SECTION
Y
AIRCRAFT SETS

DUAL PURPOSE GENERATOR

Date of design:- 1926.

Generator. The dual purpose generator is driven by a windmill and supplies the transmitting set with 1200 volts from one armature (46) for H.T. and 10 volts from the other armature (45) for filament lighting and for supply to the bobbin circuit of the magnetic or listening through key (8) (see page Y4).

The generator is designed for speed of 3500 r.p.m. and a Mortley slipping clutch (50), centrifugally operated, is fitted to prevent this speed being exceeded, and the risk of the terminal voltage exceeding its normal value.

If it is desired to "motor" the generator, the series field (49) should be short circuited at the terminals fitted on the machine. A 2 volt field exciting battery (or a tapping from the L.T. receiving battery) can be connected across the L.T. field by a D.P. switch (47) if desired.

All leads from the generator are taken to a 9-point plug fitting (31) to which is connected the generator control box. This plug (31) should never be removed whilst the machine is running, as the polarity of the L.T. field will become reversed or its residual magnetism so reduced that the generator will fail to excite. Should the polarity of the generator, through this, or any other cause, become reversed, the L.T. field should be separately excited by a 6 volt battery.

Attached to the shaft of the generator are two interrupter discs (42)(43) and a plain disc (44). Seven interrupter discs varying from 10 to 24 segments are provided, but only two can be fitted at a time. They are used to interrupt the grid-filament and the H.T. circuits at different frequencies (i.e., High or Low Note for I.C.W. transmissions). The high note disc (24 segments) is permanently fitted, and gives a note frequency of 1400 cycles. The low note discs give a note frequency between 500 cycles (10 segments) and 1160 cycles (20 segments). The plain disc (44) is common to the interrupter discs fitted and is merely used to make a brush contact to complete the interrupter circuit.

The generator is mounted on a cradle (58) which is insulated from the earth of the aircraft. Failure to keep this insulation high, tends to increase commutation noises in the receiver, especially when using H/F. The generator is shown complete in figure b. and stripped in figure c.

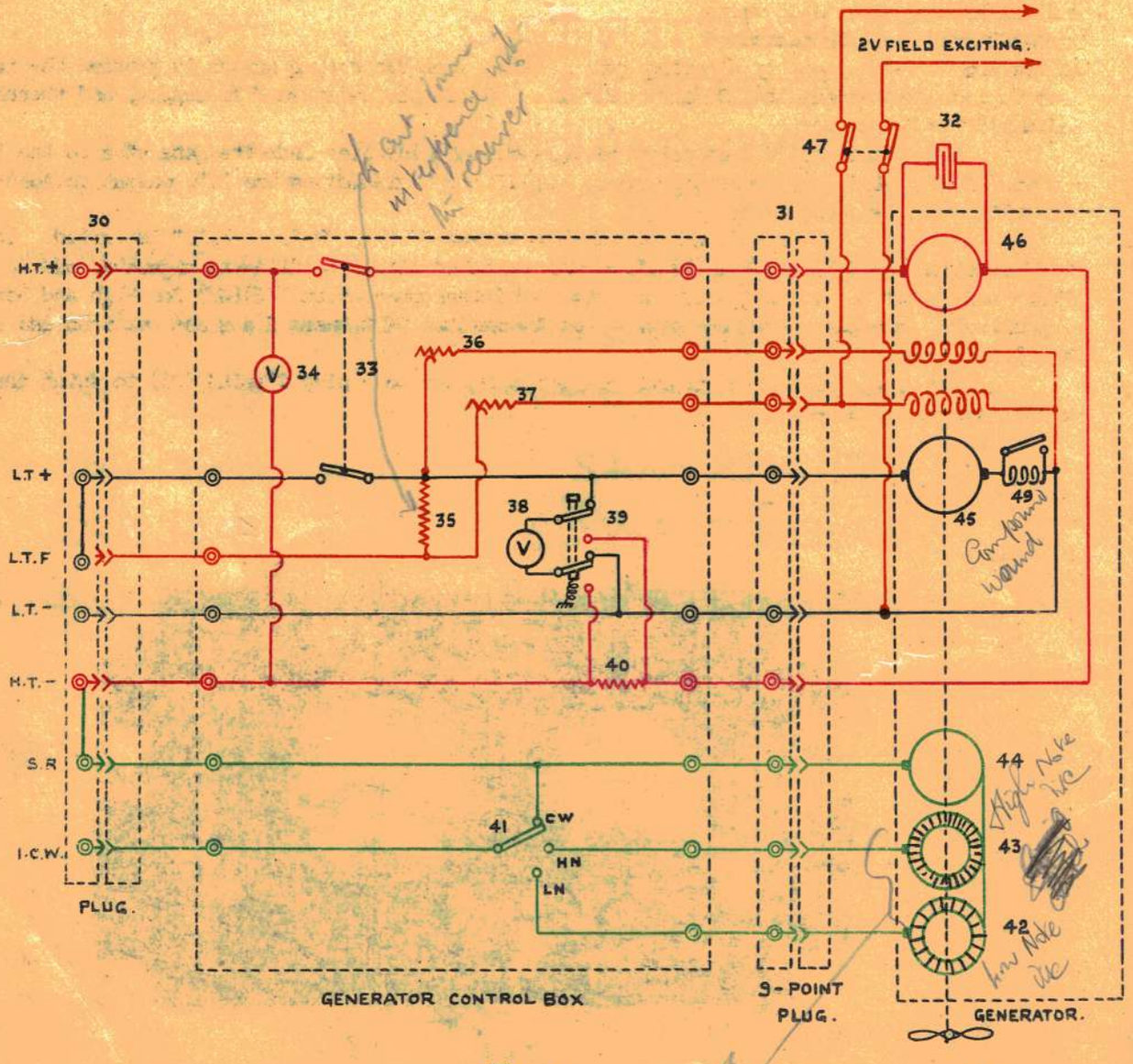


FIG. a.

DUAL PURPOSE GENERATOR

Generator Control Box. The generator control box is a separately mounted unit consisting of a base and plug-in top (figure d.). The base is secured to the aircraft and, by means of soldered connections, is the connecting link between generator and transmitter plugs (31) and (30). The top carries the H.T. and L.T. controlling and measuring instruments.

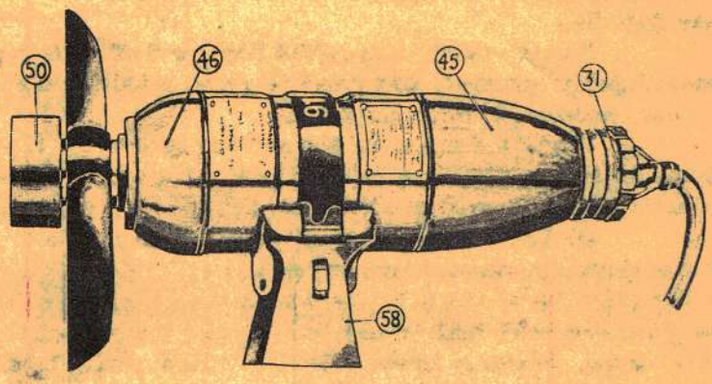


Fig b

A field regulator of 9 ohms (36)(37) is connected in the field of each generator. An additional 150 ohm resistance(35) is connected across the generator fields to reduce generator interference in the receiver. As the movement of the filament regulator (37) affects H.T. output, care should be taken, when adjusting, to prevent H.T. voltage exceeding that laid down for the transmitter in use.

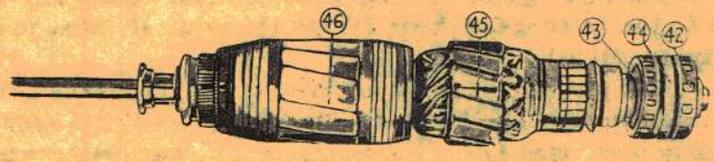


Fig c

A combined voltmeter and milliammeter(32) (0-15 volts or 0-150 milliamps) is connected across the 10 volt output by a spring switch (29). When the spring switch is pressed the instrument is connected across the 100 ohm resistance (40) in the negative H.T. supply, and therefore indicates the H.T. current.

A D.P. switch (33) controls the H.T. and L.T. supplies from the generator to the transmitter. A voltmeter (34) connected across the H.T. supply indicates the H.T. output voltage when the switch (33) is made.

A three way C.W. - I.C.W. switch (41) marked "C.W.", "H.N.", "L.N." is fitted. In the "C.W." position the grid and H.T. negative are connected direct to filament negative, and in the "H.N." and "L.N." positions through the required interrupter discs (43)(42) for High and Low Notes respectively. (see pages Y12 and Y16). With Transmitter T21C these discs are not used and therefore I.C.W. cannot be transmitted.

The outputs from the control box are connected to a plug fitting (30) to which the transmitter is connected.

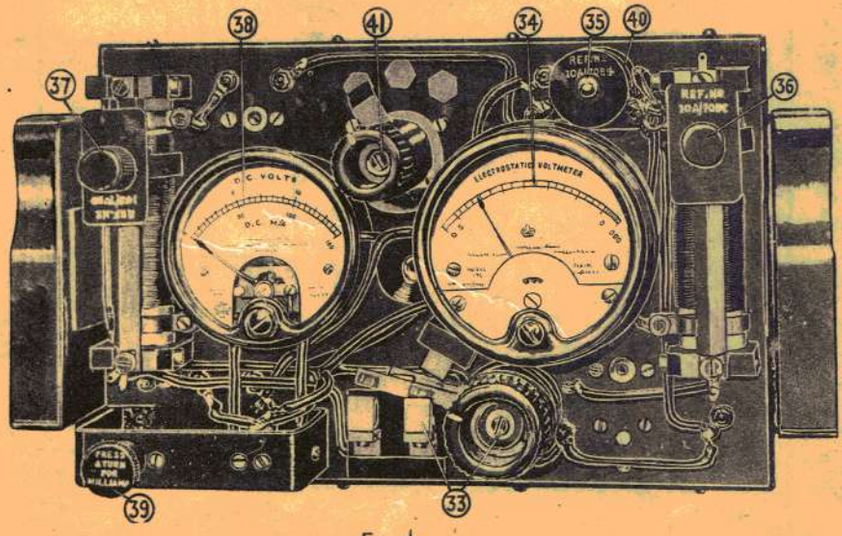


Fig d

Y4

TRANSMITTER T21C

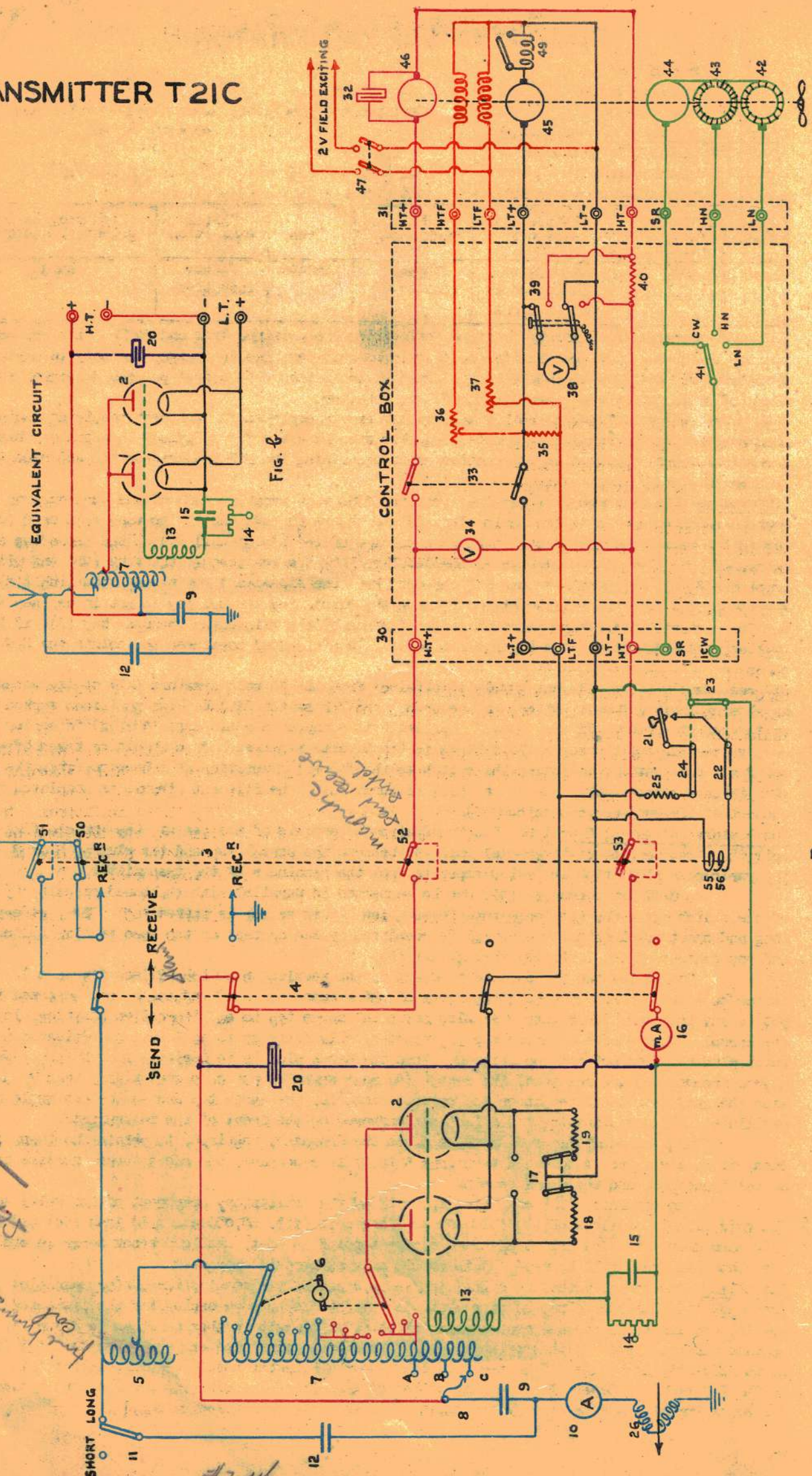


Fig. b.

Fig. a.

TRANSMITTER T21C

150 miles range (?) (?) (?)

Date of design:- 1923.
Frequency range:- 120 - 375 kc/s.
Power supply:- Dual purpose generator, 120 watts 1200 volts and 40 watts 10 volts.

Associated wavemeter:- R.A.F. W3.
Valves used:- Two V.T. 1A.
Approximate range in miles:- 150 miles.

