SUB-SECTION GC OSCILLATORS

OSCILLATOR	G31	PAGE	GC2
~~"~~	~~G32~~	~~"~~	~~GC4~~
"	G33	"	GC5

OSCILLATOR G31

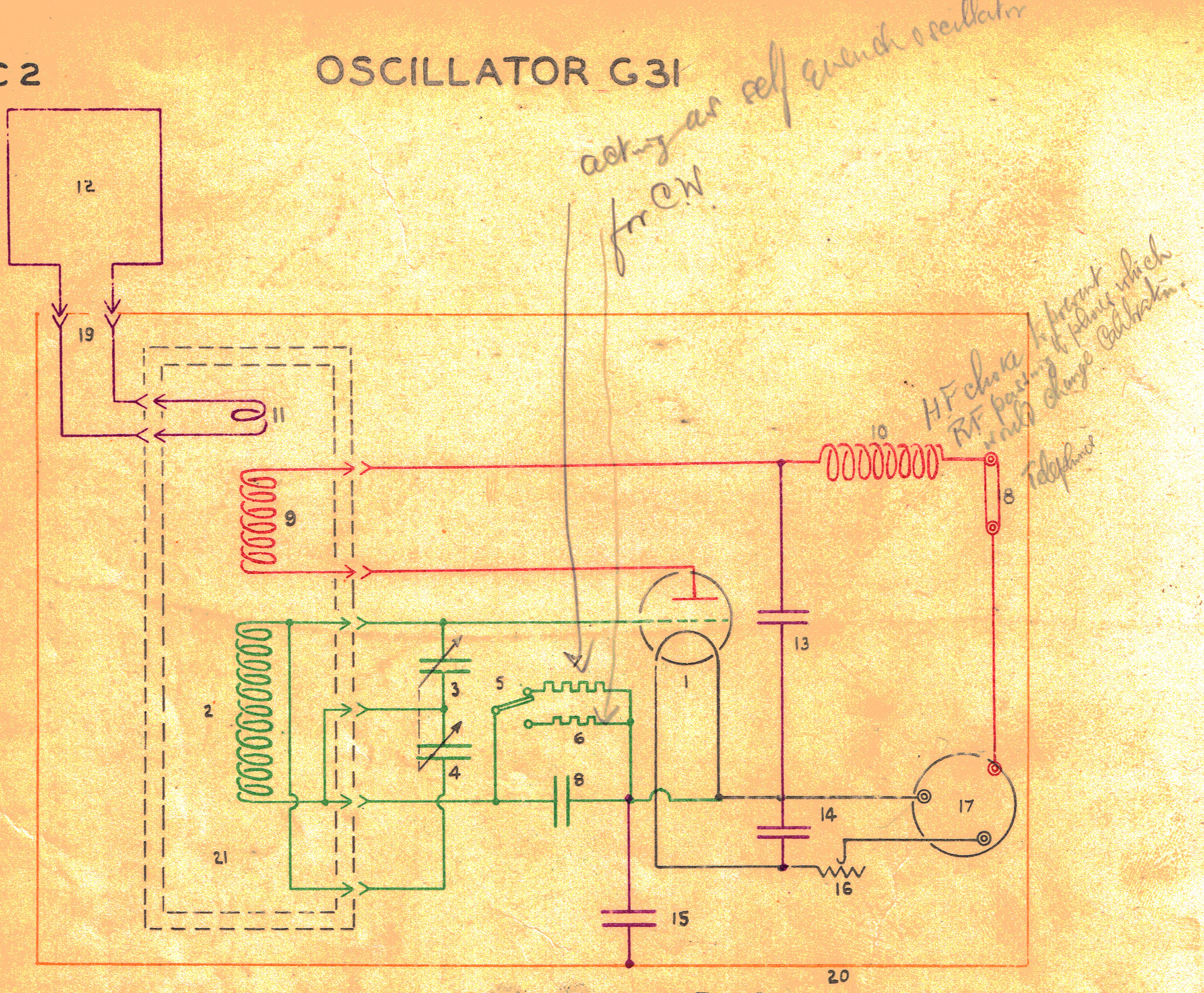

Fig. a.

RANGE 1

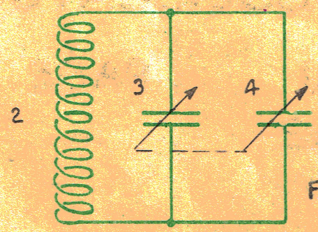

Fig. b

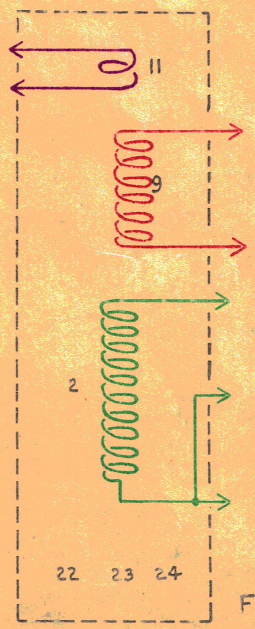

Fig. C.

