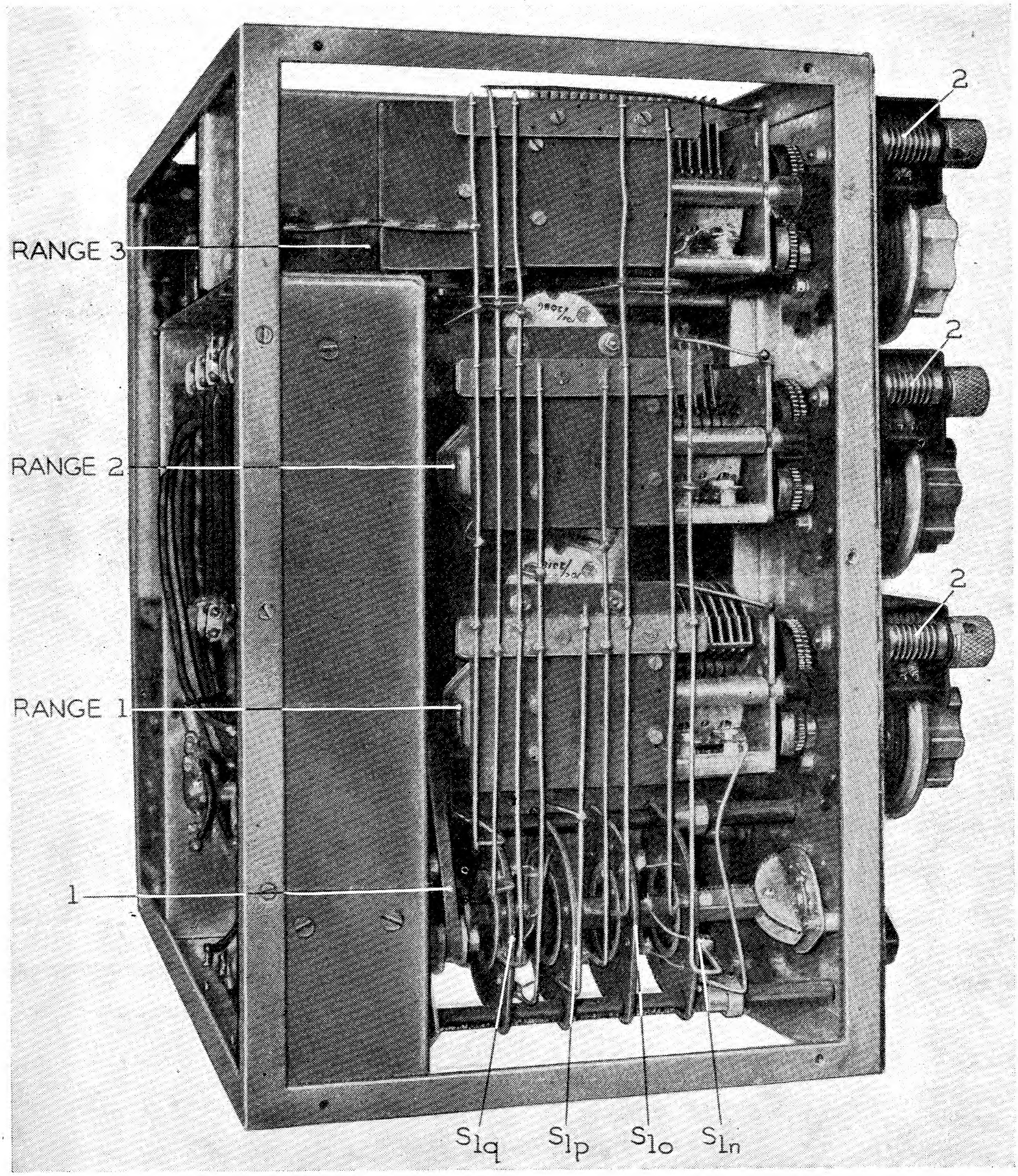


FIG. 13.—SIDE VIEW OF TRANSMITTER CHASSIS

85. The ganging link (1) between S_1 and S_2 can be seen in fig. 13 which presents a view of the M.O. end of the transmitter. The construction of S_1 and the connexions between this switch and the range coils and condensers can be traced. The click-stop mechanism (2) is partly visible in this illustration and the details are supplemented in the diagram, fig. 14.

The click-stop mechanism

86. The original click-stop mechanism, shown diagrammatically in fig. 14 is mounted on the M.O. controls for the three ranges and on the output controls for H.F. RANGES. It consists of eight split rings indicated on the diagram as a, b, c, d, e, f, g and h. Each ring has an external pip which engages in one of eight spring-loaded slotted bars, the pips being held in position in each slot by the action of the spring. Each ring and its indicating pip can be set to any position relative to the periphery of the main dial by slackening the locking screw. Each pip is marked with a different letter, the markings on fig. 19 corresponding to those on the BLUE RANGE. An improved version of this mechanism is being developed and will be described when available.

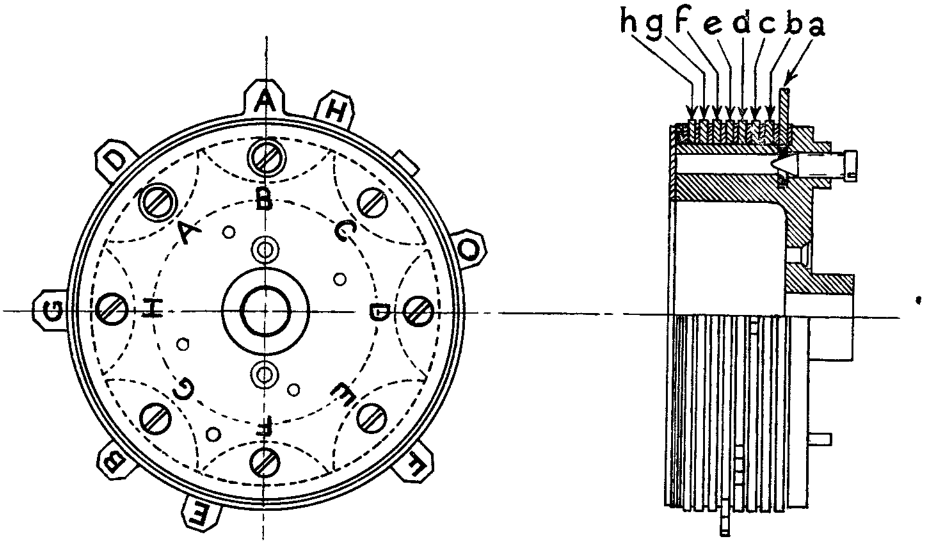


FIG. 14.—CLICK-STOP MECHANISM

87. The click-stop mechanism may be disengaged by means of a small knob control (*see* fig. 1) which lifts the set of spring-loaded bars by the action of a cam, thus preventing the pips engaging in the slots. Simultaneously, a friction drive is brought into action and this prevents the tuning dial from vibrating off its setting whilst in flight. An ivorine frequency calibrated scale is provided. The minimum spacing between adjacent selected frequencies is approximately as follows: BLUE, 25 kc/s, RED, 10 kc/s and YELLOW, one kc/s.

88. A top view of the chassis is shown in fig. 15. The connexion panel (1) is associated with the frequency range switch S_1. Another view of the condenser C_{15} can be seen in this illustration. The bevel gear (1) of the switch S_6 appears in fig. 16 which is an underside view of the instrument.

VALVES AND POWER SUPPLIES

89. Two types of valves are used in the transmitter. The M.O. and modulator valves are of the V.T.105 type (Stores Ref. 10E/216). These are non-metallized, indirectly-heated triodes, mounted on standard five-pin bases. The oscillator valve should have a ceramic base while the modulator may have the ordinary moulded base. The heater current is 0·7 amp. at 6 volts. In the power amplifier two pentodes, with standard, five-pin, ceramic bases are used and an anode connexion is brought out to the top of the envelope. These are of the type V.T.104 (Stores Ref. 10E/215) with filament current of 1·30 amp. at a nominal 6 volts.

90. The various electrode voltages and currents are shown in the accompanying TABLES which refer to transmitter types other than the T.1154C. These measurements were made with an instrument of 200,000 ohms resistance and are given for test purposes, if required.

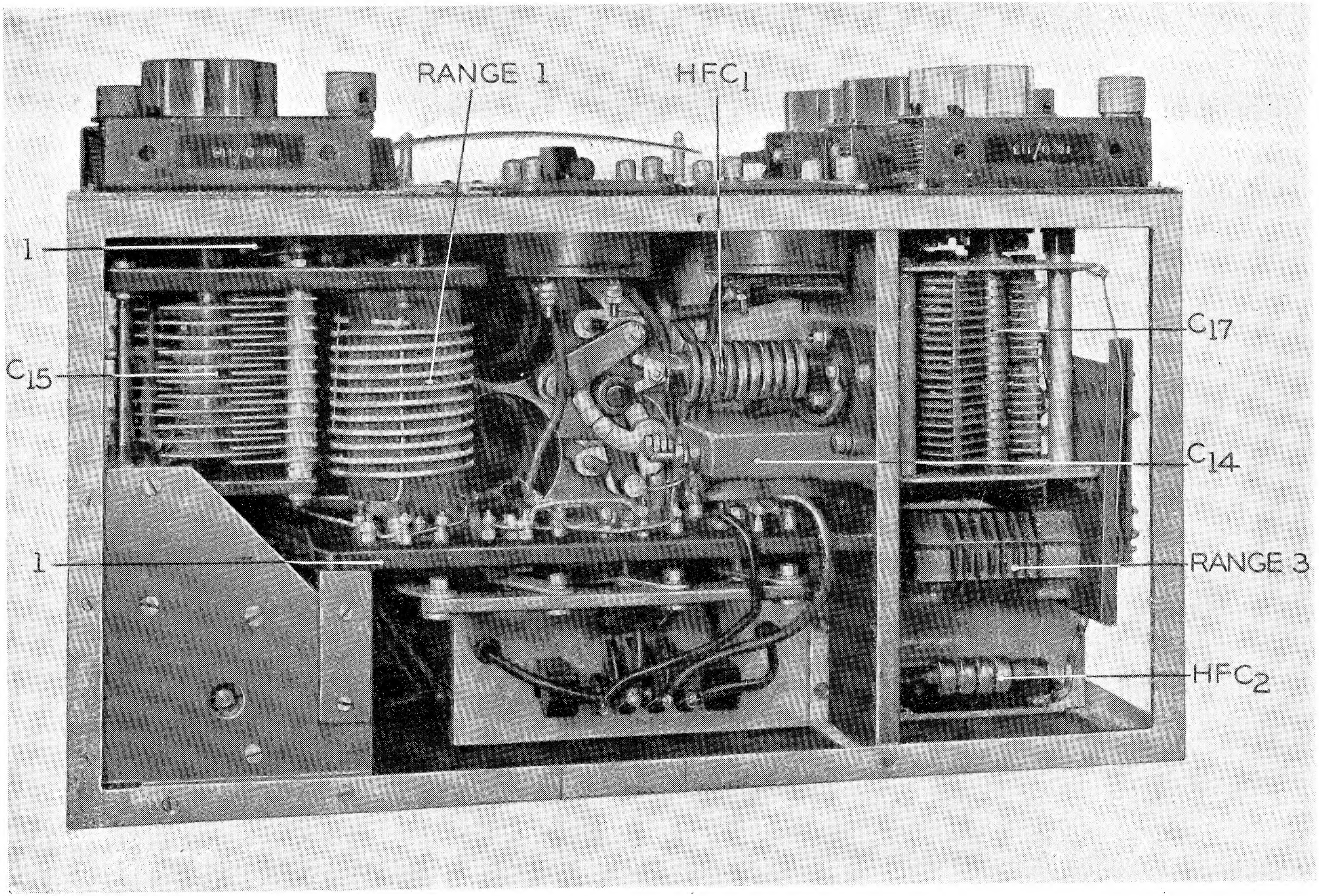


Fig. 15.—Top side view of transmitter chassis

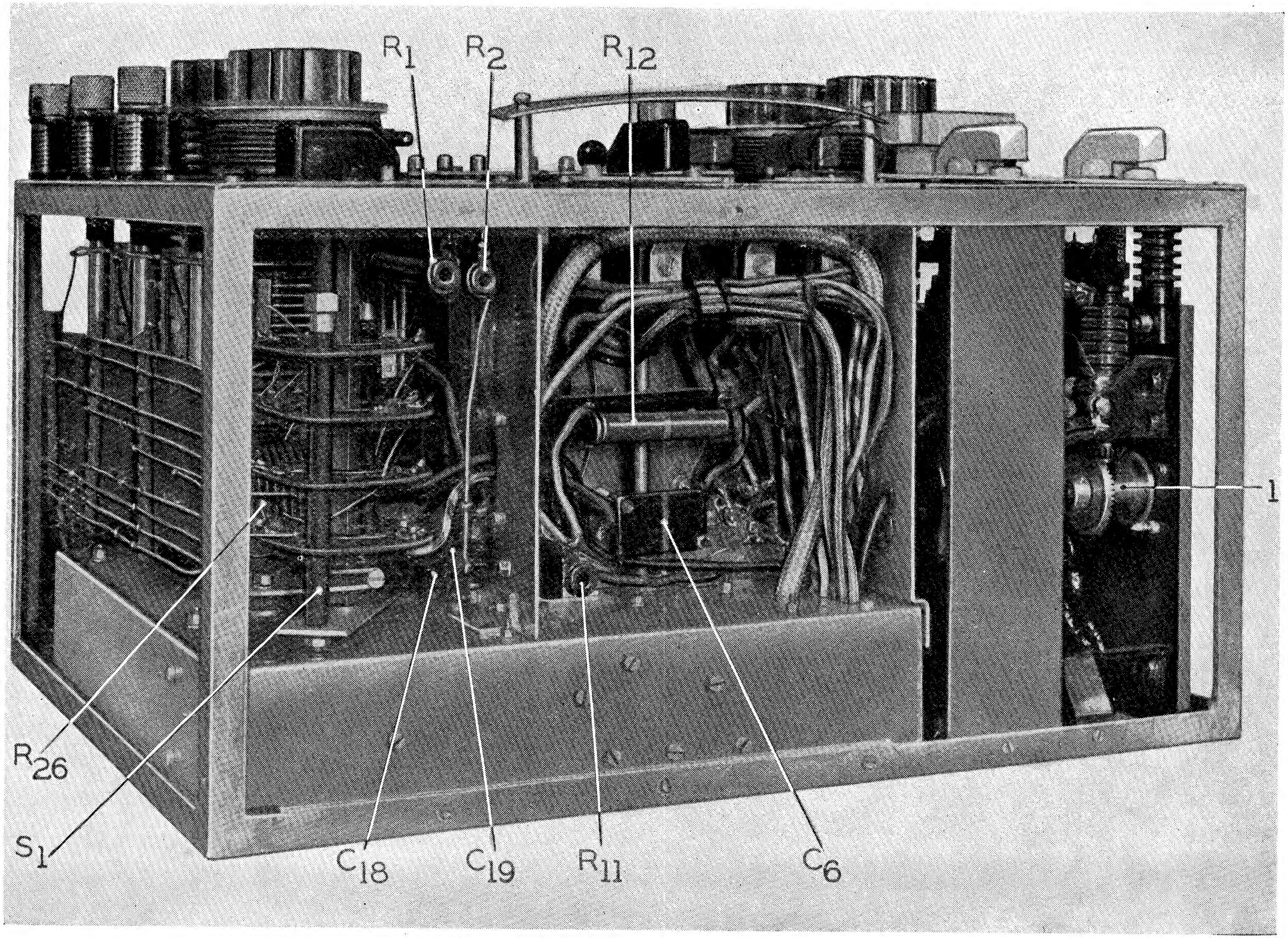


FIG. 16.—UNDERSIDE VIEW OF TRANSMITTER CHASSIS

TABLE C

MODULATOR VALVE V.T.105

Frequency	Range	H.T. supply	Anode volts				Anode current mA			
			Tune	C.W.	M.C.W.	R/T	Tune	C.W.	M.C.W.	R/T
200 kc/s	YELLOW	1,200	153	160	160	153	11·5	12	11·5	11·5
500 kc/s	YELLOW	1,200	153	160	160	153	11·5	12	11·5	11·5
3 Mc/s	RED	1,200	153	160	160	153	11·5	12	11·5	11·5
5 Mc/s	RED	1,200	153	160	160	153	11·5	12	11·5	11·5
6 Mc/s	BLUE	1,200	160	160	160	153	11·2	12	11·5	11·2
10 Mc/s	BLUE	1,200	160	160	160	153	11·2	12	11·5	11·2

OSCILLATOR VALVE V.T.105

200 kc/s	YELLOW	1,200	160	170	163	160	19·5	21	19·5	19·5
500 kc/s	YELLOW	1,200	212	233	224	212	17·7	18·6	17·8	17·7
3 Mc/s	RED	1,200	210	215	210	210	18·5	19	18·5	18·5
5 Mc/s	RED	1,200	225	235	225	225	18	18·5	18	18
6 Mc/s	BLUE	1,200	260	270	260	260	17	18	17	17
10 Mc/s	BLUE	1,200	240	250	240	240	18	18	17·5	17·5

NOTE.—On RANGE YELLOW the anode current given above includes the drain through the resistance R_1 and R_2.

91. The following TABLE D refers to measurements on the power amplifiers V_2 and V_3. The figures for the suppressor grid current (Ig3) are very variable with different valves but this is permissible within wide limits without affecting the performance of the transmitter.

TABLE D—*Sheet 1*

POWER AMPLIFIER VALVES, V.T.104

TUNE and R.T.

Frequency	200 kc/s.	500 kc/s	3 Mc/s	5 Mc/s	6 Mc/s	10Mc/s
RANGE	YELLOW	YELLOW	RED	RED	BLUE	BLUE
H.T. supply v.	1,200	1,200	1,200	1,200	1,200	1,200
Ea v.	1,160	1,160	1,155	1,155	1,155	1,155
Indicated Ia mA	98	58	55	60	58	58
True Ia mA ...	40	58	55	60	58	58
Ig 1 mA ...	2·1	4	4·2	4·6	4	3·4
Eg 2 v. ...	200	243	240	240	255	220
Ig 2 mA ...	34	28	29	28	27	32
Eg 3 v. ...	– 40	– 40	– 45	– 45	– 45	– 45
Ig 3 mA ...	0	0	0	0	0	0

C.W.

Frequency	200 kc/s	500 kc/s	3 Mc/s	5 Mc/s	6 Mc/s	10 Mc/s
RANGE	YELLOW	YELLOW	RED	RED	BLUE	BLUE
Ea v.	1,200	1,200	1,200	1,200	1,200	1,200
Indicated Ia mA	114	95	115	93	96	92
True Ia mA ...	45	95	115	93	96	92
Ig 1 v. ...	2·2	4	4·2	4·6	4	3·5
Eg 2 v. ...	215	278	300	273	290	250
Ig 2 mA ...	34	25	24	26	24	29
Eg 3 v. ...	+ 20	+ 30	+ 35	+ 30	+ 32	+ 20
Ig 3 mA ...	7	6	3	5·5	4·5	7·5

M.C.W.

Ea v.	1,155	1,150	1,150	1,150	1,153	1,155
Indicated Ia mA	85	53	55	55	50	56
True Ia mA ...	34	53	55	55	50	56
Ig 1 mA ...	2·1	4	4·2	4·6	4	3·4
Eg 2 v.	200	240	243	240	250	220
Ig 2 mA	34	28	28	28	27	31
Eg 3 v.	— 46	— 50	— 50	— 50	— 47	— 45
Ig 3 mA	1·6	1·3	1·0	1·0	1	0

92. The following TABLE E applies particularly to the T.1154C:—

TABLE E

OSCILLATOR VALVE V.T.105

200 kc/s	YELLOW	1,200	160	170	163	160	19·5	21	19·5	19·5
500 kc/s	YELLOW	1,200	212	233	224	212	17·7	18·6	17·8	17·7
2·5 Mc/s	RED	1,200	314	330	315	315	16·5	16·2	15·6	15·6
4·5 Mc/s	RED	1,200	294	305	295	294	16·1	17·8	16·1	16·1
4·5 Mc/s	BLUE 2	1,200	300	315	302	302	16·9	17·5	17·0	17·0
8·7 Mc/s	BLUE 2	1,200	260	265	256	256	17·9	18·6	18·0	18·0
8·7 Mc/s	BLUE 1	1,200	235	242	236	236	18·5	19·3	18·5	18·5
16·7 Mc/s	BLUE 1	1,200	220	230	221	221	18·9	19·5	18·9	18·9

Note.—On range YELLOW the anode current given above includes the drain through the resistances R_1 and R_2.

93. The following TABLE F refers to measurements on the power amplifiers V_2 and V_3 of T.1154C. The figures for the suppressor grid current (Ig3) are very variable with different valves but this is permissible within wide limits, without affecting the performance of the transmitter.

TABLE F

POWER AMPLIFIER VALVES V.T.104

TUNE and R.T.

Frequency	200 kc/s	500 kc/s	2·5 Mc/s	4·5 Mc/s	4·5 Mc/s	8·7 Mc/s	8·7 Mc/s	17 Mc/s
RANGE	YELLOW	YELLOW	RED	RED	BLUE 2	BLUE 2	BLUE 1	BLUE 1
H.T. supply v. ...	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200
Ea v.	1,160	1,160	1,160	1,160	1,160	1,160	1,160	1,160
Indicated Ia mA	98	58	58	58	58	58	58	58
True Ia mA ...	40	58	62	60	65	60	63	70
Ig 1 mA	2·1	4·0	5·0	4·1	4·4	3·8	1·8	2·2
Eg 2 v.	200	243	285	245	284	272	260	281
Ig 2 mA	34	28	23·5	29	24	25·5	26·5	24·2
Eg 3 v.	– 40	– 40	– 50	– 50	– 50	– 50	– 50	– 53
Ig 3	0	0	0	0	0	0	0	0
C.W.								
Ea v.	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200
Indicated Ia mA	114	95	95	95	95	95	95	95
True Ia mA ...	45	95	115	125	112	117	120	119
Ig 1 mA	2·2	4·0	5·0	4·0	4·3	3·8	1·8	2·3
Eg 2 v.	215	278	360	332	355	340	330	360
Ig 2 mA	34	25	16·2	20·1	17·2	19·5	20·5	21·2
Eg 3 v.	+ 20	+ 30	+ 52	+ 49	+ 51	+ 50	+ 50	+ 60
Ig 3 mA	7	6·0	6·0	6·0	6·0	6·0	6·0	6·0
M.C.W.								
Ea v.	1,155	1,150	1,150	1,150	1,150	1,150	1,150	1,150
Indicated Ia mA	85	53	53	53	53	53	53	53
True Ia mA ...	34	53	62	65	60	60	63	70
Ig 1	2·1	4·0	5·1	4·0	4·4	3·8	1·8	2·2
Eg 2	200	240	289	260	280	270	260	272
Ig 2	34	28	23·5	27	24·5	25·5	26·7	25
Eg 3	– 46	– 50	– 50	– 51	– 50	– 50	– 50	– 54
Ig 3	1·6	1·3	1·3	1·3	1·3	1·3	1·3	1·3

94. Power supplies for the airborne transmitters are derived from units embodying rotary transformers. These units may be of a nominal 24-volt or 12-volt input derived from the aircraft general electric system accumulators. Two power units are used for each installation, one supplying all L.T. requirements for both transmitter and receiver (or receivers, in installations where a separate

navigator-operated receiver is include second power unit has one output supply of 1,200 volts, 200 mA for the transmitter H.T. The power units are described, in detail, at the end of this chapter (paras. 181 to 211).

95. The power supplies for transmitters, types T.1154D and T.1154E, used in a mobile application, are derived through a unit, which is essentially a rectifier, supplied from the 230-volt, 50 c/s single-phase A.C. mains. This unit is the rectifier, type 26 (Stores Ref. 10D/745) and is a constituent part of the tender, signals, type 309, used in the mobile ground station T.1154D and E—R.1188. This rectifier unit will be described in the appropriate section of AIR PUBLICATION 1095.

