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.

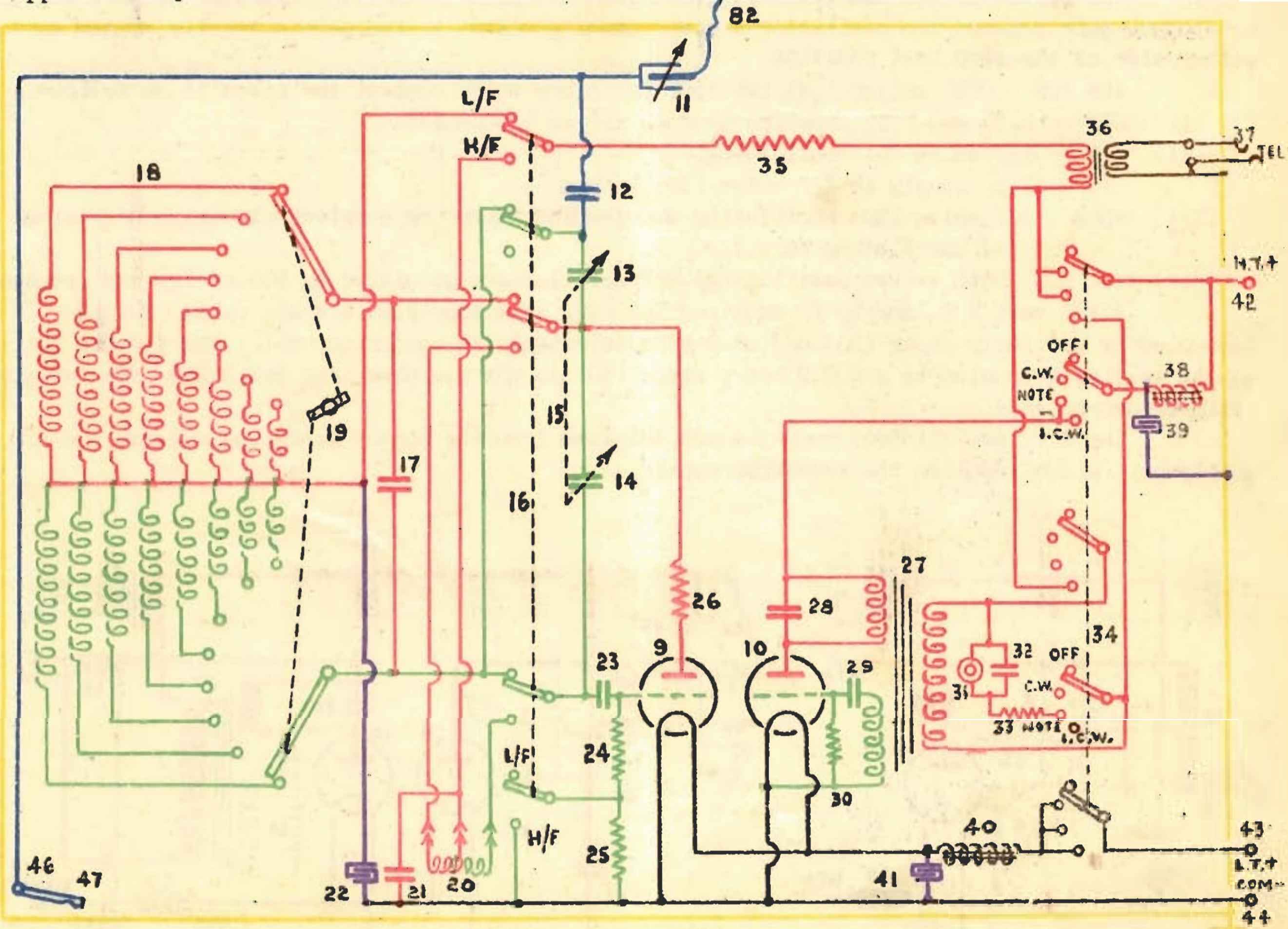
The frequency band of 15 to 24,000 kc/s is covered in 11 ranges identical with those of wavemeter G56 as follows:-

Range.	kc/s.
1	15 - 28
2	28 - 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.