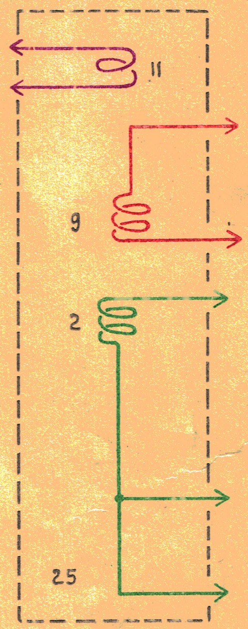

Fig. e

RANGE 2, 3 & 4.

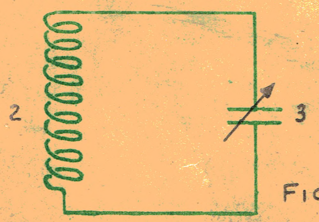

Fig. d

RANGE 5.

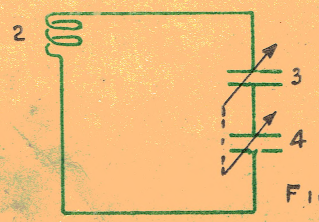

Fig. f.

OSCILLATOR G31

Date of design:- 1928.
Frequency range:- 1,500 - 25,000 kc/s.
Valve used:- NR15A
Reference:- Admiralty Handbook of W/T (1931) paragraph 845 .

G31 is used to provide oscillations for tuning receiving sets. In this respect it resembles Heterodyne Unit K5 (when the latter is used for obtaining receiving adjustments or checking an incoming signal) but is designed for use on the higher frequencies.

G31 consists of a valve oscillating circuit, similar to that employed in K5 for producing C.W., i.e., tuned grid and coupled anode. The method of producing tonic train in G31, however, is different as the "squegging" or self-quenching method is employed instead of a buzzer. Two grid leaks are provided, either of which can be introduced by a two-way C.O.S.(5) marked "Quench" or "C.W.". The smaller (5,000 ohms) leak (6) is used when producing C.W. the larger (2 megohm) leak (7) is of such a value that the grid runs negative at an audio-frequency and tonic train is produced by a squegging action. The frequency at which the grid runs negative depends on the value of the filament current, which is controlled by the filament rheostat(16), this frequency becoming lower as the filament current is increased. The frequency band is covered in five ranges, plug-in range boxes(21) to (25) being employed. The range boxes contain the appropriate grid coil(2), anode coil(9) and mutual coil (11). In addition they connect the grid tuning condensers (3) and (4) as required (series, parallel or one only) in a similar manner to the range boxes of Amplifier M11. The two condensers are each variable up to 0.15 jars and are fitted on the same shaft. Particulars of the five range boxes are given overleaf.

As the calibration of G31 varies when different valves or battery potentials are used (due to the difference in the valve characteristics), it is not possible to calibrate the scale (26) of the tuning condensers in kilocycles. Xylonite scale plates have therefore been provided, which can be calibrated in pencil for the particular valve in use by means of wavemeters G7 and G8. When graduating the xylonite discs, a disc of the same colour as the range box should be used for convenience.

The R/F by-pass arrangements are similar to those in modern H/F receivers, i.e., all are brought to one common point, which is connected by a 20-jar condenser (15) to the screen (20) of the case. The R/F choke(10) and H.T. by-pass 20-jar condenser(13) prevent R/F passing to the telephones, thus preventing the presence of the telephones from affecting the calibration. No telephone transformer is necessary although the ordinary 120-ohm telephones are used and when the telephones are not in use, a short-circuiting link should be placed across the terminals(18).

<u>To Calibrate G31.</u>

(a) Remove coupling coil (12) from the stowage position pins (27) and plug it into sockets (19). Insert correct coil box and close lid to complete the screening. Connect telephones direct to terminals (18) (red lead to positive). Set switch(5) to "Quench" and adjust rheostat (16) to give a high pitched note in the telephones.

(b) Fix coupling coil of G7 (or G8) in receiving position and couple to G31. For the higher frequency ranges of G7 (or G8) the coupling coils should be ½-inch apart. For the lower frequency ranges they should be close together. Set G7 (or G8) to the required frequency from its receiver calibration curve.

(c) Tune G31 until a sudden rise in pitch of the telephone note is observed and leave setting at point of highest pitch.

(d) G31 is now in tune with G7 (or G8) and a pencil line may be made on the xylonite scale. This calibration will remain approximately correct if the valve and battery potential are not changed.

