

# The VMARS Archive

VMARS is a not-for-profit organisation specialising in all types of vintage communications electronics. We maintain an archive of documentation to help our members understand, research, repair and enjoy their vintage radio equipment. Access by non-members is extended as a gesture of goodwill, but not as a right.

Rare documents are frequently provided free of charge by VMARS members, and all scanning and document processing is carried out on a voluntary basis. Accordingly, we do not expect others to profit from the hard work of volunteers, who give their time freely without charge.

This is a gentle reminder that the document attached to this notice is provided to you **for your personal use only**. This edition remains copyright of VMARS, and while you may sell or give your copy to someone else, this right does not extend to making further copies of this information, either to give or sell to others. This includes a prohibition on placing it on websites, or printing it for sale at rallies, boot fairs or similar public events. **If our goodwill is abused, then withdrawal of public access to our archive will be the result.**

Please refer anyone else wanting a copy back to VMARS – either to our website at <http://www.vmars.org.uk/> or by email to the Archivist at [archivist@vmarsmanuals.co.uk](mailto:archivist@vmarsmanuals.co.uk). If you want to know more about our copyright, please see the FAQ below.

## FAQ on copyright of VMARS documents

- Q** How can you copyright a document that is already in the public domain?
- A.** *Plainly the original copyright of the content has expired, or we have obtained permission to copy them. What we copyright is our own edition of the document.*
- Q.** Surely your “own edition” is identical to the original document, so cannot be copyrighted?
- A.** *Our editions are **not** identical to the original document. You will find that full advantage has been taken of electronic publishing facilities, so pages are cleaned up where possible (rendering them better than originals in some cases!), and large diagrams are prepared for both on-screen viewing and for easy printing at A4 format.*
- Q.** Why do you not just give your manuals away, as so many do via the internet these days?
- A.** *We do make all our manuals available free of charge (in soft copy) to VMARS members. These members have already covered the costs of running the archive via their subscriptions. The only time members are charged for copies is when they request them on paper, in which case charges are restricted to the cost of paper, ink and postage.*

*The VMARS archive is not a “shoe-string” operation. Money is spent on computing facilities to make copies available, and on shipping original documents securely (usually costing several pounds per shipment) to carry out the scanning. As members have already contributed to these costs, it is only reasonable that non-members should do likewise – and thus a very moderate charge is levied for copies provided to non-members. With typical commercial photocopying charges starting at 5 pence per A4 side, it will be evident that paying 4 pence for our equivalent on paper is excellent value (amounts current at Spring 2004). We also think “you get what you pay for” – we invite you to make the comparison and draw your own conclusions!*

*Despite the above, we will be making copies of essential technical information (circuit diagram, parts list, layout) freely available to all via our website from Summer 2004 onwards. This will be done to try and encourage and enable the maintenance of our remaining stock of vintage electronic equipment.*

## ***Guidance on using this electronic document***

### **Acrobat Reader version**

You need to view this document with Acrobat Reader **version 5.0** or later. It is possible that the document might open with an earlier version of the Acrobat Reader (thus allowing you to get this far!), but is also likely that some pages will not be shown correctly. You can upgrade your Acrobat Reader by direct download from the internet at <http://www.adobe.com/products/acrobat/readermain.html> or going to <http://www.adobe.com/> and navigating from there.

### **Don't miss the index!**

This document has had "bookmarks" added – which provide you with an "on-screen index". These allow you to quickly move to particular parts of the document, a numbered section or maybe the circuit diagrams for instance, merely by clicking on the page title. Click on the "Bookmarks" tab on the left hand side of the Acrobat Viewer window to access this feature – move the cursor over these titles and notice it change shape as you do so. Click on any of these titles to move to that page.

### **Large diagrams**

The large diagrams are given in two formats – in A4 size sheets to allow easy printing, and complete as originally published to allow easy on-screen viewing. These versions are in different sections of the document, which can be found within the bookmarks.

### **Printing the document on an A4 format printer**

The document has been optimised for printing on A4 size paper (this is the common size available in UK and Europe, which measures 29.7cm by 21.0cm). Please follow these steps (these are based on Acrobat Reader version 6.0 – other versions may differ in detail):

1. Work out the page numbers you want to print. If you want to print the whole document, then within "Bookmarks" (see above), first click on "**Front**", and note the page number given at the bottom of the Acrobat window – this will give you the page number of the first page to be printed. Similarly click on "**End of A4 printable copy**", to determine the last page to be printed.
2. Select "File – Print" or click on the printer icon. This will bring up the print dialog box.
3. Select the correct printer if necessary.
4. In the area marked "Print Range" click on the radio button marked "Pages from..", then enter the first and last page numbers worked out in step 1 into the "from" and "to" boxes.
5. In the "Page Handling" area, next to "Page Scaling", select "Fit to paper". Then press "OK"

### **Printing the document on an US Letter format printer**

Since A4 and US Letter sizes are similar, it is expected that this document should print satisfactorily on the latter format paper. This has not been tested however, and is not guaranteed. Follow the steps as for A4 printing, and make doubly sure that "Fit to paper" is selected (step 5).

### **Any other problems?**

Please get in touch with me at [archivist@vmarsmanuals.co.uk](mailto:archivist@vmarsmanuals.co.uk).

Richard Hankins, VMARS Archivist, Summer 2004

AIR PUBLICATION

**2550B**  
VOLUME I

2nd Edition.

July, 1948

# TRANSMITTER T.1509

Prepared by direction of  
the Minister of Supply

*A. J. Rowlands*

Promulgated by order  
of the Air Council

*J. H. Barnes*

AIR MINISTRY



1. Considerable difficulty is being experienced when the transmitter Type T.1509 is prepared for use owing to the complexity of packing and lack of instructions regarding unpacking and installation.

2. The equipment weighs about 8 cwt. and is provided with lifting eyebolts for screwing into the top of the unit. Unfortunately the sockets for these eyebolts have been stowed in their stowage position inside the transmitter cabinet and are not easily observed.

3. To prevent serious damage that may arise if the transmitter is moved by means other than the eyebolts provided, it is to be ensured that *an instruction label (specimen below) is prepared and fitted to the transmitter in a prominent position.*

**I M P O R T A N T**  
**INSTRUCTION TO UNPACKING CREW**  
**POSITION OF LIFTING EYES**

---

Remove two red transit bolts located beneath screw cover plates at top rear sides of instrument, unscrew six large bolts securing front panel of top unit and pull forward.

LIFTING EYES will be found on top left-hand side, inside cabinet.

---

**IMPORTANT.** Top unit must be replaced, six panel bolts secured and red transit bolts re-inserted **BEFORE LIFTING TRANSMITTER.**

In those instances where the transmitters are still in their packing, *the label is to be fixed to the packing* until such time as it is removed prior to installation. A fresh label should then be fixed to the transmitter as previously stated.

1. Considerable difficulty is being experienced when the transmitter Type T.1509 is prepared for use owing to the complexity of packing and lack of instructions regarding unpacking and installation.

2. The equipment weighs about 8 cwt. and is provided with lifting eyebolts for screwing into the top of the unit. Unfortunately the sockets for these eyebolts have been stowed in their stowage position inside the transmitter cabinet and are not easily observed.

3. To prevent serious damage that may arise if the transmitter is moved by means other than the eyebolts provided, it is to be ensured that *an instruction label (specimen below) is prepared and fitted to the transmitter in a prominent position.*

**I M P O R T A N T**  
**INSTRUCTION TO UNPACKING CREW**  
**POSITION OF LIFTING EYES**

---

Remove two red transit bolts located beneath screw cover plates at top rear sides of instrument, unscrew six large bolts securing front panel of top unit and pull forward.

LIFTING EYES will be found on top left-hand side, inside cabinet.

---

**IMPORTANT.** Top unit must be replaced, six panel bolts secured and red transit bolts re-inserted **BEFORE LIFTING TRANSMITTER.**

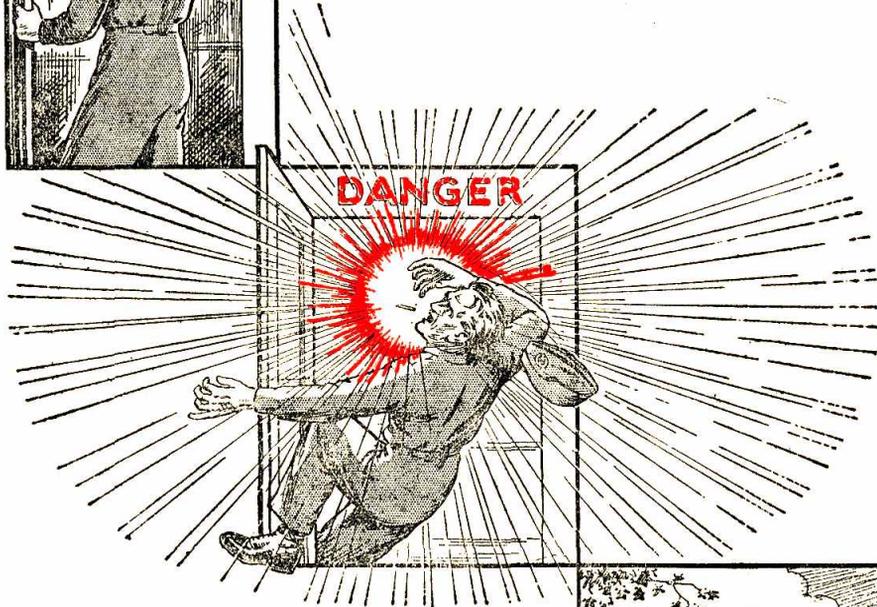
In those instances where the transmitters are still in their packing, *the label is to be fixed to the packing* until such time as it is removed prior to installation. A fresh label should then be fixed to the transmitter as previously stated.

# LIVE WIRES MEAN - DEAD MEN

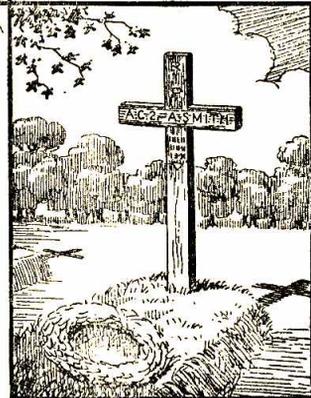
*Keep away from live circuits!*



THIS EQUIPMENT EMPLOYS  
HIGH VOLTAGES WHICH  
MAY BE LETHAL IF  
CONTACTED



TAKE EVERY PRECAUTION  
TO AVOID SHOCK



## NOTE TO READERS

The subject matter of this publication may be affected by Air Ministry Orders, or by Volume II, Part 1, leaflets in this A.P., in the associated publications listed below, or even in some others. If possible, Amendment Lists are issued to correct this Volume accordingly, but it is not always practicable to do so. When an order or leaflet contradicts any portion of this publication, the Order or leaflet is to be taken as the over-riding authority.



## LIST OF ASSOCIATED PUBLICATIONS

<i>A.P. No.</i>	<i>Title</i>
2529A, Vol. 1, Chap. 2 ....	Control unit, Type 88
2980A, Vol. 1 ....	Automatic high-speed signalling apparatus
2487, Vol. 1 ....	Telephone, telegraph and automatic switching equipment

## CONCISE DETAILS OF TRANSMITTER T.1509

<i>Purpose of equipment</i>	<i>General-purpose HF communications transmitter for use in fixed or mobile ground stations. Hand or high-speed keying. Crystal or MO control, with temperature compensated MO circuit.</i>
<i>Type of wave</i>	<i>CW, MCW, and R/T.</i>
<i>Frequency range</i>	<i>1.5 to 20 Mc/s.</i>
<i>Modulation</i>	<i>100 per cent.</i>
<i>Output impedance</i>	<i>50 ohms coaxial feeder.</i>
<i>Audio input impedance</i>	<i>600 ohms.</i>
<i>Valves</i>	<i>Oscillator, Type CV 124 (Barretter Type CV 2734) Multiplier, Type CV 124 Power Amplifier (2), Type CV 26 Modulator (2), Type CV 26</i>

### AMPLIFIER

*Compression amplifier, Type CV 1932  
Bias and muting, two valves, Type CV 1054  
First AF, Type CV 1941  
Second AF, Type CV 1932  
Push-pull output (2), Type CV 124*

### POWER UNIT

	<i>Four valves, Type CV 187 Two valves, Type CV 235 Four valves, Type CV 45 (voltage stabilisers)</i>									
<i>Power input</i>	<i>From 180/250-volt, 50-cycle AC mains</i>									
<i>Power output</i>	<i>300-watt carrier on all services</i>									
<i>Approximate overall dimensions</i>	<table><tr><td><i>Width</i></td><td><i>Depth</i></td><td><i>Height</i></td></tr><tr><td><i>2 ft. 5 in.</i></td><td><i>1 ft. 10½ in.</i></td><td><i>4 ft. 11 in.</i></td></tr><tr><td></td><td></td><td><i>(Excluding shock-absorbing base)</i></td></tr></table>	<i>Width</i>	<i>Depth</i>	<i>Height</i>	<i>2 ft. 5 in.</i>	<i>1 ft. 10½ in.</i>	<i>4 ft. 11 in.</i>			<i>(Excluding shock-absorbing base)</i>
<i>Width</i>	<i>Depth</i>	<i>Height</i>								
<i>2 ft. 5 in.</i>	<i>1 ft. 10½ in.</i>	<i>4 ft. 11 in.</i>								
		<i>(Excluding shock-absorbing base)</i>								
<i>Weight</i>	<i>800 lb.</i>									
<i>Associated equipment</i>	<i>Control unit, Type 310 (Stores Ref. 10L/171) or Control unit, Type 88 (Stores Ref. 10L/37)</i>									



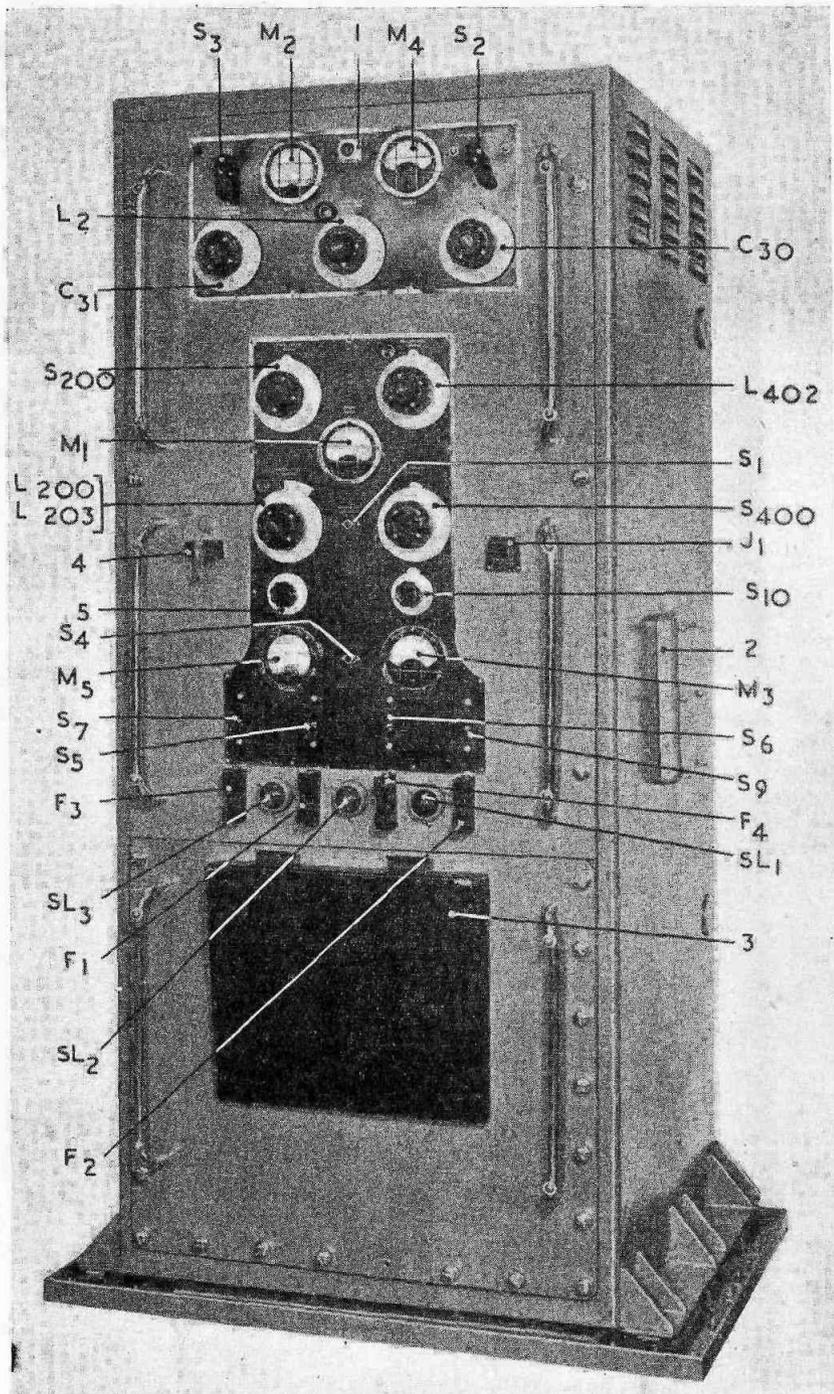
# TRANSMITTER TYPE T.1509

## LIST OF CONTENTS

	Para.		Para.
Introduction	1	Valves	111
		Connection to lines	112
General description			
Transmitter unit	5	Constructional details	
Oscillator unit	6	General	113
Master oscillator operation	15	Oscillator unit	121
Crystal control	20	Multiplier unit and modulator	128
Multiplier unit	22	Power amplifier	132
High-speed keying	26	Amplifier and power units	133
Power amplifier stage	31		
Modulator stage	37	Installation	
Amplifier, Type 367	42	Unpacking	137
Intercom. relay	48	Fan shock absorber mounting	147
Automatic gain control	51		
Muting	52	Operation	
Amplifying stages	56	Preliminary adjustments	152
Control circuits	57	Balancing of modulator valves	160
LT and HT switching	58	Adjustment of amplifier bias controls	162
Selection of service	66	Transmitter tuning (crystal control)	164
CW operation	70		
R/T operation	73	Precautions and servicing	
MCW operation	76	General	168
" Test " position of S10	77	Removal of oscillator unit	169
High-speed keying	79	Replacing the oscillator unit	172
Power unit, Type 381	80	Method of fitting master oscillator dial	174
Valves and power supplies	85	Method of fitting oscillator unit	177
Control unit, Type 310	95	Removal of the multiplier unit	179
Selection of service	98	Replacing the multiplier unit	183
CW working	102	Main unit	184
R/T working	106	Power unit	189
MCW working	108	Components	190
Power supplies	109		

## LIST OF ILLUSTRATIONS

	Fig.		Fig.
General view of transmitter, T.1509	1	Side view of transmitter, with units pulled forward for inspection	19
T.1509 oscillator unit, circuit	2	Interior of cabinet with units removed	20
Simplified circuit, master oscillator control	3	Rear view of transmitter unit	21
Simplified circuit, crystal control	4	Underside view of transmitter unit	22
Circuit of multiplier unit	5	Oscillator and amplifier units located in transmitter unit	23
High-speed keying circuit	6	Underside of oscillator unit	24
Simplified circuit of power amplifier	7	Multiplier unit and modulator valves	25
Circuit of transmitter unit, T.1509	8	Close-up view of multiplier unit	26
Simplified circuit of modulator stage	9	Power amplifier components	27
LT and HT switching circuit	10	Top of chassis, amplifier, Type 367	28
Operating circuit for CW contactor	11	Underside of amplifier chassis	29
Operating circuit for R/T relay and contactor	12	Power unit, Type 381, left-hand view	30
Amplifier, Type 367	13	Right-hand view of power unit	31
Amplifier gain control and muting circuits	14	Interconnection of units, T.1509	32
Power unit, Type 381	15	Specimen calibration charts	33
Valve bases and connections to pins	16	Fan transit bolts	34
Circuit of control unit, Type 310	17		
Interconnections of control unit and amplifier	18		



- |                               |                                  |
|-------------------------------|----------------------------------|
| 1 OUTPUT SOCKET               | 4 CRYSTAL                        |
| 2 MAIN TERMINAL BLOCK         | 5 OSCILLATOR FINE TUNING CONTROL |
| 3 TRAY FOR CALIBRATION CHARTS |                                  |

FIG. I. GENERAL VIEW OF TRANSMITTER, T.1509

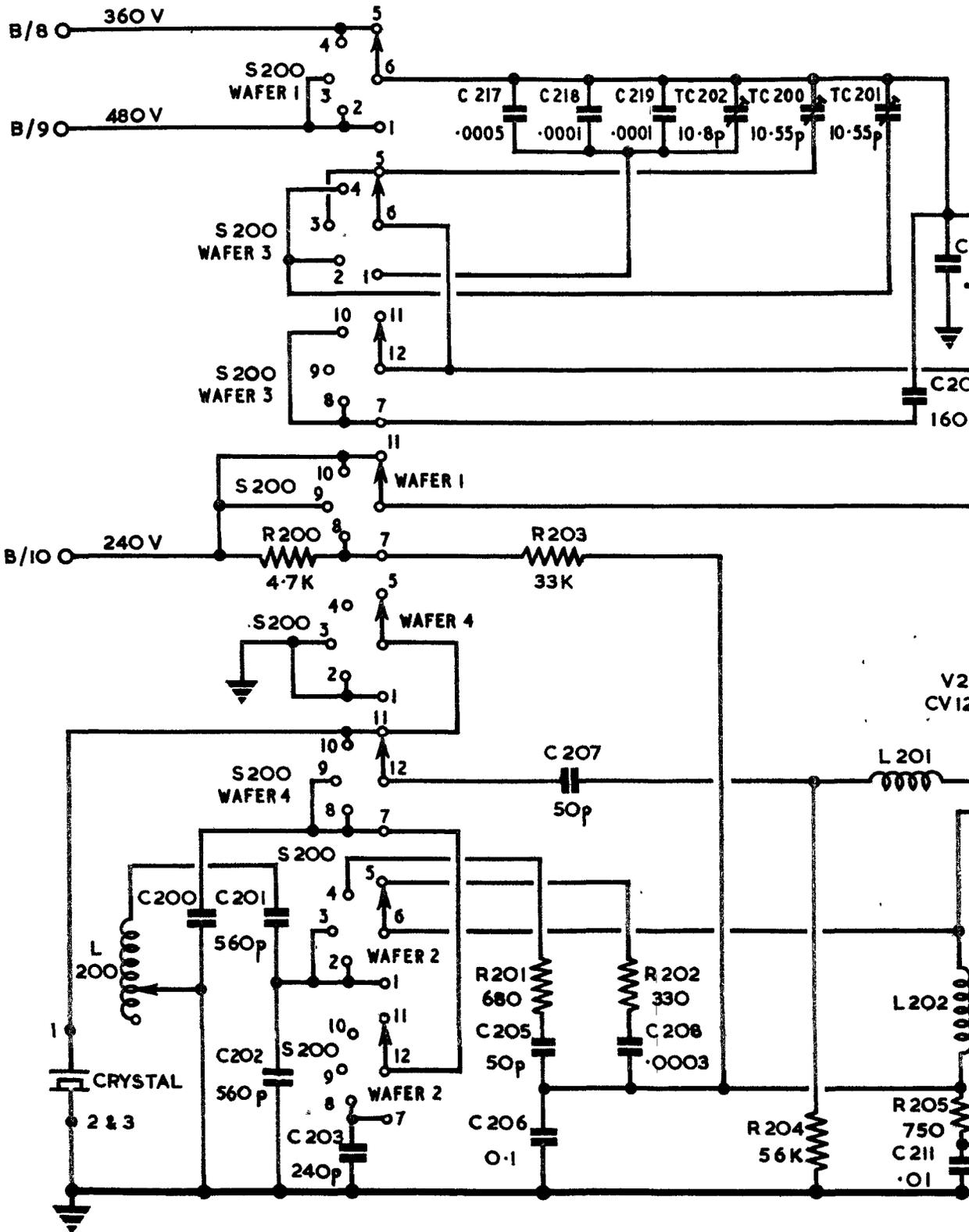
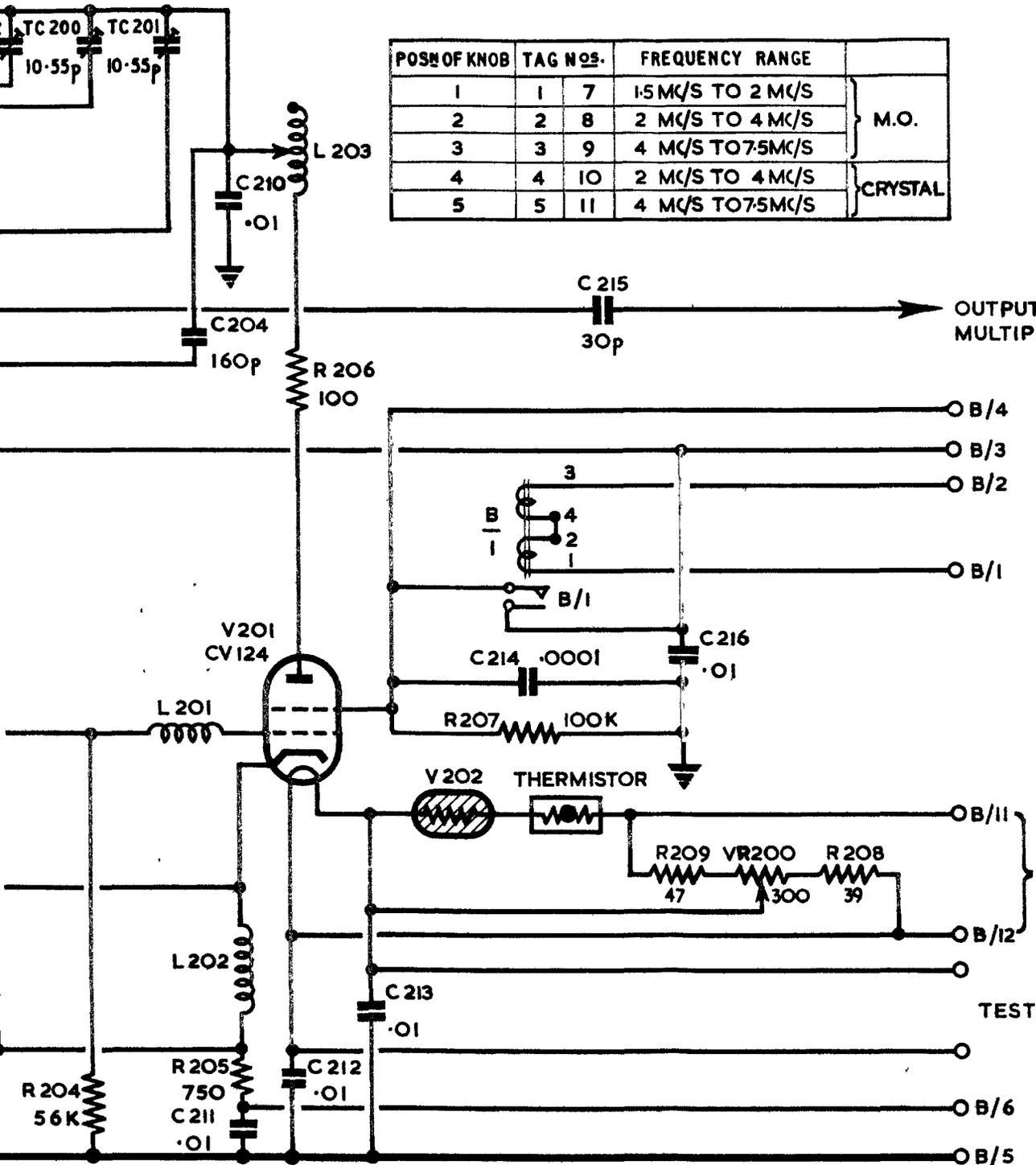


FIG. 2 — T1509, OSCILLA



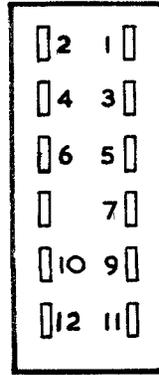
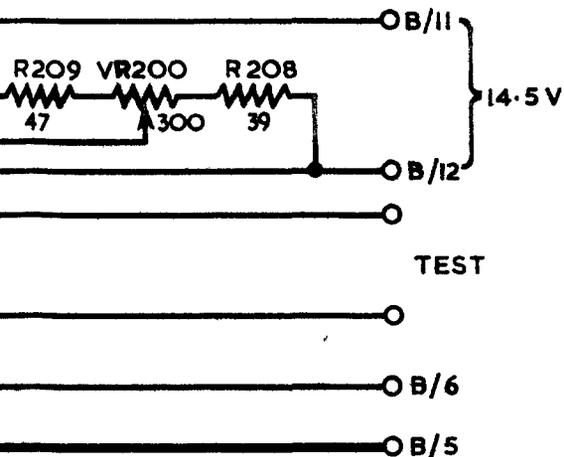
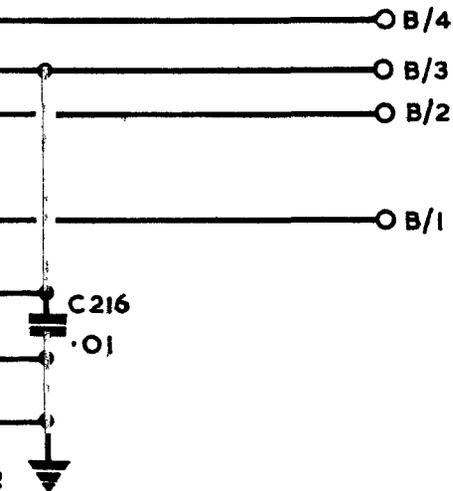


1509, OSCILLATOR UNIT, CIRCUIT

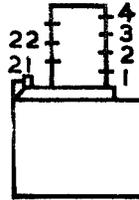


FREQUENCY RANGE	
5 MC/S TO 2 MC/S	} M.O.
MC/S TO 4 MC/S	
MC/S TO 7.5 MC/S	
MC/S TO 4 MC/S	} CRYSTAL
MC/S TO 7.5 MC/S	

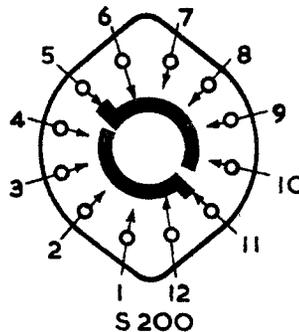
→ OUTPUT TO MULTIPLIER



PLUG B  
VIEW LOOKING AT  
BLADE CONTACTS



INDEX TO CONTACT  
NUMBERING RELAY B



FOUR WAFERS IDENTICAL  
SWITCH WAFERS VIEWED FROM  
REAR IN MAX. ANTI-CLOCKWISE  
POSITION OF KNOB.  
(THAT IS, POSITION 5)



**TRANSMITTER T.1509**  
**(Stores Ref. 10D/1721)**

**Introduction**

1. The transmitter T.1509 is a ground station transmitter for CW, MCW, or R/T operation in the frequency range from 1.5 to 20 Mc/s. Between 2 and 20 Mc/s, either crystal or master oscillator control, may be used. The range from 1.5 to 2 Mc/s is covered by MO working. A multiplier stage enables crystals from 2 to 7.5 Mc/s to cover the range of output frequencies from 2 to 20 Mc/s. Either crystal or master oscillator operation can be selected by means of a switch, no internal adjustments being required. The main condensers in the MO circuit have compensating plates, the spacing of which varies with temperature in order to provide frequency compensation.

