TYPES TBM & TBK
TRANSMITTER UNIT

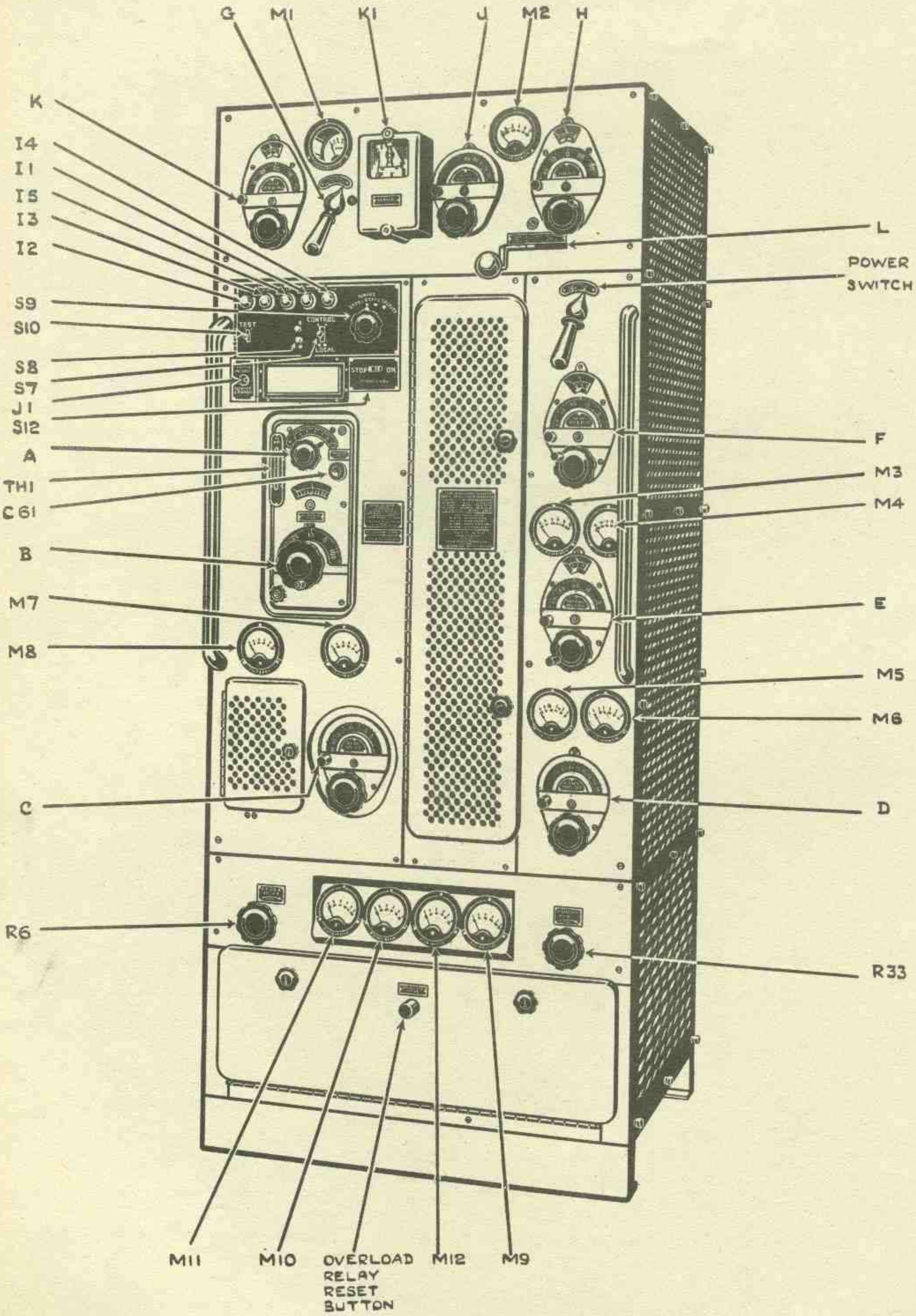

FIG. a

TYPES TBM & TBK

1. GENERAL DETAILS.

Transmitters TBM and TBK are American designed sets, the only difference between the two sets being that TBM is supplied with a Modulator Unit for M.C.W. and R/T transmissions, whereas TBK is not, and can therefore only be used for C.W. transmissions.

Frequency Range	2,000 - 18,100 Kc/s.
Type of Transmission	TBM. C.W. M.C.W. and R/T. TBK. C.W.
Power Output (Maximum)	C.W. 500 watts M.C.W. 350 watts) TBM only. R/T 350 watts)
	Both sets can operate with a reduced output power of 75 watts over the frequency band of 2,000 - 9,050 Kc/s, but, using C.W. only.
Power Supply	230 volts D.C. from Ship Mains to supply a Generator Unit having outputs of 3,000, 2,000 and 1,000 volts D.C. for Anode and Screen Grid supplies, 275 volts D.C. for Bias supplies and 160 volts 60 cycles A.C. for Filament heating.
Keying	The Keying Relay is capable of operation up to 100 words per minute for C.W. transmissions and up to 50 words per minute for M.C.W. transmissions.
Associated Wavemeters	Wavemeter Outfits GJ or GN.

2. CONSTRUCTION.

Transmitter TBK consists essentially of the following three units, their approximate dimensions have been appended to enable a rough appreciation of their size to be obtained.

(i)	Transmitter Unit.	Height 72 inches. Width 32 inches. Depth 24 inches.
(ii)	Motor Generator Unit.	Height 20 inches. Length 79 inches. Width 20 inches.
(iii)	Magnetic Controller.	Height 26½ inches. Width 17 inches. Depth 16 inches.

Transmitter TBM consists of the above three units with the addition of :-

(iv)	Modulator Unit.	Height 72 inch. Width 18 inches. Depth 24 inches.

3. TRANSMITTER UNIT.

Controls and Fittings.

The following list details the function of the various components fitted on the front panel of the Transmitter Unit, which is common to Transmitters TBM and TBK.

In order to simplify tuning procedure, certain controls of the transmitter panel are marked by a letter in addition to a name plate stating its function, these controls are tabulated in alphabetical sequence, the letter figure combination in brackets following the control letter, is the same as allocated to the components in the sketches depicted in the Handbooks.

Components not allocated a single letter are tabulated in an alphabetical numerical sequence to facilitate ready reference.

Reference should be made to Figure a when studying the following list :

TYPES TBM & TBK
MODULATOR UNIT

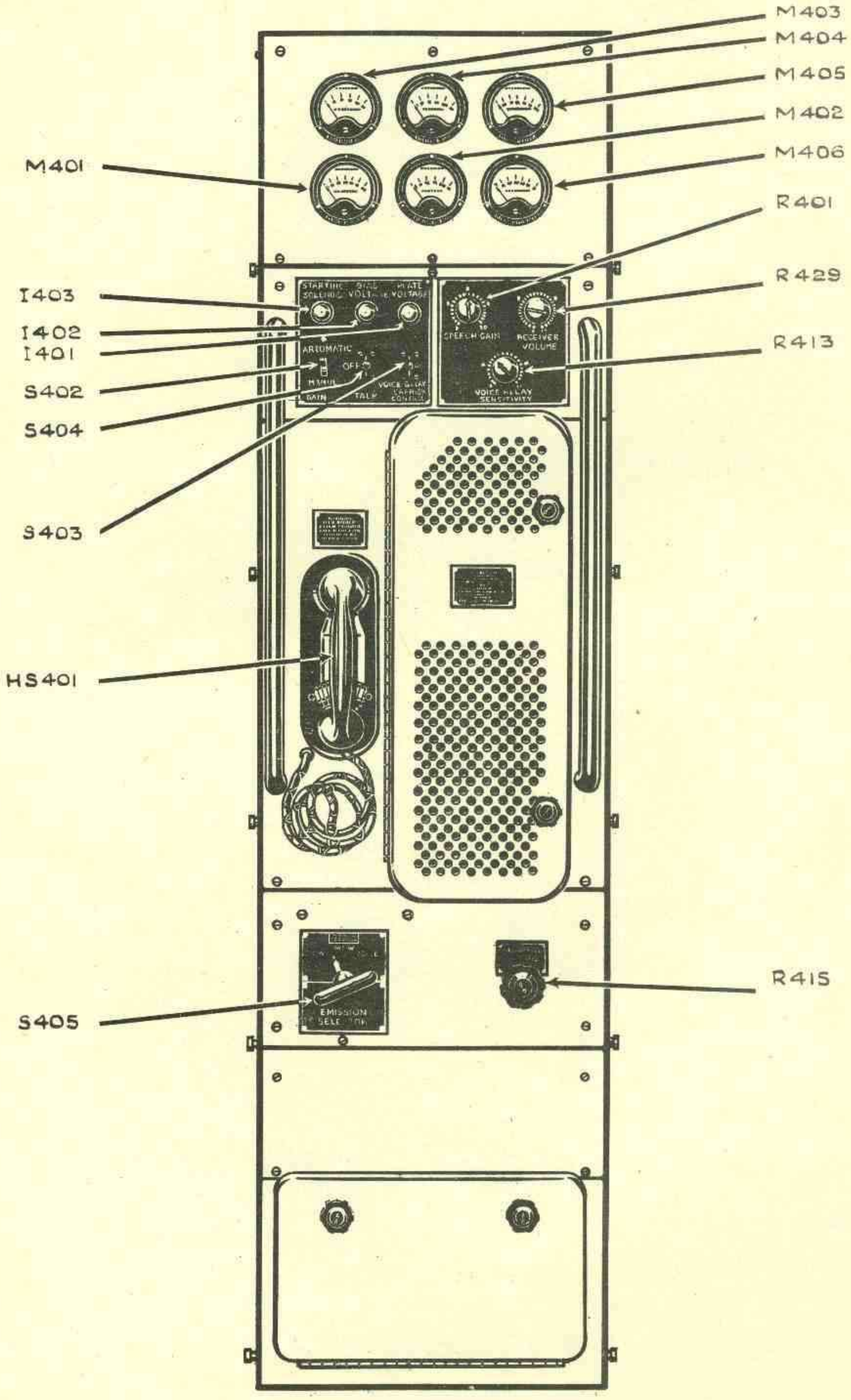

FIG. 6

Control "A" (S1) — Master Oscillator Range Switch. Two pole eight position switch to select the required combination of fixed condensers and taps on Master Oscillator Tuning Inductance to cover the frequency band desired.

Control "B" — Master Oscillator Tuning. Fine tuning of Master Oscillator tuned circuit by adjusting the position of a copper cylinder that moves laterally through the tuning inductance.

Control "C" (C14) — Doubler Circuit Tuning. Adjusts the variable condenser to tune the Doubler Circuit to twice the frequency set on the Master Oscillator tuned circuit.

Control "D" (C21) — 1st Intermediate Amplifier Tuning. Adjusts the variable condenser to tune the anode circuit of the 1st Intermediate Amplifier.

Control "E" (C29, 49) — 2nd Intermediate Amplifier Tuning. Adjusts the variable condenser and inductance to tune the anode circuit of the 2nd Intermediate Amplifier.

Control "F" (C39, L14) — Power Amplifier Tuning. Adjusts the variable condenser and inductance to tune the anode circuit of the Power Amplifier.

Control "G" (S6) — Antenna Feed. Two position switch marked "Current" and "Voltage" - connects the Aerial Tuning Inductance and Aerial Tuning Condenser in series or parallel respectively.

Control "H" (C41) — Antenna Coupling. Adjusts a variable condenser to control coupling between Power Amplifier and Aerial tuned circuits.

Control "J" (C42) — Antenna Tuning Capacitor. Adjusts a variable condenser, working in conjunction with the Antenna Tuning Inductance, to tune the Aerial circuit.

Control "K" (L13) — Antenna Tuning Inductance. Adjusts a variable inductance working in conjunction with the Antenna Tuning Capacitor, to tune the Aerial circuit.

Control "L" (S2A, S2B, S2C, S2D, S2E). — Frequency Range. Two positions 2,000 - 4,000 Kc/s and 4,000 - 18,100 Kc/s. Has following functions :

(1) Varies the basic Inductance - Capacity value of the tuned anode circuits of the 1st and 2nd Intermediate Amplifier Valves, this decides whether these stages function as "straight through" amplifiers or, as frequency doublers.
(2) Brings a fixed condenser in parallel with the power amplifier tuned circuit to cover the lower frequency band.
(3) Breaks the circuit to the Keying Relay when Control "L" is not making contact to either frequency band position.
(4) Brings an additional R/F choke into the Power Amplifier Grid Circuit to provide effective R/F impedance when working on the lower frequency band.

Indicating Lamps.

I1 (Green) — Bias Voltage. Connected across a portion of the Grid Bias Potentiometer, to give an indication when an output is being obtained from the Bias Generator.

I2. (Red) — Starting Solenoid. Indicates the circuit is complete through the bobbin of the Starting Contactor.

I3 (Red) — Plate Voltage. Indicates the circuit is complete through the bobbin of the Field Contactor.

I4 (Clear) — Master Oscillator Filament. Indicates voltage is being applied across the filament of the Master Oscillator Valve. Note, lamp is across filament and will still light if Master Oscillator Valve filament is fractured.

I5 (Amber) — Heater Circuit. In series with heater resistance in thermo-statically controlled compartment, therefore indicates when heater circuit is functioning.

Meters.

M1. Antenna Current. — Aerial current meter.

M2. Power Amplifier Plate Current. — Power Amplifier Valve anode current milliammeter.

M3. Power Amplifier Grid Current. — Power Amplifier Valve grid milliammeter.

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M4. 2nd Intermediate Amplifier Plate Current. — Anode Current milliammeter.

M5. 2nd Intermediate Amplifier Grid Current. — Grid current milliammeter.

M6. 1st Intermediate Amplifier Plate Current. — Anode current milliammeter.

M7. Master Oscillator Plate Current. — Anode current milliammeter.

M8. Master Oscillator Screen Grid Current. — Milliammeter.

M9. Power Amplifier Plate Voltage. — Voltmeter to indicate voltage being applied to anode of Power Amplifying Valve.

M10. Power Amplifier Valve Hours. — Meter with five dials marked, thousands, hundreds, tens, units and one tenth Units to indicate number of hours Power Amplifying Valve Filament has been alight.

M11. Filament Voltage. — Voltmeter indicating voltage being applied across the filaments of the 1st and 2nd Amplifying Valves.

M12. Bias Voltage. — Voltmeter connected across the output terminals of the Bias Generator.

Switches.

Power Switch (S3A, S3B, S3C, S4A, S4B, S5A, S5B, S5C). — Two positions "Low" and "High".
Low. Reduces the power output to 75 watts and can only be used for C.W. transmissions. The radio frequency fed to the aerial tuned circuit is taken from the tuned anode circuit of the 2nd Intermediate Amplifier, thus eliminating the Power Amplifier stage. All supplies to the Power Amplifier Valve are broken.
High. Connects in the Power Amplifier Valve for using the set in its normal condition to give a maximum power output of 500 watts.

