RC2

TYPE 57D/DR

FRONT VIEW

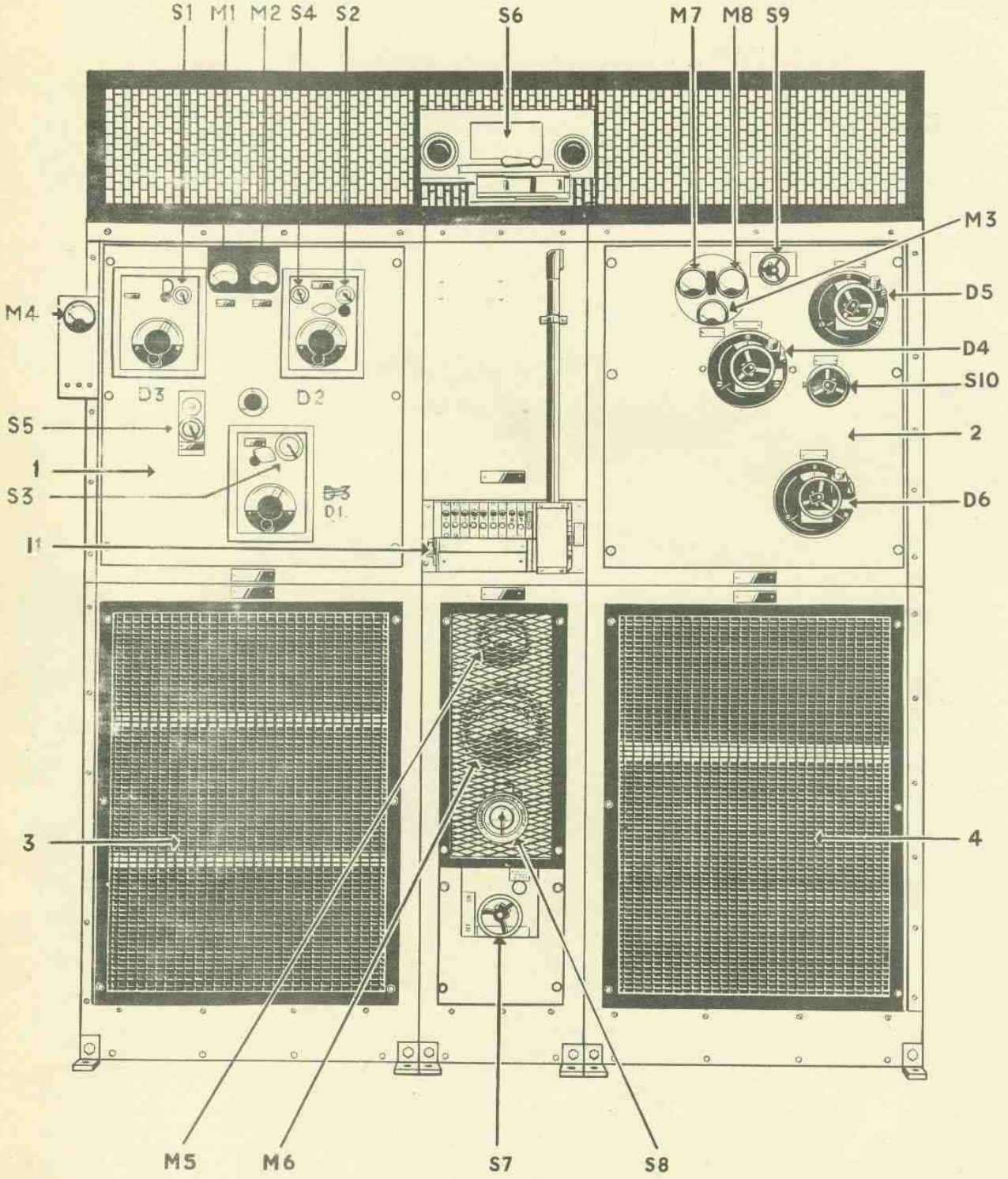

FIG. α

TYPE 57D/DR

1. GENERAL.

Type 57D is an H/F transmitter designed for use in ships fitted with C.W.S.

Date of design	1938
Modified	1941
Frequency range	3,000/21,000 kc/s.
Character of Transmission	C.W. - M.C.W. - R/T and CALL UP.
Power Supply.	400 volts 50 cycle 3 phase A.C.
Power to Final Stage.	4 kW.
Power in Aerial.	1 to 2 kW.
Type of Aerial.	Unipole.
Associated Wavemeter Outfit.	OJ

Type 57DR has been designed as the main H/F W/T and R/T transmitter for C.W.S. Capital Ships and Cruisers.

The circuit consists of a Partial Crystal Controlled Master Oscillator Unit, Intermediate Stage, and Output Stage. A tuned Unipole Aerial is inductively coupled to the Output Stage. No provision is made for self-excitation.

The transmitter is capable of hand or automatic signalling, the latter up to speeds of 150 w.p.m.

No arrangement is provided for "listening through" on the transmitting aerial.

The control of power and the change-over of the character of transmission is effected by the dialling system.

2. CONSTRUCTION.

The panels together with their associated apparatus are fitted in the Transmitter Room and occupy a floor space of approximately 8 ft. x 6 ft. A photograph of the front panels is shown in Fig. a.

Frequency Control Panel 3 PE is the upper left hand panel, (1) and contains the required units for the control of frequency, the intermediate stage, the keying unit and M.C.W. modulator.

Panel 3 PEX lower (3) contains the power supplied for the Frequency Control Panel, various bias supplies and four modulation contactors to change from one type of modulation to another.

The right hand upper panel contains the Output Stage and the Aerial Tuning Circuit (2) and the lower panel (4) accommodates the H.T. supply circuit for the intermediate stage and the filament transformer for the output valves.

The centre upper panel contains the Wave Change Order Indicator, while on the lower is mounted the Main Supply Switch, a voltmeter, indicating the auto-transformer voltage in use and a filament voltmeter, with selector switch, to enable the filament voltage of any of the silica valves to be read.

The above panels form the front of the transmitter and also part of the safety enclosure inside which is the main H.T. and Absorber Panel. The upper portion contains the three main rectifying and the absorber valves, the smoothing condensers, the associated discharge resistances and the absorber resistances. The lower portion has the filament transformers and pre-set resistances for the rectifier and absorber valves, and two main H.T. smoothing chokes and a 1/1 transformer enabling the filament voltage of the rectifying valves to be indicated on the common filament voltmeter.

The input and intermediate speech amplifier form the upper part of a second panel inside the cage and these are mounted above a unit containing the magnetic switches for varying the output of the speech amplifier. The lower portion of the panel provides stowage for the Output Circuit Coil Strips.

The upper portion of the third panel inside the cage contains the Selector Unit, the Control Circuit Rectifier Unit, the Power Contactors, the H.T. and Filament Contactors and the CWS - Direct Control change-over switch. The Main Auto-transformer is contained in the lower portion of this panel.

3. CONTROLS.

V.F.O. FREQUENCY CONTROL (D1). Varies the capacity of both the V.F.O. and the Buffer Stage tuning condensers. The dial is calibrated in divisions against the frequency covered by the Variable frequency Oscillator. Used in conjunction with the V.F.O. Range Switch (S1) to set the calibrated frequency on the V.F.O. and Buffer Stage.

V.F.O. RANGE SWITCH (S1). A two position switch marked Range 1 and Range 2. Range 1 has a frequency coverage 1·0 - 1·5 Mc/s and Range 2, 1·5 - 2·0 Mc/s. The switch is ganged and is used to select the appropriate coils and condensers to give the required frequency coverage in both the V.F.O. and Buffer Stages.

OUTPUT METER FOR V.F.O. UNIT (M1). Indicates the R/F output of the V.F.O. unit when the key is to MARK. With the key in the "SPACING" position, the indication in the meter should fall to zero.

GRID CURRENT INDICATOR FOR FIRST AMPLIFIER (M2). Provides an indication of the grid current applied to the First Amplifier Valves, ATP7's, from the Mixer Stage. The grid current will vary over wide limits with the frequency being used, so a metal rectifier shunt is fitted to the microammeter, allowing an indication to be obtained on all frequencies with a single meter. A maximum current indicates that the Mixer and Trebler Stages are tuned to the frequency obtained by the setting of the V.F.O. and the Mixer Unit Range Switch (S2).

MIXER UNIT RANGE SWITCH (S2). This switch has 5 positions, and selects the crystal, the crystal oscillator tuned circuit, and the appropriate coil in the Mixer and Trebler Stages. Used to select the frequency band to which the Mixer and/or Trebler Stages will be tuned in conjunction with the Mixer Tuning Control (D2).

MIXER TUNING CONTROL (D2). Varies the capacity of a two gang condenser used to tune the Mixer and Trebler Stages to the frequency fixed by the setting of the V.F.O. and the Mixer Unit Range Switch (S2).

TREBLER SWITCH (S4). A two position switch marked Red and Blue. In the Red position, the Mixer Stage provides frequencies between 2·3 and 7 Mc/s and is connected direct to the Amplifier Unit. In the Blue position, the R/F output of the Mixer Stage is passed through a Trebler Stage and then to the Amplifier Unit, providing frequencies between 6 and 21 Mc/s.

AMPLIFIER RANGE SWITCH (S3). Is a six position ganged switch. It selects the appropriate coil in the First Amplifier Stage and short circuits the required amount of inductance coil in the Second Amplifier, or Intermediate Stage, to cover a frequency range of 3 to 21 Mc/s in 6 overlapping steps. Used in conjunction with the Amplifier Tuning Control (D3) to tune the two amplifying stages.

AMPLIFIER TUNING CONTROL (D3). Varies the capacity of a two gang condenser. Used in conjunction with Amplifier Range Switch (S3) to tune the two stages of amplification.

TUNE - TEST SWITCH (S5). A two pole, 3-way switch and jack. Provides a local means of switching on the transmitter at Normal power for tuning or testing. (See Page DN4).

ANODE AMMETER FOR OUTPUT STAGE VALVES (M3). Indicates the current taken by the Output Stage Valves. Used to tune :-

(i) Amplifier Stages.
(ii) Output Stage.
(iii) Aerial Circuit.

WAVEMETER INDICATING UNIT (M4). Provides an indication of the performance of Wavemeter G62 when the V.F.O. is being calibrated.

TRUNK SEALING SWITCH (S6). Earths the aerial and completes the screening of the aerial trunk. This allows the various stages of the transmitter, except the aerial circuit, to be tuned or tested without outside radiation. Auxiliary contacts on the switch control :-

(i) A Red and Green lamp indicator circuit which show the position of the switch. Red indicating "Aerial Earthed Trunk Sealed" and Green, "Aerial Connected Trunk Open".
(ii) Tune - Test Switch (S5) keying circuit.
(iii) An indicator circuit which causes a neon lamp to give long flashes at the Control Unit or Units connected to the transmitter when the trunk is sealed. (See Page DA 13 para. 34).
(iv) The operation of the Aerial Isolating Switch. The aerial circuit is completely broken when the trunk is sealed by this switch. The Safe To Transmit plate also forms part of the Trunk Sealing Switch and when removed prevents the switch being placed to the Green position.

WAVE CHANGE ORDER INDICATOR (I1). See Page DM 6.

H.T. SUPPLY VOLTMETER (M5). Indicates the voltage supplied to the primary of the H.T. transformer.

FILAMENT VOLTMETER (M6). A common voltmeter for reading the filament voltage of all silica valves. Used in conjunction with Filament Voltmeter Selector Switch (S8).

FILAMENT VOLTMETER SELECTOR SWITCH (S8). A three position switch marked MR, MA and MT. It connects the Filament Voltmeter (M6) across the filaments of the Main rectifier, Main absorber and Main transmitting valves respectively. In the MR position, a 1/1 transformer is used to isolate the voltmeter from the H.T. voltage.

MAIN SUPPLY SWITCH (S7). When made, completes the 400 volt, 3 phase A.C. supply to the transmitter. When broken, isolates the transmitter from the supply mains. A quick release in the form of a Red push is provided on the switch. The switch terminals, inside the cage, are "Alive", irrespective of the Cage Door being Open or the Switch (S7) being in the OFF position. Power can be removed from the Switch (S7) by opening the appropriate Fuse Switch on Board 2 BF Distributing.

AERIAL AMMETER (M7). Used to indicate current in Balancer Unit when using Dipole Aerial Circuit. In series with meter (M8) when Unipole Aerial is being used.

AERIAL AMMETER (M8). Aerial current indicator when using Unipole or Dipole arrangement.

SERIES - PARALLEL SWITCH (S9). Used to connect Aerial Tuning Condensers (C101, C102) in series or parallel with Aerial Tuning Inductance and Coupling Coil.

AERIAL TUNING CONDENSER CONTROL (D5). Varies the capacity of the two ganged Aerial tuning condensers (C101, C102). Used in conjunction with Aerial Rough Tuning Control (S10) to tune the aerial circuit.

AERIAL ROUGH TUNING CONTROL (S10). A four position switch marked 1 to 4. Varies the amount of inductance in the aerial circuit. Used in conjunction with Aerial Tuning, Condenser Control (D5) and Series-Parallel Switch (S9) to tune the aerial circuit.