96. When the T.1154—R.1155 group equipment is used at training establishments, and for demonstration purposes, on the ground, the power supplies are obtained from the 200–250 volt, 50 c/s, single-phase A.C. mains *via* either the power unit, type 114 (Stores Ref. 10K/350) or the power unit, type 115 (Stores Ref. 10K/351). These power units are the subject of Chap. 18, Sect. 6, of this AIR PUBLICATION.

97. The power unit, type 114, comprises two separate sections, one of which, known as the main, supplies the transmitter and receiver L.T. with receiver H.T. and the second, or H.T. unit, supplies the transmitter H.T. The power unit, type 115, is a single unit rectifier which, in conjunction with a "floating" 24-volt accumulator (two 12-volt, type B, lead-acid accumulators in series) supplies the prime voltage for the two power units of the 24-volt type, as normally used in airborne installations.

INSTALLATION

98. A typical installation diagram giving the alternative connexions for single receiver and double receiver installation, is shown in fig. 18. A typical schedule of connectors is included on this diagram but having regard to the variations of connector sets imposed by the number of aircraft types in which this equipment is used, space on the diagram precluded a complete schedule. The connector schedule, taken to a stage of completion at the time of writing, is given in an APPENDIX to this chapter.

99. In setting out an installation for this equipment a degree of duplication of the information, given in Chap. 6, Sect. 3, of this AIR PUBLICATION for the receiver R.1155, is unavoidable. As the airborne equipment is interlocked to a great extent it has been considered advisable that the information given should be, as far as possible, grouped to avoid cross-reference. The transmitter valves are arranged in two compartments to which access may be obtained by means of a door (1, fig. 1). The left-hand compartment contains the two V.T. 105 valves, that in the foreground being V_4 and the one at the rear V_1. Ceramic based valves, type V.T.105 only, are to be used in the M.O. V_1 position. Either black or white based valves may be used in the modulator, V_4, position. The right-hand compartment contains the two V.T.104 power amplifiers V_2 and V_3 and the anode connectors of these should make firm contact.

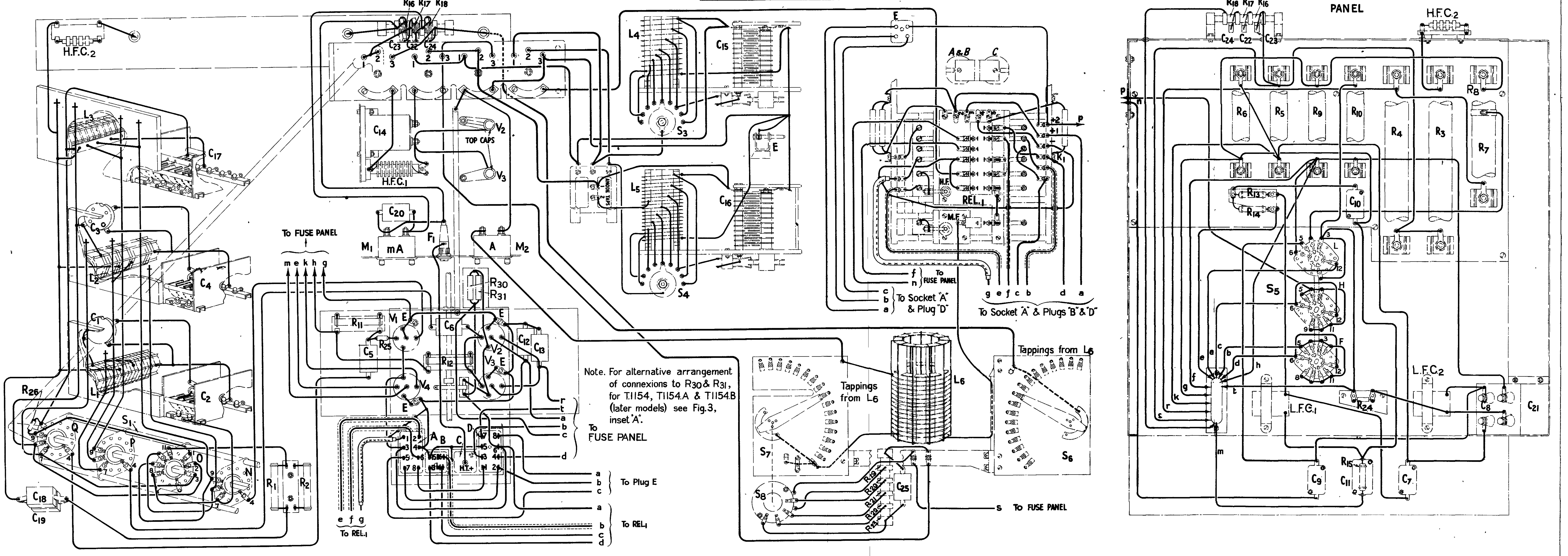
100. From a preliminary survey of the installation diagram, it will be seen that the transmitter is the main focal point for all the wiring. The connectors from the power units plug into the transmitter and so, also, do the two aerials, fixed and trailing, and the receiver inter-connexion. The D/F circuits alone (loop and visual indicators) plug into the receiver.

101. The accompanying TABLE G shows the various points of the transmitter socket and plugs, the connectors to four of which are held in position by a retaining bar (2, fig. 1) on the front panel. This bar engages with two posts (11, fig. 1).

TABLE G

TRANSMITTER SOCKETS AND PLUGS CONNEXIONS

Pin	Sk. A	Plug B	Plug C	Plug D	Plug E	Mic. Sk.	Earth Sk.
+						+	
—						—	
1	H.F.Ae		1,200 v. + H.T.	220 v. —			
2	M.F.Ae			220 v. +			
3	L.T. +			Starter fils. and Recr. H.T. P/U			
4	L.T. —			Acc. 12 v. +			

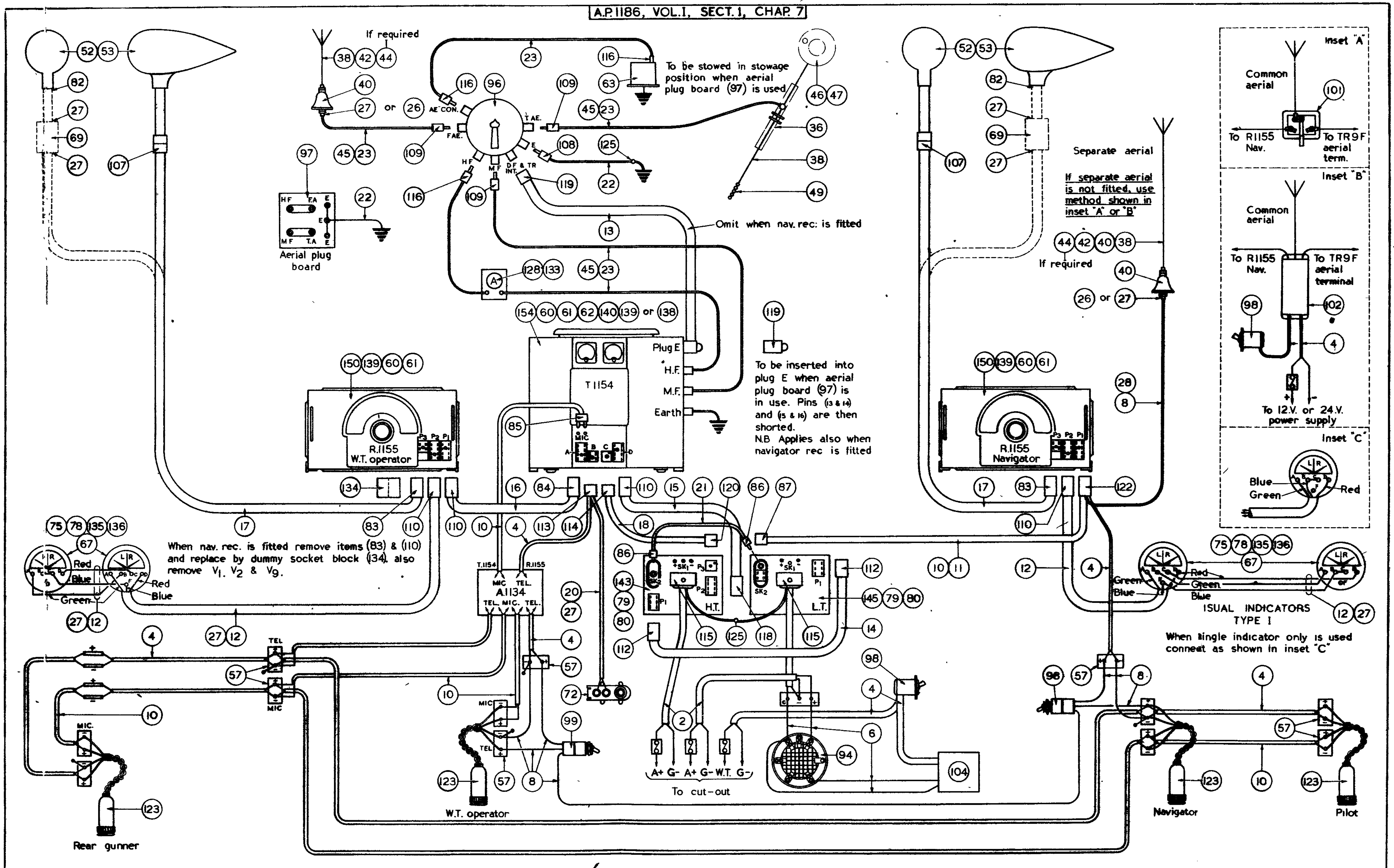


BENCH WIRING DIAGRAM OF C.W., M.C.W. TRANSMITTER

FIG.17

FIG.17

P1949 M23920/700 12/42 13000 C & P Gp. 959 (4)



TYPICAL INSTALLATION DIAGRAM (Airborne T.1154/R.1155)

FIG. 18

FIG. 18

INSTALLATION SCHEDULE

Item No.	Stores Ref. No.	Description
		GENERAL WIRING
2A	5E/1364	Cable L.T. Ducel 19 Cellse. braided; or
2B	5E/1365	Cable L.T. Ducel 37 metal braided
4	5E/1362	Cable L.T. Ducel 4 Cellse. braided
6A	5E/1360	Cable electric L.T. Unicel 19 Cellse. braided; or
6B	5E/1361	Cable electric L.T. Unicel 37 Cellse. braided
8	5E/1358	Cable electric L.T. Unicel 4 Cellse braided
10	5E/1328	Cable electric L.T. Dumet 4 metal braided
11	5E/1348	Cable electric L.T. Dumet 7 metal braided
12	5E/1351	Cable L.T. Trimet 4 metal braided
13	5E/1353	Cable L.T. Quadramet 4 metal braided
14	5E/2069	Cable electric Sextocoremet
15	5E/2067	Cable electric Octocoremet No. 1
16	5E/2068	Cable electric Octocoremet No. 2
17	5E/2033	Cable electric H.F. Dulocapmet No. 1
18	5E/758	Cable H.T. Uniplugmet No. 1
20	5E/916	Cable L.T. Unisheath 4 red braided
21	5E/130	Cable L.T. Unisheath 7 unbraided
22	5E/	Cable L.T. Uniflex 19 red braided
23	5E/82	Cable H.T. Unispark 7 unbraided
26	5A/912	Cable end eye type O.B.A.
27	5A/911	Cable end eye type 4 B.A.
28	5A/910	Cable end eye type 6 B.A.
31	5A/1810	Cable end hook type crimping Uniflex cable
34	5A/1073	Sleeve identification Uniflex cable
		W.T. FIXED EQUIPMENT
36	Special	Ae. frld. com. with lghtn. arrt. type C
38	10B/8235	Ae. wire stainless steel
40A	10B/8093	Ae. insulator type 16 (lead in); or
40B	10B/11457	Ae insulator type 49 (lead in)
42A	10B/8097	Ae. insulator type 17 (strain); or
42B	10B/8994	Ae. insulator type 18 (strain)
44	10B/9121	Ae. insulator type 18 (shroud)
45	10B/468	Ae. insulator type 177
46	10B/9005	Ae. winch type 5 frame
47	10B/9123	Ae. winch type 5 reel type B
49A	10B/7298	Ae. weight bead type No. 1; or
49B	10B/7706	Ae. weight bead type No. 2
52	10B/8478	Ae. loop type 1; or
53		Ae. loop type 3. Group to suit a/c
57	5C/430	Block terminal type B 2 way No. 1
58	5C/432	Block terminal type B 3 way No. 1
60	10A/12427	Block mounting type 1
61	10A/12428	Block mounting type 2
63	10C/564	Condenser type 764
67	10Q/2	Indicator visual type 1
69	10A/12148	Impedance matching unit type 12, or
69A	10A/12247	Impedance matching unit type 15
72	10A/7741	Key morse type F
73	Special	Label
75A	Special	Lamp holder; or
75B	10A/13078	Lamp holder type 61
78	10A/12954	Mounting anti-vibration type 119
79	10A/12421	Mounting type 51
80	10A/12422	Mounting type 52
82	10H/9872	Plug type 101
83	10H/433	Plug type 209
84	10H/434	Plug type 210
85	10H/451	Plug type 217
86	10H/8516	Plug type 68
87	10H/1518	Plug type 358
92	10A/12426	Plate anchorage type 1
94A	10C/2221	Resistance unit type 47
94B	10C/2295	Resistance unit type 52
96	10F/126	Switch unit type J; or
97	10H/681	Aerial plug board
98	5C/543	Switch box type B 1 unit
99A	10F/11714	Switch type 170 S.P.C.O.; or
99B	5D/531	Switch 2 amp. miniature S.P.C.O.
101	10H/1276	Switch type 9 S.P. 2 way; or
102A	10F/752	Relay type 265 (12-v); or
102B	10F/725	Relay type 258 (24-v)
104A	10F/493	Relay type 219 LONDEX; or
104B	10F/494	Relay type 220 LONDEX
106	10H/8531	Socket type 40
107	10H/11051	Socket type 63
108	10H/319	Socket type 135
109	10H/320	Socket type 136
110	10H/322	Socket type 137
112	10H/427	Socket type 168
113	10H/428	Socket type 169
114	10H/429	Socket type 170
115	10H/431	Socket type 171
116	10H/422	Socket type 172
117	10H/423	Socket type 173
118	10H/424	Socket type 174
119	10H/425	Socket type 175
120	10H/435	Socket type 176
122	10H/1498	Socket type 299
123	10H/2206	Socket type 359
125	5A/1058	Terminal 2 B.A. type A spring type
		W.T. REMOVABLE EQUIPMENT
128A	10A/12227	Ammeter H.W. 0–4 amps. type A; or
128B	10A/12667	Ammeter thermo 0–4 amps. type C
131	10E/542	Box valve stowage
133	10A/12674	Cover protective
134	10H/1938	Dummy sockets block
135	5C/462	Lamp instrument
136A	5L/1150	Lamp filament 12-v; or
136B	5L/1898	Lamp filament 24-v
138	10A/12423	Mounting type 53
139	10A/12424	Mounting type 54
140	10A/12425	Mounting type 55
143A	10K/13063	Power unit H.T. type 32A; or
143B	10K/13064	Power unit H.T. type 33A
145A	10K/13065	Power unit L.T. type 34A; or
145B	10K/13066	Power unit L.T. type 34B
150	10D/98	Receiver R.1155 (or R.1155A or R.1155B)
154A	10D/97	Transmitter type T.1154; or
154B	10D/99	Transmitter type T.1154A
154C	10D/196	Transmitter type T.1154B; or
154D	10D/198	Transmitter type T.1154C

TYPICAL C

(*Note.*—This installation is typical and refers only to the SUNDERLAND type aircraft)

KEY TO BASIC TYPE NOS. AND FUNCTION

541	POWER UNIT H.T. to POWER UNIT L.T.	545	SWITCH UNIT TYPE J to TRANSMITTER "D/F"
542	TRANSMITTER to RECEIVER	546	LOOP AERIAL, TYPE 3 to RECEIVER
543	POWER UNIT H.T. to TRANSMITTER	547	RECEIVER (NAV.) to POWER UNIT L.T. Only required when 2 Receivers fitted.
544	POWER UNIT H.T. to TRANSMITTER	548	Used in place of SWITCH UNIT, TYPE J and also when 2 Receivers are installed.

Aircraft Type Identification Letter and Connector Set	Comprising Connector Set		Fitted with									References in Figure
						Socket			Plug			
	Stores Ref. No.	Type	Stores Ref. No.	Cable Type	Length	Stores Ref. No.	Type	Qty.	Stores Ref. No.	Type	Qty.	
Sunderland Mk. II and Mk. III "A". Fitted with single receiver Connector Set Type T.1154/R. 1155 (Stores Ref. 10H/1556)	10H/1634	541/1	5E/2069	Sextocore-met	1′ 3″	10H/427	168	2				14, 112
	10H/1635	542/1	5E/2068	Octocore-met No. 2	3′ 2″	10H/322	137	1	10H/434	210	1	16, 110, 84
	10H/1636	543/1	5E/2067	Octocore-met No. 1	3′ 0″	10H/322	137	1				15, 110
						10H/424	174	1				118
	10H/1637	544/1	5E/758	Uniplugmet No. 1	3′ 6″	10H/429	170	1				18, 114
						10H/435	176	1				120
	10H/1638	545/1	5E/1353	Quadramet 4	1′ 10″	10H/425	175	2				13, 119
	10H/1639	546/1	5E/2033	Dulocap-met No. 1	13′ 8″	10H/11051	63	1	10H/433	209	1	17, 107, 83
	10H/1718	548/1	5E/1362	Ducel 4	6′ 0″	10H/425	175	1				119
Fitted with extra Receiver R.1155 for D/F Connector Set Type T.1154/2 R.1155/A (Stores Ref. 10H/1735)	Items 10H/1634, 10H/1635, 10H/1636 and 10H/1718 as above. Item 10H/1637 is 4′ 0″ not 3′ 6″											
	10H/2317	545/3	5E/2033	Dulocap-met No. 1	6′ 6″	10H/11051	63	1	10H/433	209	1	17, 107, 83
	10H/1640	547/1	5E/1348	Dumet 7	25′ 0″	10H/1498	299	1	10H/1518	358	1	11, 122, 87
			1328	Dumet 4	25′ 0″							10
			1362	Ducel 4	9′ 6″							4
Conversion of Single Recr. Instn. to Two Recr. Instn. Connector Set Type T.1154/R. 1155/Convn./A (Stores Ref. 10H/1986)	Item 10H/2317 (below) replaces Item 10H/1339 when converting to two receiver installation											
	10H/2317	545/3	5E/2033	Dulocapmet	6′ 6″	10H/11051	63	1	10H/433	209	1	17, 107, 83
	10H/1640	545/3	5E/1328	Dumet 4	25′ 0″	10H/1498	299	1	10H/1518	358	1	10, 122, 87
			5E/1328	Dumet 7	25′ 0″							11
			5E/1362	Ducel 4	9′ 6″							4

The following items refer to 14 connectors without reference nos.:—

Stores Ref. No.	Cable	Approx. length	Ref. in fig.	Sockets			Ref. in fig.	Plugs			Ref. in fig.
				Stores Ref. No.	Type	Qty.		Stores Ref. No.	Type	Qty.	
5E/82	Unispark 7	21′ 0″	23	10H/8531	40	1	106	10H/451	217	1	85
5E/86	Uniflex 19	6′ 0″	22	10H/319	135	2	108				
5E/916	Unisheath 4	6′ 0″	20	10H/320	136	4	109				
5E/1328	Dumet 4	4′ 0″	10	10H/322	137	1	110				
5E/1349	Ducel 19	5′ 0″	2	10H/428	169	1	113				
5E/1351	Trimet 4	14′ 0″	12	10H/431	171	2	115				
5E/1362	Ducel 4	4′ 0″	4	10H/422	172	4	116				
				10H/423	173	2	117				
		The following items refer to 15 connectors without reference nos.:—									
5E/82	Unispark 7	19′ 0″	23	10H/8531	40	1	106	10H/8531	68	2	86
5E/86	Uniflex 19	6′ 0″	22	10H/319	135	2	108	10H/451	217	1	85
5E/916	Unisheath 4	7′ 0″	20	10H/320	136	4	109				
5E/1328	Dumet 4	9′ 0″	10	10H/322	137	1	110				
5E/1349	Ducel 19	4′ 0″	2	10H/428	169	1	113				
5E/1362	Ducel 4	10′ 0″	4	10H/431	171	2	115				
5E/1351	Trimet 4	28′ 0″	4	10H/422	172	4	116				
5E/130	Unisheath 7	3′ 0″	21	10H/423	173	2	117				
		The following items refer to 2 connectors without reference nos.:—									
5E/1351	Trimet 4	18′ 0″	4	10H/322	137	1		Replaces Recr. to Indicator connector			
5E/130	Unisheath 7	3′ 0″	21	10H/8531	68	2		Connector between power units			

TABLE G

Pin	Sk. A	Plug B	PLUG C	PLUG D	PLUG E	Mic. Sk.	Earth Sk.
5	Recr. H.T. 220 v. +			L.T. −			
6	Tels.			L.T. +			
7	220 v. +			1,200 v. −			
8	220 v. −			Starter, 1,200 v. P/U			
13		Key			L.T. +		
14		REL_1 key contact			L.T. + to relay in 1,200 v. P/U		
15		Earth			220 v. + Recvr. H.T.		
16		Tels.			220 v. +		
RELEVANT CONNECTORS	To Recvr.	To tels. and key	To power supply	To power supply	To aerial switch and interlock	To Mic.	To earth
	Octocore-met 2	Ducel 4 Unisheath 4	Uniplug-met 1	Octocore-met 1	Quadramet 4	Dumet 4	Uniflex 19
	Plug, type 210 Socket, type 137	Sk., type 169 Cable end eye to Sk., type 359, or Ampl. A.1134 (or other type)	Sk., type 170 Socket, type 176	Sk., type 137 Sk., type 174	If aerial plug board fitted or if navigator operated R.1155 used. Sk., type 175	Sk., type 359 or Ampl. A.1134 (or other type)	Sk., type 135 Cable end hook

102. In laying out the equipment in the aircraft, the receiver is placed in the most convenient position for operation. The transmitter is mounted above, or to one side of the receiver. The receiver is mounted so that the tuning scales are easily visible and accessible to the operator, and the YELLOW, RED and BLUE click-stop dials on the transmitter can be seen without effort.

103. The receiver is normally positioned horizontally. In exceptional circumstances it may be mounting vertically. A distance of 1½ in. to 2 in. is allowed between the transmitter and receiver, if mounted one above the other, to permit freedom of movement for the suspension fitting. Clearance around the transmitter and receiver permits removal and replacement of plugs and sockets and of the chassis themselves and allows access to the transmitter case retaining screws.

104. The transmitter may be back, "table" or base mounted. The method depends upon the particular aircraft layout. The instrument is associated with the mountings type 53 (Stores Ref. 10A/12423) and type 54 (Stores Ref. 10A/12424). Check devices consisting of two steel chains (Stores Ref. 10A/12926) are fitted to each rubber suspension on the mountings to prevent damage to the equipment when subjected to violent shock. Instructions have been issued in leaflet form to provide for the fitment of the chains. Two chains are fitted between the central bolt securing the suspension to the mounting, type 53 or 54 and the bolts at the side securing the suspension to the transmitter or receiver. Four chains are fitted per mounting. The apparatus is put in a position where the natural illumination, through windows or ports, is good. For night work artificial illumination is provided and this consists of an adjustable light which may be thrown on any part

of the apparatus at will. The illumination is variable in intensity by means of a dimmer switch. It is usual to provide an independent light (from the left-hand side) for writing purposes and this is also adjustable. No internal illumination is provided with this equipment.