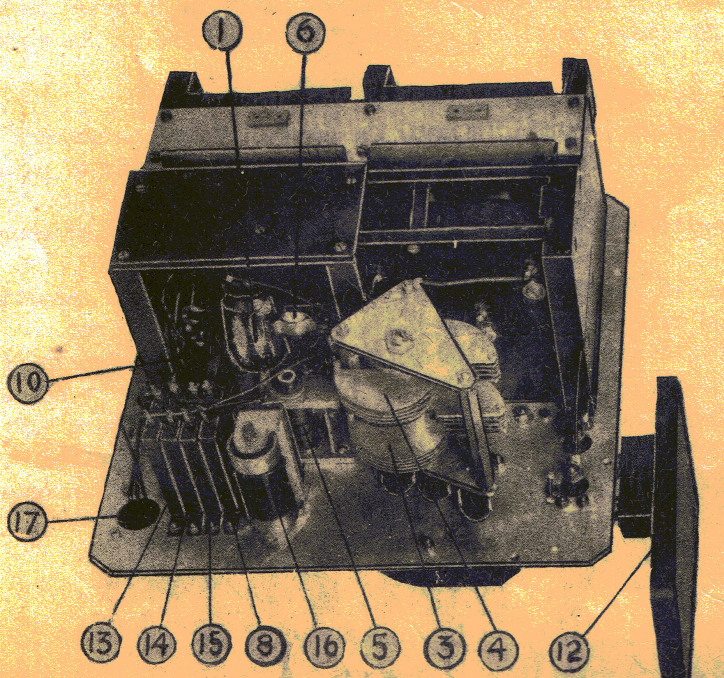

FIG a

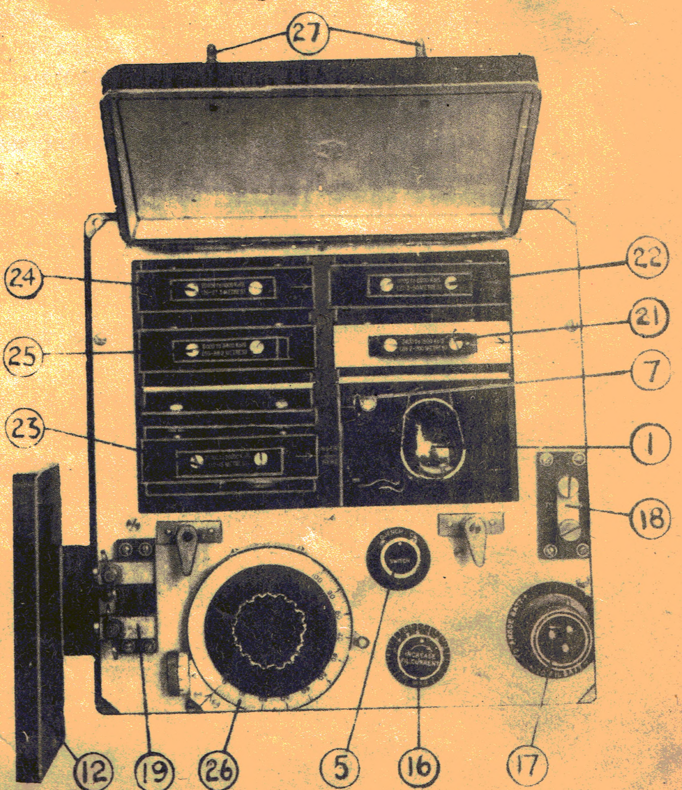

Fig b

OSCILLATOR G31 (CONTD.)

Details of Range Boxes.							
Range	Kc/s.	Grid Turns.	Anode Turns.	Mutual Turns.	Maximum Capacity.	Condensers Connected In.	Calibrating Wavemeter.
1	1,500 - 3,400	18	7	$\frac{1}{3}$	0.3	Parallel.	G8
2	3,400 - 6,000	11	6	$\frac{1}{3}$	0.15	One only.	G8
3	6,000 - 11,000	$7\frac{3}{4}$	$4\frac{1}{4}$	$\frac{1}{3}$	0.15	One only.	G7
4	11,000 - 20,000	$3\frac{3}{4}$	$3\frac{1}{4}$	$\frac{1}{3}$	0.15	One only.	G7
5	20,000 - 25,000	$2\frac{1}{4}$	$2\frac{3}{4}$	$\frac{1}{3}$	0.075	Series.	G7

To Tune a Receiver to a Definite Frequency.

(a) Set G31 to the required frequency by means of the marking on the xylonite disc. If there is any doubt as to the accuracy of this marking, re-calibrate with G7 (or G8) as above.

(b) Set receiver to oscillate, and, using the phones connected to receiver, tune receiver till a note can be heard. Now take off the receiver telephones and put on G31 telephones and move the receiver adjustments until a distinct rise in note is heard in the G31 telephones.

Alternative Method of Tuning a Receiver.

The foregoing method is accurate but rather slow and not easy for inexperienced operators. The following method is easier and quicker for rough adjustments but may have an error up to 1%. This is due to G31 being calibrated in the "Quench" position and in the following method being used in the C.W. position, involving a change of grid leak.

(a) Set G31 to the required frequency

(b) Set G31 to C.W. Set receiver to oscillate and, using phones connected to receiver, tune receiver to the dead space of the heterodyne frequency.

