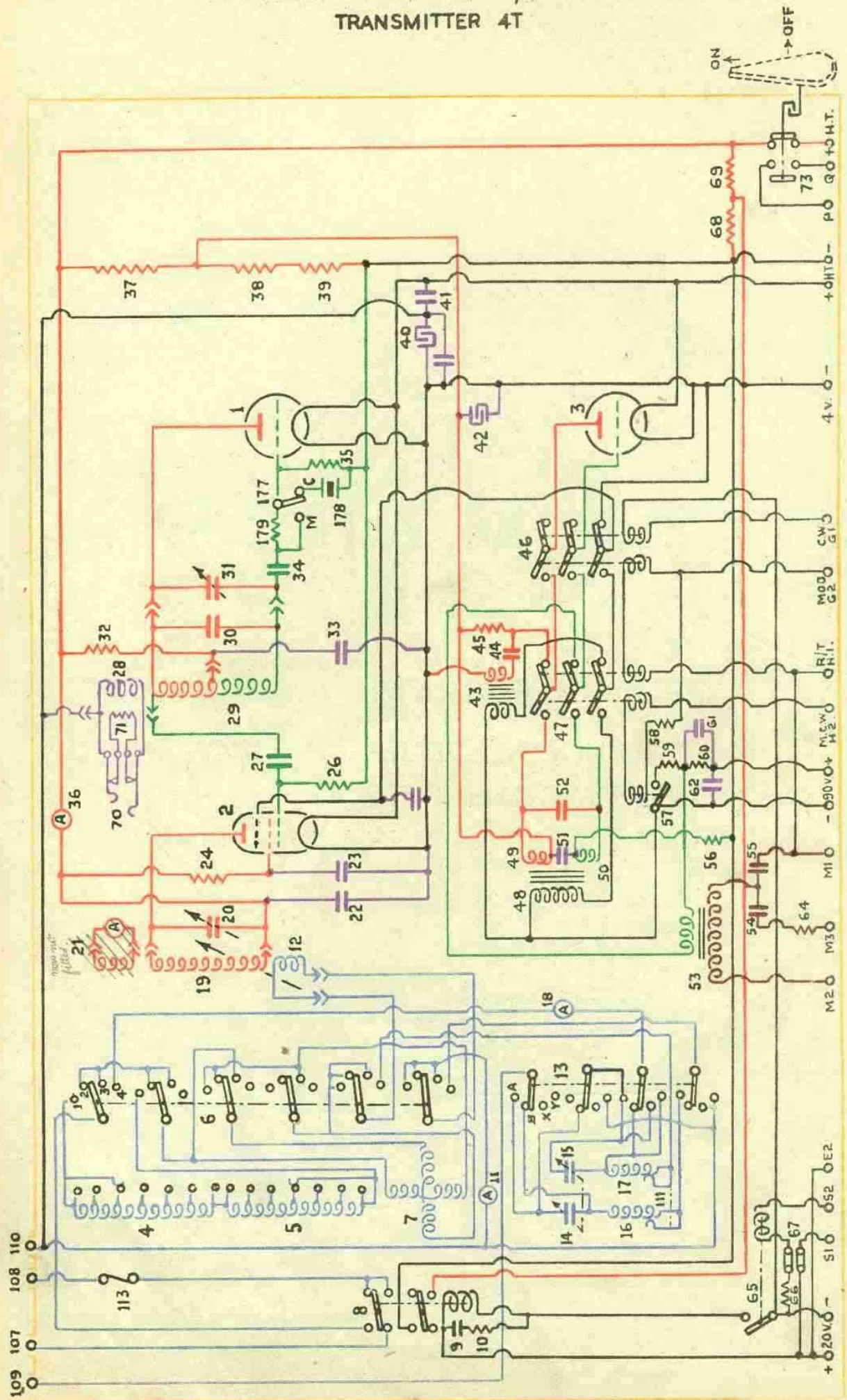
RS2

TYPES 60E/EM/ER/EMR

TRANSMITTER 4T



TYPE 60ER

FRONT VIEW

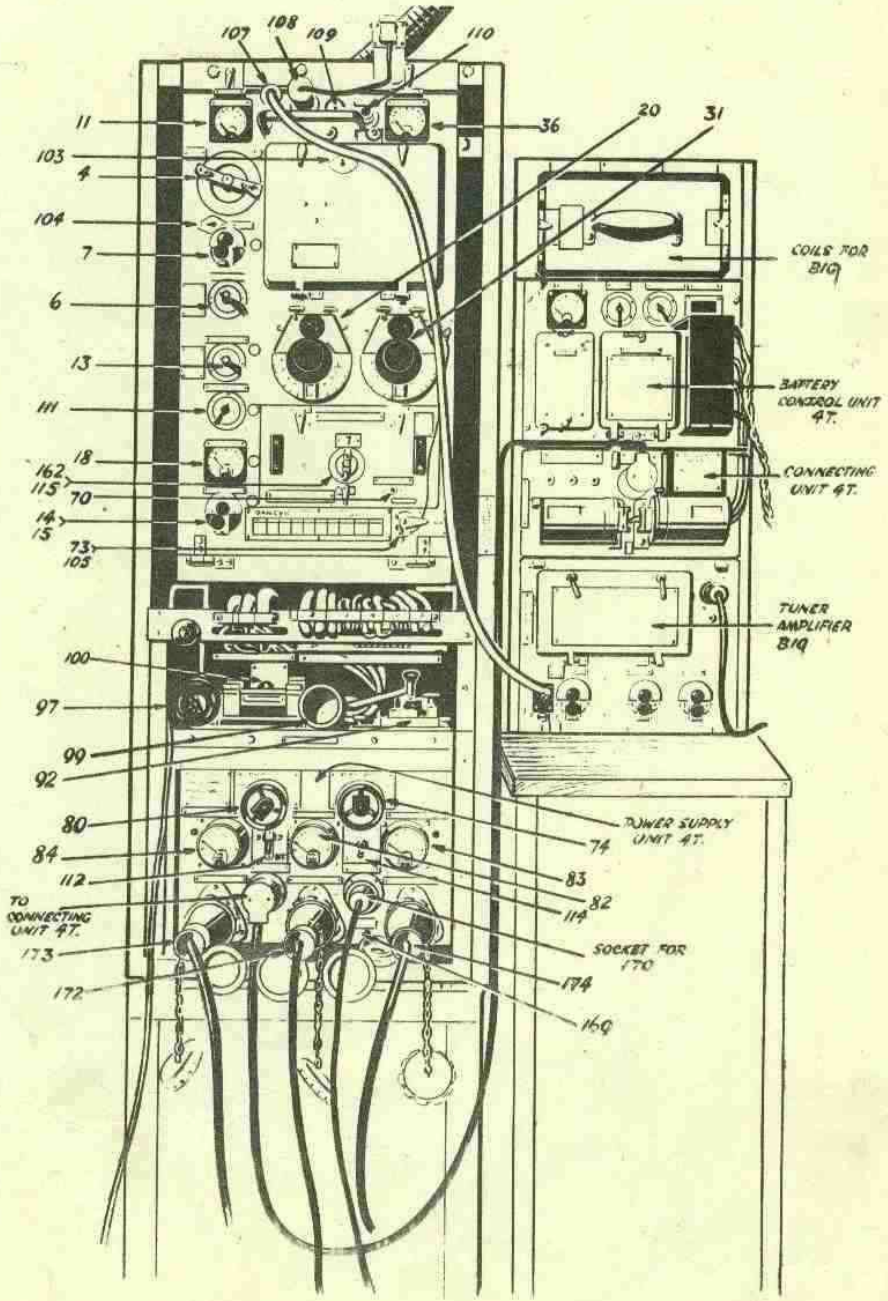


Fig 6

TYPES 60E/EM/ER/EMR

CONTROL UNIT 4T (COVERS REMOVED)

