SUB-SECTION G D WAVEMETERS IN PANELS.

WAVEMETER	G51	PAGE	GD2
WAVE INDICATOR	G52	"	GD4
" "	G53	"	GD5
" METER	G57	"	GD9
" "	G56	"	GD6

WAVEMETER G51.

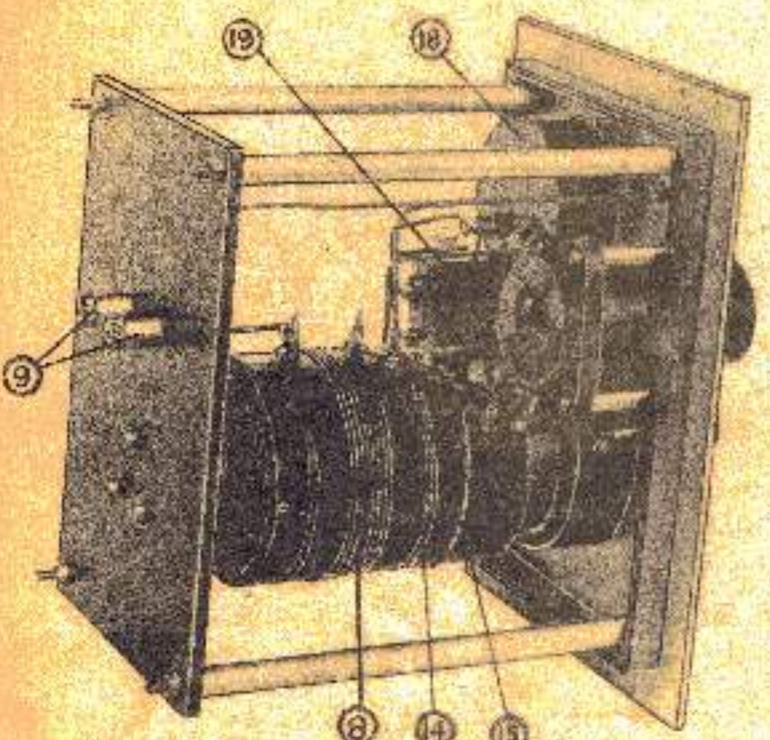

FIG. b

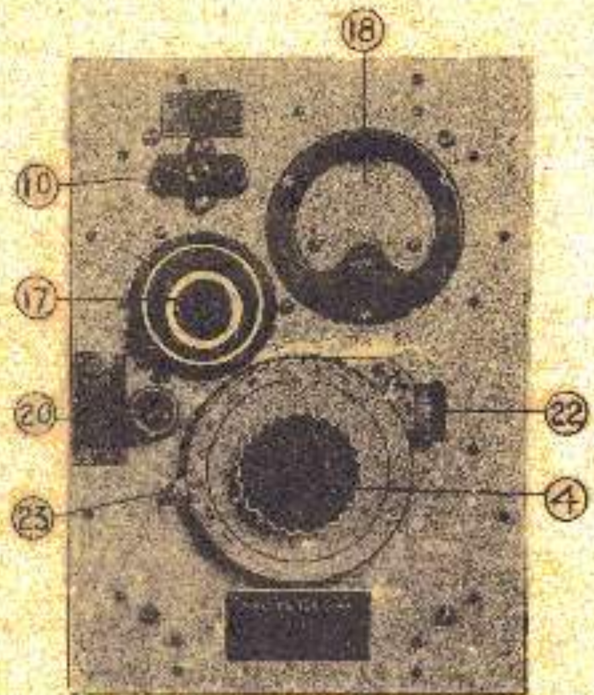

FIG. C

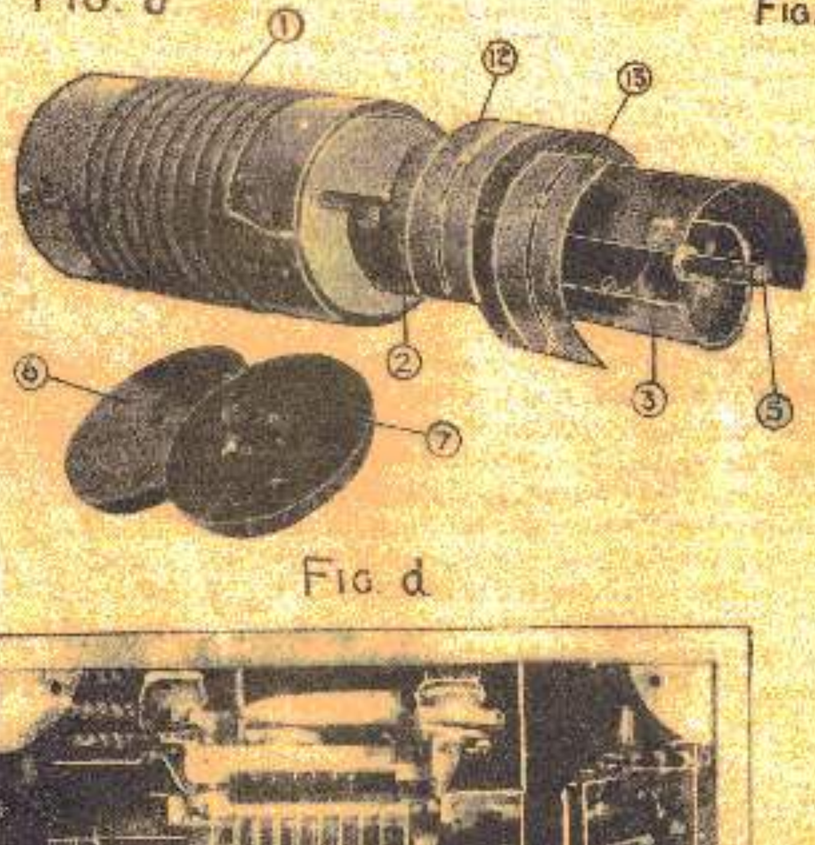

FIG. d

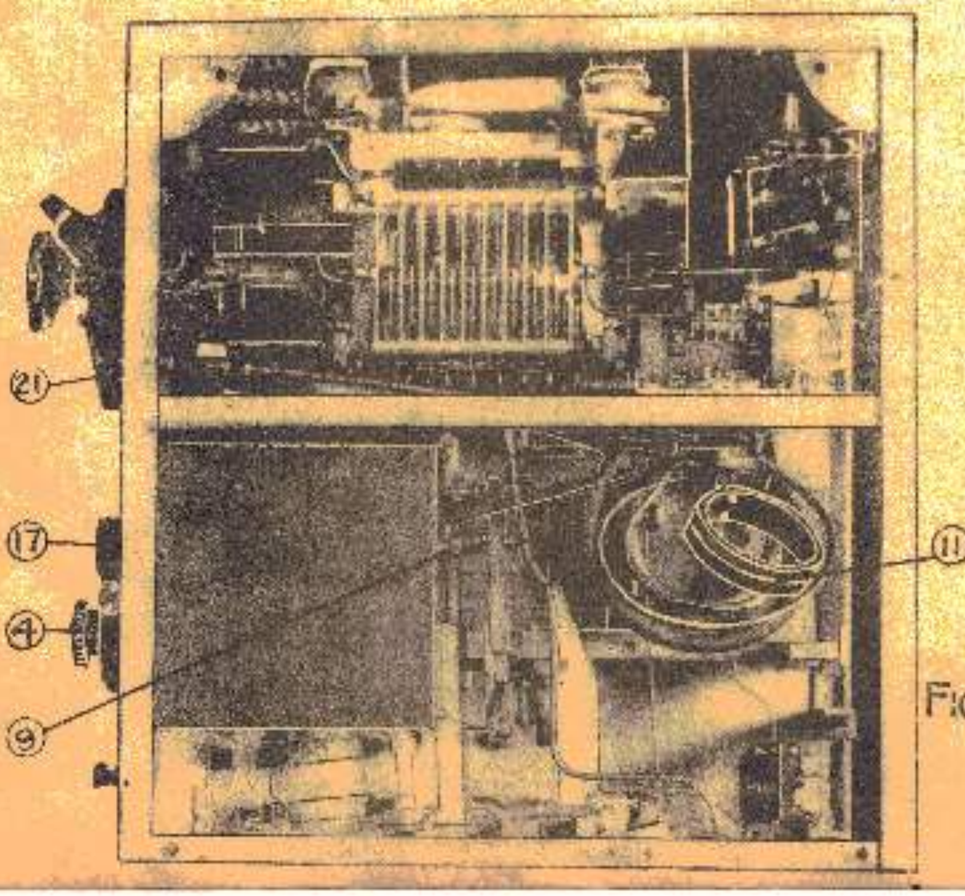

FIG. e

WAVEMETER G51

Date of design - 1939.
Frequency range - 21,500 - 28,600 kc/s.
Valve used - NDG.

G51 has been designed for use with Type 71AX, and is permanently fitted in the transmitting panel of that set, as shown in figure c, opposite and in figures in Section 5. This wavemeter covers a narrower band of frequencies than G8 (see page GA7) but the tuned circuit is designed on similar lines. The capacity of the tuning condenser is varied by moving two plates connected to the copper screen (16) between two fixed plates, which are connected to the tuning inductance (1). The fixed plates are of semi-cylindrical form and are mounted inside the former carrying the inductance (1). The moving plates, which are of tapered semi-cylindrical form, are mounted on and electrically connected in series by a common spindle (5) which carries the condenser handle (4) and which is maintained at zero R/F potential by being joined to the copper screen, thus avoiding hand capacity effects. They may be shown as two condensers (2) and (3) connected in series. Two small plates (12) and (13) connected together form an additional fixed minimum