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Colin Hinson
In the village of Blunham, Bedfordshire.

VHF TRANSMITTERS T.1131A, T.1131B & T1131J

Concise details of

V.H.F. TRANSMITTERS, T.1131A and T.1131B

Purpose of equipment	V.H.F. transmitter for ground stations, fixed or mobile, T.1131B incorporates HIGH-LOW power switch but is otherwise similar to T.1131A. T.1131B will be the final version.
Type of Wave	R/T or M.C.W.
Frequency Range	100 to 156 Mc/s.
Frequency Stability	To one part in 100,000.
Crystal Multiplication Factor	Actual freq. in Mc/s $= \frac{18 \times \text{crystal freq. in kc/s}}{1{,}000}$
Percentage Modulation	100 per cent.
Output Impedance	100 ohms, concentric feeder.
Amplifier Class	R.F. Class C. A.F. Class A and Class B, zero bias.
Microphone Type	Carbon granule.
Valves	*R.F.stages*—Crystal oscillator (1) V.T.52 (Stores Ref. 10E/11398). Trebler (2) V.T.79 (Stores Ref. 10E/11752). Doubler (2) V.T.62 (Stores Ref. 10E/11443). Output (2) V.T.62 (Stores Ref. 10E/11443). Diode-monitor (1) 6J5G (Stores Ref. 10E/348). *Modn. stages.*—Pre-amplifier (4) 6J5G (Stores Ref. 10E/348). L.F. driver (2) V.T.75 (Stores Ref. 10E/11533). Zero-bias output (2) V.T.76 (Stores Ref. 10E/11534). Tone osc. (1) 6J5G (Stores Ref. 10E/348). *Rectifier.*—Mercury (4) V.U.72 (Stores Ref. 10E/11530) or C.V.187. Hard, 300 V., 250 mA (1) V.U.71 (Stores Ref. 10E/11529) or C.V.235.
Power Input	1·2 kVA from 50 c/s mains, 200 to 250 V.
Power Output	50 watts.
Stores Ref.	T.1131A, 10D/1760.
Approximate Overall Dimensions	*Length* 1 ft. 5 in. — *Width* 1 ft. 9 in. — *Height* 6 ft.
Weight	6 cwt.

This leaf issued with A.L. No. 10, August, 1951

LIST OF CHAPTERS

Note.—*A list of contents appears at the beginning of each chapter.*

CHAPTER 1

V.H.F. TRANSMITTERS, Type T.1131A and T.1131B

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

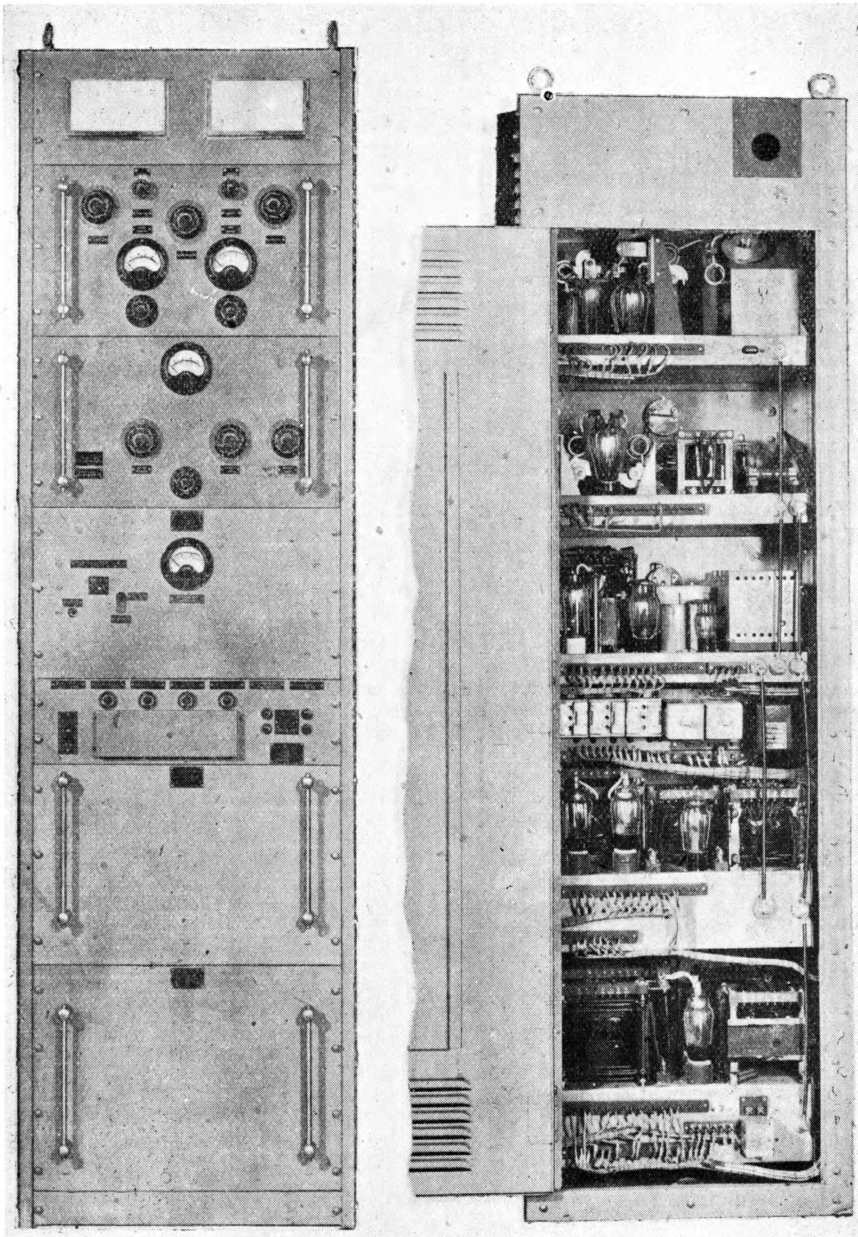


Fig. 1.—Transmitters, types T.1131A and T.1131B, front and rear views

INTRODUCTION

1. The transmitters type T.1131A and T.1131B are V.H.F. ground transmitters designed for radio-telephonic communication with aircraft within a range of 100 miles at 10,000 feet. At higher altitudes this operational range may be exceeded. Modulated-continuous-wave operation is also available.

2. The frequency range of both transmitters is 100 to 156 Mc/s. The selected frequency within this band is crystal-controlled and the crystal-frequency multiplication factor is 18.

3. Power supplies to the transmitters are derived from the single-phase 50 cycle 230 volt mains. The input power is 1125 watts.

4. The transmitters type T.1131A and T.1131B are exactly similar with the exception of a new feature on the T.1131B. This consists of a "low power" switch, which enables the transmitter to be operated on low power output where a more restricted range is required.

GENERAL DESCRIPTION

5. With the exception of those statements dealing with the differences in the two transmitters, the T.1131A and the T.1131B will hereafter be referred to as "the transmitter". Photographs in this book are of a T.1131A which is similar to the T.1131B with the exception of the POWER SWITCH FOR TUNING on the control unit, which will appear on the T.1131B as a double-pole changeover switch labelled POWER SWITCH.

Weight and dimensions

6. The weight of the transmitter is 700 lb., and the dimensions are as follows:—Height 6 ft.; width 1 ft. 8 in.; depth 1 ft. 4 in. The transmitter is mounted on resilient mountings at the time of installation; four ring bolts are provided in the top for lifting purposes.

7. The transmitter consists of six units mounted in a cabinet as illustrated in fig. 1. The units are interconnected by cable forms wired to numbered tags on each chassis, the tag boards can be seen on the right-hand photograph in the illustration. The units are listed below:—

T.1131A

Nomenclature	*Stores Ref.*	*Nomenclature used in A.P.2555E*	*Function*
(i) Driver unit, type 26	10D/1761	R.F. driver unit	R.F. oscillator and frequency multiplier
(ii) Output unit, type 31	10D/1762	R.F. output unit	R.F. output final amplifier
(iii) Modulator unit, type 1	10D/12	Modulator unit	Modulator and tone oscillator
(iv) Power unit, type 386	10K/1493	Modulator power unit	Modulator power supply
(v) Power unit, type 387	10K/1494	R.F. power unit	R.F. driver unit and R.F. output unit power supplies
(vi) Control unit, type 8	10L/11868	Control unit	Master control of switching

T.1131B

Nomenclature	*Stores Ref.*	*Nomenclature used in in A.P.2555E*	*Function*
(i) Driver unit, type 26	10D/1761	R.F. driver unit	R.F. oscillator and frequency multiplier
(ii) Output unit, type 31	10D/1762	R.F. output unit	R.F. output final amplifier
(iii) Modulator, type 102	10D/2411	Modulator unit	Modulator and tone oscillator
(iv) Power unit, type 425	10K/1901	Modulator power unit	Modulator power supply
(v) Power unit, type 387	10K/1494	R.F. power unit	R.F. driver unit and R.F. output unit power supplies
(vi) Control unit, type 323	10L/186	Control unit	Master control of switching

Circuit layout

8. The circuit of the transmitter, given in figs. 2 and 3, comprises a R.F. driver unit, a R.F. output unit and a modulator stage. Frequency multiplication is effected in the R.F. driver unit which has a crystal-controlled oscillator, a first and second trebler, and a last stage comprising a push-pull-parallel frequency doubler. Thus the output frequency is 18 times that of the crystal frequency. The driver unit is coupled by a low impedance link to the R.F. output unit which has an output circuit comprising two triodes arranged in push-pull and a rectifying diode to provide audio sidetone (monitoring).

9. The modulator unit is designed for use with a carbon microphone and consists of two single-valve amplifiers followed by three push-pull amplifier stages. The final push-pull amplifier stage is operated under Class B zero bias conditions.

10. Power supplies to the transmitter stages are provided by the R.F. power unit and the modulator power unit. The R.F. power unit gives all the power supplies required by the R.F. driver unit and the R.F. output unit. A safety switch is housed in this latter unit and when the door at the back of the transmitter cabinet is open, this switch disconnects the mains input from both power supply units. The modulator power unit provides power supplies for the modulator unit only. The switching of both power supply units is made at the control unit.

11. The control unit contains all the necessary switches and relays for the control of the various power supplies to the R.F. and modulator units. The unit also provides a 24 volt supply for the remote control of the transmitter, energising relays, and contactors, and for lighting the remote indicator lamp.

INSTALLATION

12. Easy access to the units of the transmitter is made via the door at the back of the transmitter cabinet. With this door open ascertain that the local a.c. supply is connected to the MAINS INPUT terminals on the rear of the R.F. power unit. The coaxial aerial connector must be securely fastened to the aerial plug located at the top of the power unit. Ensure that all valves are in their correct holders with top cap connections secure; the correct types of valves are given in para. 15. The fuses on the control unit must be wired with fuse wire of the correct rating. The H.T. fuses in the R.F. and modulator supply units must be examined for serviceability.

13. Before setting up, it is advisable when handling the transmitter for the first time, to check all static meter readings with the POWER SWITCH FOR TUNING in the FULL position and with crystal removed. The readings should be within the limits given in Table 1.

TABLE 1

Static meter readings

Unit	*Meter switch position*	*Meter readings*
R.F. driver	C.O.	30–34 mA
	T_1	46–56 mA
	T_2	48–58 mA
	D_1	27–38 mA
	D_2	27–38 mA
	D (Grid)	Zero
R.F. output	A_1	50–65 mA
	A_2	50–65 mA
	G_1	Zero
	G_2	Zero
Modulator unit	Cathode current	50–70 mA

14. It should be noted that all valves are quite safe with full power applied if the crystal is removed. It is possible, however, seriously to overrun the valves during the initial adjustments with full power applied. It is therefore important to make all initial adjustments with the POWER SWITCH FOR TUNING in the HALF or LOW position.

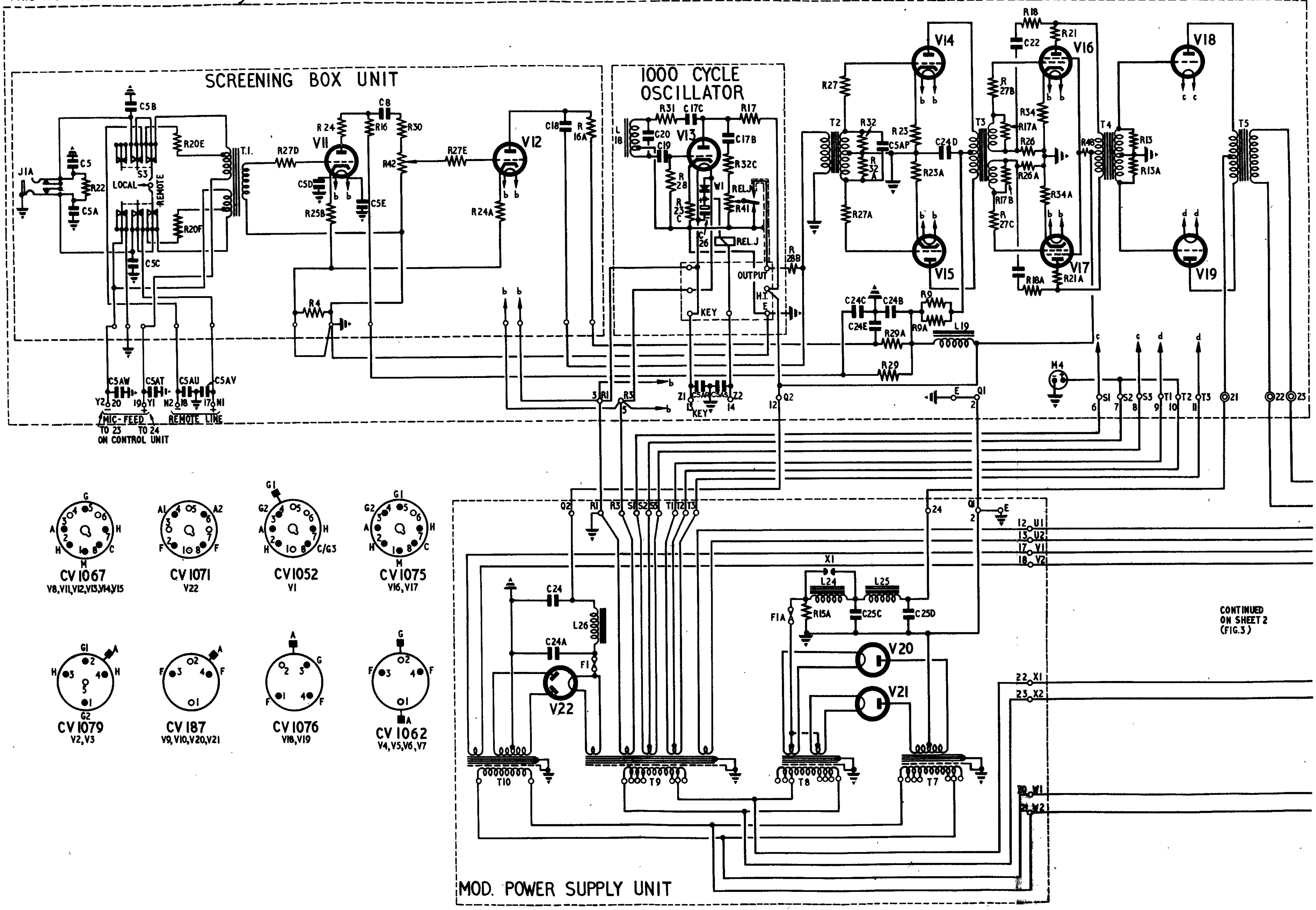
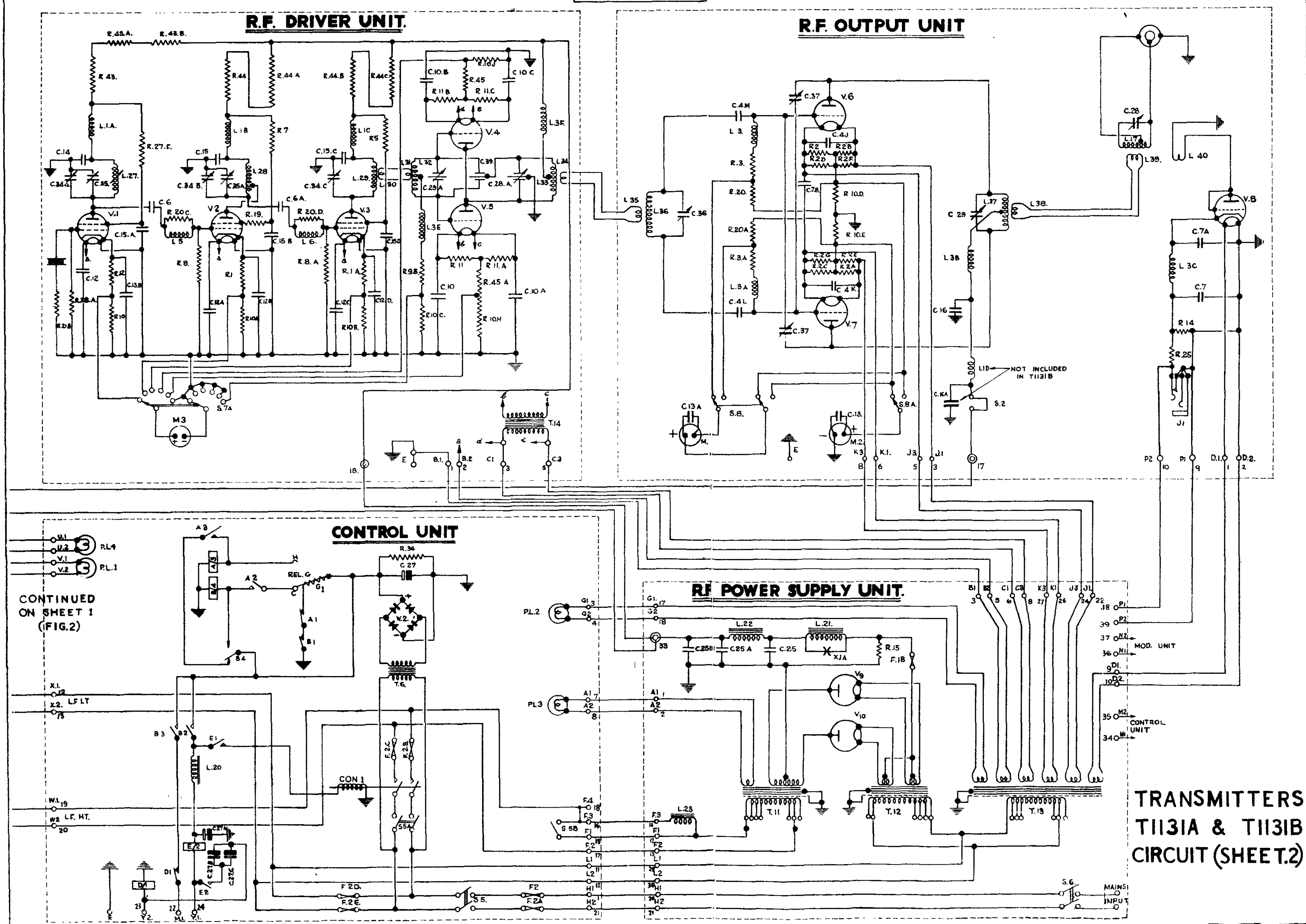


FIG. 2 TRANSMITTERS T.1131A & T.1131B — CIRCUIT (SHEET 1) FIG. 2



TRANSMITTERS T1131A & T1131B CIRCUIT (SHEET.2)

FIG. 3

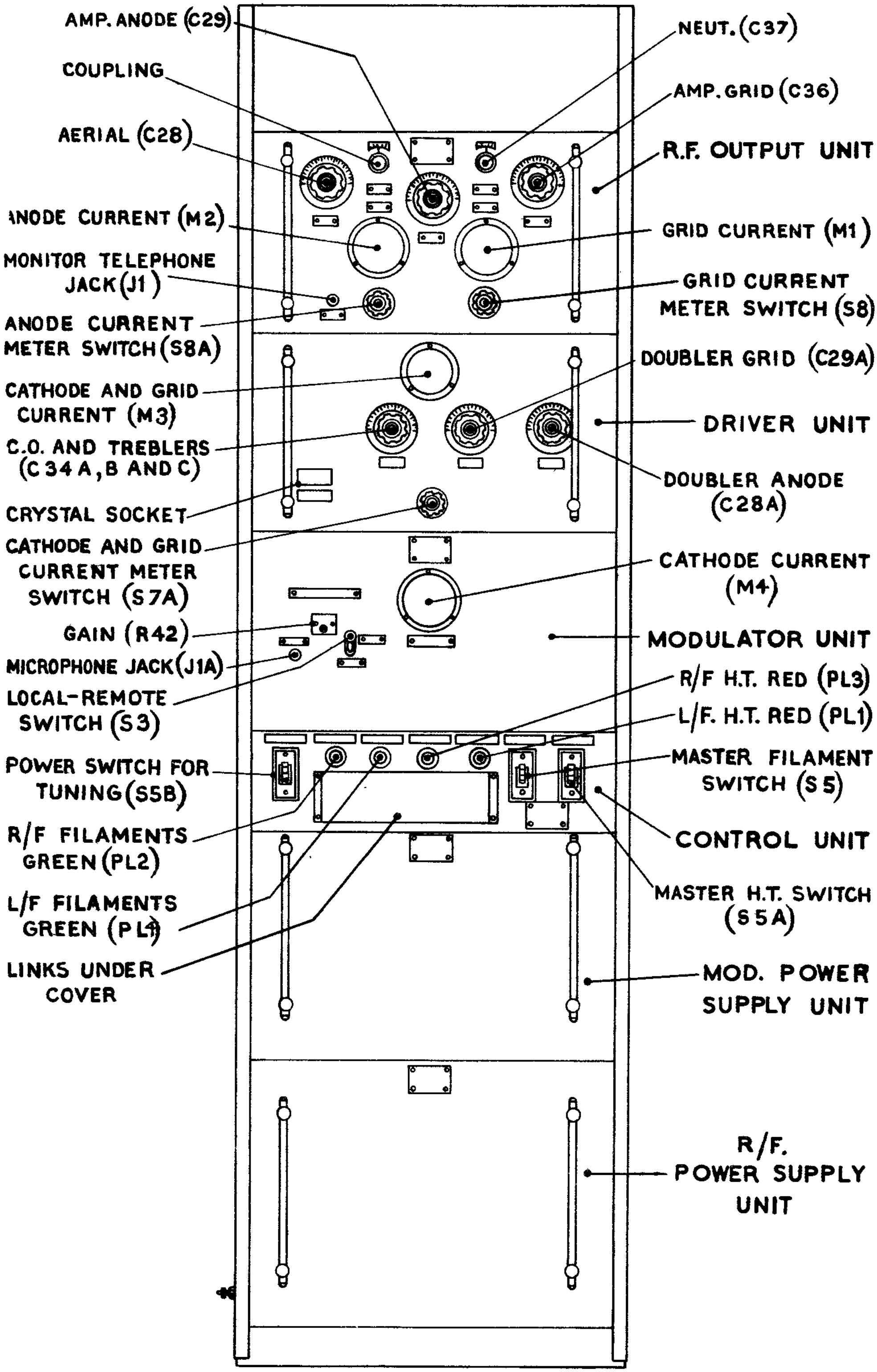


Fig. 4.—Panel controls

To face para. 16

15. The following valves are used in the T.1131A and T.1131B:—

Unit	*Function*	*Valve Type* New No.	*Valve Type* Old No.	*Circuit Ref.*
RF driver unit	Crystal oscillator Treble Doubler	CV1052 CV1079 CV1062	VT52 VT79 VT62	V_1 V_2 V_3 V_4 V_5
RF output unit	Output Monitor	CV1062 CV1067	VT62 VR67	V_6 V_7 V_8
Modulator unit	Pre-amplifier Amplifier Driver Output Tone-oscillator	CV1067 CV1067 CV1075 CV1076 CV1067	VR67 VR67 VT75 VT76 VR67	V_{11} V_{12} V_{14} V_{15} V_{16} V_{17} V_{18} V_{19} V_{13}
RF power unit	HT rectifiers	CV187 (CV1072) or (CV235)	—	V_9 V_{10}
Modulator power unit	HT rectifiers			V_{20} V_{21}
	300 volt supply rectifier	CV1071	VU71	V_{22}

SETTING-UP INSTRUCTIONS

16. In the following instructions the switches and controls printed in small capital letters are indicated on the front panel of the transmitter by labels. These annotations are also duplicated in the diagram in fig. 4.