COUPLING CONTROL (D4). Varies the position of the Coupling Coil with respect to the Output Circuit Tuning Inductance, thus controlling the transfer of energy from the Output Circuit to the Aerial Circuit.

OUTPUT CIRCUIT TUNING CONTROL (D6). Varies the capacity of the Output Circuit Tuning Condenser (C100) and thus tunes the Output Circuit.

OUTPUT CIRCUIT COIL STRIP (S11). An insulated plug-in strip, which, by means of links, connect the turns of the Output Circuit Coil in series, or in parallel sections, and thus controls the inductance of the Output Circuit Coil. Used in conjunction with the Output Circuit Tuning Control (D6) to tune the Output Circuit. (Not shown in Fig. a).

CWS - DIRECT CHANGE-OVER SWITCH (S34). A 6 pole 2-way switch which changes over the control of the H.T. Filament and Power Contacts from the Selector Unit to the Direct W/T Control Board via the Direct Control C.O.S. for Transmitters. (See Page DA20, Fig. DA6). Used to provide a Direct Method of controlling the transmitter as an alternative to the Dialling System.

4. OPERATION.

(i) Normal Operation.

All power for the transmitter is taken from the 3-phase, 400 volt, 50 cycle supply which is fed into the Main Supply Switch (S7). On making this switch, supplies are completed to the Selector Unit and a steady neon light should show on the W/T Control Unit connected to the transmitter. This light will flash intermittently if the cage door is open or the Trunk Sealing Switch is in the "Sealed" position.

Assuming that the transmitter is correctly tuned and adjusted, the Control Switch on the W/T Control Unit can now be made, when the "Green" lamp, on the W/T Unit, will light, and the H.T. and filament contactors (S14, S20) will operate. The type of transmission should then be dialled. (C.W., M.C.W., etc.) The set will always remain on the type of transmission last dialled. The required power or "Call Up" is now dialled, the neon lamp goes out, and the transmitter is ready for use.

(ii) Emergency Operation.

The "Normal - Emergency" switch is situated above the relays in the Selector Unit. When put to "Emergency", the dialling circuit is disconnected and the transmitter is switched on with the power fixed at "Normal". The Control Switch, on the W/T Control Unit must be made to complete the keying circuit and the set is ready for use.

Power cannot be altered and the transmitter can only be switched off by the "Normal - Emergency" switch being placed in the "Normal" position. If it is desired to alter the type of transmission, this must be done by altering the position of the modulation contactors (S21, S22, S23, S24) by hand.

(iii) Direct Control.

The CWS - DIRECT Control Switch (S34) is situtated at the right of the power contactors and enables the transmitter to be controlled from the Direct Control Position without using the Selector Unit; the C.W. and M.C.W. modulation contactors being operated by hand as for Emergency Operation.

When the switch is placed in the Direct Control position, its handle can be withdrawn and provides the key to operate the Direct Control C.O.S. for Transmitters. This switch should be set to the Type 57 position as indicated by the number 57 appearing in the circular window near the switch key. The high speed keying relay (S12) should then be removed from its socket, in the keying unit, and the WX plug placed into the keying socket. The stowage socket, from which the WX plug was removed, provides stowage for the keying relay under these conditions.

The two switches in the Direct Control Board and the two adjacent keys, control one transmitter in each transmitting room. (See Page DA 19 and Fig. DA 6).

The modulation contactors may be locked in any required position when hand operated by means of a screwed plug fitting. Removing the plug from its normal or "A" position breaks the bobbin circuit of the contactor and replacing the plug in the "B" or "C" socket, mechanically locks the contactor in the selected position.

No provision has been made for using R/T when the transmitter is being operated by Direct Control.

(iv) Tuning.

A Calibration Book is provided with the Master Oscillator Unit in which is given the calibration charts for V.F.O. dial settings, the Mixer Unit range switch settings, and the Mixer Tuning Control adjustments for the frequencies covered by the transmitter.

By means of the nomograms also supplied in the Calibration Book, the adjustments of the Amplifier and Output stages can be read off.

The scale divisions of the V.F.O. dial are marked along the calibration curve instead of along the vertical axis of the graph paper, so that more than one portion of the curve can be drawn on the same page. Each page covers a frequency range of 100 Kc/s, thus the calibration of the V.F.O. dial covers ten pages.

The V.F.O. frequency is only required when calibrating, or carrying out a check calibration, and is indicated horizontally along the top of each chart.

The Mixer Output frequency is scaled horizontally along the base of each chart and the corresponding Mixer Range Switch positions are given at the side of each base line.

To ensure that backlash on the V.F.O. slow motion dial is always taken up in the same direction :-

(a) Read off the calibrated dial setting for the desired frequency.

(b) Engage the vernier dial at least two main scale divisions below the calibration figure.

(c) Rotate the vernier control clockwise until the exact dial setting is obtained.

(v) Setting Frequency below 7 Mc/s.

Adjustments should be made in the following order :-

(a) Trebler Switch (S4) to "Red".

(b) Choose the correct V.F.O. calibration chart, remembering that the Mixer Output frequency is equal to the transmitted frequency.
Read off the following :-

(i) V.F.O. dial setting.

(ii) V.F.O. switch position.

(iii) Mixer Range Switch position.

Set the tuning control (D1) and range switches (S1, S2) accordingly.

(c) From the nomogram, read off the ranges and dial settings for the Mixer, Amplifier and Output Stages. Set the range switch (S3) and tuning controls (D2, D3, D6), and fit the correct Output Circuit coil strip (S11).

(d) After the transmitter adjustments have been set, two main conditions for operating the transmitter may exist :-

(i) W/T Silence - Trunk sealing switch closed.

(ii) Normal working - Trunk sealing switch open.

In case (i) it will be possible to tune the transmitter up to the aerial, by using the Tune - Test Switch (S5). In the "Tune" position, providing the Main Supply Switch (S7) is completed and the cage doors (S17, S18, S19) closed, the transmitter will be switched on, in the oscillating condition, at Normal Power.

In case (ii), the set must be operated from a W/T control unit. The Tune - Test Unit cannot be used whilst the Trunk Sealing Switch is open. (See Page DN5, Fig. DN2).

(e) Apply H.T. and check the following dial readings :-

(i) Mixer Unit. Mixer Tuning control (D2) should be tuned for maximum indication on the right hand meter (M2).

(ii) Amplifier Unit. Amplifier Tuning control (D3) should be tuned for maximum reading in the Anode Ammeter for Output Stage valves (M3), when the Output Stage is detuned and the aerial is as loosely coupled as possible.

(iii) Output Stage. Output Circuit Tuning control (D6) should be tuned for a minimum reading in meter M3, with the aerial coupling as loose as possible.

(f) The Coupling Control (D4) should now be adjusted to increase the aerial coupling and the Aerial Tuning Condenser control (D5), in conjunction with the Aerial Rough Tuning control (S10), varied until an adjustment is obtained where an increase in current to the Output Stage is shown by the anode ammeter (M3).

(g) The tuning of the Output Stage should be re-checked and brought to a position as indicated by minimum current in the anode ammeter (M3).

(h) The aerial coupling may now be increased and the Output Stage tuning re-checked for minimum current.

(i) The aerial coupling may now be increased until the anode current to the Output Stage reaches the permissible figure (0*25A), or to a maximum.

The increase in aerial coupling will probably reflect on the tuning position of the Output Stage and this should be checked and again brought to a minimum anode current and, if necessary, the aerial coupling increased to bring the Output Stage up to the required loading. (See Page R.B. 2).

The transmitter is now ready for use.

(vi) Setting Frequency above 7 Mc/s.

Adjustments should be made in the following order :-

(a) Trebler Switch (S4) to "Blue".

(b) Divide the Output Frequency by three to obtain the frequency of the Mixer Stage. Choose the correct V.F.O. Calibration Chart for this frequency and continue from (v) (b) (i) above, the instructions given for setting frequency below 7 Kc/s.

NOTE : (i) It is important that the position of switches should not be altered when the transmitter is in an oscillating condition.

(ii) When tuning the Hundreds Selector of the Wavemeter G62, always disconnect the coupling to the Transmitter Type 57 by means of the switch on the Wavemeter Exchange. The error which may occur when this precaution is not observed, is caused by the Harmonic Selector Oscillator, inside the Wavemeter G62, beating directly with the V.F.O. instead of with the harmonics of the 100 Kc/s Crystal Oscillator.

5. TECHNICAL DESCRIPTION.

The following technical description should be read in conjunction with "Notes on Frequency Control Panel for Transmitter Type 57D". (See Page RB3).

(a) V.F.O. Unit. (Fig. b).

This unit contains the Variable Frequency Oscillator and the Buffer Amplifier Stages. The screened compartment nearest the front of the unit accommodates the V.F.O. and the rear compartment of the Buffer Amplifier. The two controls, consisting of the V.F.O. Frequency Control (D1) and the V.F.O. Range Switch (S1), are ganged so that the operation of the controls sets the frequency simultaneously on the two stages.

A Colpitt Oscillator, using a MT20 triode valve (V1) is used as the V.F.O. The valve is directly heated and the filament voltage of 6 volts D.C. is obtained from the filament rectifier (W5, W6). The filament supply leads are decoupled to earth by the by-pass condensers (C13, C14).

The H.T. supply is from the Master Oscillator Unit H.T. Rectifier and the resistances (R2, R3) reduce the supply voltage to approximately 450 volts. The jack (J1) is to allow the performance of valve (V1) to be checked and the total current supplied to the V.F.O. to be measured with an external meter. Condenser (C11) is to absorb any tendency of an arc forming at the contact points of the jack. The H.T. supply lead is decoupled by the R/F choke (L2) and by-pass condenser (C16).

The inductance of the coil (L1) is controlled by the V.F.O. Range Switch (S1) which allows the frequency coverage of the V.F.O. to be divided into two sub-ranges. Greater accuracy can thus be obtained with the V.F.O. Frequency Control (D1) as a larger angular displacement is required to cover a given frequency.

TYPE 57D/DR

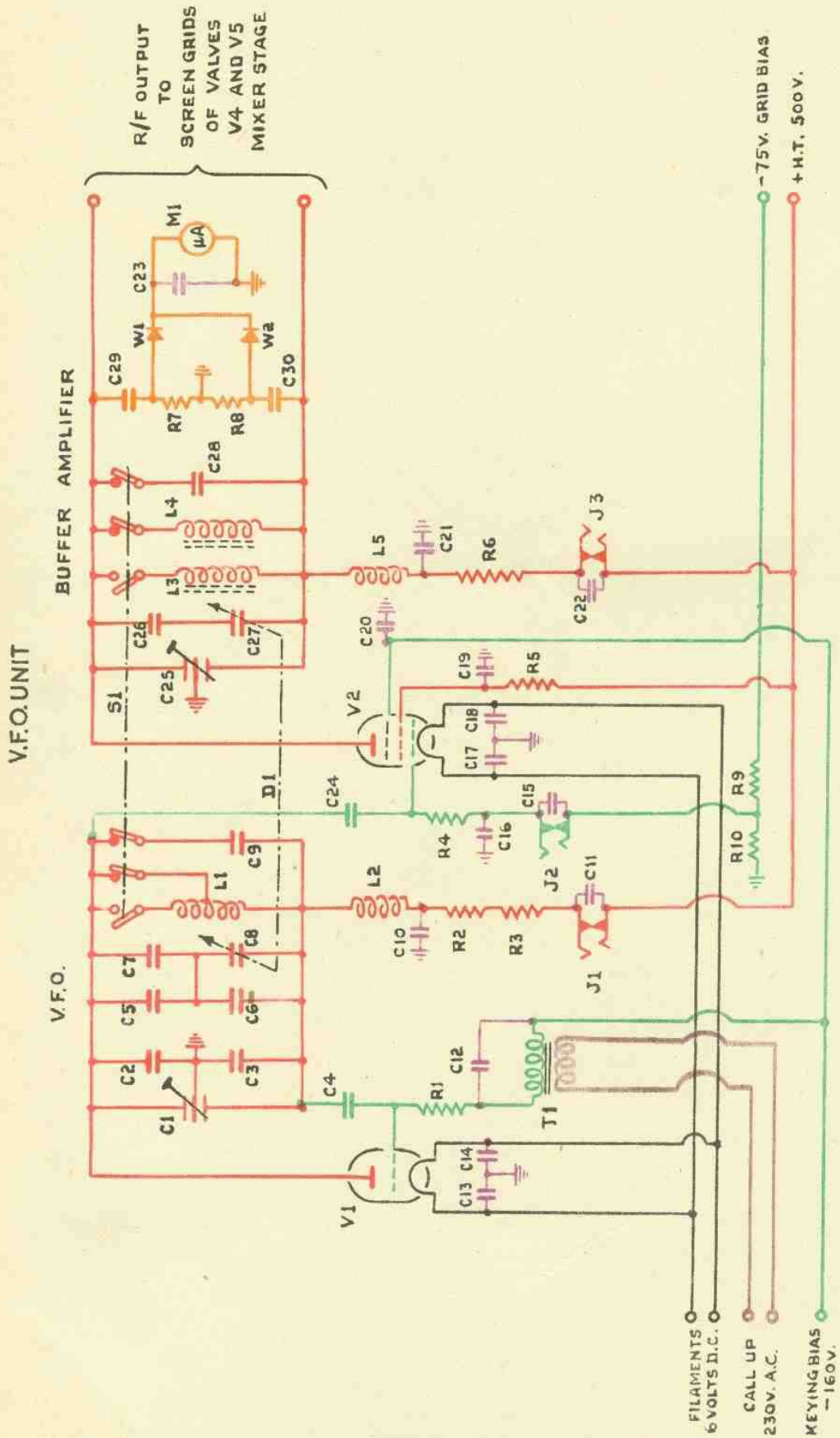

Fig. 6.