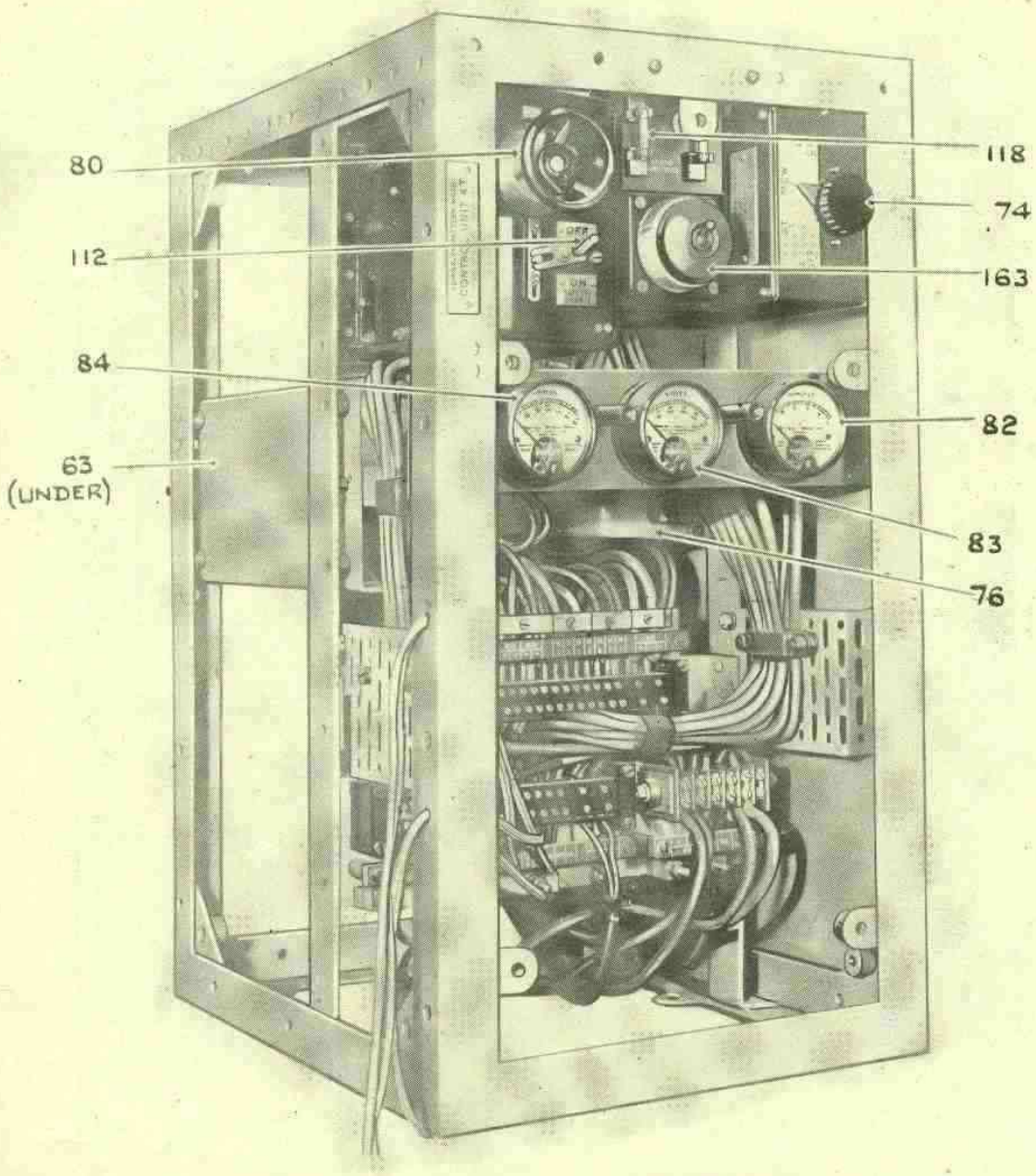


FIG. C

TYPE 60E/EM/ER/EMR

Date of design:-	1938	
Frequency Range:-	100 - 17,200 Kc/s	C.W. - M.C.W.
	400 - 17,200 Kc/s	R/T
Power Supply:-	Secondary batteries.	
Valves used:-	Master circuit, one NT68	
	Output circuit, one NT65	
	Modulator circuit, one NR16A.	
Range in miles:-	M/F - 100 miles (on 500 kc/s C.W.)	
	H/F - Variable.	
Associated Wavemeter:	C61/62.	

GENERAL. Types 60E/EM/ER/EMR are low power W/T sets and are fitted as follows:

Type 60E/ER — R.C.O. of capital ships, aircraft carriers, depot and repair ships and cruisers, as part of Standard Emergency W/T Equipment, (i.e. battery operated transmitter and receiver); also as main W/T set of certain small craft.

Type 60EM/EMR — Main office of leaders and destroyers as F/C set. Second office set of leaders or main W/T set in corvettes and below.

The only difference between Types 60E/EM and 60ER/EMR is that in the latter installations R/T transmission is possible.

The transmitter used is 4T. This transmitter is also used in Type 60D, and in conjunction with others to form Types 37PR, 38PR, 49MR and 50MR, but is fully described in this section only of B.R.222. The transmitter is designed to cover a frequency range of 100 - 17,200 kc/s using a unipole aerial. Transmission over the whole range may be made on C.W. and M.C.W. but, owing to the reduction in power produced by suppressor grid modulation, R/T transmission is not satisfactory on frequencies below 400 kc/s.

When R/T transmission is required, the valve which is used as the modulation oscillator for M.C.W. is employed as an A/F amplifier using suppressor grid modulation of the output valve. The grid of the amplifying valve is connected to the secondary winding of the microphone transformer, and the anode circuit is also transformer coupled to the suppressor grid of the output valve, to which 90 volts negative bias is applied.

Keying for both C.W. and M.C.W. is effected by applying a heavy negative bias to the grids of all valves during spacing periods, and is controlled by a magnetic key.

When R/T is used the negative bias is removed when the "Press to Speak" switch is pressed.

TRANSMITTER 4T.

Wave-form.	Method of producing oscillations.	Nature of Circuit.		Grid Excitation.		Feed.		Aerial excit-ation.	High oscillating potential electrode	Modulator Circuit.
		Master	Main	Master	Main	Master	Main			
C.W.- M.C.W. or R/T	Crystal or master controlled.	Tuned circuit between anode and grid.	Tuned circuit between anode and fila-ment.	Direct induct-ive.	Direct capac-itive from master circuit.	Series	Series	Mutual induct-ive.	Anode	Tuned circuit between anode and grid, direct induc-tive grid, excitation, series feed.

Figure b shows the complete transmitter 4T and associated apparatus which comprises Type 60ER. Fig. c shows the Control Unit 4T which takes the place of Power Supply Unit 4T (Patt.W333) in Type 60EMR. Transmitter 4T is fitted into an aluminium containing box. All circuits and valves are completely screened.