Control Switch (S7). — Two positions "Remote" and "Local".
Remote. To operate the set from a position away from the transmitter panel. (Note. An operating position adjacent to the set comes under the heading of Remote).
Local. Enables the set to be operated by the Test Switch for testing or tuning the equipment.

Start Stop Switch (S8). — Press buttons to Start or Stop the Motor Generator Unit.

Tune Operate Switch (S9). — Three positions :
Step 1. Breaks the H.T. supplies to the 1st and 2nd Intermediate Amplifier and Power Amplifier Valves for tuning the Master Oscillator Unit.
Step 2. Applies reduced H.T. supplies to 1st and 2nd Intermediate Amplifiers and Power Amplifier Valves for tuning their associated circuits.
Operate. Applies full operating voltages to all stages for normal operation.

Test Switch (S10) — Completes the supply to the Keying Relay, thus causing the transmitter to oscillate, when the Control Switch (S7) is to Local. Used for testing and tuning purposes.

Emergency Switch (S12). — Two positions :. "Stop" and "On". When in the "Stop" position it breaks the 230 volts D.C. supply to the Transmitter Unit, thus stopping the Motor Generator Unit, and isolating all the control circuits.

The heater circuits for the thermostatically controlled compartment will also be broken, so, if the Emergency Switch is in its "Stop" position for any appreciable time, a period must be allowed for the temperature to again become stable, after the Emergency Switch has been remade.

MISCELLANEOUS

M.O. Calibration Condenser (C61). Used to adjust the M.O. tuned circuit to allow for small changes in dial calibration due to ageing of parts or changes in the characteristics of the M.O. valve.

Frequency Meter Audio Output Jack (J1). For plugging in Headphones when tuning the transmitter by the "Heterodyne Method".

Keying Relay (K1). Completes the necessary circuits to enable the transmitter to oscillate, controlled by Test Key (S10) or Morse Key in Remote Control position for W/T transmissions. For R/T transmissions Keying Relay is operated by either Press Button on Handset, Talk Switch, or action of Voice Relay when in Voice control of Carrier Wave.

Filament Rheostat (R6). For adjusting the Filament Voltage to the correct value as indicated by the Filament Voltmeter (M11).

High Voltage Rheostat (R33). Controls the current through the Shunt Field of the High Voltage Generator, to adjust the potential being applied to the anodes of the Intermediate and Power Amplifying Valves.

M.O. Temperature Controlled Compartment Thermometer (TH1). Indicates the temperature of the compartment which contains all frequency determining components of the Master Oscillator circuit.

4. MODULATOR UNIT (Fig. b).

Controls and Fittings.

The following list describes the functions of the various components, fitted on the front panel of the Modulator Unit, that forms a component part of Transmitter TBM.

Meters.

M401. Anode current Milliammeter for Input Amplifying Valves.

M402. Anode current Milliammeter for Inter-Stage Amplifying Valves.

M403)
M404) Anode current Milliammeters, one in each H.T. supply circuit to the two Output Amplifying Valves.

M405. Percentage Modulation Meter. Indicates the percentage modulation being applied to the carrier when transmitting R/T.

M406. Filament Voltmeter. Indicates the voltage being applied to the filaments of the Output Amplifier.

Indicating Lamps.

I401 (Red). Plate Voltage. Indicates the circuit is complete through the bobbin of the Field Contactor.

I402 (Green). Bias Voltage. Indicates the 275 volts supply is being applied to the Modulator Unit.

I403 (Red). Starting Solenoid. Indicates the circuit is complete through the bobbin of the Starting Contactor in the Transmitter Unit.

Switches.

S402. Automatic-Manual Switch. Manual position connects the grids of the Push Pull Input Amplifier to a fixed bias voltage. The Automatic position connects the grids to a Compressor-Limiter Valve, the action of which is dealt with in the technical section.

S403. Carrier Control Switch. Two positions, "Voice Relay" and "Off". "Voice Relay" position connects the Keying Relay, in the Transmitter Unit, to a Switch Valve that becomes operative when the microphone is spoken into, so that the Transmitter Unit oscillates only while the operator is actually speaking. The "Off" position connects the control of the Keying Relay to the operation of either the Press Button on the Handset, or, to the "Talk" Switch (S404).

S404. Talk Switch. Two positions "Talk" and "Off". "Talk" position makes the supply to the bobbin of the Keying Relay in the Transmitter Unit, thus causing the Transmitter to oscillate continuously, when the C.W.-M.C.W. Voice Switch (S405) is in its "Voice" position.

S405. C.W.-M.C.W.-Voice Switch. Arranges the R/F, A/F and Control Circuits in their particular connections for the three modes of emission.

HS401. Local Handset. Contains Microphone, Receiver Earpiece and Press Button. Used for Testing Purposes.

R401. Speech Gain. A resistance attenuator unit connected in the supply to the primary of the Input Amplifier to control the gain of the Modulator Unit.

R413. Voice Relay Sensitivity. Controls the sensitivity of the Voice Relay circuit so that the level of sound necessary to cause the transmitter to oscillate can be adjusted.

R415. Filament Voltage Rheostat. To adjust the filament voltage being applied to all valves in the Modulator Unit.

R429. Receiver Volume Attenuator. To adjust the volume of the Receiver Output being fed to the earpiece in the Local Handset.

5. OPERATION.

This section details all the necessary steps required to be taken to bring the transmitter to a ready to transmit condition. It is assumed that the set has previously been tuned by wavemeter and that tabulated adjustments are readily available.

(i) High Power C.W. Transmissions.

(a) Set the following controls to the adjustments given for the frequency required :

Control "A" M.O. Range Switch
Control "B" M.O. Tuning Inductance
Control "C" Doubler Circuit Tuning Inductance
Control "D" 1st Int. Amp. Tuning Condenser
Control "E" 2nd Int. Amp. Tuning Control
Control "F" Power Amplifier Tuning Control
Control "G" Antenna Feed Switch
Control "H" Antenna Coupling Condenser
Control "J" Antenna Tuning Condenser
Control "K" Antenna Tuning Inductance
Control "L" Frequency Range Switch

(b) Set the Remote-Local Switch to "Local".

(c) Set the Tune-Operate Switch to "Operate".

(d) Set the High-Low Power Switch to "High".

(e) Set the C.W.-M.C.W.-Voice Switch (TBM only) to "C.W.".

(f) Press the "Start" button of the Start-Stop Switch, the Motor Generator Unit should now start.

(g) Adjust the Filament Voltage Rheostat until the reading in the Plate Voltmeter reads 10 volts.

(h) Adjust the Plate Voltage Rheostat until the reading in the Plate Voltmeter agrees with that laid down for power output required.

(i) Set the Remote-Local Switch to the "Remote" position. The Motor Generator should now stop.

The set is now ready for operation by the operator in the remote position.

(ii) Low Power C.W. Transmissions.

Follow the above instructions for High Power Transmissions with the following difference :-

Set the High-Low Power Switch to "Low".

(iii) High Power M.C.W. Transmissions (TBM only).

(a) Adjust the tuning controls, tabulated under High Power C.W. Transmissions, paragraph (a), to the settings given. (Note: The setting of the Antenna Coupling Condenser, Control "H", should differ from that given for C.W. transmissions).

(b) Set the C.W.-M.C.W.-Voice Switch to "M.C.W.".

(c) Set the Remote-Local Switch to "Local".

(d) Set the Tune-Operate Switch to "Operate".

(e) Set the High-Low Power Switch to "High".

(f) Press the "Start" Button of the Start-Stop Switch, the Motor Generator Unit should now start.

(g) Adjust the Filament Voltage Rheostat, on both the Transmitter and Modulator Units, to obtain a reading of 10 volts in their respective Filament Voltmeters.

(h) Adjust the Plate Voltage Rheostat to give a reading of 2700 volts in the Plate Voltmeter. (Note : Power cannot be varied when transmitting M.C.W.)

(i) Set the Remote-Local Switch to "Remote", the Motor Generator Unit will now stop and the set is ready for control from the remote position.

(iv) High Power R/T Transmissions.

(a) Adjust the Transmitter Unit as laid down in paragraphs (a) to (h) inclusive, in M.C.W. operating instructions, except that for (b) read "Set the C.W.- M.C.W.- Voice Switch to "Voice"."

(b) Adjust the Speech Gain Attenuator, in the Modulator Unit, to the position tabulated commensurate with the power required.

(c) Place the Carrier Control Switch to "Voice Relay" or "OFF" as required.

(d) If "Voice" carrier control is being used, adjust the Voice Relay Sensitivity Attenuator to the setting laid down.

(e) Place the Automatic-Manual Switch to the position required.

(f) Place the Remote-Local Switch to "Remote", the Motor Generator Unit will stop and the set is now ready to control from the remote position.

6. TUNING.

(i) General.

The transmitter is designed for tuning by the "Heterodyne Method". To enable tuning to be readily achieved, with the operator standing in a convenient position in front of the set, a socket (J1) is fitted in the front panel of the transmitter into which headphones can be plugged. The connections to this socket should be connected to the output of the Heterodyne Detector Valve of Wavemeter G73. or, to the appropriate socket in Oscillator G35, depending on which Wavemeter Outfit is being employed. In this description it is assumed Wavemeter G73 is being used, the same tuning procedure will have to be observed if Wavemeter Outfit GJ is being employed, the only exception being that Oscillator G35, would first have to be set to the correct frequency in conjunction with Wavemeter G61.

A capacity coupling is taken from the grid of the 1st Intermediate Amplifier and fed to the R/F Input Socket on Wavemeter G73.

The R/F input is mixed with the R/F oscillations of the Oscillator Stage of the G73, and the "beat" is detected by the Heterodyne Detector Stage and passed on to the headphones being worn by the operator.

The majority of the tuned circuits in the transmitter are capable of being effectively tuned to the unwanted harmonics of the desired frequency. In order to eliminate the possibility of erroneously tuning to one of these incorrect harmonics, it is essential to refer to the calibration curves printed in the Handbook and, to apply the adjustments given, for the particular frequency desired, to all tuning controls before attempting to tune through finally to the wavemeter setting.

It should be borne in mind that, for efficient frequency stability, the oven should be held at a working temperature of 60°C.

To achieve this, the heater circuits are normally left on when the set is likely to be used, but, if starting from "cold", three hours should be allowed for them to become stable.

(ii) Transmitter Unit. High Power C.W.

(a) TBM. only. Place the C.W.- M.C.W. Voice Switch to its "C.W." position.

(b) Adjust Controls "A" to "F", tabulated in Operating Instructions, to the settings obtained by reference to the calibration curves in the Handbook.

(c) Set Control "H" to approximately zero dial reading.

(d) Set the High-Low Power Switch to "High".

(e) Set the Tune-Operate Switch to "Step 1".

(f) Set the Remote-Local Switch to "Local".

(g) Start the Motor Generator Unit by pressing the "Start" button.

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(h) Adjust the filament voltage to 10 volts by the Filament Voltage Rheostat.

(i) Switch on Wavemeter G73, set the appropriate frequency by setting the Range Switch and Variable Condenser in accordance with the readings given by the Wavemeter Calibration Book (see note under). Set the change over switch to "C.W. Het. Det". Set the carrier level to 120 microamps as shown by the meter.

NOTE. Frequency to be set on wavemeter. It must be clearly appreciated that the wavemeter is coupled to the grid of the 1st Intermediate Amplifying Valve, and, that the frequency at this point will be the output frequency of the Master Oscillator Unit, not the frequency of the Master Oscillator Tuned Circuit, and not necessarily the desired transmitter output frequency, as doubling takes place in the Master Oscillator Doubler Circuit and may also occur in later stages.

In order to ascertain the correct frequency to set on the wavemeter, reference must be made to the tuning curves for the Master Oscillator Tuned Circuit, in the Handbook. From this can be seen the actual output frequency of the Master Oscillator Unit.

Examples.

Desired Frequency.	Output frequency of M.O. Unit and frequency to which wavemeter should be adjusted.
3,200 Kc/s.	3,200 Kc/s.
6,400 Kc/s.	3,200 Kc/s.
12,800 Kc/s.	3,200 Kc/s.
16,400 Kc/s.	4,100 Kc/s.

(j) Press Test Switch and tune the Doubler Circuit, Control "C" for a maximum reading in the M.O. Plate Current Meter. This step is necessary in order to produce a reasonably strong "beat note" in the headphones. Adjust the M.O. Tuning Inductance, Control "B", and the Doubler Circuit, Control "C", in step, maintaining a maximum reading in the M.O. Plate Current Meter, until a "dead space" is obtained in the headphones.

(k) Place the Tune-Operate Switch to its "Step 2" position.

(l) Tune the M.O. Doubler Circuit, Control "C" for maximum reading in the 1st Intermediate Amplifier Plate Current Meter.

(m) Tune the 1st Intermediate Amplifier Tuning Condenser, Control "D", for a maximum reading in the 2nd Intermediate Amplifier Plate Current Meter.

(n) Tune the 2nd Intermediate Amplifier tuned circuit, Control "E", for a minimum reading in the 2nd Intermediate Amplifier Plate Current Meter.

(o) Tune the Power Amplifier Tuned Circuit, Control "F" for a minimum reading in the Power Amplifier Plate Current Meter.

(p) Place the Antenna Feed Switch, Control G, to "Current Feed" and adjust the Antenna Tuning Condenser, Control "J" and Antenna Tuning Inductance, Control "K", until maximum Antenna Current is obtained, the Antenna Coupling, Control "H" may have to be increased from zero to obtain a reading.

If unable to obtain any indication in the Antenna Current Meter, shift the Antenna Feed Switch to "Voltage Feed" position and follow the same procedure as in the preceding paragraph.

(q) Place the Tune Operate Switch to "Operate" and adjust the Plate Voltage Rheostat to read 3000 volts in the Plate Voltmeter.

(r) Increase Control "H" and readjust Controls "J" and "K" for maximum Antenna Current and not exceeding a reading of 350 milliamps in the Power Amplifier Plate Current Meter.

NOTE :

After each and every aerial adjustment, operation (o) should be repeated.

Care must be exercised to ensure that the aerial circuit is being tuned to the required output frequency and not to a harmonic. Reference to the table of typical dial settings, given in the Handbook, should enable easy differentiation between true and false settings.

(iii) Transmitter Unit. Low Power C.W.

Assuming that the transmitter has been tuned for High Power, in accordance with the preceding section, it is only necessary to move the High-Low Power Switch to its "Low" position, thus eliminating the Power Amplifier Stage, to bring the circuits ready for Low Power transmissions, but, tuning has to be slightly readjusted as follows :-

(a) Move Tune-Operate Switch to Step "2".

(b) Reduce Antenna Coupling to approximately half the dial reading for High Power.

(c) Readjust the 2nd Intermediate Amplifier Tuning, Control "E", to obtain a minimum in the 2nd Intermediate Amplifier Plate Current Meter.

(d) Adjust the Antenna Tuning Inductance, Control "K", and Tuning Condenser, Control "J" to obtain a maximum reading in the Antenna Current Meter. It may be necessary to increase coupling, Control "H", to obtain an indication.

(e) Move Tune Operate Switch to "Operate".