An arrangement of series and parallel condensers (C5, C6, C7) causes the main tuning condenser (C8) to have almost a linear variation of frequency with angle of rotation. The frequency coverage of each sub-range is thus equally spaced over the V.F.O. Frequency Control Dial (D1) simplifying tuning and calibration. The fixed condensers (C5, C6, C7) are constructed from ceramic and their values have been chosen in order to make the variation of frequency with change of temperature less than 30 cycles per degree centigrade. The temperature compensation is thus of a high order. The trimmer condenser (C1) is accessible through a small hole in the front of the V.F.O. panel, and is used, at the initial calibration, to set the end points of each sub-range to about 10 and 90 scale divisions.

Condenser (C9) is introduced in parallel with a portion of the tuning coil (L1) when on the higher of the two sub-ranges. The grid coupling is provided by condenser (C4).

Resistance (R1) is the grid leak of valve (V1) and in series with the grid leak, is the secondary of the "Call Up" transformer (T1). The grid leak is connected to earth by the contact of the Keying Relay (S12) in the "Mark" position. In the "Space" position, a negative potential of 160 volts is applied to the grid of the valve (V1) via the secondary of T1 and the grid leak. This potential is sufficient to close the valve down and the oscillations in the V.F.O. circuit will be stopped.

The secondary winding of transformer (T1) is by-passed, with respect to R/F, by the condenser (C12).

The "Call Up" transformer (T1) is used to introduce a 50 cycle A.C. supply to the grid of valve (V1). This has the effect of modulating the frequency of the V.F.O. at 50 cycles. By this means, the band-width of the transmitted frequency is increased, and provides a method by which a receiving operator will be able to hear a transmitter, radiating a frequency, which differs slightly from that to which the receiver is adjusted. The supply to the transformer (T1) is controlled by the Modulation Contactor (S24). (See Fig. g).

When CALL UP is dialled, the transmitter is automatically connected for full power operation, and the Modulation Contactor (S24) completes the A.C. supply to the Call Up transformer (T1). The valve (V1) is inoperative, owing to the keying bias, until the "Keying Relay" (S12) is changed to the "Mark" position by a morse key in a W/T unit connected to the transmitter. (See Page DA7). A radio frequency, to which the transmitter is adjusted, is then radiated, modulated at a frequency of 50 cycles.

The output of the V.F.O. is capacity coupled by condenser (C24) to the control grid of an ATP7 pentode valve (V2) used in the Buffer Amplifier Stage.

(b) Buffer Amplifier Stage.

The circuit arrangement is comparable with that used in the V.F.O. circuit, thus simplifying the ganging of the two circuits. A pentode valve (V2) is used, operating under Class C conditions. (See Admiralty Handbook of W/T (1938), Section K, Para. 14). The control grid bias is obtained from the Control Grid Bias Rectifier and is reduced to a suitable value by the bias potentiometer consisting of resistances R9 and R10.

A jack (J2) is provided in order to measure the Buffer Amplifier Valve grid current with an external meter. Arcing at the jack contacts is suppressed by the condenser (C11).

The resistance (R4) provides the grid leak and the condenser (C10) acts as an R/F by-pass condenser across a portion of the grid bias potentiometer (R10).

The valve (V2) is directly heated and is supplied with 6 volts D.C. from the Filament Rectifier (W5, W6). The supply leads are decoupled by condensers C17 and C18.

The screen grid H.T. supply is from the Master Oscillator H.T. Rectifier and is reduced to a suitable value by the voltage dropping resistance (R5). The screen grid is connected to earth, with respect to R/F by condenser C19.

The H.T. supply, from the Master Oscillator H.T. Rectifier, passes via jack (J3). The total anode current taken by the Buffer Amplifier Stage can be measured with an external meter, at this point. The supply voltage is reduced to a suitable value by the resistance (R6) and the supply lead is decoupled by the R/F choke (L5) and by-pass condenser (C21).

The amplifier tuned circuit uses two iron dust core coils (L3, L4), one for each sub-range. By adjustment of the cores, the amplifier inductance is accurately ganged to that of coil L1 in the V.F.O.

Condenser (C28) is joined in parallel with coil (L4) on the higher frequency sub-range in a similar manner to condenser (C9) in the V.F.O. circuit.

The trimmer condenser (C25) is accessible through a hole at the rear of the amplifier and serves to gang the tuning capacity of the Buffer Amplifier to that of the V.F.O. The trimmer is locked after the initial calibration.

Condenser (C27) is the tuning capacity of this stage in conjunction with the fixed condenser (C26).

The suppressor grid of valve (V2) is connected to the keying bias supply. When the Keying Relay (S12) is in the "Mark" position, the suppressor grid is earthed by the key contact. In the "Space" position, a negative potential is applied to the suppressor grid which is sufficient to close the valve (V2) down. The Buffer Amplifier Stage thus becomes inoperative. Condenser (C20) is an R/F by-pass condenser, which decouples the grid bias supply line with respect to R/F.

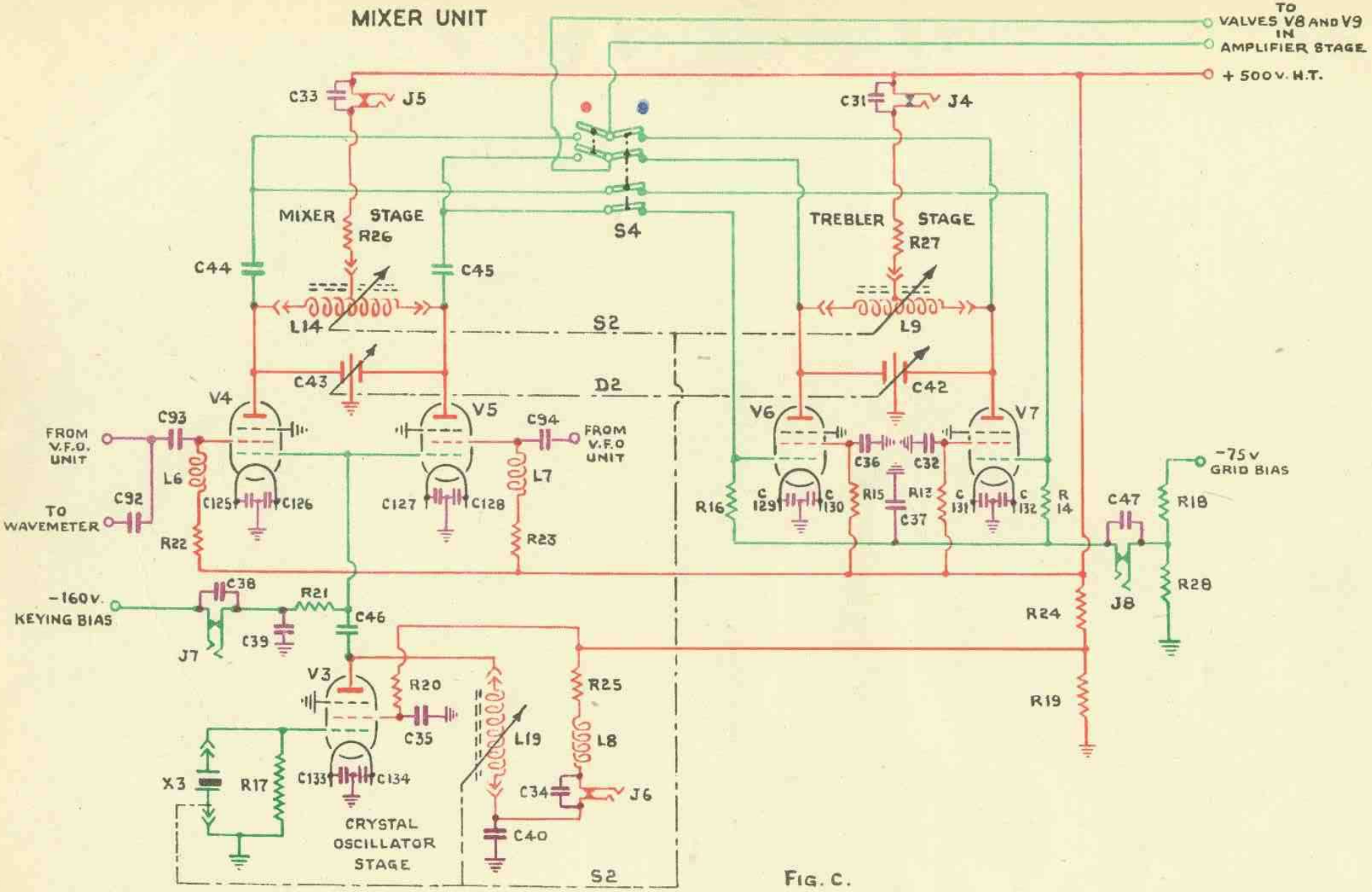
MIXER UNIT
TO VALVES V8 AND V9 IN AMPLIFIER STAGE
+ 500 V. H.T.
C33
J5
C31
J4
MIXER STAGE
R26
S4
TREBLER STAGE
R27
C44
C45
L14
L9
S2
C43
D2
C42
V4
V5
V6
V7
C93
C94
FROM V.F.O. UNIT
FROM V.F.O UNIT
L6
L7
C92
TO WAVEMETER
C125
C126
C127
C128
C129
C130
C131
C132
C36
C32
R16
R15
R13
C37
R14
-75 V GRID BIAS
C47
R18
R22
R23
C38
R21
-160 V. KEYING BIAS
C46
J7
C39
J8
R24
R28
V3
R20
R25
L19
L8
C35
C133
C134
X3
R17
C34
J6
C40
R19
CRYSTAL OSCILLATOR STAGE
S2

FIG. C.

The R/F output of the amplifier is capacity coupled to a micro-ammeter (M1), by means of which the performance of the V.F.O. and Buffer Amplifier may be checked at any moment. The condensers (C29, C30) provide the necessary coupling to the rectifier system. Resistances (R7, R8) provide the rectifier load. The junction of the two resistances (R7, R8) is earthed, to accommodate a full wave metal rectifier (W1, W2) and also to supply the earth return connection from the meter (M1). Condenser (C23) acts as a reservoir condenser and assists in providing a dead beat reading on the meter (M1). The output of the amplifier is suitable for supplying a push-pull circuit and this is capacity coupled to the screen grids of the two pentode valves (V4, V5), used in the "Mixer Stage".

(c) Mixer Unit. (See Fig. c).

The Mixer Unit contains three stages :-

(i) Mixer Stage.

(ii) Crystal Oscillator Stage.

(iii) Trebler Stage.

(i) Mixer Stage.

Two ATP7 pentode valves are used in a special circuit arrangement in order that the frequency of the Variable Frequency Oscillator may be mixed with that of the Crystal Oscillator. The arrangement practically prevents the Crystal Frequency passing through the Mixer Stage and appearing in the output circuit to give false tuning indications. The output circuit is tuned to the resultant, or mixed frequency, and thus selects the required frequency to be amplified, or multiplied, by other stages.

The V.F.O. is coupled to the screen grids of valves V4 and V5 by the coupling condensers (C93, C94). The screen grid H.T. potential is supplied from the Master Oscillator Unit H.T. Rectifier via the dropping resistances (R22, R23) and R/F chokes (L6, L7).

The Crystal Oscillator is capacity coupled to the control grids, connected in parallel by the coupling condenser (C46). The grid leak resistance (R21) is connected to earth, with respect to R/F, by the condenser (C39). The jack (J7) allows the grid current of the mixer stage to be measured and also indicates, when grid current flows, that the crystal oscillator is operating. A condenser (C38) is to absorb any arcing that may occur at the jack points.

The keying bias potential is applied to the control grids when the Keying Relay (S12) is in the "Space" position and is of such a value that the valves (V4 and V5) are closed down and the Mixer Stage becomes inoperative. In the "Mark" position, the control grids are connected to earth via the grid leak resistance (R21) and the contact of the Keying Relay (S12) and the keying bias, is removed.

Valves V4 and V5 are directly heated and a filament supply of 6 volts D.C. is obtained from the Filament Rectifier (W5, W6).

The Master Oscillator H.T. Rectifier supplies the anode voltage and jack (J5) is provided to allow the anode current taken by the mixer valves (V4 and V5) to be measured. The supply voltage is fed to the centre tap of the iron dust core coil (L14) via the dropping resistance (R26). The coil (L14) is one of five coils controlled by the Mixer Unit Range Switch (S2). The range switch (S2) is ganged to the Trebler and Crystal Oscillator stages, and by one operation, the respective coils in the three circuits are selected and the appropriate crystal connected in circuit.