Access to the Master (1), Output (2), and Modulating (3) valves is obtained through a hinged door. This door and the front panel are fitted with safety locks (103)(104) which cannot be removed until the H.T. supply switch (73) is in the 'OFF' position; neither can the key be removed from the valve access door (103) until it is closed, nor from the panel lock upper (104) until the set is returned to its normal position.

In no circumstances must the key be turned to the 'ON' position in the lower lock position until a range unit is in place in the transmitter. Sockets at the top of the panel are for receiver (107) aerial (108) earth (110). The balancer socket (109) is not used.

Range Coil. Ten plug-in range units numbered from 0 to 9 are used to cover the frequency range. Each coil unit contains the master (29) and the output (19) tuning coils, aerial coupling coil (12), wavemeter coupling coil (28) and various fixed padding condensers (30) (see figures d and e).

The wavemeter coupling (28) is fitted in each unit coupled to the master coil and connected to the wavemeter jack (70). When the wavemeter plug is removed a 100-ohm resistance (71) is connected across the wavemeter coupling coil to minimise frequency pull due to the wavemeter and its line resistance.

When Range Unit No. 9 is used condenser unit and switch design 'B' Patt. W 3768 are employed.

TRANSMITTER 4T
RANGE UNIT

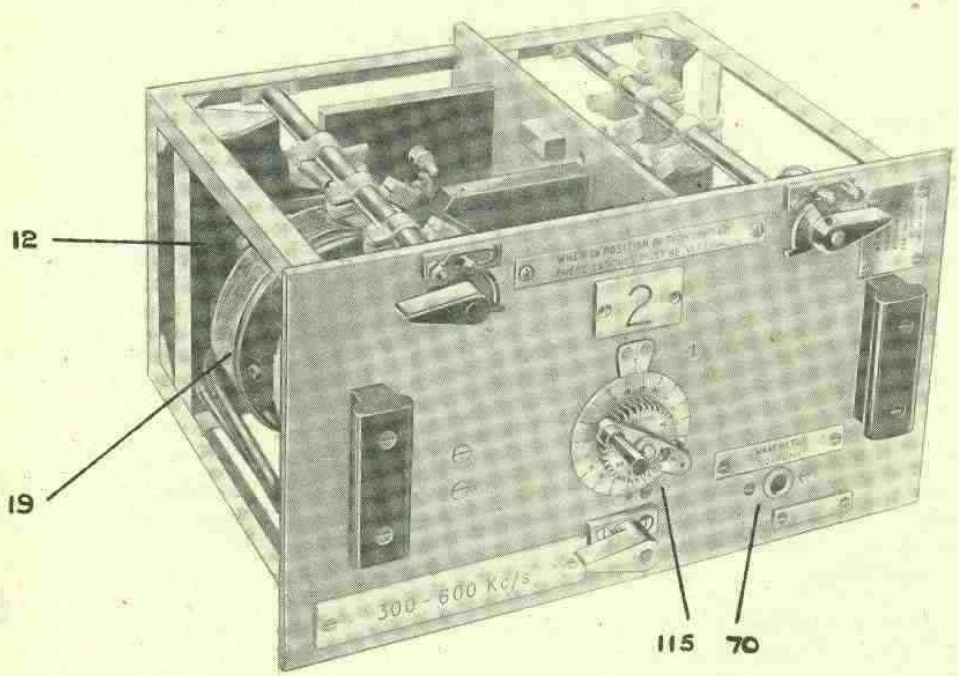


FIG. d

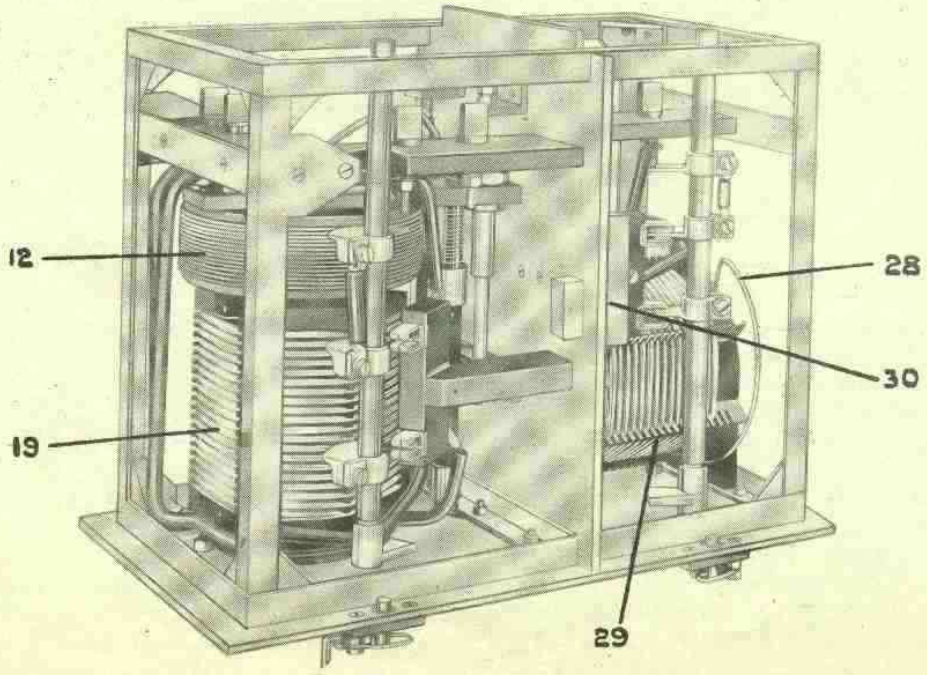


FIG. e

TYPES 60E/EM/ER/EMR

TRANSMITTER 4T

Master Oscillator Circuit. This master circuit was adopted because it oscillates readily over a wide range of frequencies. An NT68 triode valve (1) is used.

The tuned master circuit consists of the inductance (29) and variable condenser (31). The latter consists of four condensers, the vanes of all being mounted on one spindle. A small fixed condenser (30) is connected across the master tuning coil in each unit in order to match the frequency range of the master and output circuits. On range 8 an additional fixed condenser is in series with the variable condenser in both master and output circuits to limit the frequency range.

A 50,000 ohm resistance (35) is used as a grid leak, the end remote from the grid being taken to the keying circuit. Condensers (34) (0.00002 mfd). and (33) (0.01 mfd.) are grid and H.T. blocking condensers respectively. The anode resistance (32) (20,000 ohms) limits the power to the master valve to 7 - 8 watts. Condenser (27) (0.00005 mfd.) couples the master circuit to the output circuit.

The crystal unit is situated behind the master valve (1) and comprises a Crystal Master Oscillator change-over switch (177) and socket for plugging in the required crystal (178).

The crystal control circuit is inserted between the grid and filament of the master valve as shown in Fig. f.