Receiver TF

Wave form	Method of producing oscillation	Nature of circuit	Grid excitation.	Feed	Aerial excitation	High oscillating potential electrode
C.W.	Self	Tuned circuit between anode and filament.	Mutual inductive	Series	Direct inductive	Anode

Transmitter T21C is a modified form of the Transmitters T21A and T21B. With the exception of the keying, the modification does not constitute changes in design, but only in certain details of construction to enable the transmitter to be used with a dual purpose generator in place of a single purpose generator and filament battery.

Transmitter T21C is an L/F transmitter and is employed for purposes requiring medium long range. The transmitter is mounted together with receiver "Tf Modified" in a crate. This crate is removable so that an alternative crate containing the H/F transmitter T48 and receiver R47 can be fitted in its place.

H.T. Supply. The H.T. supply is obtained from the 1200 volt armature (46) of the dual purpose generator and is connected to the earth plug (8) and thence through one of the taps A, B or C (depending on the wave frequency in use) through a portion of the aerial coil (7) to the anode tap and the anodes of the valves. The circuit is completed to H.T. negative through the link (23) and milliammeter (16) when using the "listening through" key (see figure a.), or through the link (24), morse key (21), link (22) and milliammeter (16) when the "listening through key is not in use(see figure d.) Two contacts of the"send-receive" switch (4) and of the "listening through" key (3)(if in use) complete the H.T. supply. The 9 jar condenser (9) is a blocking condenser to isolate the H.T. from earth.

Filament Supply. The filament supply is obtained from the 10 volt armature (45) of the generator, or alternatively a 6 volt battery may be used. The D.P. switch (17) has two positions marked "10 volts" and "6 volts". In the "10 volt" position it connects a resistance (18)(19) in series with each valve filament to reduce the voltage to the 6 volts required. Care should be taken **after** using a 6 volt battery to return the switch to the "10 volt" position as otherwise, when the generator is used subsequently, the valves will be burnt out. The filament circuit is completed by one contact of the send-receive switch (4).

Oscillatory and Aerial Circuits. The tuned circuit consists of the aerial, the 200 mic fine tuning coil (5), that portion of the aerial coil (7) between the aerial tap and the plug A, B or C, and the variometer (26) which is fitted separate from the remainder of the transmitter.

A 0.27 jar condenser (12) can be connected in parallel with the tuned circuit, by means of the switch (11), for the lower wave frequencies. This switch is marked "L" - "S", referring to long and short wavelengths. The aerial is completed by one contact of the send-receive switch (4) and one contact of the listening through key (3).

The aerial tap is adjusted by means of the wavelength switch (6)(see figure c.). This switch has studs, numbered 1 to 12 by means of which added turns of inductance are switched in; when put to any position higher than 7 it also moves the anode tap to an alternative position, lower than the normal. This change of anode tap is, however, only designed to come into operation when the earth plug has been put into position C. When the earth plug is in position A or B (i.e., when the higher frequencies are required) the switch (6) must NEVER be put on a stud higher than 7, as otherwise the anode tap would be either on, or very close to, the earth tap and so the set would not oscillate. (Instructions to this effect are engraved on the front of the instrument).

The position of the earth tap depends on the frequency required; to obtain the lower frequencies, it is moved from A to B and then from B to C; in each case, the added turns increase both the aerial inductance and the anode tapping.

The condenser (20) completes the path of the oscillatory component of the valve current. The grid circuit consists of the 2000 mic coupling coil (13), 60,000 ohm grid leak (14) and 1.8 jar grid condenser (15). The grid leak has a centre tapping so that, should a break occur in one half, the other half can still be used. This should only be done in emergency.

Signalling. The normal method of signalling is by means of a listening through(or magnetic) key (3) (see page Y7). Another method of signalling is brought into use by unplugging the listening through key (3) and inserting the adaptor in place of it. The circuit is then as shown in figure d. The contacts of the listening through key (3) have been short circuited and the morse key (21) is connected directly in the lead from the grid leak (14) to filament negative. This lead is also part of the H.T. negative lead. Thus in this method of signalling two circuits are made and broken by the morse key (21):- (a) The grid circuit. (b) The H.T. negative supply.

TRANSMITTER T21C

Operation and Tuning. Connect the generator to the control box and the control box to the transmitter. See that the switch (17) is in the 10 volt position. Put the control switch (33) to "OFF", set the wavelength switch (6) to the approximate adjustment given on the transmitter and insert the earth plug (8) in the correct socket.

Put the control switch (33) to "ON" and adjust the field regulators (36) and (37) so that the H.T. and L.T. voltages are 1000 volts and 10 volts as shown in the voltmeters (34) and (35) respectively.

Make the send-receive switch (4) to "send".

Press the key (21) and see that readings are obtained in the aerial ammeter (10) and the H.T. milliammeter (16). The latter should not read more than 60 mA.

Tuning is now carried out with the R.A.F. wavemeter W3 (see page Y8), the angle of the wavemeter coupling coil (58) being set to a suitable angle to give the necessary glow in the wavemeter pea lamp. The "L" - "S" switch (11) is put to the required position, coarse adjustments are then made on the aerial coil (7) by the wavelength switch (6) and fine adjustments by the fine tuning coil (5). Final tuning is obtained on the variometer (26).

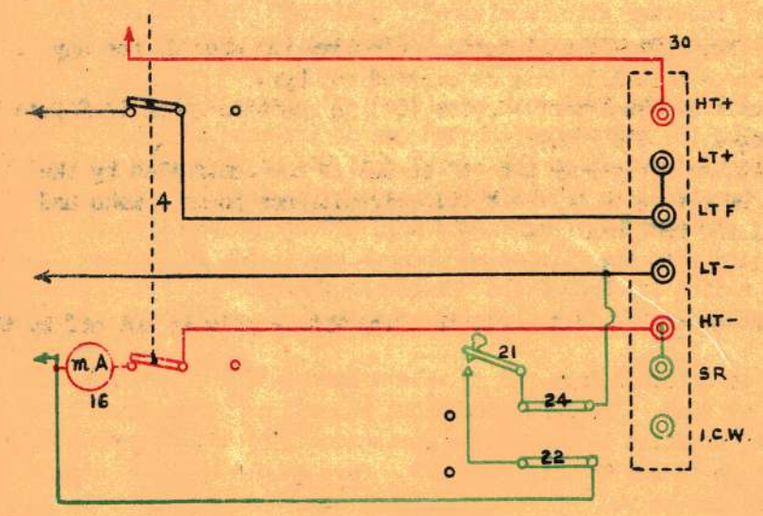


FIG. d.

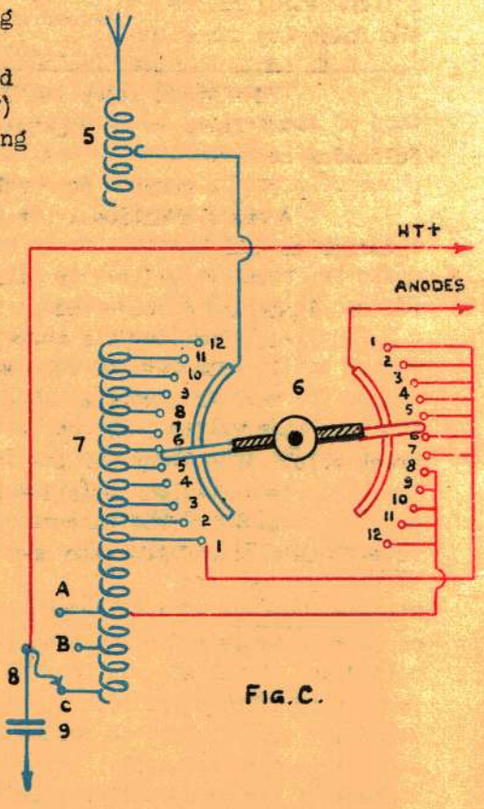


FIG. C.

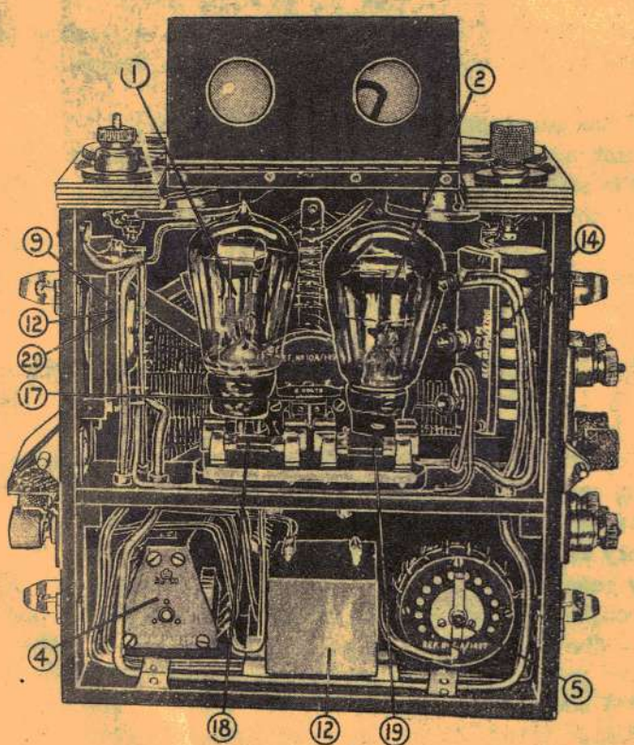


FIG f

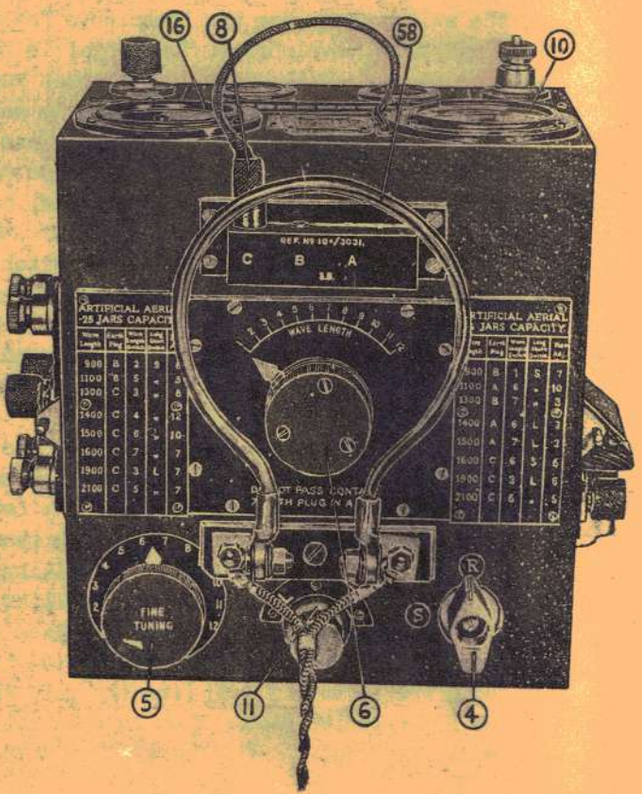


FIG e.

TRANSMITTER T21C
LISTENING THROUGH KEY

The Listening Through Key (3) fitted with T21C and Tf is shown in figure g. If secured direct to the instrument panel its adjustment is seriously affected by aircraft vibration; it is therefore normally hung on a bracket with a suspension cord.

The signalling key (21) completes the 6-volt circuit to energise the bobbins (55)(56) of the L/T key (3). When a D.P. generator is fitted, the L.T. supply is used for this and a 3 ohm resistance (25) is inserted to give correct voltage (see figure a.).

When the bobbins (55)(56) are energised the armature (57) is attracted and causes a bowing of four steel blades (50)(51)(52)(53), each of which carries a tungsten contact. The blades control the following circuits:-

(50) Receiver Aerial
(51) Transmitter Aerial.
(52) H.T. Positive.
(53) H.T. Negative.

The key must be adjusted so that the energising of the bobbin causes action in the following sequence:-

(50) break, (51) make, (52) make, (53) make.

A small additional spring behind blade (50) is fitted to ensure a good contact on the receiver aerial.

Should the listening through key magnetic unit become defective (or should, for any reason, listening through not be required) signalling may be carried out by:-

(a) Removing the magnetic unit and inserting adaptor (54) in position shown in figure h.
(b) Working the send and receive switch (4).

The making of the H.T. circuit and the change over of aerial is now controlled by the S/R switch (4). The hand key, no longer connected to the bobbin circuit, now forms a make and break which directly interrupts signalling by breaking:-

(a) The H.T. negative supply.
(b) The grid circuit.

Note. Care should be taken when removing the magnetic unit that the H.T. supply is cut off by the switch (33).

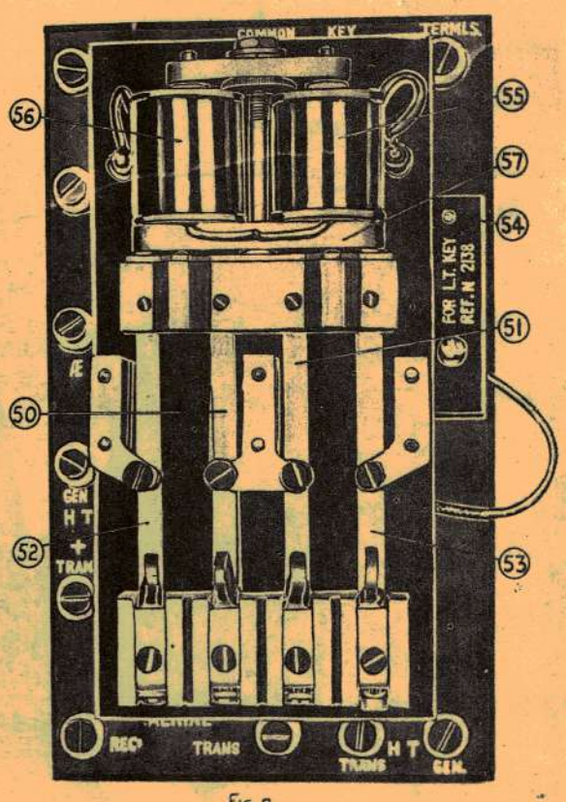


Fig g

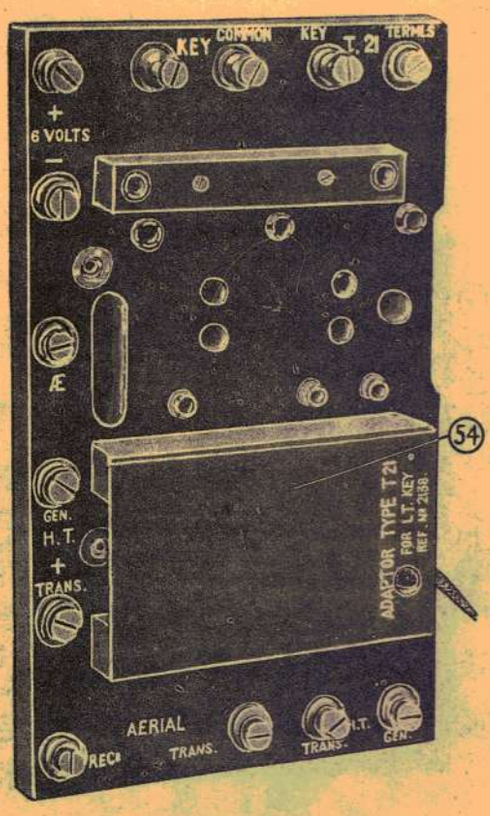


Fig. h

WAVEMETER W3

Date of design:- 1918.
Frequency range:- 75 - 1000 kc/s in four ranges.