105. The W/T key (72, fig. 18) is positioned on the right-hand side of the operator's tables and just far enough back from the edge to enable the wrist to rest on the table top. Relevant information as to the ideal positioning of the operator's table, seat and other facilities can be found elsewhere in AIR PUBLICATIONS.

106. The power units are mounted on the floor in an accessible position and if placed below the operator's table, so situated that they are not liable to be kicked. They may be mounted one over the other. They are mounted on their side. The ends from which connexions are taken are accessible from inside the cabin without removing the machines from their mounting or dismantling any other equipment. Care should be exercised to prevent interchange of the type 171 input supply sockets (115, fig. 18) between the two power units because the L.T. supply of 12 or 24 volts is connected straight on to the H.T. power unit whereas with the L.T. power unit it is taken through a dropping resistance (94, in fig. 18) first.

107. The power units are at least 48 in. away from the aircraft compass. At that distance they, conjointly, produce a deflection of less than 1 degree. The transmitter is over 30 in. from the compass and the receiver 24 in. The ammeter is 24 in. and the visual indicator 18 in. distant to guarantee negligible interference.

108. Due to the heavy current taken by the apparatus, separate cables are used for the H.T. and the L.T. power units and these are taken to the aircraft main distribution panel. Each supply is separately fused. With a 12-volt system 70 amp. minimum fuses are used and with a 24-volt, 60 amp. The recommended supply cables are 37-amp. cable in the 12-volt and 19-amp. cable in the 24-volt installation. The supply leads need not be of metal screened cable. The power units are, each, earthed through their fixing brackets.

109. The positioning of the resistance unit, type 47 or type 52 which is in the positive supply lead to the L.T. power unit is so arranged that its inclusion does not materially increase the length of leads. This resistance unit is kept away from anything which might be damaged by heat, and is never placed in the vicinity of anything inflammable. It is mounted vertically and in an open space so that the air may freely circulate through it. Setting instructions for the resistance units are incorporated later in the chapter.

110. The aerial switching unit, type J, or aerial plug board, which is used in place of it as a temporary measure, is positioned between the transmitter and the aerial lead-in points so that the "run" of the aerial leads is clean and short. It is easily accessible for operational purposes. Although aircraft may be fitted with plug boards upon delivery it is possible that selector switches may be installed at some future date. All leads, therefore, are made long enough to reach the appropriate sockets in the switch even though the switch is not fitted at the time.

111. With the aerial plug board in use, it is impossible to operate the transmitter unless certain connexions are made to the interlock plug E on the right-hand side of the transmitter. It is convenient to short-circuit the points 13 and 14, 15 and 16 of this plug by means of a "dummy" plug, type 175, suitably arranged. Alternatively, if a connector is being supplied between the four-pole plug and the selector switch (even if the switch is not fitted) shorting strips may be supplied with the connector and plugged into the socket at the end remote from the transmitter.

112. The aerial ammeter supplied for use on the H.F. RANGES is an external fitting and is positioned in the run of the H.F. aerial lead between the transmitter and the aerial switch or plug board. It is so mounted as to be read easily by the operator. The lower fixing bolt for this ammeter is attached to a bracket of insulating material such as wood or plastic and not to the metal structure. Care must be exercised to avoid breakdown.

113. Should the type 173, single-pole aerial sockets (117, fig. 18) engaging on the external ammeter and in the aerial selector switch be found to be weakly sprung and so liable to fall out due to vibration, they should be double-sprung, if possible, but otherwise they should be retained in position by a rubber band or a retaining block.

114. A small fixed condenser (63, fig. 18) is supplied for use with the aerial selector switch only and its function is to load the fixed aerial for M.F. operation. This condenser need not be installed in an accessible position. When an aerial board is used the lead and plug should be stored away.

115. All aerial leads between the transmitter and the selector switch and between the switch and the aerial lead-in points are of stout, high voltage cable such as Unispark 7 or an approved alternative. The run is kept as short as possible. These aerial leads are stood away from adjacent

metal work, particularly sharp points and angles, not only to reduce losses but also to avoid the possibility of brush discharge and breakdown. A minimum spacing of 1½ in. between the conductor and the nearest metal work is provided. On medium frequencies the R.F. voltage between aerial terminals and earth may reach 6,000.

116. Fixed aerial lead-in insulators and trailing aerial fair-leads are installed with the possibility of the 6,000 volts in mind. The fixed aerial, though normally used for H.F. may be used for M.F. should the trailing aerial be lost.

117. To convert the R.T. version of the transmitter from "carbon" to "electro-magnetic" or *vice versa,* it is necessary to remove the chassis from its case and reverse a small plate (2, fig. 11) on the back of the instrument. This plate is held in position by six screws. The microphone connexions from the amplifier A.1134 to the input terminals of the transmitter are as for the transmitter T.1083, that is, T.1083 MIC+ and E. The spills 9 and 10 inside the A.1134 should be short-circuited.

OPERATION

118. Reference should be made to fig. 1 for assistance in the operation of the transmitter. The method of inserting valves (para. 99), the colour-coded controls applicable to the RANGES and the frequency coverage, has already been given. The appropriate aerials have been mentioned and the method of fixing the external aerial ammeter used on H.F. RANGES BLUE and RED can be found in para. 112. The ammeter M_2 mounted on the front panel is used for the YELLOW RANGE. The readings on the external ammeter will vary a great deal according to the transmitter frequency. A reading in the external ammeter, of M_2 and of the milliammeter M_1, supplemented by the closing of the tuning indicator of the receiver when tuned to the same frequency as the transmitter, gives a degree of indication of the transmission.

119. As a rough indication of the performance of the transmitter, the accompanying standard record, TABLE H, is supplied. This record is arranged for the transmitter T.1154C, but on the common frequencies it is applicable to other types.

TABLE H

TYPICAL PERFORMANCE RECORD, T.1154C

H.T. 1200 V—L.T. 6 V

Range	Frequency	Ae tap	Anode tap	C.W.		M.C.W.			R/T		
				Ae amps.	Total mA	Ae amps.	Total mA	Per-centage modula-tion	Ae amps.	Total mA	Per-centage modula-lation
BLUE 1	16·7 Mc/s	2	—	1.0	210	·7	155	70	As for M.C.W.		
	8·7 Mc/s	3	—	·7	200	·5	150	70	As for M.C.W.		
BLUE 22	8·7 Mc/s	2	—	·8	165	·55	135	70	As for M.C.W.		
	4·5 Mc/s	7	—	·9	200	·65	145	70	As for M.C.W.		
RED	4·5 Mc/s	5	—	1·6	210	·9	150	70	Plug at "N" (*see* para. 63)		
	2·5 Mc/s	4	—	1·6	205	·9	145	70			
YELLOW High aerial	500 kc/s	1	30	1·55	200	1·0	155	70	1·0	155	70
	200 kc/s	14	21	1·0	155	·7	130	50	·7	130	50
YELLOW Low aerial	500 kc/s	8	33	1·7	200	1·0	155	70	1·0	155	70
	200 kc/s	17	23	·9	140	·6	120	50	·6	120	150

120. The M.O. tuning condensers C_2, C_4 and C_{17} are each provided with "click-stops" enabling the dial to click into eight different positions corresponding to pre-set frequencies within the range. The output tuning condensers C_{15} and C_{16} are also so provided with "click-stops". The sliding core control of L_6 of the YELLOW RANGE output has no "click-stops". Each "click-stop" mechanism can be disengaged by a turn of a release knob (5), (6), (7), (8) or (9) fig. 1, enabling frequencies other than those of the eight "spot" frequencies to be used. The condensers C_2 and C_4 are calibrated in megacycles and C_{17} in kilocycles.

Setting-up the click-stops

121. There are two types of "click-stop" mechanisms, the original type and an improved type. Operational procedure for the setting-up of the original type only is given here. The procedure for the new type will be promulgated in due course. The minimum spacing between adjacent selected frequencies is approximately as follows:—BLUE, every 25 kc/s; RED, every 10 kc/s; YELLOW, every 1 kc/s. To set up the original "click-stops" the following controls are used:—

(i) Range switch, S_1

(ii) Master switch, S_5

(iii) M.O. condenser C_2, C_4 or C_{17}

(iv) Output condenser, C_{15} or C_{16} or sliding core control of L_6 and tap switch S_7

(v) Tap switch S_3, S_4 or S_6.

Setting-up on H.F.

122. The letter (*see* fig. 14) to be used is selected and the pip with the same letter is engaged in the slot by rotating the dial. It is advisable to start with the last letter in alphabetical order on the particular range when commencing to set up. On RANGE 1, therefore, the letter H should be first selected. The screw (12, fig. 1), above the letter H embossed on the front of the dial, is then loosened and the dial is free to rotate with the click-stop pip marked with the letter H still engaged in its slot. RANGE 1 has been taken as typical and only the controls of that range are mentioned in these instructions.

123. The corresponding letter on the output dial of C_{15} is then engaged in its slot and the screw (13) above the letter H embossed on C_{15} is loosened. The tap switch S_3 is turned to the tap numbered 1 and the M.O. dial of C_2 to the desired frequency calibrated on its transparent scale (14). The switch S_5 is now turned to TUNE and the key K_1 depressed; the milliammeter M_1 should give a reading of something over 100 mA. The dial of C_{15} must now be turned to a position in which the needle of M_1 dips, indicating resonance of the output circuit.

124. The output should be tuned throughout its full 360 degrees since it is sometimes possible to obtain anode feed dip on M_1 at more than one position on the scale of the condenser C_{15}. The dip showing the lowest anode feed is the correct tuning point. The reason for the extra tuning point is that when the oscillator condenser is near to the centre of its frequency range, the commutator on the tuning condenser short-circuits part of the coil, giving two values of LC at which the tuning can be obtained; one, however, is the better.

125. Having obtained the correct tuning point, the switch S_3 is increased step by step, retuning C_{15} each time. The dip will not be so pronounced as the loading is increased, but S_3 should be raised until the meter just dips below the green line on the milliammeter scale, which represents approximately 65 mA. When altering the taps by S_3, the key K_1 should not be depressed. If the switch S_5 is now put to C.W. the anode feed milliammeter M_1 should read approximately 100 mA. It is not always possible to adjust the feed exactly to this figure but if the figure is exceeded by more than 15 per cent. the next lower aerial tap should be used and C_{15} retrimmed.

126. The frequency should be checked in conjunction with a crystal monitor, type 2 (Stores Ref. 10T/11390) or by using the receiver as a wavemeter. The receiver R.1155 can be used for a frequency check, by setting the frequency range switch to the range in which the transmitter frequency occurs. The receiver is tuned to the required frequency, the master switch of R.1155 set to OMNI and the volume control R_8 set to minimum. Then, with S_5 at TUNE, K_1 should be depressed and C_2 turned until closure is indicated by the tuning indicator of R.1155. Should the frequency be too high or too low, re-adjust C_2. Re-check with the tuning indicator of R.1155.

127. Finally the locking screw (12) in the white disc below the letter H embossed on the M.O. tuning control dial C_2 should be tightened. The M.O. click-stop H is now set up correctly for the frequency originally selected. The output condenser C_{15} should now be trimmed for dip on M_1 and, with S_5 in the TUNE position, this should occur on the green mark. The locking screw for the letter H should now be locked and the operation of setting-up is completed. A calibration mark will be found on the click-stop lever cover (16). The letter "H" should be marked in pencil on the white scale to coincide with this calibration mark, so that the dial may be rapidly turned to this position when required.

128. The letter H should also be marked on the dial of the condenser C_{15} in the same way. On the calibration card (2), against the letter H, should be noted in the space (17) the frequency to which the click-stop has been set and also the number to which the tap switch has been tuned for correct loading. When using inter-tuning between the transmitter and R.1155, the note in the telephone will not alter when the transmitter and receiver are tuned to the same frequency.

129. To check against a crystal monitor, the correct frequency crystal must be selected and the telephones removed from the transmitter and plugged into the monitor. The M.O. dial of C_2 should be adjusted very slowly until zero beat is heard in the telephones. The locking screw adjacent to the letter H may then be tightened and the M.O. click-stop is then set. The dial of C_{15} should then be adjusted very slowly and the position of lowest dip on M_1 obtained. This should be around the green mark on M_1. No variation in the tap position of S_3 should be necessary. The screw above the letter H is then tightened.

Setting-up on M.F.

130. Normally the YELLOW RANGE is used in conjunction with the trailing aerial, but to facilitate the setting-up on the ground, of frequencies within the range, the aerial selector switch should be adjusted to the M.F. ON FIXED AERIAL position, before commencing the initial tuning of the M.O. circuits. The output circuit can only be set up in flight when the trailing aerial T.Ae is reeled out. The procedure for setting-up click-stops on the M.O. is similar to that used for the H.F. ranges, the dials being of identical design.

131. Select the letter X, engage the correct pip X and loosen the screw above X on the M.O. dial. Then turn the M.O. dial to the position in which the required frequency coincides with the mark on the click-stop cover. The output circuit is set up as indicated below. The tap switch S_7 is set to 17, S_6 to 18 and S_5 to TUNE, the key K_1 is depressed and the reading on M_1 noted. This reading should be higher than the green mark if the output circuit is not in tune with the M.O. circuit.

132. The tap switch S_7 should be turned one tap at a time until the reading on M_1 is reduced. Each time a change in the aerial taps switch S_7 is made, the key must be released and for each adjustment the knob of L_6 must be rotated from MIN to MAX for each tap until a minimum reading is shown on M_1. The dip in the anode current will occur at a low reading of M_1 and the anode tap switch S_6 should be increased step by step adjusting back on L_6 for minimum reading until M_1 reads on the green line. It is advisable to trim L_6 after the adjustment.

133. The M.O. and output of the M.F. RANGE being in tune, the frequency should be checked by a crystal monitor. The procedure outlined in para. 129 should be adopted and when zero beat is obtained, the screw above the letter X on the dial of C_{17} should be tightened.

Tuning M.F. output circuit on trailing aerial

134. When using the trailing aerial the M.O. click-stops remain unaltered, but the tap switch adjustments on both S_6 and S_7 and the setting of the control of L_6 will be found to differ from those obtained when setting-up on fixed aerial. This is due to the increased capacitance of the aerial system. The method of tuning the output circuit is the same as that employed for tuning a fixed aerial. The aerial selector switch should, however, be turned to NORMAL.

135. A very slight variation of the setting of the control of L_6 may be noted with different speeds of travel and varying weather conditions. This should always be checked prior to transmission. When the correct settings of the output controls on the trailing aerial have been found, the letters coinciding with those of the click-stop M.O. dial should be entered on the white scale around the control of L_6. Both tap switch numbers should be marked with the frequencies on the calibration chart (2) opposite the letter engaged.

Setting-up frequencies other than those set up on click-stops

136. Should it be necessary to use a frequency in flight which has not been set up on the ground, a release device is fitted to both the M.O. and the output dials. This release enables the dials to be rotated freely without disturbance of the click-stops. The release controls are annotated (5), (6), (7), (8) and (9) on the illustration fig. 1.

137. The calibration of the M.O. dials should be used as a guide to the frequency required, and the output dial should be freely rotated for dip in the manner similar to that used in the initial setting. Before commencing to tune, the control of the tap switch must be set at tap 1. If transmissions are taking place on the desired frequency, R.1155 should be tuned to them, the dial setting noted and the inter-tune method employed between transmitter and receiver. At the conclusion of transmission the click-stops can be re-engaged by turning the M.O. release and turning the M.O. and output releases to the ON position.

Fine adjustment of BLUE and RED RANGES

138. Small levers annotated (3) and (4) on fig. 1 will be found at the right-hand side of C_2 and C_4. The purpose of these is to give fine adjustment of the frequencies to which the click-stops are set. With change of temperature, the setting-up of the click-stops signals may be reported as

slightly off tune. In other circumsta adjustment to vary the frequency slightly when interference is experienced at the receiving station. The levers are capable of varying any click-stop frequency by plus or minus 0·1 per cent. The correct position for the levers is the second position from the bottom, the frequency being decreased by an upward movement. It will be appreciated that this entails the provision of one frequency increase and two frequency decrease positions. With increases in altitude and with reduced temperature, the M.O. frequency will tend to increase and under conditions of extreme heat frequency will tend to decrease.

Aerial matching on RED RANGE

139. The pre-set adjustment of the anode tap in the output circuit coil, is provided to enable the aerial circuit to be correctly loaded when using this transmitter on a very small aerial. This anode tap is located on the right-hand side of the power amplifier valve compartment. It is necessary to remove the valves to alter its position. To alter the tap position, the lead from terminal 1 behind the transmitter panel should be disconnected and re-connected to terminal 2. This special tap position should be used when it is not possible to bring the reading on M_1 up to the green mark in the TUNE position of S_5, even with the tap switch S_4 on 9.

140. On the T.1154C to the left of the aerial tap switch a reversible three-point socket N–X will be found. An arrow on the panel points to one or the other of these letters depending upon which way this socket is inserted. The normal position is with the arrow point to N. In the reverse position a condenser of 0·0003 μF is connected across the aerial end of the circuit and earth. This enables highly resistive or inductive aerials to be loaded up satisfactorily. Such aerials may be encountered when working H.F. into the trailing aerial.

Routine—normal communications

141. Before commencing to transmit, all plugs and sockets should be checked to ensure that secure contact is being made. When not engaged in two-way communication, the switch S_5 should always be at STAND–BI. Having set the aerial selector switch to NORMAL, or alternatively, when using the aerial plug board FIXED AE to H.F., TRAILING AE TO M.F., the switch S_5 should be turned to STAND–BI. The volume control of R.1155 should now be turned until receiver noise is heard and the receiver master switch placed in the OMNI position. The tuning indicator of R.1155 will now show a green light. The receiver range switch should now be turned to the required range and the instrument adjusted roughly to the required frequency by the outer knob, fine tuning being achieved by the inner knob. When working C.W. the heterodyne-switch should be turned ON.

142. The transmitter click-stops having been previously adjusted, the calibration card on the front of the transmitter should now be consulted and the appropriate colour, RED, BLUE or YELLOW and the letter noted. The switch S_1 should now be turned to the range colour. When transmitting on BLUE or RED RANGES ensure that the correct lever (3, or 4, fig. 1) is positioned at the second marking from the top of the scale. Adjust the master oscillator dial of the correct colour to the required letter which is marked in pencil on the edge of the dial. Click into position.

143. The similarly coloured output dial should now be adjusted to the appropriate letter and the tap switch number, pencilled against this letter, should be noted. When transmitting on YELLOW RANGE a note should be made of the two numbers pencilled against the letter. On BLUE and RED the control of S_3 or S_4 should be adjusted to the number noted and on YELLOW the control of S_6 and S_7 should similarly be adjusted.

144. The master switch S_5 should be turned to TUNE. The key K_1 should now be depressed and a reading taken of the feed current on M_1. The needle should be on the green line or only very slightly below it. The key should now be released and S_5 turned to C.W. The key should again be depressed and, when using BLUE or RED the external aerial ammeter should indicate. The milliammeter M_1 should read approximately 100 mA. When transmitting on YELLOW there should be a reading on M_2 but not on the external ammeter. On this RANGE the reading on M_1 should not increase above 100 mA. when the switch is placed in C.W. position. Whilst transmitting on either the H.F. or M.F. ranges, it should be noted that a 1,200 cycles per second side-tone note should be heard in the telephones, that "listening through" with K_1 released can be tested on signals or receiver mush, that the tune indicator on R.1155 will flicker with dots and dashes if the receiver is tuned to the same frequency as the transmitter and that the instrument needles on the transmitter should flicker during dots and dashes.

145. If it becomes necessary to correct the spot frequency setting on the BLUE or RED H.F. RANGES, very slight adjustment can be effected by moving the levers, annotated (3) and (4) in fig. 1, which are situated at the right-hand side of the click-stop mechanism. An upward movement reduces the frequency slightly; downward movement increases frequency.

M.C.W. transmission

146. To obtain M.C.W. transmission, switch S_5 should be turned to M.C.W. It will be found that the feed current as read on M_1 is the same as when S_5 is in the TUNE position, that is at the green mark in the milliammeter scale.

R T transmission

147. When using transmitters fitted with R/T facilities the master switch S_5 is turned to the R/T position for this type of transmission. The setting-up procedure is exactly as for C.W. except that the switch S_5 must be turned to R/T. Two sockets are provided below the left-hand valve compartment on the front panel to accommodate the microphones. In order to connect the transmitter to the aerial, it is necessary, when transmitting on R/T, to keep the morse key depressed. The feed current reading on M_1 will be on the green mark.

148. Either carbon granule or electro-magnetic microphone may be used, but with the latter it is necessary to employ the amplifier A.1134, the output of which is connected to the microphone sockets on the transmitter. Control of R/T transmission can be exercised by the pilot and second pilot by the provision of a switch connected in parallel with the morse key. Before this facility can be used, however, switch S_5 must be in the R/T position.

Emergency working

149. Should it be necessary to utilize the BLUE or RED RANGE for transmission on the trailing aerial, due to the fixed aerial having been lost or put out of action, the aerial selector switch should be turned to the position H.F. ON TRAILING. In installations where the aerial plug board is used the positions TRAILING AE TO H/F, FIXED AE TO EARTH should be employed. Note the required frequency which is entered on the panel on the front of the transmitter and set up the master oscillator controls BLUE or RED as previously detailed. Turn the correspondingly coloured tap switch to No. 1 tap. Release the output dial by turning the small release handle (8) or (9) fig. 1 to OFF.

150. The output circuit should then be retuned as indicated in paras. 124 to 125. The transmitter is now ready for use.

151. On certain frequencies with the T.1154C the trailing aerial may be used for transmission on the H.F. RANGES when it is required to increase the range of transmission. This may be found to be useful when extra range on R/T is required. Contrary to the usual practice, the whole length of aerial should be reeled out. It will be found that the positions for the power amplifier tuning condenser and aerial tap will be in different positions from those found for the normal fixed aerial. The aerial current under these conditions will vary over wide limits and the indications of the feed meter should be taken as a means of checking radiation.

152. In certain circumstances it may be necessary to restrict the range of C.W. transmissions. In order to fulfil this requirement, the transmitter may be used in the TUNE position, which decreases the power output to about 25 per cent. Both H.F. and M.F. transmission on C.W. may be effected in this manner.

153. Due to valve failures or shortage of spares, circumstances may arise in which only one V.T.104 valve is available for use in the power amplifier stage. The transmitter will function using one valve only, but the following points should be remembered:—

(i) Free the power amplifier click-stop tuning.

(ii) Readjust the power amplifier tuning dial and aerial taps.

(iii) When setting up, load the power amplifier to as nearly as possible on the green line in TUNE position.

(iv) The single valve will then be overloaded and should be replaced as soon as possible.

(v) Always remove the faulty valve when using a single valve in the power amplifier stage.

154. Due to valve failure, or shortage of spares, circumstances may arise in which no spare M.O. valve is available. The transmitter will function, on C.W. only, without the modulator valve which may be used as an M.O. valve by inserting it in the M.O. socket. No side-tone will be available when working in this condition.

Interference between H.F. and M.F. aerials

155. This condition may occur when the M.F. circuit, connected to the trailing aerial, is tuned to a sub-multiple of the H.F. frequency being used on the fixed aerial. As an example, the M.F. may be tuned to 500 kc/s and the H.F. circuits working into the fixed aerial are tuned to 5 Mc/s. Under these conditions the M.F. is tuned to one-tenth the H.F. frequency.

156. Indications of this effect take the form of a considerable reduction of H.F. aerial current, with normal anode current indications in the TUNE and C.W. positions but low "off tune" current. The radiation in these circumstances is not greatly altered. Proof that this effect is taking place can be shown either by disconnecting the M.F. aerial plug on the transmitter or by altering the M.F. power amplifier tuning on the tap switch 1 to 17.

H.F. aerial current

157. When working on H.F. the aerial current may vary between no indication at all on parts of the tuning range and full scale deflection of the H.F. aerial ammeter on other parts of the tuning range. The variations are due to the relationship between aerial length and the frequency in use, and the radiation will be, irrespective of aerial current, approximately equal.