17. Open the door of the transmitter and remove the H.T. link S2 located at the rear of the R.F. output unit (fig. 21). Close the door and switch on the main supply to the transmitter. Set the LOCAL/REMOTE switch on the modulator unit to LOCAL.

18. Press the MASTER FILAMENT switch ON button; the green lamps should glow and the thermal delay mechanism commence to operate. Set the POWER SWITCH FOR TUNING to the HALF or LOW position.

Note.—Initial tuning should always be carried out with the switch in the HALF position.

19. Insert the appropriate crystal in the socket on the left-hand side of the front panel of the R.F. driver unit. Set up the tuning controls on the R.F. driver and R.F. output units to the approximate readings given in Table 2, interpolating for frequencies between those given.

TABLE 2
Typical calibration

Unit	*Control*	*Crystal Frequency in kc/s*						
		8670	8110	7500	7000	6500	6050	5550
R.F. driver	C.O. AND TREBLERS	17–20	25–30	40–45	55–60	65–70	80–83	90–94
	DOUBLER GRID	8–12	27–31	42–46	58–62	68–72	80–83	93–96
	DOUBLER ANODE	6–11	20–25	35–40	45–50	55–60	70–75	80–85
R.F. output	AMP. GRID	15–20	30–35	43–48	60–65	68–73	83–87	94–98
	AMP. ANODE	5–10	15–20	32–37	45–50	55–60	66–70	75–80
	AERIAL	20–25	30–35	47–52	50–55	60–65	74–78	85–90

20. Press the MASTER H.T. switch; H.T. on will be indicated by the red lamps on the control unit and readings in the meters.

21. Set the meter switch on the R.F. driver unit to the T_1 position and rotate the control C.O. AND TREBLERS. A dip in the meter (M_3) reading will be observed and the control should be set to give a minimum reading; this minimum reading should be approximately 20 mA. Now set the meter switch to the D_1 position and rotate the DOUBLER GRID control, when a sharp rise will be observed in the meter reading; adjust this control until maximum current is shown in the meter. This maximum current should be approximately 24 mA.

22. With the meter switch still at the D_1 position, rotate the DOUBLER ANODE control, when a dip will be observed; adjust the control until the meter indicates minimum current; this minimum current should be approximately 20 mA. Move the meter switch to the position D_2, and the meter reading should be approximately the same as in the position D_1.

23. On the R.F. output unit set the GRID CURRENT meter switch to position G_1 and rotate the AMP. GRID control, when a sharp rise in the meter reading will be observed; adjust the control until the GRID CURRENT meter indicates maximum current which will be 3-4 mA. Move the switch to G_2 and the grid current should be approximately the same as in the position G_1. Re-set the switch to G_1.

24. Put the POWER SWITCH FOR TUNING to the FULL position. Check the tuning of C.O. AND TREBLERS, DOUBLER GRID, DOUBLER ANODE, and AMP. GRID controls; these adjustments will usually give some increase in the reading of the R.F. output unit GRID CURRENT meter and the final adjustments should be made with this object in view. Set the COUPLING control to minimum (pointer at extreme left of scale) and the AERIAL control to zero.

25. Rotate the AMP. ANODE control and, if this stage is not neutralised, a sharp dip will be observed on the GRID CURRENT meter. Set the AMP. ANODE control to give minimum grid current. Now adjust the NEUT. control to increase the reading of GRID CURRENT and again adjust the AMP. ANODE control to give a minimum reading. As this process is continued it will be found that the dip in GRID CURRENT will become less evident, and the adjustment should be continued until it is found that on rotation of the AMP. ANODE control there is *no* dip in the grid current reading. When this condition is obtained the R.F. output unit is correctly neutralised. Adjustment of the NEUT. control will affect the grid tuning and during the above procedure grid tuning should be checked.

26. Having obtained satisfactory neutralisation, switch off MASTER H.T. and put the POWER SWITCH FOR TUNING to the HALF or LOW position. Open the door of the transmitter, replace the H.T. link S_2, and close the door. Switch on MASTER H.T. Set the ANODE CURRENT meter switch to position A_1 and rotate the AMP. ANODE control when a dip will be observed in the reading in the ANODE CURRENT meter. Adjust the control to give minimum reading. Now put the POWER SWITCH FOR TUNING to the FULL position and check the AMP. ANODE tuning, noting the dip in the reading of the ANODE CURRENT meter and the peak in the reading on the GRID CURRENT meter occur together. If necessary, slightly adjust the NEUT. control until the peak and the dip referred to above occur exactly together. The reading on the ANODE CURRENT meter should be 40 to 50 mA. Put the ANODE CURRENT meter switch to the A_2 position and check that the meter reading is approximately the same as in the A_1 position.

27. Rotate the AERIAL control, when an increase in the ANODE CURRENT meter reading should be observed, if this is not so increase COUPLING slightly, adjust the AERIAL control to give a maximum reading on the ANODE CURRENT meter, now increase COUPLING again and re-adjust the AERIAL control to give a reading on the ANODE CURRENT meter of approximately 60 mA. Increase COUPLING again and check the AMP. ANODE tuning until the sum of the two readings on the ANODE CURRENT meter (positions A_1 and A_2) is 140 mA.

28. The transmitter is now set up correctly and typical meter readings are given in Table 3. If it is required to operate from the REMOTE position, put the LOCAL/REMOTE switch to REMOTE. This will automatically switch off H.T. supplies and the transmitter becomes available for control at the remote station.

TABLE 3

Typical working meter readings

Unit	*Selector Switch Position*	*Crystal Frequency in kc/s*						
		8670	8110	7500	7000	6500	6050	5550
R.F. driver	C.O.	26–32	26–32	26–32	26–32	26–32	26–32	26–32
	T_1	44–52	44–52	44–52	44–52	44–52	44–52	44–52
	T_2	50–60	50–60	50–60	50–60	50–60	50–60	50–60
	D_1	44–54	44–54	44–54	40–50	40–50	40–50	40–50
	D_2	40–50	40–50	40–50	40–50	40–50	40–50	40–50
	D Grid	3–5	3–5	3–5	3–5	3–5	3–5	3–5
R.F. output	G_1	5–10	5–10	5–10	6–10	6–10	6–10	6–10
	G_2	5–10	5–10	6–10	6–10	6–10	6–10	6–10
	A_1	64–72	64–72	64–72	68–76	68–76	68–76	64–74
	A_2	64–72	64–72	64–72	60–70	68–76	68–76	64–74
	A_1 (unloaded dip)	42–50	42–50	42–50	35–50	35–45	35–45	35–45
	A_2 (unloaded dip)	42–50	42–50	42–50	35–50	35–45	35–45	35–45

Note.—When the transmitter has been neutralised as detailed in para. 25, the neutralisation will hold approximately for any frequency within the band. When setting up on a new frequency, there is, therefore, no need to carry out the neutralising procedure as detailed in that paragraph, but the neutralising should be checked by noting that the dip in the ANODE CURRENT meter reading, and the peak in the GRID CURRENT meter reading occur together.

29. For speech modulation the transmitter should be set up as follows. With the transmitter switched on and set up as above, apply speech modulation either locally or from the remote position. It will be noted that the reading in the cathode current meter M_4 varies as speech is applied, and the volume control on the modulator unit should be adjusted until the peak reading on the meter is approximately 200 mA. With this condition obtaining, the transmitter is being modulated 100 per cent. on peaks of speech.

30. For MCW working, plug the oscillator unit into the rear of the modulator unit chassis and adjust the volume control (R_{41}) on the oscillator unit until the reading on M_4 is approximately 200 mA with the telegraph key pressed.

31. As already stated, it is possible to operate the transmitter T.1131B to give a low power output. The transmitter T.1131B should be set up as detailed above, and the POWER SWITCH put to the LOW position. Under these conditions the output power is approximately one quarter of that obtained on FULL power. In the LOW power condition the modulator volume control should be adjusted to give a peak reading of 100 mA in the cathode current meter M_4 with speech applied. Similarly for MCW, the oscillator unit volume control (R_{41}) should be adjusted to give a reading in M_4 of 100 mA with key pressed.

DETAILED CIRCUIT DESCRIPTION

32. A complete circuit diagram of the transmitter is given in fig. 2 and 3. Circuit diagrams and photographs of the units are also given and these are referred to under the appropriate headings.

RF power unit

33. This unit gives all the power supplies required by the R.F. driver unit and the R.F. output unit. A circuit diagram of the power unit is given in fig. 5 and photographs are given in fig. 6 and 7. The photograph in fig. 6 is that of an early type of R.F. power unit. The type in current use, i.e. the power unit Type 387 is now fitted with two adapters, Type 140 (Vol. 2-R/17M) on which are mounted the valve-holders for the rectifier valves, Type CV187 (or CV235 or CV1072). The insulated tag-strip formerly mounted on the top-right of the choke L21 is now mounted on insulated pillars above the fuse F1B. The power unit chassis rests in the rack on two metal strip runners which are fitted one on each side of the chassis. These are not shown in the photograph.

34. The transformer T13 is designed to supply all the valve filaments in the R.F. driver and output units. The transformer secondary output voltages are marked on the circuit diagram. The filaments of the H.T. rectifier valves V9 and V10 are supplied by the two secondaries on the

P17242 M15684/G1398 11/50 2000 C & P Gp.1

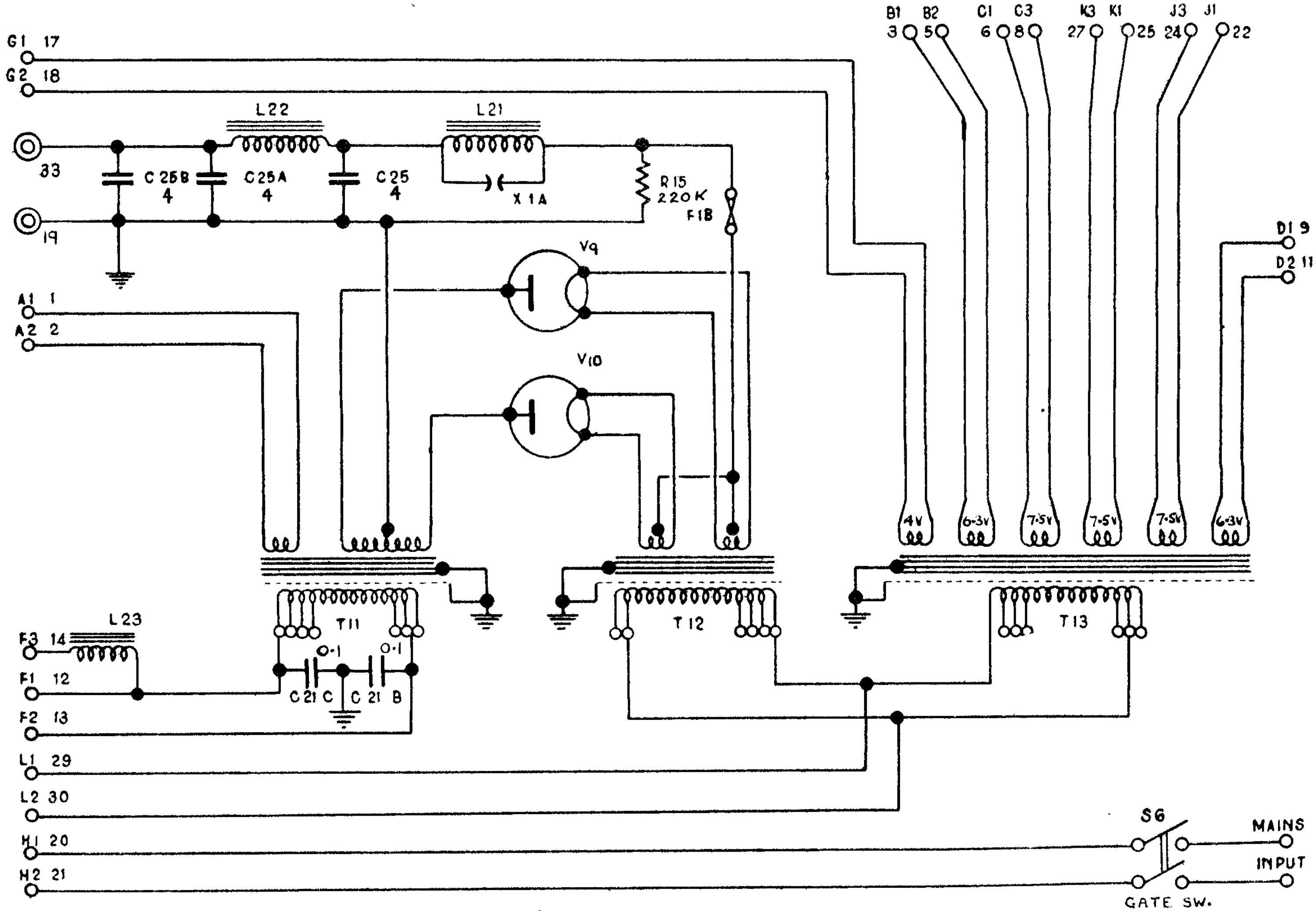


Fig. 5.—R.F. power unit—circuit

transformer T_{12}. H.T. for the rectifier valves is supplied by the transformer T_{11}. The primaries of the three transformers are wound for 230 volt a.c. supply, with tappings to cater for difference in local mains supply voltages.

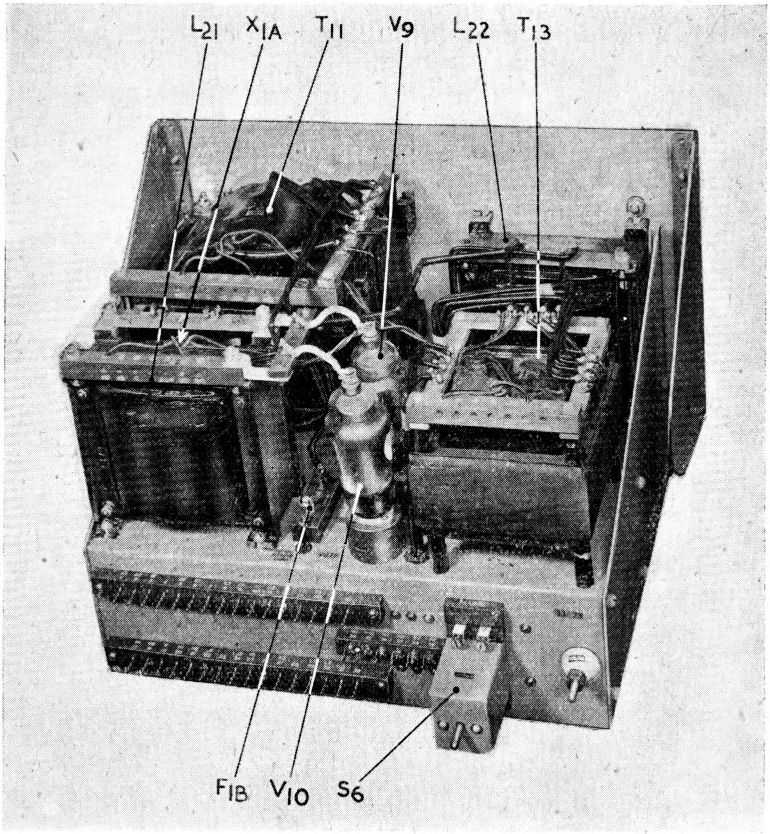


Fig. 6.—R.F. power unit—top view

35. The H.T. rectifier employs two hard rectifier valves V_9 and V_{10} (C.V.187) in a full-wave circuit with a choke input filter network consisting of the chokes L_{21} and L_{22} and the condensers C_{25}, C_{25A}, and C_{25B}. The bleeder resistor R_{15} acts as a condenser discharge resistor and the spark gap X_{1A} fitted across the choke L_{21} protects the filter circuit against abnormal surges. The rectifier output is 1000 volts 500 mA. The mains input to the primary of the H.T. transformer T_{11} is taken via the choke L_{23} which, for normal operation, is shorted out by the switch S_{5B} on the control unit. When this switch is open the output from the H.T. rectifier is reduced to approximately 500 volts so that initial setting-up of the transmitter can be done without damage to the valves.

36. A safety switch S_6 is mounted at the rear of the chassis. The mains supply to the transmitter is taken via this switch which is actuated by the door of the transmitter. When the door is open the mains supply is switched off.

Modulator power unit

37. The modulator power unit circuit diagram is given in fig. 8. Two photographic views are shown in figs. 9 and 10. This power unit is similar to the R.F. power unit and provides filament and H.T. supplies for the modulator unit. An additional H.T. rectifier with an output

of 300 volts provides H.T. supply for the low power stages of the modulator unit. The latter rectifier employs the full-wave rectifier valve V_{22} (V.U.71). In the T.1131B modulator power unit, the primary winding of the H.T. transformer T_7 is double-wound and tapped, and the mains supply can be connected either to the full winding or half winding by operation of the POWER SWITCH S_{5B} on the control unit. In this way either full or half voltage can be obtained.

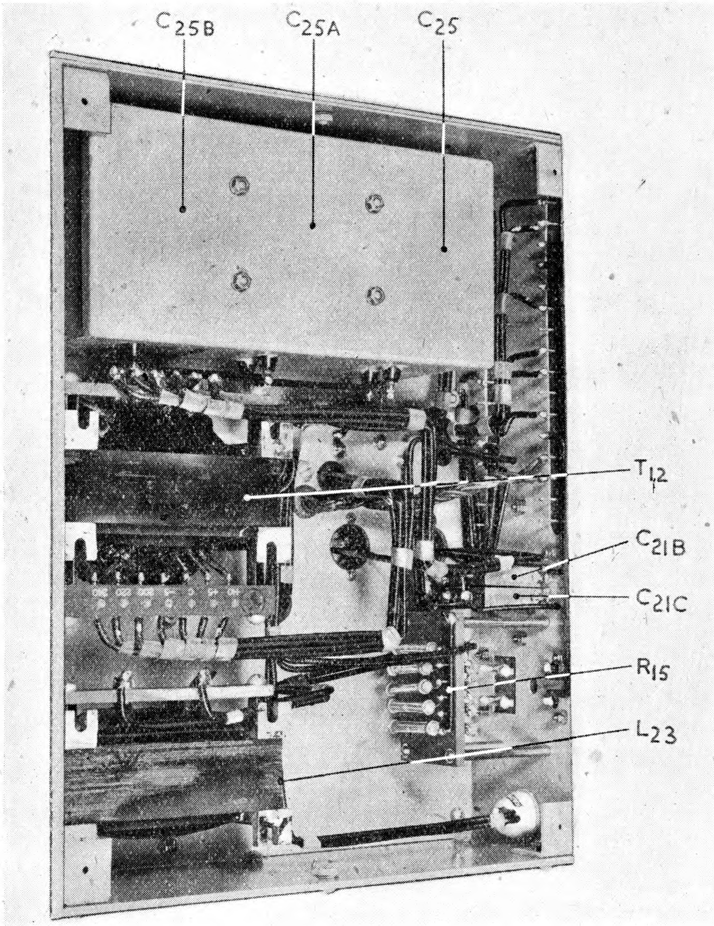


Fig. 7.—R.F. power unit—underside view

Modulator unit

38. The modulator unit circuit diagram is given in fig. 11 with photographs in figs. 12 and 13. The modulator consists of two single-valve amplifiers followed by three push-pull stages. The two single-valve amplifiers together with the LOCAL-REMOTE switch S_3, microphone transformer T_1, and the volume control R_{12}, are contained in a separate screening box which is mounted on the modulator chassis (fig. 14). The output from the screening box is coupled by the transformer T_2 to the first push-pull stage which consists of the valves V_{14} and V_{15}. This stage is coupled by the transformer T_3 to the second push-pull stage consisting of V_{16} and V_{17}. Negative feedback is applied via the resistance-capacity networks R_{18}, C_{22}, R_{26}, and R_{18A}, C_{22A}, R_{26A}. The output from this stage drives, via the transformer T_4, the output stage consisting of V_{18} and V_{19} operating under Class B zero bias conditions. Modulator output is taken from the secondary of the transformer T_5.