The wavemeter is supplied for use with aircraft M/F sets T21C and T22. It is unscreened and uses a directly connected pea lamp (7) as indicating device.

The tuning inductance, wound as a variometer is made in two halves (1) and (2) which may be connected either in series (Range 2) or in parallel (Range 1) by means of the range switch (5). When using Range 2 the dial readings must be doubled to give the correct wavelength.

The tuning capacity consists of two fixed condensers, one of these (3) is always in circuit while the other (14) is added in parallel when plug (8) is inserted in socket holes (9). The plug carries the reading off scale (6); this scale is graduated in two separate parts and dummy sockets (10) are provided for the plug (8) when the condenser (4) is not required. In this way the reading off arrow is always opposite the correct part of the scale.

In order to render the indicating device more delicate a dry cell (16) is connected across the pea lamp (7) which is thus heated to a point approaching incandescence when the push (14) is made. Spare cells (17) and (18) are stowed in the transit case (24), in the lid of which are sockets for five spare pea lamps (19) to (23).

Terminals (15) marked "Alternative Battery" are provided so that it is possible to connect up an external cell.

A choke coil (13) is fitted in series in the battery circuit to prevent R/F oscillations being set up in it and thus damping the tuned circuit. A three way switch (11) connects the battery either to the pea lamp, buzzer circuit or to off. The buzzer (12) is provided to enable the instrument to be used as a wave tester for adjusting the receiver (Tf). The pea lamp is still required to complete the L.C. circuit.

Operation. To facilitate accurate tuning the dial scale (6) now marked in metres is generally covered and the instrument recalibrated to the required frequencies from a ship transmitter.

A coupling coil (58) page Y6, figure e. is secured to the face of the transmitter and joined in series with tuned circuit of the wavemeter.

If the angle of the coupling coil is carefully adjusted it will be found that the transmitter can be accurately tuned; at the same time, an indication is provided of the constancy of frequency during transmission.

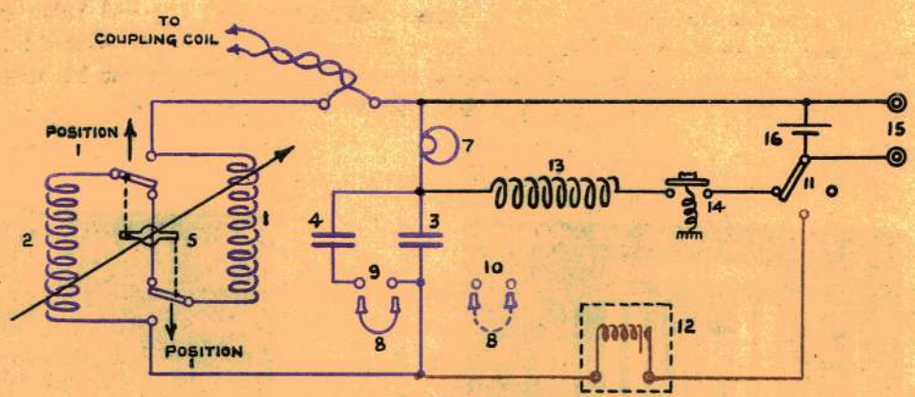


Fig. a.

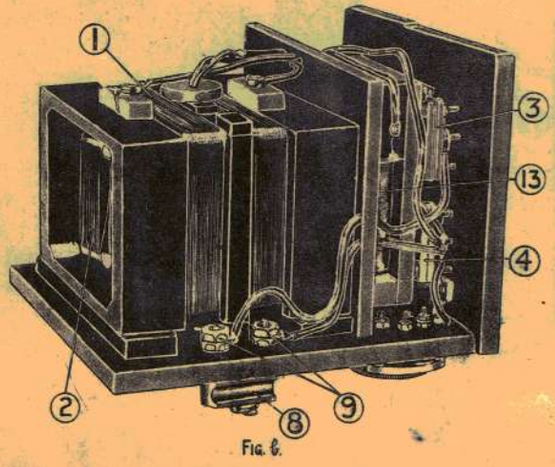


Fig. b.

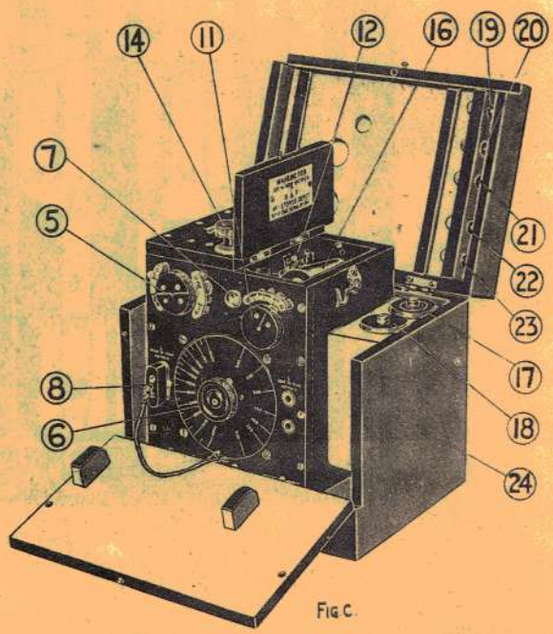


Fig. c.

RECEIVER T f (MODIFIED)

Date of design:-	1917.
Frequency Range:-	120 - 600 kc/s. Normal. 67 - 600 kc/s when used with a 6 jar aerial parallel condenser externally connected.
Where fitted:-	With Transmitter T21C. (See page Y4).
Valves and method of coupling:-	Three VR12F. One cumulative grid detector (1) transformer coupled. Two note magnifiers (2)(3) transformer coupled.

Receiver Tf modified is a tuner amplifier in which the aerial circuit is tuned and direct coupled to the grid of the detector valve (1), thus also forming the tuned grid circuit of that valve.

The aerial circuit consists of the variometer (4), and 120 mic rotating coupling coil (7), with one of four condensers (26)(27)(28)(29) and a fine tuning condenser (30) connected in parallel. The variometer is in two halves which can be connected in series (figure d.) or parallel (figure a.) by the wavelength switch (5). The coupling coil (7) is rotated inside the grid coil (8) and is used to control reaction. (See Admiralty Handbook of W/T (1931) paragraph 566). One of the condensers (26)(27)(28) or (29) is selected or the circuit is broken altogether by means of the switch (6). The positions of the switch are 0, 0.3, 0.6, 1.0 and 1.5 jars respectively. An additional condenser (23) (with a capacity variable in six steps between 1 and 6 jars) can be connected across the aerial and earth terminals for frequencies between 67 and 120 kc/s (see figure d.). This is principally for use when the receiver is fitted in a ground station.

Aerial tuning is carried out with the variometer (4) and condensers (26) to (29) and fine tuning condenser (30). The following are the inductances and wave frequencies obtained with the variometer coils in series or parallel.

Series	140 - 1000 mics	120 - 300 kc/s (67 - 120 kc/s with condenser (23)).
Parallel	35 - 250 mics	200 - 600 kc/s

In the parallel position three quarters of the reaction coil (8) is automatically cut out.

The aerial is connected through a magneto choke (9) and a 0.16 jar grid insulating condenser (11) to the grid of the cumulative grid detector valve (1). A two megohm grid leak (10) is connected in parallel with the grid condenser. The magneto choke (9) is fitted to minimise the interference caused by the make and break of the magneto of the engine.

Transformer coupling is employed between valves (1) and (2) and between valves (2) and (3). In each case the primary of the transformer is shunted by a 3 jar stabilising condenser.

The telephones are connected by means of a plug (18), which can be inserted in either of two jacks marked "One Valve" (13) and "Three Valve" (17) respectively.

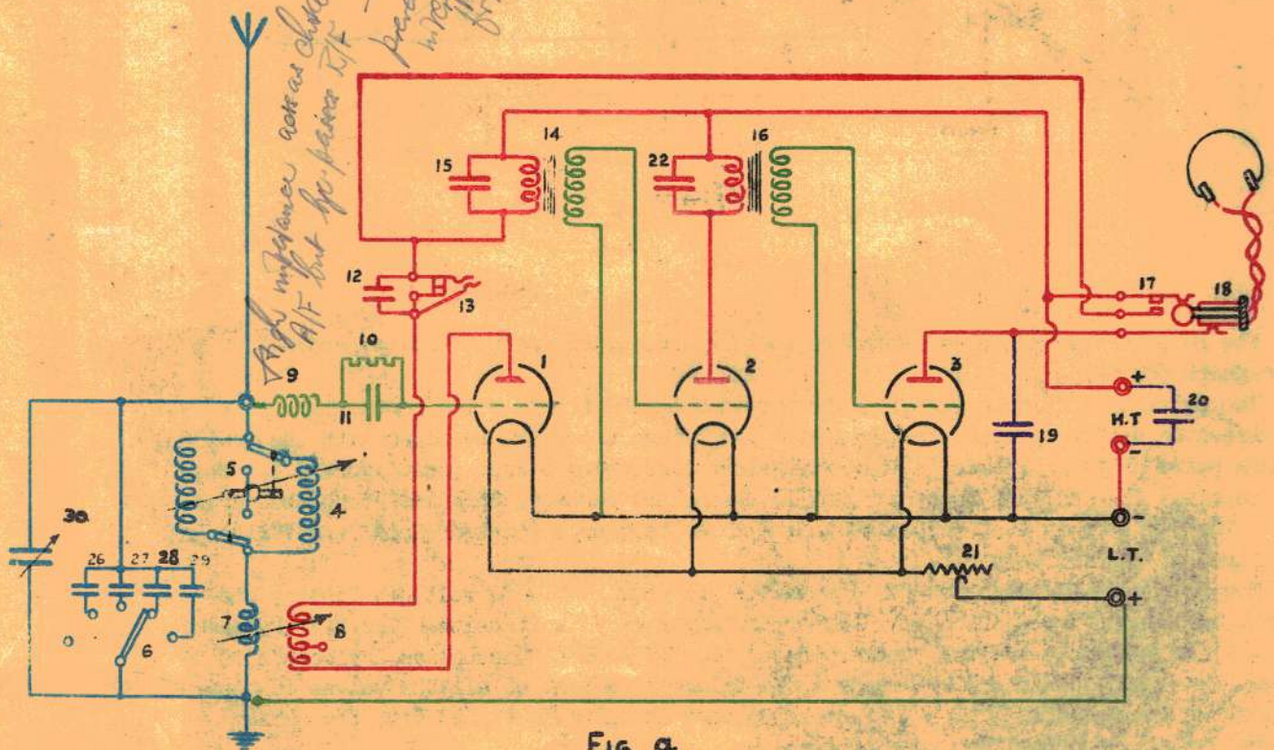


FIG. a.

RECEIVER Tf (MODIFIED)

With the telephone plug (18) in the "One Valve" position (13) (see figure b.) the detector valve (1) only is used. The plug also removes the short circuit of the condenser (12), caused by the jack (13), and therefore connects the 2 jar telephone condenser (12) in the circuit. The jack (17) short circuits the primary of the transformer (14) and its condenser (15) cutting out the valves (2) and (3), so that the positive H.T. is applied to the anode of the detector valve (1) through the jack (17), telephones and reaction coil (8) (see figure a.).

EQUIVALENT CIRCUIT

ONE VALVE POSITION

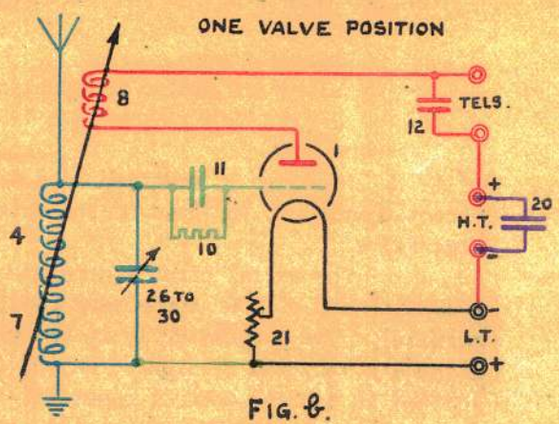


FIG. b.

For the normal or "Three Valve" position, the telephone plug (18) is moved to the "Three Valve" position (17). The telephone condenser (12) is short circuited by the jack (13), and an 8 jar telephone condenser (19) is connected between the anode of the valve (3) and the negative H.T. and L.T. supply. The short circuit in the jack (17) is removed, and H.T. is applied to the anodes of valves (1) and (2) and to valve (3) via the telephones. (See figure a.). It should be noted that in both the one and three valve positions the L.T. supply to all the valve filaments is made.

EQUIVALENT CIRCUIT

THREE VALVE POSITION.

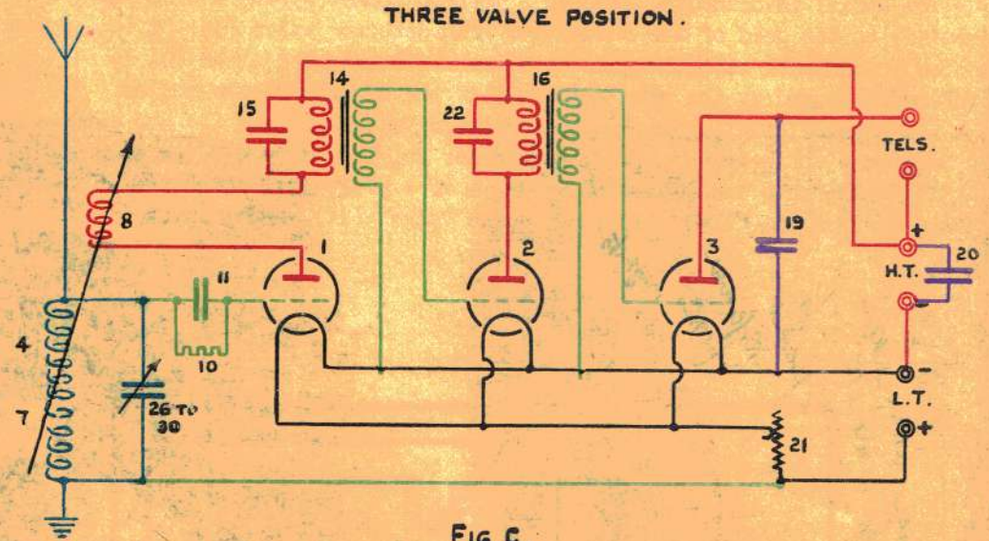


FIG. c.