158. For guidance, it should be understood that the aerial current will be at a maximum when the aerial length is equal to $\frac{\lambda}{4}$ or $\frac{3\lambda}{4}$, and at a minimum when the aerial length is equal to $\frac{\lambda}{2}$ or λ being operated.

159. When tuning on H.F. always set up the power amplifier circuits so that the anode current dips to the green mark on the milliammeter in the TUNE position and ignore the aerial current readings.

M.F. on fixed aerial

160. The condition noted as M.F. on FIXED, means that the trailing aerial has been lost or is out of action. In these circumstances the aerial selector switch should be turned to M.F. ON FIXED or alternatively, when using the aerial plug board, the positions FIXED AE TO M.F., TRAILING AE TO EARTH should be used. The receiver volume control should be increased to maximum, due to the fact that the aerial pick-up is decreased on account of the small aerial. The master oscillator should be set up as previously described and the two tap switches S_7 and S_6 turned to 17 and 18 respectively.

161. The switch S_5 is positioned at TUNE and the key is depressed. The YELLOW output knob of L_6 is rotated from maximum to minimum and, at the same time, it should be noted if the needle of M_1 dips. In the event of no dip, the tap switch S_7 should be reduced one tap at a time until a sharp dip occurs on M_1. The key should be released between each adjustment of S_7, and the correct tuning checked each time by rotating the YELLOW control of L_6. Slight variation only should occur.

162. The tap numbers on S_6 should be increased one step at a time, retuning knob of L_6 for minimum feed at each step until the needle of M_1 is at the green mark. The switch S_5 should then be turned to C.W. and the key depressed. The aerial ammeter M_2 should now read between 1·5 and 3 amps. and the needle of M_1 should be on the RED portion of the scale. The instrument is now ready for transmission.

163. In heavy static or thunder, the fixed and trailing aerials should be earthed. This condition is met by turning the aerial selector switch to EARTH. With the switch in this position, the transmitter is automatically switched off. When using the aerial plug board the position FIXED AND TRAILING AE TO EARTH should be used. The master switch S_5 should be at STAND–BI or OFF.

PRECAUTIONS AND MAINTENANCE

164. The equipment may be ground tested on the BLUE and RED H.F. RANGES by setting the aerial selector switch to NORMAL.

165. For M.F. transmission on the ground, the aerial selector switch must be turned to the position M.F. ON FIXED AERIAL and the switch S_1 set to YELLOW.

166. When switching S_5 to TUNE, should no reading appear on M_1 after depressing the key, the switch should be turned to OFF. If the H.T. power unit has been functioning normally the H.T. fuse F_1 should be inspected. The output brushes of the H.T. unit may be inspected by removing the cover. If the H.T. power unit fails to run up when the switch S_5 is turned to TUNE, check for correct positioning of the aerial selector switch. After switching OFF S_5 the L.T. fuses on the aeroplane electrical switchboard should be checked and the input brushes of the H.T. unit inspected.

The magnetic relay, type 85

167. Should the magnetic relay fail to function, the blade tips and stiffeners should be inspected to see that they are approximately in line. The pressure between blades and stiffeners can be checked by a relay gauge but on no account should the stiffener strips be bent to facilitate adjustment. Instructions for taking pressure by means of a P.O. spring balance and the correct gap between the contact tips will be described in the appropriate section of AIR PUBLICATION 1095.

168. The pressure on the gold-silver contact tip which just lifts the blades off their stiffener should be within the range 20 to 30 grams. The armature plates should be firmly screwed in position and the holding bolts securely locked and soldered. In the "just made" position, the centre of the moving contact should be within $\frac{1}{32}$ in. radially from the centre of the fixed contact. The relay spindle should roll freely from side to side under its own weight when the relay is tilted.

169. In either of the closed positions of the magnet structure a small air gap of 0·002 in. to 0·007 in. should remain between the armature plate and the central leg of the yoke. The insulation should withstand a 500-volt megger test between windings and frame and give a resistance of greater than 1 megohm. The overall characteristics of the relay may be checked by measuring the minimum voltage which, applied to each coil in turn, will just cause the relay to close. This is shown in TABLE J.

TABLE J

Coil	Terminals	Maximum value permissible to cause relay to close
A	3 and 4	4 volts
B	1 and 2	2·2 volts
C	2 and 5	1·85 volts
D	2 and K	3·2 volts

170. A transmitter trouble location chart in fig. 19 includes a diagram of the magnetic relay, type 85 with various relevant figures such as gap apertures.

Click-stops

171. Should any question arise relative to the accuracy of the click-stop frequency settings the click-stop mechanism may be tested in the following manner. Engage each of the stops in turn and slack off the corresponding locking screw, the remaining locking screws being tight. It is important that, with the locking screw slackened off, it should be possible to rotate the turning condenser freely, leaving the click-stop engaged in its lever. This applies to all the click-stop mechanisms on both the M.O. and the output circuit controls.

172. Set the transmitter up on some pre-determined frequency and lock the click-stop plate in position. Tune in this frequency on the crystal monitor to enable a beat note to be heard in the receiver R.1155. Having set up the frequencies as above, disengage the M.O. condenser click-stop and re-engage it a number of times, approaching from either direction. Each time the click-stop is engaged, the beat note should be checked against the crystal monitor. The transmitter should be allowed to run with the key depressed for at least five minutes so that any results should not be confused with initial drift.

173. The difference between the highest and the lowest of the frequencies measured should not be more than 1/3000 of the fundamental frequency of the transmitter on the BLUE and RED RANGES and not more than 1/1000 on the YELLOW RANGE.

Frequency change

174. When moving the master switch S_5 from the TUNE to the C.W. position a small change of frequency will be observed. This should not be greater than 3 kc/s on any RANGE.

Condenser C_{29}

175. In certain instruments a 0·01 μF condenser C_{29}, type 440 (Stores Ref. 10C/10629) is fitted between H.T. negative and earth. As it has been found that the necessary conditions are satisfied when C_{29} is omitted from the circuit, instructions have, therefore, been issued to Units to remove the condenser which is situated at the rear of the transmitter and mounted on the base of the chassis. The sequence of operations is as follows:—

(i) Remove the transmitter chassis from its case.

(ii) Identify the bank of condensers, at the rear of the transmitter, mounted on the base of the chassis and situated between LFC_3 and LFC_2. The condenser C_{29} is one of this bank.

(iii) A lead connected between the spill of this condenser nearer to the rear of the transmitter and the resistance R_{24} (*see* fig. 11) is disconnected and removed. The condenser C_{29} is not shown in fig. 11.

(iv) Replace the transmitter in its case.

Filament resistances R_{30}, R_{31}

176. Earlier versions of the transmitter were not fitted with resistance in the filament circuit of the V.T.104 power amplifier valves V_2 and V_3. Later issues have been so fitted, but to provide for action by Units, instructions were issued in leaflet form. The maker's modification to provide for the switching of the resistance is effected on a switch wafer of S_5. The parallel resistances R_{30} and R_{31} are brought into circuit in STAND–BI only. In other positions they are short-circuited. The resistances R_{30} and R_{31} constitute the resistance unit, type 164 (Stores Ref. 10C/4606). Where the modification is done by the service units the following is the sequence of operation for the R.T. model.

(i) Remove the valves from the transmitter.

(ii) Remove the transmitter from its case, placing it inverted, on the bench with the panel to the front. Identify the valve holder compartment (*see* fig. 25c).

Mounting of filament resistances

(iii) Replace the two screws at "X" by two $\frac{5}{8}$ in. long 6 B.A. cheese-head brass screws.

(iv) Fit the resistance unit, type 164, to these screws and secure by means of 6 B.A. washers and nuts. Coat the nuts and projecting ends of the screws with shellac varnish.

Mounting of filament switch

(v) Slacken off the screws of the cam unit assembly and separate the two parts. Place the cam unit on the switch rod as shown with the section containing the two screws underneath. Tighten sufficiently to retain the unit on the switch rod.

(vi) Fit the switch unit assembly to the valve holder screw A. The switch unit assembly has a tapped hole to accommodate the screw which should be coated with shellac varnish before fitting.

(vii) Set S_5 to the position engraved "STAND–BI".

(viii) Slide the cam unit into position so that the indent in the switch arm blade engages centrally in the groove of the semi-circular cam. Tighten the fixing screws of the cam unit assembly, and coat with shellac varnish.

(ix) Rotate the switch handle and check that the contacts of the switch unit assembly are closed at all positions except "STAND–BI". It is also important to check that the contacts are open when the switch handle is rotated to the "STAND–BI" position from either direction.

Modification to wiring of transmitter

(x) A lead connects from pin No. 6 of the 8-pin plug, type 212 (Stores Ref. 10H/438) to the positive heater socket of the adjacent V.T.104 valve holder. Disconnect this lead at the valve holder pin and transfer it to the front spill of the switch unit assembly.

(xi) From this latter tag connect a length of No. 18 s.w.g. tinned copper wire encased in Grade E insulating tubing to one of the lower soldering tags of the resistance unit, type 164. This lead is to pass under any components on the way.

(xii) Solder an insulated lead between the heater socket referred to in para. (x) and the free soldering tag of the switch assembly unit.

(xiii) In certain transmitters type T.1154B a lead which passes through the elongated hole in the back of the compartment connects to a V.T.104 heater socket as shown. This lead is to be disconnected at the heater socket and re-connected to the lower soldering tag of the resistance unit, type 164.

(xiv) Connect a suitably insulated lead between the upper soldering tag of the resistance unit, type 164, and the V.T.104 heater socket as shown.

(xv) Replace the transmitter in its case and replace the valves and front panel.

For the C.W. M.C.W. [illegible]l. The following is the sequence of operations:—

(*a*) Remove the valves from the transmitter.

(*b*) Remove the transmitter from its case, placing it inverted on the bench, with the panel to the front. Identify the valve holder compartment (*see* fig. 25d).

(*c*) Replace the two screws at "Y" by two $\frac{5}{8}$ in. long 6 B.A. cheese-head brass screws.

(*d*) Fit the resistance unit, type 164, to these screws and secure by means of 6 B.A. washers and nuts. Coat the nuts and projecting ends of the screws with shellac varnish.

Mounting of filament switch

(*e*) Cut away, as near to the valve holder sockets as possible, the two leads as shown between the heater sockets of the valves type V.T.104 and V.T.105. (Do not attempt to unsolder these leads).

(*f*) Slacken off the screws of the cam unit assembly and separate the two parts. Place the cam unit on the switch rod as shown with the section containing the two screws underneath. Tighten sufficiently to retain the unit on the switch rod.

(*g*) Fit the switch unit assembly to the valve holder screw A. The switch unit assembly has a tapped hole to accommodate the screw which should be coated with shellac varnish before fitting.

(*h*) Set S_5 to the position "STAND–BI".

(*i*) Slide the cam unit into position so that the indent in the switch arm blade engages centrally in the groove of the semi-circular cam. Tighten the fixing screw of the cam unit assembly, and coat with shellac varnish.

(*j*) Rotate the switch handle and check that the contacts of the switch unit assembly are closed at all positions except "STAND–BI". It is also important to check that the contacts are open when the switch handle is rotated to the "STAND–BI" position from either direction.

Modification to wiring of transmitter

(*k*) Connect a length of No. 18 s.w.g. tinned copper wire, encased in Grade E insulating tubing between the transmitter earthing tags B and C as shown in fig. 25, and passing beneath the switch rod.

(*l*) A lead connects from pin No. 6 of plug, type 212 (Stores Ref. 10H/438) to the heater socket of the adjacent V.T.104 valve holder. Cut away a short portion of this lead at the valve socket ensuring that the part of the lead to which two existing leads are connected, remains soldered to pin No. 6 of the plug.

(*m*) Connect an insulated lead between the remaining portion of the lead referred to in para. (xii) and the soldering tag nearest to the panel of the switch unit assembly.

(*n*) From this latter tag, connect an insulated lead to the lower soldering tag on resistance unit, type 184. This is to pass beneath any components on the way.

(*o*) Connect an insulated lead between the lower soldering tag of resistance unit, type 164, and the positive heater socket of valve, type V.T.105 as shown.

(*p*) Connect an insulated lead between the upper soldering tag of resistance unit, type 164, and the positive heater socket of valve, type V.T.104 as shown.

(*q*) Connect an insulated lead between the V.T.104 valve heater socket referred to in para. (xii) and the free soldering tag of the switch unit assembly.

(*r*) Replace and secure the transmitter in its case. Replace the valves and front panel.

Resistance R_7

177. Some issues of the resistance R_7, type 1045 (Stores Ref. 10C/1046) have the centre tapping clips of such a length that in certain circumstances of rotation of the resistance the clip might touch the case of the transmitter. Instructions for remedial measures have been issued in the leaflet A.P.1186/A.139—W. The modification consists in cutting off the surplus length of clip. Care should be taken not to fracture the porcelain tube and to ensure that the screw and nut securing the lead to this clip are still tight after the cutting operation.

M.F. RANGE aerial tuning coil

178. In certain cases the rack-retaining pin on the iron core of the M.F. RANGE aerial tuning coil of the transmitter has become loose. This defect can be remedied in the manner described in the leaflet A.P.1186/A.140—W. The following is the sequence of operations:—

(i) Remove the screws on the top, bottom and sides of the transmitter securing cover to the transmitter. Withdraw the transmitter.

(ii) Identify the M.F. aerial tuning coil control knob, shown as L_6 on fig. 1. Remove the control knob by unscrewing the single fixing screw (18) at its centre.

(iii) Remove the core retaining strip screwed to the coil former and situated at the back of the transmitter (3, fig. 11). On removing the fixing screw it may be found to be made from an insulating material, if this is the case and it is damaged or broken, it is to be replaced by a 2 B.A. brass screw, cheese head, $\frac{3}{8}$ in. (Stores Ref. 28C/2066).

(iv) Turn the control spindle (1, fig. 11) in a counter-clockwise direction until the rack is out of mesh with the skew gear wheel. Withdraw the core and rack from the back of the coil.

(v) Bind linen thread No. 40 (Stores Ref. 32B/456) tightly around the spindle over the pin securing the rack to the core. This should extend about $\frac{1}{16}$ in. on either side of the pin.

(vi) Cover the linen thread with bakelite or shellac varnish (shellac in methylated spirits Stores Ref. 33A/172).

(vii) Turn the control spindle until the driving pin at the front panel end is horizontal.

(viii) Insert the core and rack to the skew gear wheel. The rack will require guiding into position and this can be accomplished from the right-hand side of the transmitter. Turn the control spindle clockwise applying slight pressure to the core to ensure that the rack is drawn into mesh.

(ix) Replace the control knob and check to ensure that the core travels the whole length of the coil with complete rotation of the control knob between stops. In the fully counter-clockwise position of the control knob, the core should be approximately $\frac{1}{32}$ in. below the back edge of the end of the coil former.

(x) Remove the control knob. If the core does not travel the whole length of the coil, rotate 180 deg. and replace.

(xi) Replace the core retaining strip.

(xii) Replace the transmitter in the screening cover and secure with the screws previously removed.

Transmitter case screws

179. It has been found that the "coin-slot" 4 B.A. screws securing the transmitter to the case are apt, by continued use, to strip their threads. Units have been instructed to replace at the first opportunity, any such stripped screws by the special replacement screws, case securing, coin-slot, $\frac{3}{16}$ in. Whitworth (Stores Ref. 10D/590), demanded from the appropriate Maintenance Unit. Before fitting the new screws, the holes have to be tapped out to $\frac{3}{16}$ in. Whitworth.

Checking after adjustments

180. When replacing a transmitter, the adjustment of the pre-set anode tap should always be checked and set to the position found to be suitable for the aerial system of the aircraft. When replacing a transmitter the position of the carbon electro-magnetic link should be checked either by examination of the link, or by an ohm-meter test at the microphone terminals as outlined in the D.C. resistance tests.

THE POWER SUPPLIES

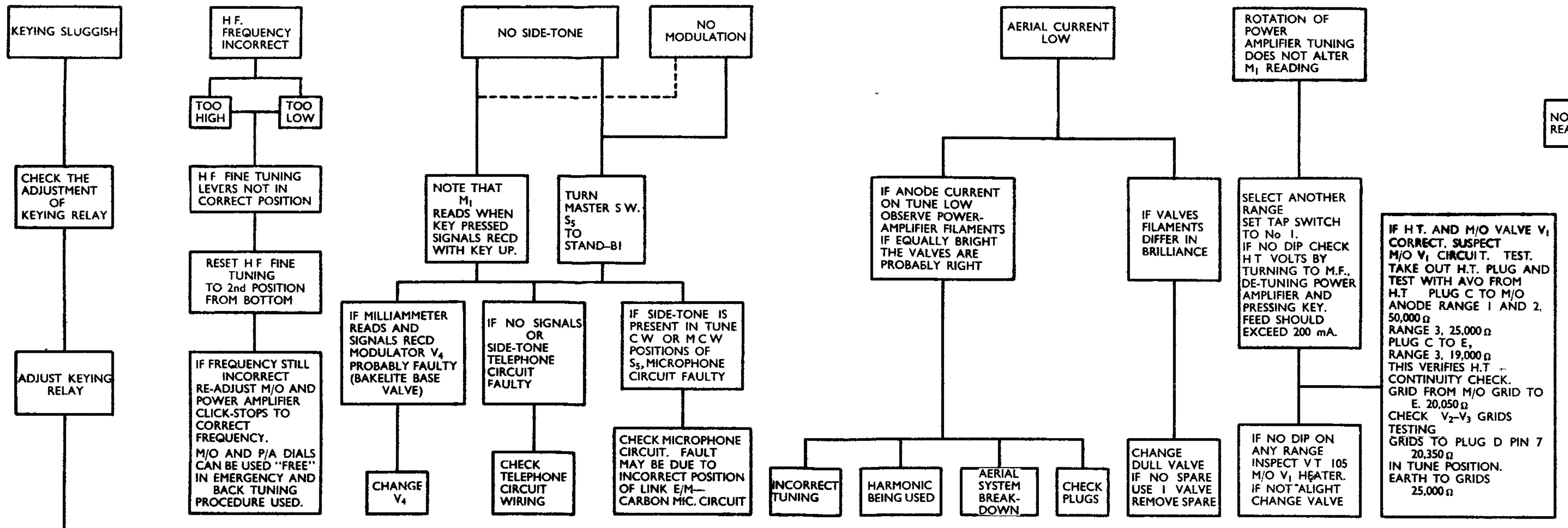
181. The power supplies for the T.1154–R.1155 equipment, when air-borne, are derived from two rotary transformer power units, one for transmitter H.T. and the other for receiver H.T. and all L.T. requirements. The power units are driven by 12-v. or 24-v. accumulators associated with the engine-driven generator of the aircraft. At the introduction of the equipment the five power units which are listed on the TABLE in para. 182 were specified for use but certain modifications to these units have been made to reduce the heavy drain upon the accumulators.

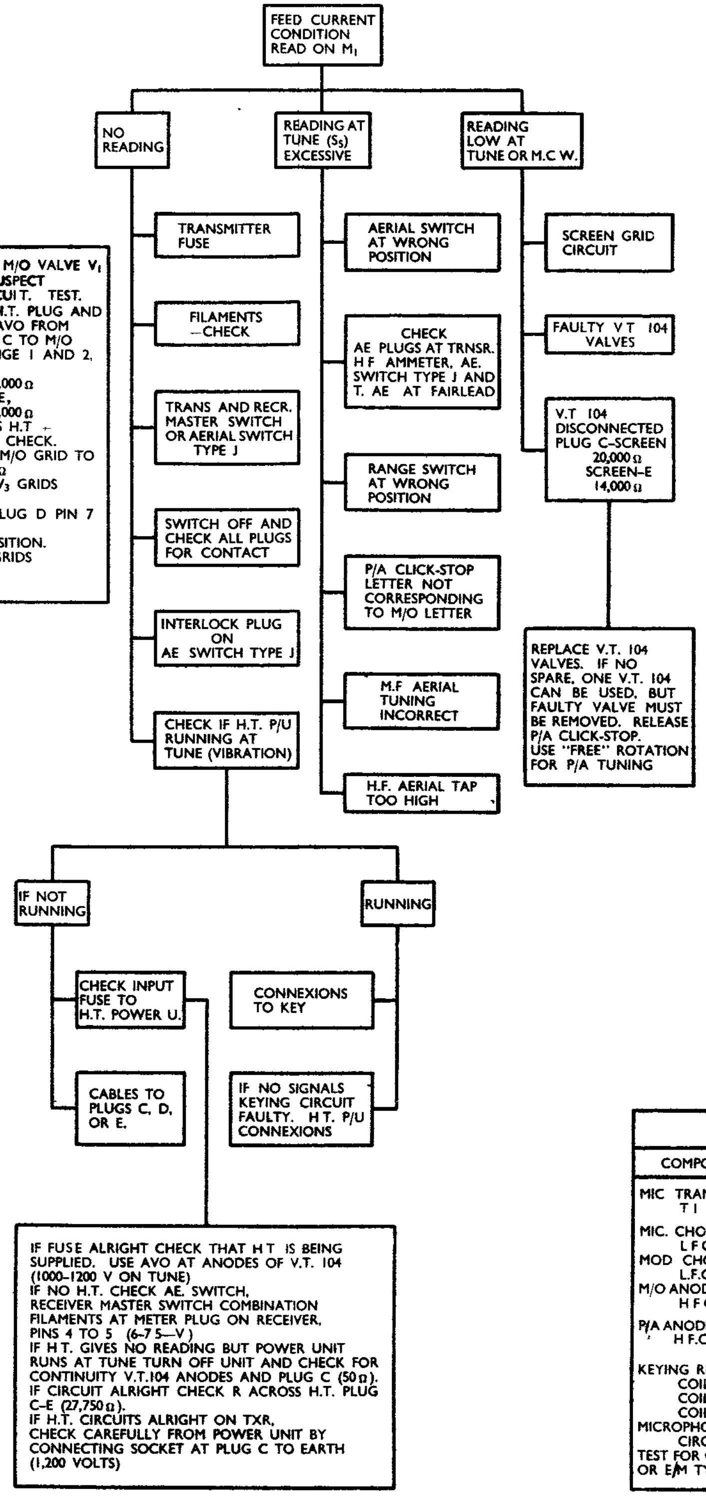
182. The accompanying TABLE K gives the electrical characteristics of all airborne power units, together with the types of rotary transformer used and other relevant details.