The tuning condenser (C43) is ganged to the trebler circuit tuning condenser (C42) and are both controlled by the Mixer Tuning Control (D2).

The output from the mixer stage is capacity coupled by condensers (C44, C45) to either the control grids of the trebler stage or the control grids of the First Amplifier Stage, depending upon the position of the Trebler Switch (S4). For frequencies below 7 Mc/s, the switch is placed in the "Red" position and, for the higher frequencies, the switch is placed in the "Blue" position, thus introducing the Trebler Stage. The mixer output is then trebled before being passed on to the amplifying stages.

The Wavemeter coupling is taken from the screen grid of valve (V4) via the coupling condenser (C92). A small R/F voltage at the frequency of the V.F.O. is thus connected to the "Wavemeter Exchange" and is used primarily for the calibration of the V.F.O.

(ii) Crystal Oscillator Stage.

A single ATP7 valve (V3) is used in this stage. The circuit consists of a crystal joined between control grid and filament and a tuned output circuit between anode and filament.

The crystal (X3), one of three, is selected by the Mixer Unit Range Switch (S2). This switch also selects the output coil (L19) to correspond to the crystal being used. The grid leak for valve (V3) is provided by resistance (R17). The output coil (L19) is of the iron dust core type. The variable core allows the output circuit to be tuned to the crystal frequency. As the coil is joined between anode and filament, the inductance of the coil is in series with the anode-filament capacity of the valve. A small portion of this capacity, grid-filament capacity, is also common to the crystal circuit and thus provides the necessary coupling between the two circuits.

AMPLIFIER UNIT

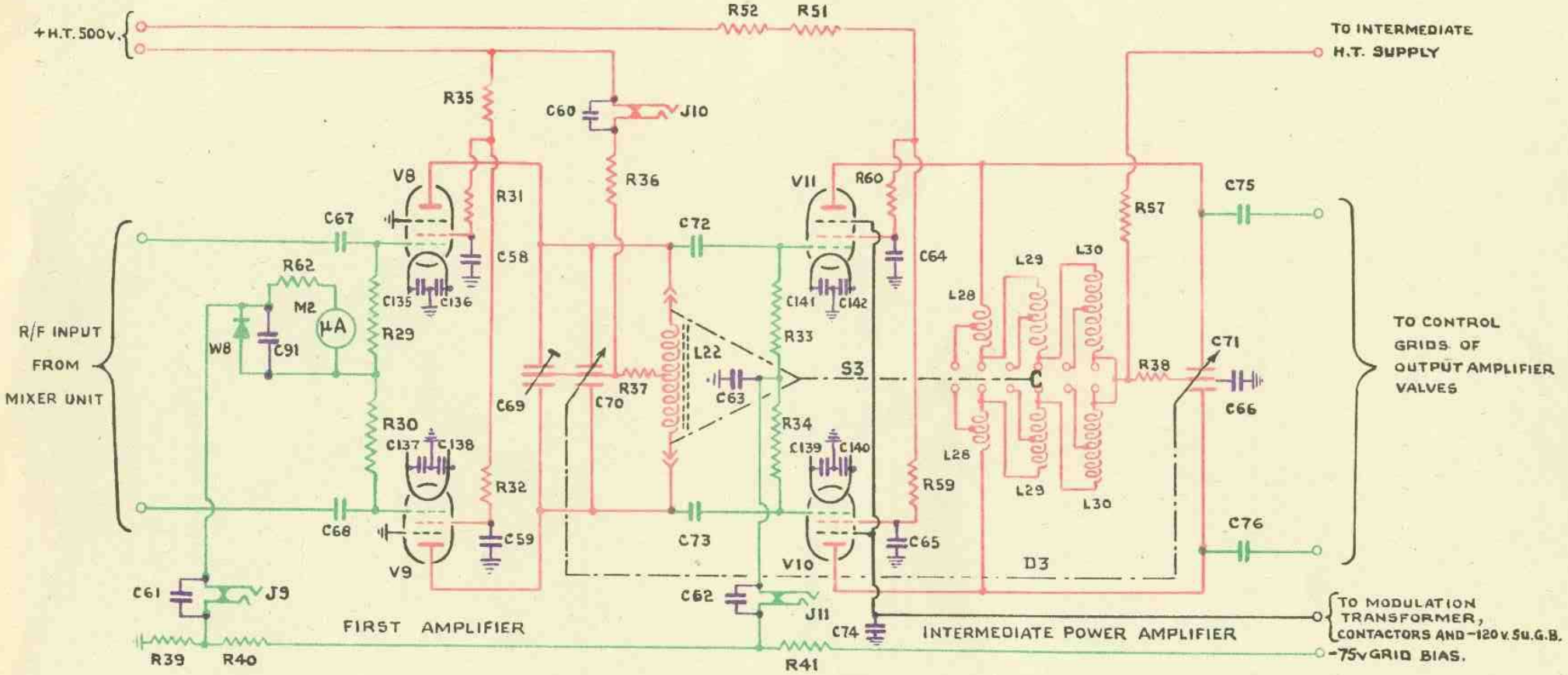

Fig. d.

The anode supply is from the Master Oscillator H.T. Rectifier and is supplied via a H.T. potentiometer consisting of resistances (R24, R19). A dropping resistance (R25) reduces the supply to a suitable value. The supply mains are decoupled by the R/F choke (L8) and by-pass condenser (C40). The jack (J6), shunted by a condenser (C34), allows the anode current of valve (V3) to be checked, and thus the performance of the crystal oscillator circuit confirmed. Condenser (C40) joins the coil (L19) to earth and to filament of valve (V3), with respect to R/F.

A tapping from the H.T. potentiometer (R24, R19) supplies the screen grid potential via the dropping resistance (R20), the condenser (C35) operating as an R/F by-pass condenser and thus holding the screen at a constant potential with respect to R/F.

The suppressor grid is maintained at earth potential. The filament supply is at 6 volts D.C. and is obtained from the Filament Rectifier (W5, W6). Condensers (C133, C134) decouple the filament supply mains and also provide the R/F connection of the output coil (L19) to filament.

(iii) Trebler Stage.

The Trebler Stage uses two ATP7 pentode valves (V6, V7) connected in push-pull and operated under Class C. conditions.

The grid bias is supplied from the control grid bias rectifier, via a potentiometer (R18, R28), and is applied to the respective grids via the grid resistances (R14, R16). The value of the grid bias is such that the valves V6 and V7 are operating at their maximum anode dissipation when the Trebler Stage is not in use.

When the Trebler Stage is required, the output of the Mixer Stage is connected by the Trebler Stage (S4) to the control grids of valves V6 and V7. The amplitude of the drive voltage is sufficient to cause the grid potential to run positive, and grid current flows. The grid current develops a voltage across resistances (R14, R16) which is sufficient to increase the standing grid bias to a value suitable for Class C operation.

By this arrangement, the current taken by the Trebler Stage is kept practically the same, irrespective of the frequency being used and thus the load on the Master Oscillator H.T. Rectifier is maintained at a constant value whether the Trebler Stage is in circuit or not.

The jack (J8) allows the grid current of valves (V6, V7) to be measured and thus giving a check on the performance of the Mixer Stage.

The screen grid potential is provided by the Master Oscillator H.T. Rectifier and is reduced to a suitable value by the dropping resistances (R13, R15). The condensers (C32, C36) are R/F by-pass condensers.

The suppressor grids are maintained at earth potential. The jack (J4) allows the anode current, taken by the Trebler Stage, to be measured.

The H.T. supply is from the Master Oscillator H.T. Rectifier and is fed to the centre tap of the iron dust core tuning coil (L9) via the voltage dropping resistance (R27). The coil, (L9) is one of five, selected by the Mixer Unit Range Switch (S2).

The filament supply for valves V6 and V7 is supplied by the filament rectifier at 6 volts, condensers (C129, C130 and C131, C132) being R/F by-pass condensers to decouple the supply leads.

The output of the Trebler Stage is isolated by the Trebler Switch (S4), when in the "Red" position, or capacity coupled to the first amplifier stage, when the "Blue" position is used.

(d) Amplifier Unit. (Fig. d).

The Amplifier Unit contains two separate stages of amplification. The two stages, being ganged, are controlled by a six position range switch (S3) and a tuning control (D3) which varies the capacity of condensers (C70, C71).

(i) First Amplifier Stage.

Two ATP7 pentode valves (V8, V9) are used in this stage. They are connected in push-pull and operate as Class C amplifiers.

The output of the Mixer Unit is capacity coupled to the control grids of valves (V8, V9) by condensers (C67, C68). Resistances (R29, R30) are the grid leak resistances for the two valves.

The amplitude of the voltage applied to the control grids of valves (V8, V9) will depend upon the frequency being used and will vary over wide limits. A meter (M2) is used as an indicator of the grid current in this stage, and as grid current will be a factor of the amplitude of the drive voltage, arrangements are made to allow one meter to cover the large range required. The meter is fitted with a shunt consisting of a metal rectifier (W8) and a fixed resistance (R62). The resistance of the metal rectifier varies according to the value of the current flowing through it. The effective resistance of the meter shunt (W8, R62) will therefore vary with the amount of grid current flowing. If the value of grid current is large, the resistance of the rectifier is relatively smaller and a smaller ratio of current will pass through the meter. With a small value of grid current, the effective resistance of the shunt (W8, R62) is increased and a larger ratio of current will pass through the meter. The meter readings are purely an indication of grid current and if a measurement of grid current is required, an external meter may be plugged into jack (J9).

OUTPUT AMPLIFIER

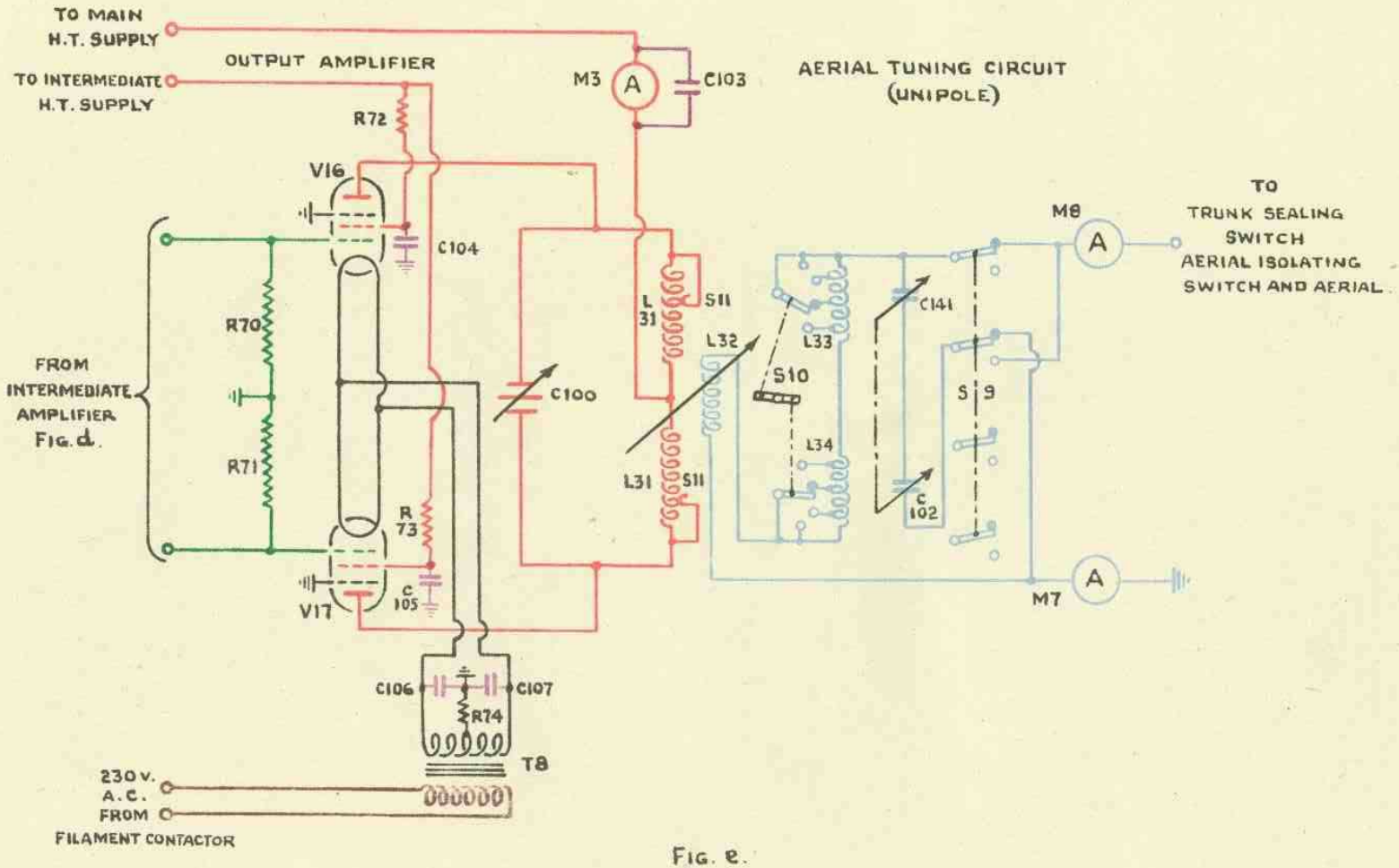

Fig. e.