To Measure the Frequency of an Incoming Signal.

(a) Tune the oscillating receiver accurately to the incoming signal. If a C.W. signal, tune to the dead space.

(b) Switch on the G31 in the "Quench" position and rotate its condenser until a rise of pitch, due to the oscillating receiver, is observed in the G31 telephones and adjust to the highest pitch.

(c) Set up G7 (or G8) and rotate its condenser until a second rise in pitch is observed in the G31 phones and adjust the G7 (or G8) condenser to the highest pitch found.

(d) Read off the exact frequency from the receiver calibration curve of G7 (or G8).

Alternative Method of Measuring an Incoming Signal.

A quicker but less accurate method is as follows:-

(a) Tune the receiver carefully to the incoming signal.

(b) Use G31 as a buzzer tester, adjusting its condenser until loudest note from G31 is heard in the receiver phones.

When strong signals are available, the frequency may be measured directly by using the G31 as a receiver either loosely coupled to an untuned aerial or without an aerial at all. A rise of pitch in the quench note indicates when G31 is exactly in tune with the signals.

To Tune a Transmitter to a Definite Frequency.

If the approximate adjustments are not known proceed as follows.-

(a) Calibrate G31 as already described having G31 setting at point of highest pitch.

(b) Press key of H/F Transmitter and adjust G31 until a further rise of pitch is observed in G31 phones. Adjust the transmitter as necessary until the change of pitch occurs on the correct setting.

(c) Switch off transmitter and check the G31 adjustment with G7 (or G8).

If the approximate adjustments are known it will be simple to leave G31 on its correct setting, as determined by G7 or G8 and then adjust the transmitter until the further rise of pitch is observed in the G31 phones.

Throughout these operations the position of G31 relative to the G7 (or G8) must of course remain unaltered.

In all the above operations it must be remembered that the oscillator itself is sensitive to incoming signals of its own frequency, and care must be taken that a false reading is not obtained from a rise in pitch in the quench note due to local interference, such as a harmonic of a neighbouring W/T transmitter. When using G31 in conjunction with a W/T receiver, it may be necessary to vary the coupling between the two. The flexible battery leads and three-plug fitting (17) provided with G31 allow for a limited alteration in its position for this purpose. If greater variations are necessary, the run of the aerial lead to the receiver should be altered to increase or reduce the coupling.

OSCILLATOR G33

Date of design:- 1934.
Frequency range:- 15 to 24,000 kc/s.
Valves used:- R/F valve. One NR16A.
A/F valve. One NR15A.
Reference:- Admiralty Handbook of W/T (1937), Vol. II, Section W (18).

G33 is used to provide oscillations for tuning receiving sets. It is also used in conjunction with wavemeter G56 for the following purposes:-

(i) As a heterodyne wavemeter in conjunction with a receiver, to measure the frequency of an incoming signal.
(ii) As a receiver to measure the transmitted frequency of a local transmitter.
(iii) As an I.C.W. transmitter for setting a receiver to a desired frequency.

As the calibration of G33 varies when different valves or battery potentials are used (due to the difference in the valve characteritics) tuning curves or scales are not provided. By coupling the G33 to the calibrated wavemeter G56 and using the latter for frequency measurement, a high degree of accuracy is obtained when the two models are used for any of the purposes enumerated above.

A diagram of the circuit used is shown in figure a.

The frequency band of 15 to 24,000 kc/s is covered in 11 ranges identical with those of wavemeter G56 as follows:-

Range.	kc/s.
1	15 - 26
2	26 - 50
3	50 - 100
4	100 - 200
5	200 - 400
6	400 - 800

Range.	kc/s.
7	800 - 1500
8	1500 - 3000
9	3000 - 6000
10	6000 - 12000
11	12000 - 24000

Ranges 1 to 8 are obtained by a series of fixed inductance coils (18) which are connected to an eight position L/F ranges switch (19). The three remaining ranges are obtained by separate plug-in coils (20). A change-over switch (16) marked "L/F - H/F", connects the first eight or the last three ranges in circuit as required.

When the L/F - H/F C.O.S. (16) is set to "L/F" the inductance in use is tuned by adjusting the variable condenser (13)(14) which has a maximum capacity of 0.5 jar. This condenser is made in two halves which are connected in parallel by means of the C.O.S. (16) for the eight L/F ranges (see figure b). A 0.03 condenser (17) is connected in parallel with the variable condenser (13)(14) when using the L/F ranges 1 to 8 to make the readings on the variable condenser scale of G33 approximately the same as those on the tuning condenser of wavemeter G56.