2. All the necessary circuits for remote control from a control unit, Type 310 or Type 88, are incorporated in the transmitter. Both units provide remote HT switching, tone-to-line keying, and facilities for modulation from a carbon microphone. The control unit, Type 310, also permits remote selection of CW, MCW, or R/T working, and intercommunication between the control point and the transmitter using a normal two-line circuit between the remote control point and the transmitting station.

3. The transmitter circuit comprises an oscillator unit, a multiplier unit (acting as a buffer stage between 1.5 and 7.5 Mc/s) and a PA and modulator stage. The oscillator and multiplier units are sub-assemblies of the transmitter unit, which in addition to the PA and modulator stages contains the control circuits referred to in *para.* 2. An amplifier unit, Type 367, for sub-modulation or amplification of keying tone, is also mounted on the transmitter unit. A power unit, Type 381, occupies the lower portion of the transmitter cabinet. The transmitter and power units can be pulled forward out of the cabinet on runners for inspection, as well as being completely removable when required. The cabinet measures 4 ft. 11 in. high by 2 ft. 5 in. wide by 1 ft. 10½ in. deep, and stands on a shock-absorbing base.

4. The transmitter is designed for operation on 180-250 volts, 50 cycle single phase AC mains and provides a 300-W. carrier on CW, MCW, or R/T. High speed keying may be employed, terminals being provided

for connection of an external relay. In these circumstances the multiplier stage is keyed. For hand operation keying takes place in the oscillator stage. When MCW is required the transmitter is set up as for R/T. The carrier is then radiated continuously, the oscillator keying contacts being short-circuited and the tone from the control unit, Type 310 or Type 88, modulates the carrier when the key is pressed.

**GENERAL DESCRIPTION**

**Transmitter unit**

5. The transmitter unit includes PA and modulator stages, the principal control circuits, the LT transformers, and the keying tone and modulator bias rectifiers. The oscillator, multiplier, and amplifier units are sub-assemblies of the transmitter unit.

**Oscillator unit**

6. The circuit of the oscillator unit is shown in *fig.* 2. Switch S200 selects the frequency range and the method of frequency control. On positions 1, 2 and 3 the valve V201 acts as a master oscillator, and on positions 4 and 5 the circuit is arranged for crystal control. A description of the circuit changes involved is given in *para.* 15 to 21.

7. Wafer 1 of S200 selects the appropriate anode and screen-grid supplies for the various conditions of working. In the three MO positions of the switch, the anode of V201 is connected to the 480-volt input from the power unit. The voltage is applied through the tapping of the variable inductance L203, the tapping point being at earth potential to RF by reason of the bypass condenser C210. In both crystal control positions of S200 the anode of V201 is connected to the 360-volt input. Resistor R206 in the anode circuit is a parasitic suppressor.

8. A potentiometer consisting of resistors R200, R203, and R205 is connected across the 240V input from the power unit, the return to earth from contact 6 of the oscillator plug B being completed in the transmitter unit (*para.* 35). For MO working on the two lower frequency ranges the screen-grid of V201 is connected to the junction of resistors R200 and R203 in this potentiometer. On the third MO range and on both crystal ranges the screen-grid is connected direct to the 240-volt input.

9. The cathode of V201 is connected via L202 to the junction of resistors R203 and

R205 in the potentiometer referred to above and is thus given a positive bias. Automatic bias for the valve is developed by the grid leak and condenser combination R204, C207. The DC cathode current returns to earth through switch S1 in the transmitter unit, which permits a milliammeter to be brought into circuit when required (*para.* 35).

10. The LT input to the unit is 14.5 volts and is dropped to 6.3 volts for the heater of V201 by means of a thermistor and the barretter V202. A shunt consisting of resistors R208, R209 and potentiometer VR200 is connected across the heater and is adjusted by means of VR200 so that a voltage of 6.3 is read on a meter placed across the points marked TEST. When this adjustment has been made, the barretter will stabilize the heater current against variations in the supply voltage.

11. In both MO and crystal conditions of working the valve V201 is keyed in the screen-grid circuit by the contacts of relay B/1. The relay is energized by the rectified keying tone from a control unit, Type 310 or Type 88, which is supplied to contacts 1 and 2 of plug B on the oscillator unit. The tone is first amplified in the amplifier, Type 367 and then rectified by the metal rectifier W1 in the transmitter unit (*fig.* 8).

12. When the transmitter is used for R/T, relay contacts B1 are short-circuited through

contacts 3 and 4 of plug B, contacts A4 of the R/T relay A/4 in the transmitter unit (*fig.* 8), and HT is thus permanently on the screen of V201.

13. Condenser C216 is the screen decoupling condenser; the screen is returned to earth *via* R207, which is by-passed by C214 only in the stand-by condition.

14. The RF output from the oscillator unit is coupled to the grid of the valve in the multiplier unit through condenser C215. Other connections to the oscillator unit are made through the plug B.

#### Master oscillator operation

15. The circuit arrangements for master oscillator operation are shown in simplified form in *fig.* 3. An electron-coupled oscillator circuit is employed, the electron stream reaching the anode of V201 being modulated at a frequency dependent upon the adjustment of the oscillatory circuit L200, C201, C202 between grid and screen of the valve.

16. The screen-grid, control-grid and cathode of V201 form an inverted triode oscillator, the screen-grid serving as the oscillator anode and being held at earth potential to RF by the condenser C214 between it and the earth line. In this type of oscillator the RF potential of the cathode varies (while that of the anode is fixed), the RF choke L202, being connected between cathode and earth.

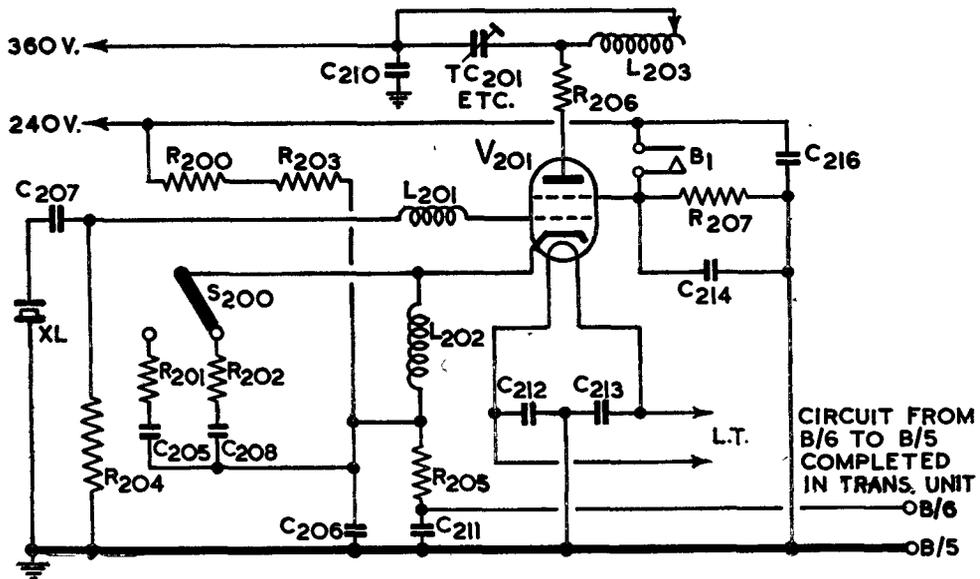


Fig. 3. Simplified circuit, master oscillator control

17. Feedback for the oscillator is obtained by the Colpitts method, the centre point of condensers C201 and C202 across the oscillator coil L200 being connected to cathode. An additional condenser C203, is placed in parallel with the coil on the two lower frequency ranges. Condenser C200 is the compensating condenser referred to in *para.* 1.

18. The anode circuit of V201 is tuned to fundamental frequency of the oscillatory circuit L200, C201, C202 to give output frequencies between 1.5 and 2 Mc/s, to twice that frequency for output frequencies between 2 and 4 Mc/s and to three times that frequency for frequencies 4 to 7.5 Mc/s. The circuit consists of the variable inductance L203 with a trimming condenser and, on position 1 of S200, an additional fixed capacity in parallel. Referring back to *fig.* 2, it will be seen that on switch position 1 the parallel capacity consists of TC202, C217 to C219 and C204 in parallel; on position 2, TC201 and C204 and on position 3, TC200.

19. In all the MO positions of S200, both crystal sockets are earthed by wafer 4.

*Crystal control*

20. Positions 4 and 5 of S200 arrange the circuit for crystal control as shown in *fig.* 4 and provide for output frequencies between 2 and 7.5 Mc/s. The crystal is connected between grid and screen of V201 and the

valve functions as an electron-coupled crystal oscillator as in the case of MO operation, the anode being tuned to the crystal frequency. A tuned circuit is included in the cathode, to provide the necessary feedback for satisfactory keying with crystal operation, consisting of choke L202 with condenser C205 or C208 in parallel. Resistors R201 and R202 reduce the Q of the circuit and oppose any tendency to the continuance of oscillations when the key is up.

21. It will be seen from the circuit diagram, *fig.* 2, that for the 2-4 Mc/s range the anode circuit tuning capacity consists of TC201 and C204, and from 4 to 7.5 Mc/s by TC200 alone. Reference should be made to *para.* 19 for MO operation on these ranges.

*Multiplier unit*

22. The output from the oscillator unit is applied to the grid of the valve V400 in the multiplier unit (*fig.* 5). For final radiated frequencies between 1.5 and 7.5 Mc/s the valve acts as a buffer, this condition obtaining in positions 1 to 3 of the switch S400 on the unit. In position 4 the anode circuit is tuned to twice, and in position 5 to three times the input frequency.

23. In order to obtain satisfactory harmonic generation, this valve is operated with a high value of negative grid bias, part

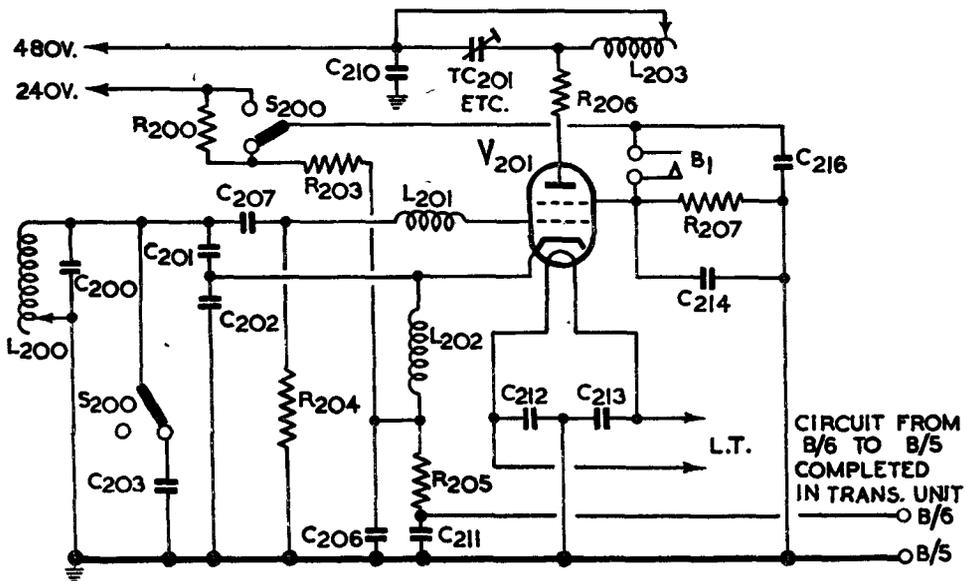


Fig. 4. Simplified circuit, crystal control

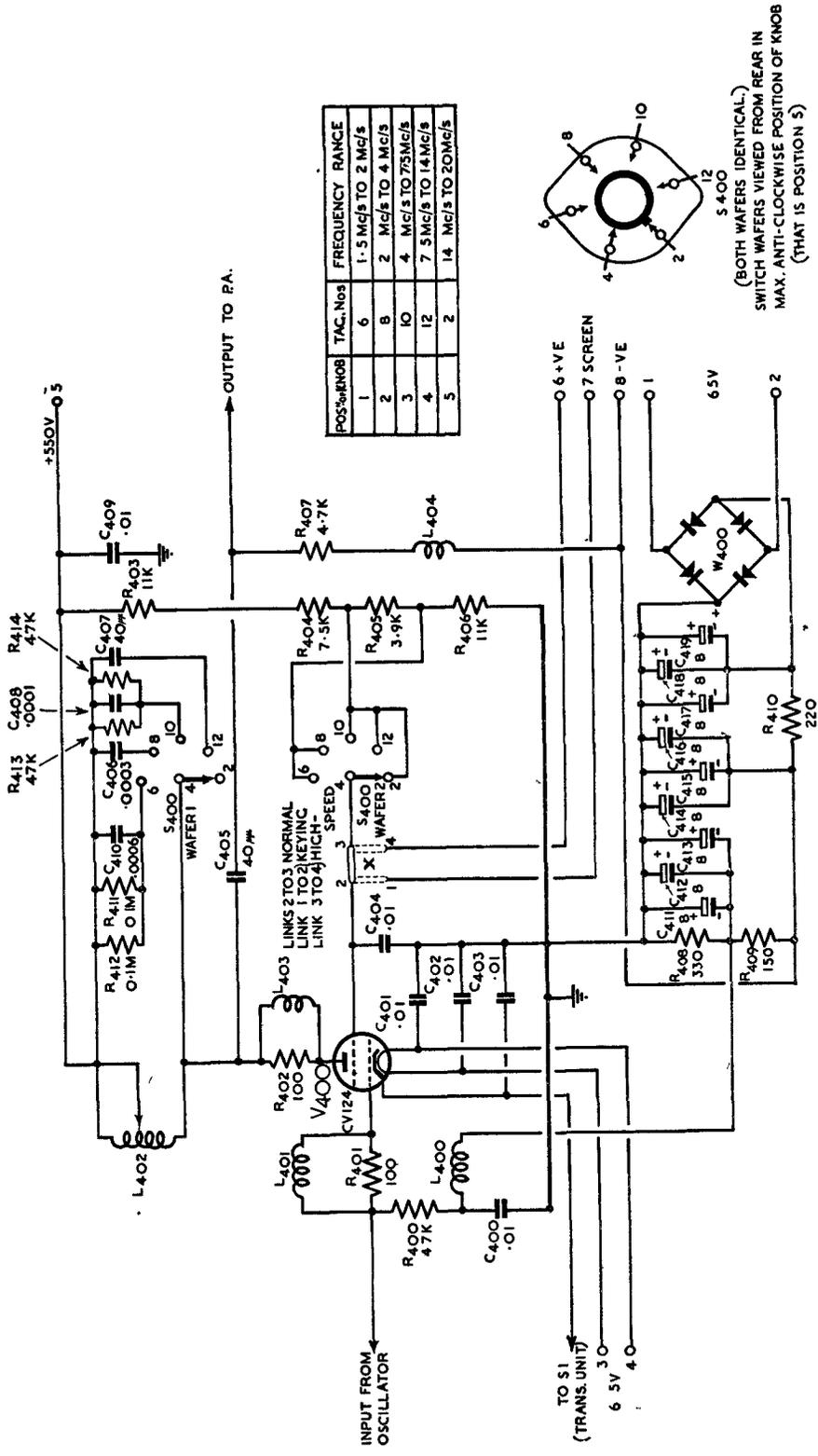


FIG. 5. CIRCUIT OF MULTIPLIER UNIT

of which is obtained by grid current flowing in R400, the remainder being a fixed supply at 32 volts approx. A negative bias of 45 volts is required for the power amplifier, and both these potentials are provided in the multiplier unit and are obtained from a metal rectifier, W.400, which is connected across a 65-volt winding on the LT transformer T2 in the transmitter unit (*fig. 8*).

**24.** The screen-grid voltage for V400 is taken from alternative tappings on the potentiometer R403 to R406 across the 550-volt HT input, the tapping being selected by wafer 2 of S400. Wafer 1 of the switch selects the parallel tuning capacity for the variable anode inductance L402. On the 1.5-2Mc/s range, resistors R411 and R412 are connected across the coil to limit the power developed when the stage is working as a buffer on the lowest frequencies. Resistors R413 and R414 perform a similar function on range 3.

**25.** Chokes L401 and L403, shunted by resistors R401 and R402, are parasitic suppressors.

#### High-speed keying

**26.** When high-speed keying is used with the transmitter it takes place in the multiplier stage. Links X are altered to the positions shown dotted on *fig. 5* and as shown in full on the simplified high-speed keying circuit diagram *fig. 6*. When the tongue (T) of the high-speed keying relay

is at "mark" (M) the supply circuit to the screen grid of V400 is completed.

**27.** When the tongue is at "space" (S) this circuit is broken, and the screen grid is connected to the negative end of resistors R408, R409 across the rectifier W.400 in the multiplier. A negative bias of approximately 45 volts is thus applied to the screen-grid and the valve is biased beyond cut-off.

**28.** The high-speed relay is connected to three terminals marked HIGH-SPEED KEY on the main terminal block, which corresponds to terminals 6, 7 and 8 on the multiplier unit, terminal 6 being ultimately connected to the relay "mark" contact; terminal 7 to the "tongue" contact; and terminal 8 to the "space" contact.

**29.** For a description of a high-speed signalling system, reference should be made to A.P.2980A, Vol. I.

**30.** The cathode of V400 in the multiplier unit is connected to switch S1 in the main unit (*fig. 8*) where it is returned to earth either direct or through a milliammeter (M1 of *fig. 1*) to read the cathode current of the valve.

#### Power amplifier stage

**31.** The power amplifier stage is shown in simplified form in *fig. 7*. Valves V1 and V2 are beam tetrodes, connected in parallel.

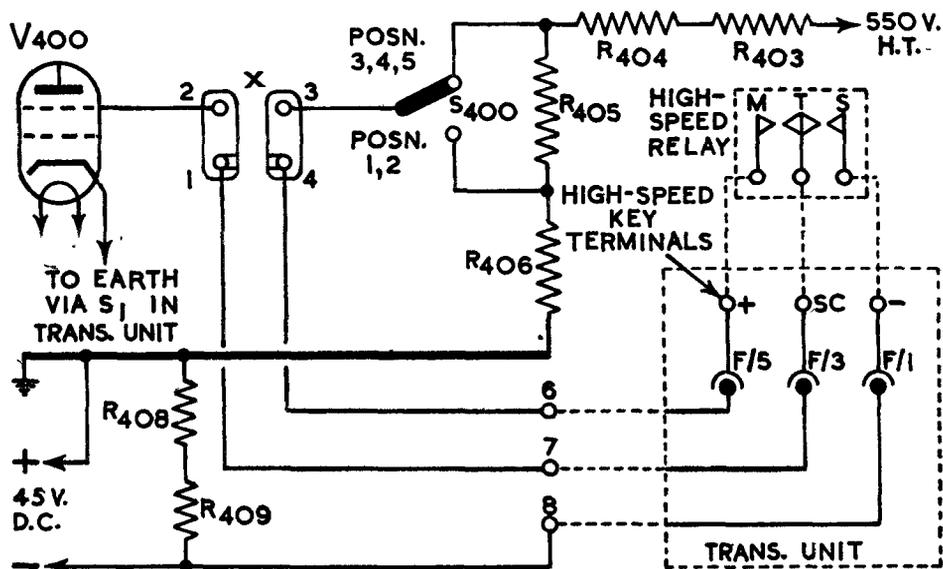


Fig. 6. High-speed keying circuit

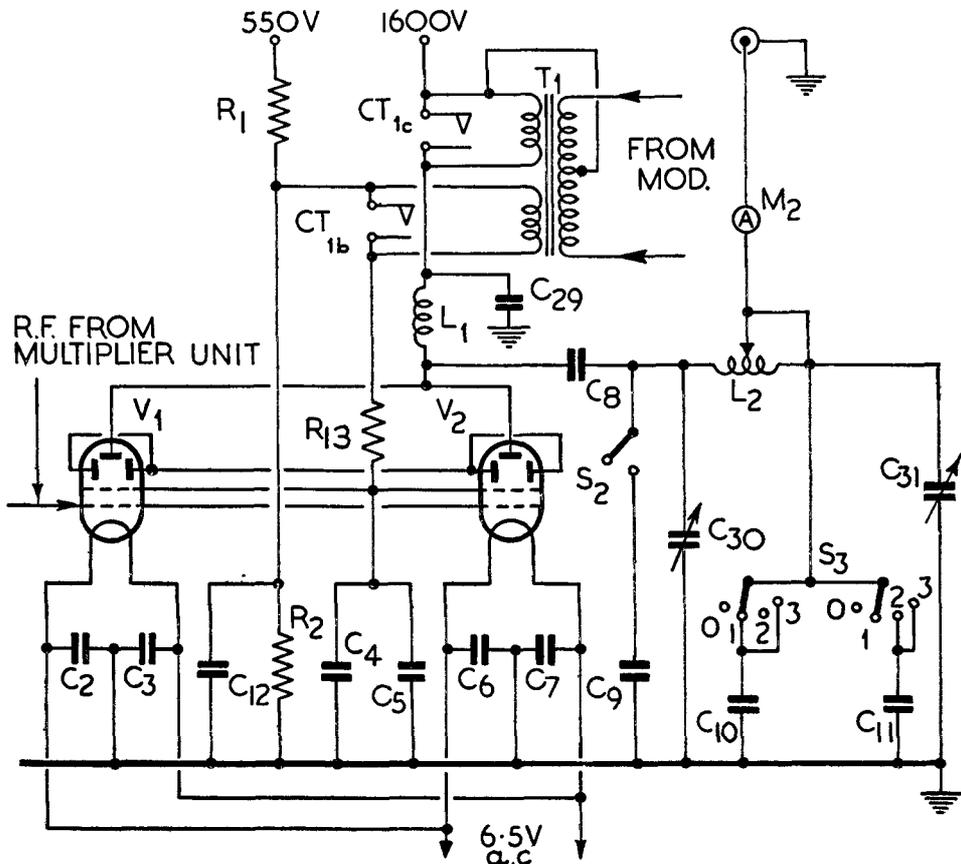


Fig. 7. Simplified circuit of power amplifier

Their tuned anode circuit consists of the variable inductance L2 and the variable condensers C30 and C31. The fixed condenser C9 is connected in parallel with C30 by the RANGE switch S2, on the 1.5—2Mc/s range. Adjustment of aerial coupling is provided by the variable condenser C31, and the fixed condensers C10, C11 (selected by the COUPLING switch S3). The switch has four positions, labelled 0 to 3 as shown in *fig. 7*. Aerial coupling is reduced as the capacity from the aerial end of L2 to earth is increased, the couplings being minimum on switch position 3 when C10, C11 and C31 are all in parallel. Meter M2 reads the RF output current.

**32.** The stage is parallel-fed through the HF choke L1. For R/T transmission, anode and screen modulation is obtained by feeding the HT supply to these electrodes through the secondary windings of the modulation transformer T1. These secondaries are short-circuited by the contacts CT1b, and CT1c of the CW contactor, CT1,

during CW transmission. The DC screen-grid voltage is tapped off from the junction of resistors R1, R2 across the 550-volt input to the unit. The resistor R13 is a parasite stopper.

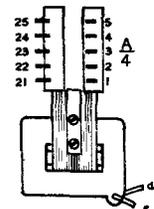
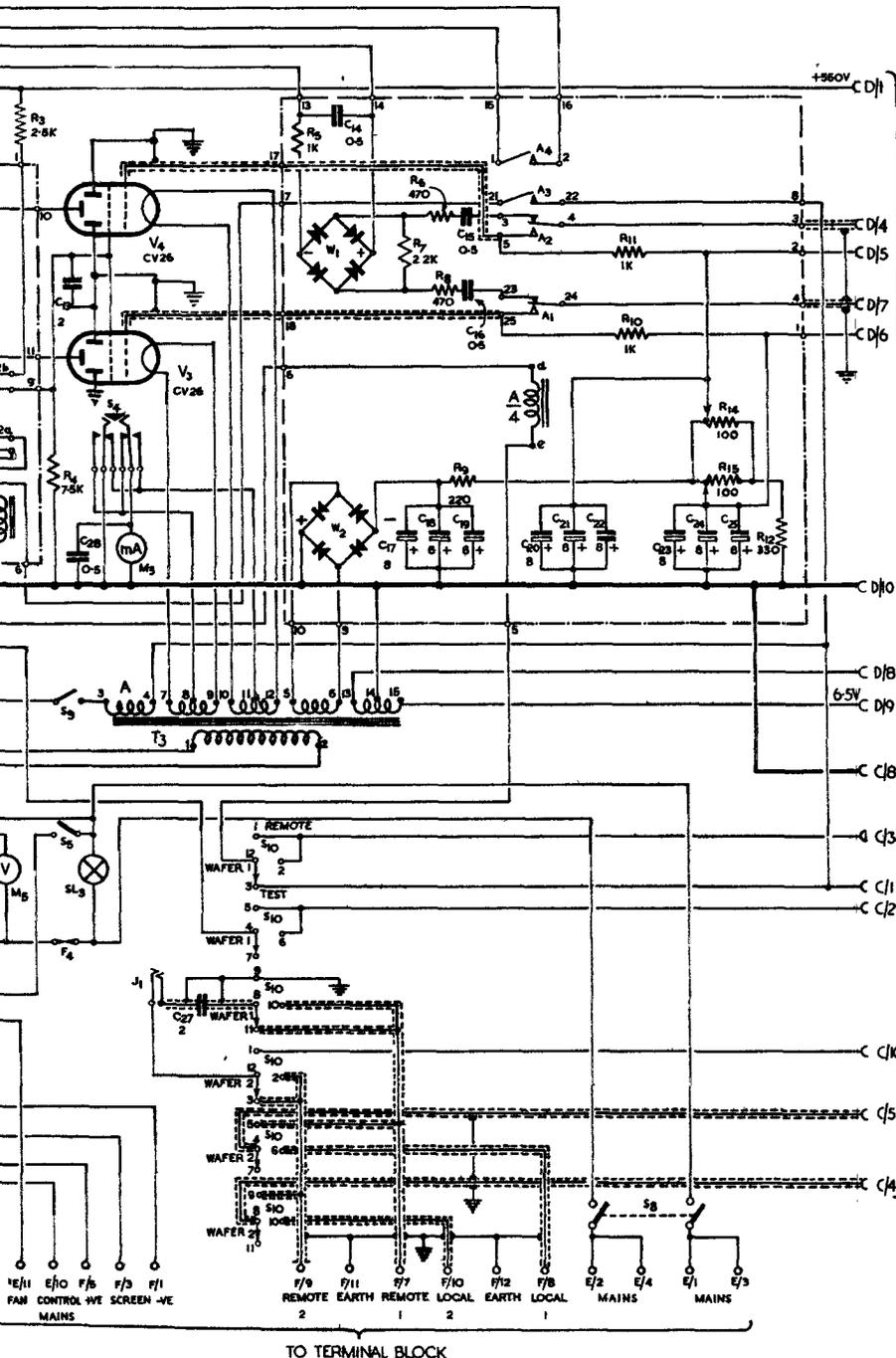
**33.** Class C operation is employed both on CW and R/T, the grid of V1 and V2 being connected to the negative end of resistors R408, R409 across the metal rectifier W.400 in the multiplier unit (*fig. 5* and *para. 23*). A negative bias of approximately 48 volts is applied to the grids, via resistor R407 and choke L404 (*fig. 5*).

**34.** Both PA valves are directly heated, and the filaments are by-passed to earth through condensers C2, C3 and C6, C7. The screen grids are maintained at earth potential to RF by condensers C4, C5.