TABLE K

ORIGINAL POWER UNITS

Type	32	33	34	34X	35
Stores Ref. No.	10K/17	10K/18	10K/19	10K/61	10K/20
Rotary, transformer type	28	29	30	30X	31
Stores Ref. No.	10K/21	10K/22	10K/23	10K/63	10K/24

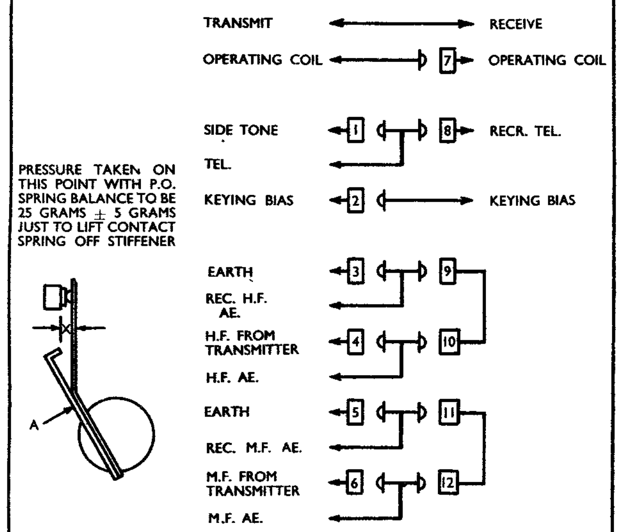




VOLTAGE TESTS		
VOLTAGE	**TEST POINTS**	**VALUE**
L T.	WITHDRAW METER PLUG AND MEASURE ACROSS CONTACTS 4 (NEG) AND 5 (POS)	6–7 8 V
	ALTERNATIVE POINT FROM KEY TO CHASSIS WITH S_5 AT TUNE	
H T.	ANODES OF V_2–V_3 TO CHASSIS	1,100–1,200-V
	GREAT CARE MUST BE TAKEN IN MAKING THIS TEST AND IT IS ESSENTIAL TO CLIP BOTH POSITIVE AND NEGATIVE LEADS TO TEST POINTS BEFORE PLACING S_5 TO TUNE	
	D.C RESISTANCE ACROSS H T AND H T — CHECK BETWEEN PLUG C AND PLUG D PIN 7 SWITCH TO RANGE BLUE OR RED	27,750 ohms

M_1 (FEED METER) CALIBRATION						
METER DEFLECTION	UNIT	TRUE CURRENT mA				
		TAPS 1–9	TAPS 10–11	TAPS 12–13	TAPS 14–15	TAPS 16–17
6 5 DIVS.	± 1 DIV	65	55	45 5	36	26
10 DIVS	± 1 DIV.	100	85	70	55	40
30 DIVS.	± 1 5 DIVS.	300	255	210	165	120

INSTRUCTIONS FOR ADJUSTMENT OF THE MAGNETIC RELAY, TYPE 85



CONTACT NO	GAP "X"	CONTACT NO	GAP "X"	CONTACT NO	GAP "X"
1	0 048" (18G)	5	0 048" (18G)	9	0 048" (18G)
2	0 028 "(22G)	6	0 048" (18G)	10	0 048" (18G)
3	0 048" (18G)	7	0 064" (16G)	11	0 048" (18G)
4	0 048" (18G)	8	0 028" (22G)	12	0 048" (18G)

NOTE—ADJUSTMENTS ARE TO BE MADE BY SETTING THE SCREW CONTACTS Nos. 1–12 TO THE REQUIRED POSITIONS AS INDICATED. ON NO ACCOUNT SHOULD THE STIFFENER STRIPS "A" BE BENT TO FACILITATE ADJUSTMENT. A SUITABLE TYPE OF GAUGE CAN BE MADE FROM A 3 in. LENGTH OF PIANO WIRE OF CORRECT DIAMETER, BEND THE WIRE AT 90 AT 5/16 in. FROM ONE END.

CIRCUIT CONTINUITY TEST				
STAGE	**CIRCUIT**	**S_5 AT**	**TEST POINTS**	**VALUE**
V_2–V_3 POWER AMPLIFIER	SUPPRESSOR GRID CIRCUITS	TUNE	SUPPRESSOR GRID, CENTRE PIN, PLUG D, PIN 7	SHORT-CIRCUIT
	,, ,,	C.W	,, ,, ,, ,,	7,000
	,, ,,	M C.W., R/T	,, ,, ,, ,,	5,000
	,, ,,	Tune	SUPPRESSOR GRID, CENTRE PIN TO EARTH	5,350
	,, ,,	C.W	,, ,, ,,	2,000
	,, ,,	M C.W , R/T	,, ,, ,,	10,350
	CONTROL GRID CIRCUITS	TUNE, M.C.W , R/T	CONTROL GRID TO PLUG D, PIN 7	20,350
	,, ,,	C.W.	,, ,, ,,	20,000
	,, ,,	M.C W., R/T	,, EARTH	25,000
	ANODE CIRCUITS	ALL POSITIONS	ANODE CAP TO PLUG C	50
	SCREEN CIRCUITS	ALL POSITIONS	SCREEN PIN TO EARTH	14,000
			,, PLUG C	20,000
			,, JUNCTION R_4–R_7	SHORT-CIRCUIT
V_1 (M/O)	ANODE CIRCUITS	BLUE/RANGES	ANODE TO PLUG C	50,000
		RED	,, ,,	25,000
		YELLOW RANGE	,, EARTH	19.000
		YELLOW RANGE	CATHODE TO EARTH	SHORT-CIRCUIT
	CATHODE	ALL POSITIONS	GRID TO EARTH	20,100
	GRID	ALL POSITIONS	GRID TO PIN 14 PLUG B RELAY TO TRANSMIT	15,100
V_4 MOD.—SIDE TONE	ANODE	ALL POSITIONS	ANODE TO PLUG C (R_6 REMOVAL FOR THIS TEST)	75,000
	CATHODE	ALL POSITIONS	CATHODE TO EARTH	800
	GRID	ALL POSITIONS	GRID TO EARTH	13.000
		ALL POSITIONS EXCEPT C.W.	PIN 7 PLUG D TO PIN 14 PLUG B	350
		C W.		SHORT-CIRCUIT
		C W	PIN 14 PLUG B TO PIN 15 PLUG B RELAY TO TRANSMIT	5,000
		R T	PIN + MIC. TO EARTH LINK SW. TO CARBON MIC	25
		R.T.	PIN + MIC. TO EARTH LINK SW. TO E/M MIC.	7
		R T.	PIN + MIC TO PIN 6 PLUG D LINK SWITCH CARBON, MIC. SW. FOR R/T	29

D C. RESISTANCE OF COMPONENTS		
COMPONENT	**TEST POINTS**	**RESISTANCE OHMS.**
MIC TRANS. T 1	PRIMARY	7
	SEC. R 13–EARTH	5,000
MIC. CHOKE L F C.3	ACROSS JOINT R27, R28 and C26	11
MOD CHOKE L.F.C 2	C_8 TO C_{21}	130
M/O ANODE CHOKE H F C 2	R_3 TO C_{18}	10
P/A ANODE CHOKE H F.C 1	ANODE V_2–V_3 TO S_2 ANODE SECT. MOVING ARM	45
KEYING RELAY		
COIL A	POS + TO NEG	12
COIL B	OPERATING COIL CONTACT TO POS — 1	1 5
COIL C	POS. + 2 TO "KEY"	2 1
MICROPHONE CIRCUIT	POS. + MIC TO EARTH LINK TO E/M SWITCH TO R/T	7
TEST FOR CARBON OR E/M TYPE	POS + MIC TO PIN 6 PLUG D LINK TO CARBON SWITCH TO R/T	29

FIG. 19

TROUBLE LOCATION CHART

FIG. 19

PP1949 M23920/700 12/42 13000 C & P Gp. 959 (4)

TABLE K (*contd.*)

Type	32	33	34	34X	35
Weight, lbs.	30$\frac{1}{4}$	29	28$\frac{1}{2}$	28$\frac{1}{2}$	27$\frac{1}{2}$
Nominal rating, watts	240	240	115	115	115
Ambient temp. range	– 40° C. to + 45° C.	– 40° C. to + 45° C.	– 40° C. to + 45° C.	– 40° C. to + 45° C.	– 40° C. to + 45° C.
Maximum ripple per cent. R.M.S.	1 on L.T.	1 on L.T.	1 H.T. 2$\frac{1}{2}$ L.T.	1 H.T. 2$\frac{1}{2}$ L.T.	1 H.T. 2$\frac{1}{2}$ L.T.
Voltage reg. n per cent.	18	18	20 H.T. 25 L.T.	20 H.T. 25 L.T.	20 H.T. 25 L.T.
Efficiency per cent. better than	60	60	50	50	50
Input voltage— Nominal	12	24	12	14	24
Actual	13·2	27·4	10·3	14	18·5
Rated outputs D.C.	1,200 v. 200 mA	1,230 v. 200 mA	217 v., 110 mA 7 v., 13 A	245 v., 110 mA 8·1 v., 13 A.	217 v., 110 mA 7 v., 13 A.

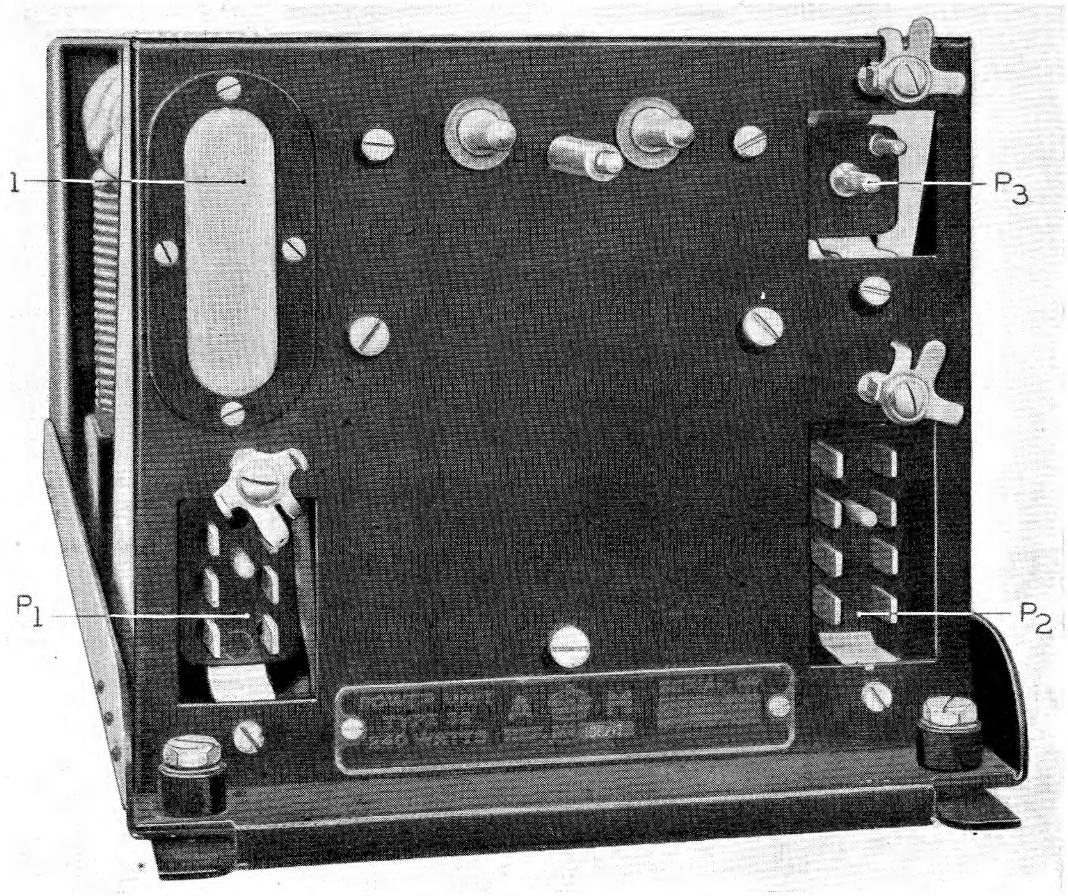


FIG. 20.—POWER UNIT, TYPE 32

183. In certain aircraft the L.T. power was derived from the power unit, type 34X. The input was "boosted" by switching IN and OUT of circuit a 2-volt 20-Ah accumulator in step with the OFF and ON charge condition of the main engine-driven generator. This condition differed from that applying to the type 34 which has a resistance unit, type 47 (*see* para. 196) in series with the input, this resistance being switched IN and OUT of circuit in step with the OFF and ON charge condition of the generator. The type 34K may now be regarded as obsolescent.

184. A leaflet A.P.1186/M detailed the procedure to be adopted when replacing the type 34X by a type 34 power unit. For record purposes the sequence of operations is herein repeated:—

(i) Disconnect and remove the 2-volt "boost" accumulator from the aircraft.

(ii) Mount the resistance unit, type 47 in a suitable position on the airframe. The site chosen should be a well-ventilated one and should be as close to the run of the existing leads as possible. The resistance unit is to be secured to the airframe by means of 2 B.A. screws, nuts and washers.

(iii) Connect the resistance unit, type 47, a switch, type 378 and the power unit, type 34 in the manner shown on the diagram included in fig. 25a.

(iv) Remove and reverse the switch label engraved "Boost cell OUT–IN". Engrave on the blank side the inscription "Resistance OUT–IN" ensuring that the words "OUT" and "IN" correspond to the setting of the switch which removes and inserts the resistance, type 47 in the L.T. supply lead. The considerations applicable to the critical setting of the resistance are dealt with later in this chapter.

185. Certain conditions imposed a modification of the power units and the two-step system of starting, originally arranged, has been eliminated. The modification merely consisted in permanently screwing up the relay contact adjustment of the single contact winding that when the relay armature is actuated the full input voltage is applied straight across the motor. The initial transitory starting voltage becomes therefore of the order of 100 amps. in the 12-volt type and 70 amps. in the 24-volt type instead of about 2 amps. above the normal running current. This running current is approximately 12-volts, 32 amps. or 24-volts, 16 amps. for the H.T. machine and 12-volts, 24 amps or 24-volts, 12 amps for the L.T. machine.

186. The illustration of fig. 20 shows a front view of a power unit. Interior views are in figs. 23 and 24. A circuit diagram of the H.T. types is shown in fig. 21. A circuit diagram of the L.T. types is shown in fig. 22. These two diagrams incorporate the modifications involved in the further "A" versions of the units which are designed, primarily, for use in installations wherein two receivers, type R.1155 are employed. These modifications, which are described in para. 195, involve the fitting of an additional four-point input socket Sk_2 and a relay REL_2 associated with it, in the L.T. unit and a single-pole socket Sk_2 in the H.T. unit. All units are screened to reduce direct radiation interference with radio apparatus.

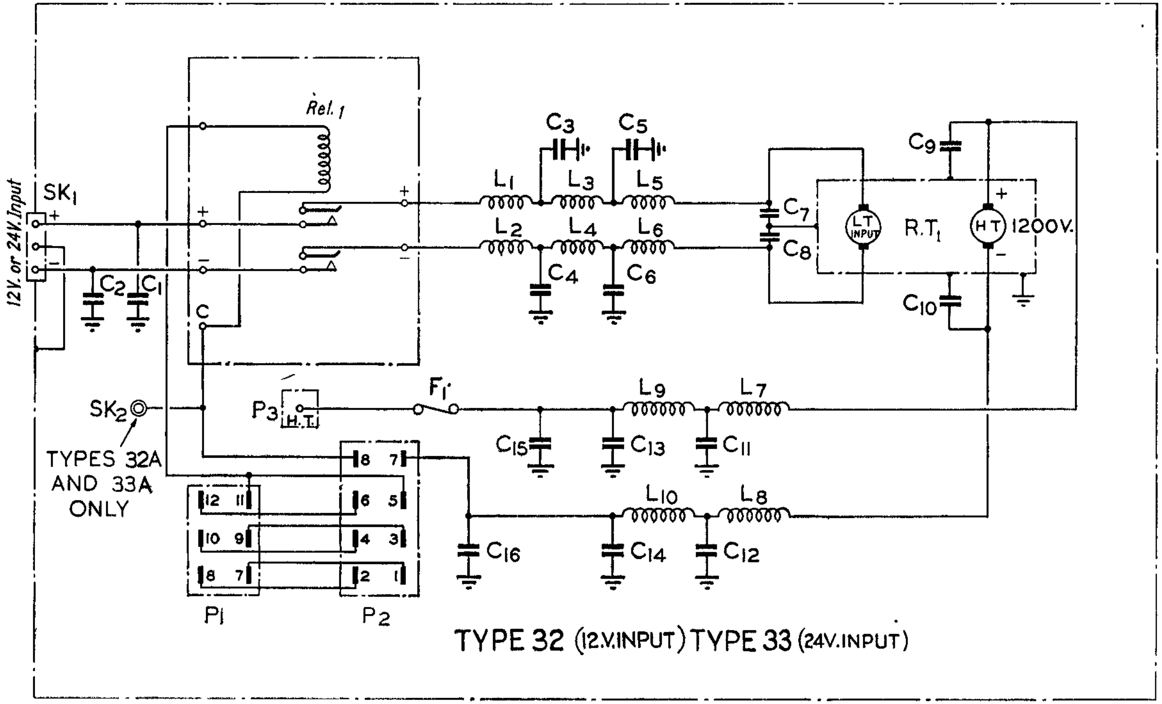
187. When the starter relay contacts of REL_1 are made, the D.C. input to the types 32 or 33 is applied, directly to a symmetrical composite R.F. filter circuit in both positive and negative lines. Each filter circuit is in effect, three series R.F. choke coils L_1–L_3–L_5 and L_2–L_4–L_6 with condensers between the line and earth. The filtered input appears across two series condensers C_7 and C_8 and the junction of these is connected to the case of the rotary transformer.

188. The rotary transformer is of the open-end type with the H.T. and L.T. armature windings wound on a common armature core, a low resistance shunt field winding being provided. A small series field winding is also incorporated to reduce starting torque. The instrument is designed to give an H.T. voltage as free as possible from commutator ripple which does not exceed 1 per cent. RMS on light load. A cooling fan is mounted on the input end. The L.T. brushes have independent pressure adjustment and both H.T. and L.T. brushes are adjustable for commutating position. The overall efficiency is at a minimum 60 per cent.

189. The output of the machine is taken through a composite filter composed of L_7, L_9, C_9, C_{11}, C_{13} in the positive lead and L_8, L_{10}, C_{10}, C_{12}, C_{14} in the negative lead, each of these condensers having a capacity of 0·004 μF. Two further condensers C_{15} and C_{16} are connected from H.T.+ and H.T.— respectively to earth. The H.T. positive is taken to a single point plug P_3, and H.T. neg. to pin 7 of the eight-point Jones plug P_2.

The L.T. power units

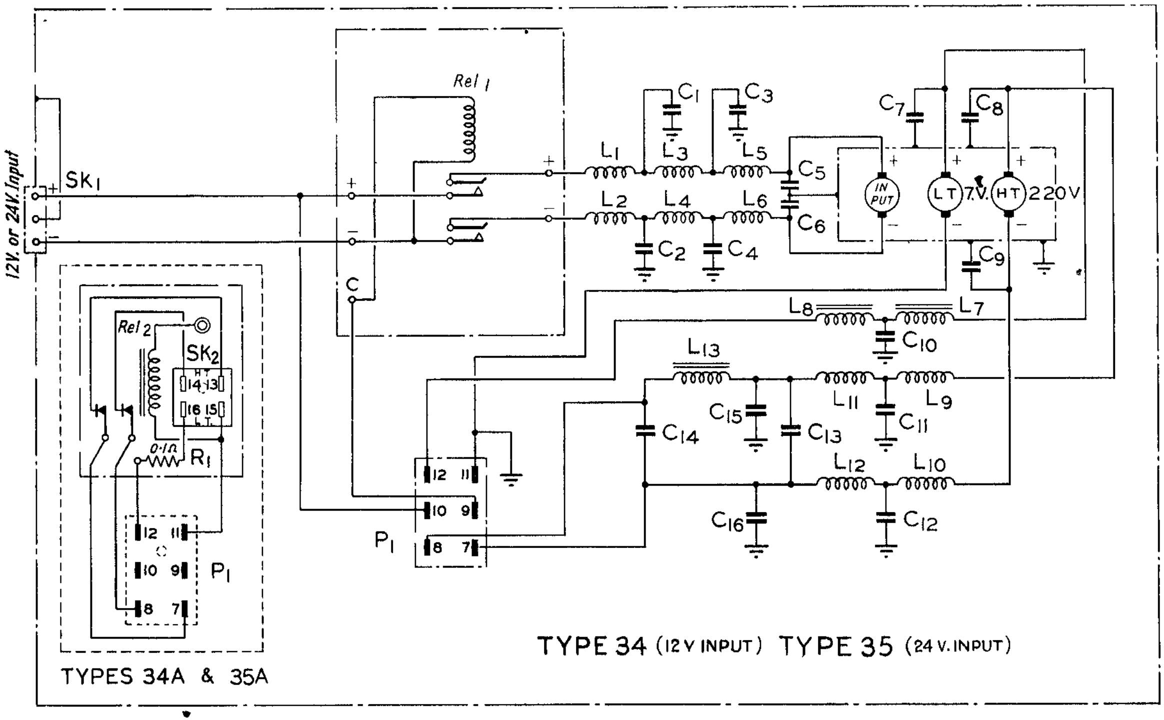
190. The units, types 34 and 35, have the D.C. input applied through starter relay REL_1 contacts to a composite filter circuit consisting of three series choke coils and three condensers in each line to the rotary transformer input.



CONDENSERS			
ANNOT'N	VALUE µF	TYPE	STORES REF. No.
C_1 to C_4	4	1058	10C/2240
C_5 to C_8	2	1057 or 1666	10C/2239 10C/3404
C_9 to C_{14}	0·004	1055	10C/2237
C_{15} C_{16}	0·25	945	10C/2040

FUSE			
F_1	750mA	33	10H/321

FIG. 21.—CIRCUIT DIAGRAM—H.T. POWER UNIT



CONDENSERS			
ANNOT'N	VALUE μF	TYPE	STORES REF. No.
C_1 C_2 C_{10}	4	1058	10C/2240
C_3 to C_7	2	1057 or 1666	10C/2239 10C/3404
C_8 C_9 C_{11} C_{12}	0·01	440	10C/10629 or 10C/8496
C_{13}	2	652	10C/288
C_{14}	4	484	10C/10825
C_{15} C_{16}	0·1	851	10C/800

RESISTANCE			
R_1	0·1Ω	2044	10C/5828

FIG. 22.—CIRCUIT DIAGRAM—L.T. POWER UNIT

191. The rotary transformer is of the open-end type with H.T. and L.T. armature output windings and the L.T. input winding wound on a common armature core, an L.T. shunt field winding being provided. A small series field winding is also provided to reduce the starting current to a reasonable value. The L.T. negative brush is permanently connected to the frame of the machine. The overall efficiency is, at a minimum, 50 per cent.

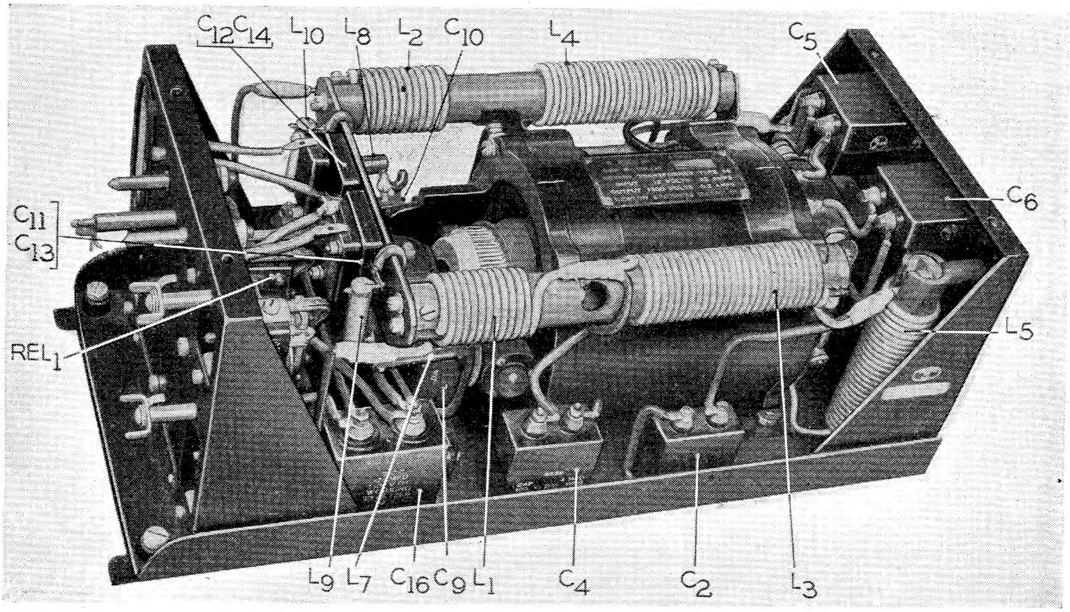


FIG. 23.—POWER UNIT, TYPE 32, INTERIOR VIEW

192. The L.T. output circuit from the transformer is smoothed in the positive line by a filter section comprising two choke coils and condensers C_7 (2 μF) and C_{10} (4 μF) connected to earth. The negative line is earthed so no filters are necessary. This output appears across the points 12 and 11 of a six-pole plug P_1. The H.T. output circuit is filtered by the filter C_8, L_9, C_{11}, L_{11} and C_9, L_{10}, C_{12}, L_{12} each condenser of 0·1 μF capacitance being connected to earth. The output appears across a 2 μF condenser C_{13} and is further filtered to earth by C_{15} and C_{16} (each of 0·1 μF) and passed to an iron-cored inductance L_{13} and a 4 μF condenser C_{14} to appear at the pins 7 (negative) and 8 (positive) of the Jones plug P_1. The illustration of fig. 24 shows an interior view of the L.T. power units.