The receiver is used as an autodyne for C.W. reception (see Admiralty Handbook of W/T (1931) paragraph 569 (c)).

Two pairs of terminals (24)(25) are provided on the front of the model, each pair forming a break on either side of the variometer (4). When using the receiver with the trailing aerial these pairs of terminals are fitted with short circuiting strips (see figure d.). When using the receiver for D/F, the short circuiting strips are removed, thus isolating the variometer (4). The D/F loop is then connected to the outer terminals (marked "Grid" and "Fil") and takes the place of the variometer (4).

The H.T. and L.T. supplies for the valves are from a 45 – 60 volt dry battery and a 2 volt accumulator respectively. The H.T. battery consists of 15 volt units. The H.T. by-pass condenser (20) is fitted in the H.T. battery box. The H.T. and L.T. supplies are connected to the receiver by a plug containing 4 sockets. The filament current of all the valves is controlled by a 1.2 ohm rheostat (21). No form of battery charging is fitted with the set and accumulators must be unshipped for this purpose.

RECEIVER Tf (MODIFIED)

CONNECTIONS FOR NORMAL RECEPTION.

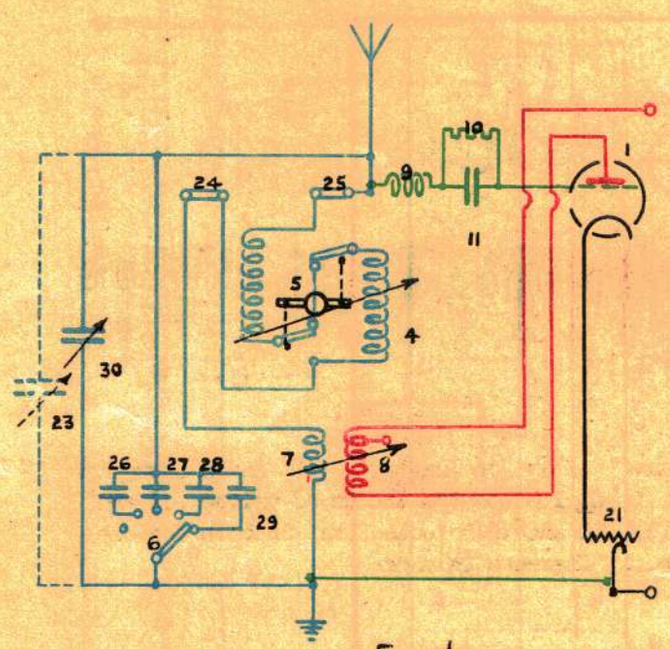


Fig. d.

CONNECTIONS FOR USE WITH D/F AERIAL.

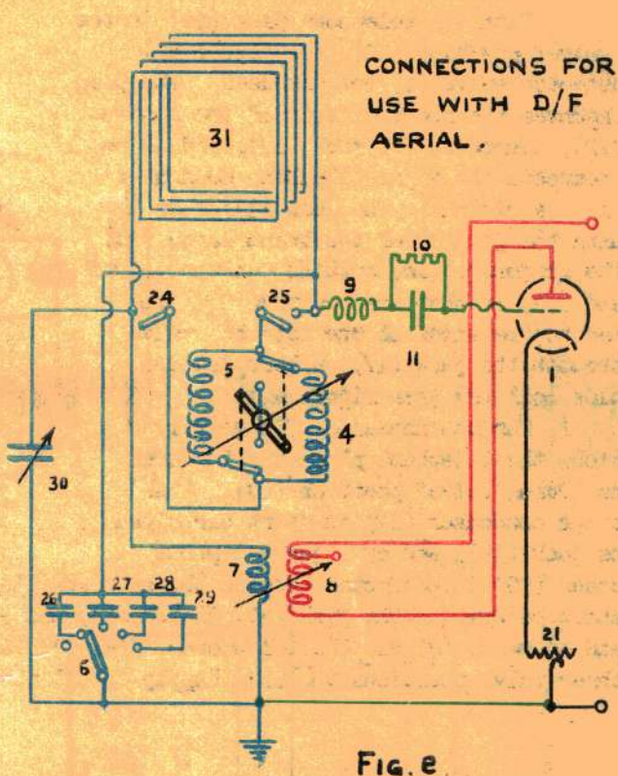


Fig. e

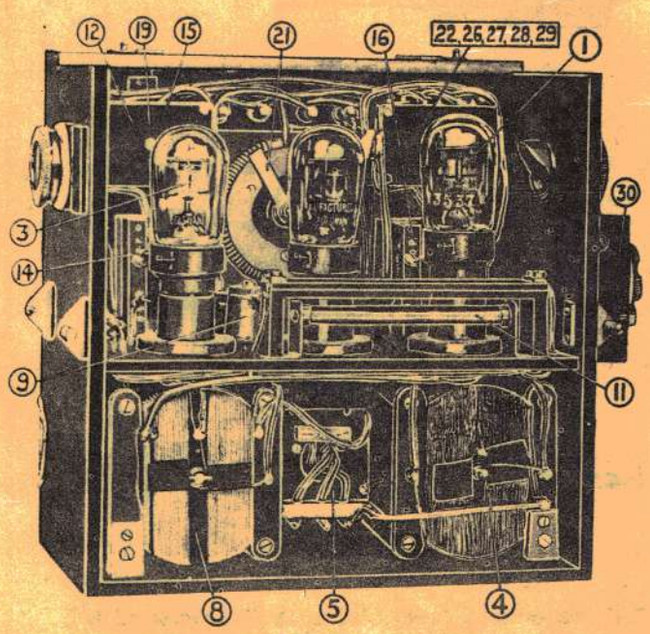


Fig. f

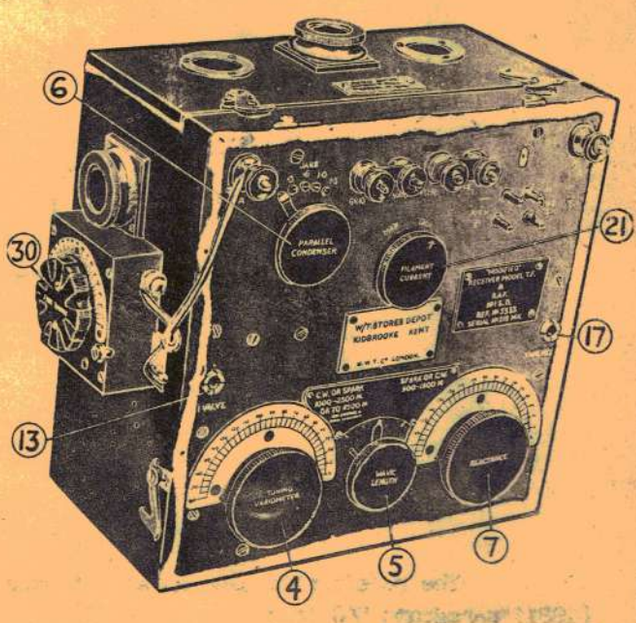


Fig. g

TRANSMITTER T48

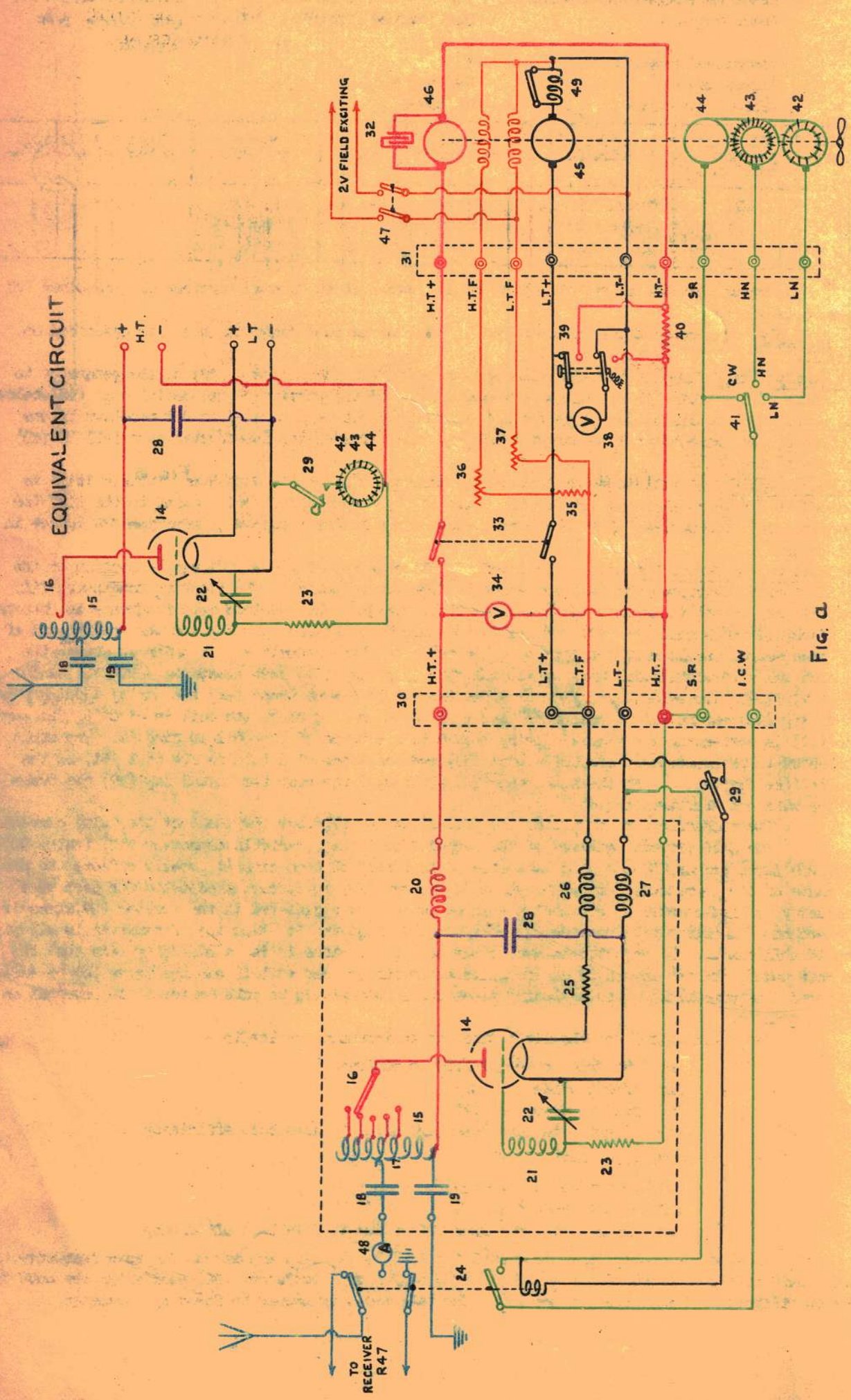


FIG. 1

TRANSMITTER T48

Date of design:- 1928.
Frequency range:- 19,740 - 28,570 kc/s.
Power supply:- Dual purpose generator, 120 watts 1200 volts, and 40 watts 10 volts.

Associated wavemeter:- 66.
Valves used:- One D.E.T.1.
Approximate range in miles:- 25 miles.

Wave form	Method of producing oscillation	Nature of circuit	Grid excitation	Feed	Aerial excitation	High oscillating potential electrode.
I.C.W.	Self.	Tuned circuit between anode and filament.	Mutual inductive.	Series	Direct inductive.	Anode

Transmitter T48 is an H/F I.C.W. transmitter. It is mounted together with receiver R47 in a wooden crate.

Power Supply. The power supply is obtained from a dual purpose generator which is described on page Y2.

H.T. Supply. The H.T. supply is 1200 volts and is taken from one armature (46) of the generator to the anode of the valve (4) through an H/F choke (20) and the portion of the aerial coil (15) below the point at which the anode tap is connected. The circuit is completed to H.T. negative by one contact of the magnetic or listening through key (24), through the interrupter disc (42) or (43) and plain disc (44).

Filament Supply. 10 volts are supplied by one armature (45) of the generator. This voltage is reduced to 7.5 to 8 volts required by the valve (4) by a resistance (25). Owing to the high frequencies used, the chokes (26)(27) are connected in the filament supply to minimise H/F losses in the leads.

Oscillatory and Aerial Circuits. The tuned circuit consists of the aerial rod, a portion of the aerial tuning inductance (15) and the earth rod (or counterpoise). The blocking condensers (18) and (19) are fitted to isolate the H.T. from the two rods. The required wave frequency is obtained by adjusting the aerial tap (17); the more the inductance between this tap and the "earth" end of the inductance, the lower the frequency generated. In this transmitter, in order to obtain the correct value of oscillating anode potential, the anode tap (16) must always be ABOVE the aerial tap (17) (i.e., the anode tapping usually has from ½ to 2 more turns than the aerial tapping.) The anode tap (16) can be set so that there are 3, 4, 5, 6 or 7 turns of the coil in circuit. The aerial tap (17) is continuously variable, giving from 0 to 6.9 turns of the coil in circuit. The whole number of turns is shown in a small window (50) and fractions of a turn on the dial (51) on the handle (see figure c.). If the anode tap (16) is brought too near the aerial tap (17) the transmitter will not function correctly.

The condenser (28) completes the path of the oscillatory component of the valve current.

The grid circuit consists of the coupling coil (21), variable condenser (22) (value 0.018 to 0.225 jars) and 45,000 ohm grid leak (23). The tuning of this circuit greatly affects the performance of the transmitter, and, unless the condenser (22) is correctly adjusted for each wave frequency, radiation will be poor and the anode current as registered in the ammeter (38) excessive. The amount of capacity will decrease, the higher the frequency to which the transmitter is adjusted. Should this capacity be adjusted inadvertently to a point where it is considerably less than the correct value, and the key pressed, excessive anode current may result, and the valve (4) be damaged. To avoid this possibility, the following procedure should always be adhered to; it is engraved on the instrument.

(a) When tuning for the first time, or to increase wavelength:-

1st Set grid condenser (22) to maximum.
2nd Adjust anode tap (16).
3rd Adjust aerial tap (17).
4th Adjust grid condenser (22) value to give best efficiency.

(b) To reduce wavelength:-

1st Adjust aerial tap (17).
2nd Adjust anode tap (16).
3rd Adjust grid condenser (22) value to give best efficiency.