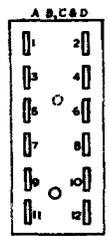
**35.** Referring to the full circuit diagram of the transmitter unit (*fig. 8*) the switch S1 is the meter switch referred to in *para. 9*



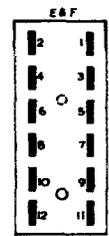




INDEX TO RELAY CONTACT NUMBERING

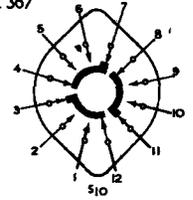


JONES SOCKETS VIEWED FROM FRONT

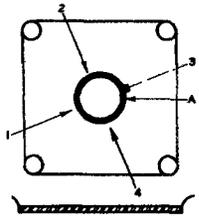


JONES PLUGS VIEWED FROM FRONT

TO AMPLIFIER TYPE 367



BOTH WAFERS IDENTICAL SWITCH SHOWN IN MAX. CLOCKWISE POSITION WHEN VIEWED FROM REAR



(BOTH WAFERS IDENTICAL) VIEWED FROM REAR

TAC POS.	KNOB INDICATION
3	0
2	1
1	2
4	3

TO TERMINAL BLOCK

# OF TRANSMITTER UNIT, T.1509



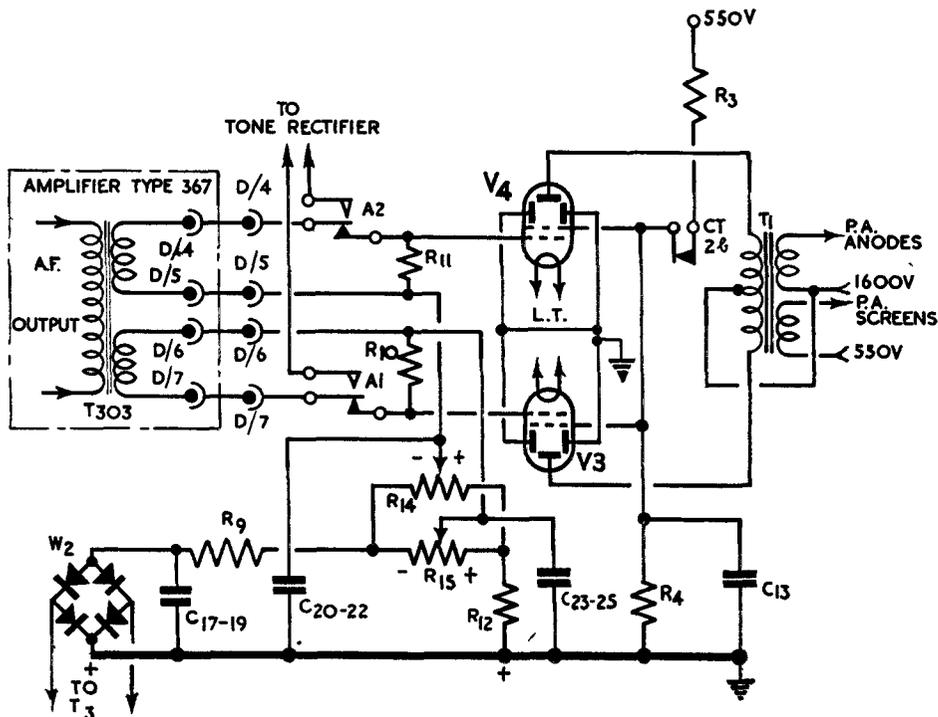


Fig. 9. Simplified circuit of modulator stage

and 30. When the contacts are in the position shown, the cathode of the oscillator valve V201 (*fig. 2*) is returned direct to earth through contact 6 of the Jones socket B and the left-hand set of switch contacts. At the same time the cathode of the multiplier valve, V400 (*fig. 5*) is earthed through the right-hand set of switch contacts and the milliammeter M1, enabling its cathode current to be read. When the switch button is pressed, the milliammeter is transferred to the cathode of V201 and the cathode of V400 is earthed direct.

36. The meter M4 reads the combined cathode current of the PA valves, V1, V2.

#### Modulator stage

37. The circuit of the modulator stage is shown in simplified form in *fig. 9* with the various relay and contactor contacts in the positions for R/T operation. The secondaries of the output transformer T303 in the speech amplifier are connected by relay contacts A1, A2, to feed the grids of the modulator valves V3, V4 in push-pull. When these contacts are reversed, as for CW working, the amplifier output is switched to the tone rectifier, W1 (*fig. 8*).

38. The stage operates under Class AB2 conditions, bias being obtained from the rectifier W2, (*fig. 8*) the input to which is taken from a secondary winding on the transformer T3 (*fig. 8*). Resistance-capacity smoothing is employed, and potentiometers R14, R15 (*fig. 9*) permit individual adjustment of the bias to each valve grid. When the potentiometers are in the minimum bias position, the grids are still negative to earth by the PD across R12.

39. Contacts CT2b of the R/T contactor, CT2, connect the screen-grids of the modulator valves to the junction of resistors R3, R4 across the 550-volt input to the transmitter unit. The HT to the anodes of V3 and V4 is taken from the 1,600-volt line and applied to the centre tap on the primary of T1.

40. Referring to the circuit diagram, *fig. 8*, it will be seen that the cathode current of either modulator valve can be read on the milliammeter M3, the push-button switch S4 enabling the meter to be switched into either cathode circuit. Normally the meter is in the cathode circuit of V3. Pressing the switch button transfers the meter to the cathode circuit of V4.

**41.** Also in *fig. 8* can be seen the resistance-capacity filter R9 and C17 to C25, which smoothes the DC output from the bias rectifier W2.

#### *Amplifier, Type 367*

**42.** A circuit diagram of the amplifier, Type 367 is given in *fig. 13*. The switch S300 must be set according to the type of control unit in use. In position 1, as shown in the diagram, the circuit is arranged for the use of a control unit, Type 310. The SERVICE switch on this unit enables a 24-volt supply to be connected with either polarity across lines 1 and 2 (terminating at contacts 4 and 5 of plug C). When the switch is at R/T, the positive side of the supply is connected to line 2 and current passes through rectifier MR300 and the operating coil of the R/T relay D/1 to line 1. In this condition the passage of current through the winding of the CW relay, E/1 is opposed by rectifier MR301.

**43.** When the R/T (D/1) relay operates, a circuit is made between contacts 1 and 3 of plug C, causing first the transmitter R/T relay, A/4, to be energized and then the transmitter R/T contactor, CT2 (*para. 73*).

**44.** Operation of the SERVICE switch on the control unit, Type 310 to the CW position connects the positive side of the 24-volt supply to line 1 and current now passes through the operating coil of the CW relay E/1 and rectifier MR301 (being opposed by MR300) to line 2.

**45.** When the CW (E/1) relay operates, a circuit is made from pin 1 to pin 2 of plug C, thereby completing the energizing circuit for the CW contactor CT1 in the transmitter (*para. 70*).

**46.** The AF input voltages (speech or keying tone) to the amplifier are applied *via* pins 4 and 5 of plug C across the primary of the transformer T300. It will be seen that although the primary is split from the DC point of view, the two halves of the winding are in series to AF through condenser C300.

**47.** When a control unit, Type 88 is used with the transmitter, the amplifier relays D/1 and E/1 are operated by 24 volts DC over a line and earth circuit, the relay for the service required being selected by the amplifier switch S300. To operate the

transmitter, the HT switch on the control unit, Type 88, is placed ON; this connects the positive terminal of a 24-volt battery to a centre tap in the output winding of the line transformer in the unit. With switch S300 in the amplifier unit in positions RT or CW, the two halves of the primary of T300 are connected in series through the right-hand pole of the switch, and their junction is returned to earth through the operating coil of relay D/1 or E/1 by one of the other two poles. The line to earth circuit for operation of the relay required is thus completed. The incoming AF voltages appear across the primary of T300 as before.

#### *Intercom. relay*

**48.** Relay F/2 enables the lines from the remote control point to be used for intercommunication with the transmitter attendant, and provides for breaking the I/C circuit when the transmitter HT is switched on.

**49.** Until the transmitter and amplifier HT circuits are made, the relay is de-energized and contacts F2 are closed. The mic-tel jack on the transmitter (J1, *fig. 8*) is connected through contact 10 of the amplifier plug C across part of the secondary winding of T300 (*fig. 13*) so that communication can be carried on over lines 1 and 2 (*fig. 13*) with the remote control point. Contacts F1 are open and there is therefore no input to the grid of V300 or V303. Telephone sets 10G/13519 must be employed for this I/C circuit, as these employ a buzzer calling device which does not affect the line relays.

**50.** When HT is switched on to the transmitter and amplifier, the relay is energized from the 550-volt input through resistors R317 and R318. Contacts F2 then open to break the I/C circuit, and contacts F1 close, connecting the amplifier input potentiometer, R325, across the secondary of T300. Simultaneously the telephone set at the control unit, Type 310 is disconnected from the lines, this operation being performed automatically when the transmitter HT switch on the unit is placed ON.

#### *Automatic gain control*

**51.** The first amplifying valve is V303, the modulating voltages from the lines being applied to the grid through the moving



after its input level has been controlled by the AGC circuit. Condensers C307, C311 and C313 are included to attenuate the output at frequencies above those required for speech transmission. This stage is transformer-coupled by T302 to two tetrode valves V305, V306 in push-pull. The unshunted cathode resistors R322, R323 are included to provide bias and negative feedback, further bias being developed across the common cathode resistor R319, shunted by C315. The output transformer T303 is provided with two secondary windings to allow the individual adjustment of the bias on the grids of the modulator valves in the transmitter.

#### Control circuits

**57.** The principal control circuits are incorporated in the transmitter unit, and are shown in full in *fig. 8*. The mains input to the transmitter, speech amplifier and power unit is connected across contacts 1 to 4 of plug E on the transmitter unit; E/2, E/4 and E/1, E/3 are paralleled for convenience when wiring up.

#### LT and HT switching

**58.** A simplified diagram of the LT and HT switching circuits is given in *fig. 10*. Provided the transmitter safety switch S8 is closed, the MAINS lamp SL3 is alight all the time the mains are connected. The circuit to the fan motor can then be completed by closing the FAN switch S7.

**59.** On closing the LT switch S5 the mains are applied *via* the safety switch S100 to the auto-transformer, T100, in the power unit, the input tapping on which is adjusted according to the supply voltage. The mechanical delay relay C/1 is also energized, its contacts C1 closing after an interval of 25 to 35 sec. to enable the HT voltage to be applied to the anodes of the power unit rectifiers *via* the HT transformer T101 when the HT switch is closed. This switch (S9 of *fig. 8*) applies the 50-volt winding of T3 (*fig. 8*) to the coil of HT contactors CT1 or CT2 according to the type of service in use, and their contacts, CT1d and CT2d, feed the mains to the HT transformers (T101, T102 of *fig. 10*) (*para. 63*).

**60.** The 230-volt controlled output from T100 returns to the transmitter and reaches the common mains line through the primaries of transformers T2, T3 in the main unit. The secondaries of T2 supply the filaments of the oscillator, multiplier, and

PA valves and the bias rectifier for the multiplier and PA valves (W.400 *fig. 5*). The secondaries of T3 supply the filaments of the modulator valves, the heaters of the valves in the amplifier, Type 367, the modulator bias rectifier W2 (*fig. 8*), the CW and R/T contactors CT1, CT2 and relay A/4.

**61.** Current also passes to the primary of T103 in the power unit, the secondaries of which supply the rectifier filaments.

**62.** The LT lamp SL2 lights up and the voltmeter M5 shows the controlled voltage.

**63.** To complete the circuit from the controlled voltage line to the primary of transformers T101, T102 in the power unit, which supply the anodes of the rectifier valves, contacts CT1a or CT2a must be closed. These belong respectively to the CW and R/T contactors (CT1, CT2 *fig. 8*). Either contactor may be energized when the HT switch S9 (*fig. 8*) is closed, the one which operates being determined by the position of the SERVICE switch on the control unit, Type 310, or, if a control unit, Type 88 is used, by the position of the switch S300 in the amplifier, Type 367 (*fig. 13*).

**64.** If the TUNE-TRANSMIT switch S6 is open (TUNE position), the input to the primaries of HT transformers T101, T102 is reduced by the LF choke L100. This is done to protect the transmitter valves during tuning. Closing the switch (TRANSMIT position) short-circuits the choke and applies the full voltage to the transformers.

#### Note . . .

*Under no circumstances must the transmitter be operated in the TUNE position.*

**65.** The HT lamp SL1 lights up when either the CW or the R/T contactor closes, indicating that the HT voltage is on the rectifier anodes.

#### Selection of service

**66.** The transmitter is operated from a control unit, Type 310, or alternatively Type 88, and provision is made for the connection of two units of either type, one in the transmitting station and the other at a suitable remote control point.

**67.** The units are connected to a terminal block on the transmitter and thence to the contacts of plug F marked LOCAL and REMOTE (*fig. 8*). Switch S10 has three positions, labelled REMOTE, LOCAL and TEST.

On the first two positions, the remote or local control unit is connected to the transmitter, and on the TEST position both are out of circuit but the transmitter HT supply is completed and the contactors are operated in the R/T-MCW position, so that the oscillator keying contacts are closed and adjustments can be carried out.

**68.** A description of the control unit, Type 310 is given in *para.* 95 to 112 of this publication and of the control unit, Type 88 in A.P.2529A, Vol. I., Chap. 2.

**69.** Switch S300 in the amplifier, Type 367 (*fig.* 13) is set to the appropriate position for the type of control unit in use. When using a Type 310 unit, selection of CW or R/T and MCW operation is carried out by the SERVICE switch on the unit and may therefore be done remotely. With a control unit, Type 88, the service is selected by switch S300 in the amplifier. The amplifier switching and relay operation is described in *para.* 42 to 45.

#### CW operation

**70.** When the CW relay E/1 in the speech amplifier (*fig.* 13) is operated from the local or remote control unit, a circuit is completed between contacts 2 and 1 of socket C in the transmitter unit (*fig.* 8). Provided that the transmitter HT switch S9 is closed, there is now a circuit from secondary A of T3, through S9, the operating coil of CT1 and wafer 1 of S10 (provided that the switch is at LOCAL or REMOTE) to contact 2 of socket C. As has been mentioned, contacts 1 and 2 of the socket are connected through the amplifier and it will be seen that this completes a return path to the other end of secondary A of T3. The controlled mains voltage has already been applied to the primary of T3 by closing the LT switch S5 (*para.* 59).

**71.** The R/T relay, A/4, is not energized in this condition and the circuit to the R/T contactor CT2 is broken at relay contacts A3. Contacts A1 and A2 of the relay apply the output from the amplifier, Type 367, which in this case consists of amplified keying tone, to the rectifier W1. The output of the rectifier, smoothed by R5 and C14 is supplied to the operating coil of the keying relay B/1 in the oscillator unit (*fig.* 2), thus applying *via* its contacts, HT to the oscillator screen grid when the telegraph key is down.

**72.** When the CW contactor CT1 operates, its contacts CT1a complete the mains input to the HT transformers T101, T102 in the power unit. Contacts CT1b and CT1c short-circuit the two secondaries of the modulation transformer T1, so that the HT supply to the anodes and screens of the PA valves does not pass through those windings.

#### R/T operation

**73.** When the R/T relay D/1 in the amplifier (*fig.* 13) is operated from the control unit, contacts 3 and 1 of socket C in the transmitter unit (*fig.* 8) are connected through the amplifier. Thus the operating circuit of the CW contactor is broken between contacts 1 and 2. A circuit is made, however, from secondary A of T3, through S9, the operating coil of the R/T relay A/4, and wafer 1 of S10 (provided that switch is at LOCAL or REMOTE) to contact 3 of socket C. As previously mentioned, contact 3 is connected to contact 1 through the speech amplifier, and this again completes the return circuit to the other end of secondary A of T3. The R/T relay, A/4, is therefore energized. The first effect to observe is the closing of relay contacts A3, which complete a second circuit from secondary A of T3, through S9, the R/T contactor CT2, and relay contacts A3, back again to the secondary, thereby energizing the R/T contactor CT2. Contacts CT2a are in parallel with contacts CT1a of CT1 (*para.* 72) and therefore complete the primary circuits of the HT transformers, T101, T102 in the power unit. Contacts CT2b apply HT to the screen grids of the modulator valves V3, V4. Since contacts CT1b and CT1c of the CW contactor CT1 are now open, the HT to the anodes and screens of the PA valves is applied through the secondaries of T1 and is modulated at audio-frequency from the microphone in the control unit.

**74.** Referring again to the R/T relay, A/4, when this is energized as described, contacts A4 close to short-circuit the keying contacts of relay B/1 in the oscillator unit (*fig.* 2). Contacts A1 and A2 change over and switch the output from the amplifier, Type 367 to the grids of the modulator valves.

**75.** In reading the foregoing paragraphs on CW and R/T operation, reference should be made primarily to the complete circuit

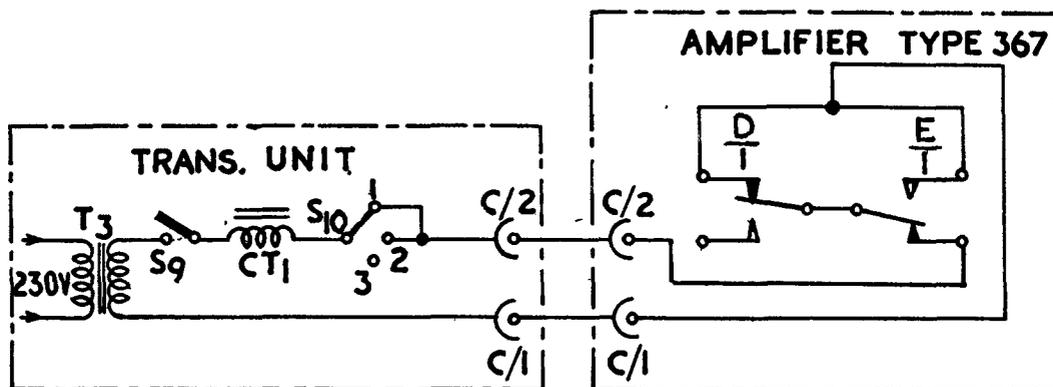


Fig. 11. Operating circuit for CW contactor

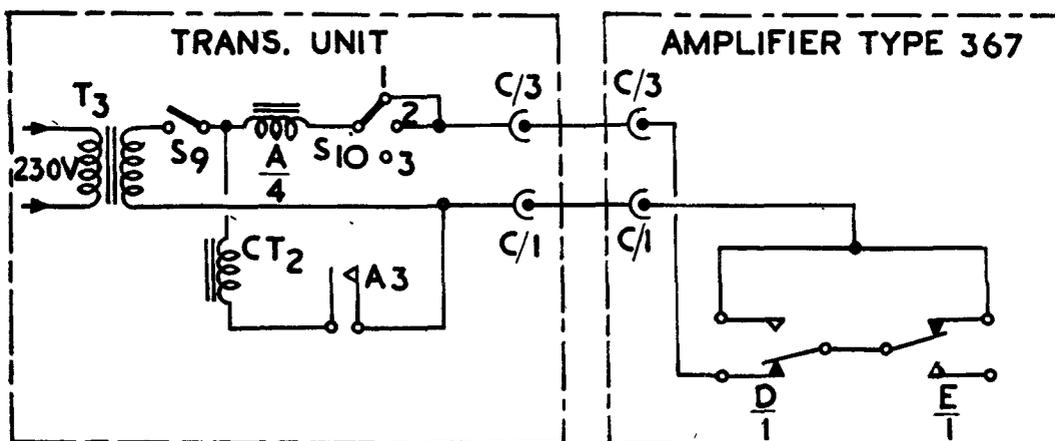


Fig. 12. Operating circuit for R/T relay and contactor

diagrams quoted in brackets. The contactor operating circuits are also shown schematically in *fig. 11* and *12*, which will assist in tracing the path of the current and the sequence of the components involved.

#### MCW operation

**76.** For MCW operation the transmitter is set up as for R/T. The HF oscillator stage is therefore permanently keyed as described in *para. 74*, and the tone from the control unit, Type 310 or Type 88 is applied by contacts A1 and A2 of the R/T relay A/4 to the grids of the modulator valves V3 and V4. The carrier is thus radiated continuously but is modulated by the tone only when the key is pressed.

#### "Test" position of S10

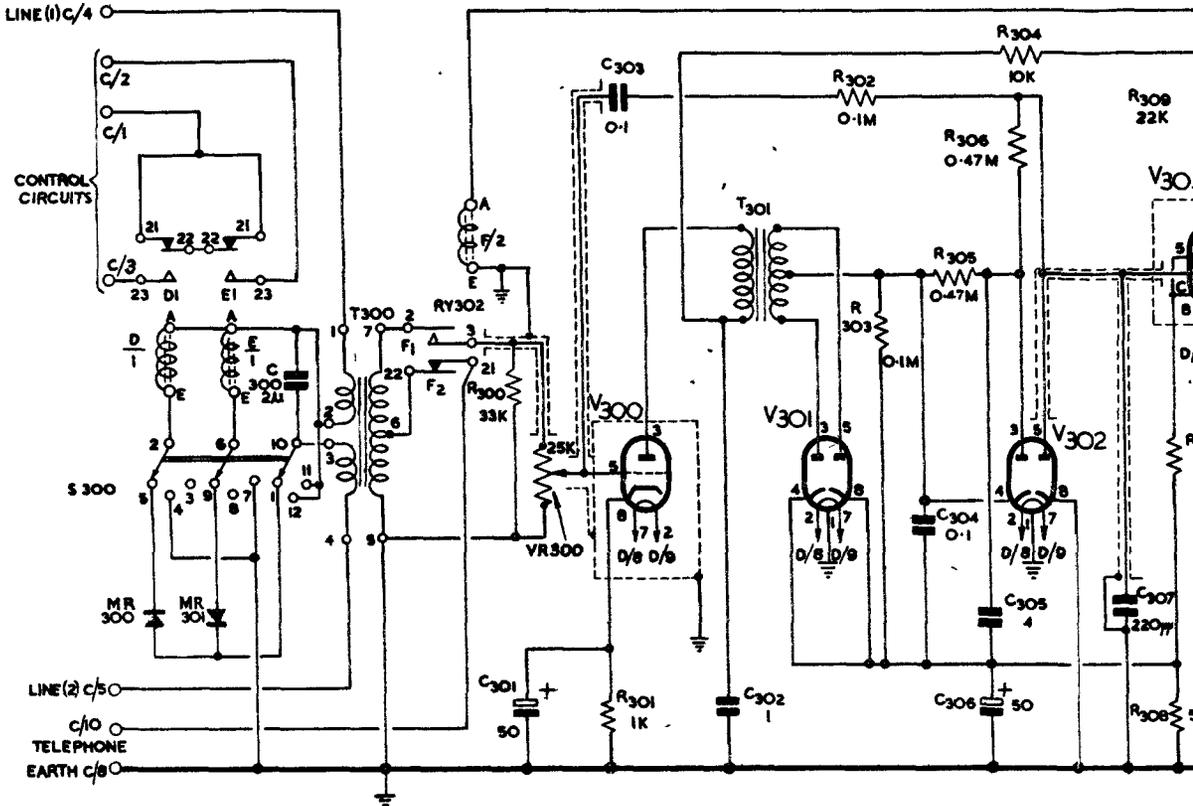
**77.** In *fig. 8* the switch S10 is shown in the

TEST position. The local and remote control units are then disconnected. The R/T relay A/4 is energized from secondary A of T3 *via* S9 and wafer 1 of the switch. This again has the effect of energizing the R/T contactor CT2, the circuit being completed by the closing of contacts A3 of relay A/4, and the HF oscillator made operative by the contact A4.

**78.** In this position of the switch, also, the telephone jack J1 is connected directly across the lines to the distant control unit, and not *via* the intercom. relay in the amplifier as for normal working (*para. 48*).

#### High-speed keying

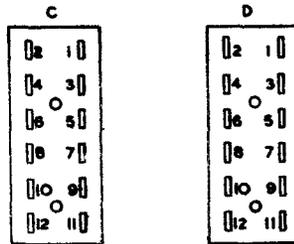
**79.** For high-speed keying service the link adjustment described in *para. 26* is made, enabling the screen of the multiplier valve



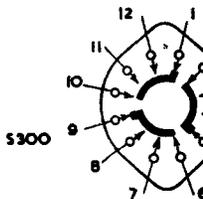
ALL POTS SHOWN IN MAX.  
ANTI-CLOCKWISE POSITION.

5300 SHOWN IN POSITION  
FOR OPERATION FROM  
CONTROL UNIT TYPE 310

CENTRE POSITION = RT. } FOR  
RIGHT HAND SIDE = CW } CONTROL UNIT  
TYPE 88



JONES PLUGS  
(VIEW LOOKING ON TACS)

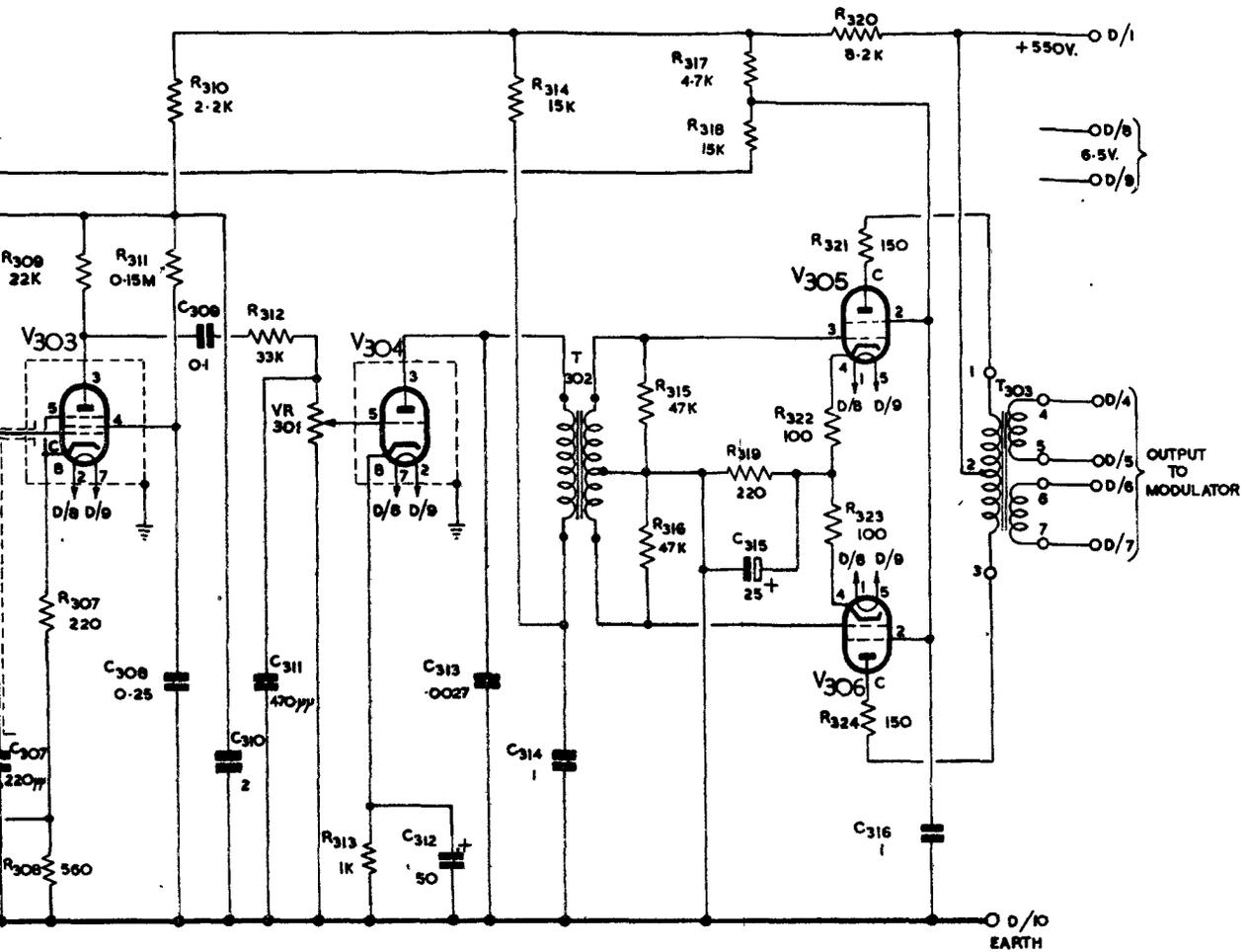


POS. OF KNOB	TAC NOS.
1	5 9 1 CON
2	4 8 12
3	3 7 11

SWITCH SHOWN IN MAX.  
POSITION WHEN VIEWED

FIG. 13. AMPLIFIER T



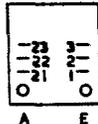


NOS.	LABEL
1	CONTROL UNIT 310
12	" " 88RT.
11	" " 88CW.

RY300 & 301



RY 302



INDEX TO RELAY CONTACT NUMBERING

IN MAX. CLOCKWISE VIEWED FROM REAR.

R TYPE 367.



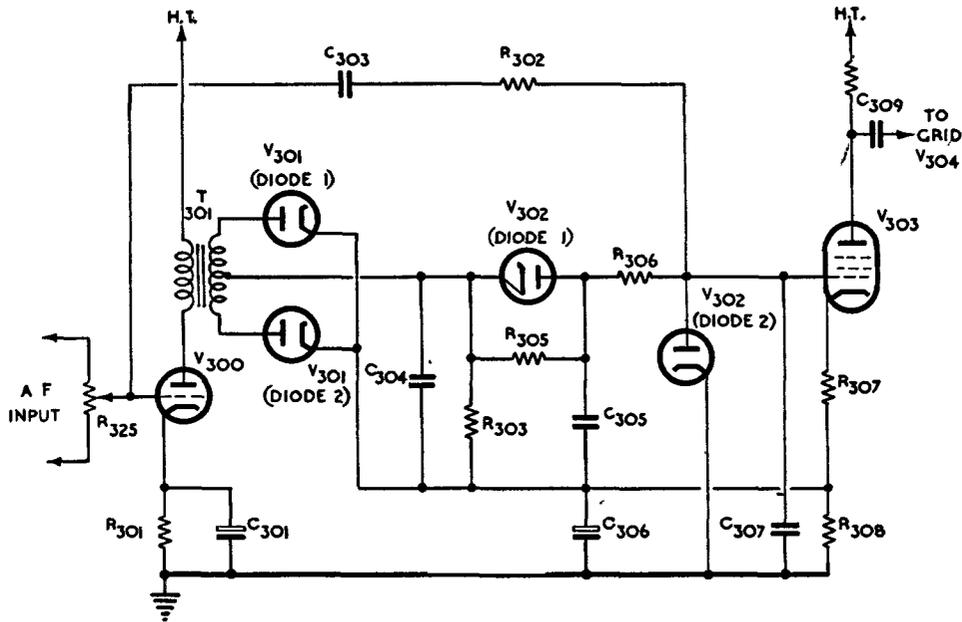


Fig. 14. Amplifier gain control and muting circuits

to be keyed from an external relay. The transmitter HT may be switched locally or remotely by means of a control unit, the latter being set for CW service and the normal telegraph circuit closed to keep the transmitter oscillator stage continuously keyed. Alternatively the use of a control unit may be avoided by shorting the contacts of the CW line relay (E/1, in the amplifier, Type 367) and the oscillator keying relay.