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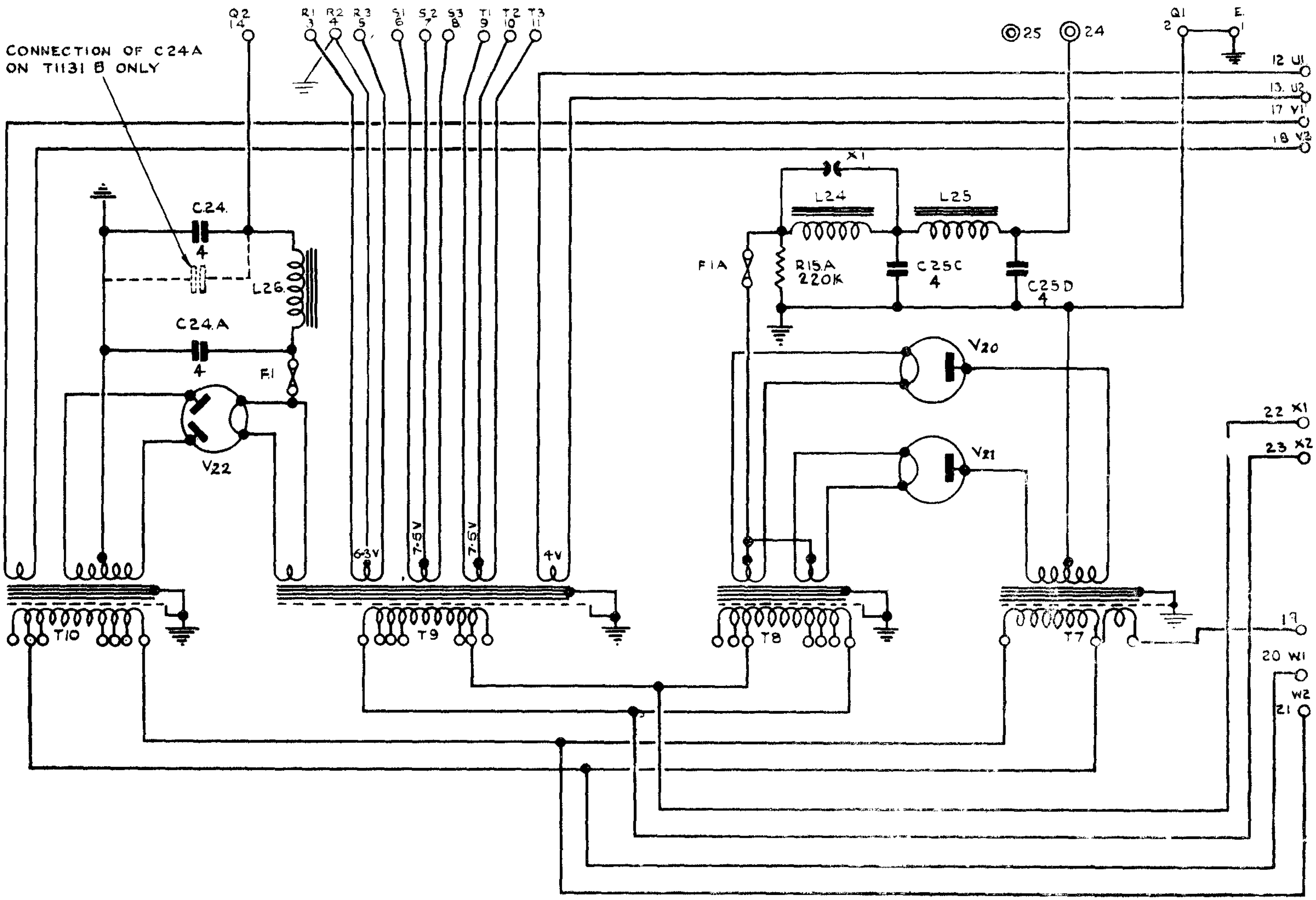

Fig. 8.—Modulator power unit—circuit

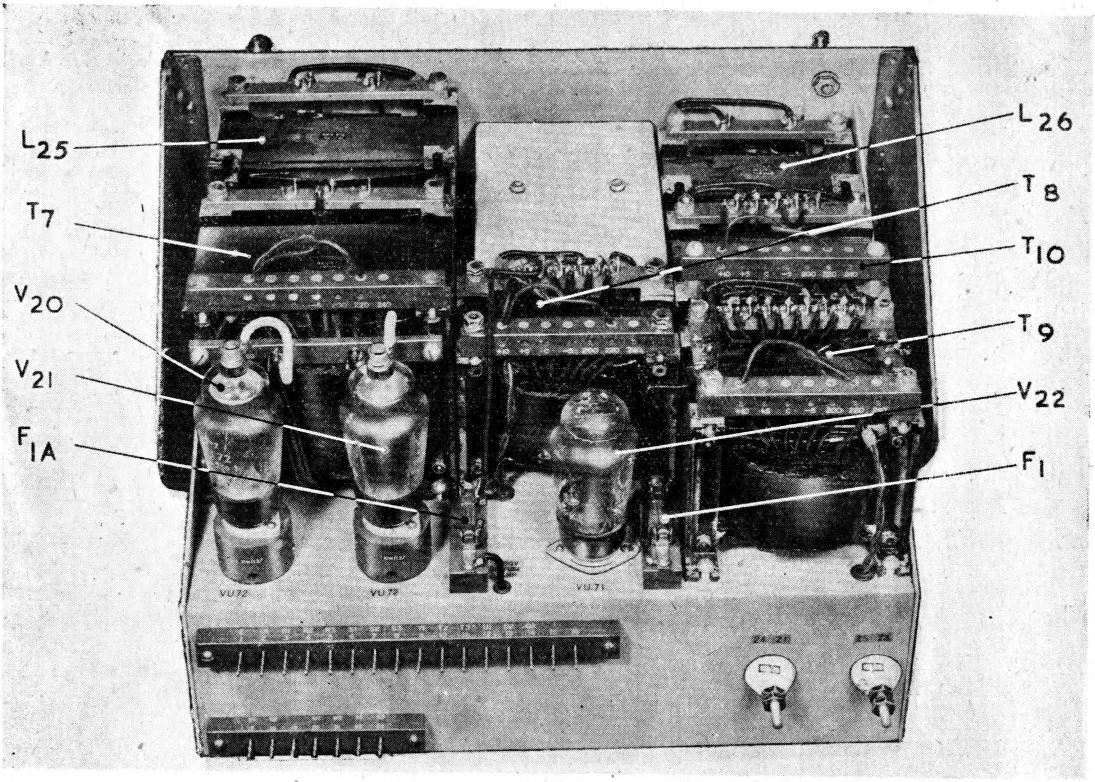

Fig. 9.—Modulator power unit—top view

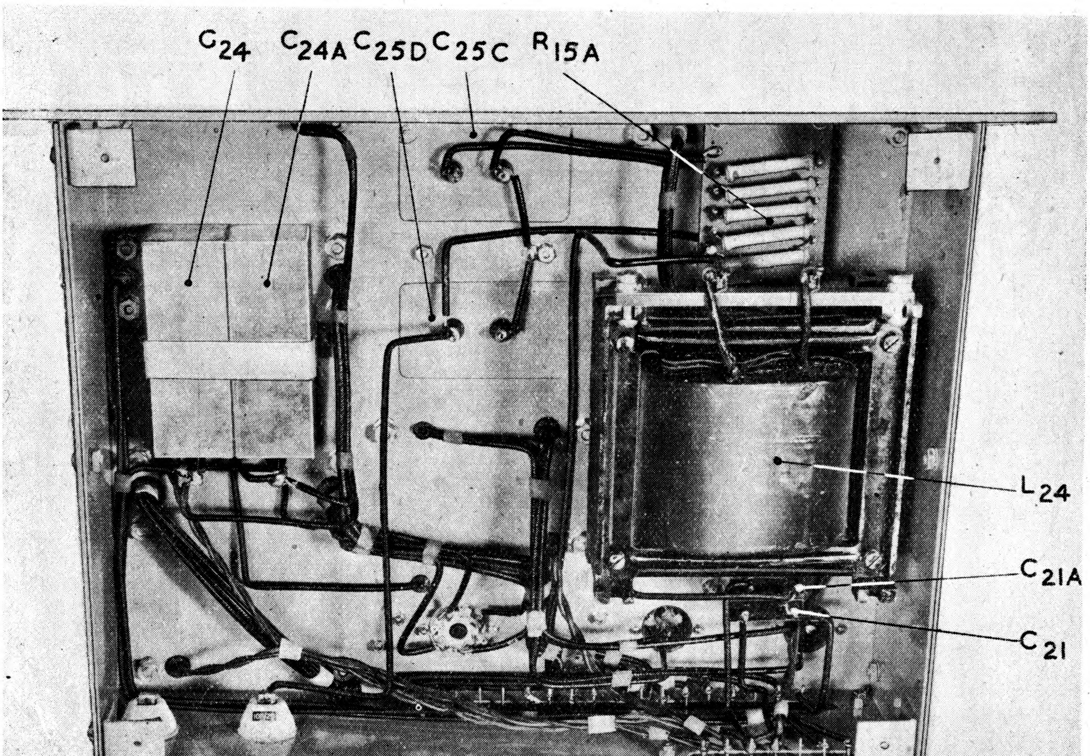

Fig. 10.—Modulator power unit—underside view

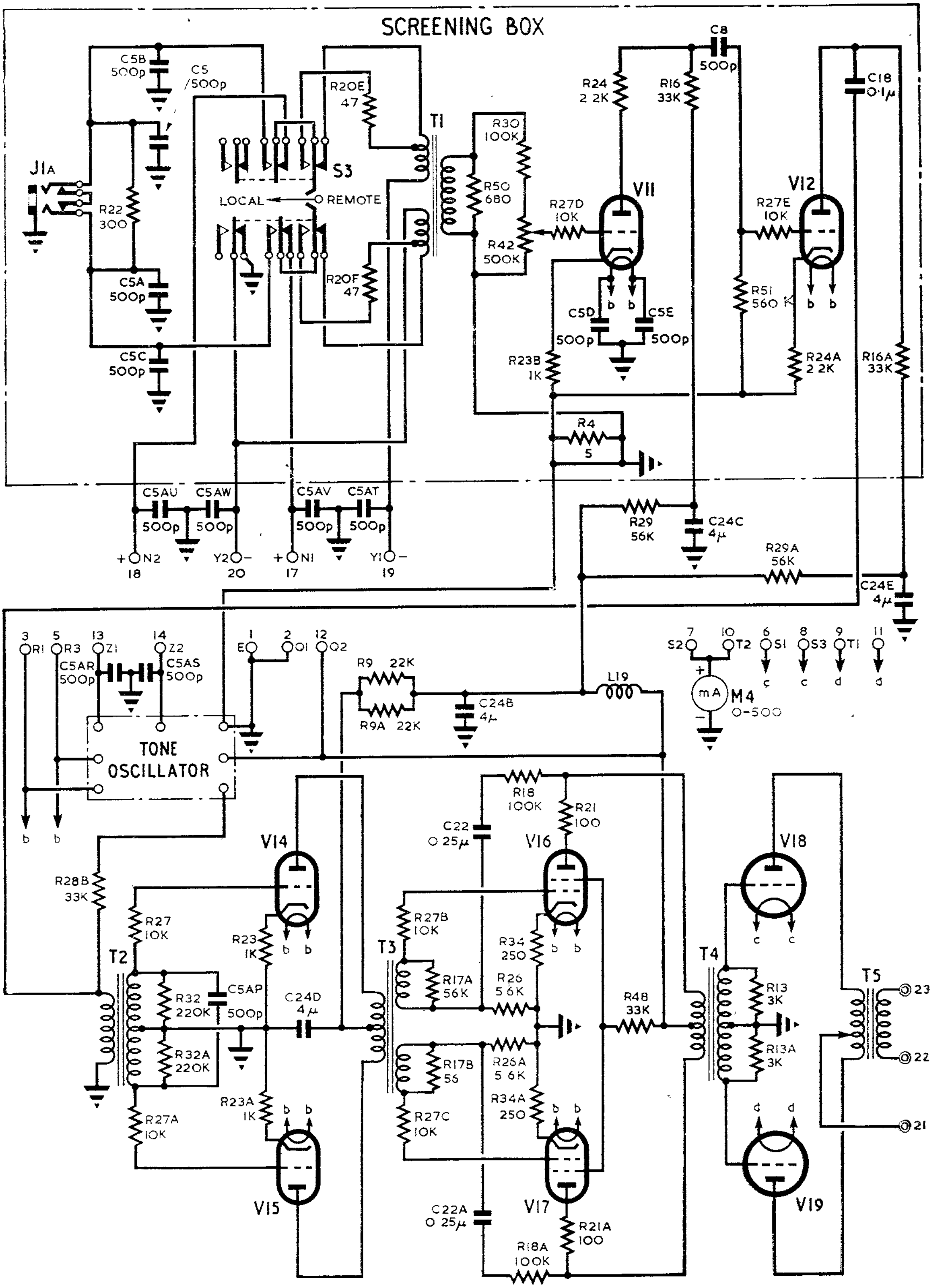

Fig. 11. Modulator unit—circuit

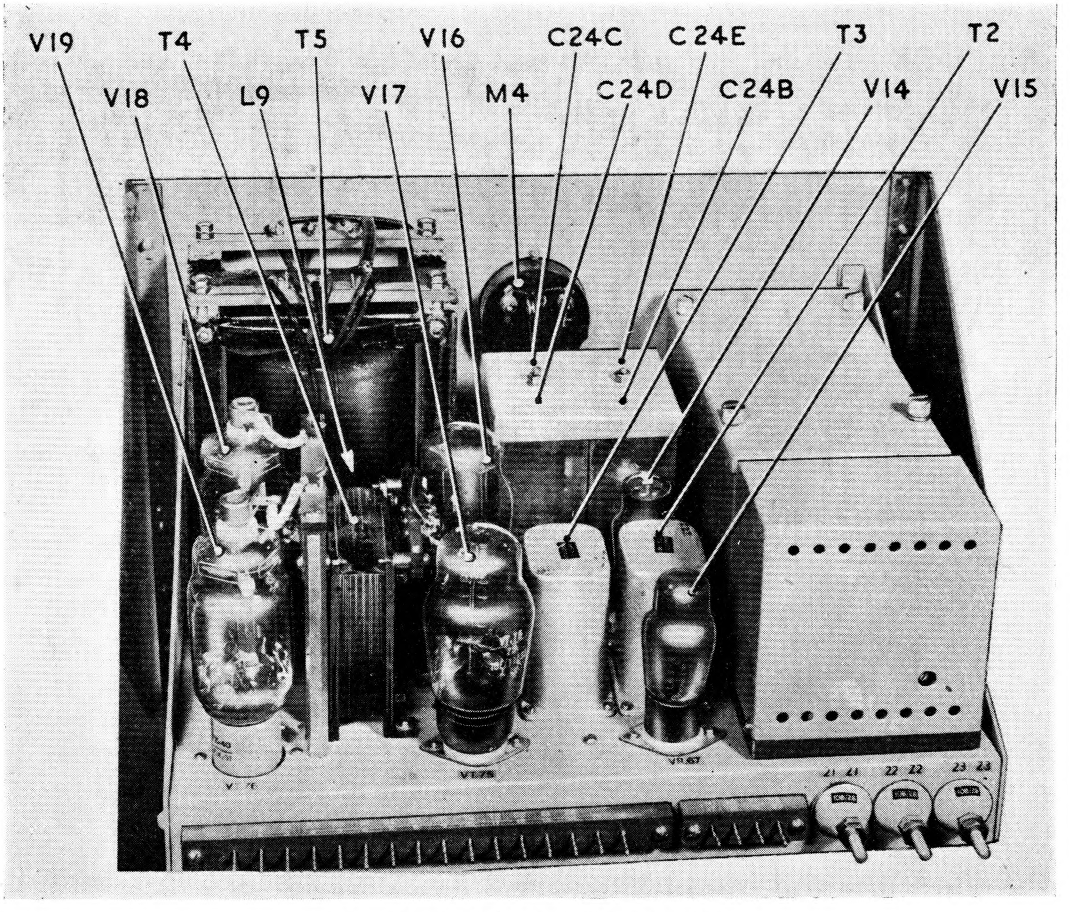

Fig. 12. Modulator unit—top view

39. The 1000 c/s tone oscillator, used for MCW operation, is a plug-in unit illustrated in fig. 15. A circuit diagram is given in fig. 16. The output from the oscillator, which is fed directly into the first push-pull stage of the modulator, is controlled by the relay J, energized from the filament supply rectified by the metal-rectifier W_1. The operation of the relay is controlled by an external telegraph key. The output voltage from the oscillator can be pre-set by the potentiometer R_{41}.

R.F. driver unit

40. A circuit diagram of this unit is given in fig. 17 and photographs are shown in figs. 18 and 19. The R.F. driver consists of a crystal-oscillator V_1, a first trebler V_2, a second trebler V_3 and a push-pull parallel doubler V_4 and V_5. The anode circuits of the oscillators and treblers are tuned by a ganged condenser consisting of C_{34A}, C_{34B}, and C_{34C}. Trimming condensers C_{35} and C_{35A} are provided on the oscillator and 1st trebler. The 2nd trebler is link-coupled to the grid circuit of the doubler by means of L_{30} and L_{31}. The grid circuit of the doubler is tuned by the condenser C_{29A} and the anode circuit by the condenser C_{28A}. The meter M_3 and the meter switch S_{7A} are provided for metering the various stages. The transformer T_{14} is provided to isolate the filaments of the two valves V_4 and V_5 in the doubler stage for measuring the cathode currents separately.

R.F. output unit

41. The circuit diagram of this unit is given in fig. 20 and photographs are shown in figs. 21 and 22. The R.F. output unit consists of two triode valves V_6 and V_7 in a neutralised push-pull circuit. The output from the driver unit is link-coupled by L_{35} and L_{36} to the grid circuit which is tuned by condenser C_{36}. The anode circuit is tuned by C_{29} and neutralising is effected by

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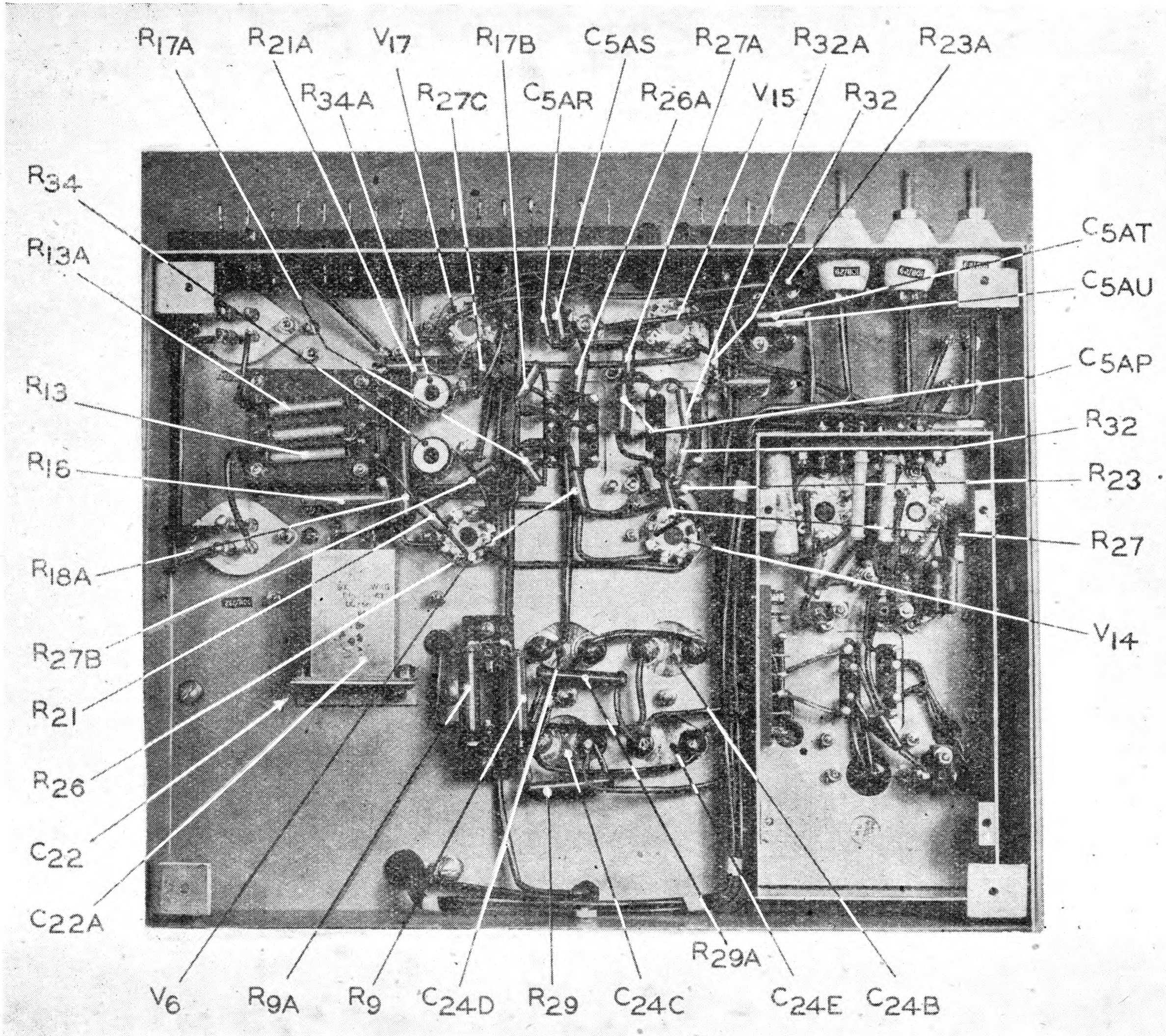