It should be noted that the aerial tap (17) is the only adjustment for wave frequency though alteration of the settings of the anode tap (16) and/or grid condenser (22) will alter the wave frequency slightly. If settings are not known for this tap they should be found by wavemeter.

TRANSMITTER T48

Signalling. A magnetic or listening through key (24) may be fitted. It has three contacts which, when operated, carry out the following functions in the order mentioned:-

Number One Contact. Breaks the receiving aerial and makes the transmitting aerial.

Number Two Contact. Breaks the receiver earth.

Number Three Contact. Makes the H.T. negative lead and connects the grid leak (23) to filament negative.

The bobbin of the magnetic key (24) is supplied from the 10 volt armature (45) of the generator and the circuit is made and broken by the morse key (29). In some cases separate transmitting and receiving aerials are fitted. In this case, the magnetic key (24) is not fitted and the morse key (29) takes the place of number three contact of the magnetic key.

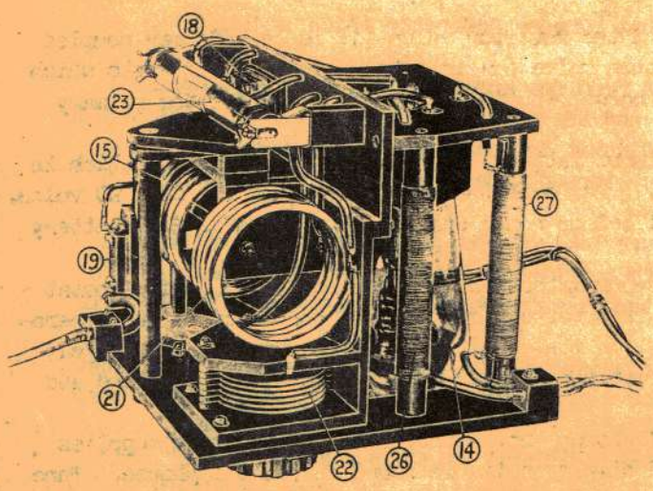


Fig b

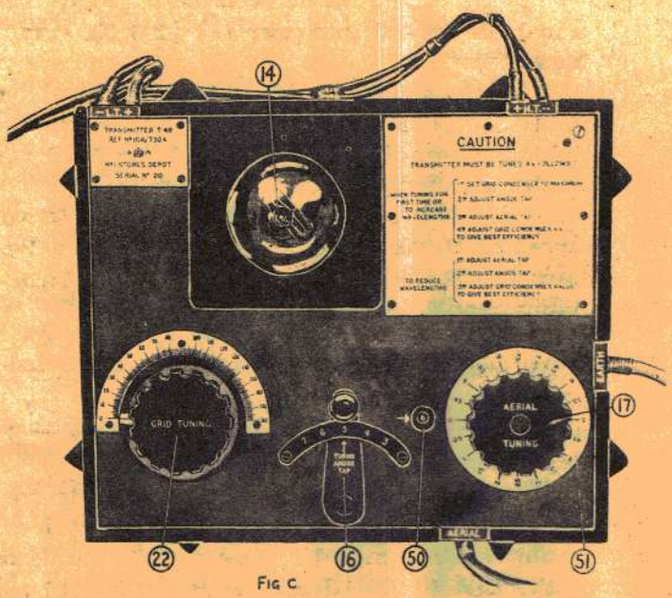


Fig c

RECEIVER R47

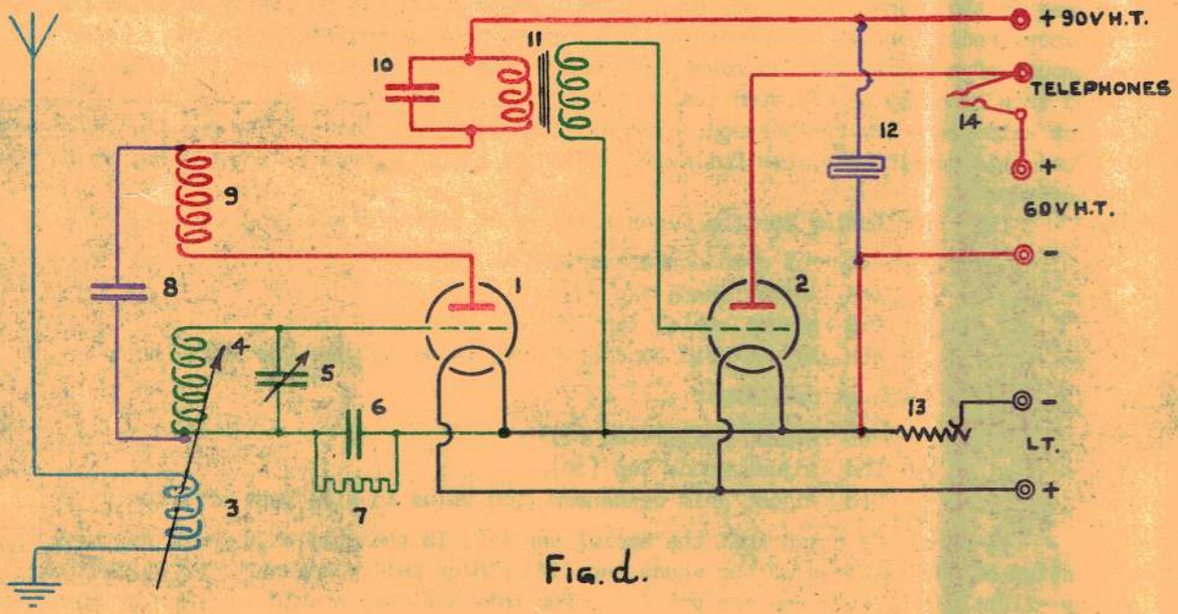


Fig. d.

RECEIVER R47

Date of design:-	1927.
Frequency range:-	21,400 - 30,000 kc/s.
Where fitted:-	With Transmitter T48 (see page Y13).
Valves and method of coupling:-	Two PM4DX. One cumulative grid detector (1) Transformer coupled. One A/F Amplifier (2).

Reference:- Admiralty Handbook of W/T (1931) paragraph 706 et seq.

Receiver R47 is an H/F receiver using the self quenching principle.

The aerial consists of the transmitting aerial rod or a short length of wire. It is untuned.

The coupling between the 1 mic aerial coil (3) and the 0.4 mic grid coil (4) is varied by moving the former (3). The 0.6 mic reaction coil (9) is tightly coupled to the grid coil (4) and variation of aerial coupling will slightly alter the amount of reaction. A 0.9 jar R/F by-pass condenser (8) is connected between the low potential ends of the grid (4) and reaction (9) coils.

The grid tuning condenser (5) has a value of from 0.08 to 0.09 jars. The values of the grid leak (7) and condenser (6) (100,000 ohms 0.54 jars) and the amount of reaction determine the "squeg" note. This note is arranged to be a very high one.

Cumulative grid detection is employed and the detector valve (1) is transformer coupled to the A/F Amplifier valve (2). The output from this valve (2) is taken to a jack (14) into which the telephones are plugged. An 8 jar R/F by-pass condenser (10) is connected across the primary of the transformer (11).

H.T. supply is obtained from a 90 volt inert battery, made up of 15 volt units, which is tapped at 60 volts for the A/F Amplifier valve (2). The detector valve (1) takes the full 90 volts. When this battery has almost run down signals will become rough and weak. A 0.3 mfd. H.T. battery by-pass condenser (12) is fitted.

Filament supply is taken from a 4 volt accumulator and is adjusted by a 10 ohm rheostat (13) in the negative lead. A 2 volt tapping from this battery may also be connected to the generator exciting switch (47) (see page Y12 figure a.). As the sensitivity of the receiver is largely dependent upon the filament current adjustment, great care should be taken to maintain a good and smooth working contact in the rheostat (13).

To operate the receiver, plug in the telephones, connect up H.T. and filament supplies and adjust the filament rheostat (13) until a loud hissing noise is heard in the telephones. Tune in the required signal by means of the condenser (5) which has a slow motion arrangement adjusted by the knob (16). Adjust the rheostat (13) and aerial coupling (15) until signals are as clear as possible. It will be found that the tuning may be slightly altered by varying the aerial coupling.

Care should be taken never to have the aerial coupling too tight as this will prevent the receiver from functioning correctly. The whole travel of the aerial coupling coil (3) is covered by turning its control handle (15) 30 times; there is no indication when looking at the receiver of the actual position of the coupling coil.

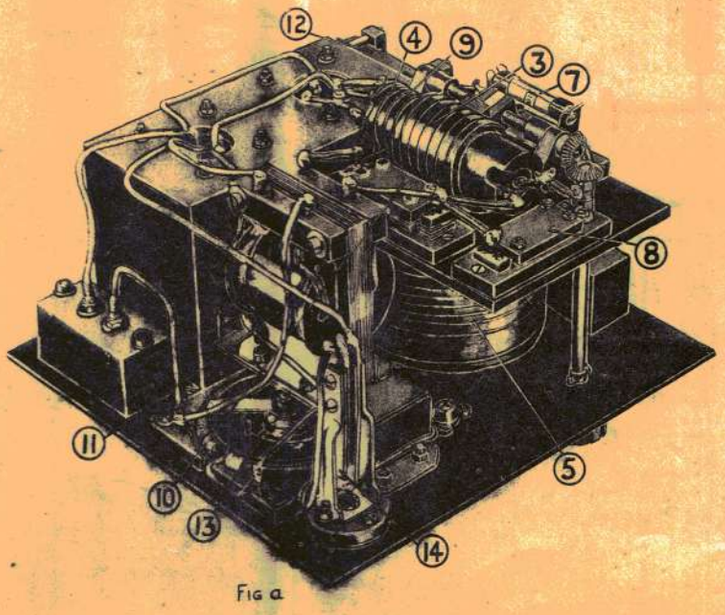


Fig a

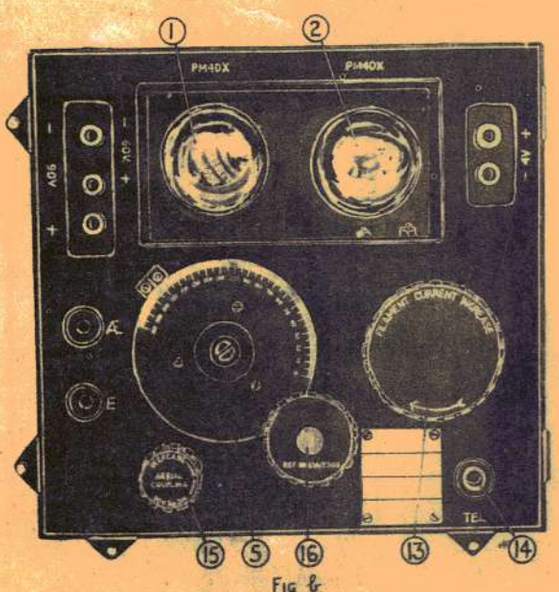


Fig b

TRANSMITTER RECEIVER TRX4

TRANSMITTER TX29

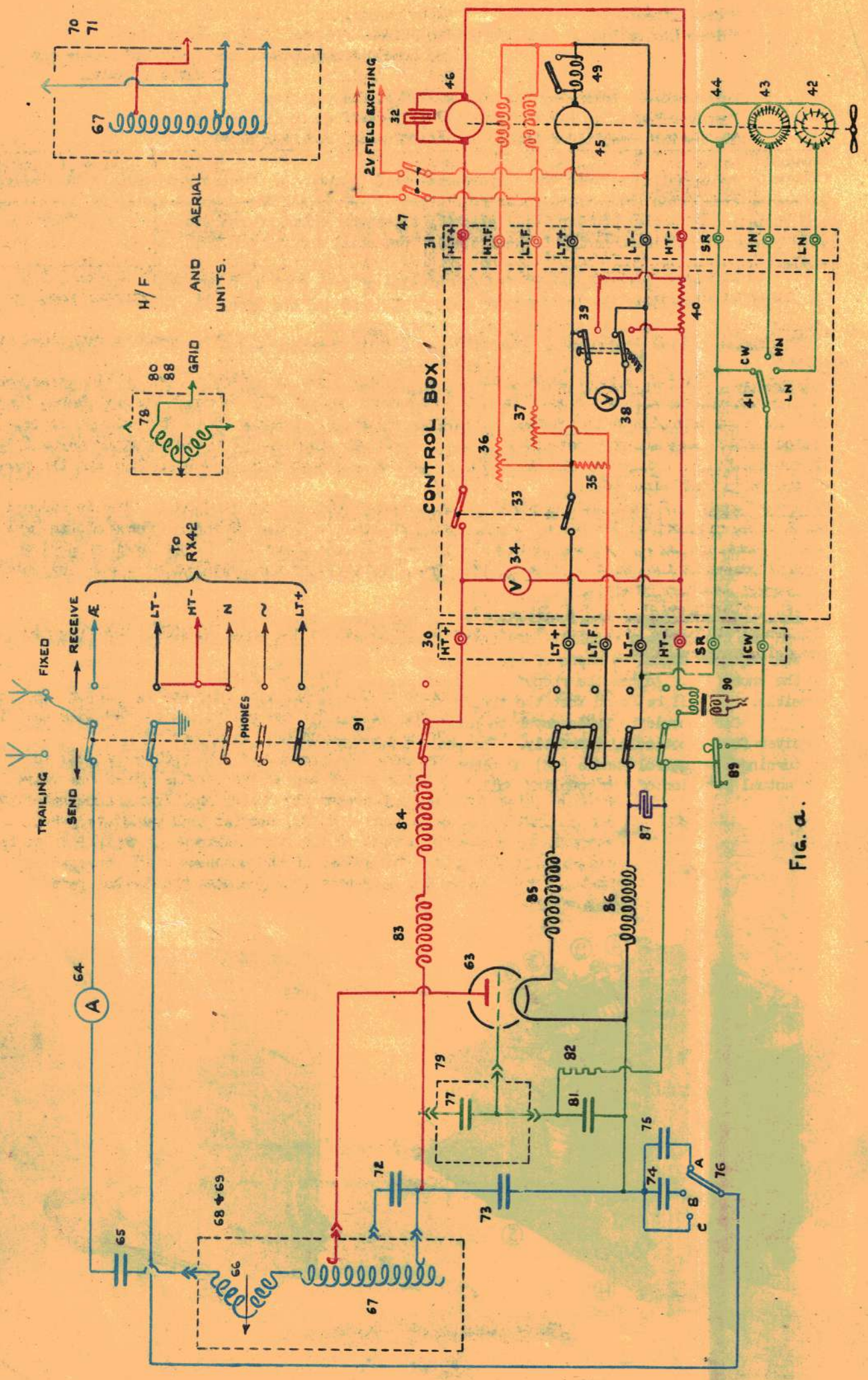


Fig. a.