**Note . . .**

*HT should always be switched to OFF at the control unit during stand-by periods of more than a few minutes.*

**Power unit, Type 381**

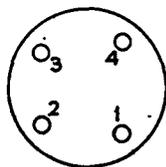
**80.** The circuit of the power unit, Type 381 is shown in fig. 15. Switch S100 is a gate switch operated by a plunger at the rear of the unit, and is closed by the plunger bearing against the rear of the cabinet when the unit is in position. The mains input is applied to the tapped auto-transformer T100. As has been described in para. 61, the controlled output voltage from T100 is applied to the primary of the filament transformer T103 when the LT switch (S5 of fig. 2) in the transmitter is closed. At the same time the coil of the mechanical delay relay C/1 is energized. Contacts C1

close after an interval of 25 to 35 sec. (pre-set by the manufacturer) in preparation for the switching on of HT. Should the transmitter HT switch be already closed when the LT is switched on, the relay ensures that the HT circuit is not completed until the LT supply has been established for a pre-determined valve heater warming period.

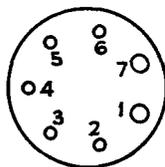
**81.** When the TUNE-TRANSMIT switch in the transmitter unit is at TUNE the input to the HT transformers T101, T102, arrives at contact 2 of plug A and the voltage on the primaries is reduced by L100. When the switch is at TRANSMIT, the input is applied to contact 6 and L100 is out of circuit so that the full 230 volts appears across the primaries of T101 and T102.

**82.** Valves V101, V102 and V104, V105, form a full-wave rectifier consisting of two pairs of parallel diodes. The 1,600 volts DC output from these valves is smoothed by a two-stage choke input filter comprising L101, L103 and condensers C107, C100, C101 and C102.

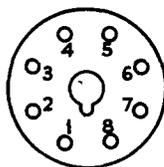
**83.** A stabilizing system consisting of the gas-filled voltage stabilizers V106 to V109 is connected in series with R102 across the 1,600-volt output and the HT supplies to



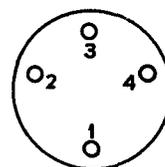
**U.S. MEDIUM  
4-PIN  
(U.S.M.4)**



**U.S. GIANT  
7-PIN  
(U.S.G.7)**



**INTERNATIONAL  
OCTAL  
(I.O.)**



**BRITISH  
4-PIN  
(B4)**

Valve Type	Type of base	Connections to pins
CV.124 (Stores Ref. 10CV/124)	USM5	1. H 2. G2 3. G1 4. C 5. H Top Cap. A
CV.26 (Stores Ref. 10CV/26)	Giant 7-pin bayonet	1. F 2. - 3. Screen grid 4. Control grid 5. Beam forming plates 6. - 7. F.
CV.1054 (Stores Ref. 10CV/1054)	I.O.	1. Metallising, internal shield 2. H 3. A2 4. C2 5. AI 6. - 7. H 8. C1
CV.1932 (Stores Ref. 10CV/1932)	I.O.	1. - 2. H 3. A 4. - 5. G 6. - 7. H 8. C
CV.1941 (Stores Ref. 10CV/1941)	I.O.	1. Metallising 2. H 3. A 4. G2 5. G3 6. - 7. H 8. C Top Cap. G1
CV.187 (Stores Ref. 10CV/187)	B4	1. - 2. - 3. F 4. F Top Cap. A
CV.235 (Stores Ref. 10CV/235)	B4	1. - 2. - 3. F 4. F Top Cap. A
CV.45 (Stores Ref. 10CV/45)	B4	1. A 2. C 3. - 4. Priming anode

**FIG. 16. VALVE BASES AND CONNECTIONS TO PINS**

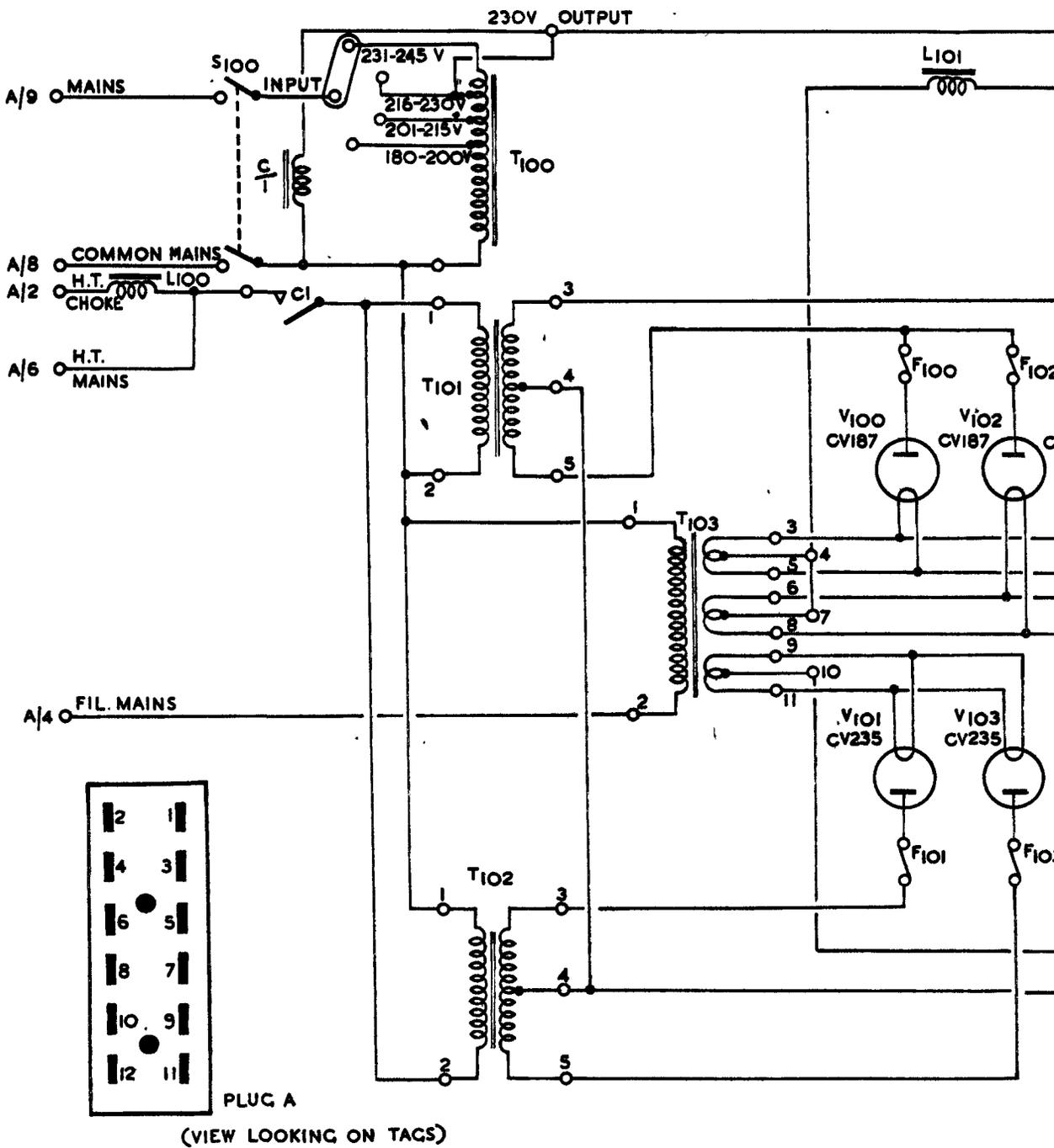
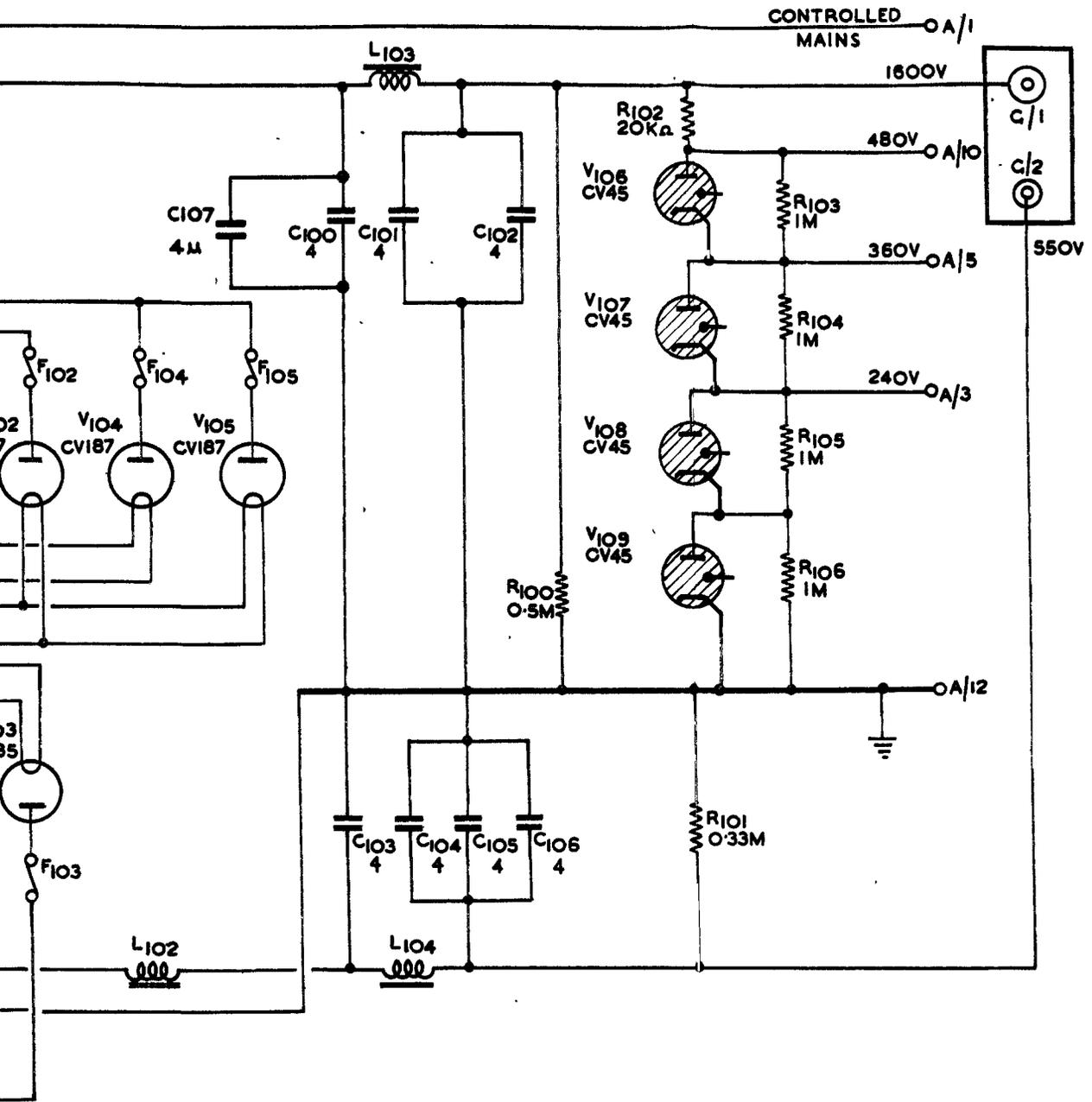


FIG.15. POWER





ER UNIT, TYPE 381



the oscillator unit are tapped off from suitable points. Resistors R103 to R106 provide the necessary potential across the stabilizers for them to strike. The resistor R102 drops the HT to 480 volts to give the stabilizers their correct voltage.

**84.** Valves V101 and V103 form a full-wave rectifier from which a DC output of 550 volts is taken for the HT supplies to the multiplier unit, amplifier, Type 367, and modulator and PA screens. Chokes L102, L104 and condensers C103 to C106 comprise a two-stage choke input filter.

#### Valves and power supplies

**85.** The valves in the oscillator and multiplier units are indirectly-heated tetrodes, Type CV124 (Stores Ref. 10CV/124) with 6.3-volt heaters taking a current of 0.9A, the anode dissipation being 25W.

**86.** Four directly-heated beam tetrodes, Type CV26 (Stores Ref. 10CV/26) are used in the PA and modulator stages with 10-volt filaments taking 5A. The anode dissipation is 100W.

**87.** Valves V300 and V304 in the amplifier, Type 367 are indirectly-heated triodes, Type CV1932 (Stores Ref. 10CV/1932), with 6.3-volt heaters taking 0.3A. The rated anode voltage is 250, and the anode dissipation 2.5W. The two double-diodes, V301 and V302, are valves Type CV1054 (Stores Ref. 10CV/1054) with 6.3-volt heaters taking 0.2A.

**88.** Valve V303 in the amplifier is an indirectly-heated variable- $\mu$  HF pentode, Type CV1941 (Stores Ref. 10CV/1941). The heater voltage is 6.3 and heater current 0.3A. The rated anode voltage is 250.

**89.** The amplifier push-pull output valves are Type CV124 (Stores Ref. 10CV/124) and are similar to those used in the oscillator and multiplier units.

**90.** All the power unit valves have 4-volt filaments taking 3.3A. The two pairs of parallel diodes for the 1,600-volt output are valves Type CV187 (Stores Ref. 10CV/187). The maximum peak anode voltage is 2,000 and the maximum DC output current 250 mA.

**91.** The two diodes which form the full-wave rectifier for the 550-volt output are

valves Type CV235 (Stores Ref. 10CV/235). This type is similar to the CV187. (The CV187 can be used in the 550-volt unit in emergency, but CV235 should not be used in the 1,600-volt supply).

**92.** Valves V106 to V109 in the power unit are gas-filled voltage stabilizers, Type CV45 (Stores Ref. 10CV/45). The maximum voltage is 135, and the normal stabilized voltage 120. The maximum space current is 75 mA.

**93.** Diagrams of the bases of all valves in the transmitter amplifier power unit, and control unit, Type 310 (*para.* 111) are given in *fig.* 16.

**94.** The applications of the various outputs from the power unit are tabulated below :—

1,600V.	....	....PA and modulator anodes.
550V.	...	... PA and modulator screens; multiplier anode and screen, and amplifier, Type 367.
480V. (stabilized)	..	Oscillator.
360V. (stabilized)	..	Anode.
240V. (stabilized)	....	Screen.

#### Control unit, Type 310

**95.** By means of a control unit, Type 310 the transmitter can be operated at considerable distances (the maximum line resistance permissible being 1,000 ohms), the HT to the transmitter switched, and CW tone modulation or R/T operation selected from a remote control point. The transmitter can be keyed or modulated for R/T. Intercommunication with the transmitter is also provided. The circuit of the unit is shown in *fig.* 17. Valve V1 is an AF oscillator for generation of the keying tone which (when the unit is set for CW operation) after rectification in the transmitter, operates the keying relay or provides the tone for MCW keying in the R/T condition. Valves V2, V3 and V4 form a two-stage amplifier for amplification of the keying tone or the input from a microphone before application to the line.

**96.** Provision is made for muting a receiver while the transmitter is working. For this



purpose a single-pole changeover contact is added to relay B/2 and brought out on terminals 4, 5 and 6 (*para.* 104). The receiver output can be supplied to a telephone jack on the control unit for operating or monitoring when required.

**97.** A power unit for operation from 100-140 and 200-240 volts AC mains is included in the instrument and provides an output of approximately 24 volts DC for the HT supply to the valves, relay operation in the unit and at the transmitter, and energization of a microphone; together with 24 volts AC for valve heaters and signal lamps. Alternatively, a 24-volt battery may be used, and terminals are provided so that it can be permanently connected to the unit, instantly replacing the power unit by means of a switch (S1), if necessary, in circumstances such as a failure of the mains supply.

#### Selection of service

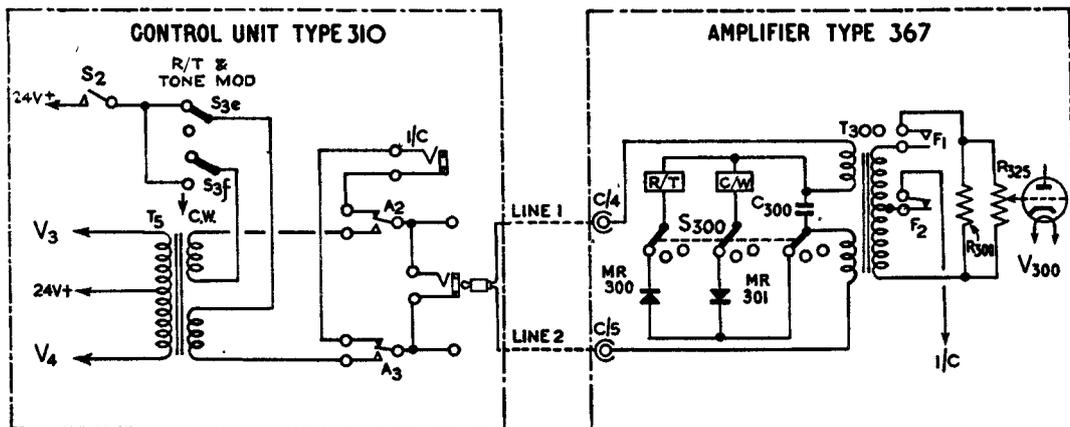
**98.** Switch S2 in *fig.* 17 is the transmitter HT control switch which when closed applies 24 volts DC to the lines to the transmitter. The positive side of the supply is connected either to line 1 or line 2 according to the position of the SERVICE switch S3. This is a three-position key switch, labelled R/T, TONE MODULATION and CW. When moved to R/T, sections *a* and *d* are operated to their upper contacts; sections *e* to *g* remain as shown. In the CW position, section *a* to *d* remain as shown in the diagram and sections *e* and *g* change over to the lower contacts. In *fig.* 17, the switch is shown in the TONE MODULATION position, and it will

be seen that a circuit is made from the positive side of the power unit or the battery (according to the position of S1), through S2 and section *e* of S3 to line 2 *via* the secondary of T5, contact A3 being made to the line when the control unit is switched on (i.e. relay A/4 is energized *via* S2, R6, S3d and R3 (*para.* 101), thus moving contacts A2/A3 to the lower position). Line 1 is earthed *via* A2, T5 and S3f. In *fig.* 18 the arrangements inside the amplifier, Type 367 in the transmitter are shown, and the circuit can be traced through the rectifier W.301 and the R/T relay back to line 1.

**99.** Referring again to *fig.* 17, when S3 is at R/T, sections *e* to *g* of S3 remain in the positions shown and the R/T relay is energized as before. In the CW position, sections *e* to *g* of S3 move to the lower contacts and the positive side of the supply is connected by section *f* to line 1. The circuit in the amplifier is then made through the CW relay and rectifier W.800 to line 2. Line 2 is then earthed in the control unit to complete the circuit.

**100.** The circuit changes in the transmitter made by the CW and R/T relays are described in *para.* 70 to 75.

**101.** When transmitter HT switch S3 is closed, irrespective of the position of S3, the relay A/4 is energized from the 24-volt supply. The transmitter HT ON lamp SL2 lights up, being connected across the 24-volt supply to the unit by contacts A1. The changeover contacts A2 and A3 disconnect



**Fig. 18.** Interconnections of control unit and amplifier

the lines to the transmitter from the I/C jack, J3 and switch them across the secondaries of the amplifier output transformer T5. Simultaneously, relay F/2 in the amplifier, Type 367 at the transmitter operates (*para.* 48 to 50) so that the I/C jack on the transmitter is disconnected from the amplifier.

#### *CW working*

**102.** It has already been mentioned (*para.* 95) that V1 is an AF oscillator for production of keying tone, feedback being obtained by anode-to-grid coupling through a portion of the secondary of T2. The frequency is approximately 1,000 cycles/sec. Automatic bias is developed across the grid leak R1. The cathode bias resistor R2 has a screw-driver adjustment and is pre-set to a position in which a sinusoidal AF output is obtained from the unit. The secondary of T2, in which the AF oscillations appear, is connected between the grid of the first stage amplifier valve V2 and earth. This valve is arranged as a cathode-follower in order to present a small load to the oscillator and also to provide a low output impedance so that valves V3 and V4 can be driven into grid current without distortion of the output waveform. The ratio of T4 can be varied by means of S4 so as to give an output of either 1 mW or 10 mW.

**103.** Valves V3 and V4 form a push-pull output stage and are coupled to the lines through the transformer T5. Keying takes place in this stage, the HT to V3 and V4 when S3 is at CW or TONE-MODULATION being supplied through section *a* of S3 the key jack J1, and key K1 section *b* of S3, and the centre tap in the primary of T5. Condenser C7 and resistor R7 form a key-click filter.

**104.** When the key is pressed, relay B/2 is energized and its changeover contacts B1 are available to reduce the gain of the associated receiver so that transmitter sidetone is heard at a comfortable level. The charge on the condenser C6 holds the relay during momentary release of the key, the rectifier W2 preventing the condenser from discharging through circuits other than the relay coils. When the key is up for longer intervals, however, the condenser has time to discharge through the relay winding, releasing contacts B1 and restoring the receiver gain to normal after about 1/4 second.

**105.** Relay contacts B2 close when the key is down, and connect the CARRIER ON lamp SL3, across the 24-volt AC supply. By reason of the delayed release of the relay described above, this lamp does not follow the keying, but remains alight until the key is left up for the delay period.

#### *R/T working*

**106.** When S3 is at R/T, sections *a* and *b* of the switch short-circuit the key, so that HT is continuously on the anodes of V3, V4. Since relay contacts A4 close when the transmitter HT is switched on by means of S2, relay B/2 is continuously energized through section *g* of S3, so that the receiver is muted, and SL3 is alight all the time the transmitter is radiating a carrier. S3*d* is now in the upper position and relay A/4 is energized *via* J2 and the microphone. A standard carbon insert-type microphone is employed; it obtains its energizing voltage *via* A/4 and R6.

**107.** Section *c* of S3 connects the secondary of the microphone transformer, T3, between grid and earth of V2, at the same time disconnecting the oscillator output from the amplifier stages; section *d* connects the microphone in series with the windings of relay A4 so that it is energized when S2 is closed. If a microphone with a pressel switch is employed, S2 may be permanently closed and the pressel used for send/receive switching.

#### **Note . . .**

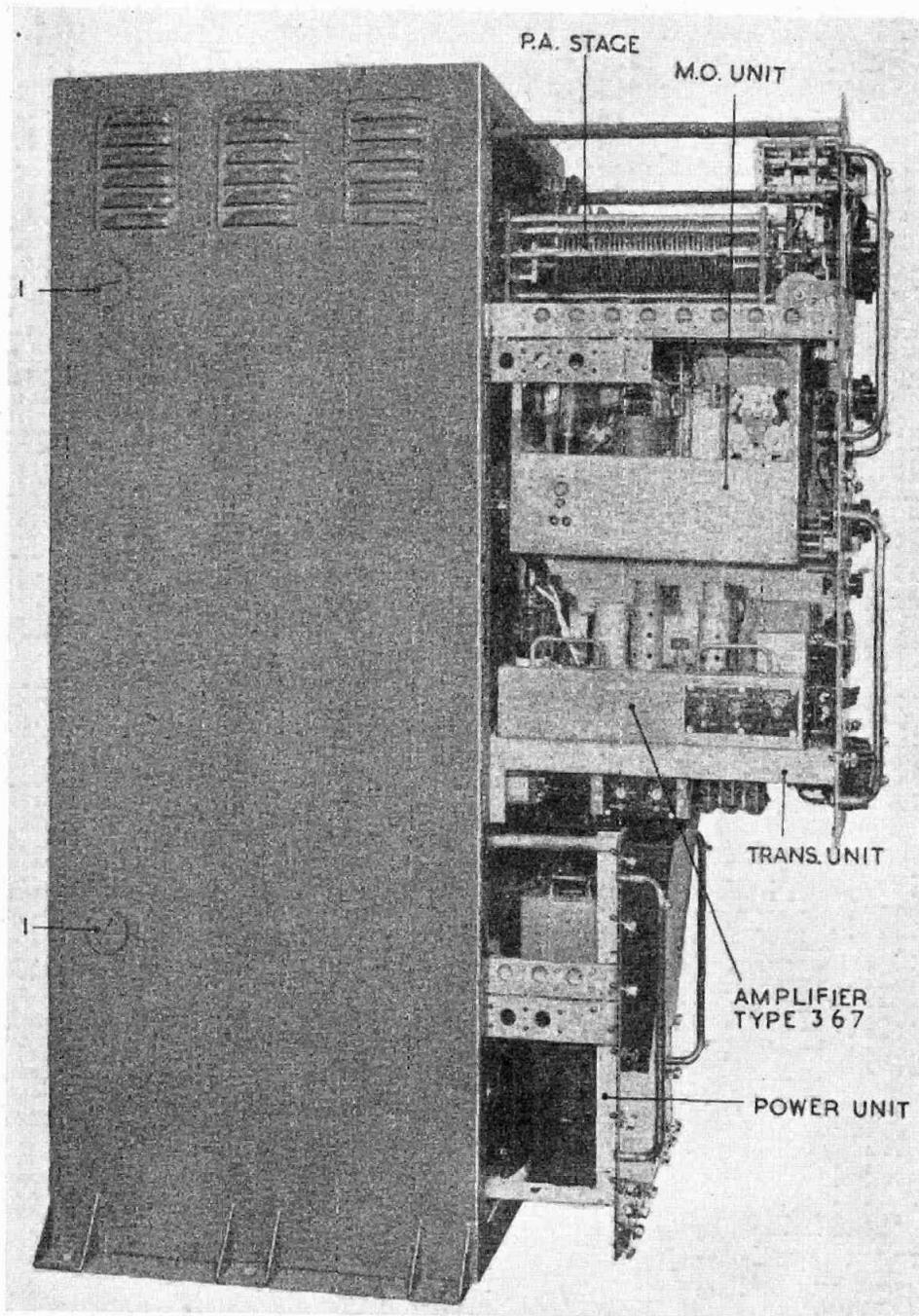
*The TRANSMITTER HT switch must be thrown to OFF during stand-by periods.*

#### *MCW working*

**108.** For MCW the transmitter must be set up as for R/T, and the supply is therefore passed to line 2 as already described. It is, however, necessary for the output from the control unit to be keyed; it will be seen from *fig.* 17 in which S3 is shown in the TONE-MODULATION (MCW) position, that this is done in the same manner as on CW.

#### *Power supplies*

**109.** The primary of the mains transformer T1, is tapped for inputs between 100/140 and 200/240 volts. One secondary supplies the full-wave metal rectifier W1, which gives an output of approximately 24 volts DC smoothed by L1 and the three condensers C1. The other secondary gives 24 volts AC for the



I REMOVABLE COVERS, FOR INSERTION OF SECURING BOLTS

**FIG. 19. SIDE VIEW OF TRANSMITTER, WITH UNITS PULLED FORWARD FOR INSPECTION**

valve heaters, which are connected in series, and for the signal lamps SL1 to SL3. The lamp SL1 lights up when the switch S1 is turned to MAINS or BATTERY. Lamps SL2 and SL3 do not light until relays A/4 or B/2 have operated as already described.

**Note . . .**

*If the lamps SL1, SL2 and SL3 are operating this does not necessarily indicate that the unit is working normally: e.g. the fuse F3 could be open circuited.*

**110.** Switch S1 selects mains or battery input to the control unit. When at MAINS, section *a* of the switch connects the main 24-volt line to the rectifier output or the battery, and sections *b* and *c* connect the signal lamps and heaters across the 24-volt AC winding of T1. Section *d* is closed to complete the mains input to T1, via a 1-amp. fuse F1. When S1 is at BATTERY the DC is applied through a 1-amp. fuse F2 to one side of S2 and the SL1 (also to SL2 and SL3 when the appropriate relays close). Spare fuses are housed inside the cabinet.

**Valves**

**111.** All valves in the unit are Type 6J5G (Stores Ref. 10E/348), VR67 (Stores Ref. 10E/11448) or CV1932 (Stores Ref. 10CV/1932). These are indirectly-heated triodes with 6.3-volt heaters and have the international octal type of base. The connections to the pins are shown in *fig. 16*.

**Connections to lines**

**112.** The remote control lines are normally connected to the unit by means of the line jack, which takes the usual type of double-ended connector from the distribution box. Terminals are provided as an alternative method of connection so that lines of steel wire which will not go into the normal plug, can conveniently be used. Such lines are employed in mobile or temporary installations in the field.