Fig. 13.—Modulator unit—underside view

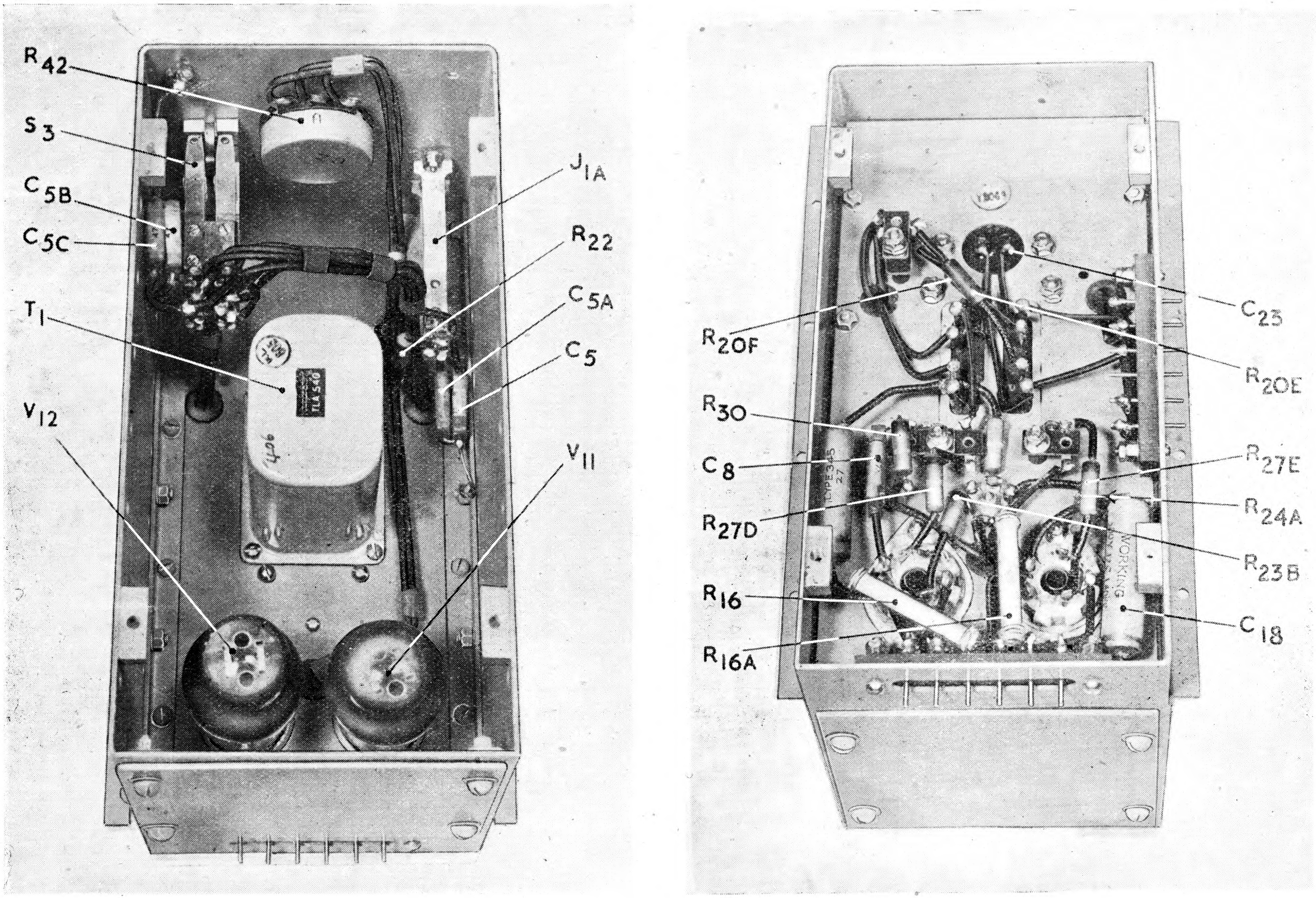


Fig. 14.—Screening box—top and underside views

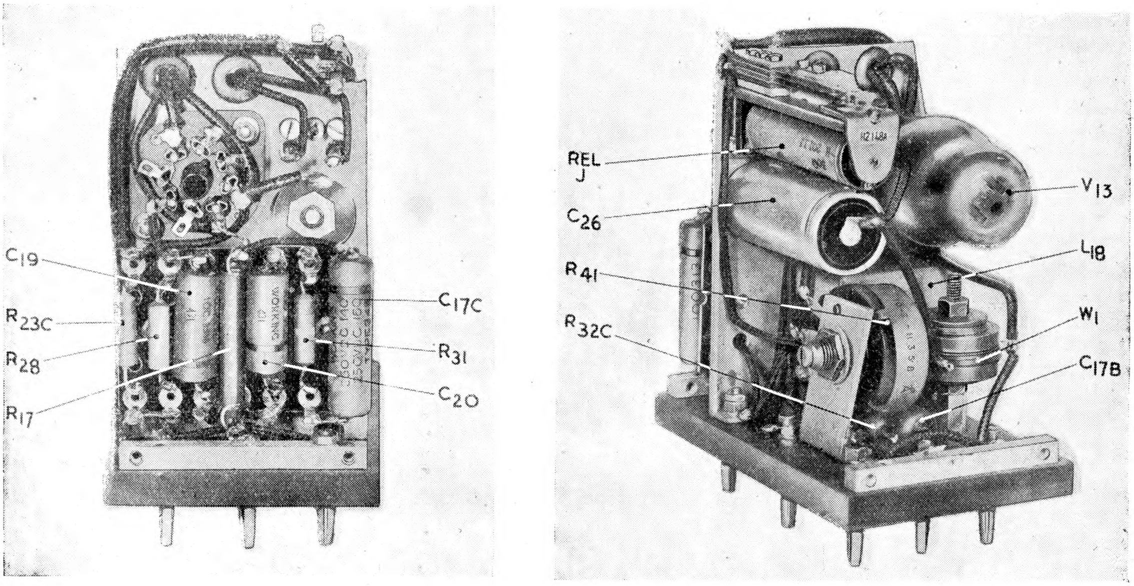


Fig. 15.—Tone oscillator

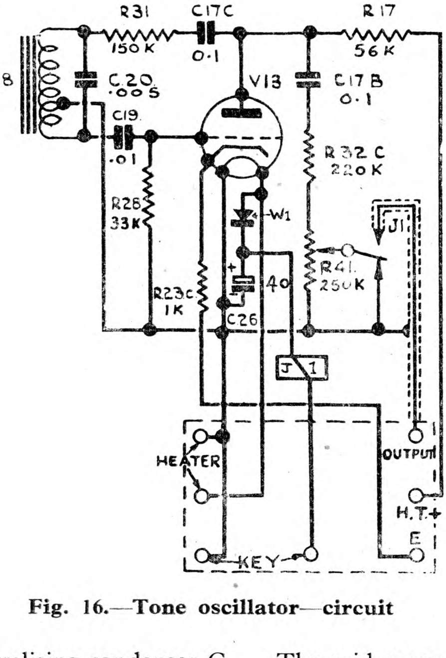


Fig. 16.—Tone oscillator—circuit

adjustment of the 2-gang neutralising condenser C_{37}. The grid current of each valve is measured by the meter M_1 in conjunction with the switch S_8, and the anode current by the meter M_2 in conjunction with the switch S_{8A}. The anode circuit is coupled to the output circuit by means of L_{37}, L_{38}, and L_{39}. The output circuit, which is tuned by C_{28}, is suitably tapped to enable the transmitter to work into a low impedance coaxial feeder. The H.T. link S_2 is provided to break H.T. for neutralising purposes.

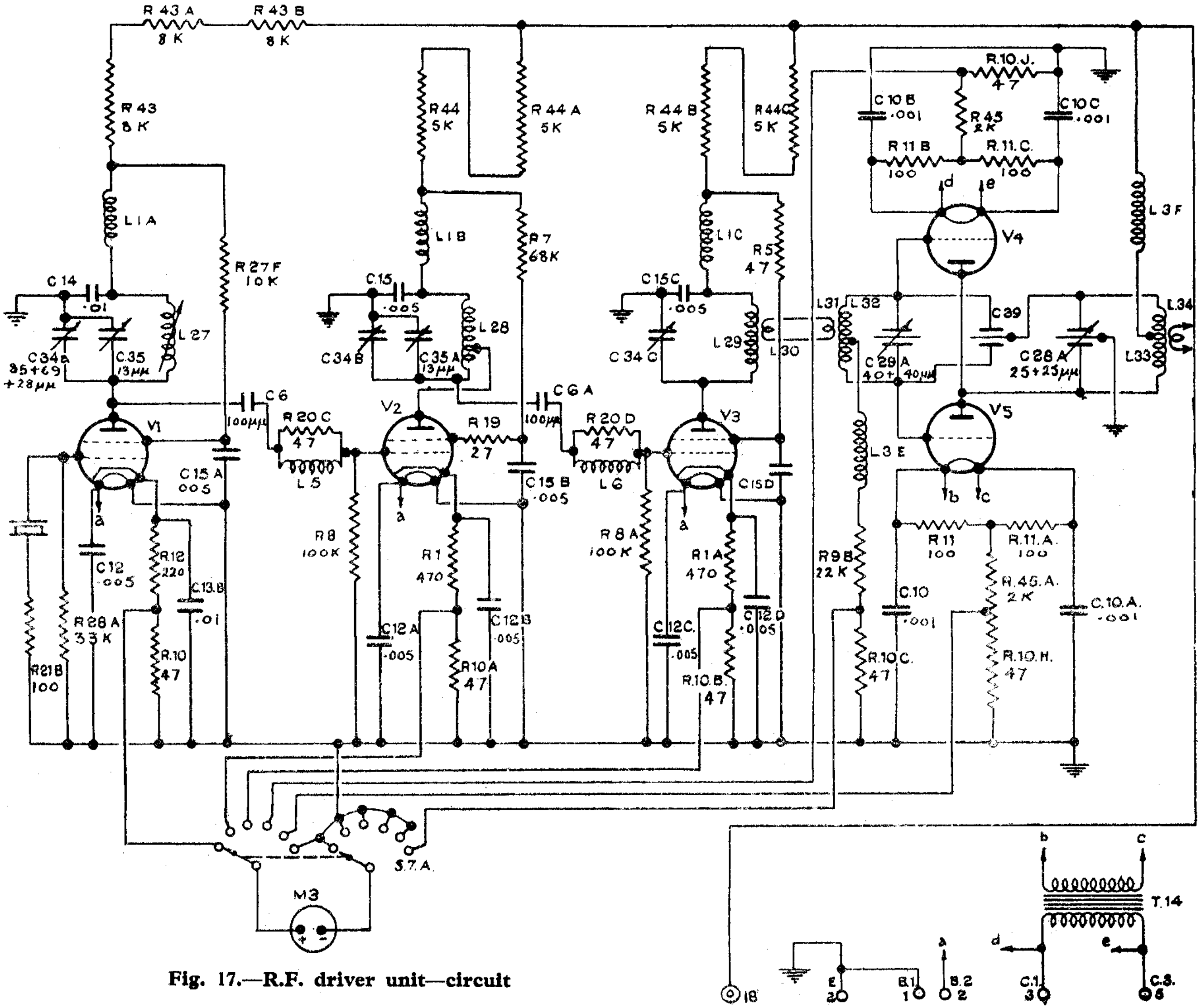


Fig. 17.—R.F. driver unit—circuit

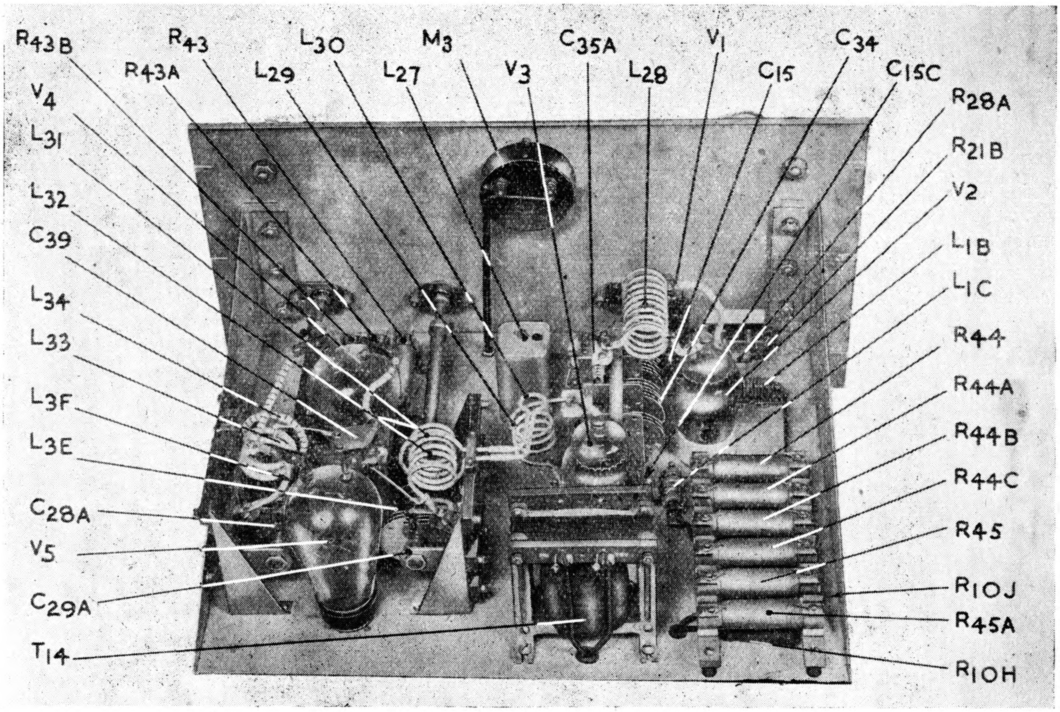


Fig. 18.—R.F. driver unit—top view

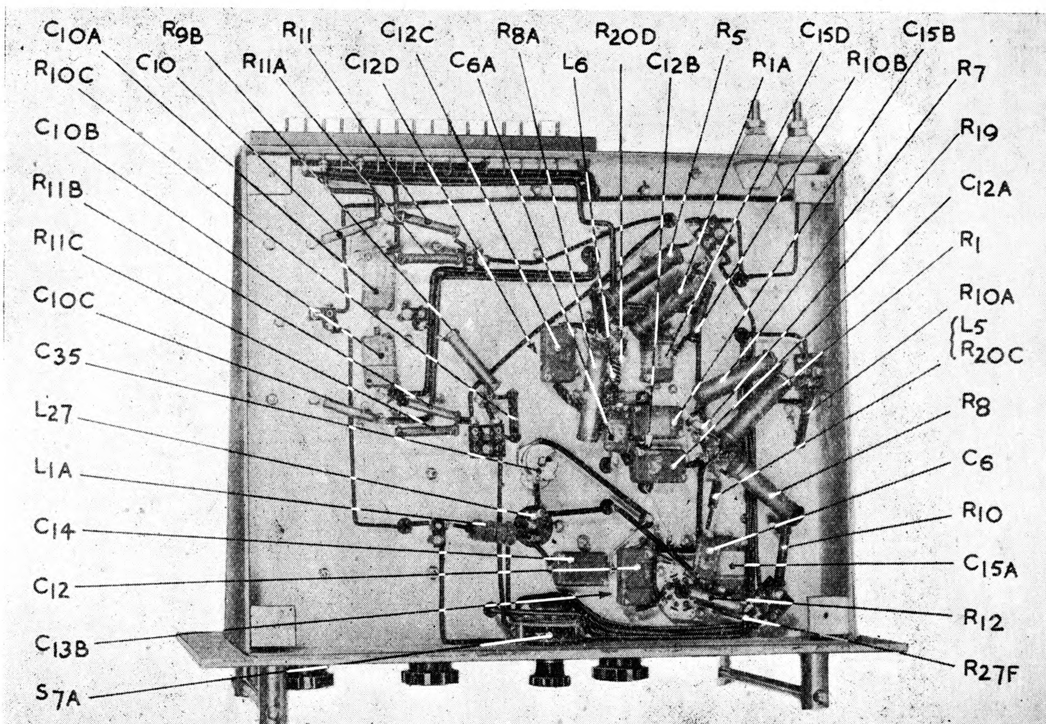


Fig. 19.—R.F. driver unit—underside view

C4M, C4L, in each case, are replaced by two condensers. 15pF each, in parallel.

(A.L.8)