MASTER CIRCUIT

(WITH CRYSTAL MODIFICATION)

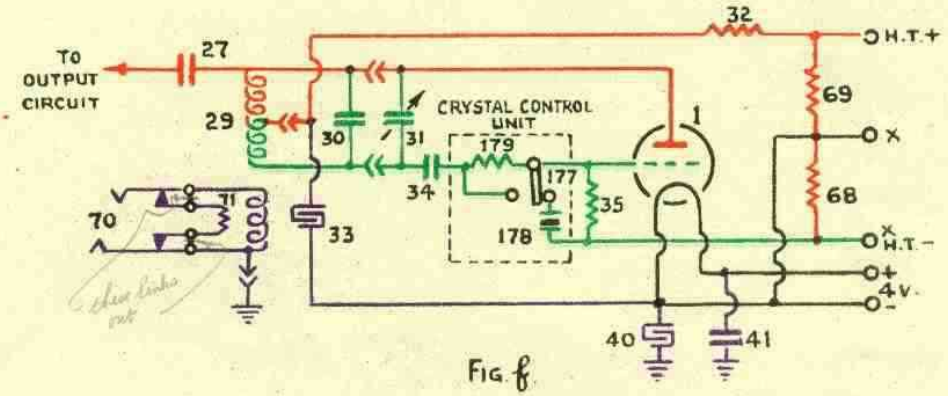


Fig. f

Output Circuit. The tuned circuit consists of inductance (19) and variable condenser (20) which is similar in construction to the master circuit tuning condensers, except that only three are fitted with values (0.000125 mfd.), (0.000288 mfd) and (0.000209 mfd.). The valve used is an NR65 pentode (2). The anode tap is fixed for each range unit and is at the top of inductance coil (19) in every case.

Resistance (26) of 50,000 ohms is the grid leak, and its lower end is connected to the keying circuit.

The screened grid of the valve is fed through the 30,000-ohm resistance (24) and is decoupled by the 0.01 mfd. condenser (23).

Condenser (22) (0.01 mfd.) is the H.T. blocking condenser, while the 1 mfd. condenser (40) is inserted between negative filament and earth to prevent short circuits when transmitter 4T is used in other W/T sets.

The output tuning indicator (21) is only fitted in some sets.

OUTPUT CIRCUIT

C.W. POSITION

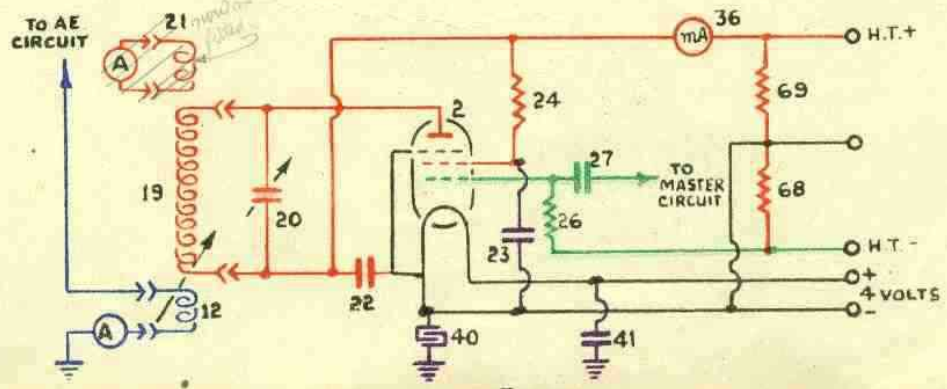


Fig. g.

TYPES 60E/EM/ER/EMR

TRANSMITTER 4T

Modulator Circuit. This circuit employs an NR16A triode valve (3), inductances (49) (50) and condensers (52) (0.05 mfd.) and (51) (2 mfd.). Coils (49) and (50) together with the coupling coil (48) are wound on an iron core, with fixed air gaps. The constants of the circuit are such that it oscillates at a frequency of approximately 1,000 c.p.s. The coupling coil is connected in the suppressor grid circuit of the output valve, and is so designed that there is an A.C. potential of approximately 90 volts across the coil.

A 90 volt negative potential is applied to the grid to ensure linear radio frequency output, and under these conditions good quality modulation is obtained to a depth of 90 - 95%.

Power to the modulator circuit is limited by the 30,000-ohm resistance (37), which is decoupled by a 1 mfd. condenser (42). This resistance forms part of a potentiometer device (37) (38) (39) connected across the H.T. supply. These resistances limit the voltage on the anode of the modulator valve to 600 volts during spacing periods. A 5000-ohm grid leak (56) is used, the lower end being connected to the keying circuit.

A/T Circuits. A 'Neophone' handset is used incorporating a "Press to Speak" switch (98) and a carbon granule microphone, which requires a polarising voltage of 4 - 8 volts obtained from the 20 volt key supply through a 200-ohm resistance (64). The microphone output of approximately one volt is amplified through the microphone transformer (53), (ratio 20:1), speech amplifier valve (3) and speech amplifier transformer (43) (ratio 2:1) to about 90 volts and applied to the suppressor grid of the output valve (2). A negative potential of 90 volts is applied to the suppressor grid for the same reason as for M.C.W.

A negative bias of 25 volts taken from the tapping of resistances (59) (50,000-ohms) and (60) (20,000-ohms) is applied to the grid of the speech amplifier valve (3), the 1-mfd. condenser (61) providing decoupling at this point.

The primary of the speech amplifier transformer (43) is parallel-fed by means of the 5,000-ohm resistance (45) and 2-mfd. condenser (44) which prevents D.C. flowing in any windings of transformers (53) and (43). Speech distortion is thus minimised.

Speech frequencies above about 3,000 cycles per second are cut-off by connecting condenser (25) (0.00028-mfd.) across the secondary of transformer (43).

The H.T. supply to the speech amplifier is limited by the 30,000-ohm resistance (37) which is decoupled by condenser (42) 1-mfd.

M C W MODULATOR CIRCUIT

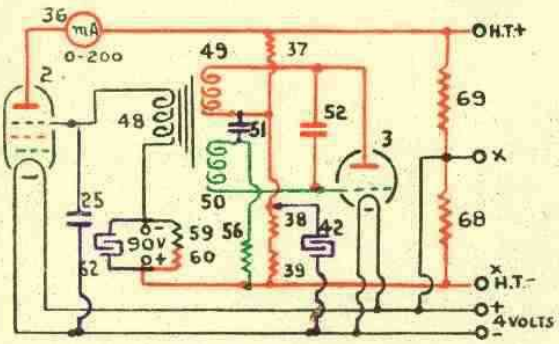


Fig. h.

R/T MODULATOR CIRCUIT

(PRESS TO SPEAK SWITCH CLOSED)

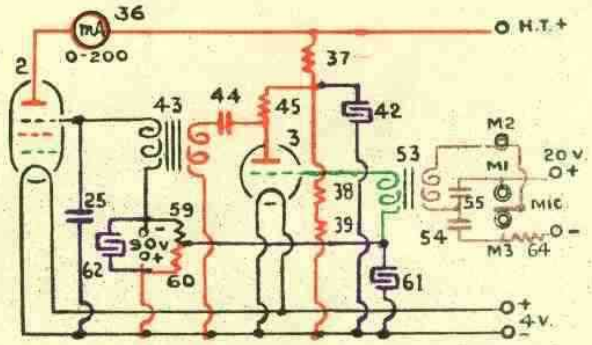


Fig. i.

Aerial Circuits. The aerial circuit components which are built into the transmitter are connected into circuit by the 6-pole, 4-way "Aerial Tuning Selector" switch (6). They may be divided roughly into two parts, viz:-

(a) For frequencies up to 1500 - 2200 kc/s, depending upon the capacity of the aerial.
(b) For frequencies above 1500 kc/s approximately.

For the lower frequencies the aerial is tuned by means of a 2500-mic. inductance (4) (5), having seven coarse and seven fine tappings, and a variometer (7) (98 mics. maximum). In addition, on the lowest frequencies (Range Unit No. 0, 100-150 kc/s.) an additional 0.00055-mfd. condenser (175) is connected in parallel with the aerial tuning inductances by means of a switch (176). This condenser is connected to the aerial lead externally and must only be used when Range Unit No.0 is in use in the transmitter.