(f) Increase Control "H" and readjust Controls "J" and "K" for maximum Antenna Current and not exceeding a reading of 150 milliamps in the 2nd Intermediate Amplifier Plate Current Meter.

Note : After each and every aerial adjustment, operation (c) should be repeated.

(iv) M.C.W. Transmissions (TBM only).

(a) First tune the transmitter to the required frequency as laid down for Tuning High Power C.W.

(b) Set the C.W.- M.C.W.- Voice Switch to "Voice".

(c) Transmit the Carrier Wave by depressing the Test Key.

(d) Readjust the Antenna Coupling Condenser, Control "H", so that 70% of normal power output on C.W. is obtained. This is indicated by a reading of 270 milliamps on the Power Amplifier Plate Current Meter.

(e) Set the C.W.- M.C.W.- Voice Switch to M.C.W.

(f) The set is now ready for keying using M.C.W.

(v) R/T Transmissions (TBM only).

(a) Carry out the operations laid down, in paragraphs 6(iv) (a) to (d) inclusive.

(b) Remove the Test Handset from the Hook-Switch.

(c) Set the Carrier Control Switch to "OFF".

(d) Press the Press Button on the Test Handset and talk into the microphone.

(e) Adjust the Speech Gain Attenuator until the Modulation Meter shows that the carrier is being modulated.

Notes :-

(i) The microphone should be held about one inch from the mouth and spoken into with a normal conversational tone.

(ii) The Speech Gain Attenuator should be increased only to the point sufficient to obtain 60% modulation when "AH" is spoken into the Test Handset. The correct degree of modulation can best be discovered by listening in.

(iii) The adjustment of the Speech Gain Attenuator is usually different for the Test Handset and for the Remove Control Microphone.

(f) Set the Carrier Control Switch to "Voice Relay".

(g) Set the Voice Relay Sensitivity Attenuator to "3".

(h) Speak into the Test Handset and check that the modulation meter and Antenna Current Meter are showing the same readings as when the Carrier Control Switch was to "OFF".

Notes :-

(i) The correct setting of the Voice Relay Sensitivity Attenuator can best be determined by listening in.

(ii) With the Carrier Control Switch set to "Voice Relay", radiation occurs whenever the microphone is spoken into.

(iii) When using the Test Handset, the Voice Relay Sensitivity Attenuator should be set to approximately "3". When operating from the remote control position it may be turned as high as local extraneous noises permit.

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RADIO FREQUENCY TRANSMITTER

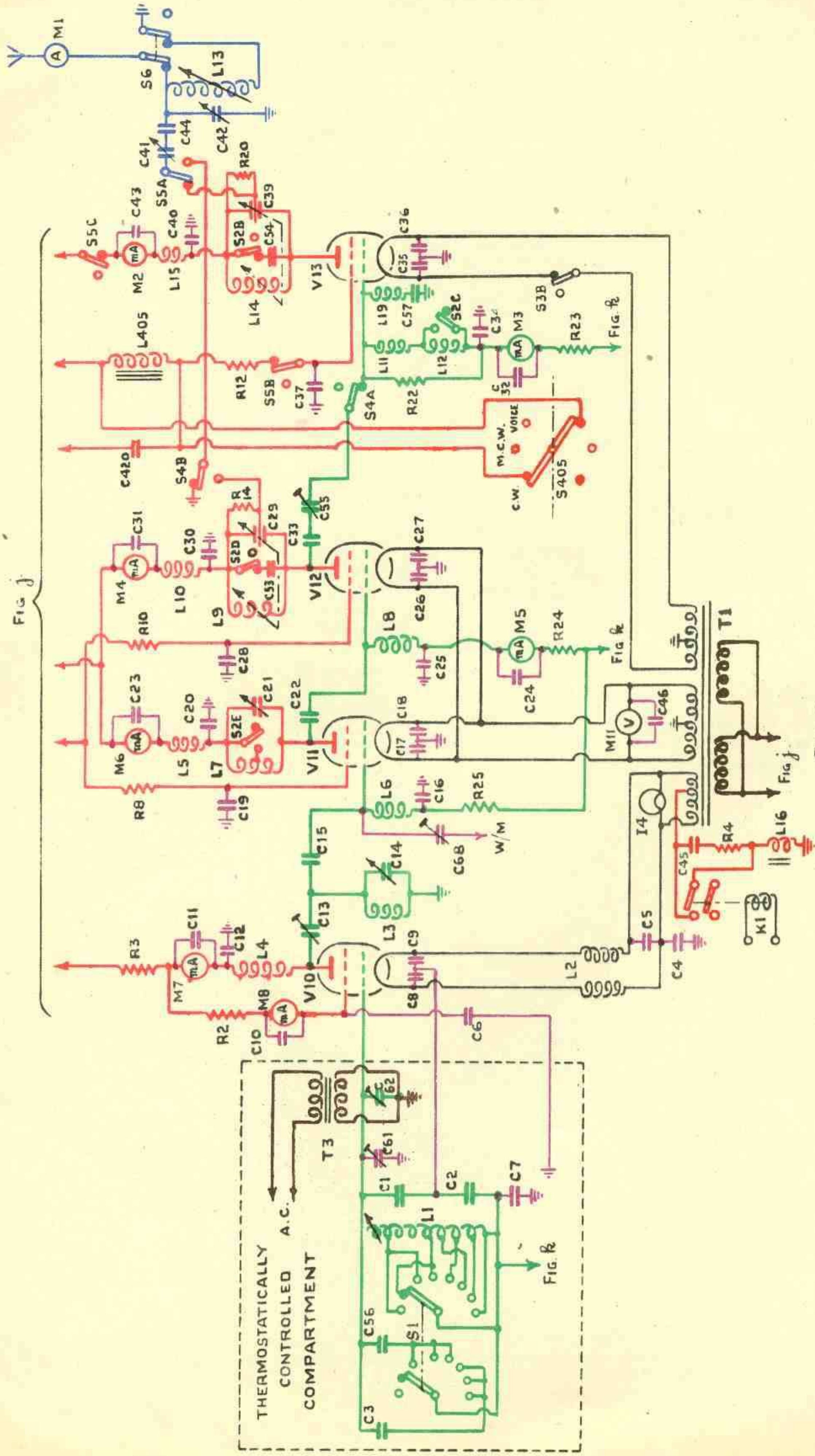

FIG. C

(i) When the Manual-Automatic Gain Switch is set to "Manual", it is necessary to maintain the percentage modulation, for different levels of speech input, by manipulation of the Speech Gain Attenuator. This can be accomplished automatically by placing the Manual-Automatic Switch to "Automatic", therefore, for normal operation the latter position should be used.

(j) To increase or decrease power, the Plate Voltage Rheostat on the Transmitter Unit can be adjusted as requisite, but, it is essential to also adjust the Speech Gain Attenuator to maintain the same percentage modulation as shown in the Modulation Meter. Failure to do this might result in over-modulation with consequent distortion.

Note :- In above description, the Carrier Control Switch has been to "Voice Relay", thus allowing the carrier to be transmitted consequent on speaking into the microphone. With the Carrier Control Switch to "OFF", the carrier will not be radiated until the Press Button on the Test Handset is pressed, or, when the Talk-off Switch is put to "Talk".

7. TECHNICAL DESCRIPTION.

Transmitter Unit (Fig. C).

(a) Master Oscillator.

The Master Oscillator employs a Type 860 valve in an electron coupled circuit which has its frequency determining components mounted in a temperature controlled compartment. The screen grid of the valve is functioning as the anode as far as the tuned circuit is concerned, it is at earth potential to R/F (C6) and is connected to the low potential end of the tuned circuit by the R/F by-pass condenser (C7) thus, the valve can be regarded as a normal Colpitts Oscillator, but, as the virtual anode of the oscillator is the screen grid of the valve, it follows that the current passing across the valve to the true anode will be modulated by the R/F potential variations present on the screen grid.

The tuned circuit has been designed to cover a frequency range of 1000 - 2262·5 Kc/s in eight bands dependent on the position of the M.O. Band Switch (S1). This switch has eight positions and arranges the necessary combination of tappings, on the rough tuning portion of the Tuning Inductance (L1) in conjunction with an arrangement of the fixed condensers C3 and C56. Fixed condensers C1 and C2 provide the main tuning capacity. Fine tuning is effected by moving a copper cylinder laterally through the Tuning Inductance (L1). The eddy currents set up in the cylinder tend to neutralize the currents in the tuning inductance with a resulting reduction in its effective inductance. The movement of the copper cylinder is controlled by a worm screw drive which is brought out to a control on the front panel, the dial geared to this control has 5000 numbered graduations, each of which is further sub-divided into two, thus, in combination with the eight positions of the Band Switch (S1), 80,000 clearly defined different adjustments can be made to this circuit.

This is extremely useful in resetting a frequency from a calibration card, for the frequency difference between adjacent minimum tuning settings is 16 cycles and, even allowing for the doubler stages later in the circuit, this allows for a high degree of accuracy in applying adjustments.

Condenser (C62), a bi-metallic type, is connected between the grid of the Master Oscillator Valve and earth, one plate is in series with the secondary of a transformer, T3, the primary of which is connected to the 160 volts A.C. output from the Generator Unit through the contact of a relay (K2) which is operated when the Keying Relay (K1) is energised (See Fig. 1). Thus, when the operating key is pressed, the physical dimensions of one plate of condenser C7 will vary due to the heating effect of the current flowing through it, and the resultant effect on its capacity is designed to neutralize any variation of the Master Oscillator valve inter-electrode capacity caused by heating during operating conditions. Condenser C7 is adjusted at the factory and its setting should not be altered.

A preset condenser (C61), also adjusted in the factory, is used to adjust the Master Oscillator tuned circuit to allow for small changes in dial calibration due to ageing of parts, or changes in the characteristics of the valve.

A radio frequency choke (L2), effective in each filament lead, prevents the high radio frequency potential on the filament, from leaking to earth through the secondary of the filament transformer (T1). R/F by-pass condensers (C8, C9) provide a centre tap on the filament for connecting to the mid-point of the main tuning condensers (C1, C2).

Approximate potentials of 700 and 300 volts are applied to the anode and screen grid respectively of the Master Oscillator valve (See Fig. J).

The values of anode and screen grid potentials are the optimum voltages for maximum frequency stability when using a Type 860 valve as an electron coupled oscillator. It has been found experimentally that, with a steady potential on the screen, frequency will vary inversely to voltage variations on the anode, conversely, with a steady potential on the anode, frequency variations appear directly effected by voltage variations on the screen. It can be seen that with a correct balance between normal operating voltages and dropping resistances, curves showing resultant frequency variations due to potential fluctuations on the anode and screen, shall be equal and opposite, thus, in this manner the transmitter can be made stable against normal variations in supply voltage.

(b) First Intermediate Amplifier.

The Master Oscillator is coupled to the first intermediate amplifier double circuit by a small preset condenser (C13). The doubler circuit, consisting of a fixed inductance (L3) and variable condenser (C14) is always tuned to the second harmonic of the Master Oscillator tuned circuit, i.e., 2000 - 4525 Kc/s, and is effectively connected between grid and filament of the first intermediate amplifier by the fixed coupling condenser (C15) and R/F by-pass condensers (C17, C18,) respectively.

This stage employs a Type 860 valve with a tuned anode circuit consisting of a tapped tuning inductance (L7) and a variable tuning condenser (C21). For transmitter output frequencies of 2,000 - 4,000 Kc/s, this stage functions as a "straight through" amplifier, and, for transmitter output frequencies of 4,000 to 18,100 Kc/s, the stage functions as a frequency doubler by one contact of the Frequency Range Switch (S2E) short circuiting approximately half of the tuning inductance (L7). It should be noted that when the Band Switch is in its 4,000 - 18,100 Kc/s position, the tuned anode circuit of the first intermediate amplifier, covers the range of 4,000 - 9,050 Kc/s, further doubling taking place in the next stage for output frequencies of 9,050 - 18,100 Kc/s.

A small preset condenser (C68) is connected to the control grid of the valve to provide a coupling for the Wavemeter Outfit.

(c) Second Intermediate Amplifier.

The anode of the first intermediate amplifier is capacity coupled to the grid of a Type 860 valve, functioning as the second intermediate amplifier, by a fixed condenser (C22). This stage employs a tuned anode circuit consisting of a variable tuning inductance L9, a split-stator tuning condenser (C29), and a fixed condenser (C63) connected in parallel, the latter component is brought into circuit by one contact (S2D) of the Frequency Range Switch when in its 2,000 - 4,000 Kc/s position. The adjustments of the tuning inductance (L9) and the tuning condenser (C29) are ganged to a single control to maintain a constant L.C. ratio throughout the whole frequency range. For transmitter output frequencies of 2,000 - 9,050 Kc/s, the stage functions as a "straight through" amplifier, and, for output frequencies of 9,050 - 18,100 Kc/s, the stage operates as a frequency doubler.

When the High-Low Power Switch is in its Low Power position, the stage functions as the output amplifier, being coupled to the aerial circuit via contacts S4B and S5A of the High-Low Power Switch and the aerial coupling condenser (C41). The use of this stage, as the output amplifier, is limited to operation within the frequency range of 2,000 - 9,050 Kc/s, and, when functioning as such, the output power is reduced to a maximum of 75 watts. Reference to the circuit diagram shows that the feed for the aerial is taken from the rotor plate of the tuning condenser (C29). As the tap of the anode tuned circuit is at earth potential from a radio frequency point of view (C30) it follows that radio frequency voltage variations present across the top section of the tuning condenser (C29) will be impressed across the aerial tuned circuit. If the shunt resistance (R14) was not across this section of the tuning condenser, the R/F voltage applied across the aerial circuit would be exactly half the amplitude of that present across the tuned circuit and would vary according to frequency.

The insertion of the shunt resistance (R14) upsets this ratio as the impedance of each half of the condenser arm will materially alter according to frequency, the net result of this arrangement is that for a constant setting of the aerial coupling condenser (C41) a substantially constant R/F potential will be applied across the aerial circuit irrespective of the frequency to which the output stage is tuned.

(d) Output Amplifier.

When the High-Low Power Switch is in its "High" position, the output of the second intermediate amplifier is coupled to the grid of a Type 861 valve, functioning as the output amplifier, via a pre-set coupling condenser (C55) and one contact (S4A) of the High-Low Power Switch.

A large fixed condenser (C33) is connected in series with the coupling condenser (C55) to protect the grid circuits of the output amplifier in the event of the coupling condenser breaking down.

The grid bias supply to the output amplifier contains two R/F choke coils (L11, L12), one of which (L12) is brought into circuit by one contact (S2C) of the Frequency Range Switch when in its 2,000 - 4,000 Kc/s position.

The output amplifier has a tuned anode circuit consisting of variable tuning inductance (L14), split stator tuning condenser (C39) and a fixed condenser (C54) that is connected in parallel by contact (S2B) of the Frequency Range Switch when in its 2,000 - 4,000 Kc/s position.

The adjustment of the tuning inductance (L14) and tuning condenser (C39) are ganged to maintain a constant L.C. ratio throughout the frequency range. The output amplifier functions as a "straight through" amplifier over the complete frequency range of 2,000 - 18,100 Kc's.