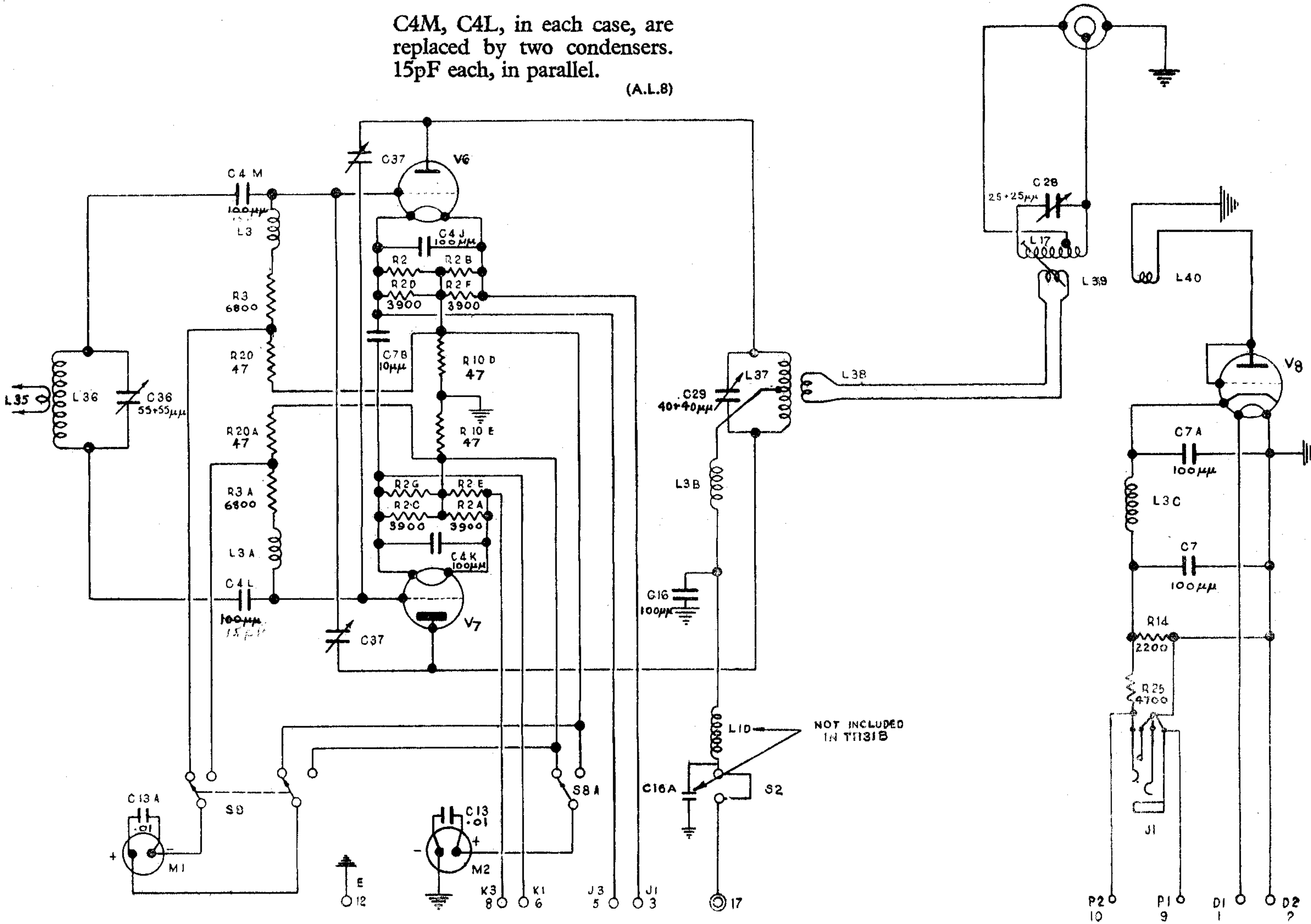


Fig. 20.—R.F. output unit—circuit

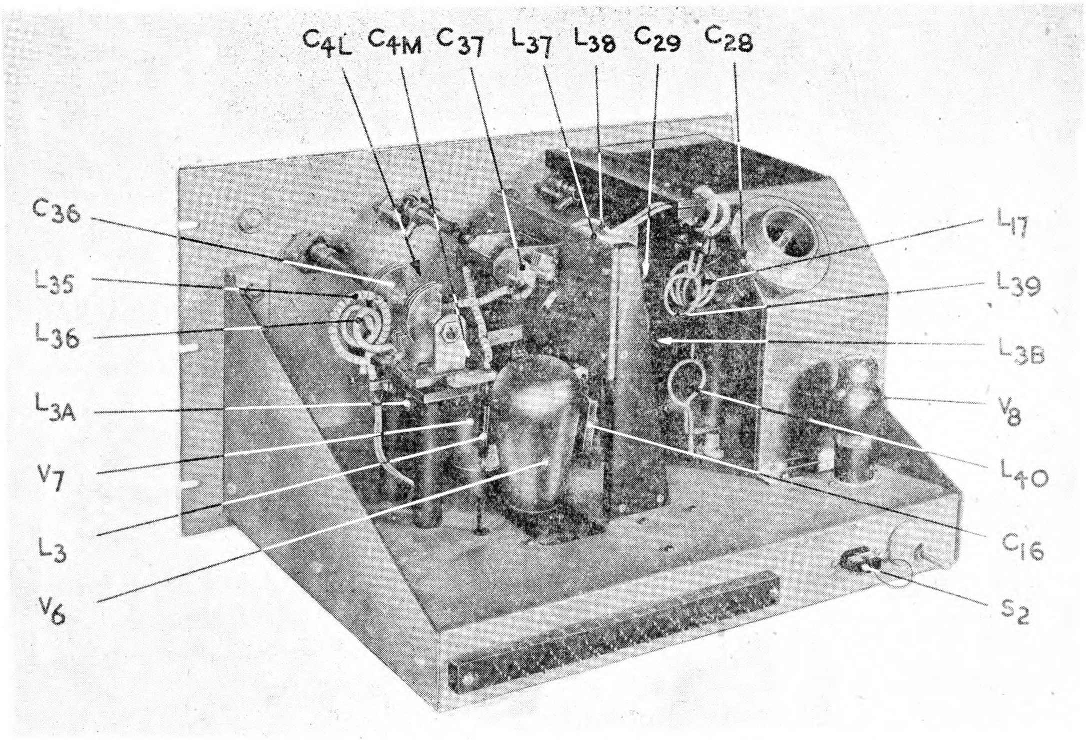


Fig. 21.—R.F. output unit—top view

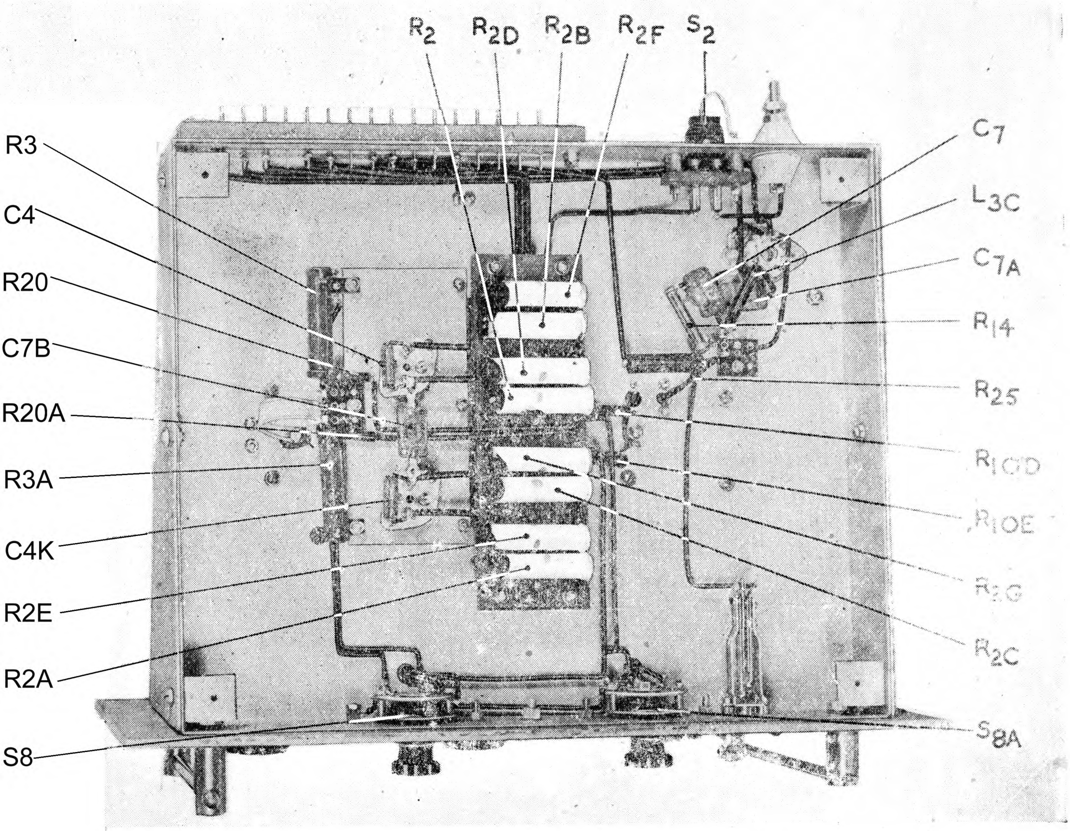


Fig. 22.—R.F. output unit—underside view

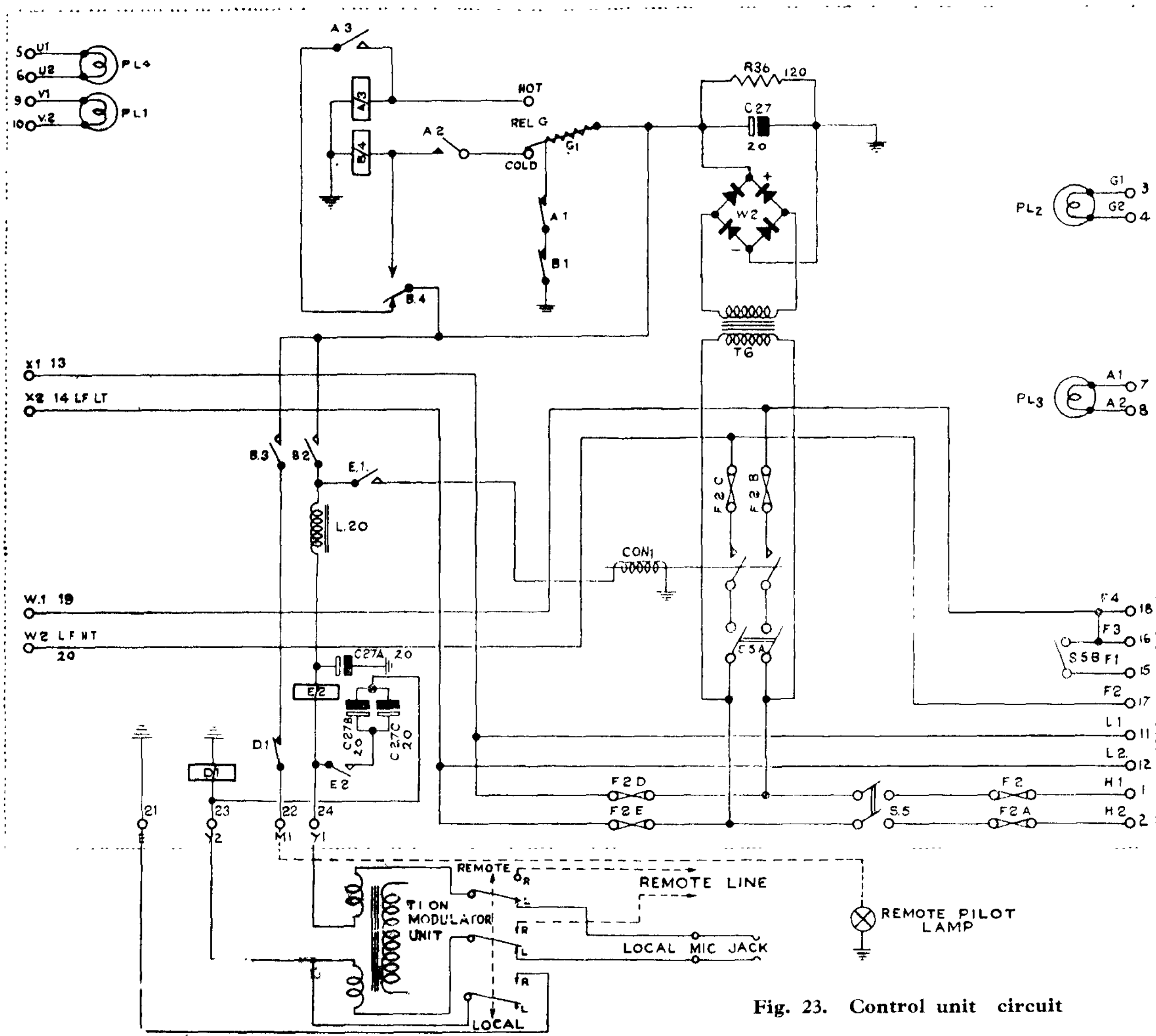


Fig. 23. Control unit circuit

42. The valve V_8, inductively coupled by means of L_{40} to the output circuit, provides facilities for monitoring the output of the transmitter.

Control unit

43. A circuit diagram of the control unit is given in fig. 23, and illustrations are shown in figs. 24 and 25. The control unit contains all the switches and relays for the control of the L.T. and H.T. supplies to the transmitter units. Pilot lamps are included to indicate when these supplies are switched on. The unit contains a delay mechanism consisting of the thermal relay RELG and two relays, relay A and relay B which give the delay of approximately 60 seconds between switching on the L.T. and H.T. supplies. The unit also provides a 24 volt d.c. supply which energises the relays and provides microphone current. The switch S_{5B} for reducing the H.T. voltage, the operation of which is described in paras. 35 and 37, is mounted on the front panel. On the T.1131A this switch is a make break and controls the R.F. H.T. only. On the T.1131B the switch is a double-pole changeover and controls the H.T. on both R.F. and modulator power units. The diagrams in fig. 27 show the differences in the connection of these switches.

44. The operation of the circuit can best be described by following the sequence of operations with reference to figs. 2 and 3. When the MASTER FILAMENTS switch S_5 is switched on, mains supply is connected to the filament transformers in the R.F. and modulator power units; the pilot lamps PL_4 and PL_2 glow, indicating that the filaments are on. At the same time the mains supply is connected to the transformer T_6 and 24 volts d.c. becomes available at the output of the rectifier W_2.

45. This 24 volt supply is connected via relay contacts A_1 and B_1 to the thermal relay RELG which commences to operate, and, after a delay of approximately 30 seconds, the contact G_1 reaches the HOT position. Relay A is then energised from the 24 volt supply. Contact A_1 opens, breaks the supply to RELG and contact G_1 commences to move towards the COLD position. At the same time relay A is held on by contact A_3 which is now closed; contact A_2 is also closed.

46. After a further delay of approximately 30 seconds contact G_1 reaches the COLD position and relay B is energised by the 24 volt supply. The operation of contact B_4 opens relay A and holds relay B on. Contact B_1 opens and maintains the RELG circuit open. At the same time contacts B_2 and B_3 are closed, and the 24 volt positive is connected to the terminal 24 (via the choke L_{20} and the relay E) and to terminal 22 via the contact D_1.

47. Referring to the circuit diagram in fig. 23 it is seen that terminals 23 and 24 are connected via the local remote switch and the microphone transformer to either a local microphone jack or a remote line dependent on the position of the LOCAL-REMOTE switch. When this switch is in the LOCAL position, this external loop circuit is made through the local microphone jack and relay E is operated, contact E_1 is closed, thus energising and closing the H.T. contactor CON_1. Now when the MASTER H.T. switch S_{5A} is switched on the mains supply is connected to the H.T. transformers in the R.F. and modulator power units. Pilot lamps PL_1 and PL_3 will glow indicating that the H.T. supply is on.

48. When the LOCAL-REMOTE switch is in the REMOTE position the MASTER H.T. switch S_{5A} is normally on. Operation of the SEND-RECEIVE switch at the remote position closes the external loop circuit between the terminals 23 and 24 and relay E is operated, thus H.T. is switched on as described in para. 44.

49. The contact E_2 is included in the circuit of the condenser C_{27B} and C_{27C} to prevent unwanted operation of relay E by condenser-charging currents when relay B operates. Relay D is included in order that a visual indication can be given at the remote position when the transmitter is ready for use. The visual indicating lamp at the remote end is connected by a line to the terminals 22 and 21. Referring again to fig. 11 it will be seen that when the LOCAL-REMOTE switch is put to the REMOTE position, relay D is shorted out, contact D_1 closes and the indicating lamp glows.

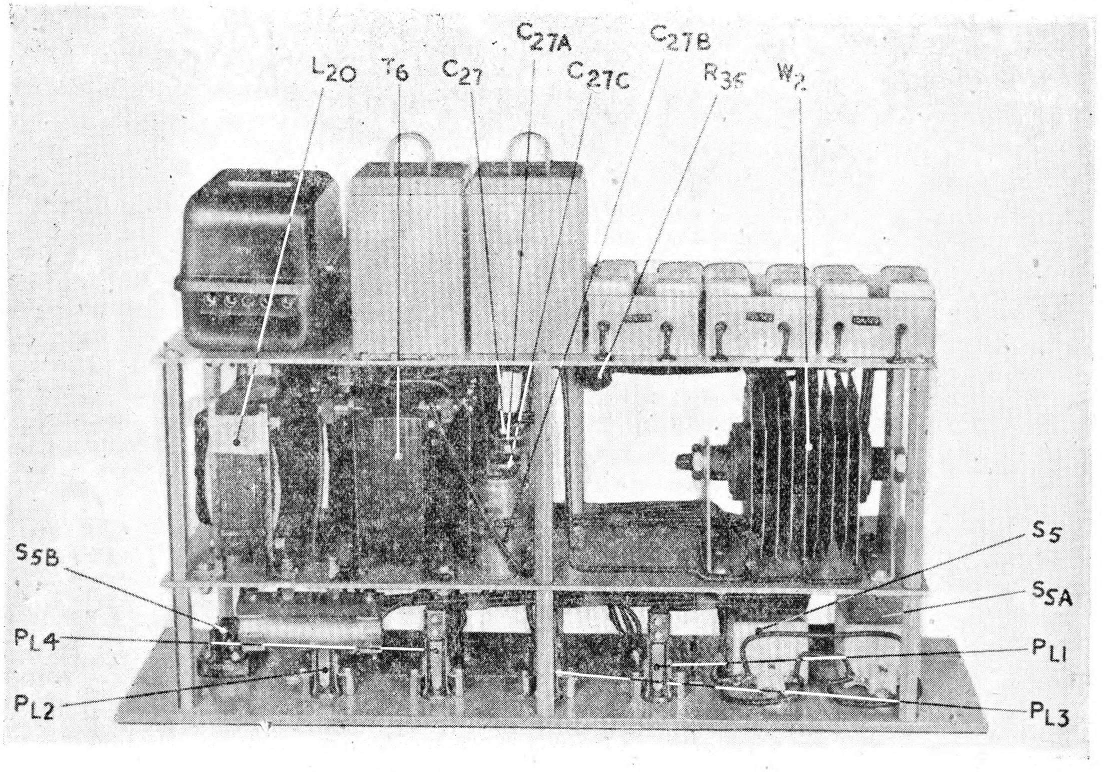


Fig. 24.—Control unit—top view

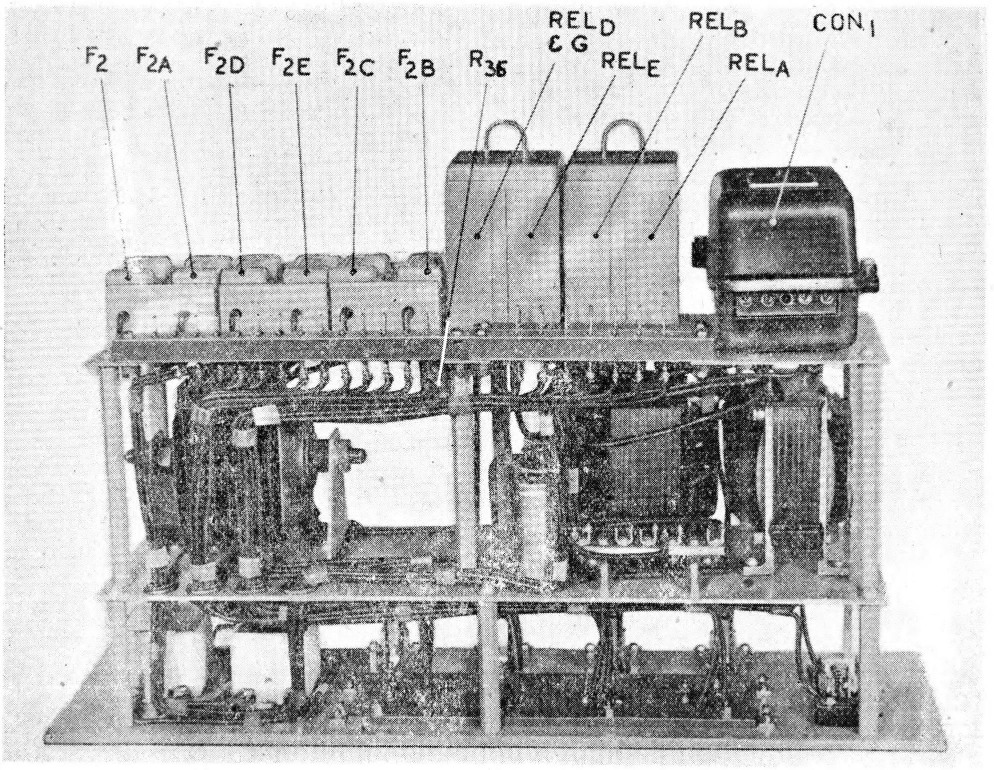


Fig. 25.—Control unit—underside view

SERVICING

50. Most of the simple faults which may occur in the transmitter can be traced by reference to the following fault-finding table.

Fault-finding

Fault	*Evidence*	*Cause*	*Remedy*
(i) No filament supplies.	No filament glow in valves. Pilot lamps PL_2 and PL_4 fail to glow.	Safety switch S_6 not making Mains fuses F_2 and F_{2A} blown. Filament fuses F_{2D} and F_{2E} blown.	Close rear door properly Renew fuses. Renew fuses.
(ii) Pilot lamps PL_2 and PL_4 fail to glow.	—	If filament supplies correct, fault will be due to defective lamps.	Renew the lamps.
(iii) No H.T. supply from R.F. power unit.	(*a*) No readings on meters of R.F. driver and R.F. output units. Pilot lamp PL_3 fails to glow. (*b*) No readings on meters of R.F. driver and R.F. output units. Pilot lamp PL_3 glows.	H.T. fuses F_{2B} and F_{2C} on control unit blown. H.T. contactor CON_1 not made. H.T. fuse F_{1B} on R.F. power unit blown. Rectifier valves V_9 and V_{10} defective.	Renew fuses. Check operation of thermal delay circuit. (See (vii)). Renew fuse. Renew valves.
(iv) No H.T. supply from modulator power unit.	(*a*) No readings on cathode current meter on modulator unit. Pilot lamp PL_1 fails to glow. (*b*) No readings on cathode current meter on modulator unit. Pilot lamp PL_1 glows.	H.T. fuses F_{2B} and F_{2C} on control unit blown. H.T. contactor CON_1 not made. H.T. fuse F_{1A} on modulator power unit blown. Rectifier valves V_{20} and V_{21} defective.	Renew fuses. Check operation of thermal delay circuit. (See (vii).) Renew fuse. Renew valves.
(v) Pilot lamps PL_1 and PL_3 fail to glow.	—	If H.T. supplies are available will be due to defective lamps.	Renew lamps.
(vi) No 300 volt supply on modulator.	No variation in reading in cathode current meter on modulator unit when transmitter is modulated.	Fuse F_1 on modulator power unit blown. Rectifier valve V_{22} defective.	Renew fuse. Renew valve.
(vii) Thermal delay circuit fails to operate.	No H.T. supplies.	Contacts A_1 or B_1 not making. Relay A not made. Relay A fails to hold in. Relay B not made.	Check contacts. Check that contact G_1 on thermal relay is made in the HOT position. Check contact A_3. Check contact G_1 on thermal relay is made in COLD position. Check contact A_2 and B_4.
(viii) H.T. contactor CON_1 fails to operate.	Pilot lamps PL_1 and PL_3 fail to glow.	No volts on contactor CON_1 coil.	Check operation of contacts B_2 and E_1.

Fault	*Evidence*	*Cause*	*Remedy*
(ix) Crystal oscillator valve V_1 fails to oscillate.	No change in cathode current of oscillator valve for any position of the control C.O. AND TREBLERS.	Defective crystal. Defective valve.	Change crystal. Change valve.
	No oscillator valve cathode current.	Defective valve. Break in H.T. circuit.	Change valve. Check H.T. circuit.
(x) 1st trebler valve V_2 not operating correctly.	No change in 1st trebler cathode current as tuning control is rotated.	Defective valve. Coupling condenser C_6 defective.	Change valve. Change condenser.
	No 1st trebler cathode current.	Defective valve. Break in H.T. circuit.	Change valve. Check H.T. circuit.
(xi) 2nd trebler valve V_3 not operating correctly.	No change in 2nd trebler cathode current when tuning control is rotated.	Defective valve. Coupling condenser C_{6A} defective.	Change valve. Change condenser.
	No 2nd trebler cathode current.	Defective valve. Break in H.T. circuit.	Change valve. Check H.T. circuit.
(xii) Doubler valves V_4 and V_5 not operating correctly.	No doubler grid current.	Defective valves. Coupling link L_{30}/L_{31} out of position.	Change valves. Replace in correct position.
	No doubler cathode current.	Defective valves. Break in H.T. circuit.	Change valves. Check H.T. circuit.
(xiii) R.F. output valves V_6 and V_7 not operating correctly.	No amplifier grid current.	Defective valves. Link between L_{34} and L_{35} disconnected.	Change valves. Reconnect link.
	No amplifier cathode current.	H.T. link S_2 removed from socket. Break in H.T. circuit.	Replace link in socket. Check H.T. circuit.
(xiv) Monitor valve V_8 not operating.	No signal in monitor telephones when transmitter is modulated.	Defective valve. Jack J_1 faulty.	Change valve. Check contact springs on jack.
(xv) No output from modulator.	No change in modulator cathode current when transmitter is modulated.	LOCAL/REMOTE switch S_3 in wrong position. Microphone not properly connected. V_{11} defective. Volume control R_{42} turned fully anti-clockwise. V_{12}, V_{14}, V_{15}, V_{16}, or V_{17} defective. No 300 volt supply.	Place S_3 in correct position. If local mic. in use check mic. and jack J_{1A}. If remote mic. in use check mic., and mic. lines. Renew valve. Adjust volume-control. Renew defective valve or valves. See item (vi).
	Incorrect static modulator cathode current.	Defective valve V_{18} and/or V_{19}.	Replace valve or valves.
(xvi) No modulation on M.C.W.	No change in modulator cathode current when key is pressed.	Oscillator unit plugs not making good contact with sockets. Defective valve V_{13}. Output control R_{41} turned fully anti-clockwise. Contact J_1 on relay J not making. Relay J not functioning.	Examine plugs. Change valve. Adjust R_{41}. Check contacts. Check relay circuits.
(xvii) No remote signal light.	Remote lamp fails to glow with LOCAL/REMOTE switch in REMOTE position.	Contacts D_1 or B_3 not making.	Check contacts.