The control grids are maintained at a negative potential obtained from the Control Grid Bias rectifier and reduced to the required value by the grid bias potentiometer (R39, R40, R41).

The screen grid potential is obtained from the Master Oscillator H.T. Rectifier and is reduced to a suitable voltage by the resistances (R35, R31, R32). Condensers (C58, C59) are the screen grid R/F by-pass condensers.

The filament supply is 6 volts D.C. from the Filament Rectifier (W5, W6), the supply leads being decoupled by condensers (C135, C136, and C137, C138).

The H.T. supply from the Master Oscillator H.T. Rectifier is fed to the centre tap of the iron dust core tuning coil (L22) via a jack (J10) and voltage dropping resistance (R36), and resistance (R37). The tuning coil (L22) is one of six, selected by the position of the Amplifier Range Switch (S3). The jack (J10) allows the anode current taken by valves V8 and V9 to be measured.

The rotor and stator of both the tuning condenser (C70) and the trimmer condenser (C69) are at the same D.C. potential, and resistance (R37) operates as both a feed resistance and a parasitic resistance. As a feed resistance, it carries the D.C. voltage to the centre tap of the tuned circuit; and as a parasitic resistance, it prevents R/F oscillations being built up, in the two halves of the tuned circuit, at approximately twice the frequency in use.

The trimmer condenser (C69) enables the First Amplifier to be ganged to the Intermediate Power Amplifier.

The output of the First Amplifier is capacity coupled by condensers (C72, C73) to the control grids of two NT38 pentode valves (V10, V11) in the Intermediate Power Amplifier Stage.

(ii) Intermediate Power Amplifier.

The second power amplifier is a push-pull stage using two NT38 pentode valves (V10, V11).

The control grids are capacity coupled to the output of the First Amplifier Stage by condensers (C72, C73). The grid leak resistances (R33, R34) are connected to earth, with respect to R/F by condenser (C63).

A negative bias is obtained from a tap on the common bias potentiometer (R39, R40, R41), for the amplifier stages. A jack (J11) allows the grid current of valves V10 and V11 to be measured.

The filament supply is from a 10 volt winding of a transformer (T7), the supply leads being decoupled by condensers (C139, C140, and C141, C142). (See Fig. g).

The screen grid potential is obtained from the Master Oscillator H.T. Rectifier via the Master Oscillator Unit Absorber resistances (R51, R52) and two voltage dropping resistances (R59, R60). The screen grids are connected to earth, with respect to R/F, by the by-pass condensers (C64, C65). (A detailed description of the action of resistances R51, R52 is given under "Keying Operation").

Suppressor grid modulation is applied to valves V10 and V11 for R/T and M.C.W. operation. For C.W. transmission, the suppressor grids are connected to earth by the Modulation Contactor (S21). For R/T or M.C.W. a suppressor grid bias of 120 volts negative is applied to the NT38 valves. This potential is obtained from the Suppressor Grid Bias Rectifier (V26) and is connected, via the secondary winding of the Modulation transformer (T24) to the suppressor grids. The audio frequency supply to the primary winding of the modulation transformer is selected by the modulation contactor (S23), depending upon the type of modulation required. For M.C.W., the output of a 1000 cycles oscillator is used and for R/T a speech amplifier. The required modulation passing through the modulation transformer (T24) varies the suppressor grid bias at the frequency of the applied modulation. The voltage of the suppressor grids are thus varied at the modulation frequency, and in turn modulate the anode current of valves V10 and V11. Condenser (C74) is an R/F by-pass condenser to decouple the suppressor grid bias supply lead. (See Fig. g).

The H.T. supply is obtained from the Intermediate H.T. Rectifier and is supplied via a voltage dropping resistance (R57) to the centre tap of three air spaced coils (L28, L29, L30). The three coils form the tuning inductance, and tappings are taken from them to the range switch (S3). The turns which are not required, on any one range, are short circuited by the range switch. The division of the total inductance into three coils reduces the coupling between the turns in use and those short circuited, thereby reducing the losses in the short circuited turns.

The rotor of the tuning condenser (C71) is at H.T. potential, and the resistance (R38) operates in a like manner to resistance (R37) in the First Amplifier Stage.

The centre point of the Intermediate Power Stage is earthed with respect to R/F by the by-pass condenser (C66).

Condenser (C71) is the tuning capacity, ganged to the First Amplifier tuning condenser (C70) and controlled by the Amplifier Tuning Control (D3).

The supply voltage to this stage is controlled by the power contactors (S15, S16) and will depend upon the tapping on the main auto transformer (T19) selected by the contactors.

The output of the Intermediate Power Amplifier is capacity coupled by the coupling condensers (C75, C76) to the control grids of valves (V16, V17) in the Output Stage.

MAIN H.T. SUPPLY, RECTIFIER AND ABSORBER CIRCUIT

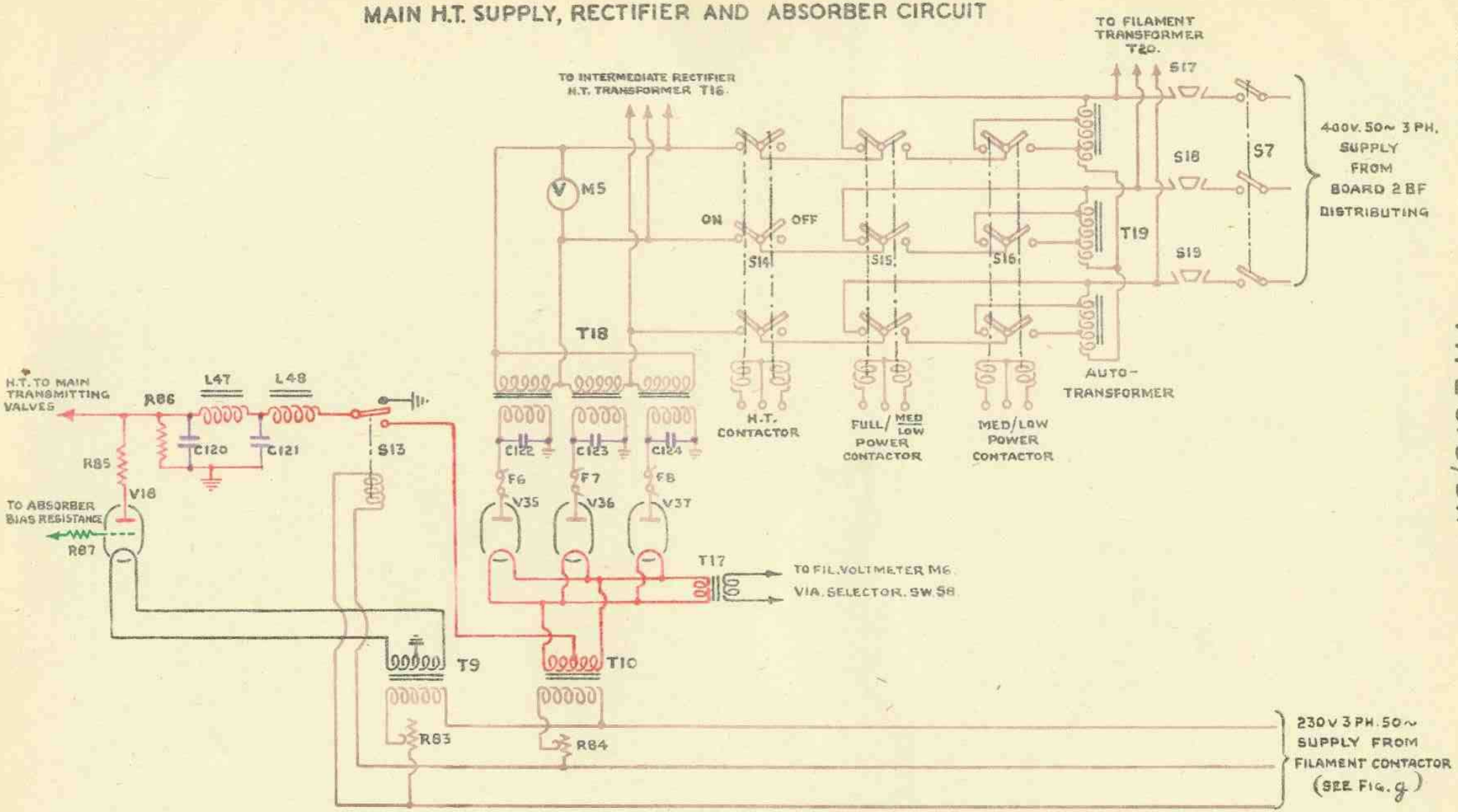

FIG. f.

(e) Output Amplifier. (Fig. e).

The output stage consists of a push-pull amplifier using two NT63 pentode valves (V16, V17). The tuned aerial circuit is mutually inductive coupled to the output circuit by a variable coupling coil (L32).

The H.T. supply is obtained from the Main H.T. Rectifier and is supplied via the anode current meter (M3) to a centre tap on the tuning inductance (L31). The inductance of the coil can be varied by six plug-in strips. By means of links, the turns of the coil can be connected in a series - parallel arrangement, depending upon the frequency being used. Calibration curves are supplied in the Handbook for Type 57D, showing the frequency covered by each of the coil strips.

The output coil (L31) is tuned by the condenser (C100), this being controlled by a tuning dial (D6).

The screen grid voltage is supplied by the intermediate H.T. rectifier via the voltage dropping resistances (R72, R73). The R/F by-pass condensers (C104, C105), maintain the grids at a constant potential with respect to R/F.

The suppressor grids are connected to earth.

Resistances (R70, R71), are the grid leaks for valves (V16, V17), the junction of the resistances being connected to earth.

The filaments are supplied with A.C. from the Output Stage Filament Transformer (T8). Filament supply leads are decoupled by the R/F by-pass condensers (C106, C107).

Automatic grid bias is provided by the resistance (R74) connected to the centre tap of the filament transformer (T8). The supply to the primary winding of the filament transformer (T8), is provided from the Filament Contactor (S20). (See Fig. g).

The Aerial Coupling Coil (L32) is controlled by the Coupling Control (D4). The coil is pivoted so that it can be moved nearer to, or further away from, the axis of the Output Coil (L31). The Coupling Coil (L32) is fitted with an arrangement which allows the turns of the coil to be connected, by means of two clip connectors, in series or in parallel. By this arrangement, a very wide range of aerials can be suitably coupled, and the transmitter correctly loaded throughout the frequency range covered by the transmitter.

The aerial circuit is tuned by a double tapped tuning inductance (L33, L34) and the aerial tuning condensers (C101, C102). The double tapped coil allowed a dipole aerial to be accommodated, but for ship use, the unipole aerial system is most used. A four position switch (S10) forms the aerial rough tuning control and short circuits an equal amount of inductance, either side of the mid-point. The tuning capacity is controlled by the tuning dial (D5).

A series - parallel switch (S9) allows the tuning capacity to be placed in series or parallel with the aerial inductance (L33, L34) and coupling coil (L32) and thus enables the aerial system to be current or voltage fed.

Aerial ammeters (M7, M8) are provided as indicators of current in the aerial. Two were originally fitted to indicate the aerial and balancer current in a dipole aerial system, but this system is not generally in use afloat.

(f) Power Supplies.

General.

All power supplies are obtained from the Central W/T Power Supply System, which consists of a 3 phase, 400 volt, 50 cycle supply. The supply is selected from any one of three 60 KVA motor alternators by a selector switch on the Power Supply Board, fitted in the Transmitter Room, and is connected to the transmitter by a fuse switch fitted in the Distribution Board.

(1) Main H.T. Supply. (See Fig. f).

The power supply is completed to the transmitter by making the Main Supply Switch (S7) and closing the cage door, thus completing Cage Door Contacts (S17, S18, S19). Power is then supplied, to the auto-transformer (T19), the Filament Supply Transformer (T20) and the C.W.S. transformer (T21). (See Fig. g).

The Auto-Transformer has two tappings on each of the windings, and, by means of Power Contactors (S15, S16), three voltages can be selected from the supply, to feed the main and intermediate H.T. Transformers (T18, T16). The voltages selected are 400, 200 and 100 volts corresponding to Full Power, Normal or Medium Power and Low Power.

The 230 volt A.C. supply to the bobbins of the Power Contactors (S15, S16) is provided by the C.W.S. Transformer (T21) and is controlled by the Power Relays in the Selector Unit operated by the dialling system. (See Page DN2).

The H.T. Contactor (S14) completes the selected supply voltage to the Main and Intermediate H.T. Transformers (T18, T16). The 230 volt A.C. supply to the bobbin circuit is normally completed by the "Set on" Power relay, which is operated by switching the control switch in a W/T unit, to the "on" position. The supply may be also completed by the Emergency Hand Switch, Tune - Test Switch, or when the transmitter is being operated in DIRECT CONTROL by the Power Control Switch. (See Pages DN5 and DA20).

The voltmeter (M5) indicates the voltage, selected by the Power Contactors (S15, S16) and applied to the Main and Intermediate H.T. transformers (T18, T16).