TRANSMITTER RECEIVER TRX4

TRANSMITTER TX29

Date of design:- 1930.
Frequency range:- 143 - 500 kc/s and ~~4,000~~ 3,000 - 15,000 kc/s.
Dual purpose generator, 120 watts 1200 volts and 40 watts 10 volts.
Associated wavemeters:- WX8 and WX13.
Valves used:- One D.E.T.1.
Approximate range in miles:- 200 on L/F. Varying on H/F.

Wave form	Method of producing oscillation.	Nature of circuit.	Grid excitation	Feed.	Aerial excitation.	High oscillating potential electrode
C.W. and I.C.W.	Self.	Tuned circuit between anode and filament.	Direct capacitive	Series	Direct inductive.	Anode.

TX29 is a combined L/F and H/F transmitter, which will generate either C.W. or I.C.W. It is fitted in conjunction with receiver RX42, the whole set being known as "Transmitter Receiver TRX4".

Power Supply. The power supply is obtained from a dual purpose generator, which is described on page Y2.

H.T. Supply. The H.T. supply is 1200 volts and is taken from one armature (46) of the generator, via the control box and one contact of the send-receive switch (91), through two R/F chokes (84) (83) and a portion of the aerial coil (67) to the anode of the valve (63). The circuit is completed to H.T. negative via the C.W. - I.C.W. switch (41), (and one of the interrupter discs (42)(43), if not using C.W.) the morse key (89), one contact of the send-receive switch (91), and the primary of the "side tone" unit (90).

Filament Supply. 10 volts are supplied by one armature (45) of the generator. This is reduced to the 8 volts required by the valve (63), by means of the two chokes (85)(86). These chokes have a small inductance value, but are designed (together with the choke (83) in the anode supply) to prevent losses in the leads when using H/F. Three contacts of the send-receive switch (91) complete the supply from the generator.

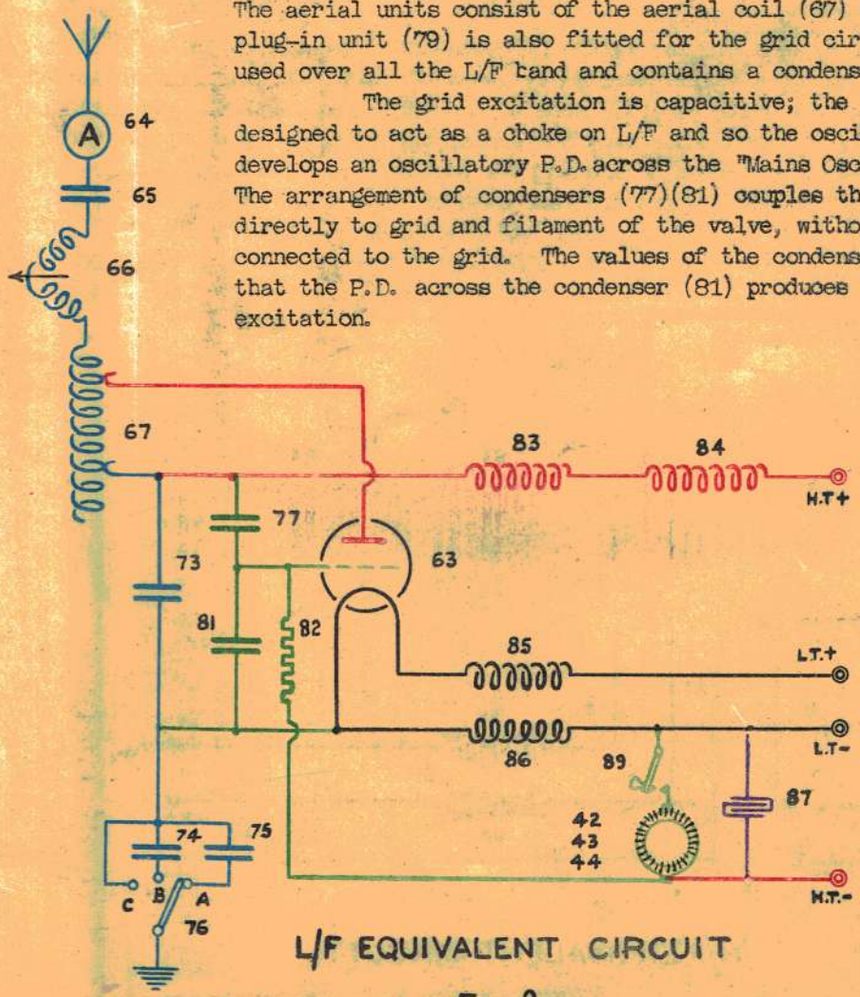
AERIAL AND OSCILLATORY CIRCUITS USING L/F.

The 143-500 kc/s band is covered by two sets of "plug-in" aerial units (68)(69); the frequencies covered are approximately:-

149 - 243 kc/s. and 193 - 517 kc/s.

The aerial units consist of the aerial coil (67) and variometer (66); a plug-in unit (79) is also fitted for the grid circuit. The same unit is used over all the L/F band and contains a condenser (77).

The grid excitation is capacitive; the inductance (84) is designed to act as a choke on L/F and so the oscillation of the valve develops an oscillatory P.D. across the "Mains Oscillating Condenser" (73). The arrangement of condensers (77)(81) couples this oscillatory P.D. directly to grid and filament of the valve, without allowing H.T. to be connected to the grid. The values of the condensers are arranged so that the P.D. across the condenser (81) produces the correct grid excitation.



L/F EQUIVALENT CIRCUIT

FIG. 8.

TRANSMITTER RECEIVER TRX4

TRANSMITTER TX 29

The base of each aerial unit contains 17 sockets; one of these forms the fixed aerial contact, while the remainder are eight alternative pairs of sockets for earth tap and anode tap. Each unit can therefore be shipped in any of eight alternative positions depending on the frequency required; in each case the appropriate amount of inductance between the variometer (66) and the earth tap to give the required frequency is then in circuit (see Tables A and B) and the amount between earth and anode taps is also arranged to give the correct anode tapping. The position of the anode tap on 500 kc/s is especially arranged for I.C.W. transmission. If C.W. is used the input will be excessive and the transmitter may be damaged. When the aerial unit has been plugged in to one of these positions, the frequency can be adjusted to any value between the limits of this particular position, by rotating the variometer (66) which is connected in series with the aerial coil (67) and fitted inside it.

The following tables give the approximate adjustments of the aerial units:-

TABLE A.

Unit X (143 - 240 kc/s).

Plug-in position	Frequency in kc/s.
1	200 - 243 C.W.
2	201 - 221 "
3	185 - 202 "
4	175 - 186 "
5	162 - 175 "
6	154 - 163 "
7	149 - 155 "
8	141 - 150 "

TABLE B.

Unit IX (200 - 500 kc/s).

Plug-in position	Frequency in kc/s.
1	414 - 517 I.C.W.
2	349 - 423 C.W.
3	301 - 353 "
4	265 - 306 "
5	240 - 270 "
6	221 - 245 "
7	206 - 224 "
8	193 - 210 "

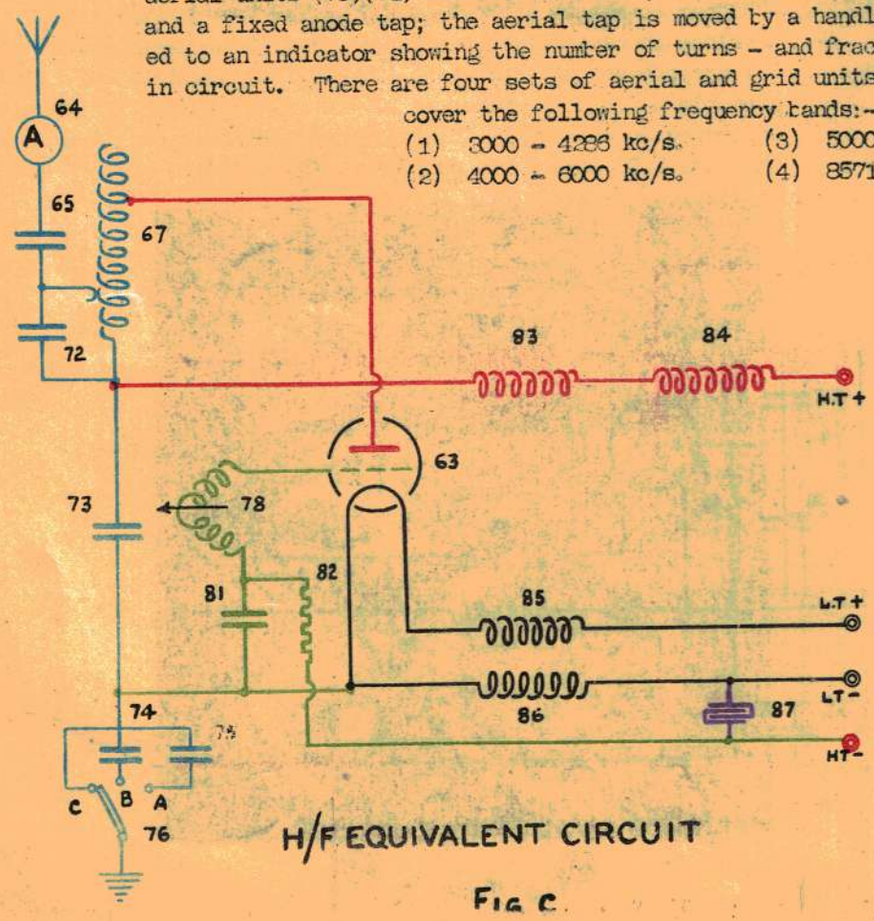
The L/F aerial used is 200 ft. of trailing wire which is connected by a link to the aerial contact of the send-receive switch (91); the aerial circuit (which is the tuned circuit of the transmitter) consists of:- The aerial, ammeter(64), series condenser (65), variometer (66), aerial coil (67), condenser (73) and (if required) condenser (74) or (75). The condenser (65) is fitted to isolate the aerial from the H.T. supply; the switch (76) can be used to bring in condensers (74) or (75), should it be necessary to increase the natural frequency of the aerial.

Tuning. Plug in the grid unit(79) and, having selected the correct aerial unit, insert it in the correct plug-in position for the frequency required. The position of the switch (76) will depend on the earth system in use. Couple the wavemeter to the coil (67) and obtain the accurate adjustment by means of the variometer (66). Aerial current should be 0.9 - 1.2 amps.

AERIAL AND OSCILLATORY CIRCUITS USING H/F.

The nature of the circuit remains similar to the L/F position, except that the grid units (80)(82) (see figure a.) now consists of a variometer(78) by means of which the grid circuit is tuned. The aerial units (70)(71) consist of a coil, on which is a variable aerial tap and a fixed anode tap; the aerial tap is moved by a handle which is connected to an indicator showing the number of turns - and fractions of a turn - in circuit. There are four sets of aerial and grid units for H/F; they cover the following frequency bands:-

(1) 3000 - 4286 kc/s. (3) 5000 - 9091 kc/s.
(2) 4000 - 6000 kc/s. (4) 8571 - 15000 kc/s.



H/F EQUIVALENT CIRCUIT

FIG C.

The grid variometer (78) is so disposed that there is the minimum possible mutual coupling between it and the aerial coil (67); the grid excitation is produced by the direct capacitive coupling between the tuned circuits, provided by the anode grid capacity of the valve (63).

On the ~~lowest of the four~~ three higher H/F bands, the aerial unit connects a condenser (72), mounted in the transmitter, across the part of the aerial coil (67) in use.

A fixed aerial, about 14 ft. long is used, connected to the aerial contact of the send-receive switch (91) by a flexible lead.

Tuning. Insert the required aerial and grid unit; couple the wavemeter to the aerial coil (67). As the aerial tap is adjusted to obtain the required frequency, the grid variometer must be kept adjusted to obtain the maximum radiation with minimum input (as registered on milliammeter (38)). The input current should NEVER exceed 80 mA. Any alteration of the grid tuning will always slightly alter the tuning.

Signalling. No "listening-through" is provided, but a send-receive switch (91) is fitted. This switch connects the aerial and earth to either transmitter or receiver and also makes the H.T. and L.T. supplies to either. The key (89) makes and breaks the H.T. negative supply as well as the circuit from grid to filament.

A "side tone" unit (90) consisting of an A/F transformer is connected in the H.T. negative lead. When using I.C.W. telephones can be connected to the secondary by plug and jack so that the operator can hear his own note.

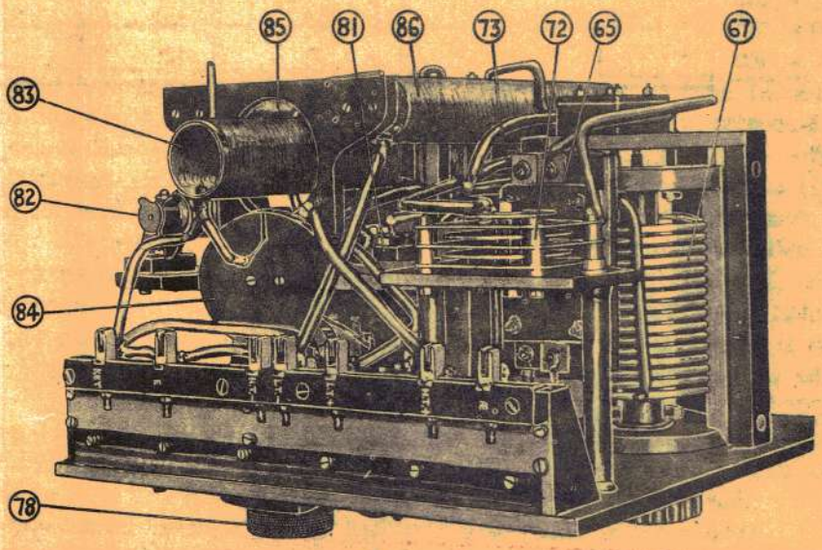


Fig. d.