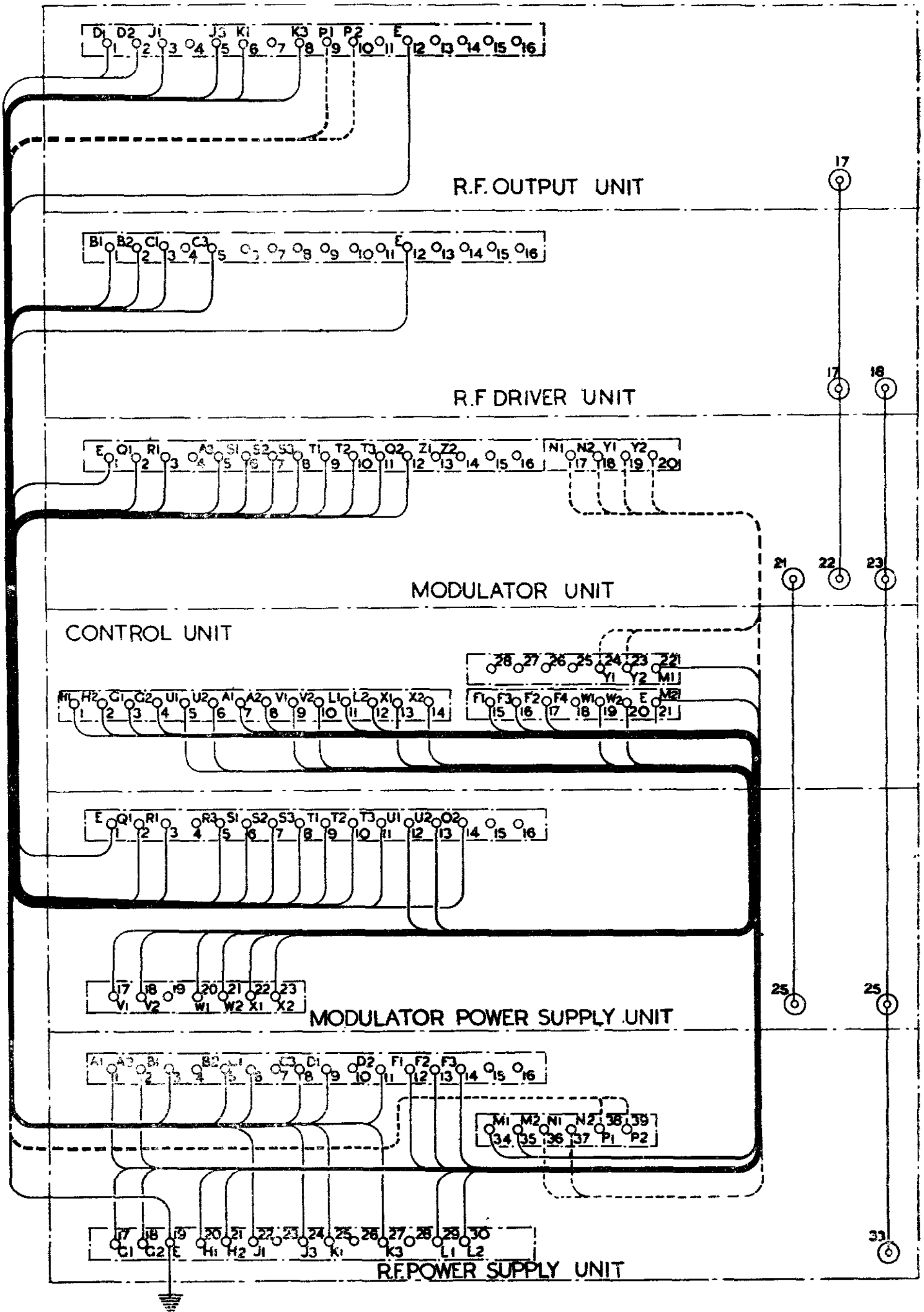


Fig. 26.—Cable forms

Notes.—(i) In this diagram the inter-unit wiring can be traced by noting that all the terminals marked with the same suffixed letter are connected together, e.g. terminal D_1 on the R.F. POWER SUPPLY UNIT is connected to terminal D_1 on the R.F. OUTPUT UNIT. On some transmitters the terminals are marked with numbers only. In these, the wiring can be traced by referring to the corresponding suffixed letters in this diagram.

(ii) This diagram shows the wiring of T.1131A. For T.1131B, the following changes should be noted:—

(*a*) Terminal 4 on the MODULATOR UNIT connects to terminal 4 on the MODULATOR POWER UNIT.

(*b*) The other differences in wiring occur in the HIGH-LOW power switch circuit and are shown in fig. 27.

Ganging of condensers C_{34A}, C_{34B}, and C_{34C}

51. Under normal conditions it should not be necessary to adjust the trimmer condensers or inductances of these circuits in any way, but should the driver unit have been subjected to bad treatment or a complete overhaul, it may be necessary to re-gang the circuits. To do this satisfactorily, proceed as follows:—

(i) Set the ganged condenser to a dial reading of 18 divisions.

(ii) Set the trimmer condensers of the crystal oscillator and T_1 to approximately one-quarter mesh.

(iii) Insert crystal of frequency 8670 kc/s approximately.

(iv) Place POWER SWITCH FOR TUNING to FULL and switch on MASTER H.T.

(v) With meter switch S_{7A} in C.O. position, vary crystal oscillator trimmer. It will be noted that as the condenser is rotated, the cathode current will fall to a minimum. On one side of resonance, this fall will be gradual, on the other, very sharp. The condenser should be set to about 1·5-2 mA above absolute minimum on the gradual side.

(vi) Set meter switch S_{7A} to T_1 position and adjust the inductance L_{28} by stretching, or compressing, the coil for resonance.

(vii) Set meter switch to T_2 position and adjust the inductance L_{29} as above for resonance.

(viii) Insert crystal of 5550 kc/s, set meter switch to T_1 position and tune the ganged condenser. The reading will be approximately 90 divisions. Repeat (v) and (vi) above. There should be little or no change.

(ix) Rotate the ganged condenser and see than T_2 tunes within the scale reading 88-92 divisions.

(x) Set the meter switch S_{7A} to DOUBLER-GRID, and tune the grid circuit.

(xi) Set the meter switch to T_1 position and note scale reading for resonance of this circuit. If the reading is higher than for T_2, increase the inductance by compressing the coil. If the reading is lower than T_2, stretch the coil. The resonance point for T_1 should be the same as for $T_2 \pm 1$ division.

(xii) Insert 8670 kc/s crystal. Set meter switch to T_1 position and rotate the ganged condenser for resonance. If this is higher on the scale than T_2, the T_1 trimmer condenser C_{35A} should be reduced. If the reading is lower than T_1, the trimmer should be increased. Resonance should occur at the same reading as $T_2 \pm 1$ division.

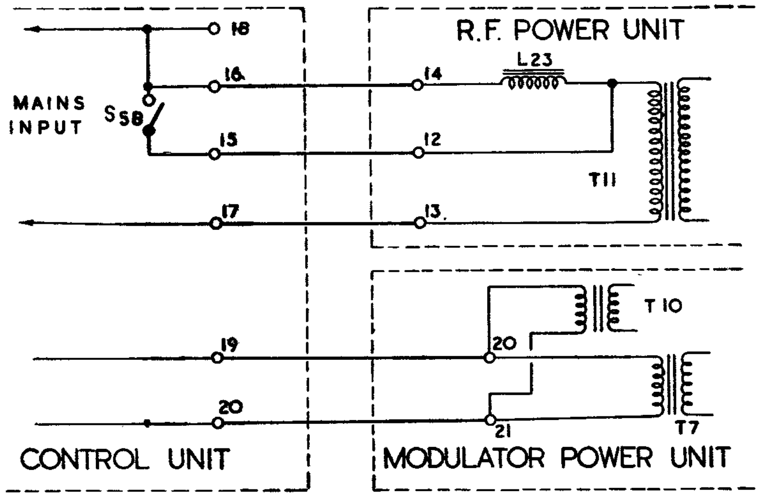
(xiii) Insert 5550 kc/s crystal and check that T_1 and T_2 are still in line at this setting. Make any readjustment necessary to the coil of T_1.

(xiv) Insert 8670 kc/s crystal and set ganged condenser to resonance for T_1 and T_2. Adjust crystal oscillator trimmer condenser C_{35} so that cathode current is 1·5-2 mA greater than absolute minimum on the gradual side of the resonance curve.

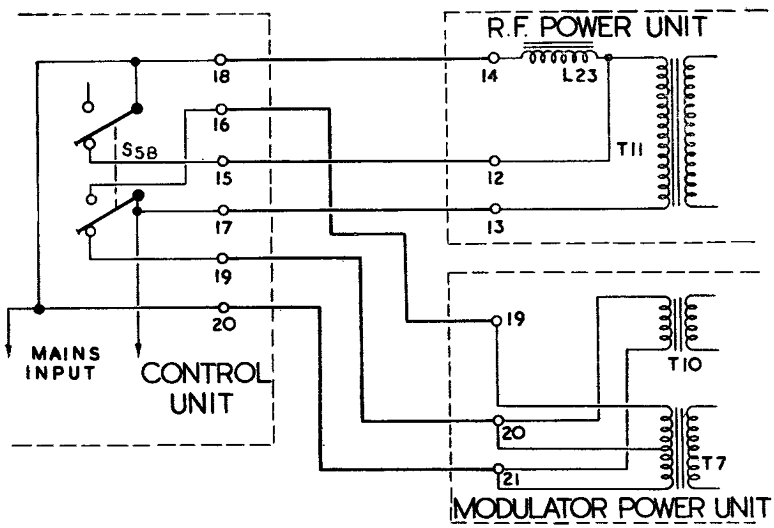
(xv) Insert 5550 kc/s crystal and see that the oscillator is oscillating normally at the resonance point for T_1 and T_2.

(xvi) If, after carrying out (i) to (v) inclusive above, the crystal oscillator refuses to oscillate for any position of the trimmer condenser, it probably means that the iron core of the oscillator inductance has become misplaced possibly through the seal on the adjusting screw protruding through the bottom of the can and chassis having broken. In this case the ganged condenser should be set to 18 divisions, the oscillator trimmer to approximately one-quarter mesh and the adjusting screw referred to above varied until the oscillator commences to function. The inductance should then be adjusted until the anode current is reading 1·5-2 mA above absolute minimum on the smooth side of resonance. **This inductance should never be varied unless it is certain that its value must have changed.**

52. It should be realised that the second trebler T_2 circuit is not provided with a trimmer condenser and relies entirely on its inductance and swing of the ganged condenser to cover the frequency range. This circuit must, therefore, be the basic one to be properly adjusted and the other two circuits brought into line. No difficulties should be experienced in covering the full frequency range of all three circuits between scale settings of 18-90 divisions.



(a) CONNECTION OF POWER SWITCH FOR TUNING ON T.1131A



(b) CONNECTION OF POWER SWITCH ON T.1131B

Fig. 27.—Wiring of power switches

[P.T.O.

Adjustment of link coupling

53. The grids of the R.F. output valves V_6 and V_7 are coupled to the doubler anode circuit by a link circuit consisting of two one-turn coils coupled to the respective tuned circuits and connected together by means of a low loss flat cable. The degree of coupling is not critical but may require adjustment on installation. This adjustment must be carried out on the driver unit. The most satisfactory position for this coil will normally be that which gives about 45°-50° coupling. When making adjustments to this coil it should be so positioned that the best possible drive is obtained on the R.F. output valves for minimum loading of the doubler anodes. The coupling should be adjusted until the figures quoted in Table 3 for doubler anode current and amplifier grid current are reached. Increases of coupling beyond this point will cause a large increase in doubler anode current without any appreciable increase in amplifier grid current. Over-coupling will also reduce the amount of dip in the doubler anode current.

Adjustment of neutralising condenser vanes

54. If the neutralising procedure as detailed in para. 25 fails to provide a satisfactory neutralising position, it is possible that the condenser vanes have changed their position relative to the knob on the front panel, due to some sudden shock. In this case the grub screws tightening the extension spindle to the slow motion drive should be slackened, and the knob set to mid-point. Vary the condenser by means of the extension spindle until a satisfactory position has been found. The grub screws should be tightened and transmitter neutralised correctly at the desired frequency.

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Chapter 2

TRANSMITTER, TYPE T.1131J

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

Introduction

1. The transmitter Type T.1131J is a development of the T.1131B, differing mainly in that the circuit of the RF output unit has been modified to give a higher efficiency in the upper frequency range (156 Mc/s). Another modification is that the HT supply to the tone oscillator is only made when the keying relay is operated. This ensures that the oscillator is working only when required and not all the time that the transmitter is switched on, as occurred in the earlier transmitters.

2. An output of 50 watts is obtained at a frequency range of 100–156 Mc/s which gives a ground-to-air range of 100 miles when the aircraft is flying at 10,000 ft. Power is supplied to the transmitter from the 230-volt 50 c/s mains and the consumption is 1,125 watts.

DESCRIPTION

3. There are six main units, which are interchangeable between transmitters; they are mounted on a standard rack. These units are:—

RF output unit Type 31	10D/17766	Final amplifier
RF driver unit Type 2	10D/17765	Oscillator and frequency multiplier
Modulator unit Type 1	10D/12	Modulator and tone oscillator
Control unit Type 323	10D/386	Master control panel
Modulator power unit Type 425	10K/1901	Power supply to modulator
RF power unit Type 778	10K/16569	Power supply to RF driver and output units

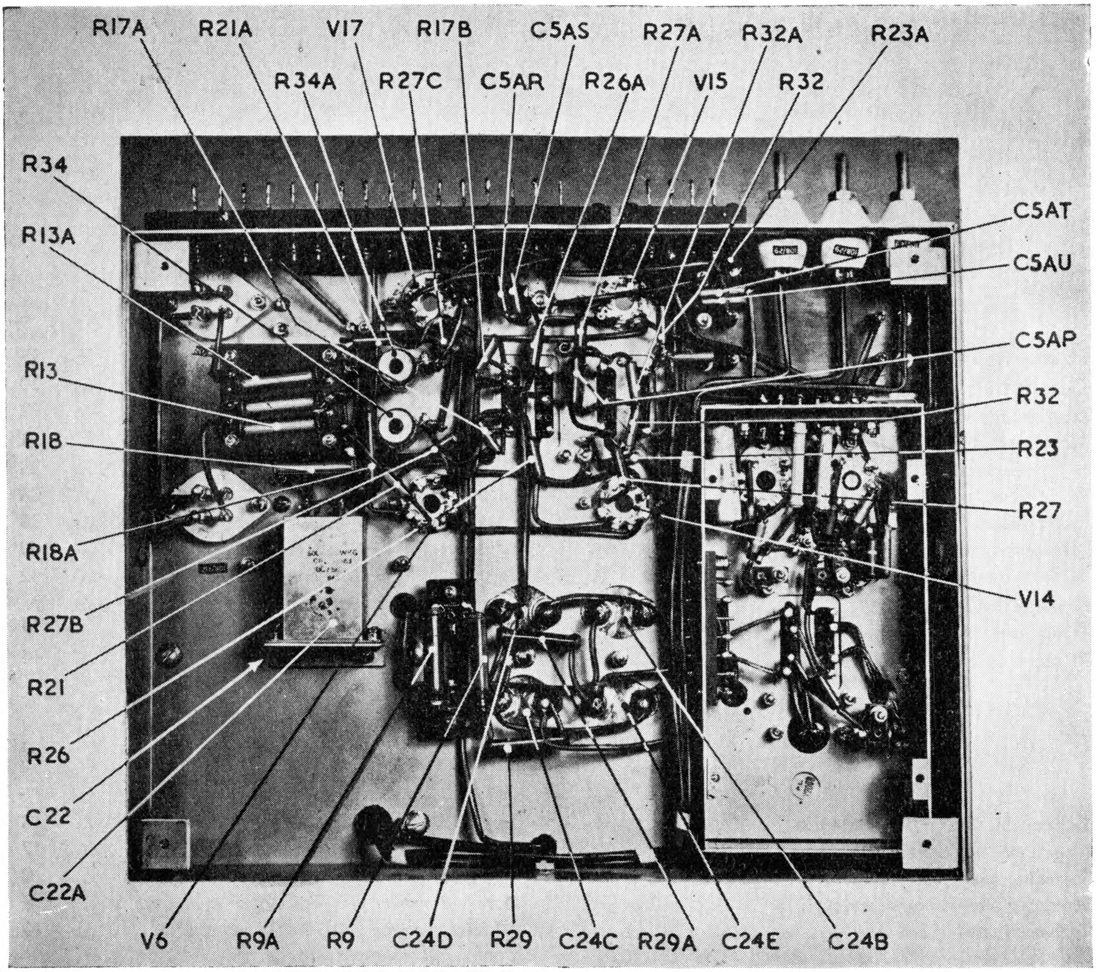

Fig. 2. Modulator—underside view

4. In appearance the units of the T.1131J are similar to those of the T.1131A & B and therefore illustrations have only been given where substantail differences exist. Reference should therefore be made to Chap. 1 for location of the controls and components.

Brief details of the circuit (*fig. 1 at end of chapter*)

5. The RF section of the transmitter consists of a crystal oscillator followed by three frequency-multiplying stages and a final amplifying stage. Anode modulation is used in the final stage. A high-power modulator is therefore required and it is designed for use with a carbon microphone. To allow the use of MCW a 1000 c/s tone oscillator is part of the modulator. There are three push-pull amplifier stages for speech and tone and in addition, or speech, there are two single-valve preamplifier stages Metering and monitoring facilities are incorporated in the units.

Modulator

6. Due to the type of modulation employed (anode) considerable undistorted power must be developed by the modulator unit and therefore five amplifying stages are used. Two are single-valve amplifiers working in Class A; the following two stages are two-valve amplifiers working in Class AB push-pull and the final stage is Class B push-pull, zero bias.

7. To prevent interference, the first two stages, the remote control switching and the microphone transformer are contained in a separate screened unit, referred to as the screening box unit. The input to the first stage (V11) is tapped off from a potentiometer (R30, R42) connected across the secondary winding of the microphone transformer. R42 is variable to allow adjustment of the depth of modulation. De-coupling of the heater is by C5D and C5E. The output from V11 is resistance—capacity fed through C8, R27E to V12. R28B and R24A are the grid bias resistors.

8. The output from V12 is transformer coupled (T2) to the push-pull stage consisting of two indirectly-heated triodes V14 and V15, C18 is the DC stopper. To prevent transients producing dangerously high voltages across the secondary of the transformers T2, resistors R32 and R32A and condenser C5AP are connected across the secondary windings. Grid bias is provided by R23 and R23A and HT de-coupling by C24D. From this stage the output is transformer fed to V16 and V17.

9. V16 and V17 are kinkless tetrodes (that is, they have pentode characteristics) and therefore to reduce distortion negative feed-back is employed through C22 and C22A. Grid bias is provided by R26 and R26A. Transient voltages are reduced by R17A and R17B.

10. From this stage the output is transformer fed to the final stage which consists of two directly heated triodes operating in Class B zero bias push-pull. Directly-heated valves with centre-tapped heater windings are used in this stage; because of the large anode voltage swing, the distortion due to heater voltage is small. The output is fed into the transformer T5 through the secondary of which passes the HT supply to the final RF output stage; the HT supply is thus modulated.

Tone oscillator

11. The tone oscillator is a plug-in unit and consists of the oscillator, the keying relay and a half-wave rectifier for supply to the keying relay.

12. A shunt-fed Hartley circuit is used with the tuned circuit (1000 c/s) consisting of L18, C20 connected between anode and grid through condensers C17C and C19. The cathode connection is tapped off the coil L18. R23C is the cathode bias resistor. Resistor R23C is the grid leak resistor to to prevent a charge building up on C19 which would cut off the value. A slight amount of grid bias will result however. The output is tapped off a potentiometer consisting of R32C and R41 with C17B as the DC stopper. R41 is variable so that the depth of modulation may be adjusted. There are two sets of contacts on the relay set; one set is connected in the output line and the other in the HT supply lead. Thus the oscillator functions only when the key is operated. In the earlier transmitter (1131A & B) the HT supply is not broken and the oscillator is functioning all the time that the transmitter is switched on.

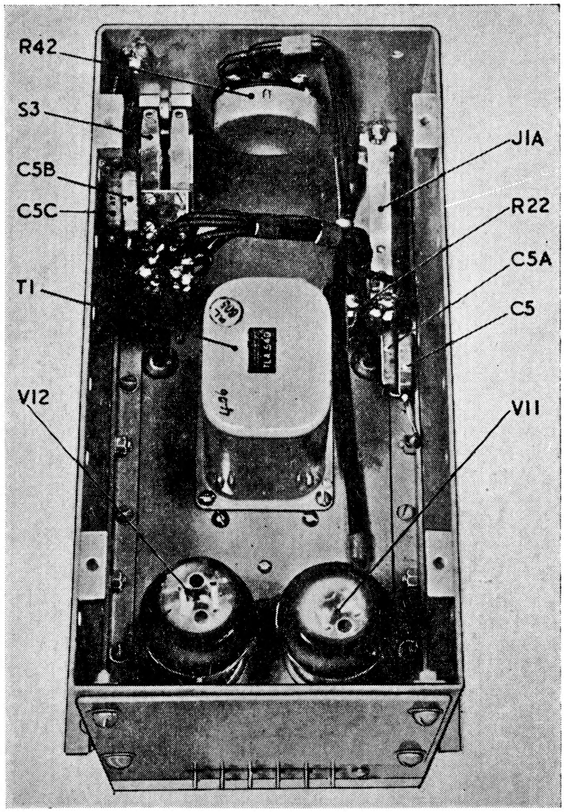

Fig. 3. Screening box—plan view

13. Power for the operation of the relay is taken from the valve heater supply through the half-wave rectifier W1. An electrolytic condenser (C26) smooths the rectifier output to prevent the relay from "chattering".