193. The development of a separate navigator-operated receiver R.1155 necessitated a further modification to the power units and these variations, which were originally service modified, now constitute the production versions which can substitute for the original types. The modifications have not been mentioned in para. 175 but are incorporated in the diagrams of figs. 21 and 22. The gauze window (1, fig. 1) is cut away for accommodation of the modifications in both cases.

Power units, types 32A, 33A, 34A and 35A

194. The production models of the navigator-operator installations power units are the type 32A (Stores Ref. 10K/13063), type 33A (Stores Ref. 10K/13084), type 34A (Stores Ref. 10K/13065) and type 35A (Stores Ref. 10K/13066). The relay unit REL_2 of the L.T. type is connected in parallel with the starter relay winding of the H.T. power unit. As soon as the latter is started up, the winding of the relay is enlarged and the H.T. supply to the additional receiver, type R.1155 is interrupted by the closing of the relay unit contacts.

195. The following is the sequence of operations when effecting the service modifications which correspond to the types mentioned:—

Modifications to L.T. power units, types 34, 34X and 35

(i) Remove the top cover of the power unit.

(ii) Remove the four screws and nuts securing the escutcheon and gauze over the vent hole in the top left-hand corner of the power unit front panel.

(iii) Remove the nut and screw located near the vent hole which secures one corner of the L.T. starter relay.

(iv) Mount the plug retaining clamp (Stores Ref. 10K/371) on the front panel of the power unit in accordance with fig. 25 securing it by the screw and nut removed in operation (iii).

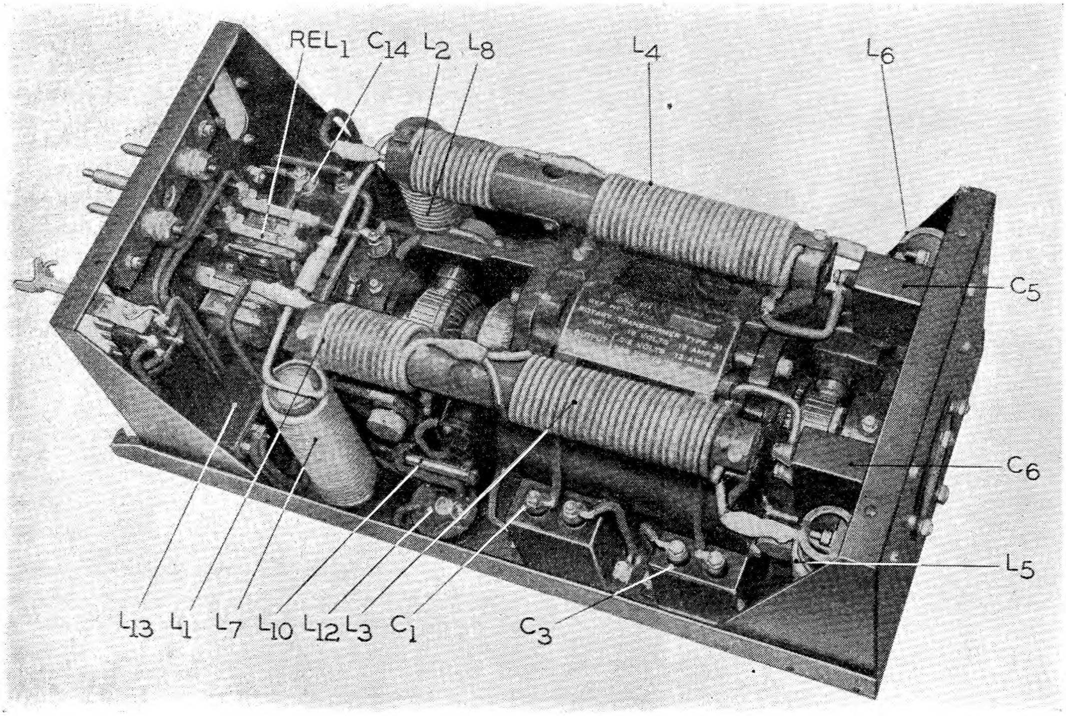


FIG. 24.—POWER UNIT, TYPE 35, INTERIOR VIEW

(v) Mount the relay unit, type 19 (Stores Ref. 10F/723) behind the front panel of the power unit in accordance with the drawing, replacing the escutcheon, but not the gauze, and using two of the screws removed in operation (ii) to secure the unit.

(vi) Use 16 s.w.g. tinned copper wire (Stores Ref. 5E/1778) encased in insulating tubing (Stores Ref. 5E/1793) connect the relay unit, type 19 to the 6-way plug P_1 type 206 (Stores Ref. 10H/426) on the front panel of the power unit in accordance with the drawing. The plug, type 206 and the socket Sk_2 of the relay unit are assumed to be viewed from behind the front panel of the power unit. These connections are summarized as follows:—

- (*a*) Connect spill 12 of the plug, type 206 to the free end of the 0·1-ohm resistance R_1 mounted on the relay unit.
- (*b*) Connect spill 11 of the plug, type 206 to spill 15 of the socket Sk_2 on the relay unit.
- (*c*) Connect spill 7 of the plug, type 206 to the relay contact A, i.e. the contact making to spill 13 of the socket.
- (*d*) Connect spill 8 of the plug, type 206 to the relay contact B, i.e. the contact making to spill 14 of the socket.

(vii) Replace the top cover of the power unit.

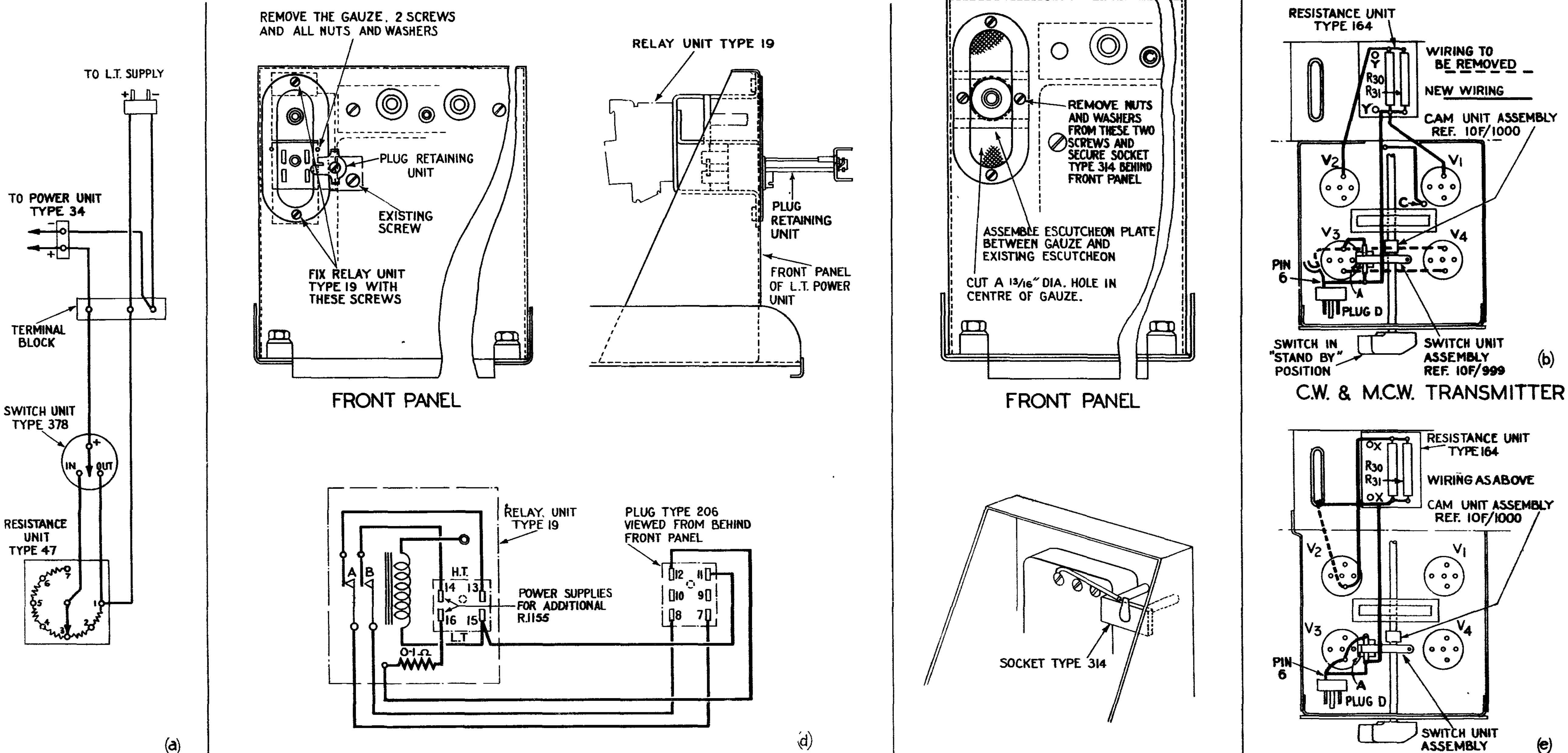
Modifications to H.T. power units, types 32 and 33

(viii) Remove the top cover of the H.T. power unit.

(ix) Cut a $\frac{13}{16}$ in. dia. hole in the gauze covering the vent hole and mount the socket, type 314 (Stores Ref. 10H/1802) behind the front panel of the power unit in accordance with the drawing.

(x) Use 16 s.w.g. tinned copper wire encased in insulating tubing, connect a lead between the socket, type 314, and terminal C of the H.T. starter relay as shown in the drawing.

(xi) Replace the top cover of the power unit.



MODIFIED L.T. SUPPLY

CONNEXIONS OF RELAY UNIT TO PLUG TYPE 206
L.T. POWER UNIT

INTERIOR
H.T. POWER UNIT

R.T., C.W. & M.C.W. TRANSMITTER
TRANS. FIL. CIRCUITS

DIAGRAM OF MODIFICATIONS TO TRANSMITTERS AND POWER UNITS

FIG. 25

FIG. 25

PP1949 M23920/700 12/42 15000 C & P Gp. 959 (4)

Resistance units, types 47 and 52

196. Since the voltage of the aircraft accumulators will alter between charge and no-charge conditions a resistance cut-in arrangement is included in the circuit between the starter accumulator and the L.T. power units, types 34, 34A, 35 or 35A. This compensates for the variation and an adjustment is provided to maintain the filament voltage between 6 and 7·8 volts. The resistance unit is included on the typical installation diagram fig. 18. The resistance is switched in and out of circuit by means of an auxiliary relay, type 219 (Stores Ref. 10F/493) on 12-volt systems or by relay type 220 (Stores Ref. 10F/220) on 24-volt systems. The resistance unit type 47 is designed for 12-volts and the unit type 52 for 24-volts.

197. The relay is energized from the starter battery *via* an extra contact on the charging cut-out. When the cut-out is closed, that is when the accumulator is being charged, the voltage is above normal and the resistance is in circuit to reduce the input voltage of the L.T. power unit to the normal figure obtained when the accumulator is not being charged.

198. When the accumulator is not being charged the auxiliary relay is not energized and the resistance unit is out of circuit. On certain aircraft the resistance unit is placed in circuit manually by means of a switch instead of automatically and precautions should be taken to ensure that the operator clearly understands its manipulation.

199. With the type 47 resistance there is no resistance permanently in circuit and the necessary amount is switched in when the aircraft is in flight. With the type 52 resistance a certain amount of the resistance is always in circuit. To determine the correct value of resistance, tests should be made, firstly on the ground and, secondly in the air, with the aircraft main electrical generator delivering its normal voltage.

Adjusting

200. With the installation completely connected, aircraft accumulators on charge and the whole of the resistance in circuit, that is, connections to resistance on terminals 1 and 6, the following procedure should be adopted:—

(i) Remove the fan-point socket from right-hand side of the transmitter.
(ii) Switch on transmitter to TUNE.
(iii) Measure voltage at terminals of the accumulator supplying current to the L.T. power unit.
(iv) Measure transmitter L.T. voltage by connecting voltmeter between positive terminal of the morse key and any convenient earthed point on the transmitter as, for example, the pillars holding the plug retaining clip.
(v) From the TABLES, given below, note the transmitter L.T. voltage as measured at (iii) above.
(vi) Adjust resistance to the tap shown at the head of the column in which the transmitter L.T. voltage occurs.

201. As an example, suppose the accumulator voltage as measured at (iii) is 14·5 volts and the transmitter L.T. voltage as observed at (iv) is 7·4 volts, then connexion on resistance to terminal 6 should be moved to terminal 5. If, however, the transmitter L.T. voltage was 7·5 volts, or higher, the connexion should be left on terminal 6.

202. The following TABLES L and M are supplied for the purpose of the above adjustment tests.

TABLE L

RESISTANCE UNIT, TYPE 47, 12-VOLT.

Accumulator voltage	TRANSMITTER L.T. VOLTAGE			
	Terminal 6	Terminal 5	Terminal 4	Terminal 3
12·2	6·0	5·9	5·8	5·7
12·5	6·2	6·1	6·0	5·9
12·75	6·35	6·25	6·15	6·05
13·0	6·5	6·4	6·3	6·2
13·25	6·65	6·55	6·45	6·35
13·5	6·8	6·7	6·6	6·5
13·75	7·0	6·9	6·8	6·7
14·0	7·15	7·05	6·95	6·85
14·25	7·35	7·25	7·15	7·05
14·5	7·5	7·4	7·3	7·2
14·7	7·6	7·5	7·4	7·3
15·0	7·8	7·7	7·6	7·5

RESISTANCE, TYPE 52, 24-VOLT

Accumulator voltage	TRANSMITTER L.T. VOLTAGE		
	Terminal 6	Terminal 5	Terminal 4
24·0	5·85	5·75	5·65
24·5	6·02	5·92	5·82
25·0	6·2	6·1	6·0
25·5	6·35	6·25	6·15
26·0	6·5	6·4	6·3
26·5	6·65	6·55	6·45
27·0	6·8	6·7	6·7
27·5	6·95	6·85	6·75
28·0	7·1	7·0	6·9
28·5	7·25	7·15	7·05
29·0	7·4	7·3	7·2
29·5	7·55	7·45	7·35
30·0	7·7	7·6	7·5

203. The standard auxiliary switching relay is the type 219 for 12-volts and type 220 for 24-volts operation. The contacts are arranged so that, on the ground, with the winding non-energized, they are closed and pass the whole of the input current. When, in the air, the winding is energized, the contacts open and the current is applied through the resistance unit.

204. To obviate placing the onus of switching the resistance, in or out of circuit, upon the operator, which would be the case if the relay winding (which consumes the negligible current of approximately 1 amp.) were connected across the main supply and operated by a series wired tumbler switch, the standard electrical cut-out has been modified to include another contact.

205. The contact is marked AUXILIARY or W/T, and when the cut-out closes, this additional contact is connected to the positive supply. Thus, by connecting the winding of the relay, type 219 or 220, between the supply or generator negative and the auxiliary contact the relay is actuated at the same time as the cut-out magnet, that is, the cut-out and the relay are in parallel.

206. If the cut-out, type E or type F is not fitted the switch box type B, 1 unit (Stores Ref. 5C/543) and lead is wired to G+ terminal in the cut-out instead of W/T.

207. The relay, type 219 or type 220 should be mounted where it is not likely to experience much vibration as it is not of very robust construction.

208. The current taken by the L.T. power unit is considerable and the varying lengths of L.T. cable peculiar to varying installations on aircraft may affect the resistance values. It is necessary, therefore, to carry out a type 52 resistance test on each *type* of aircraft.

209. When the transmitter is connected to the self-regulating generator in accordance with A.P.1095/D6, the resistance unit, type 47 or 52, will not be included in the circuit except in those installations which are manually switched. The absence of this resistance is liable to shorten the life of the valves. To reduce risk of failure, instructions for the use of the switch in A.P.1095, Vol. I, Sect. V, Chap. 8, para. 26, should be strictly followed. At the conclusion of any flight in which the emergency connexion has been used, all the transmitter and receiver valves should be replaced.

210. The oilers in the power unit rotary transformers are similar in appearance to greasers but grease should not be used. Instructions have been promulgated in the leaflet A.P.1095/G51—W for removal of the existing oilers and for their replacement by felt plugs which are to be saturated in oil (Stores Ref. 34A/60). The plugs are to be given 5 drops of oil at intervals of, approximately, 30 hours flying.

APPENDIX 2

TRANSMITTERS, Type T.1154F, G, H, J, K, L, M, N, and P

1. The above transmitters are all variants of the basic T.1154 series. They are, for the most part, electrically similar to the type from which they have been developed. Physically there are differences, brought about, in some versions, by the use of the new type click-stop mechanism referred to in para. 121 of this chapter. This type is now known as the uniclick as opposed to the older version, the multiclick. A general view of the transmitter with new click stop mechanism is shown in fig. 26.

2. The following list of transmitters, stores reference numbers and basic types from which developed, is supplied for reference:—

Transmitter type	*Stores Ref. No.*	*Basic type*	*Comments*
T.1154F	10D/893	T.1154B	Modified. Electrically the same as T.1154C. Aluminium case. Old type click-stop mechanism.
T.1154G	10D/1179	T.1154B	With new click-stop mechanism. Aluminium case.
T.1154H	10D/1180	T.1154F	With new type click-stop mechanism.
T.1154J	10D/1329	T.1154B	Steel case.
T.1154K	10D/1330	T.1154F	Steel case.
T.1154L	10D/1455	T.1154N (below)	Range 5·5–10·0 Mc/s is replaced by range 1·5–3·0 Mc/s. Designed for A.S.R. launches.
T.1154M	10D/1587	T.1154F	Steel case. New click-stop mechanism.
T.1154N	10D/1588	T.1154B	Steel case. New click-stop mechanism.
T.1154P	10D/1668	T.1154L	Aluminium case. Old click-stop mechanism. Unlikely to be brought into Service use. Only experimental models produced.

Setting up the new click-stops

3. In the multi-click type mechanism (see para. 121) the method of selection was to rotate the dial until the pip bearing the letter of the required Range became engaged in the slot. This entailed a careful watch through the aperture to ensure that the correct letter was engaged. In the uniclick type mechanism the setting-up operation is facilitated by the provision of a small selector switch mounted on the left-hand corner above the coloured dial and replacing the release controls (5), (6), (7), (8), and (9) shown on fig. 1.

4. The dial of the selector switch is lettered. The pointer is turned to the required Range letter. The click stop is then engaged by turning the coloured knob until engagement is felt. The screw above the letter embossed on the dial is loosened and the transmitter tuned as indicated in the body of this chapter.

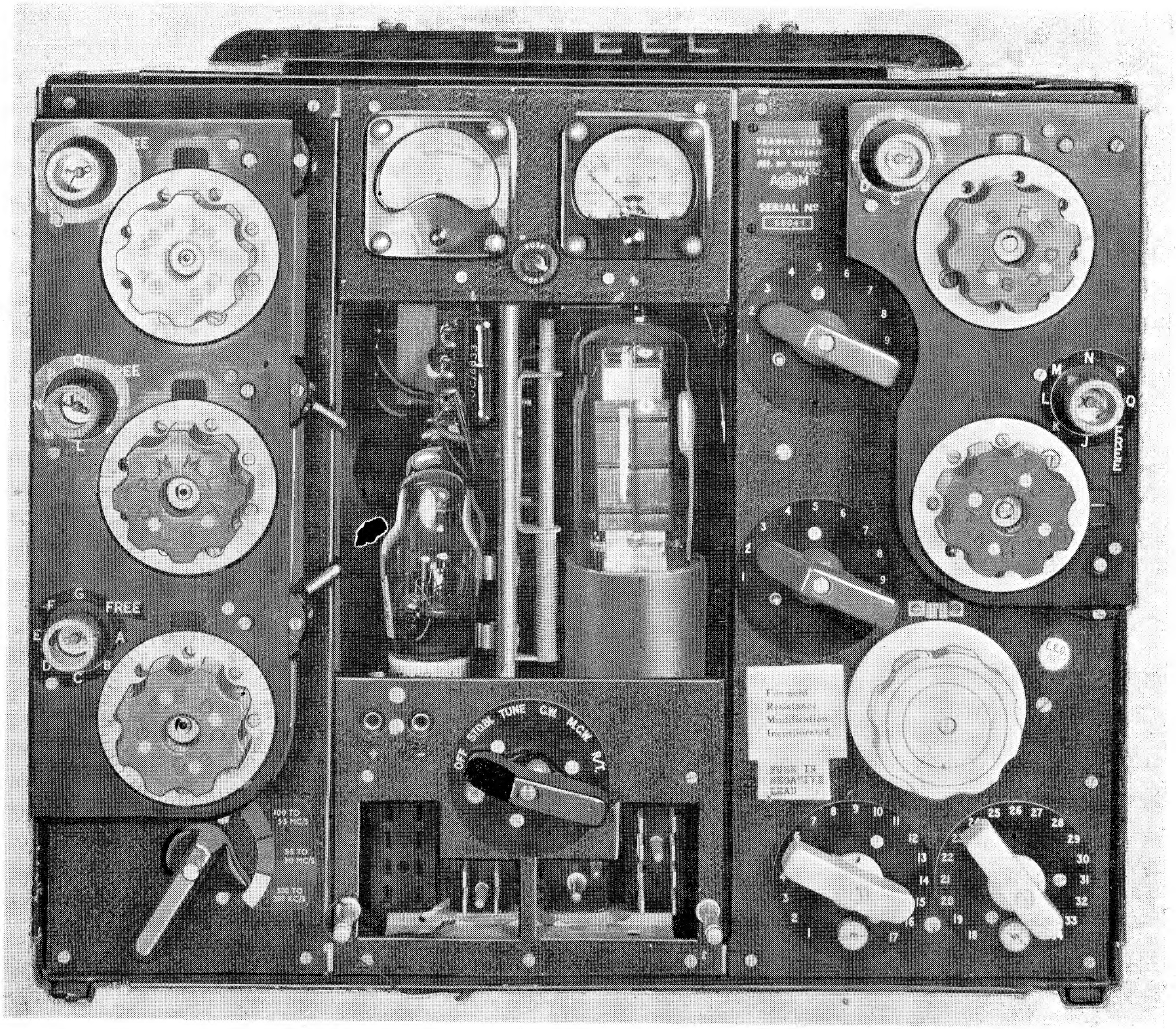


Fig. 26.—Typical transmitter fitted with uniclick stop mechanism

APPENDIX I.

NOMENCLATURE OF PARTS

The following list of parts is issued for information only. When ordering spares for these transmitters the appropriate section of AIR PUBLICATION 1086 must be used.