82
11
L/F
H/F
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TEL
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NOTE
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L/F
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L.T.+
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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.

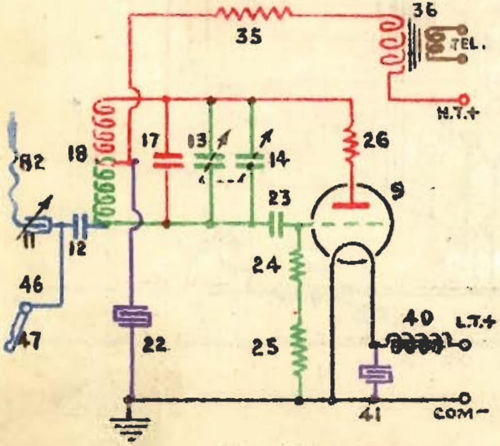
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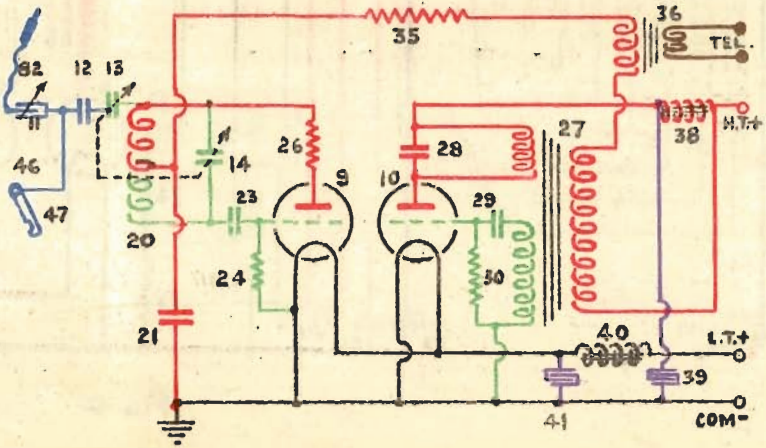
Fig. b.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L.T.+
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41
COM−

Fig. c.

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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 (1) 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.

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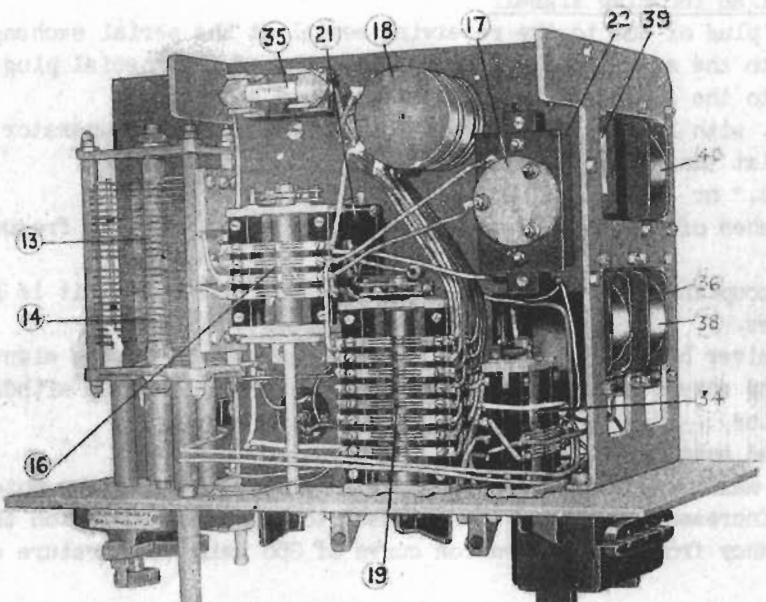

Fig. d.