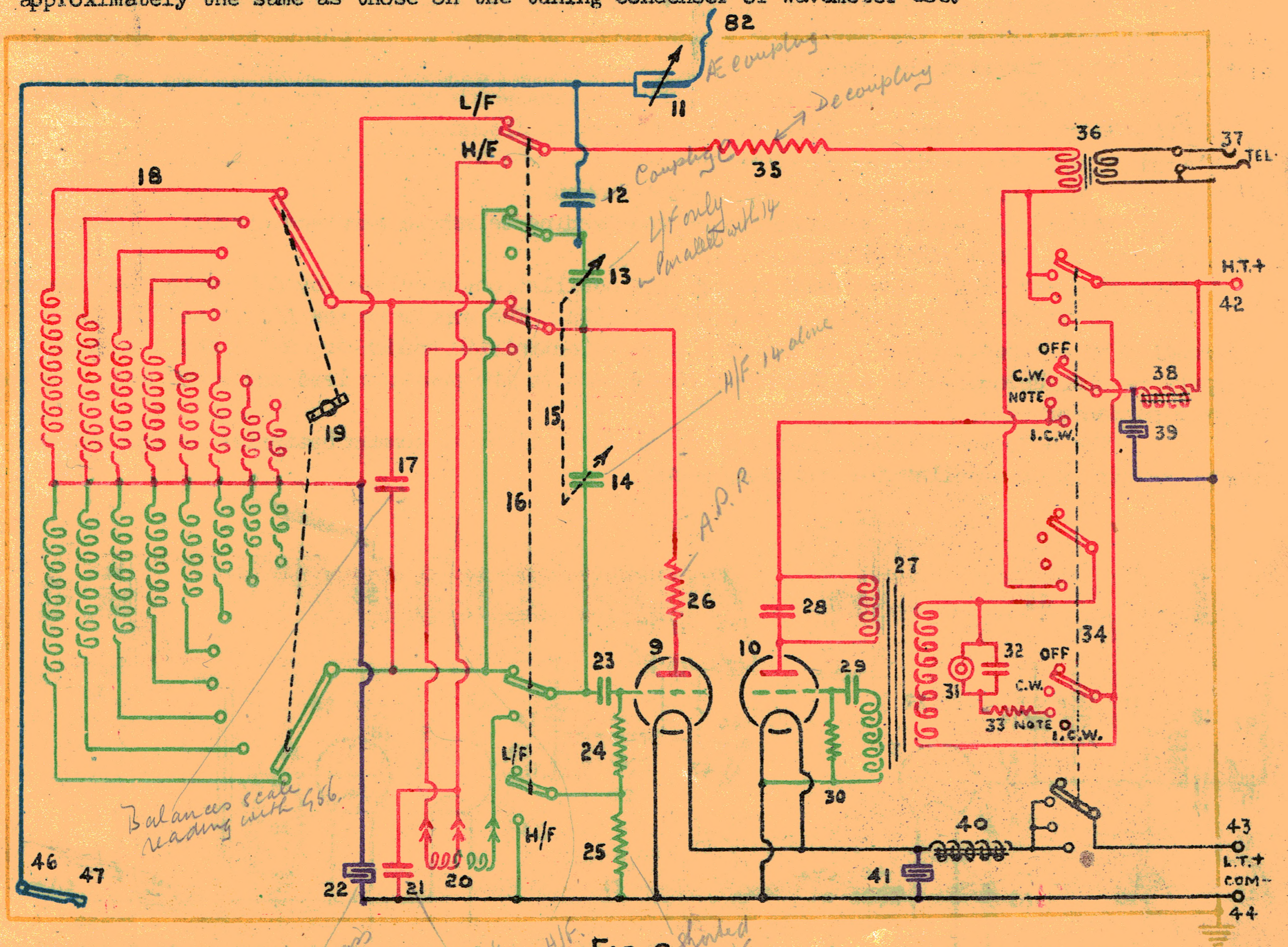

FIG. a.

OSCILLATOR G33

For the three H/F ranges 9, 10 and 11, one half only (14) of the variable condenser is used for tuning, the second half being connected in series with the output coupling condenser (12) to reduce the coupling to the wavemeter G56 as the circuit becomes stiffer. (See figure c).

The oscillatory circuit is connected to the grid of the valve (9) by a 0.0005 mfd condenser (23). For the eight L/F ranges a 10,000 ohms grid leak resistance (24) is connected in series with a 0.5 megohm resistance (25). For the three H/F ranges the 10,000 ohms resistance (24) only is used and the 0.5 megohm resistance (25) is short circuited by one contact of the L/F-H/F C.O.S.(16).

A 5 ohms resistance (26) is connected in the anode lead to the valve (9) to prevent parasitic oscillations in the connecting leads.

A 600 ohms R/F decoupling resistance (35) is connected in the H.T. supply to the valve (9) and a 0.01 mfd. R/F by-pass condenser (21) is used for the three H/F ranges. An alternative by-pass condenser (22) of 0.1 mfd. capacity is used for the eight L/F ranges, the change being effected by one contact of the L/F - H/F C.O.S. (16).

The R/F oscillatory circuit is coupled to the wavemeter through a 0.00005 mfd condenser (12) and to the receiving aerial by a special plug which slides into an insulated brass sleeve. The plug and sleeve form a variable capacity coupling which is indicated as a variable condenser (11) in figure a.