When the High-Low Power Switch is in its "High" position, a contact (S5A) connects the rotor plate of the tuning condenser to the tuned aerial circuit via the aerial coupling condenser (C41) and a fixed series condenser (C44), the latter is to protect the aerial circuit from high D.C. potentials should the coupling condenser (C41), become defective. Shunt resistance (R20) is connected across the top section of the tuning condenser for the same reason as described in the description of the second intermediate amplifier.

(e) Aerial Circuit.

The tuned aerial circuit consists of a variable tuning inductance (L13) and a variable tuning condenser (C42) that can be connected in series or parallel by the Antenna Feed Switch (S6).

An ammeter ((M1) is connected in series with the aerial circuit to indicate aerial current.

8. MODULATOR UNIT (FIG. e).

(a) General.

The Modulator consists essentially of a three-stage push-pull amplifier; its design is such that when supplied with speech input at a 6 milliwatt level from a 600 ohm. source, it will be capable of effecting 100% plate modulation of the Transmitter with an audio frequency distortion of less than ten percent.

The Modulator is a single self-contained unit, complementary to the Transmitter Unit, and similar to it in general construction and appearance.

The gain of the modulator is approximately 60 dB. Approximately 400 watts are available for modulation purposes from the final amplifier, over the audio frequency range of 100 to 5000 cycles. The same output power is available for M.C.W. operation; the modulation frequency in this case is 800 cycles obtained from an audio oscillator in the Modulator Unit.

(b) Audio-Frequency Input. (Fig. e).

The audio input to the Modulator Unit is obtained from either the Local Handset (H.S.401) or, from a remote microphone, that is fed into the audio line input terminals via a 600 ohm line. The choice of input is selected by the action of the Microphone Hook Switch (S401). When the Handset (H.S.401) is on the hook, the Hook Switch (S401) will be in the position shown in Fig. e, here the audio input from the 600 ohm line is connected through the Attenuator (R401) to the primary winding of the Input Transformer (T402). Two sets of two metal rectifiers (RX402, RX403) connected in parallel and in opposition, are connected in series across the primary winding to act as line surge limiters, the metal rectifiers will not pass current until the amplitude of the input voltage reaches a certain predetermined level, thus they will be inoperative for normal input amplitude levels.

When the Handset (H.S.401) is removed from the hook, the Hook Switch (S401) moves to the reverse position to that shown in Fig. e now the 600 ohm line is isolated and the microphone in the Handset (HS401) is connected to one side of the primary of the Microphone Transformer (T401) via the microphone resistance (R417) and one contact of the Hook Switch (S401), the other side of the Microphone Transformer (T401) is connected to the negative 12 volt D.C. supply, the positive of which is fed back to the microphone via the Push Button (PB) on the Handset. The Push Button (PB) has the "Talk-Listen Switch" (S404) connected across it, the function of this switch is discussed later.

The 12 volt D.C. supply, used to provide polarising current for the microphone, is obtained from a full wave bridge metal rectifier (RX401) which is supplied with A.C. by a secondary winding of the Filament Transformer (T408), the D.C. output from the metal rectifier is smoothed by chokes (L401, L406, L407) and condensers (C401, C417, C418, C423). The secondary winding of the Microphone Transformer (T401) is connected to the primary of the Input Transformer (T402) with the Attenuator (R401) and Surge Limiters (RX402, RX403) in circuit as for the 600 ohm input.

(c) Input Amplifier and "Compressor-Limiter". (Fig. e).

The secondary of the Input Transformer (T402) excites the grids of the two Type 6D6 indirectly heated variable-mu pentode valves (V1, V2) that comprise the push-pull Input Amplifier. A loading resistance (R402, R403) is connected across each half of the Input Transformer secondary winding to match the input impedance of the valves and to flatten the frequency response of the transformer secondary. The Input Amplifier will function either as a "straight through" amplifier, or, as a "compressor-limiter" amplifier. In the former case, a steady grid bias supply is applied to the grids of the Input Amplifier valves, this is obtained from the junction of two resistances (R405, R406) which are connected across a portion of the potentiometer (R414, R419, R420, R421), which is connected across the 275 volts supply. From the junction of resistances (R405, R406) the supply is fed to the centre of the secondary winding of the Input Transformer via the grid resistance (R404). The above grid bias circuit is brought about by placing the Automatic Manual Switch (S402) to its "Manual" position, as shown in Fig. e.

When the Automatic Manual Switch (S402) is put to "Automatic" the amplifier functions as a "compressor-limiter" amplifier. To understand the action the following explanation should be read in conjunction with the simplified diagram Fig. d.

First consider the various potentials being applied to the Type 25Z5 double diode compressor-limiter valve (V9) and the grids of the Input Amplifier valves (V1, V2) with no audio frequency input from the microphone.

The grids of the Input Amplifier valves will be at a small negative potential with respect to their cathodes by the voltage drop between points "A" and "B" on the potentiometer connected across the 275 volts supply. The anode and cathode of the Compressor Diode will be at the potential of point "A" on the potentiometer as they are connected together through R406, R405 and a part of R432, through which no current is flowing.

TYPES TBM & TBK

SIMPLIFIED DIAGRAM OF COMPRESSOR-LIMITER CIRCUIT

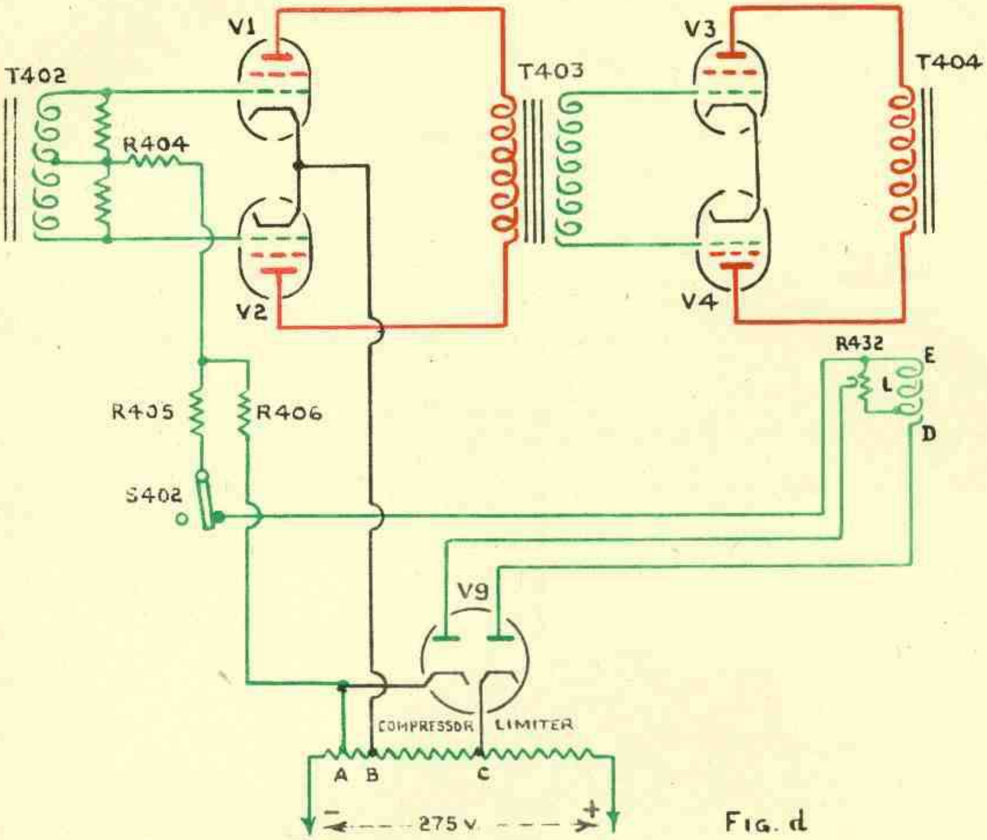

Fig. d

The Limiter Diode anode is connected to point "A" through transformer winding "L", R405 and R406, but its cathode is connected direct to point "C", therefore, a positive delay bias dependent on the voltage drop across the portion of the potentiometer between points "A" and "C" will be impressed on the cathode.

Now consider the action of this circuit with an audio frequency input being received from the microphone. The first two stages of the amplifier are initially operating in their maximum gain condition. The audio frequency voltage variations will be amplified by the Input and Inter-stage amplifiers and, a portion of this voltage will be induced into winding "L" of the transformer coupling between the Interstage and Output Amplifier stages.

The positive half-cycles will cause point "D" to become positive with respect to point "E", thus the anode of the Compressor Diode will become positive with respect to its cathode, the amount being dependent on the position of the tap on the resistance (R432) which is connected across a portion of "L". As the compressor anode and cathode are initially at the same potential, it follows that any positive voltage applied to the anode will cause the diode to pass current, this rectified current path is via a portion of R432 and through resistances R405 and R406, as the grids of the Input Amplifiers are connected to the junction of resistances R405 and R406, additional negative bias will be applied to them, which will be additive to the bias voltage being obtained direct from point "A" on the potentiometer. This additional bias will depend on the current flowing through resistance R406, the amplitude of this current being dependent on the amplitude of the audio frequency positive half cycles being applied to the anode of the Compressor diode, these in turn are dependent on the audio frequency input to the microphone and also on the setting of the slides on resistance R432. It can now be seen that the additional bias being supplied to the grids of the Input Amplifier varies directly with the amplitude of Microphone input. The net result is to reduce the gain as the input amplitude increases, thus maintaining a substantially constant output level.

The Limiter Diode would not be passing current during the above conditions, if the microphone input was being obtained from normal speech amplitudes, due to the positive bias being applied to its cathode, but, if the input level rose above this initial delay potential, then, the limiter diode anode would become sufficiently positive for the valve to pass current, the result being a voltage drop in resistance R406, the negative end of which is connected to the input amplifier grids. Thus the Limiter Diode has the effect of keeping the excitation to the grids of the Output Amplifier down to a level which will ensure the elimination of distortion.

The two Type 6D6 Valves used in push-pull as the input amplifier obtain their filament heating current from a secondary winding of the filament transformer (T408). Screen grid potential is obtained from a tapping on the 275 volts potentiometer via dropping resistance (R418). The anodes are connected to either end of the primary of the A/F coupling transformer (T403) the centre of which is earthed through the anode milliammeter (M401) and contact "C" of the C.W.-M.C.W. Voice change over switch (S405), it should be noted that the positive end of the potentiometer across the 275 volts supply is directly earthed and that the cathodes of the input amplifier valves are connected to a point towards the negative end of this potentiometer, therefore, it follows that the anodes are at a positive potential with respect to the cathodes.

PES TBM & TBK

MODULATOR UNIT

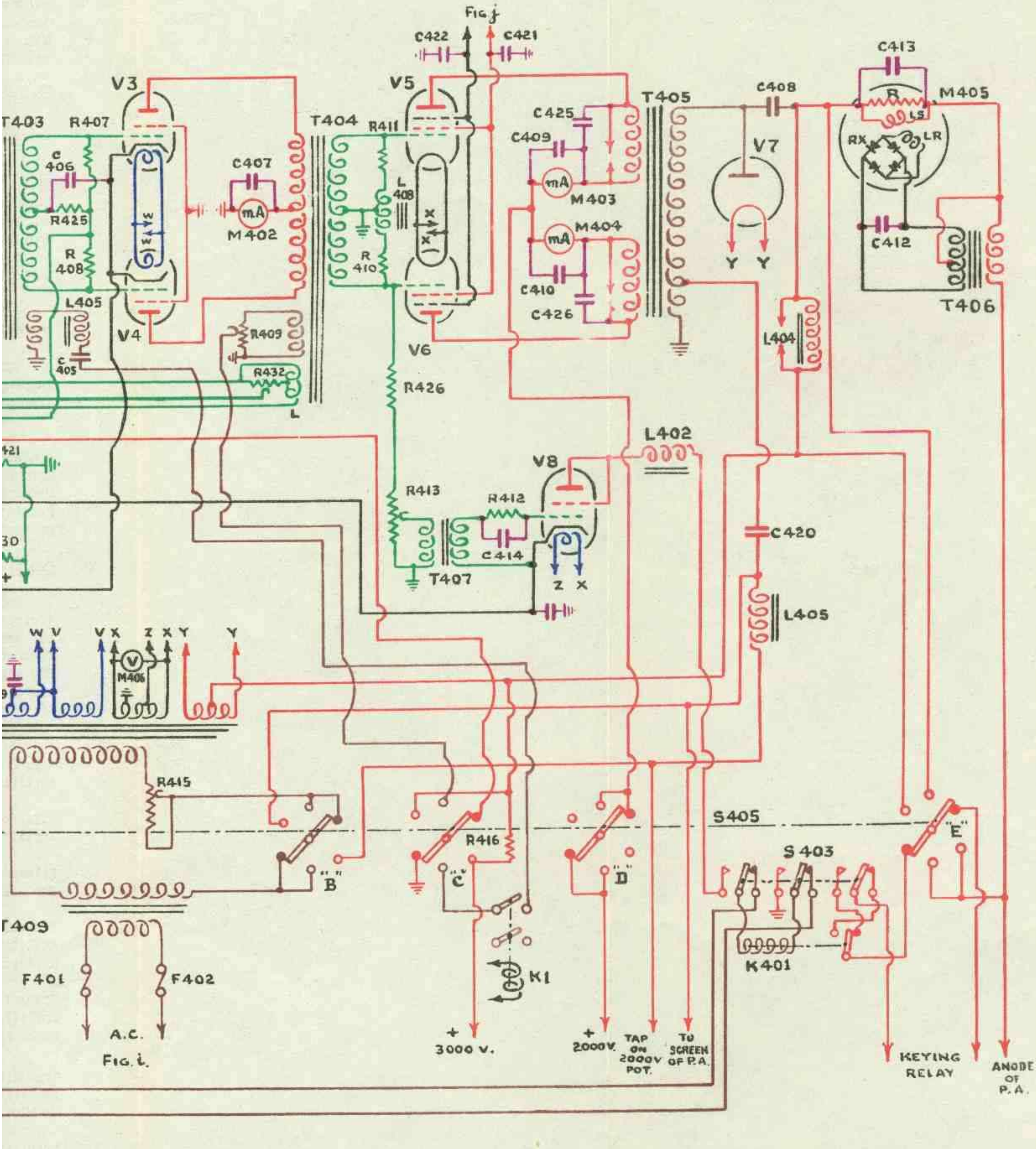

Fig. e.