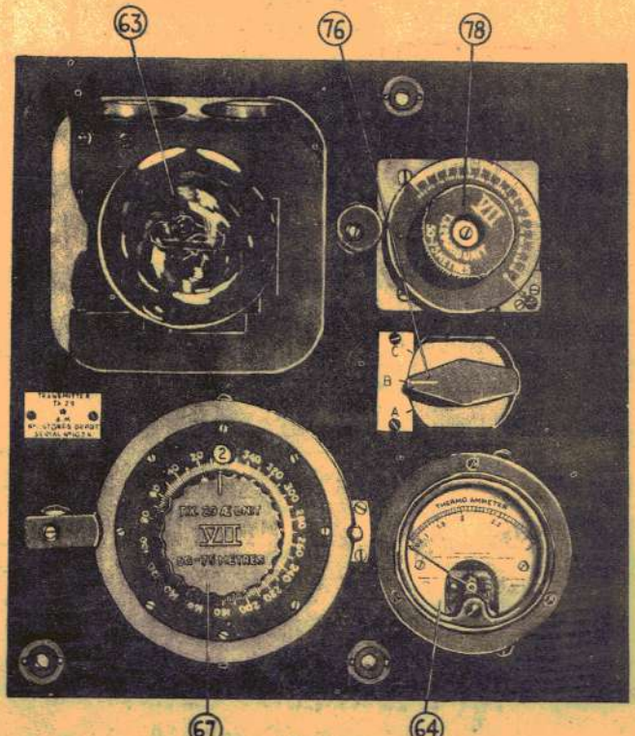


Fig e

TRANSMITTER RECEIVER TRX4
RECEIVER RX42

L/F POSITION

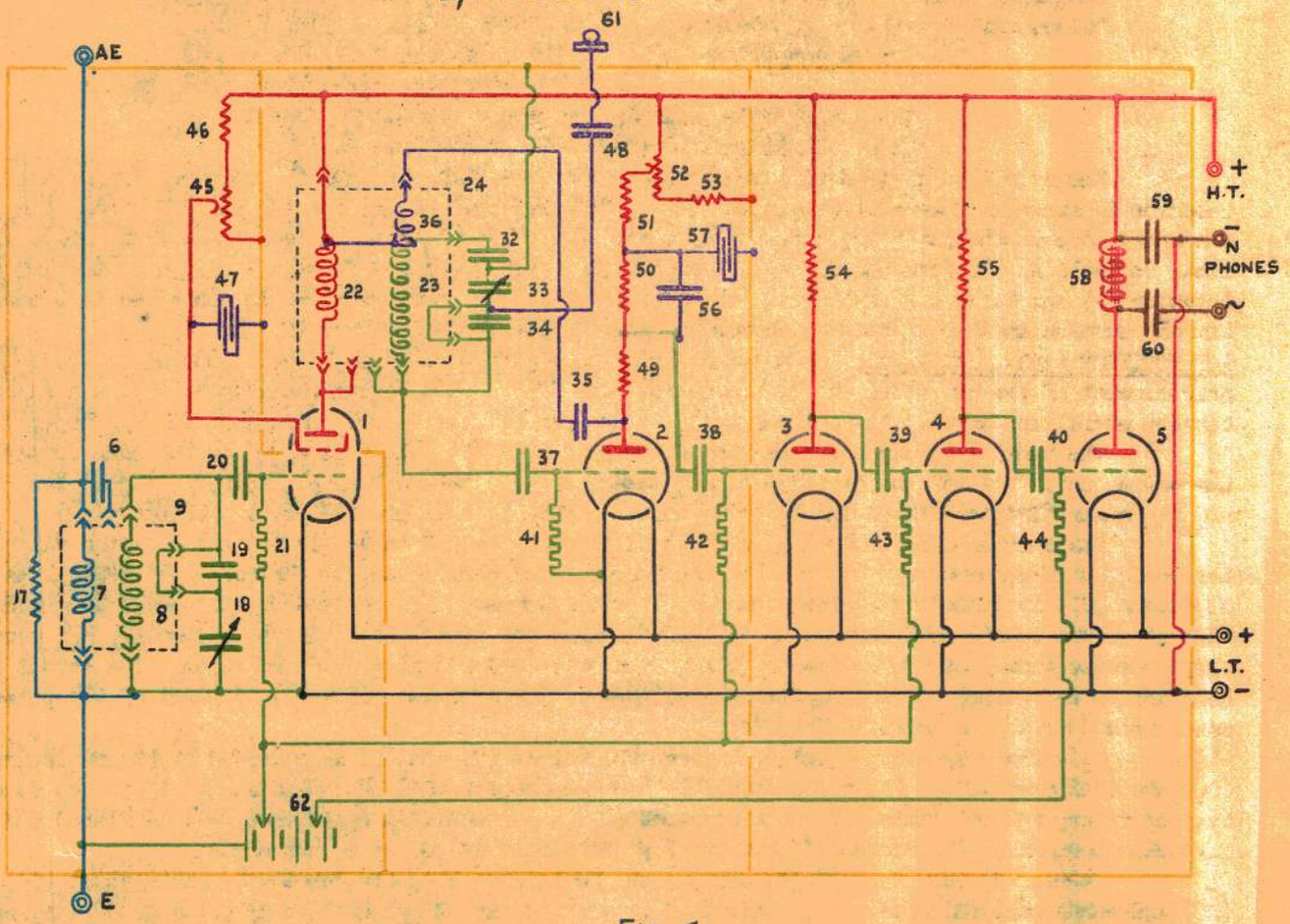


Fig. a.

H/F POSITION

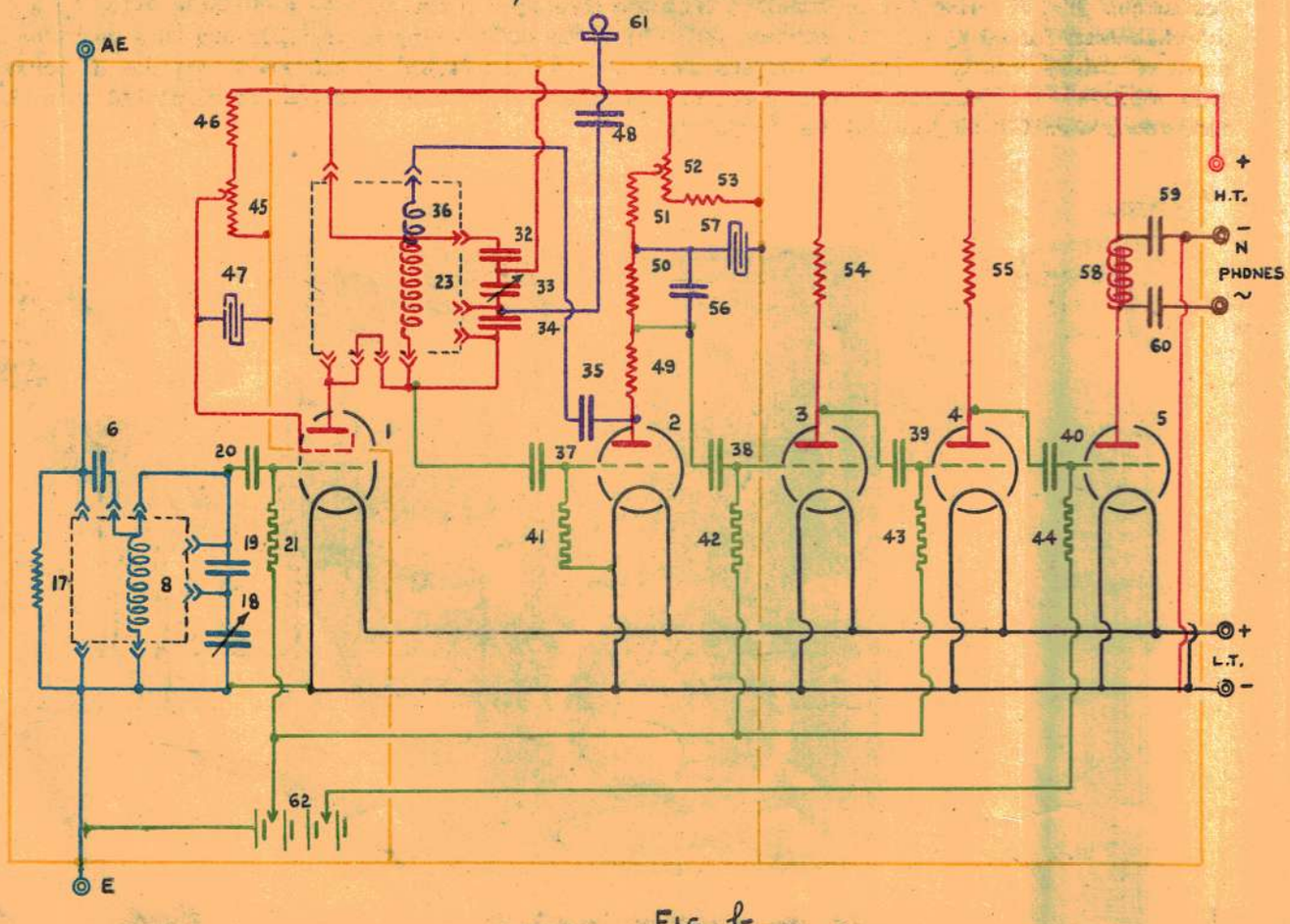


Fig. b.

TRANSMITTER RECEIVER TRX4

RECEIVER RX42 (CONT.)

Date of design:-	1930.
Frequency range:-	120 - 600 kc/s and 2725 - 15000 kc/s.
Valves used and method of coupling:-	One Cossor SG220. Four VR12F.
One R/F Amplifier (1):	In L/F position; tuned transformer.
	In H/F position; tuned choke capacity.
One detector (2) (cumulative grid); resistance capacity.	
Three A/F Amplifiers (3)(4)(5); resistance capacity.	

Receiver RX42 is used with transmitter TX29 (see page Y16) and the combined transmitter and receiver is known as Transmitter Receiver TRX4. This receiver covers the L/F and H/F bands, the necessary circuit changes being effected by means of a series of plug-in aerial and anode coils as shown in Table A. It consists of one R/F amplifying stage (screen grid valve) (1), a cumulative grid detector (2) and three A/F amplifying stages (3)(4)(5). The whole receiver is contained in a screened box and screens are fitted between valves (1) and (2) and between valves (2) and (3).

L/F POSITION (120 - 600 kc/s). An untuned aerial is employed which is loosely coupled to the tuned grid circuit of the 1st valve (1) by the aerial coil (7). A 0.5 megohm resistance (17) is connected between aerial and earth. It is permanently in the circuit but is only necessary for H/F reception.

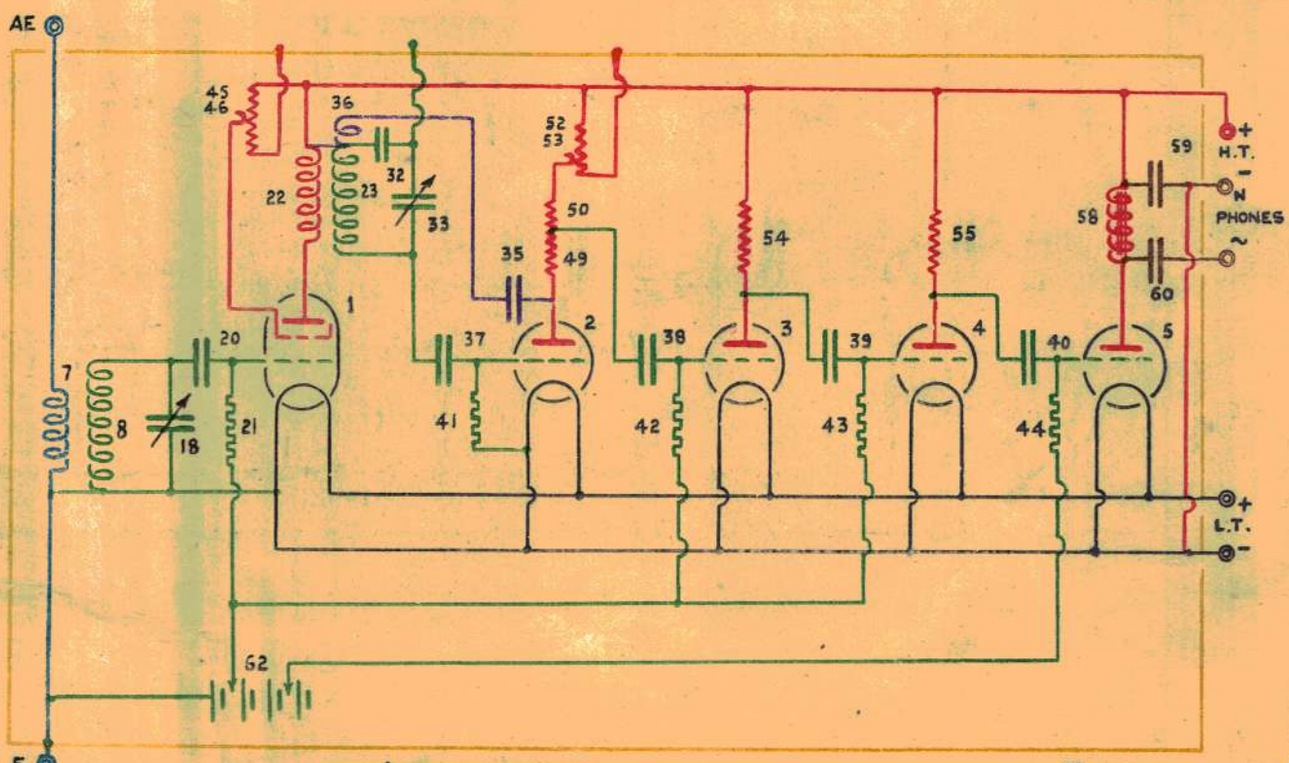
The tuned grid circuit consists of the grid coil (8) (which is wound on the same former as the aerial coil (7)) and the variable tuning condenser (18) marked "aerial tuning". A grid leak(21) and condenser (20) are fitted and 1½ volts negative grid bias is provided by the battery (62).

Tuned transformer coupling is employed between the R/F valve (1) and the detector valve(2), the tuning of the secondary (23) of the transformer being carried out by the condenser (33). The condenser (32) is fitted to isolate the H.T. from the screen. The resistance (49) is so arranged that it offers considerable impedance to the R/F component of the detector valve current; R/F oscillatory currents thus pass via condenser (35) to the coil (36) and so provide reaction. The amount of reaction is controlled by varying the H.T. voltage of the detector valve (2) by means of the potentiometer formed by the resistances (52)(53).

Resistance capacity coupling between the valves (2) and (3) is provided by the resistance (50) and condenser (38). The resistance (50) has a condenser (56) connected across it to act as a by-pass to any R/F not choked by the resistance (49). A decoupling resistance (51) is fitted and has a by-pass condenser (57) connected from the high potential end of it to the screen.

Valves (3) and (4), and (4) and (5) are resistance capacity coupled by resistances (54) and (55) and condensers (39) and (40). Valves (1)(3) and (4) are supplied with 1½ volts grid bias, and valve (5) with grid bias which can be varied from 1½ to 6 volts, by the dry battery (62) through their respective grid leaks (42)(43)(44). A choke capacity output is provided by the A/F choke (58) and condenser (60). Condenser (59) prevents a short circuit between H.T. positive and negative.