A telephone transformer (36) is connected in the H.T. supply to the R/F valve (9) to enable telephones to be used when measuring the frequency of a local transmitter by the heterodyne method. A jack (37) is fitted on the front of the instrument for connecting the telephones in circuit.

When measuring an incoming signal from a distant station a separate receiving model is used and the G33 oscillator is coupled to the receiving aerial by means of the special plug connection described above.

The model also contains an audio-frequency oscillator using a tuned anode circuit with mutual inductive grid excitation. A special transformer, containing anode and grid coils and an additional winding, gives the necessary coupling for self-excitation.

The anode coil is connected in parallel with a 0.5 mfd condenser (28) giving a fixed tuning of approximately 500 cycles/sec. The grid condenser (29) and grid leak resistance (30) of this circuit are 10 jars and 0.5 megohm respectively.

When the "ON - OFF" switch (34) is set to "I.C.W." the additional winding on the transformer (27) is connected in the H.T. supply to the R/F oscillator to modulate the supply to the R/F valve (9). When the switch (34) is set to "NOTE" the output of the modulator valve (10) feeds a telephone earpiece (31) tuned by a condenser (32) to 500 cycles/sec. The earpiece (31) is fitted inside the model.

The object of the audible 500 cycles/sec note is to enable the operator to tune the heterodyne note between the oscillator and an incoming signal to two points equally spaced on either side of the zero beat position.

The "ON - OFF" switch (34) has four positions which connect the circuits as follows:-

- (i) "OFF". H.T. and L.T. supplies to both valves disconnected.
- (ii) "C.W." R/F valve (9) oscillating.
  H.T. supply to A/F valve (10) broken.
- (iii) "NOTE" A/F valve (10) oscillating and feeding telephone earpiece circuit. R/F valve (9) oscillating (C.W.).
- (iv) "I.C.W." Both valves oscillating. R/F oscillations modulated by 500 cycles/sec frequency.

A 100-volt H.T. supply is required for G33. The supply to the A/F valve (10) is decoupled by a 8 henry choke (38) and an 8 mfds. electrolytic condenser (39). The 4 volts L.T. supply is also decoupled by a 0.012 henry choke (40) in the positive lead and a 250 mfds. electrolytic condenser (41).

The H.T. and filament supplies are obtained from the common batteries or from the A.C. supply unit which supplies the receiving models.

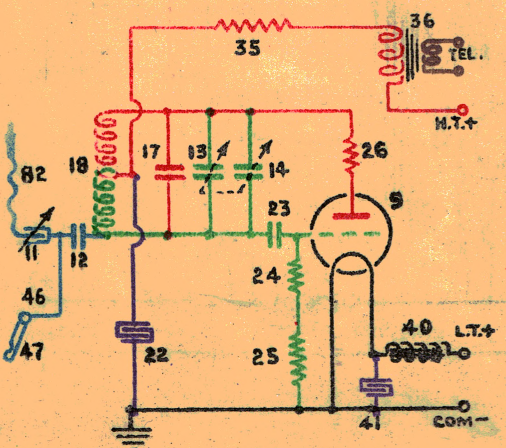

Fig. b.

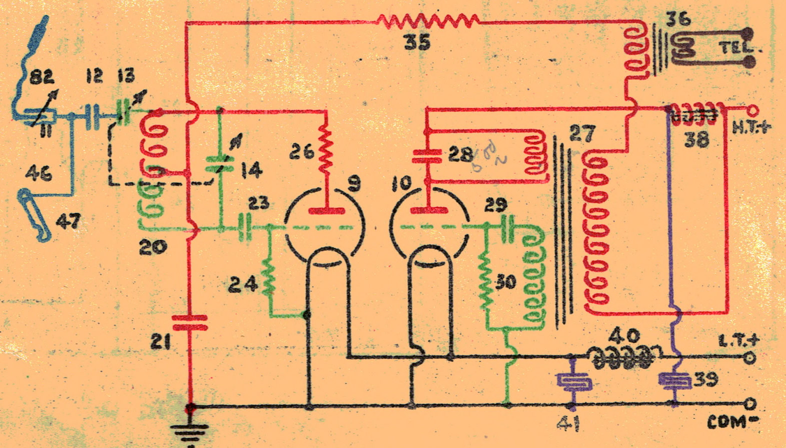

Fig. c.

OSCILLATOR G33

To measure the frequency of an incoming signal.

(a) Connect the aerial plug of G33 to the receiving aerial at the aerial exchange or to a socket connected to the same receiving aerial by means of the special plug provided.
(b) Tune the receiver to the signal frequency using its own heterodyne.
(c) Connect telephones, with long leads, to the receiver to enable the operator to listen to the signal whilst tuning the oscillator.
(d) Switch G56 to "Batt." or "A.C." and G33 to "C.W.".
(e) Set the range switches of G56 and G33 to the range which includes the frequency to be measured.
(f) Insert the aerial coupling plug of G33 and tune the oscillator until it is heard in the receiver telephones.
(g) Switch off the receiver heterodyne and use G33 in its place. When the signal is weak the aerial coupling should be reduced to the best value by partially withdrawing the aerial coupling plug.
(h) Tune G33 to the dead space (zero beat) with the signal.
(j) Tune G56 to obtain maximum deflection of the milliammeter, reducing the potentiometer setting (marked "Increase Coupling") if necessary to keep the pointer on the scale.
(k) Read off the frequency from the calibration curve of G56 using temperature corrections if necessary.