Ref. No.	Nomenclature	Qty.	Ref. in fig. 5	Remarks
10D/97	Transmitter, T.1154	1		R/T, C.W., and M.C.W., ORIGINAL VERSION
	Principal components.—			
10A/12162	Ammeter, thermo, type A	1	M_2	0 to 3·5 A.
	Assembly			
10D/112	Click lever, compensating	2		
10D/113	Click lever, non-compensating	3		
10D/114	Click ring, A–H	2		
10D/115	Click ring, J–R	2		
10D/116	Click ring, S–Z	1		
	Choke, H.F.			
10C/2054	Type 86	1	HFC_2	
10C/2087	Type 88	1	HFC_1	
	Choke, L.F.			
10C/579	Type 46	1	LFC_2	
10C/581	Type 48	1	LFC_3	
	Condenser			
10C/8496	Type 188 (or 10C/3103)	2	C_{11}, C_3	0·01 μ F
10C/437	Type 705	1	C_{21}	0·5 μ F
10C/965	Type 897	2	C_9, C_{25}	0·001 μF
10C/2018	Type 942	1	C_1	10 μμF
10C/2038	Type 943	2	C_5, C_6	0·0002 μF
10C/2039	Type 944	1	C_7	50 μμF
10C/2040	Type 945	1	C_8	0·25 μF
10C/2041	Type 946	1	C_{10}	0·0002 μF
10C/2042	Type 947	2	C_{12}, C_{20}	0·004 μF
10C/2043	Type 948	1	C_{14}	0·004 μF
10C/2044	Type 949	2	C_{18}, C_{19}	0·005 μF
10C/2045	Type 950	3	C_{22-24}	0·0003 μF
10C/2086	Type 976	1	C_3	6 μμF
10C/3103	Type 1503 (or 10C/8496)	2	C_{11}, C_{13}	0·0085 to 0·05 μF
10D/117	Drive unit, type 2	1		
	Fitted with:—			
	Assembly			
10D/112	Click lever, compensating	1		
10D/113	Click lever, non-compensating	1		
10D/114	Click ring, A–H	1		
10D/115	Click ring, J–R	1		
10D/116	Click ring, S–Z	1		
	Scale			
10D/205	RANGE 1	1		
10D/206	RANGE 2	1		
10D/207	RANGE 3	1		
10D/208	Disc, marking	3		
	Condenser			
10C/2018	Type 942	1	C_1	
10C/2044	Type 949	1	C_{18}	
10C/2086	Type 976	1	C_3	
	Resistance			
10C/677	Type 868	1	R_{26}	
10C/1042	Type 1042	2	R_1, R_2	
10H/321	Fuse, type 33	1	F_1	750 mA
	Holder			
10H/2169	Fuse, type 45	1		
10H/325	Valve, type 50	4		Five-pin
10D/106	Magnifier-unit, type 1	1		With var. cdrs. and coils
10A/12140	Milliammeter, type D	1	M_1	0 to 300 mA

Ref. No.	Nomenclature	Qty.	Ref. in. fig. 5	Remarks
	Transmitter T.1154 (*contd.*)			
	Principal components (*contd*)			
10D/108	Output-unit, type 2	1		Metal panel, *fitted with*.—
				1 off item 10D/106
				1 off item 10D/110
				2 off item 10D/113
				1 off item 10D/114
				1 off item 10D/115
				2 scale, 0D/204
	Plug			
10H/324	Type 195	1	B	Four-point
10H/430	Type 207	1	C	Single point
10H/437	Type 211	1	E	Four-point
10H/438	Type 212	1	D	Eight-point
10F/151	Relay, magnetic, type 85	1	REL_1	Keying with 5 m. 5 b. contacts
				Fitted with:—
				Contact relay
				Moving, 10F/285
				Fixed, 10F/295
	Resistance			
10C/677	Type 868	1	R_{26}	510 ohms
10C/851	Type 934	1	R_{25}	51 ohms
10C/877	Type 942	1	R_{24}	5,100 ohms
10C/1042	Type 1042	2	R_1, R_2	51,000 ohms
10C/1043	Type 1043	1	R_3	50,000 ohms
10C/1044	Type 1044	1	R_4	20,000 ohms
10C/1045	Type 1045	2	R_5, R_6	75,000 ohms
10C/1046	Type 1046	1	R_7, R_8	12,000 ohms + 2,000 ohms
10C/1047	Type 1047	1	R_9	5,000 ohms
10C/1048	Type 1048	1	R_{10}	350 ohms
10C/1049	Type 1049	1	R_{11}	15,000 ohms
10C/1050	Type 1050	1	R_{12}	20,000 ohms
10C/1051	Type 1051	1	R_{14}	7,500 ohms
10C/1052	Type 1052	1	R_{15}	820 ohms
10C/1053	Type 1053	1	R_{13}	680 ohms
10C/1054	Type 1054	1	R_{27}, R_{28}	16 ohms
10C/1055	Type 1055	1	R_{19}–R_{23}	Meter shunt 10 + 2·9 + 5·3 + 12·6 + 69·2 ohms
10C/1056	Type 1056	1	R_{16}–R_{18}	Meter shunt 10 + 19·5 + 19·5 ohms
10C/8208	Type 8208	2	R_{30}, R_{31}	1·5 ohms
	Socket			
10H/442	Type 178	1	A	Eight-point
10H/680	Type 206	1	MIC	Two-point
	Switch			
10F/152	Type 232	1	S_2	Four-way linked
10F/254	Type 293	1	S_5	Six-position, three-wafer
10K/12309	Transformer, type 188	1	T_1	25 : 1
10D/110	Tuning unit, type 10	1		A.T.1 assembly
				Fitted with:—
			S_6, S_7	Tapping switches
			L_6	Coils, dust-iron core
				Tuning device
			C_{27}	1 condenser, type 897 (10C/965)
			R_{19}–R_{23}	1 Resistance, type 1055 (10C/1055)
	Accessories			
10D/313	Case, transit	1		
10D/330	Screwdriver	1		
	Valve			
10E/215	Type V.T.104	2	V_2, V_3	Power amplifiers
10E/216	Type V.T.105	2	V_1, V_4	M/O and modulator
10D/99	Transmitter T.1154A	1	Fig. 3	C.W. and M.C.W. FIRST 1,000 PRODUCTION
	Principal components:—			
10A/12162	Ammeter, thermo, type A	1	M_2	0 to 3·5 A
10D/518	Case, transmitter	1		

Ref. No.	Nomenclature	Qty.	Ref. in fig. 3	Remarks
	Transmitter T.1154A (*contd.*)			
	Principal components (*contd.*)			
	Choke, H.F.			
10C/578	Type 70	1	HFC_1	
10C/2054	Type 86	1	HFC_2	
	Choke, L.F.			
10C/580	Type 47	1	LFC_1	
10C/582	Type 49	1	LFC_2	
	Condenser			
10C/8496	Type 188	2	C_{11}, C_{13}	0·01μF
	or			
10C/3103	Type 1503			0·0085 μF to 0·05 μF
10C/10629	Type 440	1	C_{29}	0·01 μF. To be removed
10C/965	Type 897	1	C_9	0·001μF
	or			
10C/3381	Type 1647			
10C/2038	Type 943	2	C_5, C_6	0·0002 μF
10C/2039	Type 944	1	C_7	50 $\mu\mu$F
10C/2041	Type 946	1	C_{10}	0·0002 μF
	or			
10C/3279	Type 1593			
10C/2042	Type 947	1	C_{12}	0·004 μF
10C/2043	Type 948	1	C_{14}	0·004 μF
10C/2045	Type 950	3	C_{22}–C_{24}	0·0003 μF
	or			
10C/3101	Type 1501			0·000255 μF to 0·002 μF
10C/2053	Type 955	1	C_8	0·25 μF
10C/2055	Type 956	1	C_{20}	0·004 μF
	or			
10C/3102	Type 1502			0·0034 μF to 0·05 μF
10C/3105	Type 1505	1	C_{28}	0·0034 μF to 0·05 μF
10D/521	Drive unit, type 7	1		
	Fitted with:—			
	Assembly			
10D/522	Click lever, compensating	2		
10D/523	Click lever, non-compensating	1		
10D/524	Click ring, A–H	1		
10D/525	Click ring, J–R	1		
10D/526	Click ring, S–Z	1		
	Condenser			
10C/2018	Type 942	1	C_1	10 $\mu\mu$F
10C/2044	Type 949	2	C_{18}, C_{19}	0·005 μF
10C/2086	Type 976	1	C_3	6 $\mu\mu$F
10C/3383	Type 1648	1	C_{27}	40 $\mu\mu$F
10D/530	Disc marking	3		
10D/570	Plate, operating	3		
	Resistance			
10C/677	Type 868	1	R_{26}	510 ohms
10C/1042	Type 1042	2	R_1, R_2	50,000 ohms
	or			
10C/6119	Type 6119	1		24,000 ohms
10C/1931	Type 1931	1	R_{29}	150 ohms
10F/347	Switch, type 360	1	S_1	Three-position, four-wafer
10H/321	Fuse, type 33	5	F_1	750 mA
	Holder			
10H/2169	Fuse, type 45	1		
10H/325	Valve, type 50	4		
10A/12140	Milliammeter, type D	1	M_1	0 to 300 mA
10D/531	Output unit, type 8			
	Fitted with:—			
	Assembly			
10D/523	Click lever, non-compensating	2		
10D/524	Click ring, A–H	1		
10D/525	Click ring, J–R	1		

Ref. No.	Nomenclature	Qty.	Ref. in fig. 3	Remarks
	Transmitter T.1154A (*contd.*) Principal components (*contd.*)			
10D/107	Magnifier unit, type 2	1		Complete with variable condensers and tuning coils
10D/728	Scale, plain	2		
10D/111	Tuning unit, type 11	1		A.T.1 assembly, complete with tapping switches, coils (iron dust core), and tuning device
				Condenser
			C_{27}	10C/965, type 897 *or* 10C/3381, type 1647 } 1 0·001 μF
			R_{19}, R_{20}	10C/1055 resistance, type 1055, 1, 100 ohms
	Plug			
10H/324	Type 195	1	B	Four-point
10H/430	Type 207	1	C	Single-point
10H/437	Type 211	1	E	Four-point
10H/438	Type 212	1	D	Eight-point
10F/151	Relay, magnetic, type 85	1	REL_1	Keying with 6 m. and 6 b. 10F/285, contact, moving 10F/295, contact, fixed
	Resistance			
10C/851	Type 934	1	R_{25}	51 ohms
10C/877	Type 942	1	R_{24}	5,100 ohms
10C/1043	Type 1043	1	R_3	50,000 ohms
10C/1044	Type 1044	1	R_4	20,000 ohms
10C/1045	Type 1045	2	R_5, R_6	75,000 ohms
10C/1046	Type 1046	1	R_7, R_8	12,000 ohms + 2,000 ohms
10C/1047	Type 1047	1	R_9	5,000 ohms
10C/1048	Type 1048	1	R_{10}	350 ohms
10C/1049	Type 1049	1	R_{11}	15,000 ohms
10C/1050	Type 1050	1	R_{12}	20,000 ohms
10C/1051	Type 1051	1	R_{14}	7,500 ohms
10C/1052	Type 1052	1	R_{15}	820 ohms
10C/1053	Type 1053	1	R_{13}	680 ohms
10C/1056	Type 1056	1	R_{16}–R_{18}	Meter shunt 49 ohms
10C/8208	Type 8208	2	R_{30}, R_{31}	1·5 ohms
10H/442	Socket, type 178	1	A	Eight-point
	Switch			
10F/152	Type 232	1	S_2	Three-way
10F/153	Type 233	1	S_5	Five-position, three-wafer
	Accessories:—			
10D/297	Case, transit	1		
10D/330	Screwdriver	1		
	Valve			
10E/215	Type V.T.104	2	V_2, V_3	Power amplifiers
10E/216	Type V.T.105	2	V_1, V_4	M/O and modulator
10D/196	Transmitter T.1154B			R/T, C.W., M.C.W. REMAINDER PRODUCTION
	Principal components:— As for T.1154A (above) with the following differences:—			
10C/2289	Choke, L.F., type 71	1	LFC_3	
10C/2220	Condenser, type 1031	1	C_{26}	2 μF
	Resistance			
10C/851	Type 934	1	R_{25}	51 ohms
	or			
10C/1936	Type 1936			
10C/877	Type 942	1	R_{24}	5,100 ohms
	or			
10C/1872	Type 917			4,700 ohms
10C/1047	Type 1047	1	R_9	5,000 ohms
	or			
10C/6835	Type 6835			

Ref. No.	Nomenclature	Qty.	Ref. in. fig. 5	Remarks
	Transmitter T.1154B (*contd.*)			
	Principal Components (*contd.*)			
	Resistance (*contd.*)			
10C/1044	Type 1049 *or*	1	R_{11}	15,000 ohms
10C/1916	Type 1916			
10C/1050	Type 1050 *or*	1	R_4	20,000 ohms
10C/56	Type 563			
10C/1054	Type 1054 *or*	1	R_{27}, R_{28}	16 ohms, tapped at 10 ohms
10C/6833	Type 6833			
10H/442	Socket, type 232	1	MIC	Two-point
10F/348	Switch, type 361	1	S_5	Six-position, five-wafer
10K/107	Transformer, type 231	1	T_1	25 : 1
10D/198	Transmitter, T.1154C	1	Fig. 7	R/T, C.W., M.C.W. FOR CERTAIN FLYING BOATS ONLY
	Principal components:—			
	As for T.1154A (above) with the following differences:—			
10D/574	Cask, transmitter	1		
10C/2087	Choke H.F., type 88	1	HFC_1	
	Choke, L.F.			
10C/579	Type 46	1	LFC_2	
10C/581	Type 48	1	LFC_3	
	Condenser			
10C/965	Type 897	1	C_9	0·001 μF
10C/2041	Type 946	1	C_{10}	0·0002 μF
10C/3101	Type 1501	3	C_{22}–C_{24}	0·000255 to 0·002 μF
10C/3103	Type 1503	2	C_{11}, C_{13}	0·0085 to 0·02 μF
10C/3106	Type 1506	2		0·0034 to 0·02 μF
10D/495	Drive unit, type 6	1		
	Fitted with:—			
	Assembly			
10D/112	Click lever, compensating	2		
10D/113	Click lever, non-compensating	1		
10D/114	Click ring, A–H	1		
10D/115	Click ring, J–R	1		
10D/116	Click ring, S–Z	1		
	Condenser			
10C/3104	Type 1504	2		0·0045 to 0·0115 μF
10C/3383	Type 1648	1	C_{27}	40 $\mu\mu$F
10D/208	Disc, marking	3		
	Resistance			
10C/677	Type 868	1	R_{26}	510 ohms
10C/1042	Type 1042	2	R_1, R_2	51,000 ohms
10C/1931	Type 1931	1	R_{29}	150 ohms
	Scale, calibrated			
10D/496	RANGE 1 and 2	1		
10D/497	RANGE 3	1		
10D/207	RANGE 4	1		
10F/696	Switch, type 550	1	S_1	Four-position, four-wafer
10H/321	Fuse, type 33	1	F_1	750 mA
	Holder			
10H/2169	Fuse, type 45	1		
10H/325	Valve, type 50	4		
10D/498	Output unit, type 7	1		
	Fitted with:—			
	Assembly			
10D/113	Click lever, non-compensating	2		

Ref. No.	Nomenclature	Qty.	Ref. in fig. 7	Remarks
	Transmitter T.1154C (*contd.*)			
	Principal components (*contd*)			
10D/114	Click ring, A–H	1		
10D/115	Click ring, J–R	1		
10D/499	Magnifier unit, type 3	1		*Fitted with*:— 10C/3415 condenser, type 1676, 2, 0·0006 μF
10D/204	Scale, plain	2		
10H/1567	Socket, type 307	1		Three-point reversible
	Tuning unit, type 76	1		*Fitted with*:— 10C/965, condenser, 897, 1 0·001 μF; 10C/1055, resistance, type 1055, 1, 100 ohms
	Resistance			
10C/7908	Type 95	1	R_{41}	1 megohm
10C/1049	Type 1049 *or*	1	R_{11}	15,000 ohms
10C/1916	Type 1916			
10C/1050	Type 1050 *or*	1	R_{12}	20,000 ohms
10C/56	Type 563			
10C/1903	Type 1903	1	R_{40}	100 ohms
10H/680	Socket, type 206	1	MIC	Two-point
	Switch			
10F/254	Type 293	1	S_5	Six-position, three-wafer
10F/677	Type 537	1	S_2	Four-way
10K/12309	Transformer, type 188	1	T_1	25 : 1
	Accessories:—			
10D/491	Case, transit	1		
10D/730	Transmitter T.1154D	1		
	Principal components:— This transmitter differs from the standard type in the following components·—			
10D/732	Drive unit, type 13	1		
10D/736	Magnifier unit, type 4	1		
10D/738	Output unit, type 10	1		
	Scale			
10D/734	RANGE 1	1		
10D/735	RANGE 2	1		
10D/731	Transmitter, T.1154E	1		
	Principal components:— This transmitter differs from the standard type in the following components·—			
10D/733	Drive unit, type 14	1		
10D/737	Magnifier unit, type 5	1		
10D/739	Output unit, type 11	1		
	Scale			
10D/734	RANGE 1	1		
10D/735	RANGE 2	1		
	INSTALLATION SCHEDULE			
	A schedule of all the items comprising a complete installation is contained in an APPENDIX to the ORDER, A.M.O.N/1243/1941			
	The subjoined schedule of connector sets embodies details available at the time of compilation.			

Ref. No.	Nomenclature	Qty.	Ref. in. fig. 19	Remarks
	CONNECTORS		Fig. 19	For KEY refer to diagram
10H/1556	Connector set, type T.1154/ R.1155/A	1		SUNDERLAND AIRCRAFT, Mk. II and III, fitted with single receiver
	Comprising:—			
	Connector			
10H/1634	Type 541/1	1	14	Sextocoremet, 1 ft. 3 in. long *Fitted with*:— 10H/427, Socket, type 168, 2
10H/1635	Type 542/1	1	16	Octocoremet No. 2, 3 ft. 2 in. long. *Fitted with*:— 10H/434, plug, type 210, 1 10H/322, socket, type 137, 1
10H/1636	Type 543/1	1	15	Octocoremet No. 1, 3 ft. long *Fitted with*:— 10H/322, socket, type 137, 1 10H/424, socket, type 174, 1
10H/1637	Type 544/1	1	18	Uniplugmet No. 1, 3 ft. 6 in. long. *Fitted with*:— 10H/429, socket, type 170, 1 10H/435, socket, type 176, 1
10H/1638	Type 545/1	1	13	Quadramet 4, 1 ft. 10 in. long *Fitted with*:— 10H/425, socket, type 175, 2
10H/1639	Type 546/1	1	17	Dulocapmet, No. 1, 13 ft. 8 in. long. *Fitted with*:— 10H/433, plug, type 209, 1 10H/11051, socket, type 63, 1
10H/1718	Type 548/1	1		Ducel 4, 6 in. long *Fitted with*:— 10H/425, socket, type 175, 1
	The following items to be provisioned for fourteen connectors without reference numbers.—			
10H/451	Plug, type 217	1		
	Socket			
10H/8531	Type 40	1		
10H/319	Type 135	2		
10H/320	Type 136	4		
10H/322	Type 137	1		
10H/428	Type 169	1		
10H/431	Type 171	2		
10H/422	Type 172	4		
10H/423	Type 173	2		
	Cable			
5E/82	Unispark 7	19 ft.		
5E/86	Uniflex 19	6 ft.		
5E/916	Unisheath 4	7 ft.		
5E/1328	Dumet 4	9 ft.		
5E/1349	Ducel 19	4 ft.		
5E/1351	Trimet 4	36 ft.		
5E/1362	Ducel 4	10 ft.		
10H/1735	Connector set, type T.1154/2-R.1155/A	1		SUNDERLAND, Mk. II and III. Fitted with navigator operated R.1155
	Connectors, as items 10H/1634-10H/1636 inclusive			
10H/1637	Type 544/1	1		As above, but 4 ft. long
10H/2317	Type 545/3	1		Dulocapmet No. 1, 6 ft. 6 in. long. *Fitted with*:— 10H/433, plug, type 209, 1 10H/11051, socket, type 63, 1
10H/1639	Type 546/1			Omitted

Ref. No.	Nomenclature	Qty.	Ref. in fig. 19	Remarks
	CONNECTORS (*contd.*) Connector set, type T.1154/2-R.1154/A (*contd.*) Comprising (*contd*)			
10H/1640	Type 547/1	1		Dumet 7, 25 ft. long Dumet 4, 25 ft. long Ducel 4, 9 ft. 6 in. long *Fitted with* :— 10H/1518, plug, type 358, 1 10H/1498, socket, type 299, 1
	The following items to be provisioned for fifteen connectors without reference numbers:— As items 10H/451 to 5E/1349 inclusive and 5E/1362, above, with:—			
10H/8531	Plug, type 68	2		
	Cable			
5E/1351	Trimet 4	28 ft.		
5E/130	Unisheath 7	3 ft.		
10H/1276	Switch, type 9	1		S–P, two-way
	The following items are required to convert single receiver installation to two receiver installation			SUNDERLAND
10H 1986	Connector set, type T.1154/R.1155/Convn./A			
	Comprising:— Connector			
10H/2317	Type 545/3	1		Dulocapmet, 6 ft. 6 in. long *Fitted with* :— 10H/433, plug, type 209, 1 10H/11051, socket, type 63, 1 Replaces 10H/1639 when converting to two receiver installation
10H/1640	Type 547/1	1		As item 10H/1640
	The following items to be provisioned for two connectors without reference numbers:—			
5E/1351	Cable, Trimet 4	18 ft.		Replaces receiver to visual indicator connector
10H/322	Socket, type 137	1		(as above)
5E/130	Cable, Unisheath	3 ft.		Connector between Power Units
10H/8531	Socket, type 68	2		(as above)
10H/1276	Switch, type 9	1		S–P, two-way
10H/1546	Connector set, type T.1154/R.1155/AE	1		HALIFAX I. Fitted with single receiver
	Comprising:— Connector			
10H/1951	Type 541/2	1		*See* item 10H/1634
10H/1653	Type 542/3	1		As item 10H/1635, but 2 ft. 4 in. long
10H/1654	Type 543/4	1		As item 10H/1636 but 1 ft. 6 in. long
10H/1655	Type 544/3	1		As item 10H/1637, but 1 ft. 6 in. long
10H/1656	Type 545/4	1		As item 10H/1638, but 6 ft. 8 in. long
10H/1657	Type 546/4	1		As item 10H/1639, but 18 ft. 6 in. long
10H/1718	Type 548/1	1		As item 10H/1718

Ref. No.	Nomenclature	Qty.	Ref. in fig. 19	Remarks
	CONNECTORS (*contd.*)			
	The following items to be provisioned for fifteen connectors without reference numbers:— As items 10H/451 to 10H/423 inclusive:—			
	Cable			
5E/82	Unispark 7	21 ft.		
5E/86	Uniflex 19	6 ft.		
5E/916	Unisheath 4	6 ft.		
5E/1328	Dumet 4	4 ft.		
5E/1340	Ducel 19	5 ft.		
5E/1351	Trimet 4	14 ft.		
5E/1362	Ducel 4	4 ft.		
10H/1985	Connector set, type T.1154/2–R.1155/AE	1		HALIFAX I. Fitted with navigator-operated receiver
	Items required to convert single receiver installation to two receiver installation			
10H/13025	Connector set, type T.1154/R.1155/Convn./AE	1		
10H/1023	Connector set, type T.1154/R.1155/ADZ	1		HAMPDEN. Fitted with single receiver
	Comprising:—			
	Connector			
10H/1646	Type 541/3	1		As item 10H/1634, but 1 ft. 6 in. long
10H/1647	Type 542/2	1		As item 10H/1635, but 4 ft. 0 in. long
10H/1648	Type 543/3	1		As item 10H/1636, but 4 ft. 8 in. long
10H/1649	Type 544/2	1		As item 10H/1637, but 4 ft. 8 in. long
10H/1650	Type 545/3	1		As item 10H/1638, but 1 ft. 8 in. long
10H/1718	Type 548/1	1		As 10H/1718 SUNDERLAND
	The following items to be provisioned for sixteen connectors without reference numbers:— As items 10H/451 to 10H/423 inclusive, with:—			
	Cable			
5E/82	Unispark 7	40 ft.		
5E/86	Uniflex 19	5 ft.		
5E/916	Unisheath 4	7 ft.		
5E/1328	Dumet 4	7 ft.		
5E/1351	Trimet 4	24 ft.		
5E/1362	Ducel 4	8 ft.		
5E/1365	Ducel 37	16 ft.		
5E/2033	Dulocapmet No. 1	10 ft.		
10H/1983	Connector set, type T.1154/2–R.1155/AD	1		HAMPDEN. Fitted with navigator-operated receiver
	Items required to convert a single receiver installation to two receiver installation:—			
10H/13022	Connector set, type T.1154/R.1155/Convn./AD	2		

Ref. No.	Nomenclature	Qty.	Ref. in fig. 19	Remarks
	CONNECTORS (*contd.*)			
10H/1547	Connector set, type T.1154/R.1155/AF	1		MANCHESTER. Fitted with single receiver
	Comprising:—			
	Connector			
10H/1659	Type 541/4	1		As item 10H/1634, but 1 ft. 2 in. long
10H/1660	Type 542/4	1		As item 10H/1635, but 3 ft. 0 in. long
10H/1661	Type 543/5	1		As item 10H/1636, but 6 ft. 2 in. long
10H/1662	Type 544/4	1		As item 10H/1637, but 6 ft. 2 in. long
10H/1663	Type 545/5	1		As item 10H/1638, but 4 ft. 6 in. long
10H/1664	Type 546/5	1		As item 10H/1639, but 4 ft. 2 in. long
10H/1718	Type 548/1	1		As item 10H/1718, SUNDERLAND
	The following items to be provisioned for fifteen connectors without reference numbers:— As items 10H/451 to 10H/423, inclusive, with:—			
	Cable			
5E/82	Unispark 7	17 ft.		
5E/86	Uniflex 19	7 ft.		
5E/916	Unisheath 4	10 ft.		
5E/1328	Dumet 4	3 ft.		
5E/1351	Trimet 4	22 ft		
5E/1362	Ducel 4	3 ft		
5E/1364	Ducel 19	3 ft		
10H/1988	Connector set, type T.1154/2–R.1155/AF	1		MANCHESTER. Fitted with navigator-operated receiver
	Items required to convert single receiver installation to two receiver installation:—			
10H/13026	Connector set, type T.1154/R.1155/Convn./AF/AU	1		
10H/1548	Connector set, type T.1154C/R.1155/AG	1		STIRLING. Fitted with single receiver
	Comprising:—			
	Connector			As these connectors differ only in length from items previously given these differences, only, will be shown here
10H/1666	Type 541/5	1		7½ in.
10H/1667	Type 542/5	1		As item 10H/1635
10H/1668	Type 543/6	1		5 ft. 6 in.
10H/1669	Type 544/5	1		4 ft. 8 in.
10H/1670	Type 545/6	1		5 ft. 1 in.
10H/1671	Type 546/6	1		13 ft. 0 in.
10H/1718	Type 548/1	1		
	The following items to be provisioned for fifteen connectors without reference numbers:— As items 10H/451 to 10H/423 inclusive, with:—			
	Cable			
5E/82	Unispark 7	23 ft.		