The primary winding of transformer (T18) is connected in delta and the secondary in star with the neutral point earthed. Each of the three secondary windings is connected to the anode of a NU26 rectifier valve (V35, V36, V37). The resultant H.T. rectified supply is developed between the filaments of the three rectifying valves and the earthed neutral point. R/F by-pass condensers (C122, C123, C124) are connected between the anodes of each of the valves and earth, to protect the windings of the transformer (T18).

The filament supply is obtained via the Filament Supply Transformer (T20) and the Filament Contactor (S20). (See Fig. g). The bobbin circuit of this contactor is operated in parallel with the H.T. Contactor (S14).

A preset resistance (R84) controls the primary voltage of the Filament Transformer (T10). The filament voltage applied to the rectifier valves may be read on a common filament voltmeter (M6). The H.T. potential on the filaments of the rectifying valves is isolated from the voltmeter (M6) by the transformer (T17).

The H.T. supply is taken from the centre tap on the filament transformer (T10) to the H.T. Smoothing Condenser, Discharge Switch (S13). The bobbin circuit of switch (S13) is operated by the filament supply voltage. When the filament supply is completed, the short circuit across the smoothing condensers (C120, C121), is removed and the H.T. supply connected to the smoothing circuit. Opening the Cage Door breaks the filament supply, the bobbin circuit of switch (S13) is de-energised and the smoothing condensers (C120, C121), are short circuited through earth and are discharged.

The H.T. smoothing consists of two stages of choke-capacity filter (L48, C121, L47, C120), and a loading resistance (R86) which has the effect of stabilising the load on the rectifying system.

To maintain a constant load on the rectifier supply, when keying, an absorber valve (V18) is used. The main absorber valve (V18) is a NT54 and, together with the Main absorber resistance (R85), is connected in parallel with the H.T. supply to the main transmitting valves (V16, V17). By suitable grid bias arrangements, operated by the keying circuit, the valve (V18) passes current during the "Spacing" intervals when keying, and is closed down when the key is to "Mark". The value of the absorber resistance (R85) is such, that the power absorbed in the spacing condition, approximates that taken by the transmitter when radiating, and thus the loading conditions and H.T. voltage remain practically constant.

The grid resistance (R87) is used to apply a negative potential to the control grid when the valve (V18) is passing current.

The absorber filament transformer (T9) is supplied in parallel with the rectifier filament transformer (T10), but is connected to another phase in order to balance the loading of the supply phases. The centre point of the filament of the absorber is held at earth potential by the earthed centre tap on the transformer (T9). The preset resistance (R83) allows the small changes of filament voltage, between different valves of the same type, to be accommodated.

The C.W.S. transformer (T21) is connected to the supply side of the gate contacts (S17, S18, S19). (See Fig. g). It is a step down transformer and is used to provide a 230 volt A.C. supply to the Control Circuit Rectifier Transformer (T22), Selector Unit Rectifier Transformer (T23), Power Relay contacts, in the Selector Unit, Trunk Sealing Switch Indicating Lamps, bobbin circuit of the Aerial Isolating Switch, and the Direct Control Indicating lamps.

The Control Circuit Rectifier Transformer (T22) supplies a metal rectifier (W9) which has two separate output terminals.

(i) Provides 75 volts, smoothed by the choke-capacity filter circuit (L49, C125) to operate the bobbin circuit of the keying relay (S12).
(ii) Supplies 75 volts, unsmoothed, which is used to operate the relays in the Selector Unit.

A common negative is used for the two supply voltages. (See Page DM4).

The Selector Unit Rectifier Transformer (T23) output is rectified by the metal rectifier (W10) and provides 230 volts D.C. to operate the neon indicating lamps at the W/T Units and Central Control Exchange. (See Page DA7, para. 15, and Page DN8).

The 230 volts A.C., supplied to the Power Relay contacts, is the operating voltage for the bobbin circuits of the Power Contactors. (See Page DN5).

By auxiliary contacts fitted in the Trunk Sealing Switch, the 230 volt A.C. supply is switched to one of two indicating lamps. Red and Green shades are fitted over the lamps which, when alight, indicate the trunk is "sealed" or "open" respectively.

The supply to the bobbin circuit of the Aerial Isolating Switch is controlled by an auxiliary contact on the Cage Door. When the door is closed, the bobbin is energised and the aerial is connected to the transmitter. Opening the Cage Door interrupts the bobbin circuit supply. The Isolating Switch returns to its rest position, isolating the aerial from the transmitter, and connecting the aerial to earth.

The Direct Control indicating lamps are controlled by the Key change-over switch fitted on the Direct W/T Control Board situated in the R.C.O. (See Page DA20, DA21).

TYPE 57D/DR

RC19

FILAMENT CIRCUITS

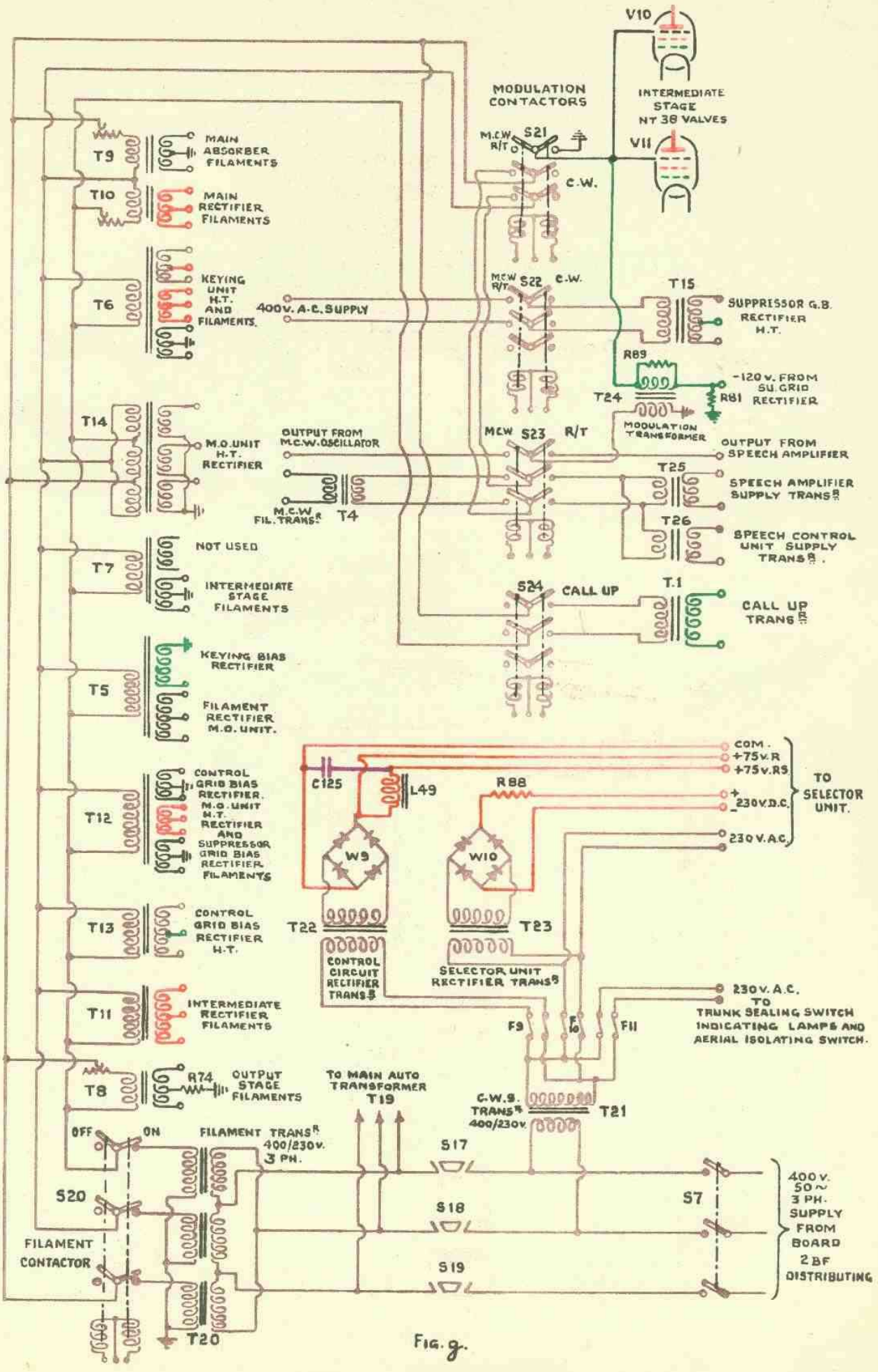

Fig. 9.

TYPE 57 D/DR

SUBSIDIARY RECTIFIER CIRCUITS

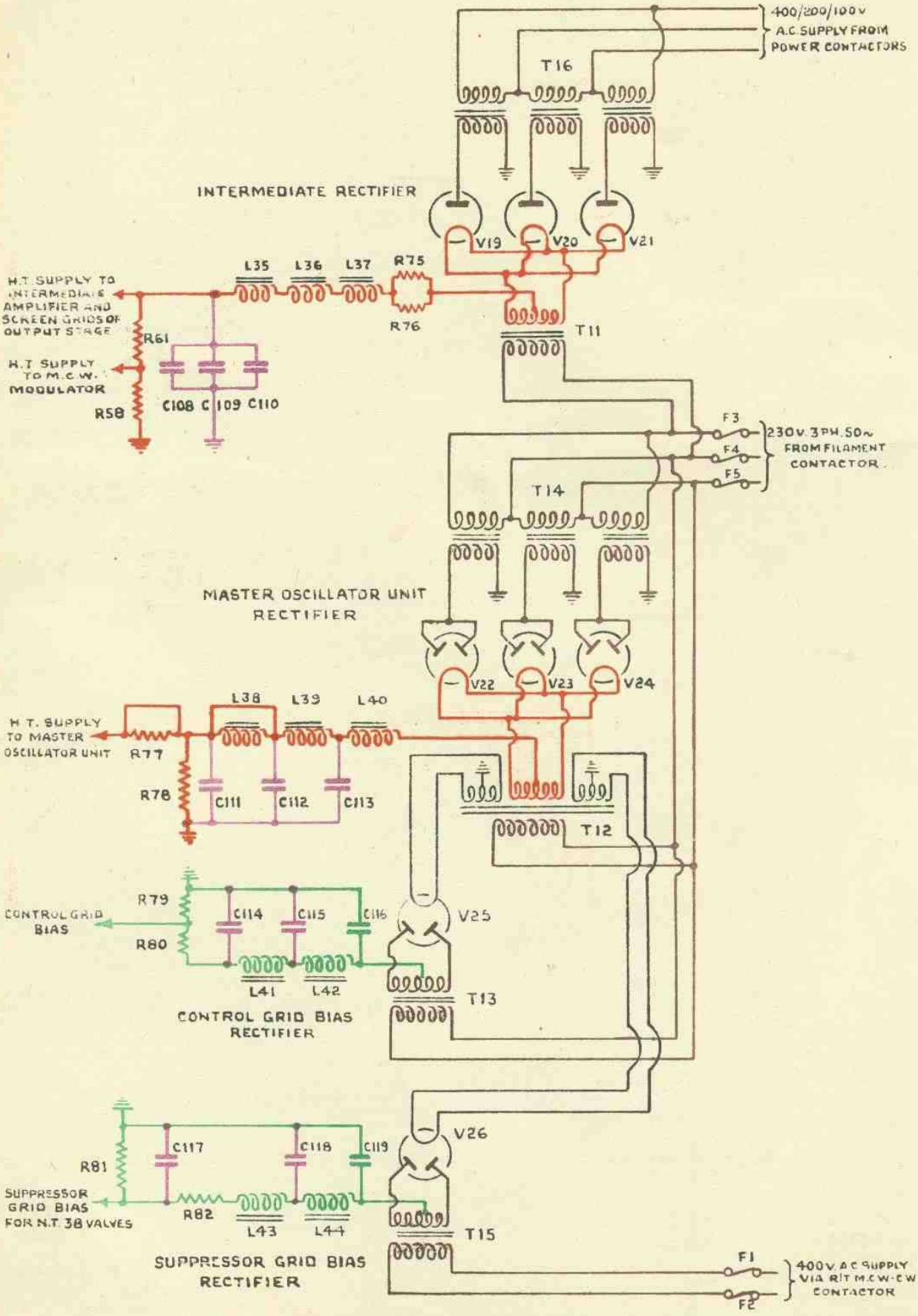

FIG. 4.

(g) Filament Supply. (Fig. g).

The Filament Supply Transformer (T20) reduces the supply voltage from 400 volts to 230 volts 3-phase. The Filament Contactor (S20) controls the supply from transformer (T20) to the various transformer primary windings, the bobbin circuit of contactor (S20) is supplied and controlled in parallel with the H.T. contactor (S14).

The supply to the transformer primary windings is divided between the three phases in order to obtain a balanced load.

The various transformers are described in conjunction with the circuits in which they are used.

The Filament Contactor (S20) also controls the supply via the modulation contactors (S21, S23, S24) to the M.C.W. oscillator filament transformer (T4), speech amplifier transformer (T25), speech control unit transformer (T26) and the "call up" transformer (T1). The modulation contactor (S22) controls a 400 volt A.C. supply to the suppressor grid bias H.T. transformer (T15).