TYPES TBM

MODULATOR

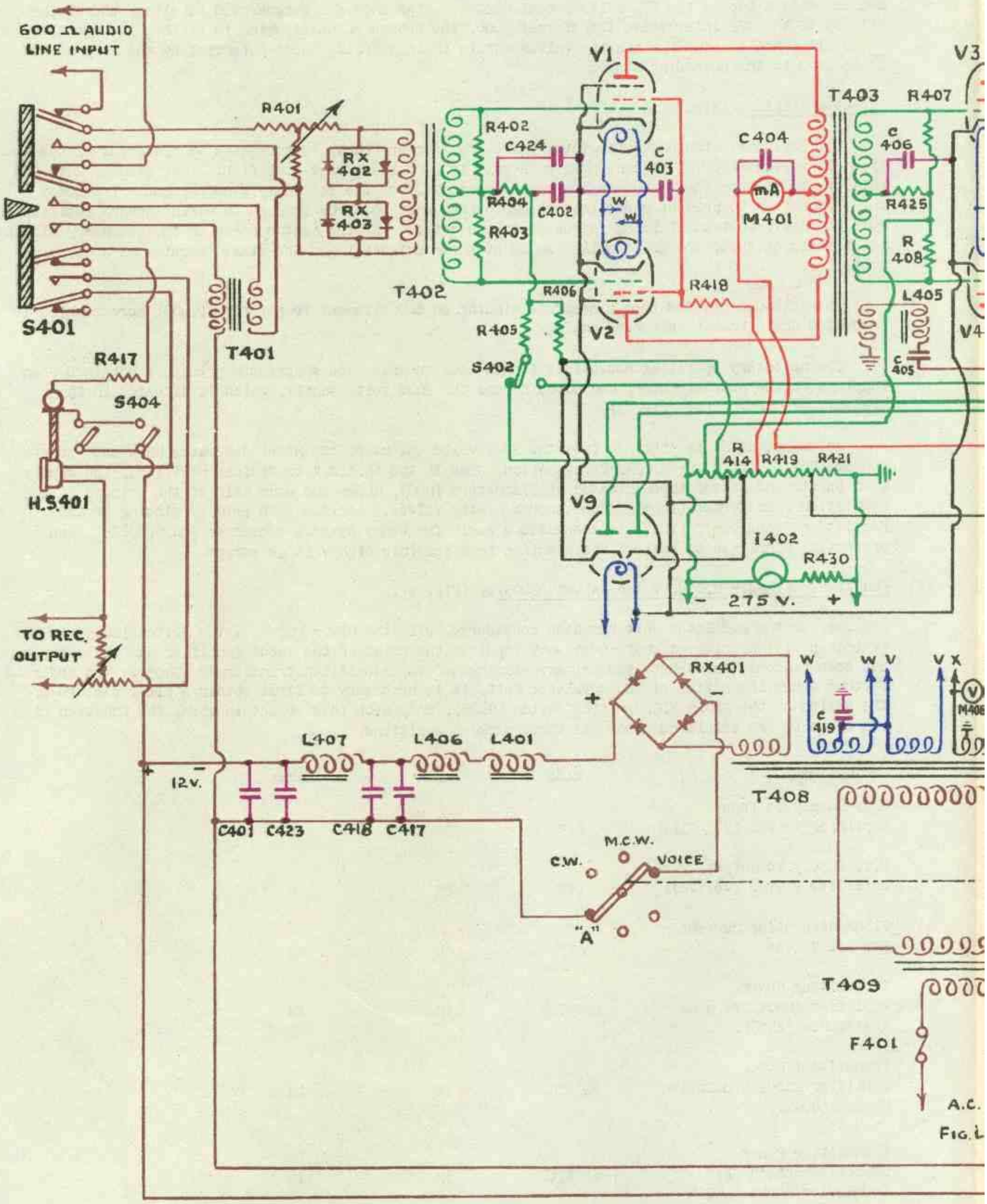

FIG. L

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TYPES TBM & TBK

(d) Interstage Amplifier (Fig. e).

The secondary of the A/F transformer (T403) is connected to the grids of the two Type 807 valves (V3, V4) connected in push-pull which comprise the Interstage Amplifier. Grid bias potential is obtained from a tapping on the potentiometer across the 275 volts supply which is fed to the centre of the transformer secondary via the grid resistance (R425). A resistance (R407, R408) is connected across each half of the transformer secondary to flatten the frequency response and to match the input impedance to the valve impedance. The screen grids of the valves are earthed and the cathodes are connected to a tap on the 275 volts potentiometer. The anodes are connected to either end of the primary of the A/F inter-valve transformer T404, the centre point of which is earthed through the anode milliammeter (M402), thus the valves obtain their positive anode potential by the same method as is used in the preceding stage.

(e) Output Amplifier (Fig. e).

The secondary winding of the inter-valve transformer (T404) is connected to the grids of the two Type 803 valves (V5, V6) connected in push-pull to form the output amplifier. Resistances R410 and R411 are to flatten the frequency response of each half of the secondary winding, audio-frequency choke (L408) is to prevent undue loss of audio-frequency power by leakage to earth through resistances R410 and R411, instead of being impressed on the grids. As the centre point of the secondary winding is directly earthed, the grids will also be at earth potential and the stage operates as a class "B" amplifier.

The cathodes are fed from a separate winding on the Filament Transformer (T408) across which is connected the filament voltmeter (M406).

The necessary operating potentials for the screen grids and suppressor grids are obtained from tappings on the potentiometer, connected across the 2000 volts supply, which is situated in the Transmitter Unit. (See Fig. j).

Anode potential is obtained from the 2000 volts output of the Motor Generator Unit and fed via contact "D" of the C.W.- M.C.W.-Voice Switch, when in the "M.C.W." or "Voice" positions, the supply then splits and passes through anode milliammeters (M403, M404) and each half of the primary of the Modulation Transformer (T405) to the anodes of the valves. Across each primary winding of the Modulation Transformer (T405) is connected a radio frequency by-pass condenser (C425, C426), and a protecting spark gap to protect the windings from possible high voltage surges.

(f) Functions of C.W.- M.C.W. Voice Switch (S405). (Fig. e).

So far the Modulator Unit has been considered, with the C.W.- M.C.W. Voice Switch (S405) in the "Voice" position, with an audio-frequency input to the grids of the Input Amplifier and the circuit has been followed through to the primary windings of the Modulation Transformer (T405). In order to further study the action of the Modulator Unit, it is necessary to first obtain a clear picture of the action of the C.W.- M.C.W.-Voice Switch (S405), and, with this object in view, the function of its contacts are tabulated under its three working positions.

	C.W.	M.C.W.	VOICE.
H.T. Supply to Input Amplifier Valves (V1, V2).	OFF	OFF	ON
H.T. Supply to Output Amplifier Valves (V5, V6).	OFF	ON	ON
Filament Heating Current For All Valves.	OFF	ON	ON
Transmitter Power Amplifier Anode Dropping Resistance (R416).	SHORTED	IN	IN
Transmitter Power Amplifier Anode Modulation Choke (L404).	SHORTED	IN	IN
Transmitter Power Amplifier Screen Grid Modulation Choke (L405)	SHORTED	IN	IN
Modulation Meter (M405)	SHORTED	SHORTED	IN
M.C.W. Audio Oscillator Circuit.	BROKEN	MADE	BROKEN

TYPES TBM & TBK

SIMPLIFIED DIAGRAM OF MODULATOR UNIT OUTPUT FOR VOICE OPERATION

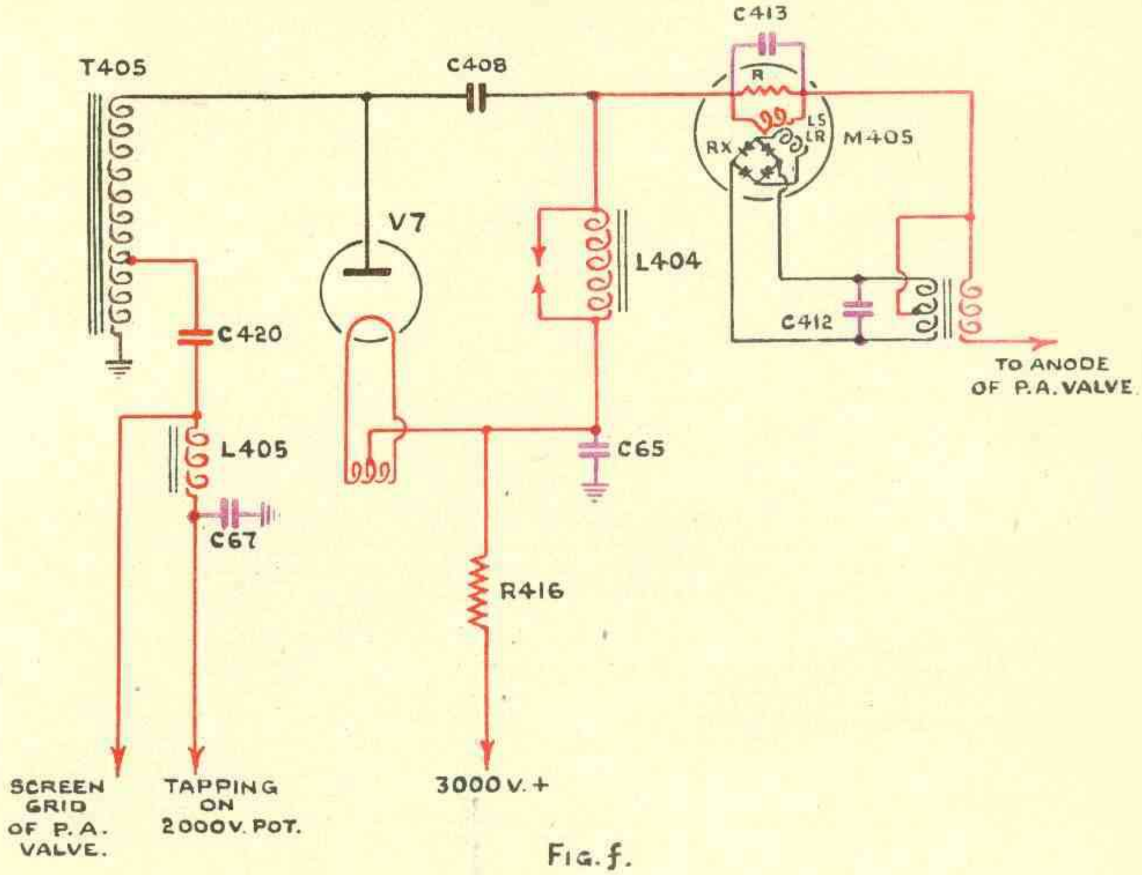

Fig. f.

(g) Modulation of Transmitter.

(i) Voice. (Fig. e and f).

The anode and screen grid of the Transmitter Power Amplifier Valve are modulated.

The secondary winding of the Modulation Transformer (T405) has the Modulation Choke (L404) effectively connected across it for audio frequencies by A/F by-pass condensers (C408, C65), C65 is situated in the Transmitter Unit. The 3000 volts H.T. supply to the anode of the Transmitter Power Amplifier Valve is fed via a dropping resistance (R416), Modulation Choke (L404), Modulation Meter (M405) and the primary winding of the Modulation Meter Transformer (T406), thus the H.T. supply to the anode will be modulated by the audio frequency voltage variations present in the Modulation Choke (L404).

The supply to the screen grid of the Power Amplifier Valve is taken from a tapping on the potentiometer connected across the 2000 volts supply, and, fed via the Screen Grid Modulation Choke (L405), this is effectively connected across a portion of the secondary of the Modulation Transformer (T405) by by-pass condenser (C420, C67) (C67 is situated in Transmitter Unit), therefore the voltage applied to the screen grid of the Transmitter Power Amplifier Valve will be modulated by the audio frequency voltage variations present across the Screen Grid Modulation Choke (L405).

A Type 1616 valve (V7) is connected across the Modulation Choke (L404), it functions as a Modulation Limiter to prevent excessive audio frequency voltage variations being passed on to the Transmitter Power Amplifier Valve, thus eliminating the possibility of damage to the latter. The Modulation Limiter (V7) is biassed by having the centre point of its filament transformer winding connected to the 2,700 volts supply, thus it will not become operative until the positive audio frequency half cycles, at its anode, rise above the level of this bias.

When the Modulation Limiter becomes conductive, it acts as impedance across the Modulation Choke (L404), its value varying inversely to the current being passed; so that any excessive audio frequency voltage variations will not be apparent across the Modulation Choke (L404).

A Modulation Meter (M405) is connected in the circuit, the dial is calibrated to indicate the approximate percentage modulation of the transmitter. The D.C. component of valve current will pass through resistance (R) and the condenser (C413) will by-pass the audio frequency variations, connected across the resistance (R) is the Stator Coil (LS) of the Meter. The Rotor Coil (LR) is pivoted in the centre of the Stator Coil (LS), and is supplied with rectified current obtained from the metal rectifier (RX), the metal rectifier being supplied from the secondary of the Modulation Meter Transformer (T406) with audio frequency voltage variations.

(h) M.C.W. Operation. (Fig. g). For M.C.W. operation the Input Amplifier is disconnected. The Inter-stage Amplifier (V3, V4) now acts as an audio oscillator when the keying relay (K1) is energised, by operating the Test Switch (S10) on the Transmitter Unit or by pressing a morse key in a remote position.

One contact of the Keying Relay (K1) completes a closed circuit consisting of a part of resistance (R409) connected across a separate winding (LB) on the audio frequency inter-stage coupling transformer (T404), condenser (C405), choke (L405) and a winding (LA) coupled to secondary winding of the transformer (T403).

On the Keying Relay (K1) being energised, a momentary voltage will be induced across winding (LB), a portion of this potential dependent on the position of the tap on resistance R409, will be applied across the remainder of the circuit causing it to oscillate at its natural frequency of approximately 800 cycles, this audio frequency oscillation is coupled to the grids of the Audio Oscillator Valves (V3, V4) by the mutual coupling existing between the coil LA and the secondary of transformer T403. Audio frequency variations on the grids cause the anode current to be modulated at the same frequency, thus causing audio frequency voltage variations across the primary of transformer T404, as coil LB, forming part of the oscillator circuit, is coupled to this, the initial 800-cycle oscillation will be maintained and the stage (V3, V4) will continue to oscillate as long as the Keying Relay (K1) is energised. The output from this stage is passed on to the Output Amplifier and amplified in the normal manner.

The audio frequency output from the Output Amplifier is used to modulate the anode and screen grid in exactly the same manner as described for Voice Operation in the preceding section. The Modulation Limiter Valve (V7) also functions as described under Voice Operation. It should be noted that the Modulation Meter is not in the circuit for M.C.W. operation.

(i) Carrier Control for Voice Transmissions. Two methods of controlling the radio frequency carrier transmissions are available for use when the set is being used for Voice operation.

1. Manual Control - whereby the operator causes the Transmitter Unit to oscillate by pressing the Press Button (PB) on the Handset (HS401) or by placing the Talk Switch (S404) to its "Talk" position.

2. Voice Relay Control - whereby the Transmitter Unit oscillates consequent on the operator speaking into the microphone in the Handset (HS401), the Press Button (PB) in this case having no effect on the operation of the Transmitter Unit.

Figure h is a simplified diagram of the circuits concerned.

(j) Manual Control. (Fig. h). When the Carrier Control Switch (S403) is placed to its "Manual" position, the Voice Relay (K401) is operated by the 12 volts D.C. supply from the Metal Rectifier (RX401), used also to provide a polarising current for the microphone.