Ref. No.	Nomenclature	Qty.	Ref. in fig. 19	Remarks
	CONNECTORS (*contd.*)			
	Connector set, type T.1154C/R.1155/AG (*contd.*)			
	Comprising (*contd.*)			
	Cable (*contd.*)			
5E/86	Uniflex 19	10 ft.		
5E/916	Unisheath 4	14 ft.		
5E/1328	Dumet 4	3 ft.		
5E/1351	Trimet 4	47 ft.		
5E/1362	Ducel 4	3 ft.		
5E/1364	Ducel 19	17 ft.		
10H/1991	Connector set, type T.1154/2R.1155/AG Items required to convert a single receiver installation to two receiver installations:—	1		STIRLING. Fitted with navigator operated receiver
10H/1307	Connector set, type T.1154/R.1155/Convn./AG	1 1		
10H/1544	Connector set, type T.1154/R.1155/H	1		WELLINGTON IC, II, III, IV Fitted with single receiver
	Comprising:—			
	Connector			
10H/1719	Type 541/6	1		5 ft. 5 in.
10H/1635	Type 542/1	1		
10H/1721	Type 543/7	1		3 ft. 5 in.
10H/1722	Type 544/6	1		3 ft. 8 in.
10H/1723	Type 545/7	1		3 ft. 9 in.
10H/1724	Type 546/7	1		10 ft. 3 in
10H/1718	Type 548/1	1		
	The following items to be provisioned for fifteen connectors without reference numbers:— As items 10H/451 to 10H/423 inclusive, with:—			
	Cable			
5E/82	Unispark 7	15 ft.		
5E/86	Uniflex 19	8 ft.		
5E/916	Unisheath 4	8 ft.		
5E/1328	Dumet 4	6 ft.		
5E/1351	Trimet 4	16 ft.		
5E/1362	Ducel 4	6 ft.		
5E/1364	Ducel 19	7 ft.		
10H/1982	Connector set, type T.1154/2–R.1155/H	1		WELLINGTON IC, II, III, IV. Fitted with navigator-operated receiver
	Items required to convert a single receiver installation to a two receiver installation			
10H/13023	Connector set, type T.1154/R.1155/Convn./H	1		
10H/1545	Connector set, type T.1154/R.1155/G	1		WHITLEY V. Fitted with single receiver
	Comprising:—			
	Connector			
10H/1686	Type 541/7	1		12 in.
10H/1635	Type 542/1	1		
10H/1687	Type 543/9	1		1 ft. 1 in.
10H/1688	Type 544/8	1		12 in.
10H/1689	Type 545/9	1		3 ft. 5 in
10H/1690	Type 546/9	1		6 ft. 8 in.
10H/1718	Type 548/1	1		

Ref. No.	Nomenclature	Qty.	Ref. in fig. 19	Remarks
	CONNECTORS (*contd.*)			
	Connector set, type T.1154/R.1155/G (*contd.*)			
	Comprising (*contd.*)			
	The following items to be provisioned for fourteen connectors without reference numbers:— As ıtems 10H/451 to 10H/423 inclusive, with.— 5E/82, 12 ft.; 5E/86, 5 ft.; 5E/916, 9 ft.; 5E/1328, 5 ft.; 5E/1351, 25 ft.; 5E/1362, 6 ft.; 5E/1365, 8 ft.			
10H/1984	Connector set, type T.1154/2R.1155/G	1		WHITLEY V. Fitted with navigator operated receiver
	Items required to convert a single receiver installation to a two receiver installation:—			
10H/13024	Connector set, type T.1154/R.1155/Convn./G	1		
10H/1550	Connector set type T.1154/R.1155/P	1		BEAUFIGHTER. Fitted with single receiver
	Comprising:—			
	Connector			
10H/1693	Type 541/8	1		11 in.
10H/1694	Type 542/8	1		4 ft. 7 in.
10H/1695	Type 543/10	1		4 ft. 8 in.
10H/1696	Type 544/9	1		5 ft. 1 in.
10H/1697	Type 545/10	1		1 ft. 3 in.
10H/1698	Type 546/10	1		15 ft. 0 in.
10H/1718	Type 548/1	1		
	The following items to be provisioned for fifteen connectors without reference numbers:— As items 10H/451 to 10H/423, inclusive, with:— 5E/82, 38 ft.; 5E/86, 9 ft.; 5E/916, 8 ft ; 5E/1328, 5 ft.; 5E/1351, 30 ft.; 5E/1362, 5 ft.; 5E/1364, 6 ft.			
10H/972	Connector set, type T.1154/R.1155/T	1		BLENHEIM IV. Fitted with single receiver
	Comprising:—			
	Connector			
10H/1700	Type 541/9	1		2 ft. 4 in.
10H/1701	Type 542/9	1		3 ft. 6 in.
10H/1702	Type 543/11	1		8 ft. 6 in.
10H/1703	Type 544/10	1		8 ft. 6 in.
10H/1704	Type 548/11	1		3 ft. 0 in.
10H/1718	Type 548/1	1		
	The following items to be provisioned for fifteen connectors without reference numbers:— As items 10H/451 to 10H/423, inclusive, with:— 5E/82, 21 ft.; 5E/86, 8 ft.; 5E/916, 9 ft.; 5E/1328, 7 ft.; 5E/1362, 8 ft.; 5E/1365, 11 ft.			
10H/1987	Connector set, type T.1154/2R.1155/T	1		BLENHEIM IV. Fitted with navigator operated receiver
	The following items are required to convert single receiver installation to two receiver installation:—			
10H/13021	Connector set, type T.1154/R.1155/Convn./T			

Ref. No.	Nomenclature	Qty.	Ref. in fig. 19	Remarks
	CONNECTORS (*contd.*)			
10H/1554	Connector set, type T.1154/R.1155/AB	1		WELLINGTON V. Fitted with single receiver
	Comprising:—			
	Connector			
10H/1641	Type 541/10	1		2 ft. 0 in.
10H/1720	Type 542/7	1		4 ft. 6 in.
10H/1642	Type 543/2	1		3 ft. 6 in.
10H/1723	Type 544/7	1		3 ft. 4 in.
10H/1643	Type 545/2	1		6 ft. 0 in.
10H/1644	Type 546/2	1		3 ft. 2 in.
10H/1718	Type 548/1	1		
	The following items to be provisioned for fifteen connectors without reference numbers:— As items 10H/451, 10H/319 to 10H/423, inclusive, with:— 5E/82, 26 ft.; 5E/86, 16 ft.; 5E/916, 11 ft.; 5E/1328, 6 ft.; 5E/1364, 10 ft.; 5E/1351, 17 ft.; 5E/1362, 6 ft.			
10H/13115	Connector set, type T.1154/2R.1155/AB	1		WELLINGTON V. Fitted with navigator operated receiver
	The following items are required to convert single receiver installation to two receiver installation:—			
10H/13029	Connector set, type T.1154/R.1155/Convn./AB	1		
10H/1555	Connector set, type T.1154/2–R.1155/AM	1		BLENHEIM V. Fitted with navigator operated receiver
	Comprising.—			
	Connector			
10H/1711	Type 541/11	1		3 ft. 7 in.
10H/1712	Type 542/10	1		3 ft. 6 in.
10H/1713	Type 543/12	1		2 ft. 6 in.
10H/1714	Type 544/12	1		2 ft. 8 in.
10H/1716	Type 546/13	1		13 ft. 0 in.
10H/1717	Type 547/14	1		Dumet 7, 30 ft. 0 in. Dumet 4, 30 ft. 0 in. Ducel 4, 8 ft. 0 in.
10H/1718	Type 548/1	1		
	The following items to be provisioned for sixteen connectors without reference numbers:— As items 10H/451 to 10H/423, inclusive, with:—			
10H/6516	Plug, type 68	2		
	Items 5E/82, 14 ft.; 5E/86, 6 ft.; 5E/130, 5 ft.; 5E/196, 10 ft.; 5E/1328, 4 ft.; 5E/1351, 15 ft.; 5E/1362, 13 ft.; 5E/1364, 7 ft.			
10H/1551	Connector set, type T.1154/R.1155/AH	1		ALBEMARLE. Fitted with single receiver
	Comprising:—			
	Connector			
10H/1726	Type 541/12	1		2 ft. 10 in.
10H/1673	Type 542/11	1		4 ft. 7 in.
10H/1674	Type 543/8	1		15 ft. 6 in.
10H/1675	Type 544/11	1		15 ft. 6 in.
10H/1676	Type 545/8	1		8 in.
10H/1677	Type 546/8	1		2 ft. 6 in.
10H/1718	Type 548/1	1		

Ref. No.	Nomenclature	Qty.	Ref. in fig. 19	Remarks
	CONNECTORS (*contd.*)			
	Connector set, type T.1154/R.1155/AH (*contd.*)			
	Comprising (*contd.*)			
	Connector (*contd.*)			
	The following items to be provisioned for fourteen connectors without reference numbers:—			
	As items 10H/451 to 10H/453, inclusive, with:—			
	Items 5E/82, 15 ft.; 5E/86, 10 ft.; 5E/916, 7 ft.; 5E/1328, 3 ft.; 5E/1351, 14 ft.; 5E/1362, 3 ft.; 5E/1364, 6 ft.			
10H/1990	Connector set, type T.1154/2R.1155/AH	1		ALBEMARLE. Fitted with navigator operated receiver
	Items required to convert single receiver installation to two receiver installation:—			
10H/13028	Connector set, type T.1154/R.1155/Convn./AH			
10H/1549	Connector set, type T.1154/R.1155/C	1		BEAUFORT. Fitted with single receiver
	Comprising:—			
	Connector			
10H/1679	Type 541/15	1		4 ft. 4 in.
10H/1680	Type 542/15	1		4 ft. 3 in.
10H/1681	Type 543/15	1		2 ft. 8 in.
10H/1682	Type 544/15	1		3 ft. 1 in.
10H/1697	Type 545/10	1		1 ft. 3 in.
10H/1718	Type 548/1	1		
	The following items to be provisioned for fifteen connectors without reference numbers:—			
10H/433	Plug, type 209			
	Items 10H/451 to 10H/423, inclusive, with:—			
	Items 5E/82, 14 ft.; 5E/86, 7 ft.; 5E/916, 12 ft.; 5E/1328, 5 ft.; 5E/1351, 22 ft.; 5E/1362, 5 ft.; 5E/1364, 7 ft.			
10H/1552	Connector set, type T.1154/R.1155/U	1		MOSQUITO. Fitted with single receiver
	Comprising:—			
	Connector			
10H/1707	Type 541/14	1		3 ft. 2 in.
10H/1732	Type 542/14	1		3 ft. 9 in.
10H/1733	Type 543/14	1		5 ft. 6 in.
10H/1708	Type 544/14	1		5 ft. 8 in.
10H/1734	Type 545/14	1		1 ft. 10 in.
10H/1718	Type 548/1	1		
	The following items to be provisioned for fifteen connectors without reference numbers:—			
	As items 5E/82, 16 ft.; 5E/86, 6 ft.; 5E/916, 7 ft.; 5E/1328, 13 ft.; 5E/1351, 10 ft.; 5E/1362, 8 ft.; 5E/1364, 8 ft.			
10H/1738	Connector set, type T.1154/R.1155/D	1		BOTHA. Fitted with single receiver
	Comprising:—			
	Connector			
10H/1727	Type 541/13	1		9½ in.
10H/1728	Type 542/12	1		2 ft. 6 in.
10H/1654	Type 543/4	1		1 ft. 6 in.
10H/1729	Type 544/13	1		1 ft. 3¼ in.
10H/1730	Type 545/13	1		11½ in.
10H/1731	Type 546/12	1		1 ft. 9 in.
10H/1718	Type 548/1	1		

Ref. No.	Nomenclature	Qty.	Ref. in fig. 19	Remarks
	CONNECTORS (*contd.*)			
	Connector set, type T.1154/R.1155/D (*contd.*)			
	Comprising (*contd.*)			
	Connector (*contd.*)			
	The following items to be provisioned for fourteen connectors without reference numbers:—			
	Items 10H/451 to 10H/423, inclusive, with:—			
	Items 5E/86, 5 ft.; 5E/916, 4 ft.; 5E/1328, 7 ft.; 5E/1364, 11 ft.; 5E/1351, 23 ft.; 5E/1362, 6 ft			
10H/1553	Connector set, type T.1154/R 1155/AJ	1 1		ANSON. Fitted with single receiver
	Comprising:—			
	Connector			
10H/1651	Type 541/16	1		8¼ in.
10H/1683	Type 542/13	1		3 ft. 1½ in.
10H/1684	Type 543/13	1		3 ft. 8½ in.
10H/1709	Type 544/16	1		3 ft. 11 in.
10H/1705	Type 545/12	1		3½ in.
10H/1718	Type 548/1			
	The following items to be provisioned for seventeen connectors without reference numbers:—			
10H/8118	Plug, type 62	1		
10H/7961	Disc, indicating, type P/62/D	1		
10H/9872	Plug, type 101	1		
	With items 10H/433 to 10H/423, inclusive, and items:—			
	5E/82, 13 ft.; 5E/86, 10 ft.; 5E/916, 10 ft.; 5E/1328, 4 ft.; 5E/1351, 18 ft.; 5E/1362, 5 ft.; 5E/1365, 2 ft.; 5E/2057, 5 ft.			
10H/1992	Connector set, type T.1154/2 R.1155/AV	1		WARWICK. Fitted with navigator operated receiver
10H/1993	Connector set, type T.1154/2 R.1155/AU	1		LANCASTER. Fitted with navigator operated receiver
10K/17	Power unit, type 32			12-volts
	Principal components:—			
10K/71	Base	1		
10K/72	Cover	1		
	Choke, H.F.			
10C/2232	Type 95	2		
10C/2233	Type 96	2		
10C/2234	Type 97	4		
	Condenser			
10C/2040	Type 945	2	C_{15}, C_{16}	0·25 μF
	or			
10C/2238	Type 1056	6	C_9–C_{14}	0·004 μF
10C/2239	Type 1057 *or* }	4	C_5–C_8	2 μF
10C/3404	Type 1666 }			
10C/2240	Type 1058	4	C_1–C_4	4 μF
10H/623	Clip, type 13	3		
10H/321	Fuse, type 33	1		750 mA
10H/2169	Holder, fuse, type 45	1		
10K/21	Rotary transformer, type 28	1	RT_1	In: 12 v., 240 w. Out: 1,200 v., 200 mA
	Plug,			
10H/426	Type 206	1	P_1	
10H/430	Type 207	1		
10H/438	Type 212	1	P_2	
10H/624	Type 245	1		

Ref. No.	Nomenclature	Qty.	Ref. in fig. 21	Remarks
	CONNECTORS (*contd.*)			
	Connector set, type T.1154/2 R.1155/AU (*contd.*)			
	Comprising (*contd.*)			
10F/331	Starter, type 5	1	REL_1	
10K/13063	Power unit, type 32A			12 volts
	Principal components:—			
	As for type 32 (above) with:—			
10H/1802	Socket unit, type 314	1		*Fitted with:—* 10H/9352 socket, type 47
10K/18	Power unit, type 33			24 volts
	Principal components:—			
	As for type 32 (above) except:			
	Choke, H.F.			
10C/2736	Type 121	2		Substitute for 10C/2232
10C/2737	Type 122	2		Substitute for 10C/2233
10K/13064	Power unit, type 33A			24 volts
	Principal components:—			
	As for type 33 with:—			
10H/1802	Socket unit, type 314			*See* power unit, type 32A
10K/19	Power unit, type 34			12 volts
	Principal components:—			
10K/73	Base	1		
10K/72	Cover	1		
	Choke, H.F.			
10C/2232	Type 95	2		
10C/2233	Type 96	2		
10C/2234	Type 97	2		
10C/2235	Type 98—spools	2		
10C/2236	Type 99	2		
10C/3146	Choke, L.F., type 110	1		
	Condenser			
10C/10629	Type 440	4	C_8, C_9, C_{11}, C_{12}	0·01 μF. May be marked 10C/8496
10C/10825	Type 484	1	C_{14}	4 μF
10C/288	Type 652	1	C_{13}	2 μF
10C/800	Type 851	2	C_{15}, C_{16}	0·1 μF
10C/2239	Type 1057 *or*	5	C_3–C_7	2 μF
10C/3404	Type 1666			
10C/2240	Type 1058	3	C_1, C_2, C_{10}	4 μF
10H/623	Clips, type 13	1		
	Plug			
10H/426	Type 206	1	P_1	6-point
10H/624	Type 245	1		
10K/23	Rotary transformer	1	RT_1	In: 12 v., 100 w. Out: 240 v., 100 mA H.T 5·8 v., 13 A., L.T.
10F/332	Starter, type 6	1	REL_1	
10K/13065	Power unit, type 34A			12 volts
	Principal components:—			
	As power unit, type 34, with:—			
10K/371	Plug retaining unit, type 19	1		
10F/723	Relay unit, type 19	1	REL_2	
10C/8528	Resistance, type 2044	1	R_1	0·1 ohm
10H/327	Socket, type 138	1		4-point
10K/20	Power unit, type 35			24 volts
	Principal components:—			
	As for power unit, type 34, except:—			
10F/334	Starter, type 8	1	REL_1	Substitute for 10F/332
10K/13066	Power unit, type 35A			24 volts
	Principal components:—			
	As for power unit, type 35, with items:—			
	10K/371, 10F/723, 10C/8528 and 10H/327 (*See* power unit, type 34A)			

P1586 M23919/699 2/43 13000 C & P **Gp. 1**

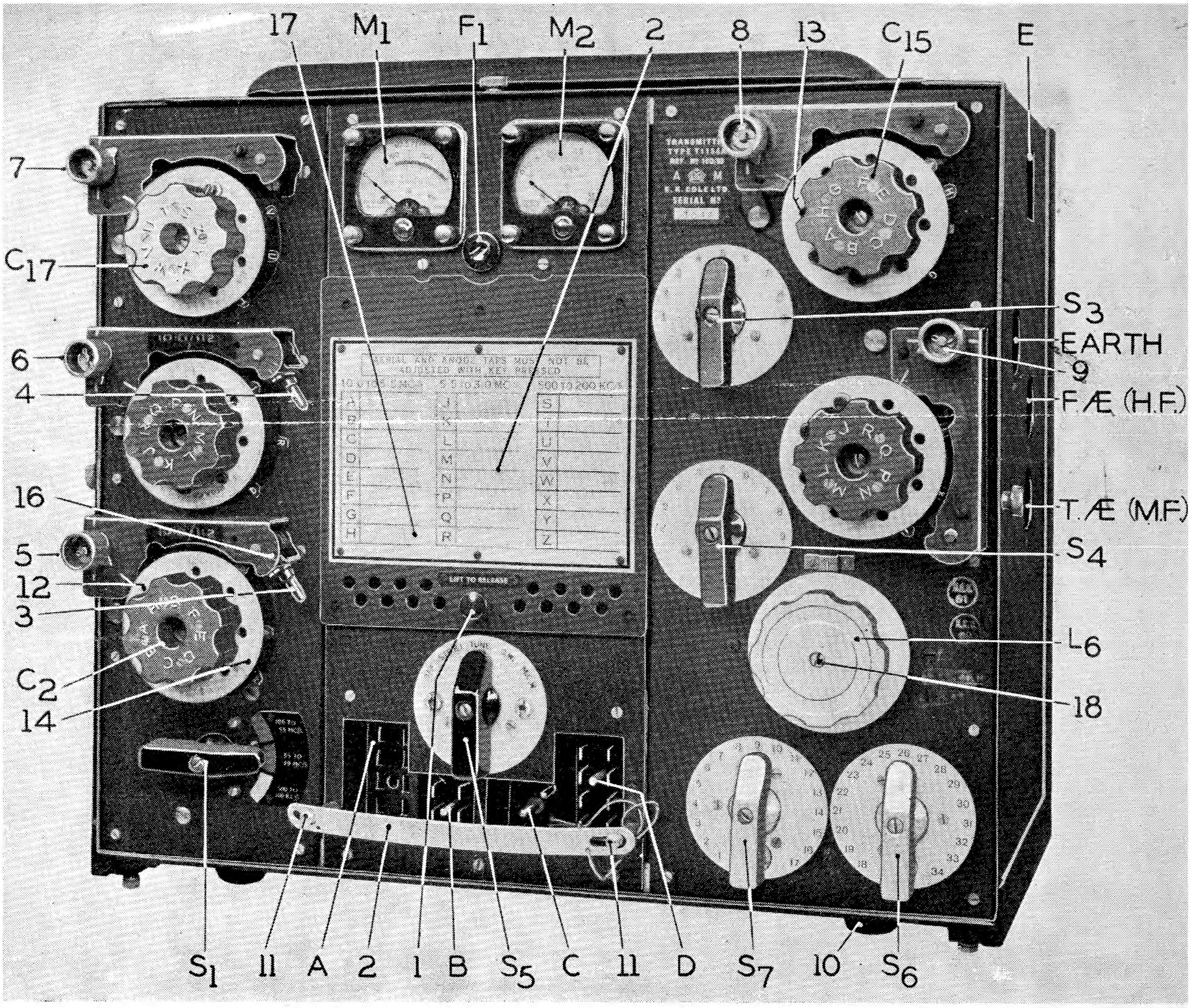


Fig. 1.—Transmitter T.1154