RF driver unit

14. There is a crystal oscillator followed by three frequency-multiplying stages. All the multiplying stages operate in Class C; the first two are single-valve, trebler circuits and the last stage a two-valve push-push doubler circuit.

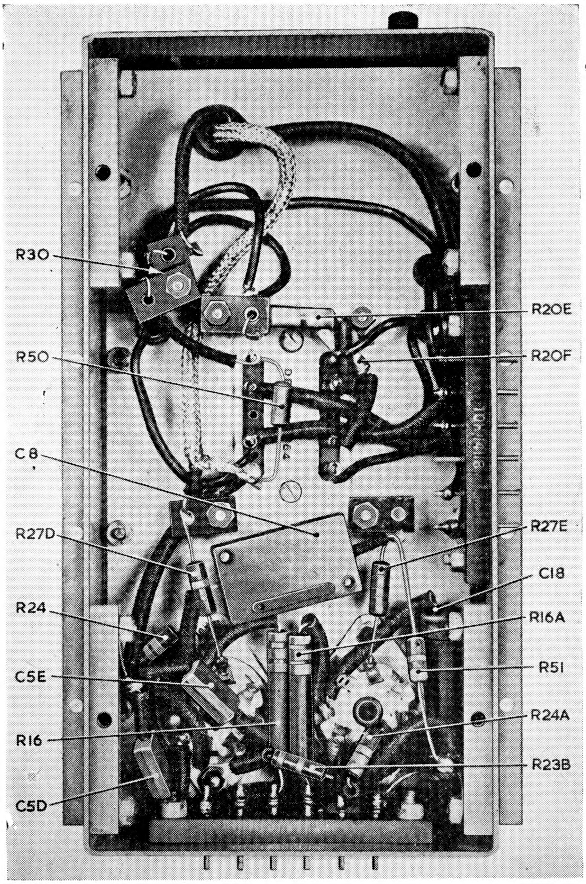

Fig. 4. Screening box—underside

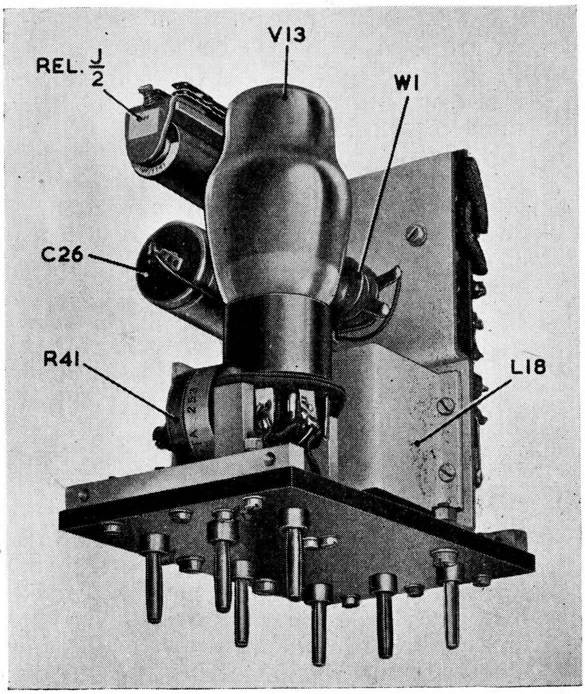

Fig. 5. Tone oscillator—front view

Oscillator

15. A tuned-anode, crystal grid (TA-XG) circuit is used with a pentode valve (V1, CV1052) operating under Class C conditions. There are two forms of bias applied; a protective bias utilizing the cathode current through resistors R10 and R12 and the grid bias due to the grid current through R28A. No separate condenser is used to maintain the bias voltage during the negative half cycle; instead use is made of the inter-electrode capacity of the valve, mainly between the grid and cathode. To prevent excess current flowing through and damaging the crystal, resistor R21B is connected in series with the crystal. In the anode line is a parallel circuit consisting of C14, C34A, C35 and L27 which is tuned to the fundamental frequency of the crystal (actually an eighteenth of the final RF) and from the anode side of this the output of the oscillator is fed to the first trebler stage. R23 and L5 are to prevent parasitic oscillations.

Frequency multiplying stages

16. The first two stages are similar and employ kinkless-tetrodes (have pentode characteristics) operating in Class C to give high efficiency and also generate third harmonies. Anode parallel-tuned circuits are tuned to three times the input frequency. The anode tap from V2 is part way up L28 to match the load.

17. From V3 the output is link-fed to a two-valve push-push doubler and amplifier stage. In this type of circuit the grids are fed 180 deg. out of phase and thus operate only on alternate half cycles. The anodes are connected in parallel and therefore a pulse appears at the anode strap at each half cycle giving twice the input frequency and therefore the parallel circuit C28A, L34, is tuned to the output frequency. Neutralizing is effected by C39.

Metering and de-coupling

18. An indication of the cathode current of any of the valves can be read on M3 by operation of the change-over switch.

19. Feedback through the heater circuit is prevented by de-coupling each valve heater to earth (through C12, C12A, C12C and

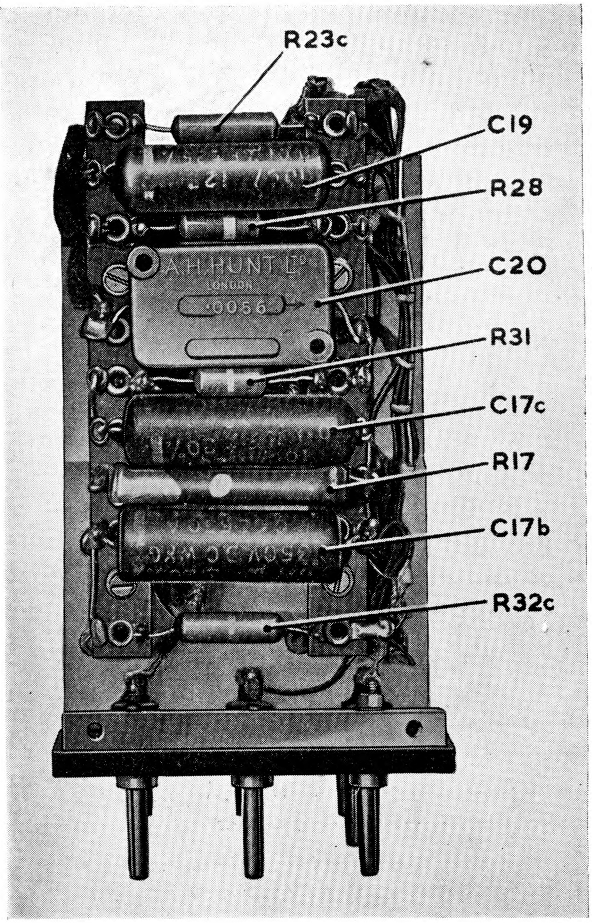

Fig. 6. Tone oscillator—rear view

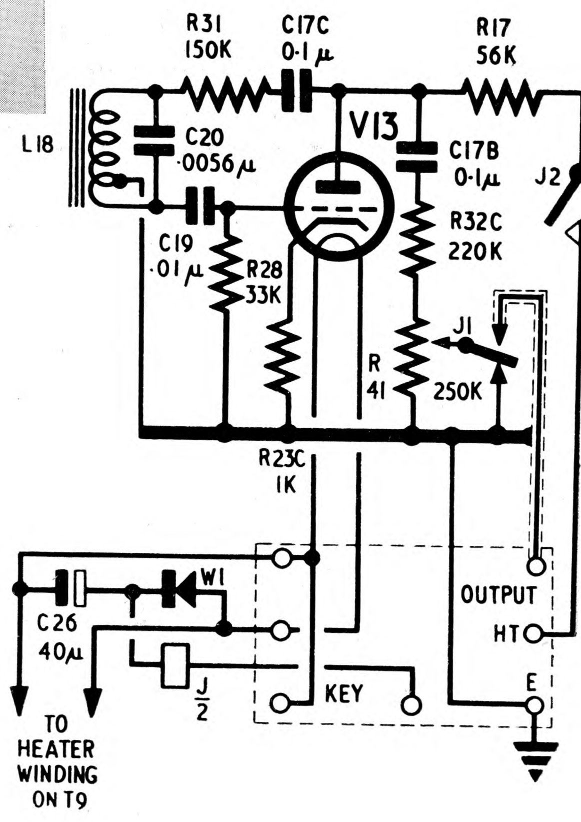

Fig. 7. Tone oscillator—circuit

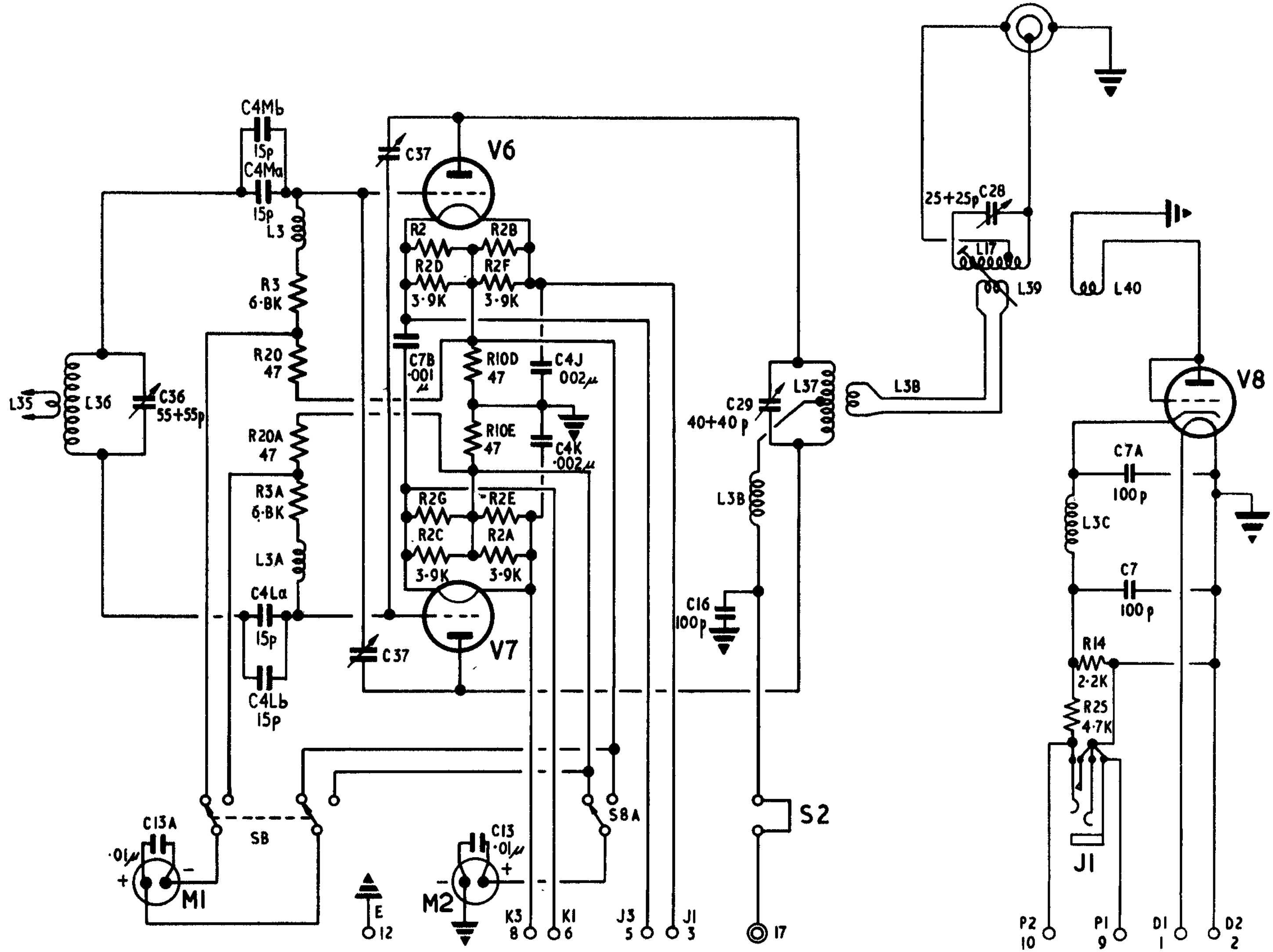

Fig. 8. RF output unit—circuit

C10, C10A, C10B, C10C). Similarly, feedback through the HT supply is reduced by the RF chokes in the HT supply leads (L1A, L1B, L1C, L3F).

RF output unit

20. In the output unit is the final amplifier the output matching transformer and the monitoring diode. The final amplifier has two directly-heated triodes in a neutralized push-pull circuit operating in Class C. Neutralization is effected by C37 which is a two-ganged condenser. Grid bias is effected in two stages—standing bias due to the volts-drop across the cathode resistors (R2, R2B, R2D, R2F and R2A, R2C, R2E, R2G) and auto-bias due to grid current through R3 and R3A charging condensers C4Ma, C4Mb and C4La, C4Lb.

21. The output is fed into a parallel tuned circuit C29, L37 (output frequency); also on to the centre tap of L39 is fed the modulated HT supply. Matching down of the impedance to the 100 ohm co-axial feeder is by the transformer L39, L17. Inductively coupled to the transformer is the anode lead of the monitoring valve V8.

Metering and monitoring

22. Meter M1 gives indication of grid current by measuring the volts-drop across resistors R20 and R20A; similarly, M2 in conjunction with R10D or R10E indicates cathode current. To enable the operator to ascertain if the transmitter is working the valve V8 is used as a monitor. Its grid is strapped to the anode and it then functions as a diode detector. RF is induced in L40 and is rectified by V8. This rectified output appears across R14, and can be heard by the operator when a headset is connected into J1.

23. The rectified output will also give an indication of over modulation, particularly with the tone oscillator in circuit. As 100 per cent modulation is employed, over modulation will give rise to second harmonics which will immediately be apparent. Distortion will also be detectable on the speech channel. Condensers C7 and C7A with choke L3C form a RF filter.

RF power unit

24. The RF power unit provides HT and LT supplies to the RF driver and output units. LT supplies are fed from transformer T13 which has seven secondary windings:—

4V	for pilot lamp PL2
6·3V	for V1, V2 and V3
7·5V	for V4 and V5 (via transformer T14)
7·5V, 7·5V	for V6 and V9
6·3V	for monitor valve V8

25. HT supply of 1000V for all the RF valves is from the full-wave rectifier using two diodes (CV187). The cathodes are fed from T12 and the anodes from T11. An addition secondary winding on T11 is used to supply pilot lamp PL2. The output from the rectifier is smoothed by the two-stage choke input filter, L21, C25; L22, C25A and C25B.

26. When the power switch for tuning is at LOW, the transformer T11 is fed through the choke L23 and thus the HT voltage is reduced.

Modulator power unit

27. The modulator power unit produces 1000V, 300V, and filament supplies for the modulator unit. The LT supplies are taken from transformer T9 and are:—

4V	for the pilot lamp PL4
6·3V	for all valves in the modulator except the output stage
7·5V, 7·5V	for the two valve in the output stage

28. Also taken from T9 is the filament winding for the 300V, full-wave rectifier valve V22 (CV1071). A separate transformer (T10) is used to feed the anodes of V22. A 4V winding is also fitted to T10 for the pilot lamp PL1. Smoothing of the 300V supply is by the capacity input filter C24A, L26, C24.

29. The 1000V supply is from the two-valve rectifier (two CV1072 or CV235). The filaments are fed from T8 and the anodes from T7. Smoothing is by a two-stage choke input filter L24, C25C, L25, C25D.

Half-power circuit

30. Half power conditions are obtained by reducing the output from the anode transformers T7 and T10. A simplified circuit is shown in fig. 10. Transformer T7 has a centre-tapped primary. On full power the main voltage is fed to T10 and to half of the winding of T7. The ratio of half the primary to the secondary is that required to give the full output voltage.

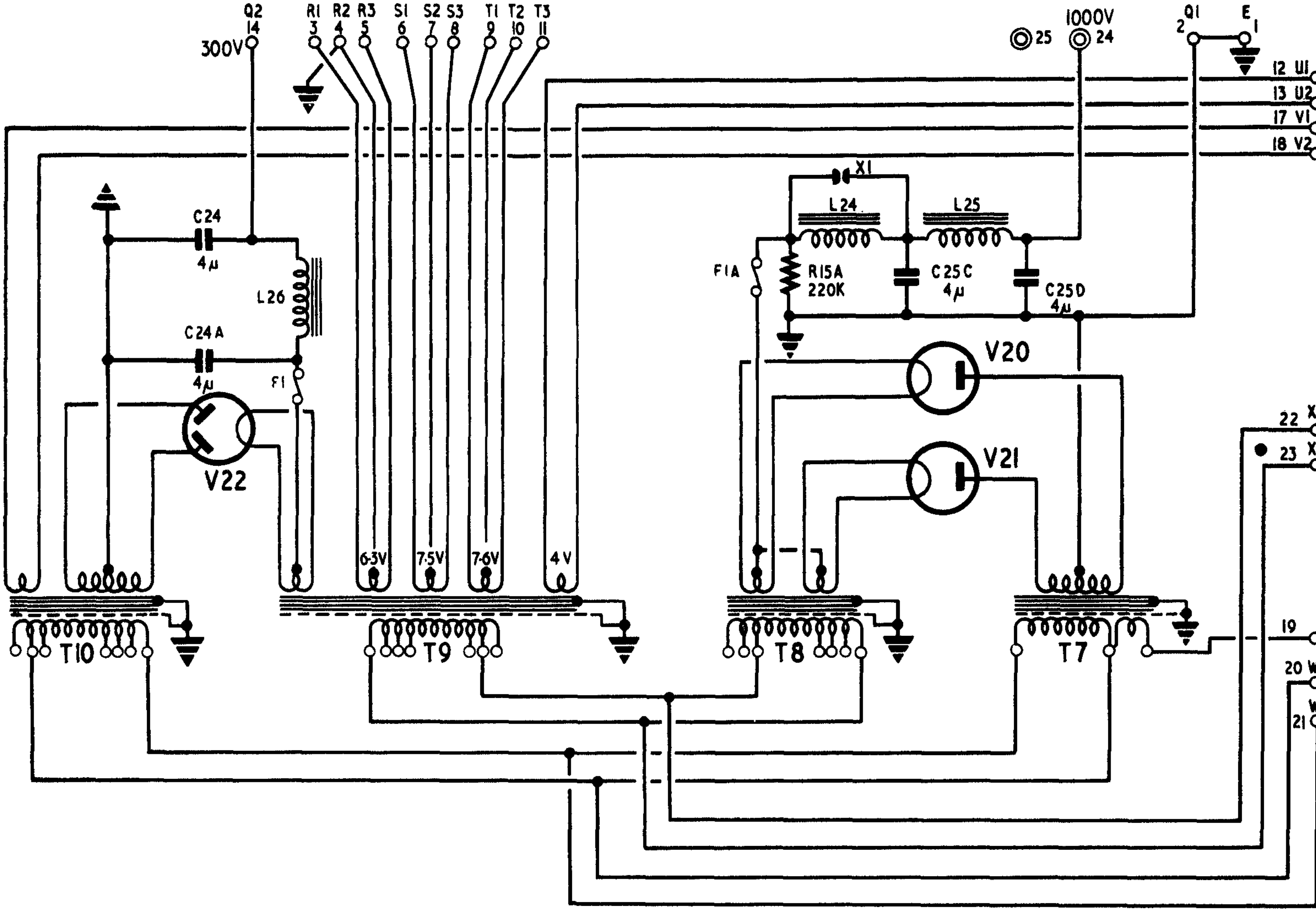

Fig. 9. Modulator power unit—circuit

TABLE 1

RF driver switch	Meter reading (MA)	RF output switch	Meter reading (MA)	Modulator unit	Meter reading (MA)
CO	30–34	A1	50–65	Cathode	
T1	46–56	A2	50–65	Current	50–70
T2	48–58	G1	Zero		
D1	27–38	G2	Zero		
D (grid)	Zero				

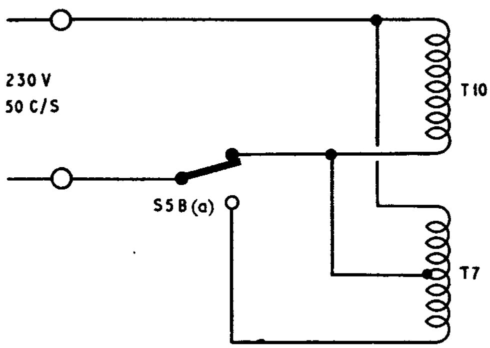

Fig. 10. Modulator power unit—half power circuit

31. When the switch is turned to half-power, full mains voltage is applied to the primary of T7 which therefore reduces the transformation ratio to one half of that for full power conditions. The output voltage is thereby reduced to one half full power conditions. In addition the primary of T10 is connected in series with half the primary of T7 and so the voltage applied to T10 is reduced and therefore the output voltage is also reduced.

Safety interlock switch

32. Mounted at the rear of the RF power unit is the interlock switch. Through this switch passes the main power supplies to the transmitter and its normal position is spring loaded into the off position. It is actuated by the closing of the rear door, so that when the door is opened the mains supply is automatically cut off to the transmitter. Complete reliance should not be made on it and the mains supply switch should be broken before attempting to carry out any internal adjustments.

SETTING-UP INSTRUCTIONS

33. Access to the transmitter is made by way of a door at the rear of the cabinet. An interlock switch is actuated by the door so that the main power supply (230 volts, 50 c/s) is broken when the door is opened. This switch must *not* be held in the closed position with the door open to allow internal adjustments to be made with power on.