The circuit through the Voice Relay (K401) is not completed until the Press Button (PB) on the Handset (HS401) is pressed, as the polarising current for the microphone also flows through this Press Button, it will have to be pressed before the operator can speak, so that the Voice Relay will be energised all the time the microphone is operative. The Voice Relay (K401), on being energised, will attract contact "A" to the left-hand position, thereby short-circuiting the Test Switch (S10) in the Transmitter Unit via one contact of the C.W.-M.C.W.-Voice Switch (S405) when it is in the "Voice" position. Short circuiting the Test Switch (S10) has the effect of completing the 230 volts ships D.C. supply through the bobbin of the Keying Relay (K1) as described in the Control Circuits section. Energising the Keying Relay causes the Transmitter Unit to oscillate as described in the Transmitter Unit section.

(k) Voice Relay Control. (Fig. h). When the Carrier Control Switch (S403) is moved to its "Voice Relay" position, the Voice Relay (K401) is isolated from the 12 volts D.C. supply, and connected in series with an audio frequency choke (L402) to function as the load for a Type 807 valve (V8) operating as a cumulative grid detector. The grid of this valve is excited by audio frequency voltage variations, obtained from the grid circuit of the Output Amplifier, and fed via resistance R426 and transformer T407. Grid leak resistance (R412) and grid condenser (C414) are inserted to provide the detector action. The anode of the valve is at earth potential, and, the cathode has a small negative bias, obtained from a tap on the potentiometer connected across the 275 volts output from the Generator Unit. This arrangement allows the valve to pass current under static conditions, of a sufficient amplitude to energise the Voice Relay (K401), it can be seen by reference to Fig. h that with the Carrier Control Switch (S403) in the "Voice Relay" position, the D.C. supply to the Keying Relay (K1) is broken when the Voice Relay (K401) is energised.

When the operator speaks into the microphone audio frequency voltage variations will be present in transformer (T407) by virtue of its connection to the grid circuit of the Output Amplifier, and, due to the detecting action of valve V8, there will be a resultant decrease in the mean anode current, this decrease will be sufficient to cause the Voice Relay (K401) to become inoperative, consequently its contact will revert to its rest position and the 230 volts D.C. supply to the Keying Relay (K1) will be completed. Thus when the Carrier Control Switch (S403) is to its "Voice Relay" position, the Transmitter Unit will oscillate only during the actual time that the operator is speaking into the microphone.

TYPES TBM & TBK

SIMPLIFIED DIAGRAM OF MODULATOR UNIT IN M.C.W. OPERATION

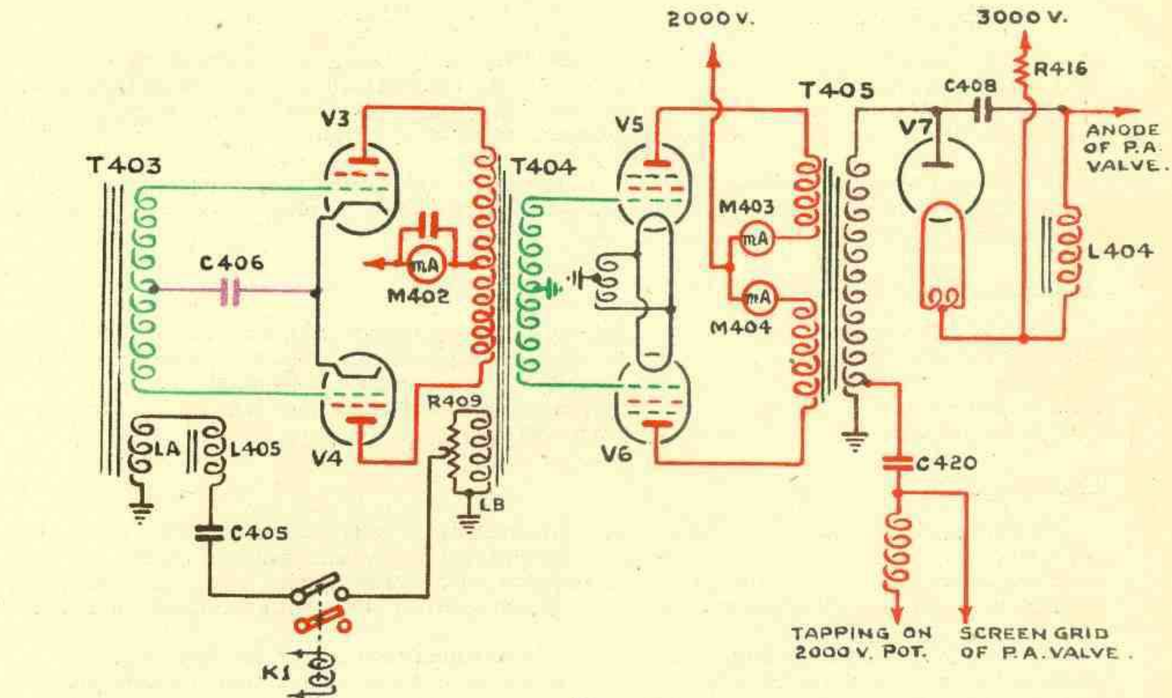

FIG. g

SIMPLIFIED DIAGRAM OF VOICE RELAY-MANUAL CARRIER CONTROL

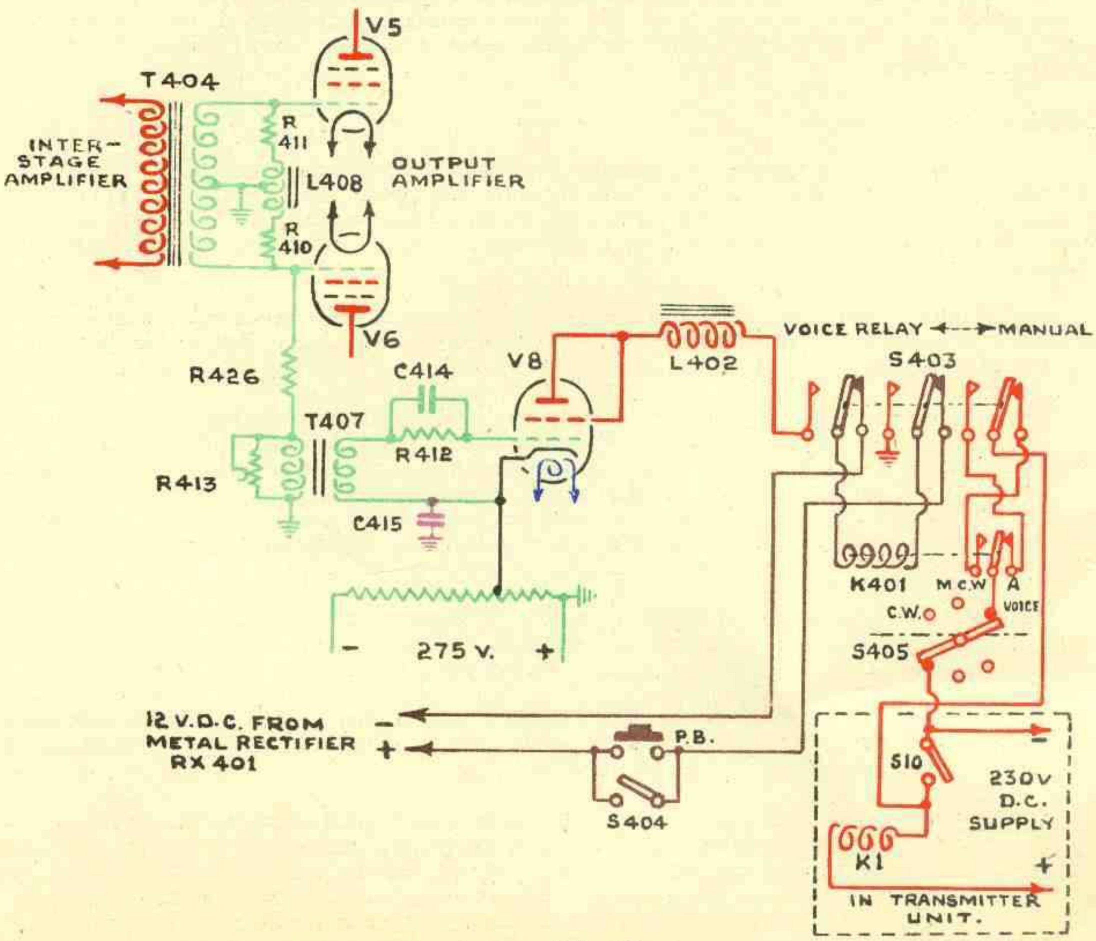

FIG. h.

9. POWER SUPPLIES.

Motor Generator Unit (Fig. 1).

(a) D.C.Motor. The D.C. Motor is fed from the 230 volts ships D.C. supply; its starting resistance and control circuits are contained in the Magnetic Controller, their action being described in the section headed Control Circuits. The D.C. Motor is a shunt wound machine with four main poles and two inter-poles; it is rated at 5 H.P. and has a constant speed of 1800. r.p.m.

A pair of slip rings are mounted on the armature shaft. The armature winding is tapped at two points and connected to the slip rings. A.C. power output of 535 watts, 160 volts, 60 cycles is available from the slip rings for filament heating.

(b) Low Voltage and Bias Generator. (Fig. 1).

The Low Voltage and Bias Generator is coupled to the common shaft rotated by the D.C. Motor; the unit has a two pole field and a double commutator two winding armature. The two outputs are rated at 1,000 volts at 0·075 amps and 275 volts at 1·3 amps. It is a compound wound generator, the shunt field is excited from the 275 volt output through the preset Field Regulator (R13) and the series field is connected in series with the 1000 volts armature winding.

(c) Main Plate Generator. (Fig. 1).

The Main Plate Generator is connected to the common shaft. It is a compound wound machine, the series field being connected in series with its armature winding and, the shunt field being separately excited from the 275 volts output of the Low Voltage and Bias Generator. Voltage output is adjustable by the Plate Voltage Rheostat (R33) which is connected in series with the shunt field winding.

The generator has two armature windings which are connected to two separate commutators. The outputs rated at 2,000 volts and 1,000 volts, are connected in series so that there is available from the unit both 2000 volts and 3,000 volts outputs. The generator will deliver 2,000 volts at 0·75 amps and 3,000 volts at 0·35 amps.

10. FILAMENT SUPPLIES. (Fig. j).

(a) General.

The 160 volt 60 cycle output from the Motor Generator Unit is utilised to provide filament heating current for all the valves in both the Transmitter and Modulator Units; it is connected to the primary windings of two transformers (T1, T408), joined in parallel, that feed the Transmitter and Modulator filament circuits respectively, through one contact of the Main Contactor (K823) located in the Magnetic Controller.

(b) Transmitter Unit. (Fig. j).

The A.C. supply is connected to the primary of the Filament Transformer (T1) through the Filament Rheostat (R6) and Compensating Resistance (R11), the latter is brought into circuit when the High-Low Power Switch is in its "Low" position by contact S3A opening, thus compensating for the reduced primary impedance due to a reduction of load on the secondary, consequent on the supply to the power amplifier valve being broken.

A meter (M10) is connected across the primary winding of the filament transformer, when the High-Low Power Switch is in its "High" position, by contact S3C. This meter will show the actual time that the Type 861 power amplifier valve has been alight.

The filament transformer has three secondary windings, one each for the Master Oscillator and Power Amplifier Valves, and one for the two Intermediate Amplifiers that are connected in parallel. The Master Oscillator valve winding gives an output of 10 volts; its tapped centre point is connected to a contact of the Keying Relay (K1), the function of which is described in the section on Keying. The supply to the filament is fed via the R/F chokes (L2), across the supply end of which is connected the M.O. Filament "On" Lamp ([illegible]; it should be observed that this lamp is really mis-named as it will still burn even though the filament of the valve may be fractured.

The centre of the secondary winding, supplying the filaments of the two Intermediate Amplifying valves, is directly earthed and, connected across the winding, is the Filament Voltmeter (M11); this should be adjusted to read 10 volts, by the Filament Rheostat (R6).

The Power Amplifier Valve is supplied with 11 volts, obtained from a separate winding that has its centre point directly earthed. This supply is only completed to the filament, by contact S3B of the High-Low Power Switch when it is in its "High" position.

(c) The Modulator Unit. (Fig. j). A.C. supply is fed through fuses (F401, F402) to the primary of a 2/1 step-down transformer (T409), the secondary of which is connected to the primary of the Filament Transformer (T408), through the Modulator Filament Rheostat (R415), when the C.W. - M.C.W. Voice Switch (S405) is to either "M.C.W." or "Voice". The Modulator Filament Transformer has five secondary windings the functions of which will be described in order from the left as shown in Figure j. No. 1 winding is connected to a metal rectifier that has an output of 12 volts, this is used to provide a polarising current for the microphone, and to operate the Voice Relay under Manual operating conditions.

POWER SUPPLIES

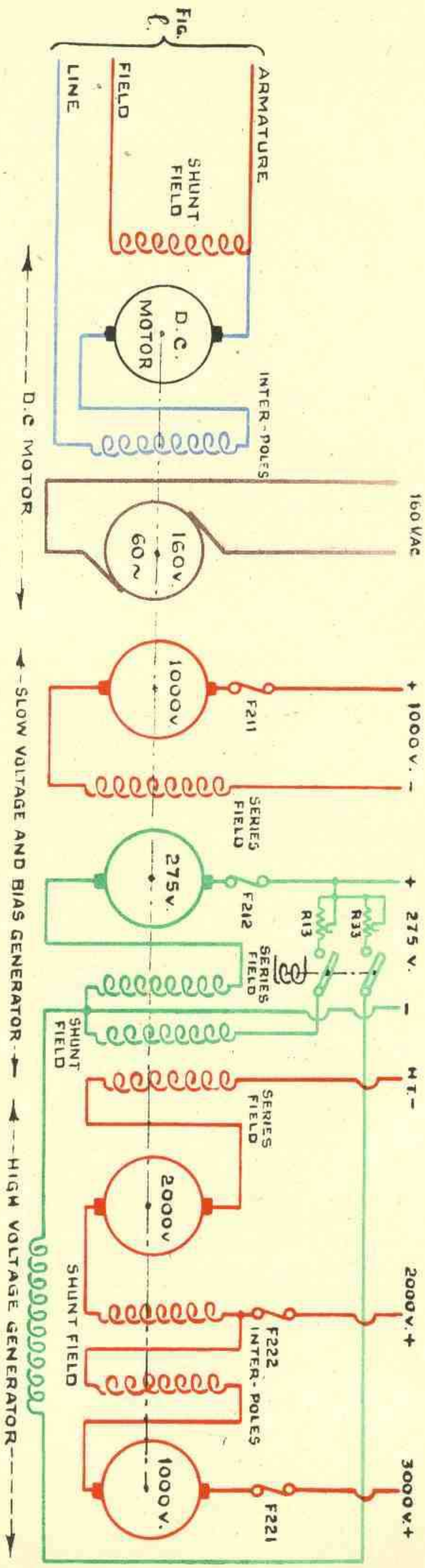

Fig. i.

No. 2 winding gives an output of 25 volts and is connected to the heater of (V9) a Type 25Z5 used as a Compressor-Limiter.