Aerial tuning on H/F is effected by means of two inductances (17) (16) of approximately 40 mics. and two 0.00055-mfd. variable condensers (14) (15) for dipole working and one of each for unipole working. The aerial is coupled to the output circuit by means of the coil (12), which is contained in the range units and is of the size suitable to the frequencies covered by the unit.

The first three positions of the aerial tuning selector switch (6) are used for the lower range of frequencies, the arrangement of the aerial circuit components on each position are detailed below.

In order to protect the aerial circuit components from excessive currents which may be induced in the aerial from adjacent high-power transmitters, a Patt. 5342, 3 amp fuse (113) is fitted internally between the aerial socket and the heel of the magnetic key (8) send-receive contact.

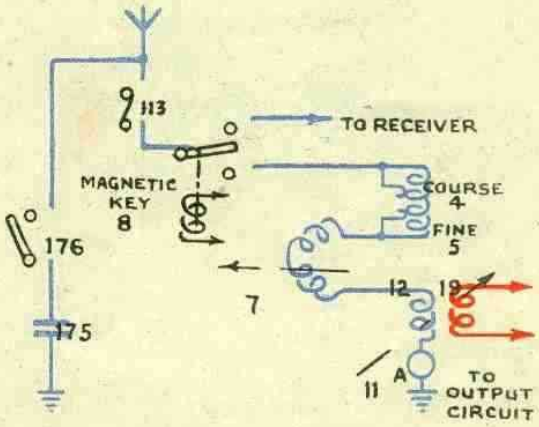
Aerial Tuning Selector Switch, Position I (Red). The aerial circuit in this position is shown in its simplest form in Fig. j. It will be seen that in this case it consists of the aerial tuning inductance (4) (5), variometer (7) and aerial coupling coil (12). In the case of the lowest frequencies the condenser (175) is brought into circuit also by making the switch (176). Continuous tuning is effected by making the complete range of tappings on the fine tuning inductance (5) cover adjacent tappings on the coarse tuning inductance (4), while the variometer covers adjacent tappings on the fine tuning.

The range of frequencies covered by the aerial tuning adjustments varies with the capacity of the aerial. Thus with an aerial capacity of 0.00044-mfd. the frequency range is 100-1350 kc/s while with an aerial capacity of 0.0011-mfd. the frequency range is 100-850 kc/s.

The lowest frequency available on a small aerial is governed by the total inductance available in the transmitter, hence the provision of the external condenser (175) for use with range unit '0' to enable the effective aerial capacity to be increased while with a larger aerial the limiting factor is the lowest frequency to which the master and output circuits will tune, viz:- 100 kc/s.

M/F AERIAL CIRCUIT
AERIAL TUNING SELECTOR SWITCH
POSITION I RED

Fig. j



Aerial Tuning Selector Switch, Position II. (Blue). With the switch in this position the aerial circuit components are connected as shown in Fig. k. The M/F aerial tuning inductance (4) (5) is completely disconnected and the aerial is tuned by the variometer (7) only. The rotor and stator of the variometer are connected in series, the variations of inductance being 20 to 100 mics. approximately (including the aerial coupling coil (12)). The range of frequencies covered in this position varies considerably with the capacity of the aerial, e.g. with an aerial capacity of 0.00044-mfd. the frequency range is 750-1500 kc/s and with an aerial capacity of 0.0011 mfd. the frequency range is 480-1050 kc/s.

Aerial Tuning Selector Switch, Position III (Black). With the switch in this position the aerial circuit components are connected as shown in Fig. l. The rotor and stator of the variometer are now connected in parallel the inductance variations being now from 10 to 40 mics. (including the aerial coupling coil (12)). As in positions I and II, the aerial capacity affects the range of frequencies covered in this position, typical figures being with an aerial capacity of 0.00044 mfd. the frequency range is 1200-2200 kc/s while with an aerial capacity of 0.0011 mfd. the frequency range is 750 - 1500 kc/s.

M/F AERIAL CIRCUIT
AERIAL TUNING SELECTOR SWITCH
POSITION II BLUE.

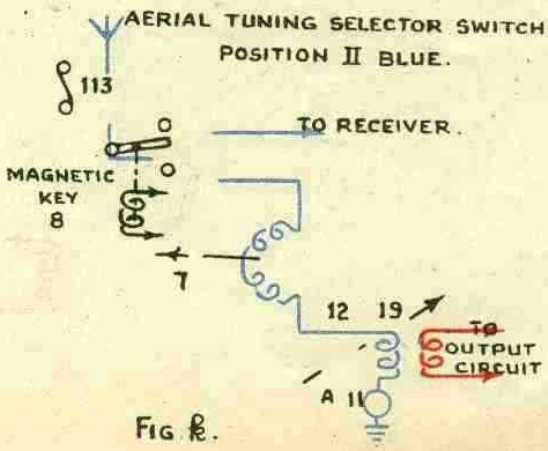


Fig. k.

AERIAL TUNING SELECTOR SWITCH
POSITION III BLACK.

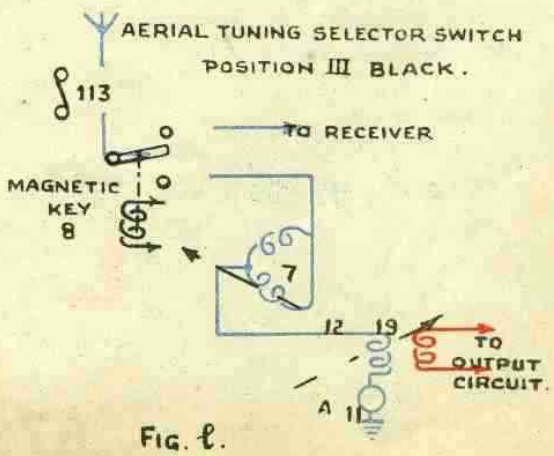


Fig. l.

TYPES 60E/EM/ER/EMR

TRANSMITTER 4T

Aerial Tuning Selector Switch. Position IV (Green). This is the H/F aerial tuning position, the circuit of which is shown in Fig. m. All the M/F aerial tuning components are disconnected from the aerial, which is connected through the 4-pole, 4-way H/F Aerial Tuning Selector Switch (13) to the H/F aerial tuning components. These are duplicated to provide for dipole working, which is, however, not used in Types 60E/ER/EM/EMR. The components consist of two 0.00055-mfd. variable condensers (14) (15), which are adjusted simultaneously and two inductances (16) and (17) adjusted by the H/F aerial tuning switch (111). The H/F aerial circuit is coupled to the output circuit by a coupling coil (12) contained in the appropriate range unit.

The first two positions of the H/F aerial tuning selector switch, "A" and "B" are for dipole working and are not used.

The arrangement of the H/F aerial circuit for each position of the switch is given below.

H/F Aerial Tuning Selector Switch. Position "A". The arrangement of the components in this position of the switch is shown in Fig. m. This is for dipole working and the components, consisting of the two inductances (16) (17) each in series with a condenser (14) (15), are arranged symmetrically on either side of the aerial coupling coil (12) and connected to the aerial and balancer unit respectively.

H/F Aerial Tuning Selector Switch. Position "B". The arrangement of the components in this position of the switch is shown in Fig. n. This also is for dipole working and differs from that in position "A" in that the variable condensers (14) (15) are connected in series across the inductances (16) (17) and aerial coupling coil (12).