The bobbin circuits of the modulation contactors are operated by 230 volts A.C. and are normally controlled by the dialling system, but they may be set by hand, and locked in the desired position by a plug and socket arrangement.

The Modulation Contactors complete the following duties to arrange the different modes of transmission :-

TYPE OF TRANSMISSION.	MODULATION CONTACTOR.	OPERATION.
C.W.	S21	Earths suppressor grids of Intermediate Amplifier valves (V10, V11).
	S22	Disconnects supply to Suppressor grid bias rectifier H.T. transformer (T15).
M.C.W.	S21	Removes earth connection from suppressor grids of valves (V10, V11). Completes 230 volt A.C. supply to contactor (S23).
	S23	Supplies M.C.W. oscillator filament transformer (T4). Connects output from M.C.W. oscillator to primary of Modulation Transformer (T24).
	S22	Completes 400 volt A.C. supply to suppressor grid bias rectifier H.T. transformer (T15) thus providing suppressor grid bias of 120 volts negative via secondary of Modulation Transformer (T24) to valves V10, V11.
R/T	S21	As for M.C.W.
	S23	Supplies Speech Amplifier Supply transformer (T25) and Speech Control Unit Supply transformer (T26). Connects output from Speech Amplifier to primary of Modulation Transformer (T24).
	S22	As for M.C.W.
CALL UP.	S21	As for C.W.
	S22	As for C.W.
	S23	As 230 volt supply is broken by contactor (S21) the position of contactor (S23) is of no importance.
	S24	Completes supply to CALL UP transformer (T1).

(h) Subsidiary Rectifier Circuits. (Fig. h).

(i) Intermediate H.T. Rectifier.

The supply voltage to the Intermediate rectifier H.T. transformer (T16) is selected by the power contactors (S15, S16) from the auto-transformer (T19) and may be of 400, 200, or 100 volts, as for the Main H.T. transformer (T18). The H.T. contactor controls the supply to the transformer (T16), the primary winding being connected in delta and the secondary winding star with the neutral point earthed. Three NU13A rectifying valves (V19, V20, V21) are used, one secondary winding being connected to the anode of each valve.

The Intermediate rectifier filament transformer (T11) is supplied with 230 volts which is controlled by the filament contactor (S20). (See Fig. g).

The rectified H.T. output is taken from the centre tap of the filament secondary winding to a limiting device consisting of two resistances (R75, R76) in parallel. The smoothing circuit consists of a choke-capacity filter (L35, L36, L37, C108, C109, C110) and a loading resistance (R61, R58).

A tap from the junction of resistances (R61, R58) is used to supply the H.T. voltage for the M.C.W. oscillator valve (V15).

The Intermediate rectifier supplies both screen grid and anode voltage for the Intermediate Amplifier stage and also the screen grid voltage for the Output stage valves (V16, V17).

(ii) Master Oscillator Unit H.T. Rectifier. (Fig. h).

The Master Oscillator Rectifier H.T. transformer (T14) and the Master Oscillator Rectifier filament transformer (T12) are both supplied and controlled by the Filament Contactor (S20). (See Fig. g).

The H.T. transformer (T14) is delta-star connected, the secondary windings being connected to the anodes of three NU3 valves (V22, V23, V24). The NU3 valve is a full wave rectifying valve, but the two anodes are strapped together at the valve base.

The filament transformer (T12) has three secondary windings, only one of which is associated with the Master Oscillator H.T. rectifier. The filaments of valves (V22, V23, V24), are supplied in parallel and the H.T. supply is taken from a centre tap on the filament winding. The smoothing circuit consists of two stages of choke-capacity filter (L40, C113, L39, C111, C112), and resistance (R78) is used as a stabilising resistance and also discharges the smoothing condensers when power is switched off.

The original smoothing circuit consisted of three stages of choke-capacity filter (L40, C113, L39, C112, L38, C111), together with the limiting resistance (R77) but, as the existing unit requires more current than the original Master Oscillator, resistance (R77) and choke (L38) are short circuited.

(iii) Control Grid Bias Rectifier. (Fig. h).

The Control Grid Bias Rectifier H.T. transformer (T13) is supplied from a single phase, at 230 volts, controlled by the Filament Contactor (S20). (See Fig. g).

The filament of the NU3 rectifying valve (V25) is heated by the second winding of the Master Oscillator Rectifier Filament transformer (T12), the centre point being earthed.

The negative potential is taken from a centre tap on the H.T. transformer (T13) and smoothed by a reservoir condenser (C116) and two stages of choke-capacity filter (L42, C115, L41, C114). Voltage stabilising resistances (R79, R80), are connected in parallel with the smoothing condensers (C114, C115) and the bias voltage is taken from the junction of the two resistances (R79, R80). The bias voltage is of the order of 75 volts, but this is reduced to the required value by potentiometers, associated with the stage being supplied.

(iv) Suppressor Grid Bias Rectifier. (Fig. h).

The filament of the NU3 rectifying valve (V26) is heated by the third winding of the Master Oscillator Rectifier Filament transformer (T12), the centre tap is earthed.

The Suppressor Grid Bias Rectifier H.T. transformer (T15), is supplied with 400 volts A.C. by the Modulation Contactor (S22) when in the $\frac{M.C.W.}{R/T}$ position. The negative potential is taken from a centre tap on the secondary winding of $\frac{R/T}{}$ transformer (T15) and smoothed by the reservoir condenser (C119), one stage of choke-capacity filter (L44, C118) and one stage of choke-resistance-capacity filter (L43, R82, C117). Stabilising resistance (R81) is connected in parallel with the bias supply, which is connected to the suppressor grids of valves (V10, V11) via the secondary winding of the Modulation Transformer (T24). (See Fig. g).

The Suppressor Grid Bias, approximately 120 volts negative, is thus applied to valves (~~S21, S22~~) (V10, V11) when the Modulation Contacts (S21, S22) are placed in the $\frac{M.C.W.}{R/T}$ position.

The 230 volt 3-phase supply to transformers T11, T14, T12 and T13 is supplied via fuses F3, F4 and F5 and the 400 volt supply to transformer (T15) via fuses F1 and F2.

(1) Keying and Absorber Circuit. (Fig. 1).

The transmitter is controlled by grid signalling and two absorber valves are used to stabilise the voltage supplied by the Main Rectifier and the Master Oscillator Unit Rectifier. (See Admiralty Handbook of W/T (1938) Vol. II, Sec. K, Para. 59).

A keying bias of 160 volts negative is obtained from transformer (T5), supplied with 230 volts A.C. via the Filament Contactor (S20). (See Fig. g). The transformer (T5) has two secondary windings. The output of the first winding is rectified by the half wave metal rectifier (W4) and provides the keying bias. Condenser (C86) is a reservoir condenser and resistance (R48) stabilises the rectified voltage.

The rectifier is connected via resistance (R47) to the keying relay (S12) and to the grid of the Absorber Driver valve (V12), the grid of valve (V1), the suppressor grid of valve (V2) and the control grids of valves (V4, V5). The resistance (R47) provides a load for the rectifier when the keying relay is in the MARK position and prevents a direct short circuit of the bias supply.

The output of the second winding of transformer (T5) is rectified by metal rectifiers (W5, W6), connected to operate as a full wave rectifier, and provides the filament supply for valves V1, V2, V3, V4, V5, V6, V7, V8, V9 and V13. The output voltage is smoothed by the reservoir condenser (C88) and a single stage of choke-capacity filter (L32, C89). The centre point of the stabilising resistances (R53, R54, R55, R56) is at earth potential.

The grid bias voltage for operating the absorber valves (V13, V18), is obtained from the Absorber Bias Rectifier (V14). The transformer (T6) is supplied from the Filament Contactor (S20), and has three secondary windings. Two of the windings provide the filament and H.T. voltage for the NU12 rectifier valve (V14). The third winding is the filament supply to the NR47 valve (V12) used to control the grid bias for the absorber valves (V13, V18).

The rectified H.T. output is taken from the filament winding centre tap to the anode of the Absorber Driver valve (V12), and the centre point of the H.T. winding is connected to earth via the bias resistances (R49, R50). A reservoir condenser (C87) is connected across the rectified supply.

The filaments of valves V12, V13 and V18 are shown in the simplified diagram Fig. 1 as being directly earthed. This has been done in order that the keying operation may be followed more easily. The filaments are earthed by the centre tap on the filament winding as shown on transformers (T6, T9) and the earthed centre point of the filament rectifier.

Keying Operation.

Spacing.

With the keying relay (S12) in the "space" position, a keying bias of 160 volts negative is applied to the grid of the Absorber Driver valve (V12), the grid of the V.F.O. valve (V1), the suppressor grid of the Buffer Stage valve (V2) and the control grids of the Mixer Stage valves (V4, V5).

The negative potential is sufficient to close down the respective stages.

The grid of the Absorber Driver valve (V12)is biassed back beyond cut off. With no current flowing across valve (V12), the potential across resistances (R49, R50) will be zero as these resistances are in series with the valve (V12). The grid and filament of both Master Oscillator Unit Absorber valve (V13) and Main Absorber valve (V18) will thus be at the same potential, and current will flow across the absorber valves and through their associated absorber resistances.

The voltage applied to the screen grids of valves (V10, V11) is supplied via the Master Oscillator Unit absorber resistances (R51, R52). As the absorber valve (V13) passes current, there will be a voltage drop across the absorber resistances (R51, R52), and the voltage applied to the screen grids of valves V10, V11 is reduced. This reduces the anode current passing across valves (V10, V11) to a safe value in the spacing condition.

Marking.

The Keying relay (S12) short circuits the keying bias rectifier, through the resistance (R47), and earth.

The control grids of valves V1, V4, V5 are connected by the keying relay (S12), and earth, to their own respective filaments, current flows across the valves and the stages are excited. The suppressor grid of valve (V2) is connected to earth by the same operation of the keying relay (S12) allowing current to flow through the valve (V2) and the Buffer Stage to become operative.

The current flowing across the Absorber Drive valve (V12) also passes through the resistances (R49, R50). A negative potential is developed across resistance (R50), which is joined between grid and filament of the M.O. unit absorber valve (V13) and is of sufficient value to close this valve down.

The negative potential developed across the two resistances (R49, R50) is applied to the grid of the Main absorber valve (V18) via resistance (R87), and will close the valve down.

When the M.O. unit absorber valve is closed down, the current passing through the absorber resistances (R51, R52) will be reduced considerably. The voltage dropped by the two resistances will be less and the screen grids of valves (V10, V11) obtain their normal supply voltage.

The resistance (R87) is used to apply a negative bias on the grid of the Main Absorber valve (V18) when the valve is operative in the "Spacing" condition.

(j) R/T Amplifier and Speech Control Unit. (Fig. k).

The R/T Amplifier consists of the Input and Intermediate amplifiers used in the Type 405 Wa/T set. Four stages of amplification are provided and arrangements are made for tone correction and delayed automatic gain control. The Power Unit, which is part of the Intermediate Amplifier, provides H.T. and heater supplies for the two amplifiers.

The three microphone supply cables, Port, Starboard and Local, are permanently connected to the input transformer (T27) via the protecting resistances (R116, R117, R118, R119, R120, R121). (See Page DA 16, para. 41, and Page DA 11, Fig. DA4).

A resistance (R115) is connected across the common microphone supply and reduces the variation in the impedance, at the end of the microphone lines, when two or more microphones are switched into circuit in parallel. The resistance is centre-tapped to earth, to preserve stability and minimise extraneous noise.

A detailed explanation of the first two stages, including voice operated A.G.C. and tone correction circuits is given in the Handbook of W/T (1938) Vol. II, Section N, para. 40, 42, 43 and 44.

The output of the second stage is connected to the Local Input Jack (J14) which may be used for modulating the transmitter, from a local source, in case of a failure of the Input Amplifier.

The manual volume control (R122) provides a means for adjusting the overall gain of the amplifiers. The slider of the control can be set by a screw-driver adjustment, to select the amplitude of the A/F voltage applied to the grid of the valve (V29).

A positive potential, provided by the H.T. potentiometer (R26, R27), is applied to the cathode of valve V29 and is normally used for muting the amplifiers when not actually in use. When the switch (S33) is completed, the lower end of the cathode bias resistance (R125) is connected to earth, the muting bias is removed and valve (V29) becomes operative, with the normal bias developed across the cathode resistance (R125).

When used with Transmitter Type 57DR, the muting switch (S33) is kept permanently closed, and the operation of the amplifiers is controlled by the modulation contactor (S23) which completes the 230 volt A.C. supply to the primary winding of the supply transformer (T25).

As indirectly heated valves are used in the amplifiers, an interval of approximately thirty seconds is required after the power supplies are completed, before the cathodes have reached their operating temperature and the amplifier can be used.