No. 3 winding is used to supply 6·3 volts to the heaters of the Type 6D6 valves (V1, V2) used as the Input Amplifier, and the Type 807 valves (V3, V4) functioning as the Inter-Stage Amplifier.

No. 4 winding gives an output of 10 volts and is connected to the filaments of the two Type 803 valves (V5, V6) that comprise the Output Amplifier. A voltmeter (M406) is connected across this winding. The Modulator Filament Rheostat (R415) should be adjusted to obtain a reading of 10 volts in the voltmeter (M406).

A tapping on No. 4 winding to give 6·3 volts is employed to supply the heater circuit of the Type 807 (V8) valve that is used to operate the Voice Relay when the Carrier Control Switch is to "Voice".

No. 5 winding gives an output of 2·5 volts that is used to supply the filament of the Type 1616 valve (V7) working as a Modulator Limiter.

11. H.T. SUPPLIES. (Fig. j).

(a) Transmitter Unit.

The 1000 volts output of the Motor Generator Unit is used to supply anode and screen grid potentials, for the Type 860 Master Oscillator Valve (V10). The positive supply is fed through a dropping resistance (R3), anode current milliammeter (M7) and R/F Choke (L4) to give an effective potential of 700 volts on the anode of the valve. The screen grid is provided with an operating potential of 300 volts through a dropping resistance (R2) and the screen grid current milliammeter (M8).

The 1000 volt negative output from the generator is earthed through the bobbin (K5) of the 1,000 volt overload Relay. Under operating conditions, the centre of the Master Oscillator Valve filament winding is connected to earth, by the contact of the Keying Relay (K1) to somplete the 1,000 volt circuit.

The two Type 860 valves (V11, V12) used as the First and Second Intermediate Amplifiers obtain their H.T. supply from the 2,000 volts output of the High Voltage Generator. When the Tune-Operate Switch (S9) is to "Operate", the full voltage is applied to the valves, but when it is in its "Step 2" position, the voltage is reduced, for tuning purposes, by a dropping resistance (R18) being brought into circuit. The supply from the Tune-Operate Switch is fed to each valve in parallel via their respective anode current milliammeters (M6, M4), R/F Choke Coils (L5, L10) and the tuning inductances in their tuned anode circuits. The 2,000 volt negative is earthed through the bobbin (K7) of the High Voltage Overload Relay, the return being provided by the earthed centre tap on the filament transformer. A potentiometer (R15, R16, R45, R46, R47, R48) is connected across the 2,000 volts supply, a tapping on this is used to supply the screen grids of the Intermediate Amplifiers via their respective dropping resistances (R8, R10).

The potential applied to the anode of the Type 861 Power Amplifier (V13) varies according to the position of the Tune-Operate Switch (S9) and also the position of the C.W.- M.C.W.-Voice Switch (S405).

With the Tune-Operate Switch (S9) in its "Step 2" position, a reduced potential, for tuning purposes, obtained from the 2,000 volts output of the High Voltage Generator, is applied to the anode via the anode current milliammeter (M2) contact S5C of the High-Low Power Switch when in its "High" position, R/F Choke Coil (L15) and the tuning inductance forming part of the tuned anode circuit. With the Tune-Operate Switch (S9) in its "Operate" position and the C.W.- M.C.W.-Voice Switch (S405) to "Voice", the 3000 volts output of the High Voltage Generator is fed through a dropping resistance (R416), that drops the voltage to 2,700 volts, Modulation Choke (L404) and Modulation Meter and Modulation Meter Transformer (shown as "M" on sketch) to the "Operate" contact of the "Tune-Operate" Switch. When the C.W.- M.C.W. Voice Switch (S405) is moved to its "M.C.W." position, the H.T. supply circuit is the same as the "Voice" position with the exception that the Modulation Meter and Modulation Meter Transformer ("M") are short circuited . For "C.W." operation, the series dropping resistance (R416) is short-circuited, thus allowing the full 3,000 volts to be applied to the anode, and the Modulation Choke (L404) is also short-circuited, both these operations being performed by the C.W.- M.C.W. Voice Switch (S405) when in its "C.W." position.

The screen grid of the Power Amplifier Valve (V13) is supplied from a tapping on the 2,000 volts potentiometer, through Screen Grid Modulation Choke (L405), Resistance (R12) and contact S5B of the High-Low Power Switch when in its "High" position. The Screen Grid Modulation Choke (L405) is short-circuited by one contact of the C.W.- M.C.W. Voice Switch when in its "C.W." position.

(b) Modulator Unit. (Fig. j).

The 275 volts output from the Bias Generator is applied across a potentiometer (R414, R419, R420, R421) the positive end of which is earthed.

The centre point of the primary winding of transformer (T403) is connected to earth through the anode current milliammeter (M401) and contact "C" of the C.W.- M.C.W.-Voice Switch (S405) when in its "Voice" position, therefore, the anodes of the two Type 6D6 valves (V1, V2) are at earth potential. The cathodes of these two valves are connected to a tapping on the 275 volts potentiometer, this tapping is 250 volts below earth potential, therefore it follows that the anodes of these valves are 250 volts positive with respect to their cathodes. The Suppressor Grids of these two valves are externally connected to their cathodes, and the screen grids are connected to a tapping on the 275 volts potentiometer via dropping resistance (R418), this gives them a 100 volts positive potential with respect to the cathodes.

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H.T. & FILAMENT SUPPLIES

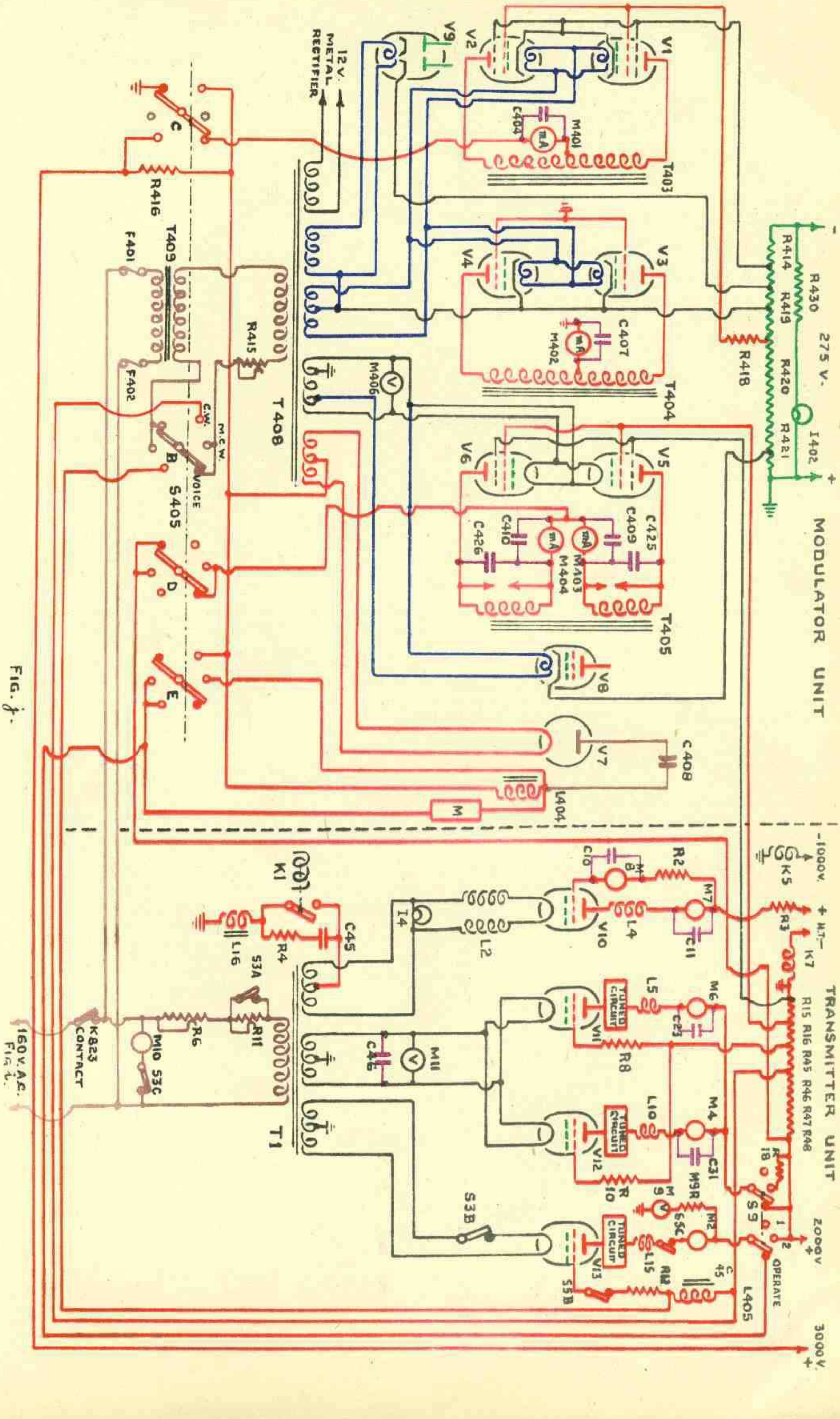

FIG. 8.

The two Type 807 valves (V3, V4) functioning as the Inter-Stage Amplifier, have their anodes connected to earth through the two halves of the primary winding of transformer (T404) and the anode current milliammeter (M402). The screen grids are directly connected to earth. The cathodes are provided with a 250 volts negative potential from a tapping on the potentiometer across the 275 volts supply, therefore the anodes and screen grids are 250 volts positive with respect to the cathodes. The centre tap of the secondary winding of the Filament Transformer, that supplies the heater circuits of the valves comprising the input and Inter-Stage Amplifiers, is connected to the 250 volts negative tapping on the 275 volts potentiometer. This is done to bring the heater potentials close to those present on the cathodes to eliminate the possibility of the insulation between heaters and cathode breaking down due to an appreciably large voltage difference existing between them.

The Output Amplifier, two Type 803 valves (V5, V6) obtains its anode potential from the 2,000 volts output of the High Voltage Generator; it is fed through the C.W.- M.C.W. Voice Switch when in either its "M.C.W." or "Voice" positions, a separate anode current milliammeter (M403, M404) and one of the two primary windings of the transformer (T405) to the anode of each valve. Tappings on the potentiometer across the 2,000 volts supply provide potentials of 300 and 40 volts for the screen grids and suppressor grids respectively of these valves.

12. GRID BIAS SUPPLIES. (Fig. k).

(a) Transmitter Unit.

The 275 volts output from the Low Voltage and Bias Generator is applied to a resistance network consisting of a potentiometer (R19, R21, R28) with a single resistance (R1) connected in parallel. The Bias Indicating Lamp (I1) is connected across a portion of resistance (R19). The lamp will burn whenever the 275 volts is applied across the resistances. Voltmeter (M12) will indicate the voltage output from the Bias Generator.

The positive side of the resistance combination is directly earthed and, as under operating conditions, the filaments of all the valves will be at earth potential, it follows that any voltage tappings taken from the resistances will be negative with reference to the filament potentials.

The Type 860 Master Oscillator Valve (V10) has an effective bias of 100 volts applied to its grid, obtained from a tapping on resistance R1 and fed through the tuning inductance forming part of the Master Oscillator tuned circuit.

The First and Second Intermediate Amplifiers (V11, V12) have an operating grid bias of 200 volts taken from a common tapping on a resistance (R28) forming part of the potentiometer. This potential is applied to the valves through their respective grid resistances (R25, R24) and R/F Chokes (L6, L8).

Grid bias of 150 volts, obtained from a tapping on resistance (R21) is used for the Type 861 Power Amplifier Valve (V13); it is applied through the grid resistance (R23), grid current milliammeter (M3) and R/F Choke (L11). An additional R/F Choke (L12) is brought into circuit when the Frequency Range Switch is placed to its 2,000 - 4,000 Kc/s position.

(b) Modulator Unit. (Fig. k).

A parallel feed from the 275 volts supply is applied across a potentiometer (R421, R420, R419, R414) situated in the Modulator Unit. Suitable tappings on this potentiometer are used to provide the requisite H.T. and Screen Grid potentials for certain stages as shown in Fig. e and, in addition, other tappings provide grid bias potentials as shown in Fig. i.

A Bias Indicating Lamp (I402), with its associated series resistance (R430) is connected across the potentiometer to indicate when power is being applied.

The Input Amplifier, employing two Type 6D6 valves (V1, V2) obtains a grid bias of 7½ volts from a tapping on the potentiometer. This is fed to the centre of the secondary of the Input Transformer (T402) through grid resistances R404 and R406.

The two Type 807 valves (V3, V4) comprising the Inter-Stage Amplifier, operate with a grid bias of 16 volts obtained from a further tapping on the potentiometer. This is applied to the centre of the secondary winding of the coupling transformer (T403) via grid resistance (R425).

The Output Amplifier, Type 803 valves (V5, V6) operating as a Class "B" Amplifier, has its grids connected directly to earth through the two halves of the secondary winding of the coupling transformer (T404).

13. CONTROLS CIRCUITS. (Fig. 1).

(a) General.

The 230 volts D.C. supply from the ships mains is fed direct to a double pole switch (S821) in the Magnetic Controller, this switch is manually operated by an extension arm that protrudes through the side of the Unit, and switch must be placed in its "Off" position before the access door can be opened. The supply then passes through the two main fuses (F821, F822) from which point power is taken to operate all the relays in the starting and keying systems, the supply to the Motor Generator Unit and, to actuate the temperature controlling elements in the compartment enclosing the frequency determining components of the Master Oscillator tuned circuit.

GRID BIAS SUPPLIES

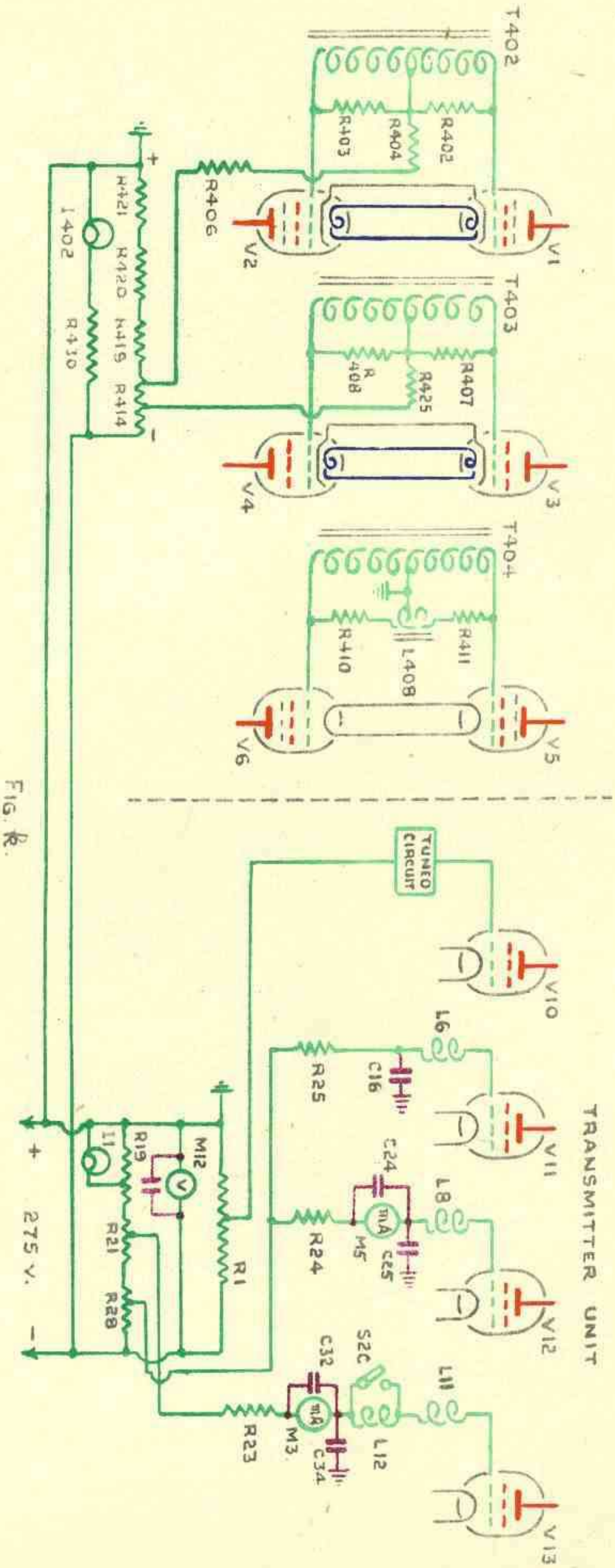

FIG. R.