H/F AERIAL CIRCUIT

AERIAL TUNING SELECTOR SWITCH, POSITION IV GREEN.
H/F AERIAL TUNING SELECTOR SWITCH, POSITION A.

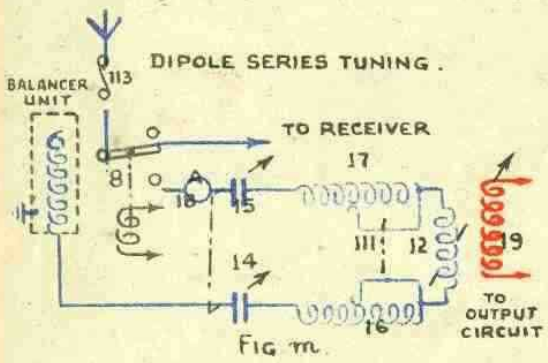


Fig. m.

AERIAL TUNING SELECTOR SWITCH, POSITION IV GREEN
H/F AERIAL TUNING SELECTOR SWITCH, POSITION B.

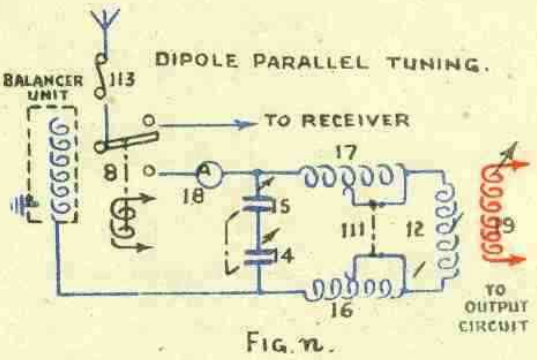


Fig. n.

H/F Aerial Tuning Selector Switch. Position "X". The arrangement of the components in this position of the switch is shown in Fig. o. This is the "Series" position for unipole working, the aerial tuning condenser (15) and inductance (17) being in series between the aerial and the coupling coil (12) which is earthed.

H/F Aerial Tuning Selector Switch. Position "Y". The arrangement of the components in this position of the switch is shown in Fig. p. This is the "Parallel" position for unipole working, the aerial condenser (15) being connected in parallel across the tuning inductance (17) and coupling coil (12).

H/F AERIAL CIRCUIT

AE. TUNING SELECTOR SWITCH, POSITION IV GREEN
H/F AE. TUNING SELECTOR SWITCH, POSITION X.

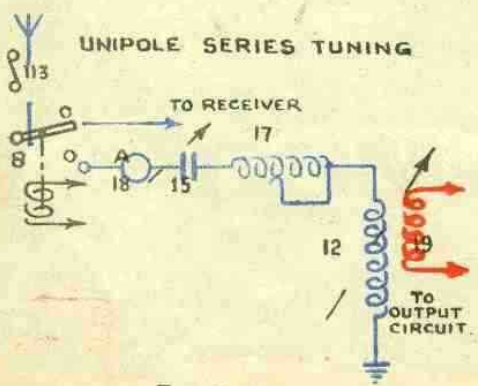


Fig. o.

AERIAL TUNING SELECTOR SWITCH, POSITION IV GREEN.
H/F AERIAL TUNING SELECTOR SWITCH, POSITION Y.

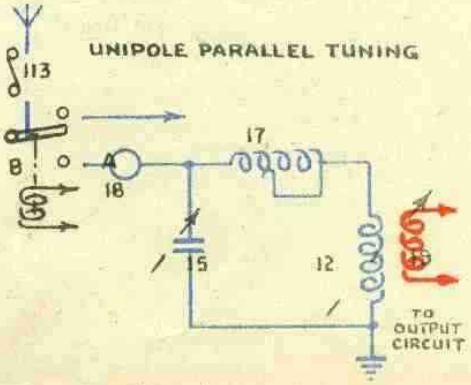


Fig. p.

TYPES 60E/EM/ER/EMR

POWER SUPPLIES

GENERAL. Power supplies required for transmitter 4T are as follows:-

(a) 900 volts D.C. for H.T. supply; motor generator, driven from 20 volt battery.

(b) 4 volts D.C. for L.T. supply; 4 volt battery.

(c) 90 volts D.C. for grid bias; dry battery.

(d) 20 volts D.C. for control and keying purposes.
In types 60E/ER :- 20 volt battery.
" " 60EM/EMR:- Under emergency conditions from a 20 volt battery.
Under normal conditions from a potentiometer across the ship's 110/220 volt mains.

TYPE 60E/ER

Twelve accumulators are divided into six separate two-cell units for portability. Five of these units are used in series to form the 20-volt battery (90), the remaining unit being used for the filament battery (89).

The 20-volt battery supplies:-

(a) The motor generator (75) which takes 18/24 volts giving an output of 900 volts, 150 watts to supply the total H.T. for the transmitter.

(b) Motor generator switch starting unit (76).

(c) Keying and Control circuits.

(d) Microphone (97) (when R/T is used).

Battery charging from the ship's mains is arranged via charging resistance (81), the "Battery charging" switch (112) and Power supply switch (80).

Power Supply Switch Positions.

Position 1. (4 volt and 20 volt charge).	Both batteries in series for charging.
Position 2. (20 volt charge).	20 volt battery only on charge.
Positon 3. (OFF).	
Position 4. (ON).	Transmitter ON, 20-volt supply to starting switch unit (76) and auxiliary circuits, 4 volt supply to filaments.

The 110/220-volt D.C. mains supply is connected via plug and socket (172) and through charging resistances (81) which are 14-ohm resistances with a link for putting either one or both in series according to the mains supply available.

The supplies from the 4-volt and 20-volt batteries are connected to the power unit by plug and socket (173) and (174).

TYPE 60EM/EMR

The power supply to the control and keying circuits is taken from the ship's 110/220-volt mains via a double pole switch (163) and potentiometer (164). Under "Emergency Conditions" all the power supplies are as for Types 60E/ER.

The supply for the motor generator is taken from the 20-volt battery.

The filament supply is ALWAYS taken from the 4-volt battery.

Potentiometer (164).

110-volt ships:- 56-ohms, 20-amps, tapping at 14-ohms.
220-volt ships:- 88-ohms, 2.5 amps, tapping at 11-ohms.

TYPES 60E/EM/ER/EMR

POWER SUPPLIES

The functions of the Power Supply Switch (80) in its various positions are as follows:-

Position 1.	Charging supply switch (112) ON	4-volt and 20-volt batteries in series for charging.
Position 2.	Charging supply switch ON	20-volt battery ONLY on charge.
Position 3.	Charging supply switch OFF.	Transmitter ON. 20-volt battery supply to motor generator, starting switch unit and control circuits; 4-volt supply to transmitter filaments.
Position 4.	Charging supply switch and potentiometer supply switch (163) ON.	Transmitter ON. 20-volt battery supply to motor generator. 20-volt supply from potentiometer to switch starting unit (76) and control circuits. 20-volt battery "Floating" across ship's mains.

NOTE:- Position 3 is the Emergency "Transmitter ON" position and is used if D.C. mains fail, when all supplies are taken from batteries.

Position 4 is the Normal "Transmitter ON" position and is provided to obviate the use of a duplicate 20-volt battery.

An indicator unit 4T is provided, consisting of two voltmeters (83) and (84) with "press to read" switches and an ammeter (82), which enables the condition of the batteries and charging rate to be noted. The charging resistance (81) is 14-ohms for 110-volt ships, and two in series for 220-volt ships.

Power Supply Unit 4T (Type 60ER).
Control Supply Unit 4T (Type 60EMR).