A 120 volt dry battery made up of 15 volt units supplies H.T. to the anodes of all valves. The screen grid of valve (1) is supplied from the same source cut down to a suitable value by a potentiometer formed by the resistances (46)(45). The latter (45) is variable and thus provides a means of volume control. The R/F by-pass condenser (47) is fitted to prevent variations of screen grid voltage. A 2 volt accumulator supplies the filaments. These supplies are completed when the send-receive switch (91) is put to "Receive".



L/F EQUIVALENT CIRCUIT. FIG.C.

TRANSMITTER RECEIVER TRX4

RECEIVER RX42 (CONT.)

H/F POSITION (2725 - 15,000 kc/s). In this position the aerial is loosely coupled to the tuned grid circuit of the first valve (1) by the small condenser (6). To prevent any possibility of this condenser being damaged by static charges, a resistance (17) is fitted, and provides a high resistance path to earth. The tuned circuit consists of the variable condenser (18) and fixed condenser (19) connected across the coil (8). Tuned choke capacity coupling is employed between the valves (1) and (2), the tuning being carried out by the fixed condenser (34) and variable condenser (33). On the lowest frequency band of the H/F range (C in Table A) the condensers (19) and (34) are short circuited as in the L/F position.

TABLE A.

H/F			L/F		
Aerial Unit	Anode Unit	Frequency	Aerial Unit	Anode Unit	Frequency
A	A	15,000 - 12,500	D	D	600 - 250
A1	A1	13,043 - 9,677	E	E	429 - 167
A2	A2	11,110 - 8,110	F	F	200 - 120
B	B	8,820 - 6,380			
B1	B1	6,977 - 4,762			
C	C	5,000 - 2,725			

The A/F stages are the same as for L/F.

Operation. Plug in the appropriate aerial and anode units for the frequency required. Put the send-receive switch (91)(see page Y23 figure g.) to "receive " and set the volume control (45) to maximum.

Tune in by the aerial condenser (18) and anode condenser (33). The aerial tuning will be found to be relatively flat compared with the anode tuning. Lastly, reduce the volume control (45) if necessary.

The receiver will always be required to oscillate when receiving H/F; it will also be used oscillating on L/F to autodyne C.W. signals. It is brought into oscillation by adjusting the potentiometer(52). The pin (61) is provided so that, when it is touched, a "click" will be heard in the telephones if the receiver is oscillating.

When work is completed break H.T. circuit by removing the 6 point plug, as otherwise there is a continuous discharge through the potentiometers (45)(46) and (52)(53).

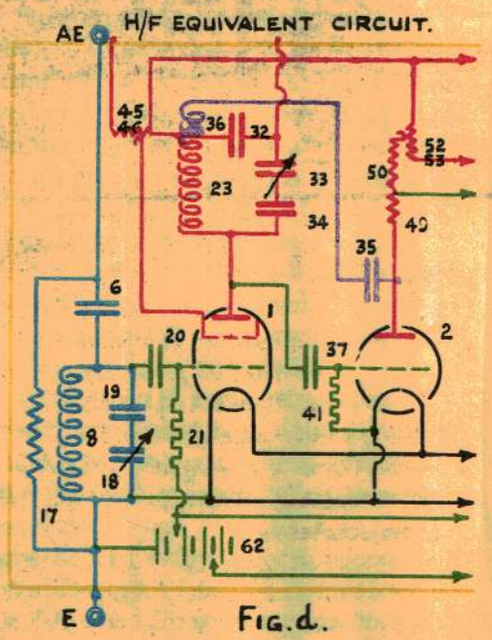


FIG. d.

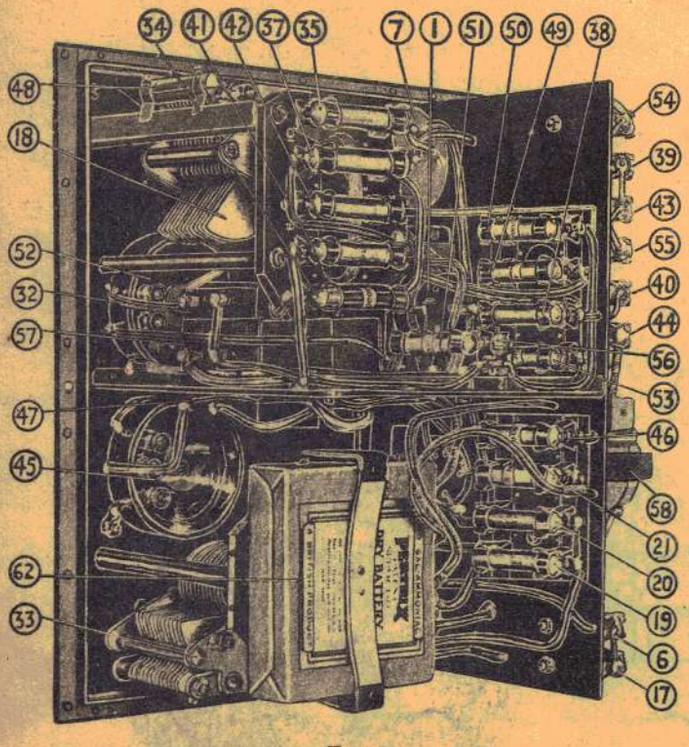


FIG. e

FIG. f

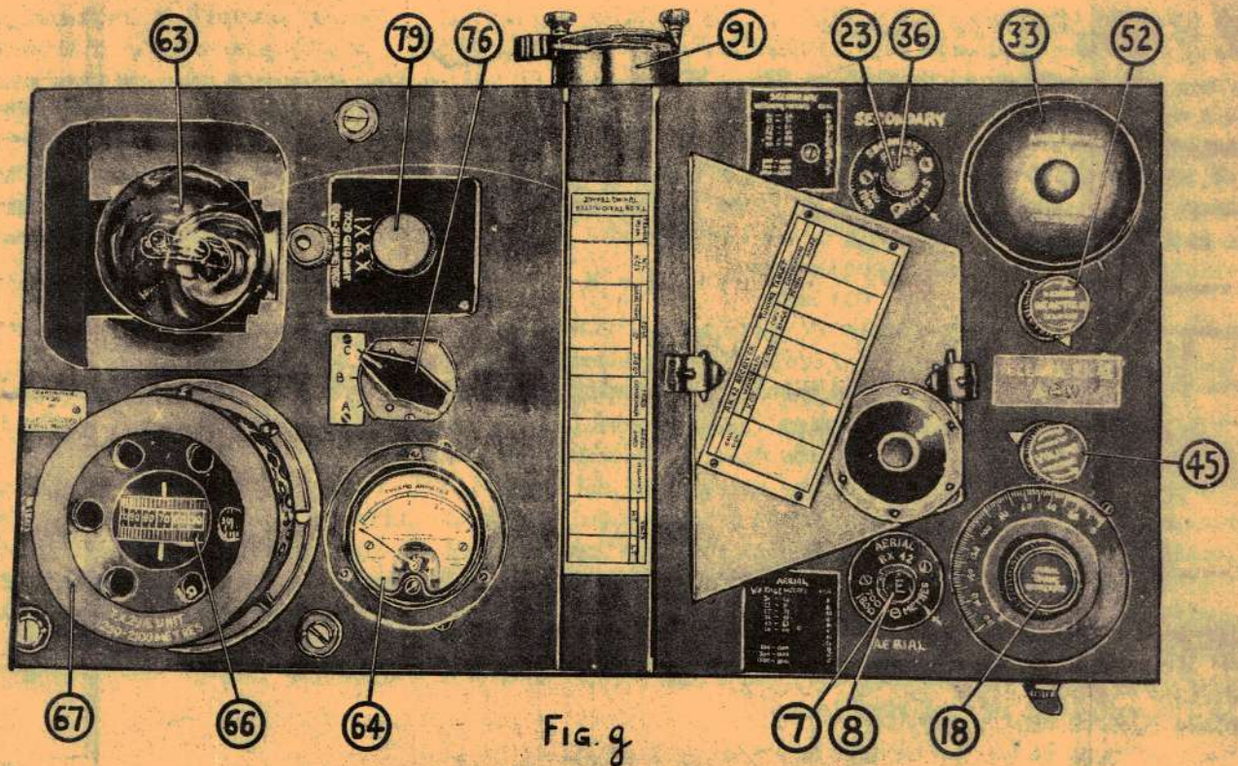


Fig. g

WAVEMETER WX13

Date of design:- 1930.
Frequency range:- 3000 - 15000 kc/s.

The WX13 wavemeter is supplied for use with the transmitter TX29. It is similar in design and operation to the WX8 (see page Y24) except that the coil (100) has four tappings brought to a five position range switch (101), and a fixed condenser (102), is joined across the variable condenser (103). The dial has five scales engraved on it which cover the following frequencies:-

Range 1.	9000 - 15000 kc/s.	Range 4.	3500 - 5500 kc/s.
" 2.	6000 - 9500 kc/s.	" 5.	3000 - 4500 kc/s.
" 3.	5000 - 7000 kc/s.		

The setting and locking arrangements are exactly similar to those of the WX8 wavemeter.

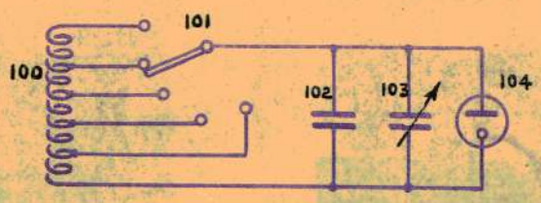


Fig. a

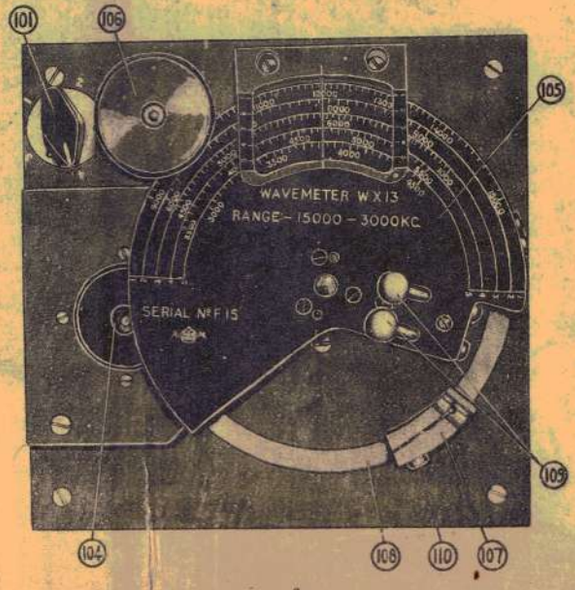


Fig b

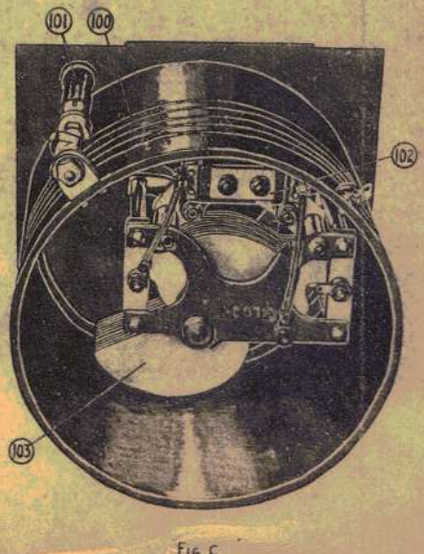


Fig c

Y24

WAVEMETER WX8

Date of design:- 1930.
Frequency range:- 125 - 600 kc/s.

The WX8 wavemeter is supplied for use with transmitter TX29. The instrument is unscreened, employs no mutual coil and uses a neon lamp (104) as indicating device. The circuit consists of a coil (100), with one tapping, tuned by a variable condenser (103) across which is joined the neon lamp (104). A metal dial (105) is fixed to the condenser (103) and has two scales engraved on it. A switch (101) inserts the whole or part of the coil (100) in circuit thus providing the two ranges which cover the following frequencies:-

Range 1. 250 - 600 kc/s. Range 2. 125 - 250 kc/s.

On range 1 the scale is graduated to 10 kc/s with an accuracy of 2 kc/s and on range 2 to 5 kc/s with an accuracy of 1 kc/s. The condenser is operated by a slow motion device (106).

Provision is made for setting and locking the condenser in any two desired positions. This is achieved by means of clamps (107), rotatable on a ring (108) fixed to the face of the instrument, and bolts (109) fitted to the dial. The clamps and bolts are painted red and green. To set the wavemeter to a given frequency, release the set screw (110), insert the bolt (109) in the clamp slot, rotate the dial to the required frequency and set up the screw (110). The wavemeter is now locked in this position; withdraw bolt to allow free movement of dial. The clamp remains set in position so that to return to the same frequency it is merely a matter of turning the dial to the position for engaging the bolt in the slot. Care must, of course, be taken to use the same colour clamp and bolt.

The instrument should be placed far enough from the transmitter that at resonance a glow in the neon lamp is just visible.

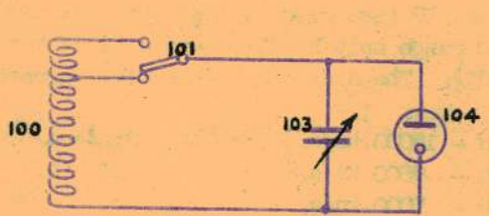


FIG. a.

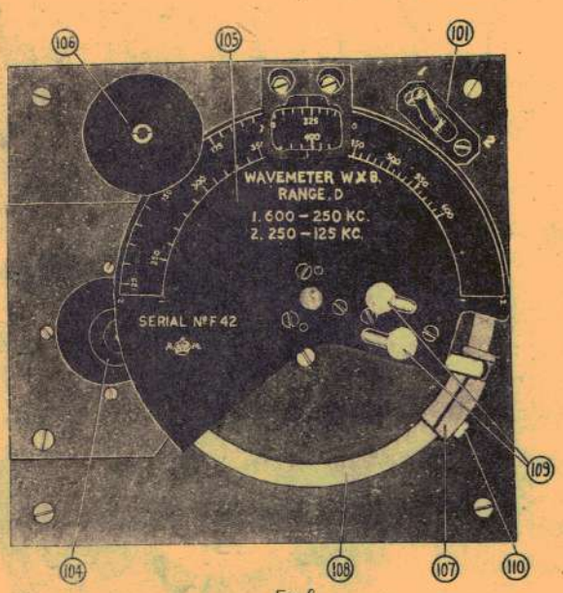


FIG. b

FIG c