TYPES TBM & TBK

Figure 1 depicts the control circuits for Transmitter TBM, the control circuits for Transmitter TBK are fundamentally the same, the main difference being that the C.W.- M.C.W. Voice Switch (S405) is not fitted and the circuits changed over by this switch are permanently wired for C.W. operation.

(b) Motor Generator Control Circuits.

On pressing the Start button of the Start-Stop Switch (S8) the circuit is completed through the bobbin of the Starting Contactor (K4) and the Starting Solenoid Indicating Lamp (I2) via the Emergency Switch (S12), Fuses (F1, F2), contact "A" of the Remote-Local Switch (S7) when in its "Local" position, contact "E" of the Start-Stop Switch (S8), contacts of the Overload Relays (K5, K7), Door Switches (S406, S407), in the Modulator Unit (TBM. only), and the Door Switches (S14, S15, S16) in the Transmitter Unit.

Contact "G" of the Starting Contactor (K4) completes the supply to the Field Contactor (K9), with the Plate On Indicator Lamp (I3) in parallel. In Transmitter TBM a further break is introduced in this circuit when the C.W.- M.C.W. Voice Switch (S405) is in a mid-position between its contacts. When the Field Contactor (K9) operates, contact "I" connects the 275 volts output of the Bias Generator to the High Voltage Generator Shunt Field Coil through the Generator Field Regulator (R33), and contact "J" connects the 275 volts to the Low Voltage Generator Shunt Field Coil via the Low Voltage Generator preset Field Resistance (R13).

Contact "H" of the Starting Contactor (K4) completes the D.C. supply to the main coil (K822M) of the Accelerating Contactor via contact "M" of the Line Contactor (K821), contact "H" of the Starting Contactor (K4) and the contact of the Main Overload Relay (K824). When the Accelerating Contactor (K822M) operates contact "Q" removes the short circuit off the major portion of the Starting Resistance (R824). Contact "O" completes the supply to the Main Coil (K823M) of the Main Contactor. Contact "P" completes the supply to the Neutralising Coils (K822N, K823N) of the Accelerating and Main Contactors via contact "O".

Contact "P" also completes the supply to the Line Contactor (K821) via contact "O" and contact "U" of the Main Contactor. Contact "T" of Main Contactor (K823M) removes the short circuit from the remaining portion of the Starting Resistance (R824). Contact "S" breaks the positive return for the Keying and Compensating Relays (K1, K2), details of the Keying Circuits are described under a separate heading later. Contact "R" breaks the 160 volts A.C. output from the Motor Generator Unit to the primary of the Modulator and Transmitter Filament Transformers.

The contacts of the Line Contactor (K821) functions as follows : Contacts "K" and "L" complete the positive and negative supplies to the Motor Generator Unit. Contact "M" breaks the supply to the Accelerating Contactor (K822M) and contact "N" completes a holding on circuit for the bobbin of the Line Contactor (K821) through its economy resistance (R823).

To summarise, the condition of the control circuits, up to the moment when the Line Contactor (K821) operates is as follows :-

(1) The Starting (K4) Field (K9), Accelerating (K822M) Main (K823M) and Line (K821) Contactors have all been energised.

(2) The Neutralising Coils (~~K822N~~ K822N, K823N) of the Accelerating and Main Contactors respectively have been energised.

(3) The D.C. supply is completed to the Motor Generator Unit.

(4) All the Starting Resistance (R824) is in series with the Motor Armature winding.

(5) The 160 volts A.C. output from the Motor Generator Unit is broken.

(6) The D.C. supply is removed from the Keying Circuits potentiometer (R36, R20).

The further action of the control circuits onwards from this point will now be considered.

When the Line Contactor operates, contact "M" will open and break the supply to the main coil of the Accelerating Contactor (K822M). The Accelerating Contactor will not immediately throw off due to the high retentivity of its core, this residual magnetism will, after a certain predetermined period of time, be neutralised by the field set up by the Neutralising Coil (K822N). The time delay is dependent on the current flowing through the Neutralising Coil (K822N), this is controlled by the timing resistance (R821). When the Accelerating Contactor (K822M) does throw off its contact "Q" short circuits a portion of the Starting Resistance (R824). Contact "O" breaks the supply to the Main Coil of the Main Contactor (K823M). Contact "P" breaks but the circuit through the Neutralising Coils (K822N, K823N) is maintained through contact "U" of the Main Contactor.

The Main Contactor (K823M) will not throw off immediately for the same reasons, described above, as for the Accelerating Contactor (K822M). When the Main Contactor (K823M) does throw off, its contacts perform the following functions : Contact "R" completes the A.C. supply to the Filament Transformers. Contact "S" completes the supply to the Keying Circuits potentiometer (R36, R20). Contact "T" short circuits the remaining portion of the Starting Resistance (R824). Contact "U" breaks the supply to the Neutralising Coils (K822N , K823N).

Thus, after the complete cycle of operation of the various contactors has been completed, consequent on pressing the "Start" button of the "Start-Stop" Switch (S8), the Line (K821), Starting (K4) and Field (K9) contactors are the only contactors that remain energised and the circuits are in the following condition :

(i) The D.C. supply is complete to the Motor Generator Unit.

(ii) The Starting Resistance (R824) is completely short circuited.

(iii) The 160 volts A.C. output from the Motor Generator Unit is being applied to the Transmitter and Modulator Filament Transformer.

(iv) The D.C. supply is being applied across the keying circuits potentiometer (R36, R20).

TYPES TBM & TBK

CONTROL CIRCUITS

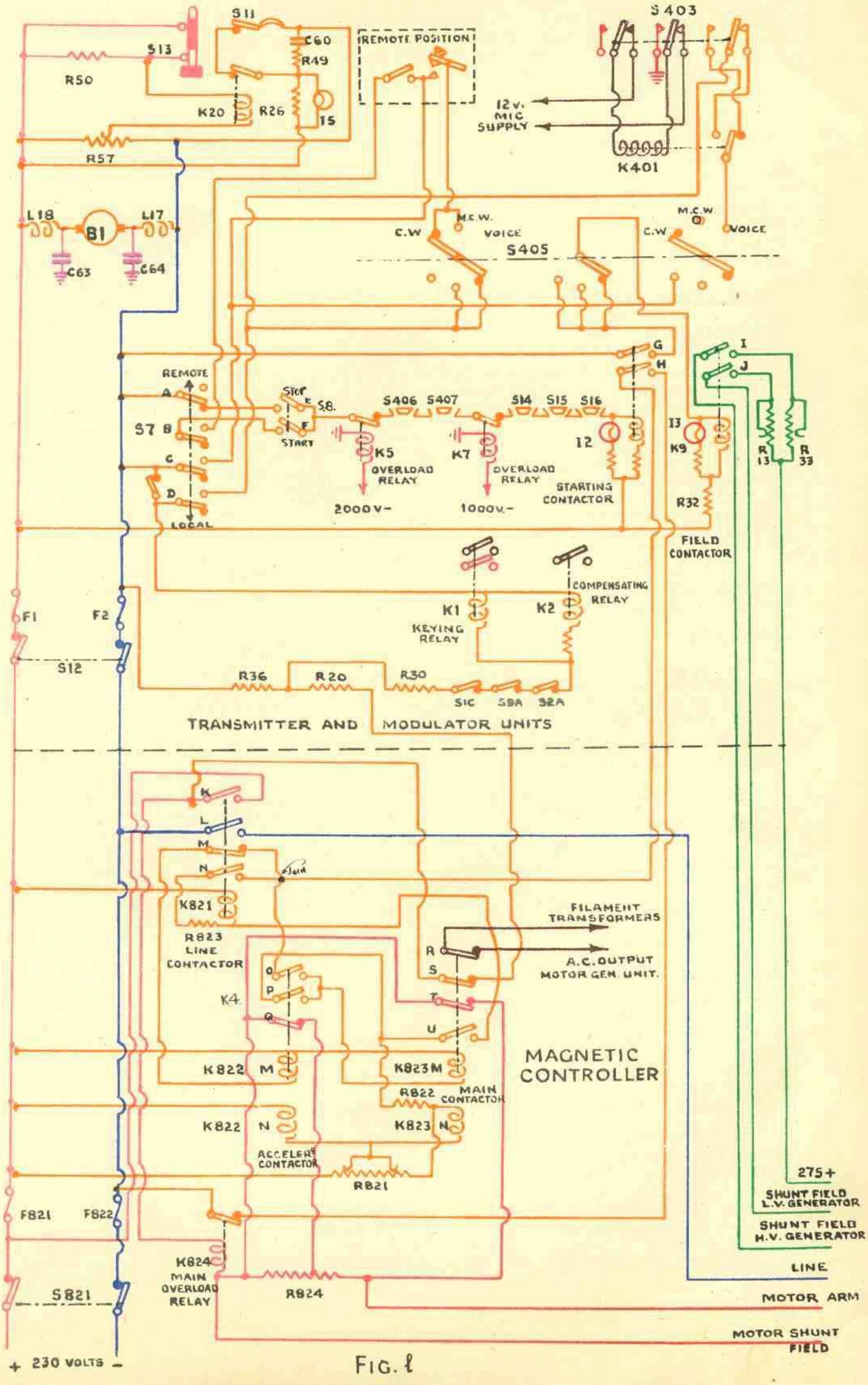

FIG. 1

On pressing the "Stop" button of the Start-Stop Switch (S8), the supply to the Starting Contactor (K4) will be broken. Contact "H" breaks the supply to the Line Contactor (K821) and contact "G" breaks the supply to the Field Contactor (K9), thus stopping the Motor Generator Unit and breaking the supply to its two Shunt Fields.

For remote operation the Remote-Local Switch (S7) must be placed to its "Remote" position and the "Start" button of the Start-Stop Switch (S8) must be depressed. The operation of the starting circuits is now controlled by the switch in the remote position. Their sequence of operation is the same as described above for local control, the difference being that the supply to the Starting Contactor (K4) is now completed through contact "C" of Remote-Local Switch, Control Switch in remote position, contact "B" of Remote-Local Switch, and contact "F" of the Start-Stop Switch. It should be noted that primary control of the starting circuits is still invested in the operator at the transmitter, as pressing the "Stop" button of the Start-Stop Switch (S8) will stop the Motor Generator Unit even though the Remote-Local Switch (S7) may be to "Remote".

14. OVERLOAD DEVICES.

(a) Main Overload Relay (K824). Set to operate at 26·4 amps. Bobbin is in series with supply to motor armature and shunt field windings.

When relay operates, the negative return for the Line Contactor (K821) is broken and the Motor Generator Unit will stop. On operation the contact is retained in its off position by a mechanical interlock, it can be reset by pressing a button that protrudes through the side panel of the Magnetic Controller.

(b) Low Voltage Overload Relay (K7). Adjusted against the tension of a spring to operate at a selected current of between 0·1 and 0·4 amps. Bobbin is in series with the negative return of the 1,000 volts output of the Low Voltage Generator.

(c) High Voltage Overload Relay (K5). Adjusted against the tension of a spring, to operate at a selected current of between 0·5 and 2 amps. Bobbin is in series with the common negative return of the 2,000 and 3,000 volt outputs of the High Voltage Generator.

On operation of the two latter Overload Relays, their contacts are held in the off position by a mechanical interlock, this interlock can be released and the relays reset, by pressing the Overload Relay Reset Button situated on the front panel of the Transmitter Unit.

15. OVEN CIRCUITS.

The supply for the temperature controlling components fitted in the thermostatically controlled oven is taken from the fuses (F1, F2) in the 230 volts D.C. supply. A blower motor (B1) with associated smoothing chokes (L17, L18) is connected across the supply, the blower circulates the air across the heating resistance (R26) and around the temperature controlled compartment.

The temperature is maintained at within half a degree of 60°C by the action of the mercury type thermostatic switch (S13).

When the temperature of the oven is below 60°C, the Thermostatic Switch (S13) short circuits a resistance (R50) that is in series with the Thermostat Relay (K20), the negative return of the relay is taken to a suitable preset tapping on a resistance (R57) that is connected across the 230 volts supply.

On resistance R50 being short circuited, sufficient current will flow through the bobbin of the Thermostat Relay (K20) to cause it to operate; its contact then completes the supply through the Heater Resistance (R26), with the "Heater On" Indicating Lamp (I5) in parallel. A Temperature Protection Switch (S11) is connected in series with the Heater Resistance (R26) to prevent overheating, should the Thermostatic Switch (S13) become defective; it breaks when the temperature rises to approximately 70°C, and makes when the temperature falls to approximately 55°C.

16. D.C. KEYING CIRCUITS.

As described previously, the Keying Potentiometer (R36, R20) is connected across the D.C. supply after the Motor Generator Unit has attained its normal running speed. The junction of resistances R36 and R20 is used to supply a suitable voltage to operate the Keying and Compensating Relays (K1, K2). The supply is fed through a series resistance (R30), auxiliary contacts on the Frequency Range Switch S1C, Tune-Operate Switch (S9A), M.O. Range Switch (S2A), the two bobbins of the relays, connected in parallel, and, with the Remote-Local Switch (S7) to "Local", to one side of the Test-Tune Switch (S10). The negative return being completed when the Test-Tune Switch (S10) is operated.

When the Remote-Local Switch (S7) is moved to its "Remote" position, the Keying Relays can still be operated by the Test-Tune Switch and, in addition, when the C.W.- M.C.W.-Voice Switch (S405) is to "C.W." or "M.C.W.", by the Morse Key in the remote position.

When the C.W.- M.C.W. Voice Switch (S405) is in its "Voice" position, the Keying Relays are controlled as described in Para. 7(i), entitled "Carrier Control for Voice Transmissions".