When measuring an incoming I.C.W. signal, the same method is used as for a C.W. signal, described above, but the zero beat will not be so well defined.

When measuring the frequency of an incoming signal below 100 kc/s it is difficult to determine the exact zero beat position in the middle of the dead space (see h above). In this case the 500 cycle note oscillator should be used as follows:-

(l) Set the switch on G33 to "Note" when the A/F oscillator in the model will generate a 500-cycle note in the air due to the earpiece inside G33. (The R/F oscillator will still be generating C.W.).
(m) Detune the R/F oscillator in G33 from the dead space to beat with the signal.
(n) Adjust the beat note observed in the receiver telephones to the same as the 500-cycle note in the G33 earpiece.
(o) Measure the frequency of G33 with G56 as in (j) and (k) above.
(p) Tune the oscillator of G33 to give the same 500-cycle note on the other side of the dead space.
(q) Measure this frequency as in (j) and (k) above which should be approximately 1 kc. different from the first measurement. The mean of these two frequencies is the true frequency of the signal.

Extreme accuracy using the 500 cycle note can be obtained by directing the transmitting station to make long dashes and observing the secondary beats between the heterodyne note and the 500 cycle note in the G33.

In carrying out the measurements referred to in (l) and (q) above, it is possible to make an error by setting the beat frequency to 1000 or even 2000 cycles instead of 500 cycles. It is therefore necessary to check that the two measured frequencies on either side of the dead space are approximately 1000 cycles apart.

When measuring signal frequencies above 3000 kc/s with a self-oscillating receiver it is unnecessary to stop the local oscillation by reducing reaction. Actually it will usually be found that the G33 oscillator, even with weak coupling, will be strong enough to shut down the self-oscillation of the receiver over a small range of tuning in which the signal may be heard heterodyned by G33. In other respects the measurement is made as in (a) to (k) above.

To measure the frequency of a local transmitter.

The frequency of a local transmitter can be measured with the aid of a receiver in the same way as signal frequencies. A much simpler method, however, is to use the telephones plugged into the jack in G33 and tune this directly to the transmitter frequency. G56 is used as before to measure the frequency of G33. When the transmitter is in a different office of the same ship it may be necessary to connect G33 to a receiving aerial.

To calibrate or set a receiver to a desired frequency.

(a) Set G56, to the required frequency, from the calibration book.
(b) Set G33 to I.C.W. and tune to give maximum deflection in the milliammeter of G56, care being taken to find the fundamental frequency.
(c) Connect G33 to the receiving aerial with the coupling plug pushed right in.
(d) When the oscillation has been picked up in the receiver, partially withdraw the coupling plug to avoid overloading and to sharpen the final tuning of the receiver.

When G33 is connected to an aerial, there will be appreciable radiation which will increase as the frequency is increased. A ship using G33 in this manner during wireless silence is therefore liable to be picked up and located by D/F.

Note:- It has been found that certain valves NR16A will not oscillate on all ranges of G33. If the model fails to oscillate on any of the ranges whilst continuing to oscillate on other ranges it is probable that the valve (9) in use in unsuitable and a number of valves should be tried to obtain a satisfactory valve.

OSCILLATOR G33

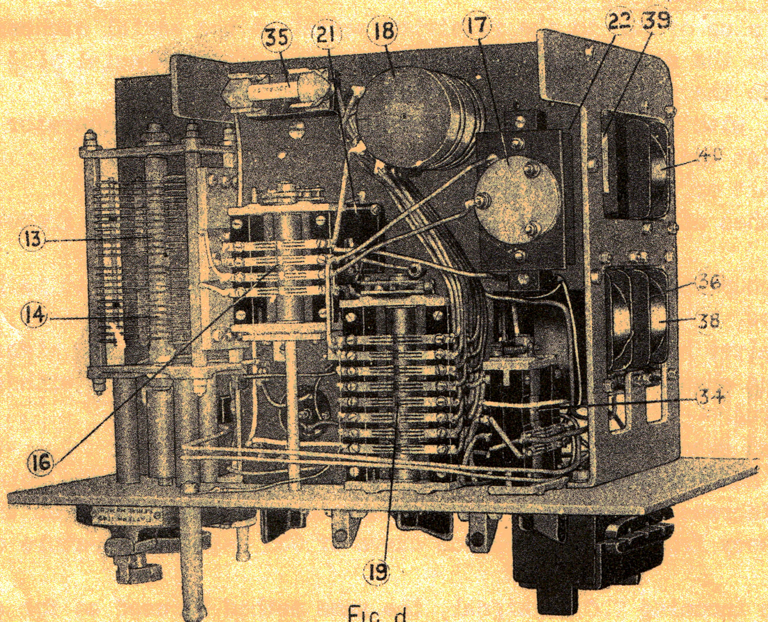

Fig. d.