34. Before beginning the actual setting-up procedure the crystal should be removed and the gauges read for static conditions. When the transmitter is correctly adjusted and the crystal is removed, full power may be safely applied to the valves, but when adjustments are being made excessive power may be applied and so damage the valves. The readings should therefore be taken firstly on half power when approximately half the meter readings should be given.

Static meter readings

35. Take first on half power and then on full power. Table 1 gives full power readings. Crystal removed.

Setting-up procedure

36.

Note . . .

All inital adjustments are made on half power.

(1) Open door and remove link S2 which is located at the rear of the HT output unit.

(2) Close door and switch on mains supply to the transmitter.

(3) Set LOCAL/REMOTE switch to LOCAL.

(4) Press MASTER FILAMENT button ON.

(5) Plug the appropriate crystal into the socket on the front of the driver unit.

(6) Set the tuning controls to the settings given in Table 2. Interpolate for frequencies not given.

(7) Press the HT MASTER switch. HT on will be indicated by the red lamps on the control panel and the readings on the meters.

TABLE 2

Unit	Control	8670	8110	7500	7000	6500	6050	5550
		For crystal frequency in kc/s						
RF DRIVER	CO and treblers	7–10	20–25	35–40	50–55	60–65	70–75	90–95
	Doubler grid	8–12	25–30	40–45	52–57	64–69	75–80	92–97
	Doubler anode	12–17	28–35	45–50	55–60	60–65	70–75	85–90
RF OUTPUT	Amp. grid	15–20	30–35	43–48	60–65	68–73	83–87	94–98
	Amp. anode	5–10	15–20	32–37	45–50	55–60	66–70	75–80
	Aerial	15–20	25–30	35–40	50–55	58–63	68–72	80–85

RF driver unit

(8) Set the meter switch to T1. Rotate CO AND TREBLERS control until a 'dip' on meter reading (M3) is seen. The control should be set to this minimum position which should be approximately 20 mA.

(9) Set meter to D1.
Rotate DOUBLER GRID control until maximum current is shown (approx. 24 mA.).

(10) Meter at D1.
Rotate DOUBLER ANODE control. observe dip—set to minimum reading (approx. 20 mA.).

(11) Repeat (10) at D2.

RF output unit

(12) Set GRID CURRENT meter switch to G1. Rotate AMP. GRID control to give max. current on GRID CURRENT meter. (3–4 mA.).

(13) Set G2 and repeat (12).

(14) Reset switch to G1.

Neutralization

(15) Put POWER SWITCH TO TUNING to FULL.

(16) Set COUPLING control to minimum (pointer at extreme left of scale)

(17) Aerial control to zero

(18) Rotate AMP. ANODE control, if not neutralized a sharp dip will be seen in meter reading.
- (*a*) Set AMP. ANODE to give minimum grid current
- (*b*) Adjust NEUT. control to increase grid current
- (*c*) Again set AMP. ANODE to give minimum grid current
- (*d*) Repeat until no 'dip' is observed

Note . . .
This will affect the grid tuning which should be checked during the test.

(19) Switch off MASTER HT

(20) Put SWITCH FOR TUNING to HALF (or LOW)

(21) Replace link S2

(22) Switch on MASTER HT

(23) Set ANODE CURRENT meter switch to A1. Rotate AMP. ANODE control and observe dip in ANODE CURRENT meter reading. Adjust to minimum reading.

(24)
- (*a*) POWER SWITCH FOR TUNING TO FULL.
- (*b*) Check AMP. ANODE tuning.
- (*c*) Note that dip in anode current and peak in grid current readings occur together
- (*d*) If not, adjust NEUT. control until they do.
- (*e*) ANODE CURRENT reading should be 40–50 mA.
- (*f*) Check that reading at A1 is approximately the same as at A2.

(25) Rotate AERIAL control—anode current should increase
If it does not:—
- (*a*) Increase coupling slightly
- (*b*) Adjust AERIAL control to give maximum anode current reading
- (*c*) Again increase coupling
- (*d*) Re-adjust AERIAL control to give ANODE CURRENT meter reading of approximately 60 mA.
- (*e*) Increase coupling yet again until the sum of the two readings on the ANODE CURRENT meter is 140 mA.

FINAL ADJUSTMENT OUTPUT UNIT, TYPE 31

(26)
- (*a*) Lower power position—Tune driver unit for maximum output at 100 Mc/s. Grid current to doubler must exceed 2 mA.
- (*b*) Tune AMP GRID for maximum grid current

TABLE 3

Typical meter readings—Transmitter working

Unit	Selector switch position	8670	8110	7500	7000	6500	6050	5550
		Crystal frequency in kc/s						
RF DRIVER	CO	26–32	26–32	26–32	26–32	26–32	26–32	26–32
	T1	44–52	44–52	44–52	44–52	44–52	46–54	44–52
	T2	50–60	50–60	50–60	50–60	50–60	50–60	50–60
	D1	44–54	44–54	44–54	40–54	40–50	40–50	40–50
	D2	45–55	45–55	45–55	45–55	45–55	45–55	45–55
	D grid	3–5	3–5	3–5	3–5	3–5	3–5	3–5
RF OUTPUT	G1	5–10	5–10	5–10	6–10	6–10	6–10	6–10
	G2	5–10	5–10	6–10	6–10	6–10	6–10	6–10
	A1	64–72	64–72	64–72	68–76	68–76	68–76	64–74
	A2	64–72	64–72	64–72	60–70	68–76	68–76	64–74
	(Unloaded) A1 (dip)	42–50	42–50	42–50	35–50	35–45	35–45	35–45
	(Unloaded) A2 (dip)	42–50	42–50	42–50	35–50	34–45	35–45	35–45

(*c*) Full power—resonate AMP ANODES and AERIAL tuning

(*d*) Re-check all control including NEUT.

(*e*) Repeat (*a*), (*b*), (*c*), (*d*) at 156 Mc/s —minimum grid current of 6·5 mA.

Note . . .

Do not load anodes above 65 *mA at* 156 *Mc/s.*

(27) Should any circuit not cover the frequency range, change the inductance by carefully bending the coil in the required direction. Before bending, slacken off the securing nuts.

Note . . .

Take care not to break the capacitor insulators.

(28) The RF stage is now correctly set-up. A table of typical readings is given in Table 3.

Note . . .

When the transmitter has been neutralized as described in (15)–(18) *it will be approximately correct for any frequency within the band. When setting-up a new frequency therefore, there is no need to carry out the full neutralizing procedure. Neutralization should be checked however by noting that the dip in anode current reading occurs at the same time as the peak of the grid current readings.*

MODULATOR UNIT

37. The LF section must be correctly adjusted before adjusting the depth of modulation.

Speech

(1) Switch on the transmitter with the POWER SWITCH to LOW

(2) Apply speech modulation—Note variation in cathode current meter reading

(3) Adjust volume control until peak reading on M4 is 100 mA (200 mA on full power)
This gives 100 per cent modulation on peaks of speech.

MCW

(1) Plug oscillator unit into rear of modulator chassis

(2) Press key and adjust volume control until meter (M4) reads 100 mA (200 mA on full load).

Ganging of condensers C34A, C34B and C34C

38. Under normal conditions it should not be necessary to adjust the trimmer condensers or inductances of these circuits in any way, but should the driver unit have been subjected to bad treatment or a complete overhaul, it may be necessary to re-gang the circuits. To do this, proceed as follows:—

(1) Set the ganged condenser to a dial reading of 18 divisions.

(2) Set the trimmer condensers of the crystal oscillator and T1 to approximately one-quarter mesh.

(3) Insert crystal of frequency 7985 kc/s approximately.

(4) Place POWER SWITCH FOR TUNING to FULL and switch on MASTER HT.

(5) With meter switch S7A in C.O. position, vary crystal oscillator trimmer. It will be noted that as the condenser is rotated, the cathode current will fall to a minimum. On one side of resonance this fall will be gradual, on the other, very sharp. The condenser should be set to about 1·5–2 mA. above absolute minimum on the gradual side.

(6) Set meter switch S7A to T1 position and adjust the inductance L28 by stretching, or compressing, the coil for resonance.

(7) Set meter switch to T2 position and adjust the inductance L29 as above for resonance.

(8) Insert crystal of 5550 kc/s, set meter switch to T1 position and tune the ganged condenser. The reading will be approximately 90 divisions. Repeat (5) and (6) above. There should be little or no change.

(9) Rotate the ganged condenser and see that T2 tunes within the scale reading 88–92 divisions.

(10) Set the meter switch S7A to DOUBLE GRID, and tune the grid circuit.

(11) Set the meter switch to T1 position and note scale reading for resonance of this circuit. If the reading is higher than for T2, increase the inductance by compressing the coil. If the reading is lower than T2, stretch the coil. The resonance point for T1 should be the same as for T2 $\pm$ 1 division.

(12) Insert 7985 kc/s crystal. Set meter switch to T1 position and rotate the ganged condenser for resonance. If this is higher on the scale than T2, the T1 trimmer condenser C35A should be reduced. If the reading is lower than T1, the trimmer should be increased. Resonance should occur at the same reading as T2 $\pm$ 1 division.

(13) Insert 5550 kc/s crystal and check that that T1 and T2 are still in line at this setting. Make any readjustment necessary to the coil of T1.

(14) Insert 7985 kc/s crystal and set ganged condenser to resonance for T1 and T2. Adjust crystal oscillator trimmer condenser C35 so that cathode current is 1·5–2 mA greater than absolute minimum on the gradual side of the resonance curve.

(15) Insert 5550 kc/s crystal and see that the oscillator is oscillating normally at the resonance point for T1 and T2.

(16) If, after carrying out (1) to (5) inclusive, the crystal oscillator refuses to oscillate for any position of the trimmer condenser, it probably means that the iron core of the oscillator inductance has become misplaced possibly through the seal on the adjusting screw protruding through the bottom of the can and chassis having broken. In this case the ganged condenser should be set to 18 divisions, the oscillator trimmer to approximately one-quarter mesh and the adjusting screw referred to above varied until the oscillator commences to function. The inductance should then be adjusted until the anode current is reading 1·5–2 mA above absolute minimum on the smooth side of resonance.

Note . . .

This inductance should never be varied unless it is certain that its value must have changed.

39. It should be realised that the second trebler T2 circuit is not provided with a trimmer condenser and relies entirely on its inductance and swing of the ganged condenser to cover the frequency range. This circuit must, therefore, be the basic one to be properly adjusted and other two circuits brought into line. No difficulties should be experienced in covering the full frequency range of all three circuits between scale settings of 18–90 divisions.

Adjustment of link coupling

40. The grids of the RF output valves V6 and V7 are coupled to the doubler anode circuit by a link circuit consisting of two one-turn coils coupled to the respective tuned circuits and connected together by means of a low-loss flat cable. The degree of coupling is not critical but may require adjustment on installation. This adjustment must be carried out on the driver unit. The most satisfactory position for this coil will normally be that which gives about 45 deg. – 50 deg. coupling.

41. When making adjustments to this coil it should be so positioned that the best possible drive is obtained on the RF output valves for minimum loading of the doubler anodes. The coupling should be adjusted until the figures quoted in Table 3 for doubler anode current and amplifier grid current are reached. Increases of coupling beyond this point will cause a large increase in doubler anode current without any appreciable increase in amplifier grid current. Over coupling will also reduce the amount of dip in the doubler anode current.

Adjustment of neutralizing condenser vanes

42. If the neutralizing procedure as detailed in para. 36 fails to provide a satisfactory neutralizing position, it is possible that the condenser vanes have changed their position relative to the knob on the front panel, due to some sudden shock. In this case, the grub screws tightening the extension spindle to the slow-motion drive should be slackened and the knob set to mid-point. Vary the condenser by means of the extension spindle until a satisfactory position has been found. The grub screws should be then tightened and transmitter neutralized correctly at the desired frequency.

Precautions when removing the modulator power unit from rack

43. With the introduction of the valve adapters Type 140 to the modulator power unit (Vol. 2 R/18M), the overall height of the rectifier valve CV187 as CV235 has been increased to the extent of preventing the free movement of the chassis when it is withdrawn from the transmitter rack. To avoid damage due to the valves, the valves must be removed from their holders before any attempt is made to slide the modulator power unit from the transmitter.

SERVICING

44. Most of the simple faults which may develop in the transmitter can be traced by reference to the following fault-finding table.

FAULT-FINDING

Fault	Evidence	Cause	Remedy
(1) No filament supplies.	No filament glow in valves. Pilot lamps PL2 and PL4 fail to glow.	Safety switch S6 not making.	Close rear door properly.
		Mains fuses F2 and F2A blown.	Renew fuses.
		Filament fuses F2D and F2E blown.	Renew fuses.
(2) Pilot lamps PL2 and PL4 fail to glow.	—	If filament supplies correct, fault will be due to defective lamps.	Renew the lamps.
(3) No HT supply from RF power unit.	(*a*) No readings on meters of RF driver and RF output units. Pilot lamp PL3 fails to glow	HT fuses F2B and F2C on control unit blown.	Renew fuses.
		HT contactor CON1 not made.	Check operation of thermal delay circuit (See 7).
	(*b*) No readings on meters of RF driver and RF output units. Pilot lamp PL3 glows.	HT fuse F1B on RF power unit blown.	Renew fuse.
		Rectifier valves V9 and V10 defective.	Renew valves.

Fault	Evidence	Cause	Remedy
(4) No HT supply from modulator power unit.	(*a*) No readings on cathode current meter on modulator unit. Pilot lamp PL1 fails to glow.	HT fuses F2B and F2C on control unit blown.	Renew fuses.
		HT contactor CON1 not made.	Check operation of thermal delay circuit (See 7).
	(*b*) No readings on cathode current meter on modulator unit. Pilot lamp PL1 glows.	HT fuse F1A on modulator power unit blown.	Renew fuse.
		Rectifier valves V20 and V21 defective.	Renew valves.
(5) Pilot lamps PL1 and PL3 fail to glow.	—	If HT supplies are available, will be due to defective lamps.	Renew lamps.
(6) No 300-volt supply on modulator.	No variation in reading in cathode current meter on modulator unit when transmitter is modulated.	Fuse F1 on modulator power unit blown	Renew fuse.
		Rectifier valve V22 defective.	Renew valve.
(7) Thermal delay circuit fails to operate.	No HT supplies.	Contacts A1 or B1 not making.	Check contacts.
		Relay A not made	Check that contact G1 on thermal relay is made in the hot position.
		Relay A fails to hold in.	Check contact A3.
		Relay B not made.	Check contact G1 on thermal relay is made in cold position. Check contact A2 and B4.
(8) HT contactor Con1 fails to operate.	Pilot lamps PL1 and PL3 fail to glow	No volts on contactor Con1 coil.	Check operation of contacts B2 and E1.
(9) Crystal oscillator valve V1 fails to oscillate.	No change in cathode current of oscillator valve for any position of the control CO AND TREBLERS.	Defective crystal	Change crystal
		Defective valve.	Change valve.
	No oscillator valve cathode current.	Defective valve.	Change valve.
		Break in HT circuit.	Change HT circuit
(10) 1st trebler valve V2 not operating correctly.	No change in 1st trebler cathode current as tuning control is rotated.	Defective valve.	Change valve.
		Coupling condenser C6 defective.	Change condenser.
	No 1st trebler cathode current.	Defective valve.	Change valve.
		Break in HT circuit	Check HT circuit.

FAULT-FINDING—*continued*

Fault	Evidence	Cause	Remedy
(11) 2nd trebler valve V3 not operating correctly.	No change in 2nd trebler cathode current when tuning control is rotated.	Defective valve. Coupling condenser C6A defective.	Change valve. Change condenser.
	No 2nd trebler cathode current.	Defective valve. Break in HT circuit.	Change valve. Check HT circuit.
(12) Doubler valves V4 and V5 not operating correctly.	No doubler grid current.	Defective valves. Coupling link L30/L31 out of position.	Change valves. Replace in correct position.
	No doubler cathode current.	Defective valves. Break in HT circuit.	Change valves. Check HT circuit.
(13) RF output valve V6 and V7 not operating correctly.	No amplifier grid current.	Defective valves. Link between L34 and L35 disconnected.	Change valves. Reconnect link.
	No amplifier cathode current.	HT link S2 removed from socket. Break in HT circuit.	Replace link in socket. Check HT circuit.
(14) Monitor valve V8 not operating	No signal in monitor telephones when transmitter is modulated.	Defective valve. Jack J1 faulty.	Change valve. Check contact springs on jack.
(15) No output from modulator.	No change in modulator cathode current when transmitter is modulated.	LOCAL / REMOTE switch S3 in wrong position. Microphone not properly connected. V11 defective. Volume control R42 turned fully counter-clockwise. V12, V14, V15, V16, or V17 defective. No 300-volt supply.	Place S3 in correct position. If local mic. in use check mic. and jack J1A. IF remote mic. in use check mic., and mic. lines. Renew valve. Adjust volume control. Renew defective valve or valves. See item (6).
	Incorrect static modulator cathode current.	Defective valve V18 and/or V19.	Replace valve or valves.
(16) No modulation on MCW.	No change in modulator cathode current when key is pressed.	Oscillator unit plugs not making good contact with sockets. Defective valve V13. Output control R41 turned fully counter-clockwise. Contact J1 on relay J not making. Relay J not functioning.	Examine plugs. Change valve. Adjust R41. Check contacts. Check relay circuits.
(17) No remote signal light.	Remote lamp fails to glow with LOCAL/REMOTE switch in REMOTE position.	Contacts D1 or B3 not making.	Check contacts.

Appendix

The component parts of the T.1131J are the same as listed in Appendix 1, Chapter 1, for the T.1131B apart from the following exceptions.

Components fitted in T.1131J but *not* in T.1131B

Item	*Quantity*	*Stores Ref.*
Choke HF Type 855	1	10C/18196
Capacitor Type 6352	1	10C/18199
Capacitor Type 6353	1	10C/18200
Capacitor Type 6354	1	10C/18301
Capacitor fixed mica.	1	10CZ/124306
Capacitor fixed ceramic	4	10CZ/132073
Inductor Type 1598	1	10C/18197
Inductor Type 1597	1	10C/18195
Inductor Type 1599	1	10C/18198
Inductor Type 1594	1	10C/18192
Inductor Type 1595	1	10C/18193
Inductor and capacitor unit Type 135	1	10C/18315
Spindle extension	1	10AS/245
Beads insulation	20	10B/27

Components *not* fitted to T.1131J but fitted in T.1131B

		Quantity	*Stores Ref.*
RF driver unit			
	Condenser Type 5136	1	10C/15135
	Condenser Type 5137	1	10C/15136
	Condenser Type 5141	1	10C/15141
	Coil (anode T2)	1	10D/2587
	Coil (anode T1)	1	10D/2588
	Coil (link)	1	10D/2589
	Coil (doubler grid)	1	10D/2590
	Coil (anode)	1	10D/2591
	Insulator Type 597	1	10B/2631
Output unit			
	Choke HF Type 93	1	10C/2185
	Coil (anode)	1	10D/2570
	Condenser Type 5136	1	10C/15135

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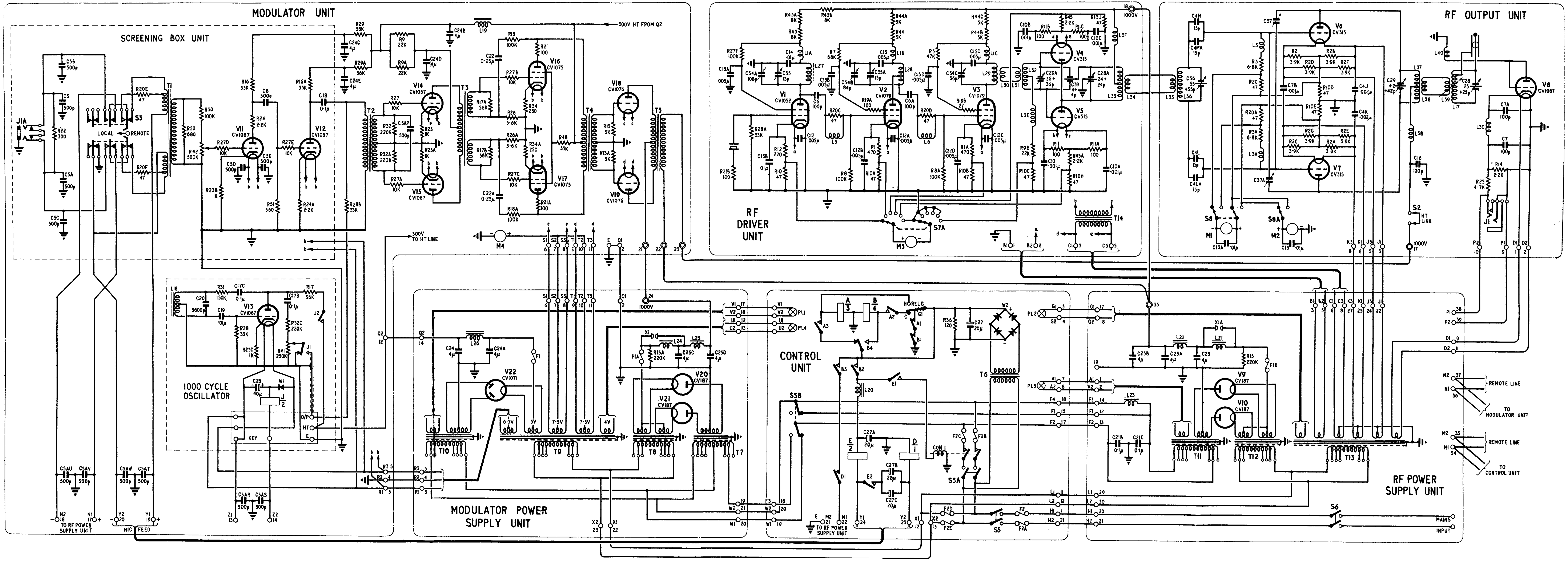

FIG.1

TRANSMITTER TYPE T.1131J – CIRCUIT

FIG.1