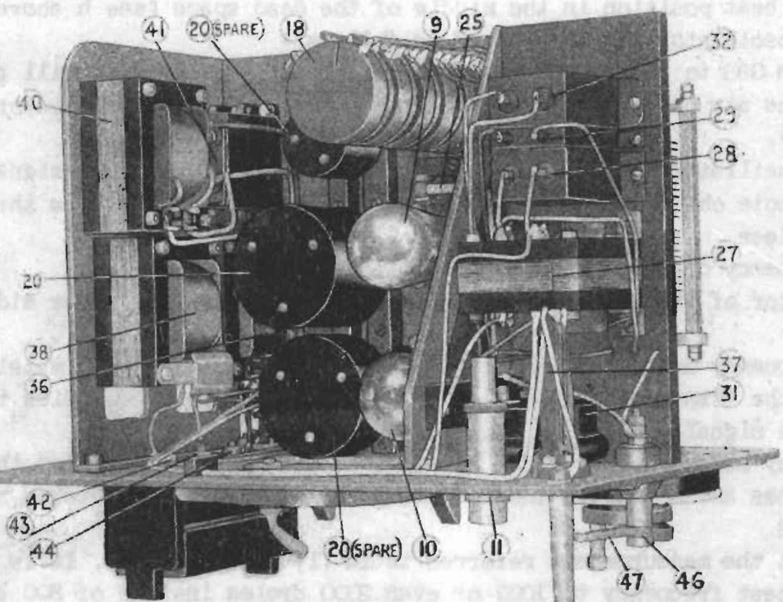

Fig e.

OSCILLATOR G33 AND WAVEMETER G56 MOUNTED IN A RACK

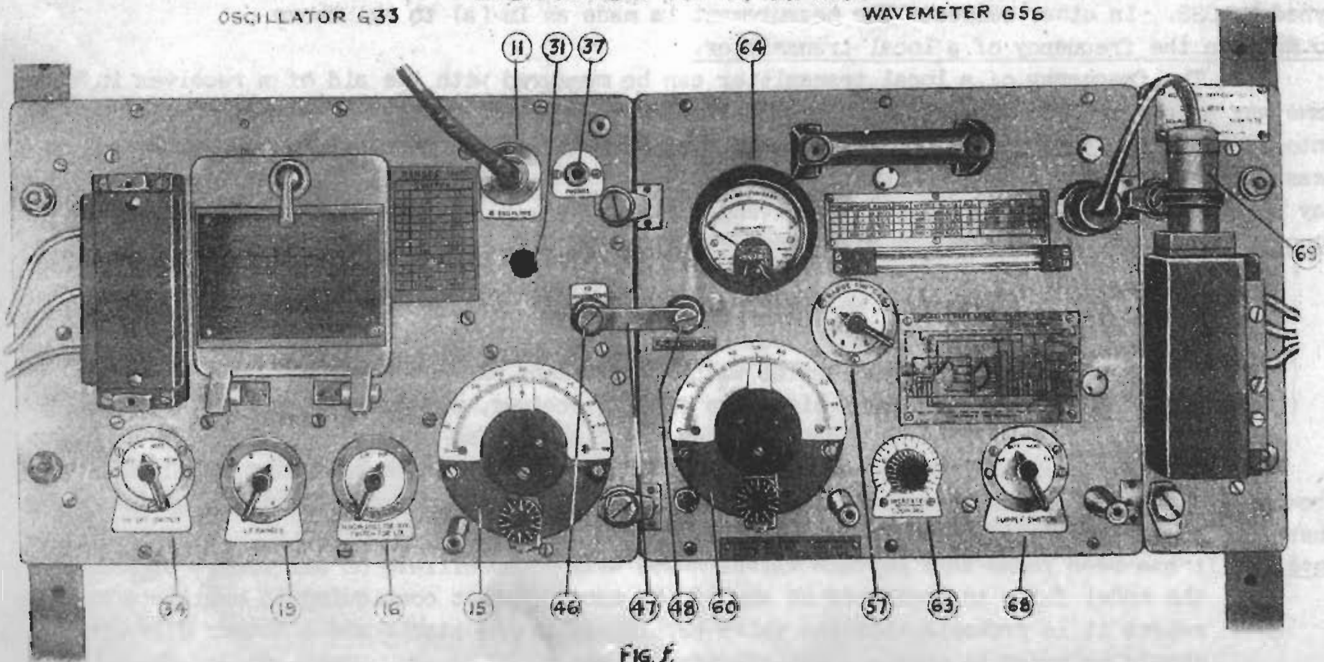

FIG. F.