## CONSTRUCTIONAL DETAILS

**General**

**113.** A general view of the transmitter is given in *fig. 1*. In this figure the controls are labelled with their circuit references and it should therefore be consulted when reading the section on operation. For transit purposes, the controls are covered by three rectangular metal plates, which are attached to the withdrawal handles by

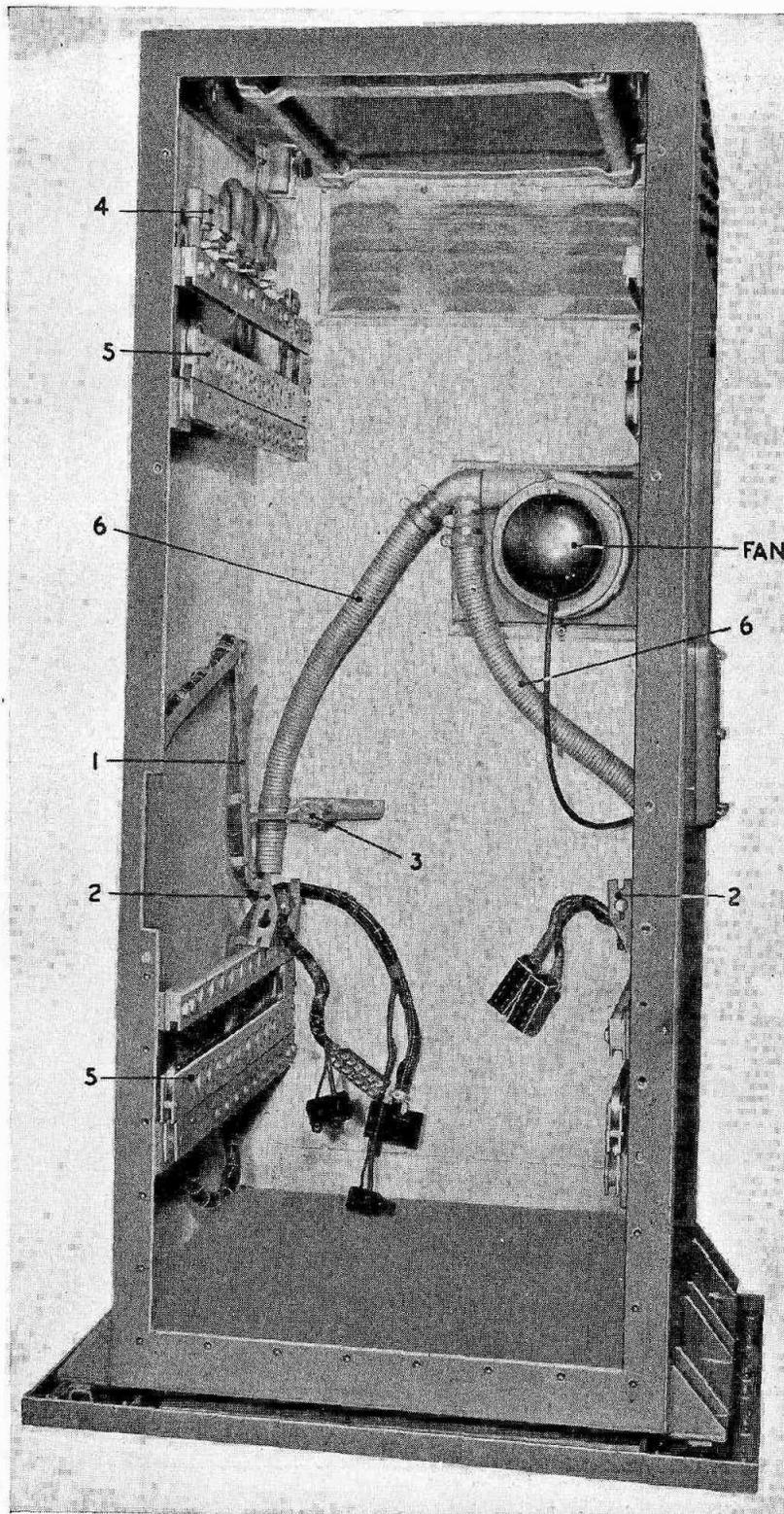
means of the screws and washers which can be seen in the illustration. When the transmitter is in use the cover plates are stowed inside the top of the cabinet. The transmitter cabinet stands on a shock-absorbing base. The tray assembly (3) contains two pull-up drawers with calibration charts and data sheets.

**114.** In *fig. 19* the main and power units of the transmitter are shown pulled forward out of the cabinet on their runners. To remove a unit completely it must be pulled out until arrested by a stop. The connectors may then be removed (*para. 116*). The stop is cleared by raising the front of the unit, after which the unit can be lifted bodily out of the cabinet.

**115.** The covers (1) in *fig. 19* give access to two apertures through which bolts are inserted to hold the internal units firmly when the equipment is being transported. There are two similar apertures in the other side of the case. This view shows the location in the main unit of the MO and amplifier sub-assemblies. The multiplier unit is not visible in this illustration, being on the other side of the main unit behind the oscillator unit. The modulator stage is part of the main unit and is not seen in *fig. 19* as it is on the far side of the amplifier unit.

**116.** A view of the case with the units withdrawn is given in *fig. 20*. The connectors from the power unit and terminal block to the transmitter unit are supported by pivoted arms, one of which is seen at (1). Each arm has at its free end a flange (2) which is attached to the rear of the transmitter unit. The large holes in the flanges are of sufficient diameter to clear the heads of the fixing screws on the transmitter unit, so that the screws need not be removed when the unit is lifted out of the cabinet, it being sufficient merely to slacken them enough for the flange to be moved slightly until the hole coincides with the top screw head after which it can be withdrawn over the screw head.

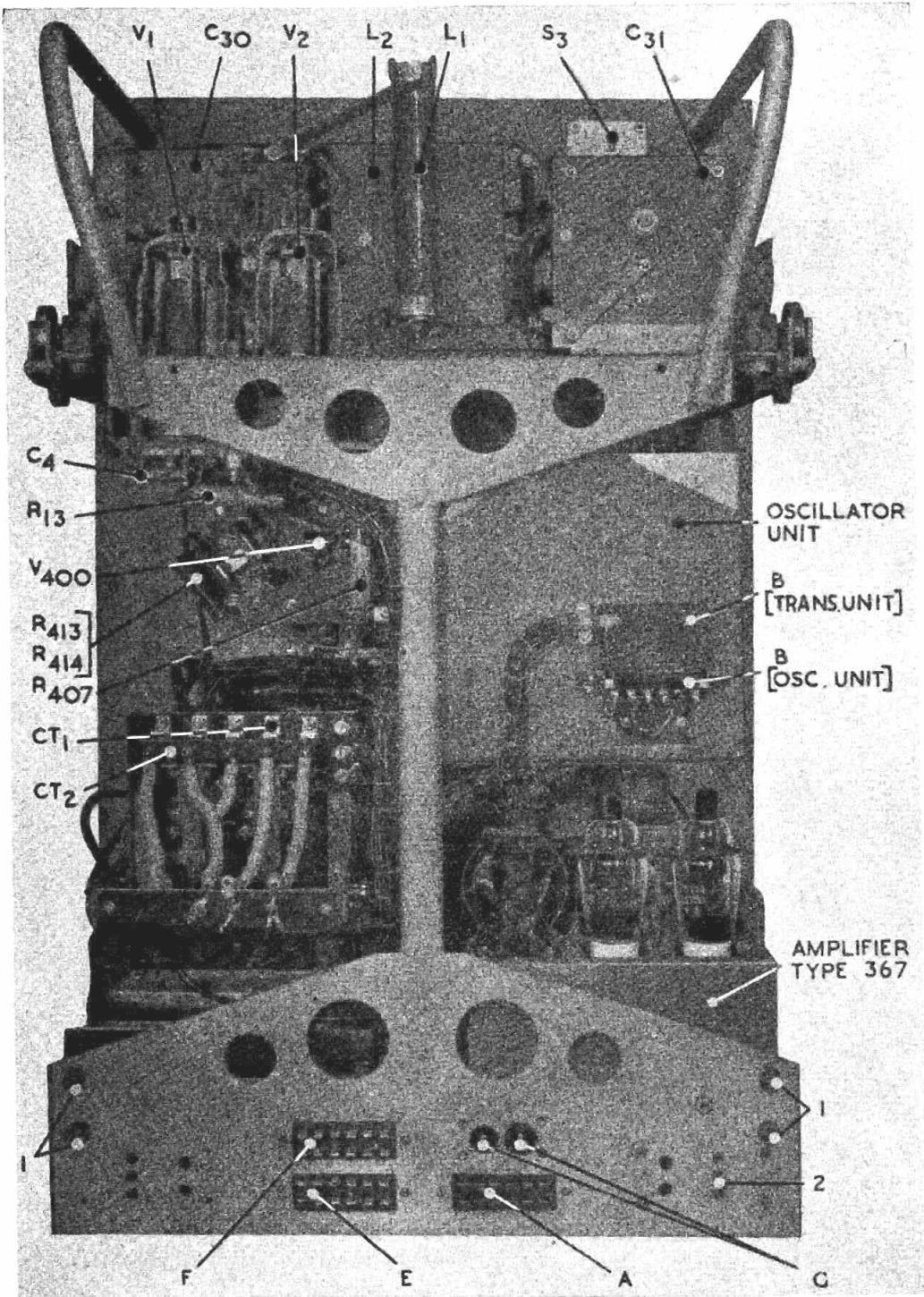
**117.** The bracket (3) fixed to the rear of the cabinet operates the safety switch S8, on the transmitter unit. When the unit is inside the cabinet, a plunger bears against the bracket and closes the switch contacts. As soon as the unit is pulled forward, the plunger is released and the switch contacts break, cutting off the mains input to the transmitter. A similar plunger-operated



- 1 HINGED ARM, CARRYING CONNECTOR CABLE
- 2 FLANGE FOR ATTACHMENT OF CABLE ARMS TO UNITS
- 3 STOP FOR ACTUATING PLUNGER-TYPE SAFETY SWITCH ON TRANSMITTER UNIT

- 4 BOLTS FOR SECURING UNITS DURING TRANSIT
- 5 SLIDING RUNNERS (SUPPORTING UNITS WHEN IN CABINET)
- 6 AIR DUCTS FROM BLOWER

**FIG. 20. INTERIOR OF CABINET WITH UNITS REMOVED**



I SCREWS FOR ATTACHMENT OF CABLE ARMS

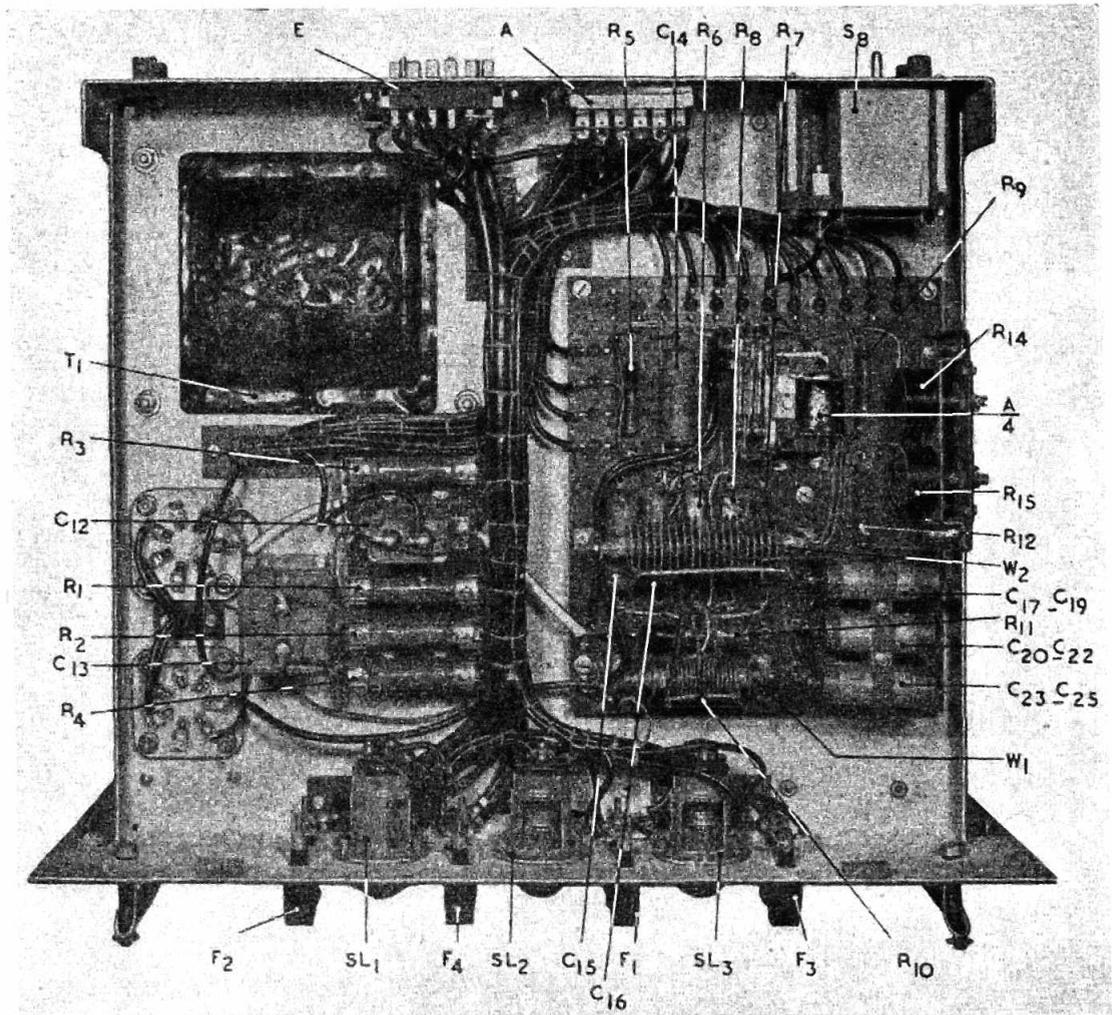
FIG. 21. REAR VIEW OF TRANSMITTER UNIT

switch is provided on the power unit and is operated by the plunger bearing against the back of the cabinet.

**118.** In *fig. 20* the stowage for the bolts mentioned in *para. 115* can be seen at (4) and also one set of the runners (5) for the transmitter and power units. Behind the bolts is a set of four ringbolts which screw into the top of the cabinet for hoisting purposes. At the back of the cabinet are the ducts (6) for delivering air from the blower.

**119.** A rear view of the transmitter unit is given in *fig. 21* showing at (1) the screws which hold the cable-carrying arms (*para.*

116) and at (2) the plunger of the safety switch S8 (*para. 117*). Plug G and socket A at the bottom of the unit receive the two cables from the power unit (seen at the left of the cabinet in *fig. 20*) and plugs E and F the two cables from the terminal block (on the right of the cabinet in *fig. 20*). The plug and socket B on the right of *fig. 21* are for the oscillator supplies and the connections from the oscillator unit to the transmitter unit except for the RF output lead from the coupling condenser C215 in the oscillator unit which is taken direct to the choke and condenser assembly, L401, R401, at the rear of the multiplier unit (shown in *fig. 23*).

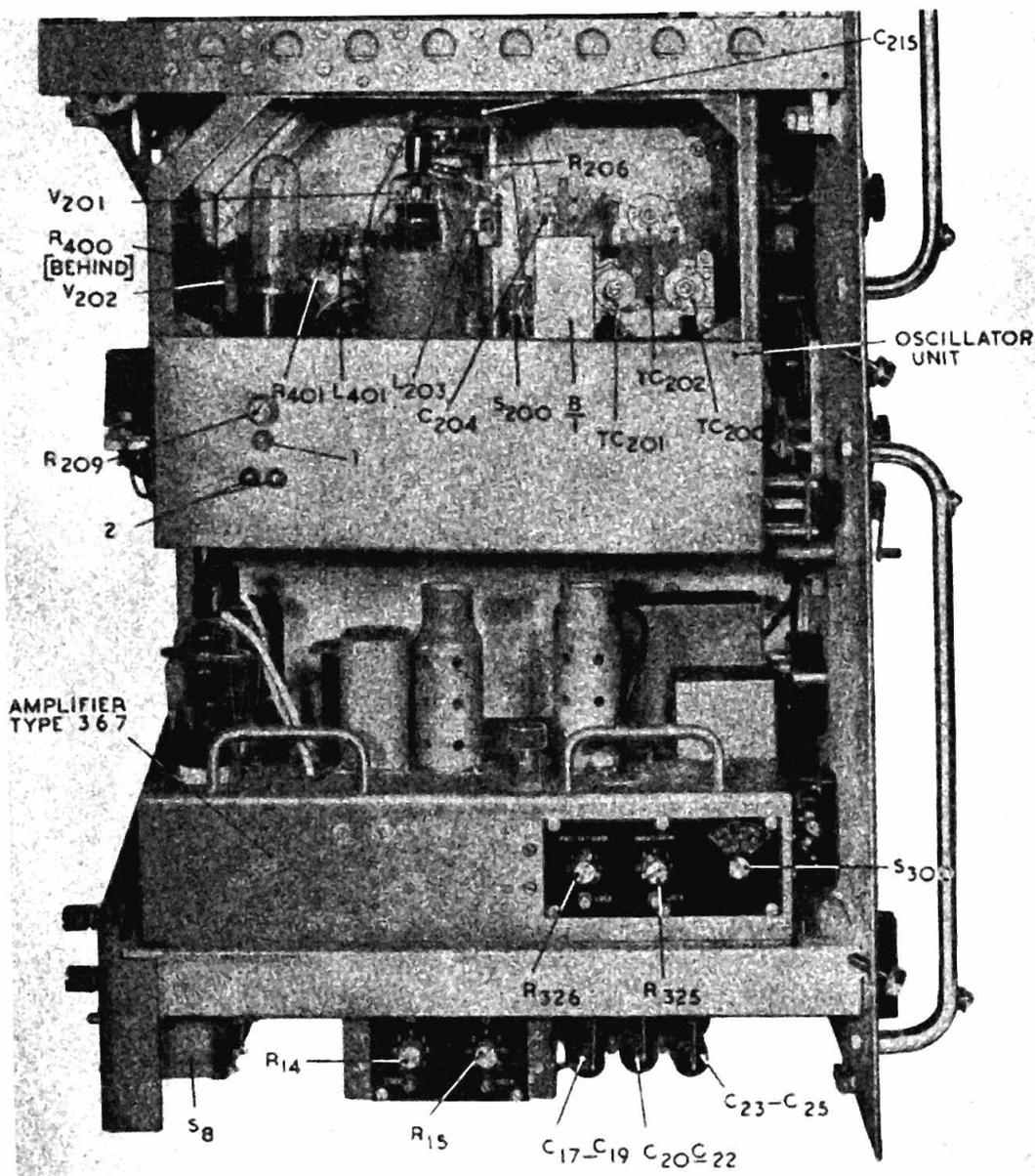


**Fig. 22. Underside view of transmitter unit**

120. The components on the underside of the transmitter unit are shown in *fig. 22*. On the right of the illustration can be seen the assembly mounting the R T relay, A 4 the tone and modulator bias rectifiers (W1, W2), the modulator bias controls (R14, R15) and associated components. The transmitter unit safety switch S8, is in the top right-hand corner of the illustration.

#### Oscillator unit

121. The oscillator unit is shown in position in the transmitter unit in *fig. 23* with the amplifier, Type 367 below it. Coil L203 is the anode tuning inductance, and is adjusted simultaneously with the oscillator coil L200, by means of the OSCILLATOR TUNING control on the front panel. The oscillator coil can be seen in the underside



1 LOCKING SCREW FOR LT POTENTIO METER

2 TEST POINTS FOR LT VOLTAGE MEASUREMENT

Fig. 23. Oscillator and amplifier units located in transmitter unit

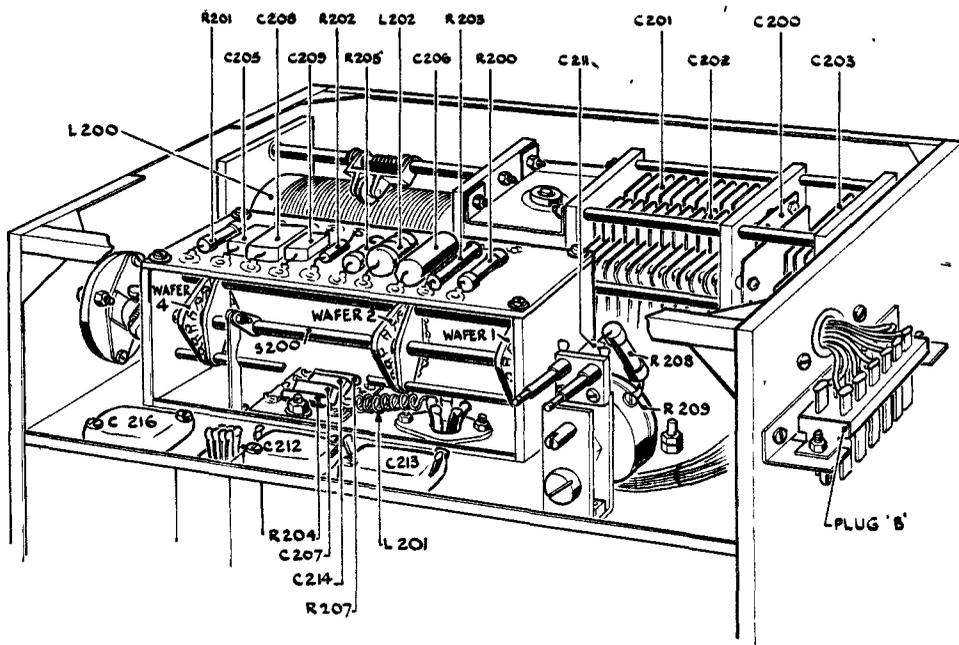


Fig. 24. Underside of oscillator unit

view of the unit, *fig. 24*. Both coils are rotatable (L203 being driven through bevel gearing) and have pulley-wheel wipers which travel up and down the windings as the coils are turned.

**122.** A vernier adjustment is provided for the coil setting, consisting of a cam, actuated by the INCREASE-DECREASE knob on the front panel, which bears against a rocking bar. The bar is coupled to the coil driving shaft when the LOCK knob on the tuning control is screwed in and consequently causes the coils to shift through one dial division in either direction.

**123.** Wafers 1, 2 and 4 of S200 are below the chassis (*fig. 24*) and wafer 3, which can just be seen in *fig. 23*, is on the top deck.

**124.** The screw adjustment R209, in *fig. 23* enables the voltage across the heater of V201 to be adjusted to 6.3 volts, at which it is kept constant by the barretter V202. When adjusting R209 the voltage is read by connecting a voltmeter to the plug (2). The screw (1) enables R209 to be locked when the correct setting is found.

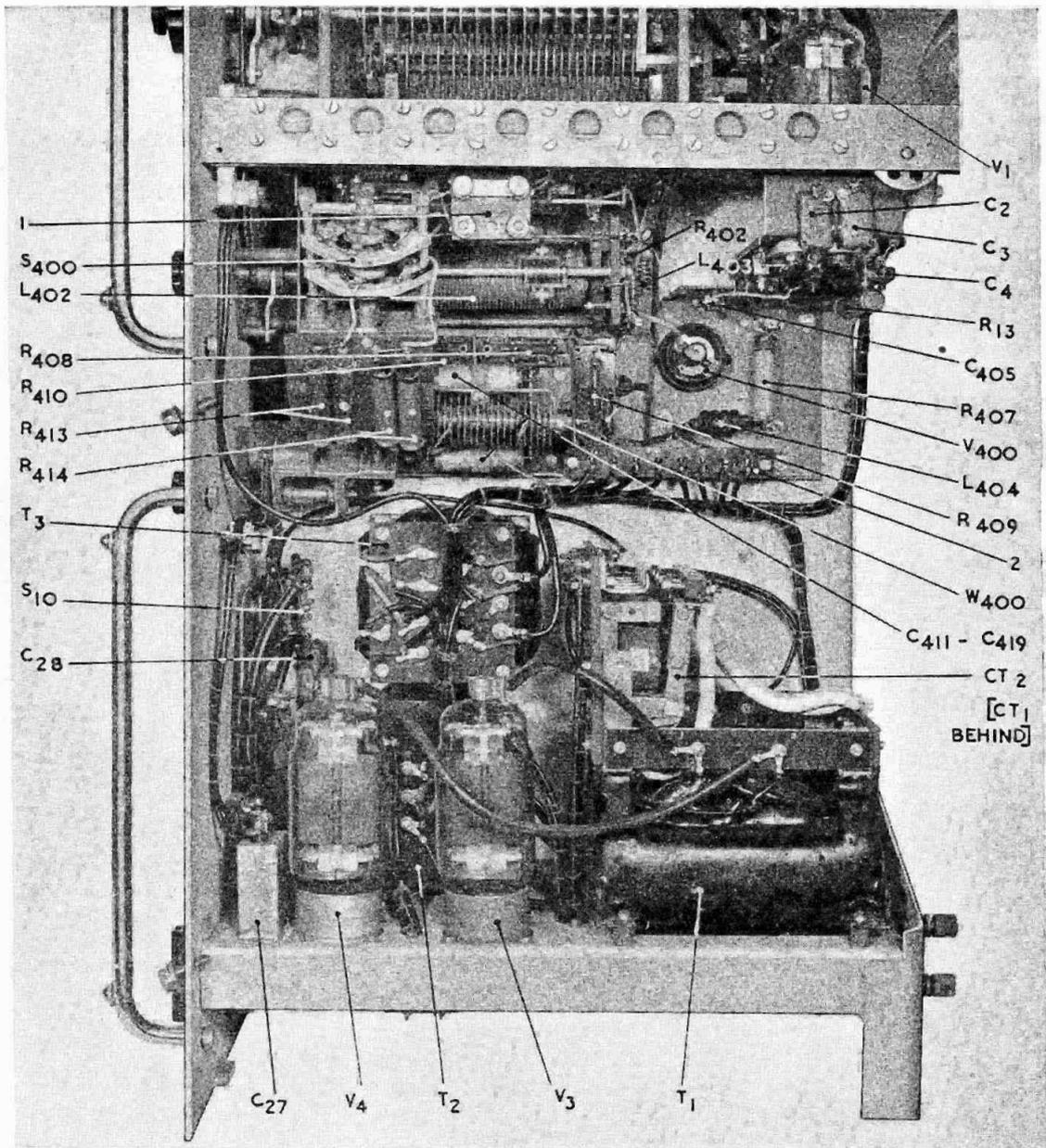
**125.** Part of the multiplier unit can be seen between V201 and V202 in *fig. 23*, the components R401 and L401 being adjacent to the base of the multiplier valve V400 which is mounted horizontally.

**126.** Both the amplifier gain controls R325 and R326 and the modulator bias adjustments, R14 and R15, are visible in the illustration.

**127.** Referring to the underside view of the oscillator unit, *fig. 24*, condenser C200 is the compensating condenser, the spacing of its two plates varying with temperature changes and so counteracting the effects of expansion and contraction of the oscillator coil L200. One plate is mounted on zero temperature coefficient metal and the other mounted on brass rods. Both are fixed to the main assembly of C201, C202. Expansion or contraction of the brass rods varies the spacing of the plates.

#### Multiplier unit and modulator

**128.** The view of the transmitter unit *fig. 25* shows the components of the multiplier unit at the top and the modulator unit at the bottom. The multiplier output coupling condenser C405 is connected directly to the grid pin of the holder of the PA valves V1 and V2, and the multiplier valve cathode to switch S1 in the transmitter unit. Apart from this and the multiplier input connection, described in *para 119*, all other connections are made to the tagboard (2). The links (1) are shown in the position for hand keying of the transmitter. When



**Fig. 25. Multiplier unit and modulator valves**

high-speed keying is required they must be reconnected as shown in *fig. 5* and *6* (*para. 26*).

**129.** The multiplier tuning coil L402 is rotatable similarly to the oscillator tuning coils, but is not provided with a vernier adjustment.

**130.** Both the multiplier and oscillator units can be removed as complete assemblies

from the main unit. The layout of the multiplier components which cannot be seen in *fig. 25* is shown in *fig. 26*.

**131.** The CW and R/T contactors CT1 and CT2, form one assembly with the modulation transformer T1.

**Power amplifier**

**132.** A view of the PA components is given in *fig. 27*. One of the fixed output

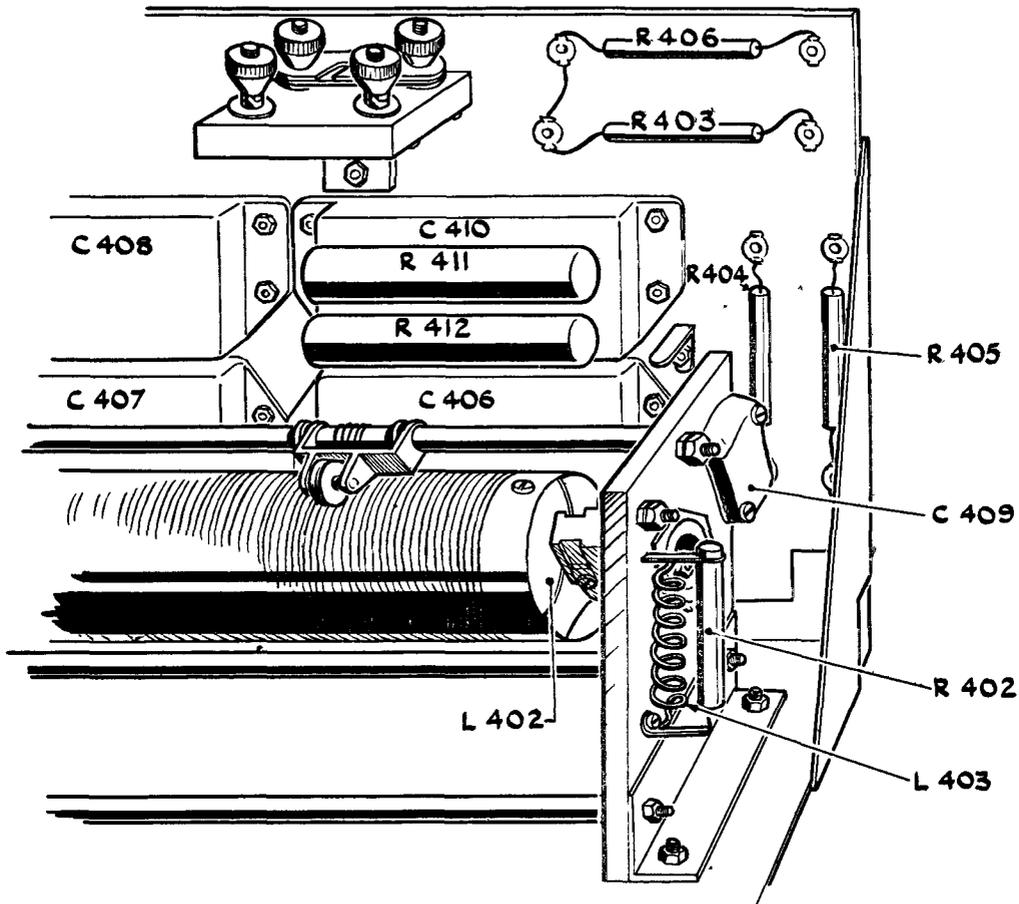


Fig. 26. Close-up view of multiplier unit

coupling condensers, C10, is visible and C11 is behind the variable coupling condenser C31. Condenser C9 is connected in parallel with the anode tuning condenser C30 by means of the RANGE switch S2 on the 1.5-2Mc/s band only. A special wire-wound vitreous resistor is used to form the anode choke L1.