These units are arranged as base supports for transmitter 4T.

In type 60ER all the battery supplies and ship's mains supply for charging are supplied via plugs, and sockets mounted on the lower part of the front panel, the upper panel contains the power supply switch (80) with position 3 as the "OFF" position, two voltmeters (83) (84) with "Press to read" switches, ammeter (82) and the C.W. - M.C.W. - R/T switch (74). (See fig. t.)

In Type 60EMR, the same unit is fitted with a few variations.

The lower assembly contains only a terminal board. The upper section contains the power supply switch (80), two voltmeters (83) (84) with "Press to read" switches, ammeter (82), C.W. - M.C.W. - R/T switch (74) and the potentiometer switch (163).

Under normal operating conditions the 20-volt supply to the motor generator switch starting unit (76), noise suppression unit relay (167), keying control and microphone (97) circuits are taken from the ship's mains via a double-pole switch (163) and potentiometer (164) with a fixed tapping to give a normal 20-volt supply. The reason for this is that the 20-volt battery is "floating" across the ship's mains. In order to prevent getting 110/220 volts across the 20-volt circuits in the event of the 20-volt battery fuse blowing, it is necessary to have an independent 20-volt supply to these circuits.

In addition to the power supply switch (80), a 2-pole, 1-way switch (91) is fitted alongside the morse key at each control position and controls the key circuit and motor generator starting unit (76). The latter is provided with two magnetic switches (78) and (79) One completes the 20-volt supply circuit to the motor generator, and the other to the 4-volt filament supply circuit.

A 90-volt dry battery (63) is provided to bias the suppressor grid of the output valve for M.C.W. or R/T transmission.

AUXILIARY CIRCUITS.

The auxiliary circuits may be divided into three parts viz:-

(a) Control circuits.
(b) Motor Generator starting circuits.
(c) Keying circuits.

and all are fed from the 20-volt supply, either from the 20-volt battery, or a tapping on the potentiometer, resistance across the ship's mains. Circuits are shewn in figures r and s.

TYPES 60E/EM/ER/EMR

AUXILIARY CIRCUITS

Control Circuits.

The control circuits of Types 60E/EM/ER/EMR are substantially identical. The 2-pole 3-way "C.W.-M.C.W.-R/T" switch (74) controls the 20-volt supply to the "lock-on" relays (46) (47) in Transmitter 4T, which controls the character of transmission. These relays consist of two magnetically operated 3-pole, 2-way switches connected together in such a way as to act as a 3-pole, 3-way switch. The contacts of each relay are held together in one way by virtue of the spring bias of the blades and are made to operate the other way by completing the circuit of one of the two bobbins. At the same time a latch arrangement is automatically operated, which holds the contacts in this position against the tension of the springs (this feature is necessary in certain cases where the Transmitter 4T is fitted in C.W.S. ships). To return the relays to their original position it is necessary to energise the second bobbin, which releases the locking device.

A siemens relay (57) is also operated by the external C.W.-M.C.W.-R/T switch (74) when the latter is in the M.C.W. or R/T position. This relay connects the 70,000-ohm resistance (59) (60) (see Fig.4) across the 90-volt supply for providing the speech amplifier valve (3) grid bias. A 350-ohm resistance (58) is connected in series with the bobbin of this relay to drop the volts to a suitable value.

Motor-Generator Starting Circuits.

The motor-generator starting circuits of Types 60E/ER differ somewhat from those of Types 60EM/EMR. In the former installations the motor-generator is started by the Switch Starting Unit (76) when the Power Supply Switch (80) is made to the "Set On" position, while in the latter it is necessary to also make the double-pole switch (91) at either the local or remote control position before the motor generator is started.

Types 60E/ER. When the set is to be controlled locally, i.e. "Local-Remote Control" switch (114) set to 'Local' the action of putting the Power Supply Switch (80) to Position 4 completes the bobbin circuit of the magnetic Switch (78) in the Switch Starting Unit (76) With the Local-Remote Control switch in the 'Remote' position the bobbin circuit of the magnetic switch (78) is broken until the control switch (91) at the remote control position is made.

One contact of the magnetic switch (78) completes the 20-volt supply to the field winding of the motor-generator (75) directly and the armature circuit through the starting resistance (77). The second contact of the magnetic switch (78) completes the circuit of the second magnetic switch (79) also in series with the starting resistance (77). When the motor-generator has run up to speed the voltage drop across the starting resistance is less and the second magnetic switch (79) operates. One contact of this switch short-circuits the starting resistance and the other completes the 4-volt supply to the transmitter.

Types 60EM/EMR. In these sets it is necessary to make the double-pole switch (91) at the local control position or the "Remote Control" switch (114) and the double-pole switch (91) at the remote control position in order to start the motor-generator. After this operation has been performed the Switch Starting Unit (76) operates as in Types 60E/ER.

Keying Circuits.

These circuits are similar to the motor-generator starting circuits in-that in Types 60E/ER the keying circuit is completed by the power supply switch (80) and Local-Remote Control switch (114) whereas in Types 60EM/EMR it is necessary to make the double-pole switch (91) at the local position or the Remote Control switch (114) and the double-pole switch (91) at the remote control position.

In either case, pressing the morse key completes the circuit of the signalling relay (65) in Transmitter 4T through the 125-ohm resistance (66). The same effect is produced when the telephone handset is removed from its cradle (thus making the interlock switch (100) in the cradle) and the "Press to Speak" switch (98) on the handset is made.

Keying of the Transmitter (either for W/T or R/T) also operates the relay (167) of the Noise Suppression Unit 4T, as it is connected in parallel with the signalling relay circuit, in series with a 300-ohm resistance (168). The contact of this relay connects a 6-ohm resistance (166) across the telephone lines, thus reducing the noise in the telephones (95).

TYPES 60E/EM/ER/EMR

AUXILIARY CIRCUITS

A form of grid keying is employed for Transmitter 4T. The principle of the method will be understood by reference to Fig.9, in which 'V' represents the transmitter valves which it is required to key. The resistances R1 (69) and R2 (68) are connected across the transmitter H.T. supply of 'E' volts, the anodes of the valves being connected to point 'C' and the grids to point 'B', while the filaments are connected to point 'A' at the junction of the two resistances. Under these conditions, the potential at the point 'A' will be $\frac{(R2)\ E}{R1 + R2}$ and thus the grids of the valves will be at this potential negative to their filaments. By suitable adjustments of the resistances, this potential can be made such that the valves are shut down. If now the magnetic key (8) be connected across the resistance R2, on pressing the morse key the magnetic key will short-circuit the resistance, thereby removing the negative bias on the grids and the transmitter oscillatory circuits will oscillate normally.

As no current is required for this purpose, the resistance may have high values, thus making the current drain on the H.T. supply negligible and keeping the physical dimensions of the resistances small. In Transmitter 4T, R1 (69) is 300,000-ohms and R2 (68) is 100,000-ohms. Thus with an H.T. supply of 900 volts the grids of the transmitter valves (1) (2) (3) are run 225 volts negative during spacing periods.

GRID SIGNALLING CIRCUIT

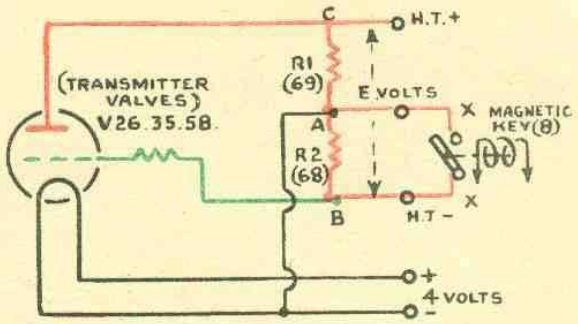


Fig 9.