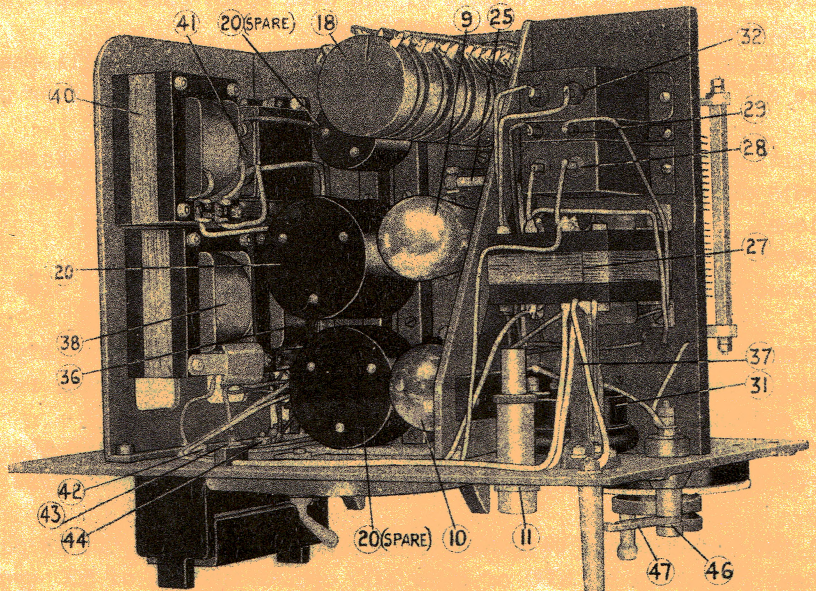

Fig e.

OSCILLATOR G33 AND WAVEMETER G56

MOUNTED IN A RACK

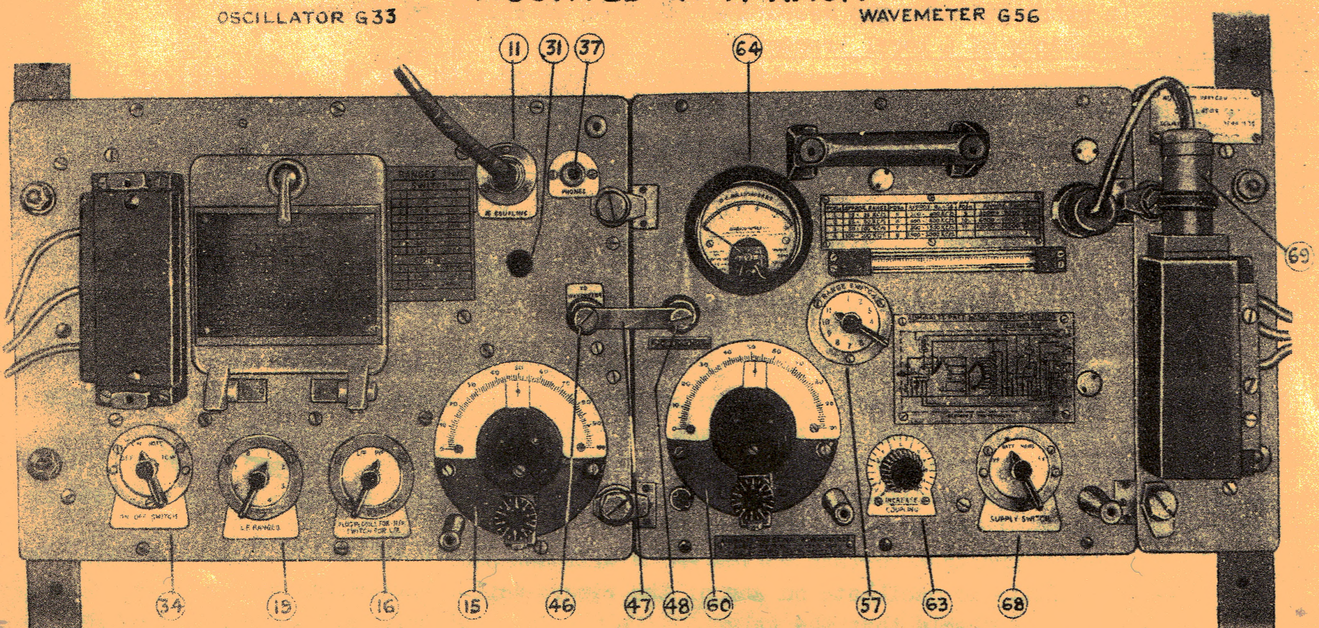

Fig. f.