#### Amplifier and power units

**133.** Two views of the amplifier, Type 367 are given in *fig. 28* and *29*. The amplifier can be removed from the main unit by undoing the thumbscrew seen in *fig. 28* and pulling the unit forward; all connections to the amplifier are made through the plugs C and D, which engage directly with two sockets in the transmitter unit.

**134.** The power unit is shown in *fig. 30* and *31*. Plugs A and G for the connectors to the main unit can be seen in *fig. 20*. The two drawers containing calibration charts of

data sheets are fitted on the front of the power unit.

**135.** Both views of the power unit show the mechanical time-delay relay C/1. This can be adjusted by means of a small calibrated scale, and is set by the manufacturer to give a time delay of 35 to 45 sec.

**136.** The resistors R103 to R106 are not visible in the illustrations of the power unit, being mounted underneath the holders of the stabilizer valves, V106 to V109. The voltage-dropping choke L100 is on the base of the unit, between chokes L101 and L102.

## INSTALLATION

### Unpacking

**137.** Before attempting to unpack the transmitter, Type T.509, the following instructions should be carefully read. All concerned are warned that the packing arrangements for this transmitter are complex.

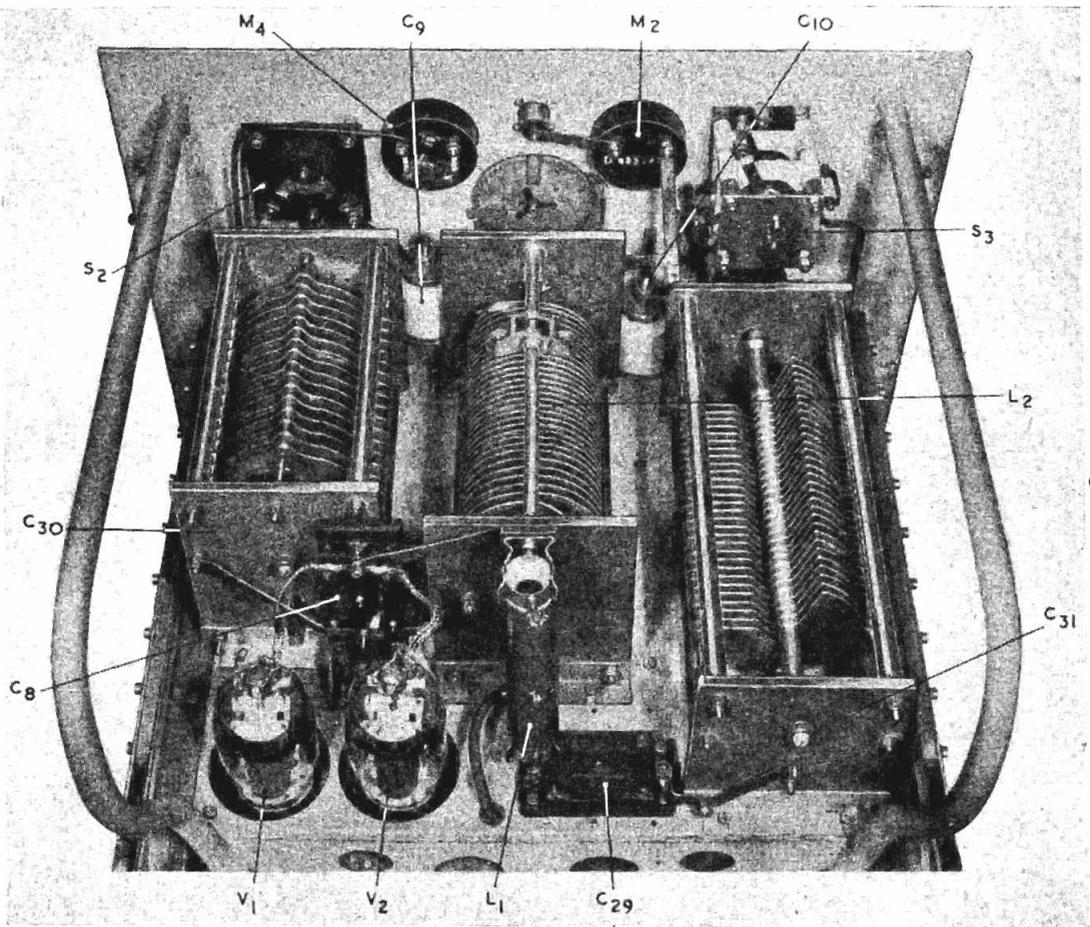


Fig. 27. Power amplifier components

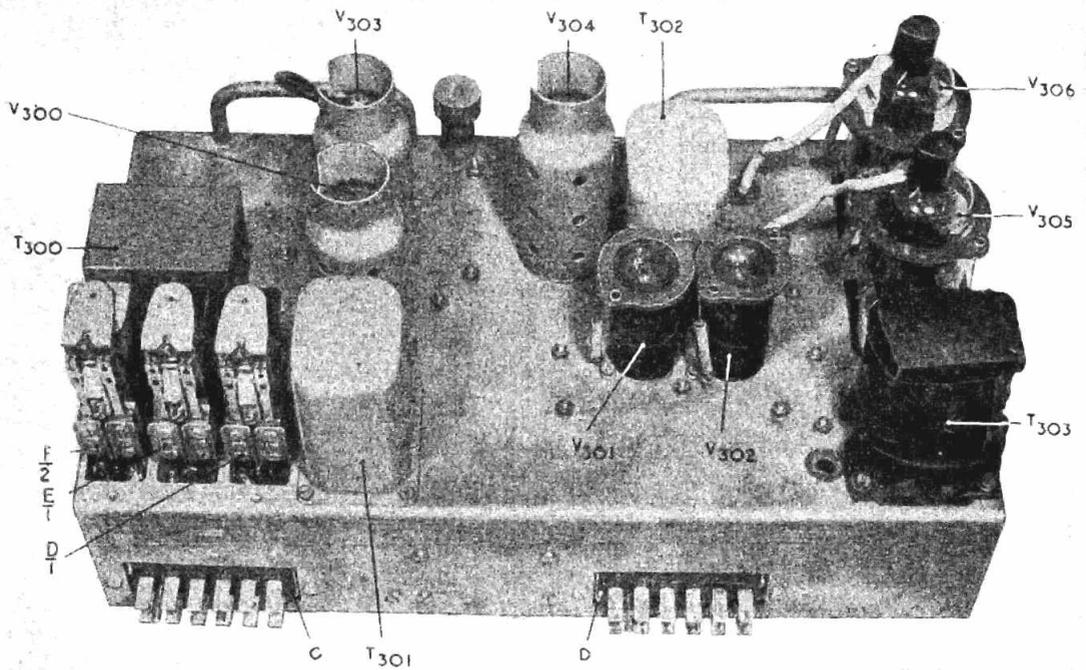


Fig. 28. Top of chassis, amplifier, Type 367



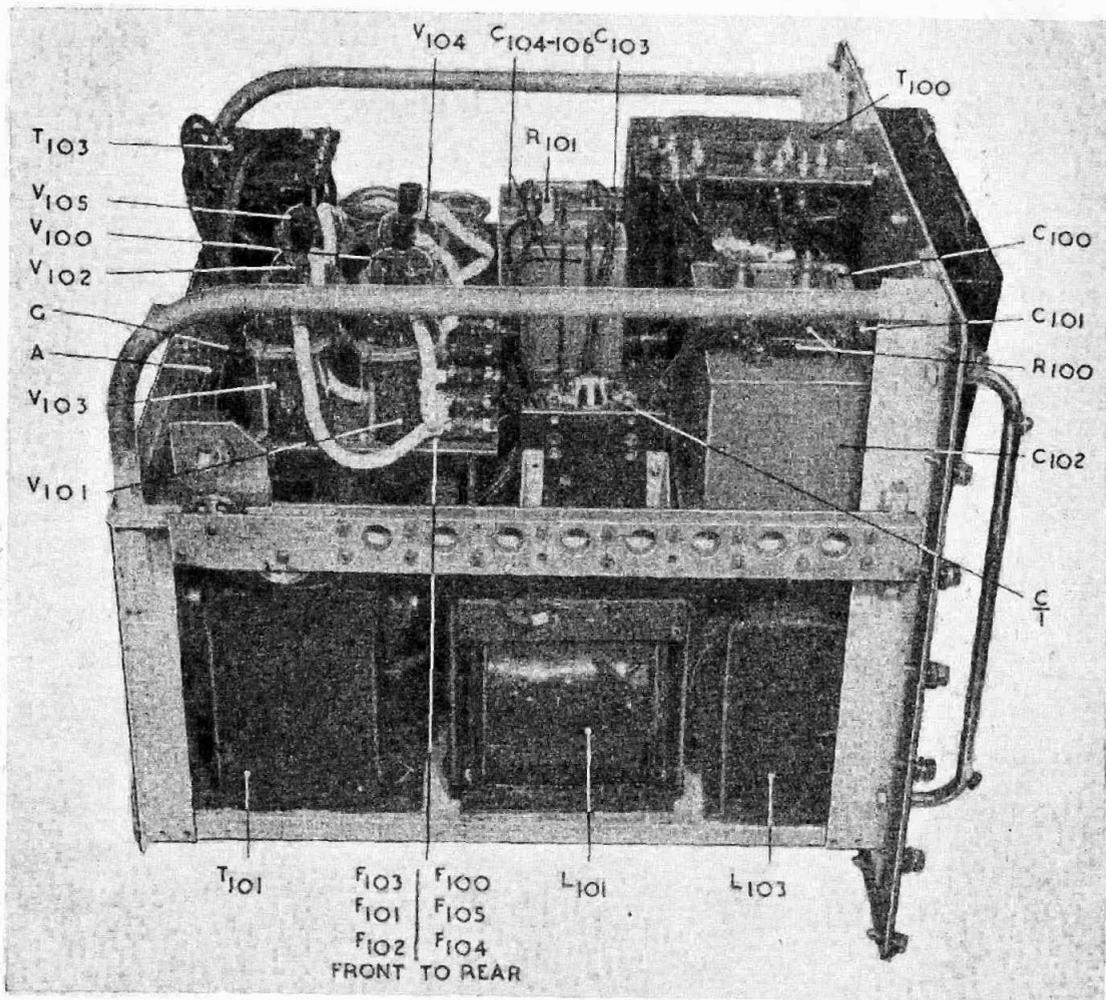


Fig. 30. Power unit, Type 381, left-hand view

138. It will be seen that the outer wooden packing case is secured to the wooden base by means of brackets and bolts. After removing the bolts, the outer wooden case can be lifted off the transmitter. This exposes a wooden frame also fixed to the wooden base by means of brackets and bolts. The top of this wooden frame is bolted to the top of the transmitter. After removing this frame, the packing "liner" should be removed.

139. At this stage it is well to appreciate that the transmitter weighs approximately 8 cwt. and, to prevent serious damage, no attempt should be made to move the transmitter without attaching the lifting eyes provided. Adequate lifting tackle will be required.

140. The top two disc covers situated on the sides of the transmitter should then be unscrewed. These disc covers are shown at (1) of fig. 19. On removing these covers, two red securing bolts will be visible and these must be unscrewed and removed.

141. The six front panel bolts of the top unit should also be unscrewed.

142. The top (main) unit of the transmitter can now be drawn outwards.

143. Four lifting eyes, which are situated inside the transmitter, must now be removed (para. 118 and fig. 20). These eyes are situated in the top left-hand corner and are secured by means of clips. The four lifting

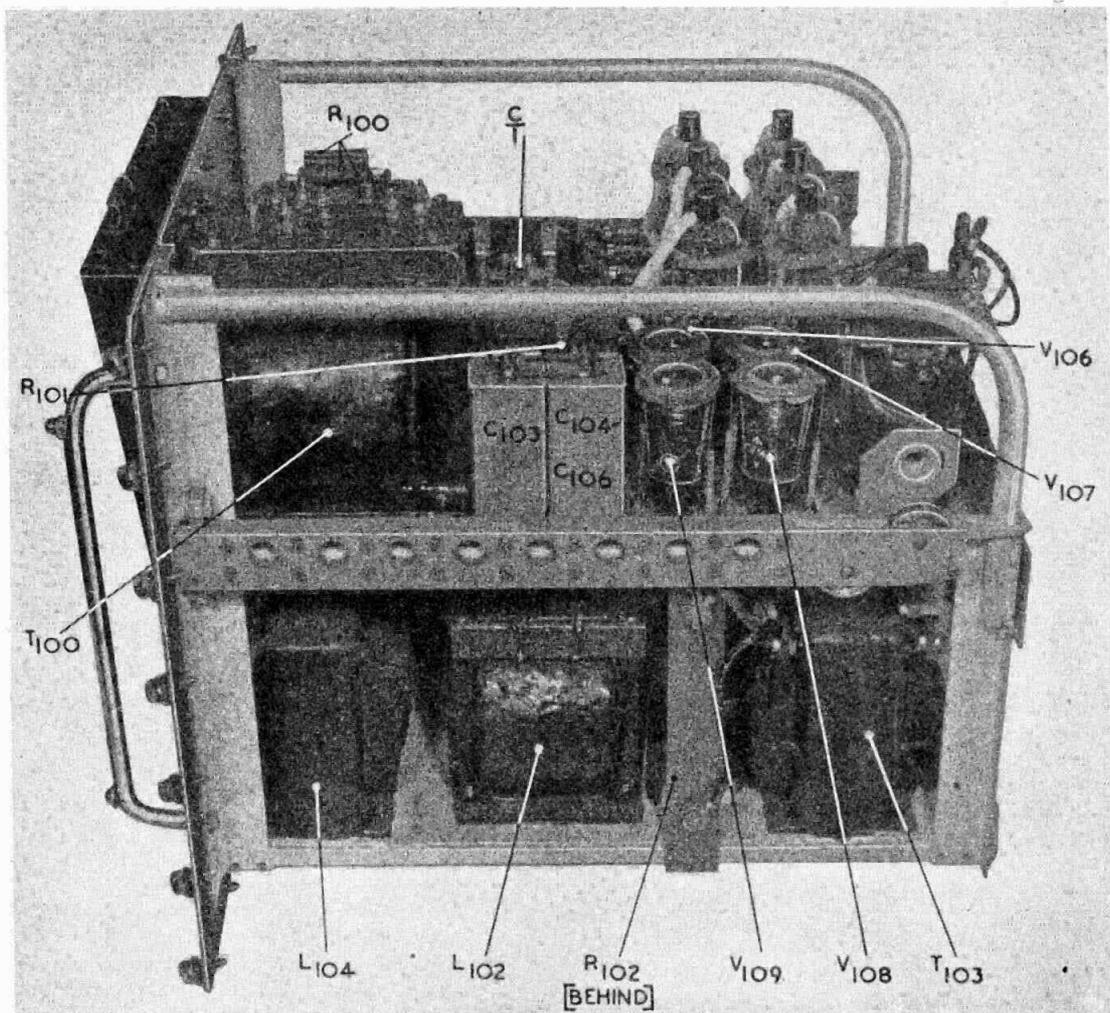


Fig. 31. Right-hand view of power unit

eyes screw into the top of the steel transmitter case.

**144.** After unpacking, and *before moving* the transmitter to its final position, the two red transit bolts (previously removed as described in *para. 140*) *must be* reinserted and screwed up tight. To do this the top unit should be pushed back into the transmitter case and the six panel bolts secured. The transmitter may now be moved to the required position.

**145.** Having positioned the transmitter, remove the four disc covers which enclose the four securing bolts. The four red securing bolts must again be removed and stowed, together with the lifting eyes, in the clips provided in the transmitter case (*fig. 20*).

**146.** After unscrewing the protective covers from the front of the transmitter, these may be stowed inside and at the top of the transmitter case. To position these covers the transmitter unit must be completely removed as described in *para. 114*. The covers are secured by means of the bolts and butterfly nuts provided. Before replacing the transmitter unit, the fan transit bolts must be loosened as described in *para. 147*.

#### Fan shock absorber mounting

**147.** When installing the transmitter and before operating it, two transit bolts must be loosened from the fan housing to bring the shock absorber mountings into operation. Before these bolts are loosened, the top unit of the transmitter must be removed as

described in *para.* 114. Reference should be made to *fig.* 34.

- (1) Unscrew the butterfly nut (B) until it is tight against the head of bolt (C), then unscrew the nut (A) until it firmly Locks (B) into the position where it has just been placed.
- (2) Using a large screwdriver screw up bolt (C) in a clockwise direction to the full extent of its travel. This operation carries the collar (D) away from the fan mounting plate which was previously held between it and locknut (A).

**Note . . .**

*Considerable force should be used to ensure that (A) (B) and (C) remain in this position during operation.*

- (3) The fan should then be freely suspended.
- (4) When re-packing this procedure should be reversed.

**148.** The transmitter is designed for operation with an aerial system fed by a 50-ohm coaxial cable. The cable is connected to the transmitter at the coaxial socket (1) shown in the general view of the transmitter *fig.* 1.

**149.** All other connections are made to the terminal block on the right-hand side of the cabinet, shown at (2) in *fig.* 1. The block is provided with a removable cover, which must be replaced after the connections are made. A rear view of the block, looking inside the cabinet, is given in the installation diagram *fig.* 32.

**150.** The remote control lines are connected to the REMOTE terminals on the block, and the control unit in the transmitting station to the terminal marked LOCAL. No connection is made in the present installation to the terminals marked CONTROL MAINS.

**Note . . .**

*The lines must be connected to their corresponding numbers.*

**151.** When a high-speed keying relay is used, it is connected to the three HIGH SPEED KEY terminals in the transmitter. The relay terminals are marked M, T and S, and are connected respectively to the POSITIVE SCREEN, and NEGATIVE terminals at the transmitter. The relay will normally

be a relay, magnetic, Type P (Stores Ref. 10F/8783) a description of which is given in A.P.2980A, Vol. I, Sect. 4, Chap. 1.

## OPERATION

### Preliminary adjustments

**152.** The transmitter output should be connected to a 50-ohm 450-watt artificial aerial load and the following procedure followed, referring to *fig.* 1 for locations of controls except where otherwise stated:—

- (1) Place the LOCAL-REMOTE-TEST switch (S10) at TEST. In this condition the transmitter circuits are arranged as for R/T or MCW.
- (2) Place the TUNE-TRANSMIT switch S6 at TUNE.
- (3) Close the LT switch (S5).
- (4) Find the required frequency on the calibration charts (A and B of *fig.* 33). Note that if this is above 7.5 Mc/s it will be necessary to divide by 2 or by 3 to arrive at the correct oscillator frequency.
- (5) Set the oscillator range switch (S200) to the appropriate position. Set the oscillator tuning dial (L200, L203, *fig.* 1) to the figures shown on the chart provided with the transmitter. The dial can be "read off" to great precision. The numbers shown in the window indicate the number of coil turns in use, the number on the dial sub-divides each coil turn by 100, and the vernier divides the dial division by 10. Each transmitter is individually calibrated, and the re-setting accuracy of the oscillator is such that the transmitter output can be reset to better than 50 cycles in one megacycle in any part of the range—the use of wavemeters for setting-up purposes is thus avoided.
- (6) Set the MULTIPLIER RANGE switch (S400) in the appropriate position for the output frequency. The dial of this switch is marked with the multiplication factors for the various ranges of output frequency and consequently enables the correct master oscillator frequency to be arrived at.
- (7) Place the MULTIPLIER RANGE control (L402), the AMPLIFIER INDUCTOR (L2) and the AMPLIFIER CAPACITOR (C30) at the readings indicated on the charts.

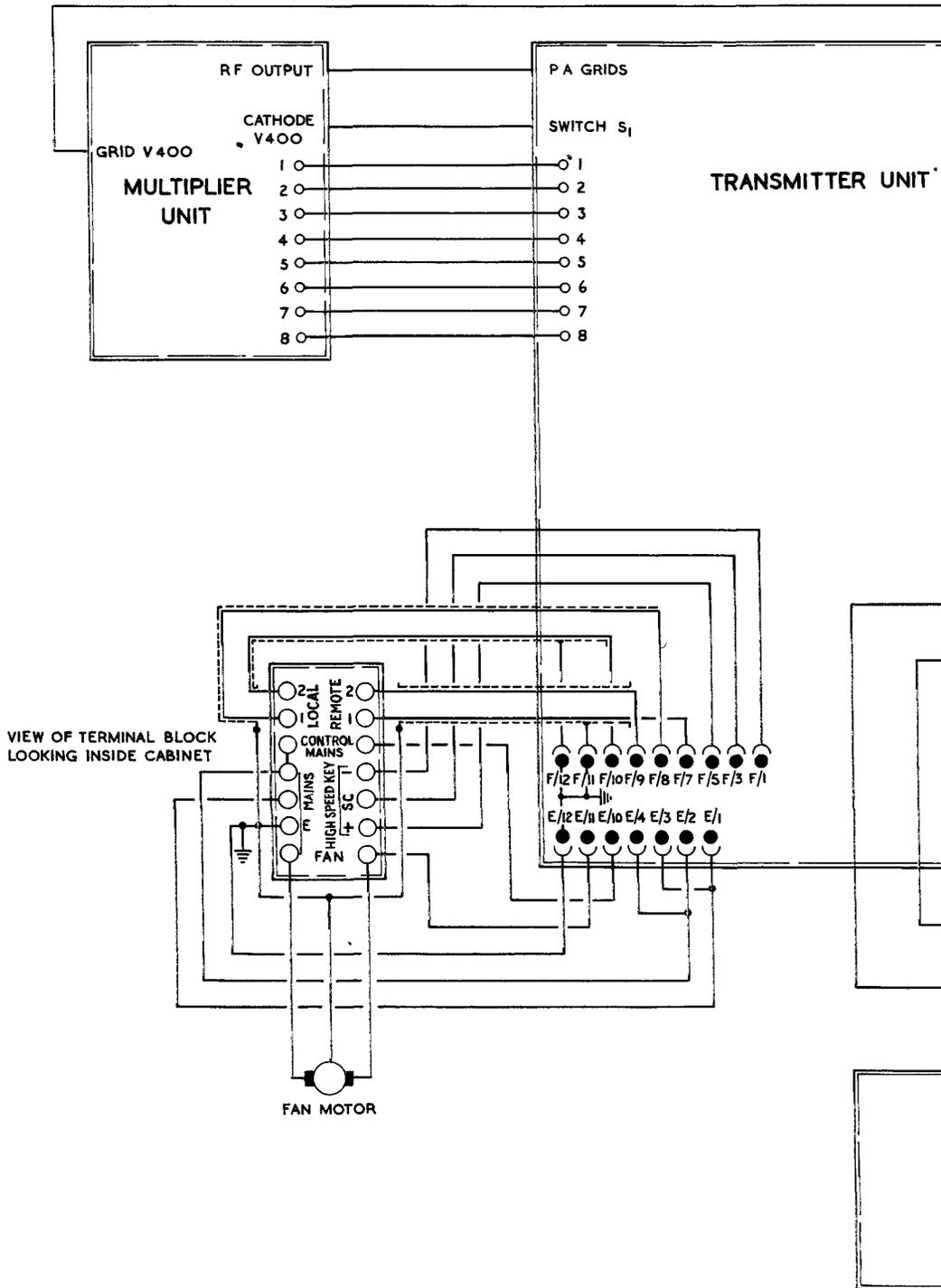
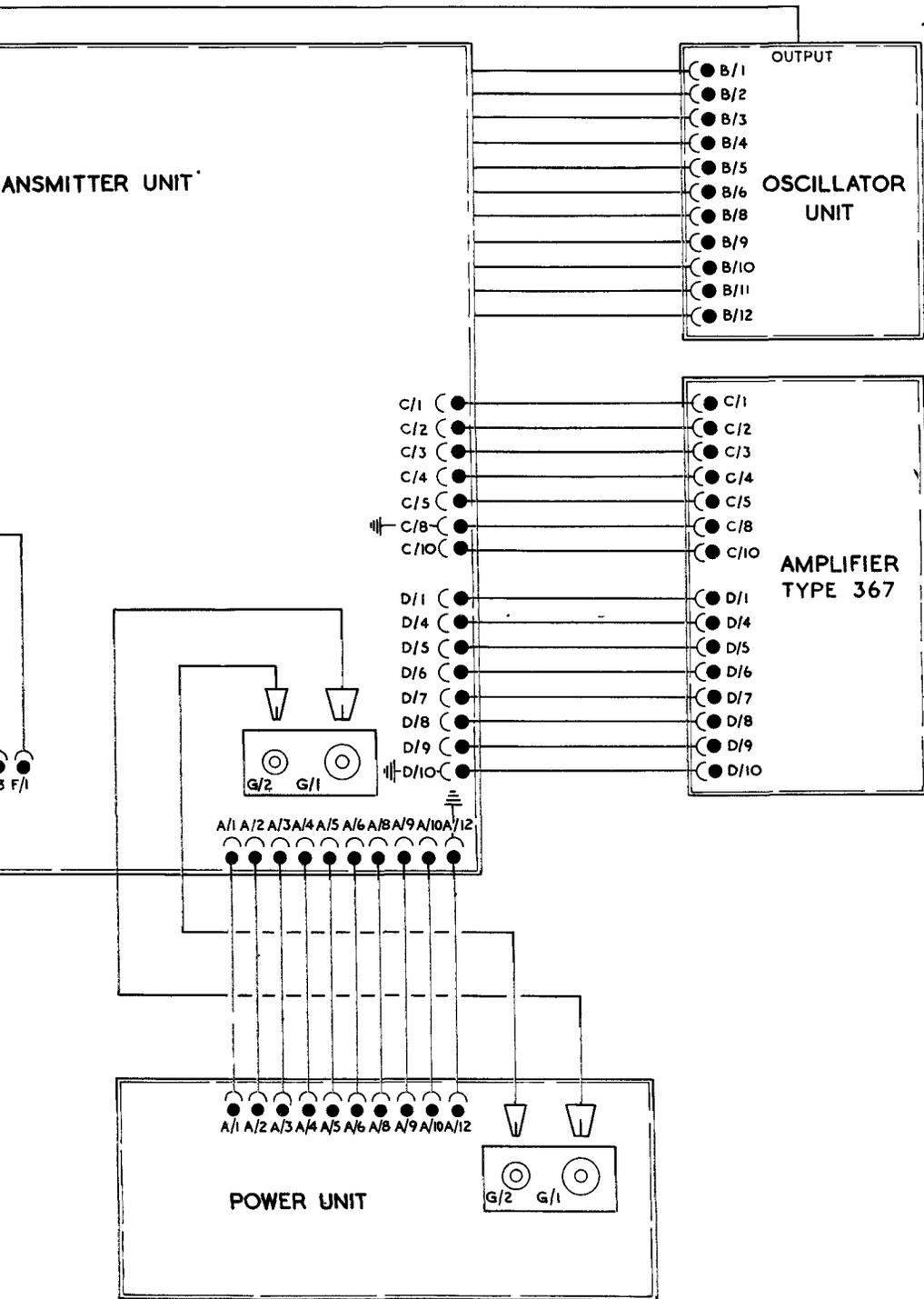


FIG. 32 — INTERCONNECTING





CONNECTION OF UNITS, 'T.1509



**A**

TRANSMITTER TYPE 1509 OSCILLATOR TYPE 180 SERIAL NO CALIBRATION SHEET 2 OF						
FREQUENCY MC/S	RANGE	OSCILLATOR TUNE	MULTIPLIER TUNE	POWER AMPLIFIER		
				CAPACITOR	INDUCTOR	COUPLING
4.3	4.0-7.5	22-04.3	18.33	15	15.18	0/46
4.4	"	20-81.3				
4.5	"	19-66.8				
4.6	"	18-60.2	17.12	14	14.57	0/43
4.7	"	17-58.6				
4.8	"	16-63.0	16.04	13	14.07	0/41
4.9	"	15-72.1				
5.0	"	14-87.4	15.1	12.5	13.58	0/41
5.05	"	14-45.3				
5.1	"	14-05.8	14.27	12.0	12.9	0/39
5.15	"	13-67.7				
5.2	"	13-31.0				

FREQUENCY 4.3 MC/S TO 5.2 MC/S CALIBRATED.....  
 OVERLEAF 5.25 MC/S TO 6.1 MC/S DATE .....

NOTE - MULTIPLIER AND POWER AMPLIFIER  
TUNINGS ARE APPROXIMATE ONLY

**B**

TRANSMITTER TYPE 1509 OSCILLATOR TYPE 180 CALIBRATION SHEET 4 OF							
FREQUENCY MC/S	OSCILLATOR	MULTIPLIER RANGE	MULTIPLIER TUNE	POWER AMPLIFIER			
				CAPACITOR	INDUCTOR	COUPLING	
7.5	↑ SET M.O. TO 2 REQUIRED FREQUENCY. ↓	7.5-14	12.23	10	8.45	0/28	
8.0		"	11.39	10	7.86	0/28	
9.0		"	10.49	7	7.48	0/23	
10.0		"	8.33	7	5.98	0/21	
11.0		"	7.62	8	5.39	0/19	
12.0		"	6.65	8	4.82	0/16.5	
14.0		"	5.39	7	3.98	0/13	
14.0		↓ SET M.O. TO 3 REQUIRED FREQUENCY. ↑	14-20	7.85	7	3.8	0/12.5
15.0			"	7.41	6	3.5	0/12
16.0			"	6.92	35	3.74	0/10
18.0	"		5.89	2.0	3.34	0/7.5	
20.0	"	5.14	0	2.88	0/6.0		

FREQUENCY 7.5 MC/S TO 20.0 MC/S. CALIBRATED.....  
 DATE .....

NOTE - MULTIPLIER AND POWER AMPLIFIER  
TUNINGS ARE APPROXIMATE ONLY.

Fig. 33. Specimen calibration charts

The range switch, S2, should be set to the required frequency range.