The magnetic key (8) used in the Transmitter 4T for signalling purposes as described above is a magnetically operated 2-pole, 2-way switch. The aerial is connected via the aerial socket (108) and aerial circuit fuse (113) to one pole and is changed over from receiver to transmitter with the movement of the key, thus providing for 'listening-through' during spacing periods. The other pole short-circuits the 100,000-ohm resistance (68) when the key operates.

The contacts of the key are spring-loaded into the "Receive" position and are pulled into the "Transmit" position by two bobbins connected in series. These bobbins are supplied directly from the auxiliary circuit 20-volt D.C. supply through a high-speed relay (65). The high-speed relay also is operated from the auxiliary 20-volt D.C. supply via the morse key or "Press While Speaking" switch on the telephone handset. The link (67) in the Transmitter 4T must be set to the correct position for internal signalling relay supply, as indicated on the label attached.

R/T Control Circuits.

The microphone requires a polarising voltage of 4 to 8 volts and this is obtained from the 20-volt supply through a 200-ohm resistance (64). The circuit is so arranged that this supply is only connected to the microphone circuit when the C.W.-M.C.W.-R/T switch (74) is made to "R/T". The "Press While Speaking" switch (98) fitted in the microphone handset in series with a "Safety Switch" (100) is connected between the positive line of the microphone polarising supply and the terminal S2 of the key line and is thus in parallel with the morse key (92) and takes its place for switching on the carrier wave for R/T.

The Safety Switch (100) is fitted on the microphone stowage holder in such a way that it can only be closed when the microphone handset is out of its stowage position. This prevents the accidental switching on of the carrier wave when removing or replacing the handset.

An R/T Control Unit is fitted in both the local and remote control positions. This unit contains all the necessary equipment required at an operator's control position for an R/T transmission. It includes:-

(i) A Patt. 5756 Telephone Handset with a 7-pin plug and flexible lead.

(ii) A Patt. 5755 Connecting Box with 7-pin socket. (Local Only).

(iii) A Patt.6783 Mount for the Handset, with interlocking safety switch.

The Patt. 5756 Telephone Handset consists of a microphone unit (97) "Press While Speaking" switch (98) and telephone receiver (99).

The microphone units are connected in parallel direct to the microphone transformer in the Transmitter 4T via the terminals "M1","M2" and "M3".

A Patt. 4480 Loudspeaker is provided for use on the Bridge during R/T transmissions and is plugged in the telephone jack (95) at the remote control operator's position.

TYPES 60E/EM/ER/EMR
TUNING

TUNING. MASTER CONTROL.

To tune the transmitter the following procedure should be carried out:-

(i) Select the range unit covering the frequency it is desired to transmit and insert it in the transmitter.
Note:- Care must be taken to ensure that the two latches at the top of the transmitter are vertical before the key is pressed.

(ii) Set the Master Tuning Condenser (31) as determined by the appropriate curve in the "Book of Typical Master Tuning Curves" supplied with the transmitter.

(iii) Set the C.W.-M.C.W.-R/T switch (74) to "C.W."

(iv) Set the Aerial Tuning Selector Switch (6) to a position between III and IV.

(v) Press the morse key (92). The output valve anode ammeter (36) may read as much as 150 milliamps.

(vi) Tune the output circuit to the maximum dip in the output valve anode current.

(vii) Accurate adjustment of the frequency may now be made by means of the G61/G62 wavemeter (if available), which should be plugged into the socket (70) provided on the range unit, the Master Tuning Condenser (31) being adjusted to give maximum deflection in the Wavemeter Milliammeter.

(viii) Retune the master and output circuits as in (vi).

(ix) Set the aerial coupling to '0' by means of the aerial coupling control (162) on the range unit.

(x) Set the Aerial Tuning Selector switch (6) to the position covering the frequency required. The range of frequencies covered by each position of this switch varies with the capacity of the aerial e.g.:-

Switch.	Tuning.	AE Capacity.	Frequency Range.
Position I (Red)	M/F	0.00044mfd.*	100 - 1350 kc/s.
" "	"	0.0011 mfd.	100 - 850 kc/s.
Position II (Blue)	M/F	0.00044mfd.	750 - 1500 kc/s.
" "	"	0.0011 mfd.	480 - 1050 kc/s.
Position III (Black)	M/F	0.00044mfd.	1200 - 2200 kc/s.
" "	"	0.0011 mfd.	750 - 1500 kc/s.
Position IV (Green)	H/F	-	1500 - 1250 kc/s.

Note:- * In position I of the switch the external condenser (175) should be switched in to obtain the lowest frequencies when the aerial capacity is small. This condenser must never be used in other positions of the range switch or with a range unit other than '0'.
In position IV the "H/F Tuning Selector" switch (13) should also be set to the appropriate position for the unipole aerial (X or Y).

(xi) Tune the aerial circuit for maximum aerial current. It will be found that the maximum aerial current coincides with a sharp rise in anode current indicated by the output valve anode ammeter (36). The reading of this meter may therefore be used for accurate tuning of the aerial circuit when the aerial current is small. When transmitting on H/F care should be taken to use only the two positions (X and Y) of the "H/F Aerial Tuning Selector" switch (13) appropriate to the unipole aerials. Both Series and Parallel positions should be tried, the one which gives the greater aerial current being used.

TYPES 60E/EM/ER/EMR

TUNING

Note:- To facilitate rapid tuning of the aerial circuit the controls required for a given frequency band are selected by the "Aerial Tuning Selector" switch (6). Each position of the switch has a number and associated colour. Coloured buttons fitted at the side of each aerial tuning control indicate, by the same colour, which controls are to be used for the various positions of the "Aerial Tuning Selector".

(xii) Adjust the aerial coupling control (162) for maximum aerial current.
NOTE:- THE EXTERNAL CONDENSER (175) MUST ONLY BE USED TO TUNE THE AERIAL TO THE LOWEST FREQUENCIES, i.e. when range unit '0' is in use. IT MUST NEVER BE SWITCHED INTO CIRCUIT WHEN TUNING THE TRANSMITTER TO HIGH FREQUENCIES, as although an increased reading will be obtained on the aerial ammeter the true aerial current will be much reduced.

The above procedure should be carried out on C.W. If M.C.W. or R/T is required the control switch (74) should be made to the appropriate position after tuning is completed.

TUNING WITH CRYSTAL.

To tune the transmitter with crystal control:-

(i) Select the range unit covering the frequency it is desired to transmit and insert it in the transmitter. It may be found that the next lowest range unit will have to be used.

(ii) Insert crystal for appropriate frequency in socket behind Master oscillator valve.

(iii) Put switch behind Master Oscillator valve to 'Crystal' position.

(iv) Set the C.W.-M.C.W.-R/T switch (74) to C.W.

(v) Set the Aerial Tuning Selector Switch (6) to a position between III and IV.

(vi) Press the morse key (92). The output valve anode ammeter (36) may read as much as 150 milliamps.

(vii) Tune the output circuit to the maximum dip in the output valve anode current and then allow to rise slightly.

(viii) Set the aerial coupling to '0' by means of the aerial coupling control (162) on the range unit.

Then carry on as for tuning with Master.