To prevent unnecessary delay, and to provide an indication to the operator requiring to use the R/T amplifier, an indicator circuit is used in conjunction with the Selector Unit. The indicator circuit is operated by lines called "P" and "Q" and, when these two lines are completed, a relay in the selector unit causes the neon indicator lamp on the W/T unit to flash. To complete "P" and "Q" lines, two relays are used. Relay (S30) is operated from the A.C. supply mains in parallel with the supply transformer (T25). The metal rectifier (W11) is used to rectify the A.C. supply as the bobbin circuit is D.C. operated. The "P" and "Q" circuit is thus completed as soon as the supply voltage is completed to the power transformer (T25) by the R/T modulation contactor (S23), and the neon lamp will start flashing. The supply is also completed to the transformer (T26) which supplies the delay relay (S29) and valve (V34). The bobbin circuit of the relay (S29) is in series with the indirectly heated valve (V34). Current cannot pass through th bobbin of the relay (S29) until the cathode of the valve has reached its working temperature. When valve (V34) passes current, the delay relay (S29) is operated and opens the "P" and "Q" circuit, thus restoring the indicator circuit to normal and stops the neon lamp flashing. The time taken for the valve (V34) to reach its working temperature will be the same as that required for the indirectly heated valves in the amplifier, thus when the neon lamp ceases to flash, it indicates the amplifier is ready for use. (See Page DN 7, para. 5).

The output of the R/T amplifier is choke-capacity coupled to four contactors (S25, S26, S27, S28), the bobbin circuits of which are operated in conjunction with the power contactors (S15, S16). By using two potentiometers (R130, R131, and R132, R133), the output of the amplifier can be varied in conjunction with the power tapping being used for the transmitter and thus the depth of modulation maintained, within practical limits, irrespective of the power output of the carrier frequency. (See Handbook of W/T (1938). Vol. II, Section N, para. 14).

TYPE 57D/DR

KEYING AND ABSORBER CIRCUIT
SIMPLIFIED DIAGRAM

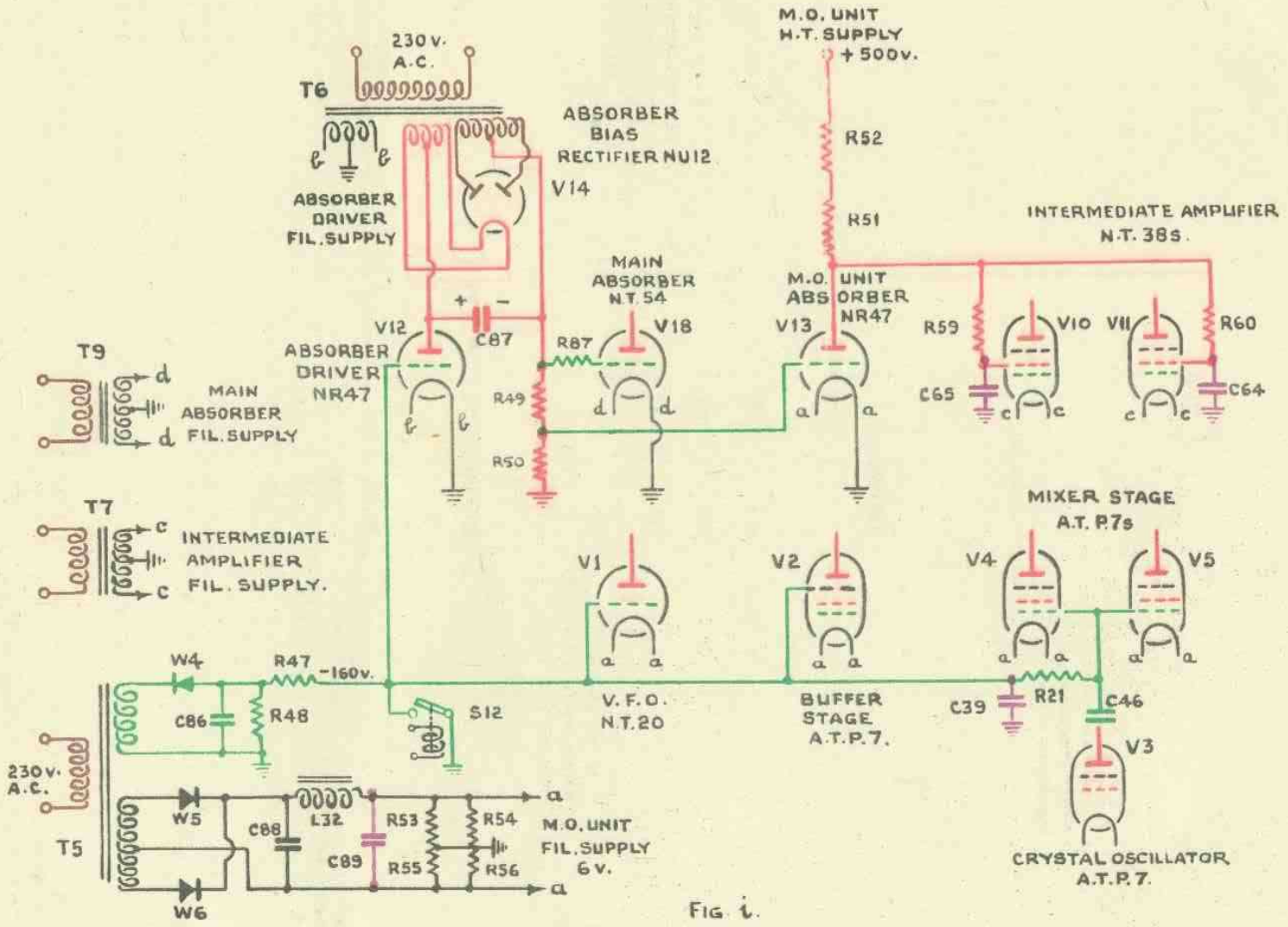

Fig. 1.

TYPE 57D/DR

(k) M.C.W. Oscillator. (Fig. j).

The M.C.W. oscillator consists of a Hartley circuit using an MT20 directly heated triode valve (V15). (See Handbook of W/T (1938), Vol. II, Section K, para. 7).

The H.T. supply voltage is obtained from the Intermediate H.T. Rectifier and is reduced to a suitable value by the potentiometer consisting of resistances (R61, R58).

The inductance of one winding of transformer (T3) is tuned to approximately 1000 c/s by the two fixed condensers (C80, C81). The frequency of modulation may be varied by altering the air gap of the transformer (T3) and thus varying the inductance of the tuned circuit. Condenser (C82) is the grid condenser and grid bias is provided by the grid resistance (R46).

Transformer (T4) supplies the filament of valve (V15) with A.C., the supply being completed from the M.C.W. modulation contactor (S23).

The output of the oscillator is taken from the secondary winding of the transformer (T3) via the modulation contactor (S23) to the primary winding of the modulation transformer (T24) and thon to earth, the circuit being completed by the earth connection on transformer (T3).

The oscillator is not keyed, and when switched on, will maintain a continuous audio frequency note that can be heard at the transmitter. The frequency of the note varies slightly as the transmitter is keyed, due to the inductance of transformer (T3) altering as the load on the transformer (T5) varies during keying, but this variation of note frequency is not perceptible in the modulated output frequency of the transmitter.

M.C.W. OSCILLATOR

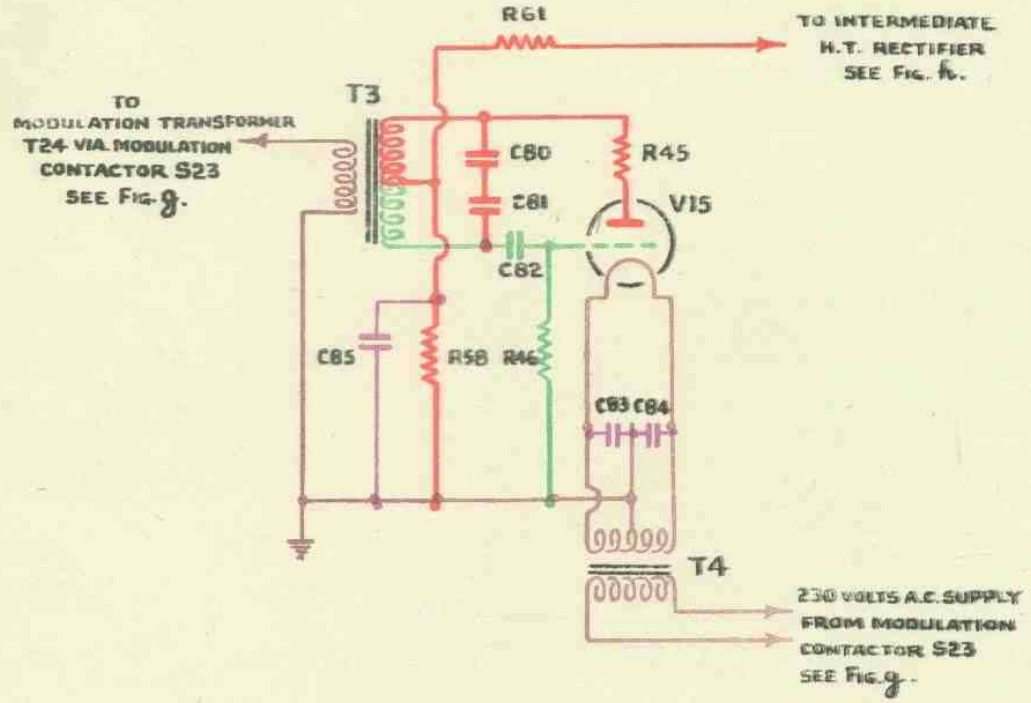

Fig. j.

RC27

TYPE 57D/DR

R/T AMPLIFIER AND SPEECH CONTROL UNIT
SIMPLIFIED DIAGRAM

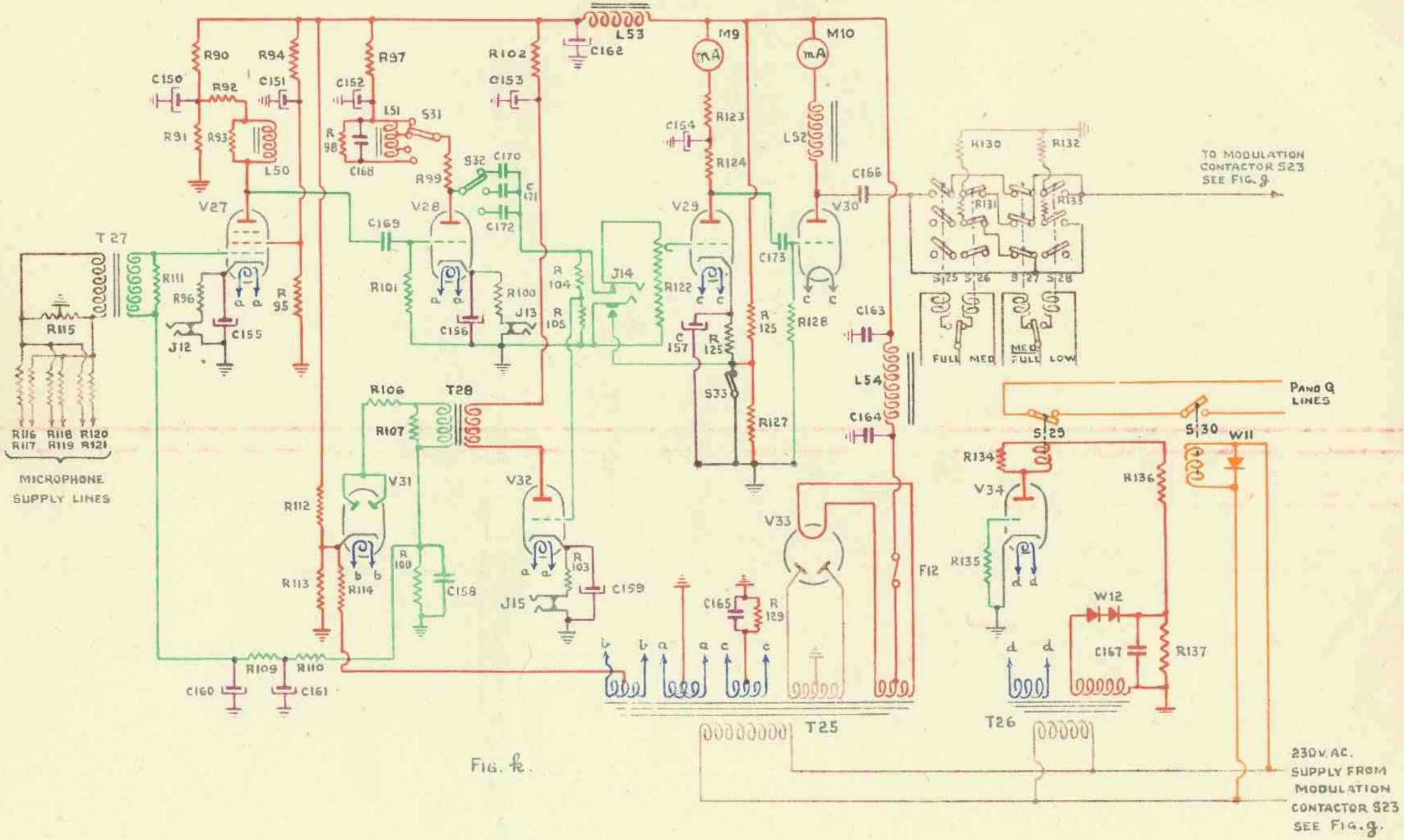

FIG. 4.