- (8) Place the coupling switch S3, in position 3 (minimum coupling) and the COUPLING CAPACITOR (C31) at maximum capacity (minimum dial reading) (highest dial reading).

153. The HT switch S9, can now be closed, and a reading will be observed on the DRIVE INPUT meter M1. This indicates the multiplier cathode current. As the multiplier and amplifier stage calibration is only approximate, these stages should now be trimmed, the multiplier being adjusted for minimum current on M1, and the amplifier, by means of the AMPLIFIER INDUCTOR, for minimum current on the INPUT meter (M4).

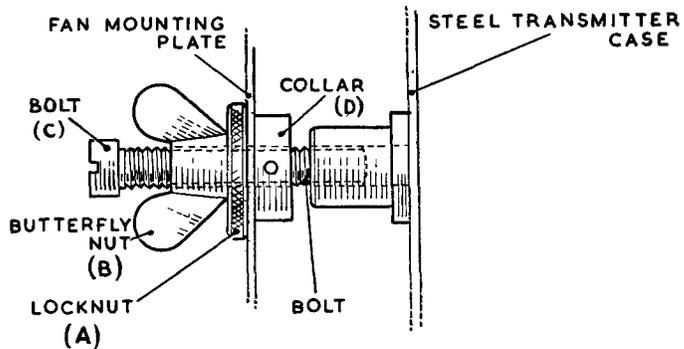


Fig. 34. Fan transit bolts

154. The power amplifier can now be loaded. Loading is controlled by the COUPLING CAPACITOR (C31) in conjunction with the fixed condensers C10 and C11 (fig. 8) the latter being put in parallel with C31 via S3; the setting will vary according

to the frequency and type of load. Adjustment must therefore be made as follows to suit the prevailing conditions.

**155.** Leave S3 on position 3, and rotate C31 towards minimum capacity, observing the cathode current of the amplifier stage on M4. Should no increase of current be shown by the time minimum capacity is reached, S3 should be turned to position 2, C31 replaced at maximum and the process repeated.

**156.** If a similar result is obtained reduce S3 to position 1 and again to 0 if required. It will usually be found that the 0 position of S3 is the correct setting for frequencies above 7 Mc/s.

**157.** When the correct setting of S3 is found, C31 should be returned to maximum, and then slowly reduced in capacity until the current shown by M4 is about 190 mA. The AMPLIFIER INDUCTOR control (L2) is then rotated slowly to obtain a minimum reading of M4. Further reduction in the capacity of C31 will bring the reading of M4 up to 190 mA again. Adjustment of L2 and C31 in this manner should be continued until the reading of M4 can no longer be reduced by trimming L2. Should it be found that it is impossible to dip the reading of M4 below 190 mA (with the switch S3 on position 3 and the condenser C31 at maximum capacity) due to the transmitter load being reactive, L2 should be readjusted a turn or so in one direction and C31 re-trimmed for minimum reading on M4. If this is not effective, rotate L2 a similar amount in the opposite direction at the point where adjustment was originally started and again retrim C31 for minimum reading on M4. In the event of it being found impossible to obtain the above conditions, a highly reactive load is indicated and correct functioning of the transmitter will be unobtainable.

**158.** Now place the TUNE-TRANSMIT switch (S6) at TRANSMIT, and again observe the reading of M4. This should be 350 mA; if this is not so, slight readjustment of C31 and L2 should be made, ensuring that L2 is tuned to the centre of the "dip" when a reading of 350 mA on M4 is obtained.

**159.** The transmitter is now correctly tuned for maximum output and the audio-frequency stages can be adjusted for correct operation.

#### Balancing of modulator valves

**160.** Leaving the transmitter adjusted as described in the preceding paragraphs, read the current shown on the MODULATOR meter M3. This will be the cathode current of V3. To read the current of V4, press the switch-button S4. Both readings should be the same, and approximately 50 mA with no signal applied to the modulator. If this is not so, the pre-set bias controls, R14 and R15 (*fig. 23*) must be adjusted. These controls are inside the transmitter unit, which must be pulled forward from the cabinet for the adjustment to be made.

**161.** The bias to V3 is adjusted by R14, and that to V4 by R15. As the mains input to the transmitter unit is automatically broken by the plunger-operated gate switch, S8 (*fig. 8 and 22*) when the unit is withdrawn, it will be necessary to replace the unit between each adjustment. Note that after the unit is replaced no current will be shown on the meters until the delay contactor has closed (i.e. for about 30 sec.).

#### Adjustment of amplifier bias controls

**162.** When the modulator grid bias has been adjusted as described, the two gain controls in the amplifier, Type 367, must be set so that the drive to the modulator will provide 100 per cent. modulation. For this purpose the control unit, Type 310 is required; the two LINE terminals on the unit must be connected to the appropriate LOCAL terminals on the transmitter terminal block. The transmitter switch S10, must be turned to LOCAL. Set the switch S300 on the amplifier (shown in *fig. 23*) to the CONTROL UNIT 310 position. Carry out the following adjustments:—

- (1) Connect a telegraph key to the KEY jack on the control unit, Type 310.
- (2) Set the SERVICE switch on the control unit at TONE MODULATION.
- (3) Set switch S4 on the control unit at 1 mW.
- (4) Turn the INPUT GAIN control R325 in the amplifier to its mid-position. This control and the PRE-SET GAIN control, R326, are fitted on the side of the amplifier chassis (*fig. 23*).
- (5) Replace the transmitter in the cabinet; place the TUNE-TRANSMIT switch at TRANSMIT.
- (6) Close the transmitter LT switch S5 and the HT switch S9.

- (7) Switch on the transmitter by closing the switch S2 (marked HT ON) on the control unit, Type 310.
- (8) Press the telegraph key and observe the current shown on the transmitter MODULATOR meter M3.
- (9) The INPUT GAIN and PRE-SET GAIN controls can now be adjusted to provide the correct drive to the modulator valves for 100 per cent. modulation. Adjust the PRE-SET GAIN control so that the current shown on M3 is 150 mA. If this figure is not reached by the time the control is fully clockwise, the control should be reduced to about 8 on its scale, and the INPUT GAIN control should be advanced (clockwise) until the required reading of 150 mA is obtained. Lock both controls by tightening the locking screws provided.

**163.** The speech amplifier and modulator are now correctly adjusted, and should not require further attention. Periodic checking of the modulator current balance should be made, and re-balancing adjustments carried out when necessary.

#### Transmitter tuning (crystal control)

**164.** The transmitter crystal sockets are shown at (4) in *fig. 1*. For output frequencies between 2 Mc/s and 7.5 Mc/s, crystals of the output frequency are used. From 7.5 Mc/s to 14 Mc/s the crystals must be half the output frequency, and from 14 Mc/s to 20 Mc/s one-third the output frequency.

**165.** Tuning is carried out as for MO working, except that after setting-up the oscillator stage, the transmitter should be switched on and, with the multiplier stage off tune, the OSCILLATOR TUNING control should be adjusted for *maximum* reading on the DRIVE INPUT meter (M1).

**166.** The multiplier and output stages are then tuned as already described.

**167.** Now, with the TUNE-TRANSMIT switch on TRANSMIT, check the keying with the local receiver. Slight re-adjustment of the oscillator tuning control may be needed to obtain satisfactory keying characteristics.

### PRECAUTIONS AND SERVICING

#### General

**168.** The oscillator coils and contact wheels should be cleaned at regular intervals to

ensure smooth frequency control. This can be done with the unit in position. Remove the cover from the lower half of the unit. Use a small clean brush, some clean lint-free rag, and some carbon tetrachloride. The coils can be rotated whilst the cleaning material is held against them. The wheels and the rod on which they run should be given careful attention; the wheel can be lifted free of the coil, and the rod rubbed clean. After the cleaning is complete, the wheels must be replaced in their correct position on the coil as described in *para. 176*.

#### Removal of oscillator unit

**169.** This should only be done when *absolutely* essential, since the frequency calibration may be impaired as a result. To remove the oscillator unit, the dials and back plates of the OSCILLATOR TUNING and INCREASE/DECREASE controls must be detached from their spindles and the bezel adjacent to the OSCILLATOR TUNING control (through which turns of inductance in circuit are shown) must be unscrewed.

**170.** Disconnect socket B on the cableform from the main unit from the oscillator plug B (*fig. 21*). Disconnect the lead from the condenser C215 in the oscillator unit to the mounting of R401 and L401 at the rear of the multiplier unit. This lead should be detached at the multiplier end where it is secured by a terminal.

**171.** The unit may now be removed by unbolting it from the two mounting brackets beneath it and removing the two bolts which secure it to the deck of the power amplifier stage in the main unit.

#### Replacing the oscillator unit

**172.** Frequency instability may be encountered unless the following precautions are taken :—

- (1) The oscillator sub-chassis must lie snugly in the main chassis and must not be under strain at any point.
- (2) The sub-chassis sides must not contact the panel Parker Kalon screws.

**173.** The bolt holes in the range switch spindle bearing plate must lie in line with their respective bolt holes in the main panel after the sub-chassis is fixed in position, so that the bearing plate may be bolted to the main panel after the sub-chassis is fixed in position and so that the bearing plate may be bolted to the main panel without putting

any strain on the spindle. Forcing the bearing plate into position will throw the ceramic switch contacts out of position and the range switch will then prove ineffective.

#### **Method of fitting master oscillator dial**

**174.** The dial actuating the variable inductance in the anode and grid of the master oscillator carries two grub screws. One grub screw has a pointed end and the other is flat. The pointed screw fits into a hole in the driving shaft. When fitting the dial, the pointed grub screw should be at 3 o'clock, when the flat one is at 12 o'clock.

**175.** The pointed grub screw should be screwed home in its locating hole in the shaft before tightening the flat grub screw. If this procedure is adopted the original calibration will be maintained.

**176.** The correct position of the contact rollers on the coil is as follows:—

- (1) With the window dial against the 30 division (end of travel) stop, and reading 30.70, the grid (lower) coil roller should be at  $2\frac{1}{4}$  turns from the forward end.
- (2) The anode (upper) roller should then be  $3\frac{1}{4}$  turns from the bottom.

#### **Method of fitting oscillator unit**

**177.** Place the bezel and all the fixing screws in their respective holes and screw them into the main panel so that they are no more than finger tight, check the operation of the controls for excessive stiffness.

**178.** If all is well, screw home the top fixing screws on the amplifier deck. After this is done, screw home the bottom screws above the speech amplifier housing. Check operation, and check the frequency against a sub-standard to ensure that the calibration is correct.

#### **Removal of the multiplier unit**

**179.** Before removing the multiplier unit, detach the knobs and back plates of the MULTIPLIER RANGE and MULTIPLIER TUNING controls and the bezel adjacent to the multiplier tuning dial.

**180.** Disconnect the leads to the tagboard (2) (*fig. 25*) and the grey lead from C405 in the multiplier unit to the grid pin of valve VI in the power amplifier.

**181.** Disconnect the lead from the cathode of V400 to the switch S1 (on the oscillator side of the main unit) and also the flying input lead from the oscillator.

**182.** In order to remove the multiplier unit, the transformer T3 (*fig. 25*) must be unscrewed from the vertical chassis and pulled slightly forward so that the unit can be pulled back far enough for the control spindles to clear the hole in the front panel.

#### **Replacing the multiplier unit**

**183.** When the unit is replaced, the dial setting must be aligned with the settings of the contact rollers on the variable inductances. The dial is replaced by a procedure which is similar to that on the oscillator unit described in *para.* 174 to 176. The roller in this case is set on the front end of the coil when the dial is reading 35/50.

#### **Main unit**

**184.** Facilities which are provided in the cabinet for raising or lowering the main unit and power unit also permit correction of horizontal misalignment.

**185.** The corrections are carried out by varying the position of the runner channels, which are operated by two vertically mounted bolts working in brackets attached to the cabinet sides. Locking bolts are also provided to lock the final adjustment.

**186.** The channels can be moved through a distance of approximately  $\pm\frac{1}{4}$  in., but adjustment is actually limited to one-tenth of an inch, which represents the clearance between the panel bolts and their clearance holes.

**187.** Lateral movement, by which the units may be moved to one side or the other, is effected by the addition or subtraction of shims placed behind the channels. It should be noted, however, that to correct excessive lateral movement, shims should be added to the left-hand side of the cabinet only to prevent the transmitter chassis moving too far to the left. Excessive movement in this direction would endanger the speech amplifier potentiometer spindles and locking devices through contact with the cabinet side when withdrawing the unit from, or returning it to, the cabinet.

**188.** Stops in the form of pins are provided in the cabinet channels, to prevent the channels falling out when the unit is placed

on them. The pins come up against the rear edge of the rollers when the channels are pulled forward and care should be taken to ascertain that the stops are correctly positioned before placing the unit on the channels. If this is not done, there is nothing to prevent the unit rolling off the channels and falling to the ground. For the same reason, if it is found that the unit will not go properly home, it can be assumed that the channels stops are on the wrong side of the rollers. If for any reason it is thought that the unit is incorrectly mounted, it is strongly urged that the block and tackle is affixed before any attempt is made to withdraw the unit. This precaution is necessary to prevent accidents to personnel.

#### Power unit

**189.** Adjustment of the power pack in the cabinet is undertaken in a similar manner to that of the transmitter unit, and the precautions mentioned in the case of the main unit also apply to this unit.

#### Components

**190.** The following are the Air Ministry Type and Stores Ref. numbers of the

components mentioned in this volume and which may need renewal. The information given here may be added to or superseded by, Vol. II, Part 1 leaflets or by Vol. III.

#### Note . . .

*Smoothing chokes L101 and L103 (fig. 15). Modification leaflets have been distributed in connection with the replacement of the choke L101 (Stores Ref. 10C/16919) in transmitters having serial numbers 101 to 497 (inclusive) and 1,101 to 1,250 (inclusive) instructing personnel to renew this choke using choke Stores Ref. 10C/17967. In the event of choke L103 becoming defective in the same series of transmitters, i.e. serial numbers 101 to 497 and 1,101 to 1,250, this, again, should be renewed by fitting choke Stores Ref. 10C/17967. Chokes L101 and L103 supplied in transmitters having serial numbers 501 to 1,100 (inclusive) have the same reference numbers as those fitted in transmitters having serial numbers 101 to 497 and 1,101 to 1,250. However, the chokes fitted in transmitters serial numbers 501 to 1,100 are unlikely to become defective (being of different manufacture) but, in the event of breakdown, should be renewed by fitting the new choke Stores Ref. 10C/17967.*

Stores Ref.	Nomenclature	Qty.	Ref. in fig. 15	Remarks
10D/1721	Transmitter, Type T.1509			Ground station transmitter,
	Consisting of—			CW, MCW, and R/T
10K/1454	Power unit, Type 381	1		See below
10D/1758	Transmitter unit, Type 59	1		See below
	Includes—			
10U/239	Amplifying unit, Type 367	1		See below
10D/2604	Multiplier unit	1		See below
10V/600	Oscillator unit, Type 180	1		See below
10K/1454	<b>Power unit, Type 381</b>			
	Principal components—			
10C/12847	Condensers, Type 4095	4	C100-C102 C107	4 $\mu$ F, $\pm 20$ per cent., 2 kV DC
10C/14758	Condensers, Type 4956	4	C103-C106	4 $\mu$ F, $\pm 20$ per cent., 600V DC
10C/16918	Choke, LF, Type 702	1	L100	Series choke, mains
10C/17967	Choke, LF, Type 806	1	L101	Smoothing
10C/16919	Choke, LF, Type 703	1	L103	Smoothing
10C/16920	Choke, LF, Type 704	2	L102 L104	Smoothing
10AD/33	Contactors, Type 65	1	C I	Time delay, single-pole, 250V AC
10H/9613	Fuses, Type 5	6	F100-F105	1A, 1 $\frac{1}{4}$ in. glass cartridge
10H/10153	Holder, fuse, Type 3	6		1 $\frac{1}{4}$ in. cartridge, baseboard mounting

Stores Ref.	Nomenclature	Qty.	Ref. in fig. 15	Remarks
10H/499	Holder, valve, Type 75	10		British 4-pin
10H/4048	Plug, Type 563	1	A	12-pole
10H/Z.A. 25618	Plug, 2-pole, moulded, No.38	1	G1 G2	2-pole
	<b>Resistors</b>			
10W/9849	Type 3029	3	R100	1.5M, $\pm 20$ per cent., 2 watt
10W/9836	Type 3022	1	R101	0.33M, $\pm 20$ per cent., 2 watt
10W/6322	Type 6322	4	R103-R106	1M, $\pm 20$ per cent., $\frac{1}{2}$ watt
10W/9820	Type 306	1	R102	20K, $\pm 5$ per cent., 65 watt
10AS/69	Retainers, valve, Type 292	6		For valves CV187 and CV235
10A/19281	Retainers, valve, Type 219	4		For valves, CV45
10F/26	Switch, Type 189	1	S100	Safety switch
10K/16303	Transformer, Type 2226	1	T100	Auto-transformer
10K/16304	Transformer, Type 2227	1	T101	For 1,600V output
10K/16305	Transformer, Type 2228	1	T102	For 550V output
10K/16306	Transformer, Type 2229	1	T103	Filament transformer
10CV/187	Valves, Type CV187	4	V100 V102 V104 V105	
10CV/235	Valves, Type CV235	2	V101 V103	
10CV/45	Valves, Type CV45	4	V106-V109	
10HA/4766	Connectors, valve, Type 41	3		Bead insulated conductor and insulated valve cap, Stores Ref. 10A/12351 6-in. long
10HA/4765	Connectors, valve, Type 40	3		Bead insulated conductor and insulated valve cap, Stores Ref. 10A/12351, 5 $\frac{1}{8}$ in. long
10D/1758	<b>Transmitter unit, Type 59</b>		<i>Ref. in fig. 8</i>	
	<b>Principal components—</b>			
10U/239	Amplifying unit, Type 367	1		See below
5Q/10723	Ammeter, thermo, 0-5	1	M2	2 $\frac{1}{2}$ in. dial, flush mounting
10AB/11	Cap, lamp, Type 22	1		Glass dome. Red. Used with lampholder, Type 25
10AB/955	Caps, lamp, Type 24	2		Glass dome. Green. Used with lampholder, Type 25
10A/17589	Couplings, Type 138 (flexible)	3		For $\frac{1}{4}$ in. spindle
	<b>Condensers—</b>			
10C/15098	Type 5111	6	C1 C2 C3 C6 C7 C26	.01 $\mu$ F, $\pm 20$ per cent., 350V
10C/15255	Type 5212	2	C4 C5	.01 $\mu$ F, $\pm 20$ per cent., 750V DC
10C/7764	Type 109	2	C8 C29	.002 $\mu$ F, $\pm 20$ per cent., mica
10C/16912	Type 6024	1	C9	250 $\mu$ F $\pm 5$ per cent., Porcelain pot, 5 kV
10C/16913	Type 6025	1	C10	800 $\mu$ F, $\pm 5$ per cent., Porce- lain pot, 5 kV
10C/16914	Type 6026	1	C11	1,600 $\mu$ F, Porcelain pot, 5 kV
10C/14962	Type 5050	1	C12	1 $\mu$ F, $\pm 20$ per cent., 600V DC

Stores Ref.	Nomenclature	Qty.	Ref. in fig. 8	Remarks
Condensers—(contd.)				
10C/15926	Type 5293	1	C13	2 $\mu$ F, $\pm 20$ per cent., 600V DC
10C/15241	Type 5207	4	C14-C16, C28	0.5 $\mu$ F, $\pm 20$ per cent., 350V DC
10C/14893	Type 5011	9	C17-C25	8 $\mu$ F, $\pm 20$ per cent., 125V DC
10C/14449	Type 4784	1	C27	2 $\mu$ F, $\pm 20$ per cent., 250V DC
5E/679	Wire, fuse, 10A	1	F1	LT
5E/677	Wire, fuse, 15A	1	F4	Common
5E/676	Wire, fuse, 15A	1	F2	HT
5E/759	Wire, fuse, 5A	1	F3	Fan
10C/14709	Inductance, Type 1194	1	L2	Anode choke, 650 mA
5A/3450	Holder, fuse, 15 amp.	4		
5A/3451	Fuse carrier	1		
10H/18789	Holder, valve, Type 348	4		American 7-pin. Clip sockets on ceramic base
10H/1049	Jack, Type 17	1	J1	Midget, 2-contact
5L/2	Lamps, filament, 260V, 15W, Type A	3	SL1-SL3	
10AB/8	Lampholders, Type 25	3		Panel mounting
	Include—			
10AB/12	Lampholder, Type 24	1		Bayonet, screwed base
10AB/10	Adaptor, Type 23	1		
5Q/1504	Milliammeter, MC 10-100	1	M1	2½-in. dial, flush mounting
5Q/3091	Milliammeter, MC, 0-300	1	M3	2½-in. dial, flush mounting
5Q/3092	Milliammeter, MC, 0-500	1	M4	2½-in. dial, flush mounting
10D/2604	Multiplier unit	1		See below See below
10V/600	Oscillator unit, Type 180	1		
10H/4048	Plug, Type 563	2		12-pole
10H/ZA.26518	Plug, 2-pole, No.38	1	G1 G2	2-pole
10D/17351	Rectifier, metal, Type 269	1	W1	Selenium bridge. Tone rectifier
10D/17352	Rectifier, metal, Type 270	1	W2	Selenium bridge. Bias rectifier
10F/16632	Relay, magnetic, Type 1123	1	A4	R/T relay, 50V AC ; 2 makes 6 mm. silver ; 2 changeovers, 6 mm. silver
Resistors—				
10W/10080	Type 361	1	R1	4,000 ohms, $\pm 5$ per cent., 15 watt, vitreous rod
10W/17415	Type 5871	1	R2	20,000 ohms, $\pm 5$ per cent., 15 watt, vitreous rod
10W/17414	Type 5870	1	R3	2,500 ohms, $\pm 5$ per cent., 15 watt, vitreous rod
10W/16311	Type 4927	1	R4	7,500 ohms, $\pm 5$ per cent., 15 watt, vitreous rod
10W/8226	Type 8226	1	R5	1,000 ohms, $\pm 20$ per cent., $\frac{3}{4}$ watt, carbon rod
10W/8755	Type 2205	2	R6 R8.	470 ohms, $\pm 20$ per cent., 1 watt, carbon rod
10W/8756	Type 2206	1	R7	2,200 ohms, $\pm 20$ per cent., 1 watt, carbon rod

Stores Ref.	Nomenclature	Qty.	Ref. in fig. 8	Remarks
	Resistors—(contd.)			
10W/9896	Type 3036	1	R13	330 ohms, $\pm 20$ per cent., $2\frac{1}{2}$ watt, vitreous rod
10W/16987	Type 5496	1	R9	220 ohms, $\pm 5$ per cent., 5 watt vitreous rod
10W/17096	Type 5553	1	R12	330 ohms, $\pm 5$ per cent., 5 watt, vitreous rod
10W/9910	Type 3074	2	R10 R11	1,000 ohms, $\pm 20$ per cent., $2\frac{1}{2}$ watt, carbon rod
10W/17420	Type 5876	2	R14 R15	100 ohms, wire-wound potentiometer. Modulator bias adjustment
10W/17416	Type 5872	1	L1	90 ohms, vitreous rod. Used as RF choke
10AS/83	Retainers, valve, Type 299	4		Spun glass harness with retaining springs for valves CV26
10F/11062	Switches, Type 157	2	S1 S4	Push-button plunger
10F/16618	Switch, Type 1710	1	S3	Coupling switch
10F/16617	Switch, Type 1709	1	S2	Range switch
10F/106857	Switches, Type 267	4	S5-S7 S9	Single-pole ON/OFF
10F/26	Switch, Type 189	1	S8	Safety switch
10F/16619	Switch, Type 1711	1	S10	3-pole, 3-position, break before make, 2-wafer
10H/160	Socket, Type 486	1		Single-pole. Output socket
10H/4010	Sockets, Type 526	4		12-pole, Jones
10K/16296	Transformer unit, Type 118	1		
	Includes—			
10K/16297	Transformer, Type 2221	1	T1	Modulation transformer
10AD/34	Contactors, Type 66	2	CT1 CT2	CW and R/T 50V AC
10K/16476	Transformer, Type 2467	1	T2	RF filaments and bias supplies
10K/16299	Transformer, Type 2223	1	T3	Modulator filaments and contactor operation
10CV/26	Valves, Type CV26	4	V1-V4	
5Q/12521	Voltmeter, MC, 0-300V AC	1	M5	$2\frac{1}{2}$ in. dial
10A/11836	Knobs, Type 8	2		Bar type moulded
10AF/47	Guards, meter	5		Steel plate with grille, for $2\frac{1}{2}$ in. instrument
10U/239	<b>Amplifying unit, Type 367</b>		<i>Ref. in fig. 13</i>	Tone and modulation amplifier
	Principal components—			
	Condensers—			
10C/14889	Type 5008	3	C302 C314 C316	$1 \mu\text{F}$ , $\pm 20$ per cent., 250V DC
10C/14449	Type 4784	1	C300	$2 \mu\text{F}$ , $\pm 20$ per cent., 250V DC
10C/15079	Type 5099	3	C303 C304 C309	$0.1 \mu\text{F}$ , $\pm 20$ per cent., 350V DC
10C/14998	Type 5069	1	C305	$4 \mu\text{F}$ , $\pm 20$ per cent., 250V DC
10C/14654	Type 4898	3	C301 C306 C312	$50 \mu\text{F}$ , $\pm 20$ per cent., 12V electrolytic
10C/15159	Type 5157	1	C307	$220 \mu\text{F}$ , $\pm 10$ per cent., 350V DC
10C/15082	Type 5102	1	C308	$0.25 \mu\text{F}$ , $\pm 20$ per cent., 350V
10C/14630	Type 4892	1	C310	$2 \mu\text{F}$ , $\pm 20$ per cent., 400V DC
10C/15100	Type 5113	1	C311	$470 \mu\text{F}$ , $\pm 10$ per cent., 350V

Stores Ref.	Nomenclature	Qty.	Ref. in fig. 13	Remarks
Condensers—(contd.)				
10C /16224	Type 5455	1	C313	.0027 $\mu$ F, $\pm 10$ per cent., 350V
10C /14302	Type 4715	1	C315	25 $\mu$ F, 25V, electrolytic
10HA /4768	Connectors, valve, Type 42	2		Bead-insulated conductor, and cap 10A /12351, 7 $\frac{1}{2}$ in. long
10H /3248	Holder, valve, Type 240	2		5-pin, American
10H /ZC2641	Holder, valve	3		International octal
10H /493	Holder, valve, Type 73	2		International octal
10H /4048	Plugs, Type 563	2		12-pole
10D /17411	Rectifiers, metal, Type 277	2	W.300 W.301	Selenium
10F /2861	Relays, magnetic, Type 1047	2	$\frac{D}{I}$ $\frac{E}{I}$	P.O. 3,000 type, 1,000 ohms coil, 24V AC
10F /2822	Relay, magnetic, Type 1022	1	$\frac{F}{2}$	P.O. 3,000 type, 2,000 ohms coil, 48-50V AC
10A /13234	Retainers, valve, Type 24	2		Paxolin yoke, with spring anchors
Resistors—				
10W /6086	Type 6086	2	R300 R312	33,000 ohms, $\pm 20$ per cent., $\frac{1}{2}$ watt
10W /6083	Type 6083	2	R301 R313	1,000 ohms, $\pm 20$ per cent., $\frac{1}{2}$ watt
10W /6840	Type 6840	2	R302 R303	0.1M, $\pm 20$ per cent., $\frac{1}{2}$ watt
10W /6079	Type 6079	1	R304	10,000 ohms, $\pm 20$ per cent., $\frac{1}{2}$ watt
10W /6320	Type 6320	2	R305 R306	470,000 ohms, $\pm 20$ per cent., $\frac{1}{2}$ watt
10W /6080	Type 6080	1	R307	220 ohms, $\pm 20$ per cent., $\frac{1}{2}$ watt
10W /1106	Type 1106	1	R308	560 ohms, $\pm 10$ per cent., $\frac{1}{2}$ watt
10W /8424	Type 8424	2	R314	15,000 ohms, $\pm 20$ per cent., $\frac{1}{2}$ watt
10W /1847	Type 1847	1	R310	2,200 ohms, $\pm 20$ per cent., $\frac{1}{2}$ watt
10W /10965	Type 3680	1	R311	0.15M, $\pm 5$ per cent., $\frac{1}{2}$ watt
10W /6081	Type 6081	2	R315 R316	47,000 ohms, $\pm 20$ per cent., $\frac{1}{2}$ watt
10W /8160	Type 8160	1	R317	4,700 ohms, $\pm 20$ per cent., 1 watt
10W /9640	Type 2875	2	R321 R324	150 ohms, $\pm 20$ per cent., $\frac{1}{2}$ watt
10W /1954	Type 1954	2	R322 R323	100 ohms, $\pm 20$ per cent., $\frac{1}{2}$ watt
10W /1614	Type 1614	1	R309	22,000 ohms, $\pm 10$ per cent.,
10W /10839	Type 3605	1	R318	15,000 ohms, $\pm 15$ per cent., 5 watt
10W /8757	Type 2207	1	R319	220 ohms, $\pm 20$ per cent., 2 watt
10W /17422	Type 5878	1	R320	8,200 ohms, $\pm 5$ per cent., 15 watt
10W /17536	Type 5991	1	R325	Potentiometer, 25,000 ohms
10W /8654	Type 2152	1	R326	Potentiometer, 100,000 ohms
10AL /25	Screen, Type 210	3		Valve screen
10F /16636	Switch, Type 1716	1	S300	3-pole, 3-position
10K /16314	Transformer, Type 2234	1	T300	Input

Stores Ref.	Nomenclature	Qty.	Ref. in fig. 13	Remarks
10K/11888	Transformer, Type 96	2	T301 T302	Intervalve
10K/16315	Transformer, Type 2235	1	T303	
10CV/1932	Valves, Type CV1932	2	V300 V304	
10CV/1054	Valves, Type CV1054	2	V301 V302	
10CV/1941	Valve, Type CV1941	1	V303	
10CV/124	Valves, Type CV124	2	V305 V306	
10V/600	<b>Oscillator unit, Type 180</b>		<i>Ref. in fig. 2</i>	Master oscillator chassis assembly
	Principal components—			
10C/16958	Choke, HF, Type 779	1	L202	1.5 mH
	Condensers—			
10C/15183	Type 5173	2	C205 C207	47 pF, ±10 per cent.
10C/15079	Type 5099	1	C206	.01 μF, ±20 per cent., 350V
10C/11054	Type 3325	1	C208	300 pF, ±10 per cent., 350V
10C/4246	Type 2191	1	C210	.01 μF, ±10 per cent., 750V
10C/15098	Type 5111	4	C211—C213	.01 μF, ±20 per cent., 350V
			C216	
10C/13791	Type 4514	1	C214	100 pF, ±20 per cent., 350V
10C/16959	Type 6040	1	C215	30 pF, ±20 per cent.
			C209	
10C/16960	Type 6041	1	C217	500 pF, ±5 per cent., 250V
10C/3693	Type 1868	2	C218 C219	100 pF, ±5 per cent., 750V
10H/19214	Holder, valve, Type 350	1		For barretter
10H/3248	Holder, valve, Type 240	1		5-pin American
10A/12057	Mountings, anti-vibration, Type 35	4		
10H/4048	Plug, Type 563	1		12-pole
	Resistors—			
10W/753	Type 891	1	R200	4,700 ohms, ±10 per cent., $\frac{3}{4}$ watt
10W/9693	Type 2922	1	R201	680 ohms, ±10 per cent., $\frac{3}{4}$ watt
10W/6414	Type 6414	1	R202	330 ohms, ±10 per cent., $\frac{3}{4}$ watt
10W/1694	Type 1694	1	R203	33,000 ohms, ±10 per cent., $\frac{3}{4}$ watt
10W/8518	Type 2040	1	R204	56,000 ohms, ±10 per cent., $\frac{3}{4}$ watt
10W/9694	Type 2923	1	R205	750 ohms, ±5 per cent., $\frac{3}{4}$ watt
10W/1954	Type 1954	1	R206	100 ohms, ±20 per cent., $\frac{3}{4}$ watt
10W/6840	Type 6840	1	R207	100,000 ohms, ±20 per cent., $\frac{3}{4}$ watt
10W/1841	Type 1841	1	R208	39 ohms, ±10 per cent., $\frac{3}{4}$ watt
10W/17537	Type 5992	1	VR200	Potentiometer, 300 ohms
10W/1827	Type 1827	1	R209	47 ohms, ±10 per cent., $\frac{3}{4}$ watt
10F/1824	Relay, magnetic, Type 681	1	B	Keying relay, 200 ohms
10AB/3569	Retainer, valve, Type 131	1		Spun glass harness with two retaining springs
10W/17655	Thermistor (1 amp), Type 1	1		
10CV/124	Valve, Type CV124	1	V201	
10CV/2734	Valve, Type CV2734	1	V202	Barretter

Stores Ref.	Nomenclature	Qty.	Ref. in fig. 5	Remarks
10D /2604	<b>Multiplier unit</b>			Frequency multiplier and bias control chassis assembly.
10C /16958	Principal components— Choke, HF, Type 779	2	L400 L404	1.5 mH
	Condensers—			
10C /15098	Type 5111	4	C400—C403	.01 $\mu$ F, $\pm$ 20 per cent., 350V, DC
10C /4246	Type 2191	2	C404 C409	.01 $\mu$ F, $\pm$ 10 per cent., 750V, DC
10C /17502	Type 6062	1	C405	40 $\mu$ F, $\pm$ 10 per cent., 250V, DC
10C /17000	Type 6060	1	C406	300 $\mu$ F, $\pm$ 5 per cent., 750V
10C /16998	Type 6058	1	C407	40 $\mu$ F, $\pm$ 5 per cent., 750V DC
10C /16999	Type 6059	1	C408	100 $\mu$ F, $\pm$ 5 per cent., 750V, DC
10C /17501	Type 6061	1	C410	600 $\mu$ F, $\pm$ 5 per cent., 750V, DC
10C /14893	Type 5011	9	C411—C419	8 $\mu$ F, 125V, DC, electrolytic
10D /17352	Rectifier, metal, Type 270	1	W400	Bias rectifier
10F /16667	Switch, Type 1728	1	S400	5-position, 3 ceramic wafers
	Resistors—			
10W /9669	Type 2901	1	R400	47,000 ohms, $\pm$ 20 per cent., 2 watt
10W /1954	Type 1954	1	R401	100 ohms, $\pm$ 20 per cent., $\frac{1}{2}$ watt
10W /9141	Type 2493	1	R402	100 ohms, $\pm$ 20 per cent., 1 watt
10W /17535	Type 5990	2	R403 R406	11,000 ohms, $\pm$ 5 per cent., 12 watt, vitreous
10W /17059	Type 5517	1	R404	7,500 ohms, 5 watt
10W /15099	Type 3808	1	R405	3,900 ohms, 5 watt
10W /9922	Type 3086	1	R407	4,700 ohms, $\pm$ 20 per cent., 3 watt
10W /17096	Type 5553	1	R408	330 ohms, 5 watt
10W /17095	Type 5552	1	R409	150 ohms, 5 watt
10W /16987	Type 5496	1	R410	220 ohms, 5 watt
10W /9950	Type 3106	2	R411 R412	100,000 ohms, $\pm$ 20 per cent., $2\frac{1}{2}$ watt
10W /9944	Type 3100	2	R413 R414	47,000 ohms, $\pm$ 20 per cent., $2\frac{1}{2}$ watt
10CV /124	Valve, Type CV124	1	V400	
10A /12351	Valve clip, Type 2	1		
10H /3248	Holder, valve, Type 240	1		5-pin American
10K /2154	<b>Fan assemblies, Type 2</b>			
	Consisting of—			
10A /11206	Mounting, anti-vibration, Type 11	4		Load 4 lb.
10K /16334	Inserts, filter	1		$5\frac{7}{8}$ in. square by 1 in.
10K /16332	Fan, Type 52	1		200-230V, AC, 200 watts, fitted with suppressor condensers

Stores Ref.	Nomenclature	Qty.	Ref. in fig. 5	Remarks
	Including—			
10K /16333	Brushes, carbon	2		
	Accessories—			
10A /19094	Frame, mounting, Type 49	1		Steel frame with 6 shock- absorbing mountings
10HA /4699	Connector, Type 3107	1		Cleated cableform assembly on steel bar
	Including—			
10H /4048	Plug, Type 563	1		12-pole
10H /4053	Socket, Type 531	1		12-pole
10A /14855	Cover, Type 250	1		For 10H /4048
10A /14850	Cover, Type 245	1		For 10H /4053
10H /Z.A. 26517	Sockets, 2-pole, moulded, No. 44	2		
10HA /4700	Connector, Type 3108	1		Assembly on cableform
	Including—			
10H /4053	Sockets, Type 531	2		12-pole
10A /14855	Covers, Type 250	1		For 10H /4053
10AC /16	Eyebolts, Type 41	4		For hoisting transmitter
10D /17274	Bolts, transit	4		For locking runners
10D /17618	Case, transit (Non- tropical)	1		For transmitter, Type T.1509 and mounting, Type 49, com- plete with valve carton and pack-up spares case
	Includes—			
10D /17658	Case, transit	1		For T.1509 without valve car- ton and pack-up spares case
10D /17619	Carton, valves	1		Valve container in which cer- tain valves are stowed during transit
10D /17620	Case, transit	1		For pack-up spares for T.1509
	Containing—			
10K /16334	Insert, filter	2		
10K /16333	Brush, carbon	6		
10H /9613	Fuse, Type 5	30		
10CV /187	Valve, Type CV187	4		
10CV /45	Valve, Type CV45	4		
10CV /235	Valve, Type CV235	2		
10CV /1932	Valve, Type CV1932	2		
10CV /1054	Valve, Type CV1054	2		
10CV /1941	Valve, Type CV1941	1		
10CV /124	Valve, Type CV124	4		
10CV /26	Valve, Type CV26	4		
10CV /2734	Valve, Type CV2734	4		
5L /2	Lamp, filament, Type A	3		260 volts, 15 watts
10F /1824	Relay, magnetic, Type 681	1		
	Fuse wire	2		Formers, each wound with 30 feet of wire, Stores Ref. 5E /759

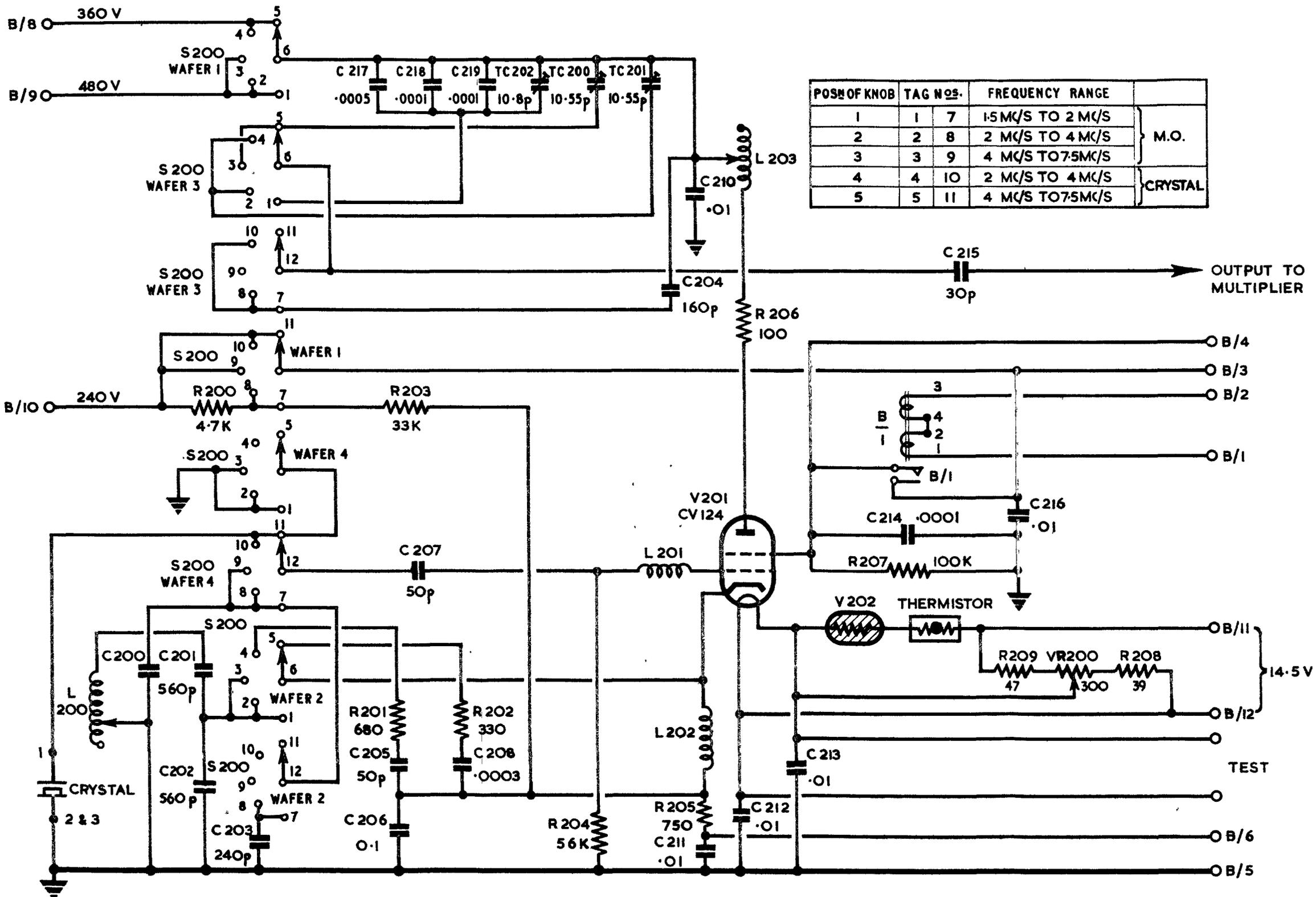
Stores Ref.	Nomenclature	Qty.	Ref. in fig. 17	Remarks
	Connectors—			
10HA/4880	Type 3203	1		Mains connector, includes socket, Type 237 (Stores Ref. 10H/1094)
10HA/4881	Type 3204	1		Receiver connection, includes socket (1), Type M (Stores Ref. 5X/766), Pin socket (6) (Stores Ref. 5X/846) and cable, Septovin (Stores Ref. 5E/2115)
10HA/4882	Type 3205	1		Battery connection, includes socket, Type 269 (1) (Stores Ref. 10H/1262) and cable, Duvin 4 (Stores Ref. 5E/2108)
	Fuses—			
10H/107	Type 23	4		250mA
10H/9613	Type 5	5		1 ampere
10H/2169	Holders, fuse, Type 45	3		Panel mounting, including 1 carrier fuse, Type 7 (Stores Ref. 10H/14542)
10H/493	Holders, valve, Type 73	4		International octal
10F/744	Handles, G.P.O. Key	2		No. 1 Black
10H/1739	Jacks, Type 1	5		Telephone, single circuit
10A/14604	Bushes, Type 56	5		
10H/461	Jacks, lamp, Type 2	3		Tropical finish
10A/14181	Knobs, Type 131	1		
5L/1702	Lamps, P.O. No. 2	3		24 Volts, 2.4 watts, jack type
10A/10256	Mounting, Type 15	2		
10AE/194	Panel and clip assembly	1		Spare fuse panel
10D/17585	Panel, Type 575	1		Fitted with 9 sockets, Type 98 (Stores Ref. 10H/209)
	Plugs—			
5X/762	Type M6	1		
10H/1095	Type 292	1		3-pole
10H/1261	Type 316	1		2-pole
10AE/133	Plug link	2		Voltage changing
5X/845	Pins plug, Type M	6		
	Relay magnetic—			
10F/2807	Type 1011	1	A	P.O. K.3000 200 + 200 ohms
			4	4 changeover contacts
10FB/1391	Type 995	1	B	P.O. K.3000 500 + 500 ohms
			2	2 changeover contacts
	Rectifiers, metal—			
10D/17586	Type 284	1	W1	
10D/17587	Type 285	1	W2	
	Resistors—			
10W/6926	Type 6926	1	R3	33 ohms $\pm$ 20 per cent.
10W/1954	Type 1954	1	R5	100 ohms $\pm$ 20 per cent.
10W/6082	Type 6082	2	R6, R7	330 ohms $\pm$ 20 per cent.
10W/6840	Type 6840	1	R1	100,000 ohms $\pm$ 20 per cent.
10W/8426	Type 8426	1	R4	1,500 ohms $\pm$ 20 per cent.
10W/15496	Type 4205	1	R2	Potentiometer, 25,000 ohms
	Switches—			
10FB/486	Type 913	1		G.P.O. lever key, 2 changeovers
10F/10255	Type 145	1		G.P.O. lever key, 4 changeovers
10F/1211	Type 975	1		2-pole changeover, 3 amperes

Stores Ref.	Nomenclature	Qty.	Ref. in fig. 17	Remarks
10F/16711	Switch unit, Type 313	1		3-pole 3-way wafer switch assembled with and operated with switch, Type 152 (Stores Ref. 10F/10338). Switch unit also includes switch, Type 1761 (Stores Ref. 10F/16712)
	Tagboards—			
10AE/195	Type 762	1		With 3 wiring tags
10AE/196	Type 763	1		With 7 wiring tags
	Transformers—			
10K/16410	Type 2364	1	T1	Iron-cored mains, transformer, in metal case
10K/16411	Type 2365	1	T2	Iron-cored oscillator transformer in metal case
10K/16412	Type 2366	1	T3	Iron-cored microphone transformer in metal case
10K/16413	Type 2367	1	T4	Iron-cored intervalve transformer in metal case
10K/16414	Type 2368	1	T5	Iron-cored output transformer in metal case
10H/7227	Terminals, 4BA, Type C	2		Plain, 1½ in. shank
10CV/1932	Valve, Type CV1932	4	V1 to V4	
10AT/19	Window, Type 112	1		
10AJ/14	Mounting, Type 835	1		Mounting tray. Only required when control unit is mounted in a vehicle. Four mountings, anti-vibration, Type 10 (Stores Ref. 10A/11205), are included

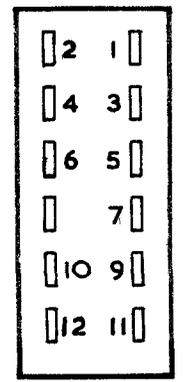




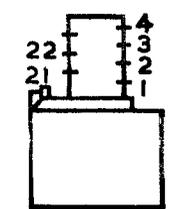




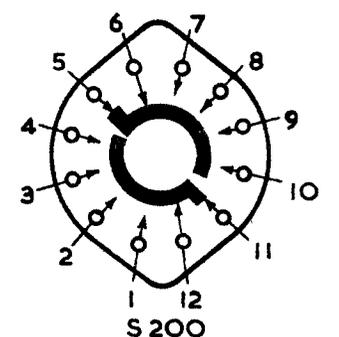
POSN OF KNOB	TAG NOS.	FREQUENCY RANGE	
1	1 7	1.5 MC/S TO 2 MC/S	M.O.
2	2 8	2 MC/S TO 4 MC/S	
3	3 9	4 MC/S TO 7.5 MC/S	
4	4 10	2 MC/S TO 4 MC/S	CRYSTAL
5	5 11	4 MC/S TO 7.5 MC/S	



PLUG B  
VIEW LOOKING AT  
BLADE CONTACTS



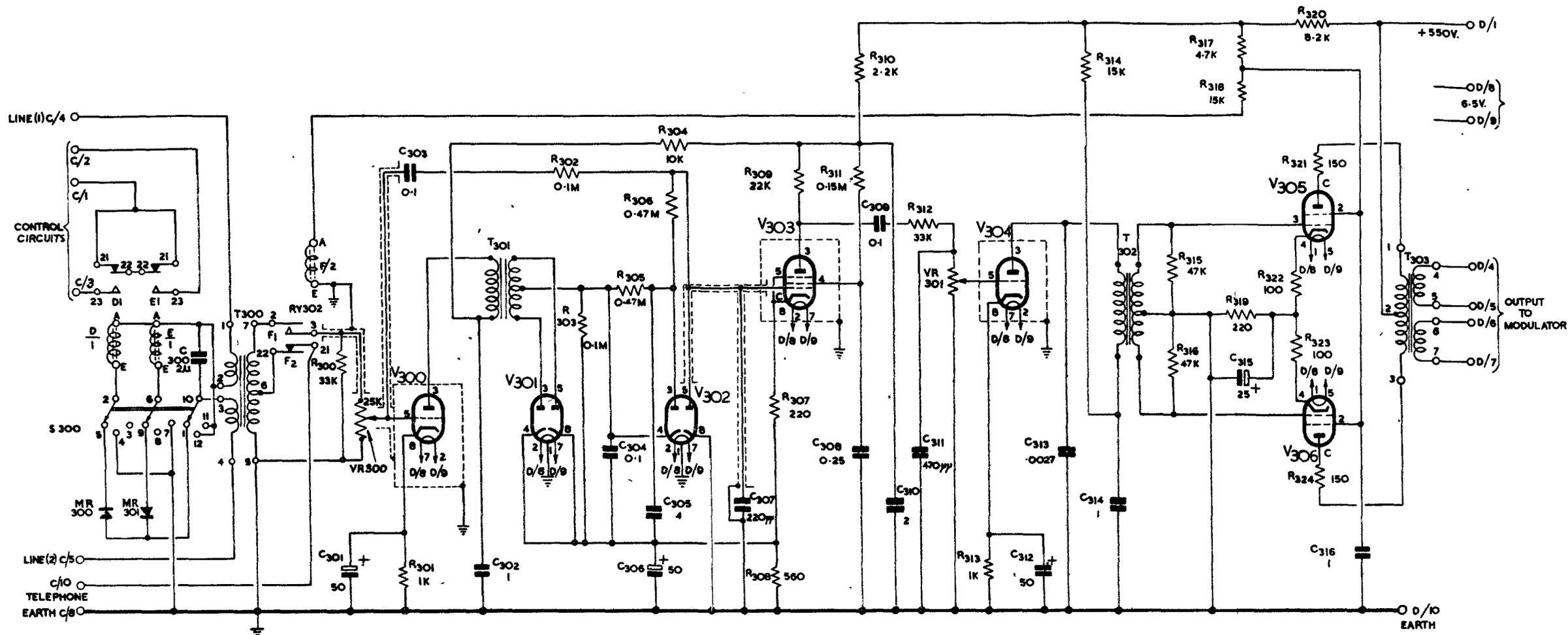
INDEX TO CONTACT  
NUMBERING RELAY B  
1



FOUR WAFERS IDENTICAL  
SWITCH WAFERS VIEWED FROM  
REAR IN MAX. ANTI-CLOCKWISE  
POSITION OF KNOB.  
(THAT IS, POSITION 5)

FIG. 2 — T1509, OSCILLATOR UNIT, CIRCUIT

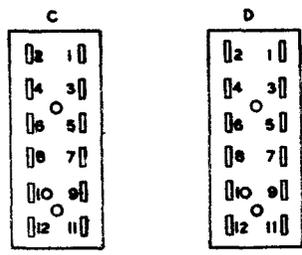




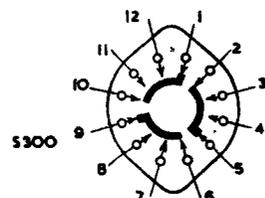
ALL POTS SHOWN IN MAX. ANTI-CLOCKWISE POSITION.

S300 SHOWN IN POSITION FOR OPERATION FROM CONTROL UNIT TYPE 310

CENTRE POSITION = RT. FOR CONTROL UNIT TYPE 88  
 RIGHT HAND SIDE = CW

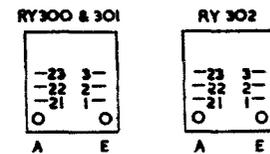


JONES PLUGS (VIEW LOOKING ON TACS)



POS. OF KNOB	TAC NOS.	LABEL
1	5 9 1	CONTROL UNIT 310
2	4 8 12	" " 88RT.
3	3 7 11	" " 88CW.

SWITCH SHOWN IN MAX. CLOCKWISE POSITION WHEN VIEWED FROM REAR.



INDEX TO RELAY CONTACT NUMBERING

FIG. 13. AMPLIFIER TYPE 367.

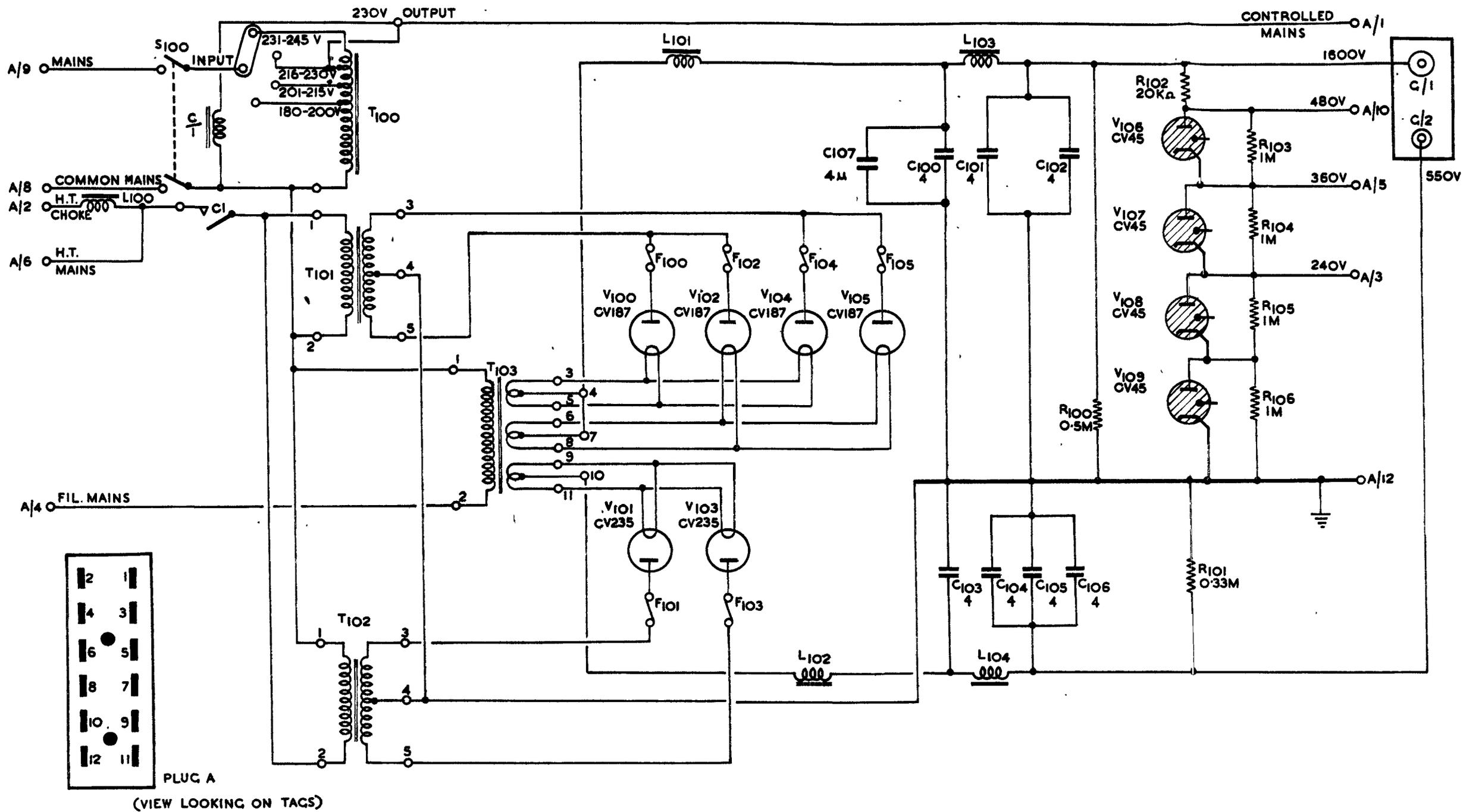


FIG.15. POWER UNIT, TYPE 381

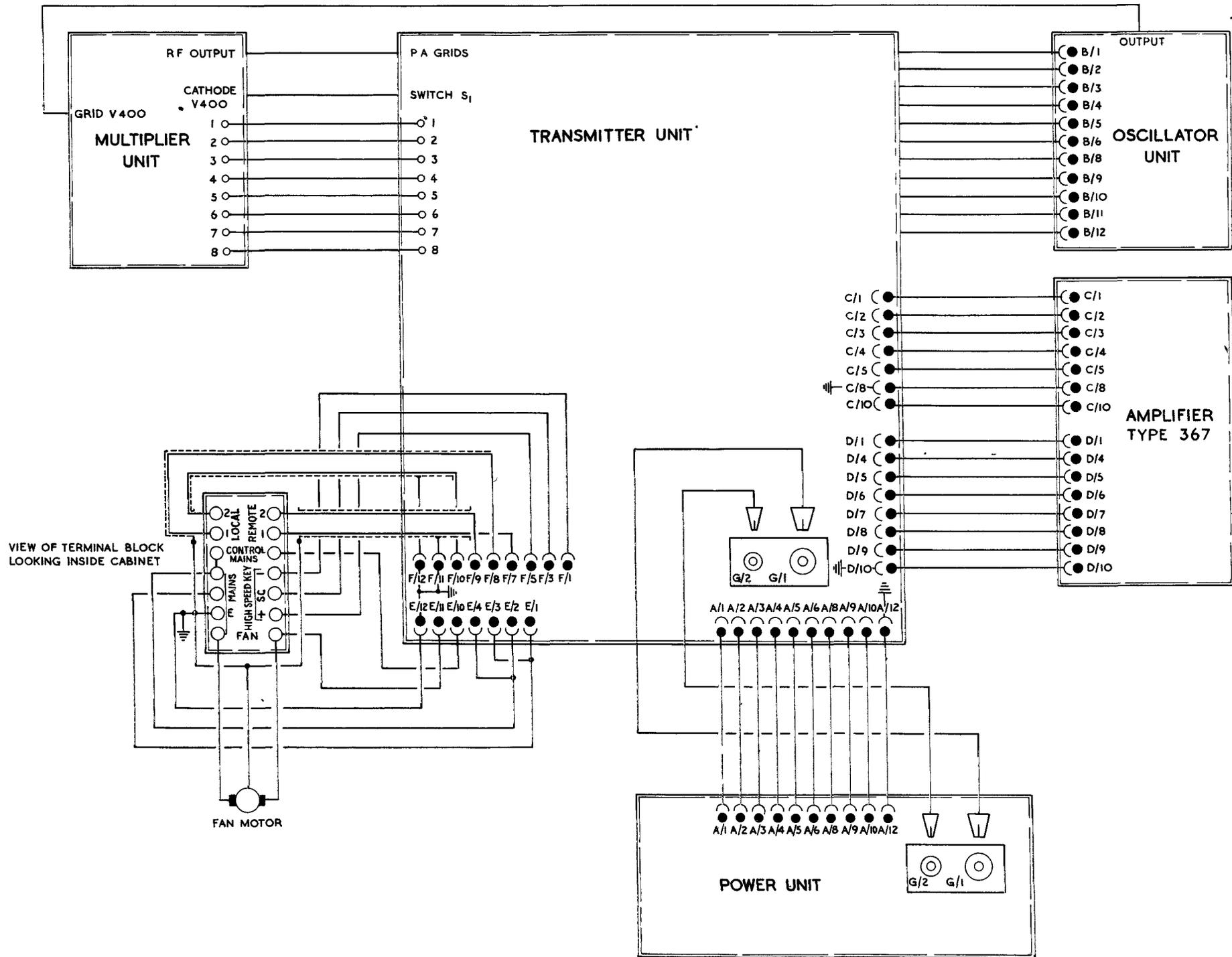


FIG. 32 — INTERCONNECTION OF UNITS, T.1509