capacity in parallel with the variable capacity, by being placed in proximity to the semi-cylindrical fixed plates. The position of the plates (13) and (12) is adjusted in Signal School to give the wavemeter the correct frequency range. A mechanical vernier (22) with a disengaging arm (23) is fitted to the condenser scale for accurate reading off.

Figure (d) shows part of a second G51 wavemeter stripped to reveal the inductance (1), condensers (2) and (3), the adjustable plates (13) and (12), and spindle (5) with the two bearing plates (6) and (7) which are all mounted inside a concentric former carrying the mutual coil (8), and the diode valve coupling coils (14) and (15).

The indicating device is similar to that used in G8 (see page GA10) and comprises a small diode valve (17) and milliammeter (18). The filament of the valve is lit by a small single turn coil (15) coupled to the main inductance (1). H.T. voltage for the diode valve is supplied by means of a second coil (14) of two turns also coupled to the main wavemeter inductance (1). The D.C. milliammeter (18), shunted by a condenser (19), is placed in the anode circuit of the valve and indicates the value of the rectified current. This value will obviously be a maximum when the wavemeter circuit is in tune with the wave being measured. The filament circuit can be broken by a key (20) which can be locked in the closed position when the wavemeter is in use, but which should normally be left "open".

Coupling to the transmitter is effected by a coupling coil (11) connected via terminals (9) to the mutual coil (8). A pea lamp (10) is connected in this coupling circuit and serves as a fuse to protect the wavemeter in case the coupling to the transmitter is too tight. If the pea lamp filament glows, when the transmitting key is pressed the wavemeter coupling is too tight and must be reduced until the pea lamp ceases to glow. If this is not attended to before making the key (20) to complete the filament circuit of the diode valve (17) there is a risk of burning out the diode valve filament. The coupling can be varied by rotating the coupling coil (11) by means of a handle (21) on the front panel just above the wavemeter. The position of the coupling coil relative to the transmitter can be altered to suit the power being used. Two stiff leads connect the coupling coil to the wavemeter, as any movement in these leads would affect the calibration. Both ends of one of these leads are earthed to the framework of the panel as earthing one end only was found unsatisfactory due to eddy currents set up in the aluminium panels.

Resonance is indicated by the maximum reading of the milliammeter (18) and not, of course by the pea lamp (10). Two calibration curves are supplied, one of which is for use when the set is first switched on and the other for use when the set has been in use for some time and the wavemeter has been warmed up by the heat of the transmitting valve.

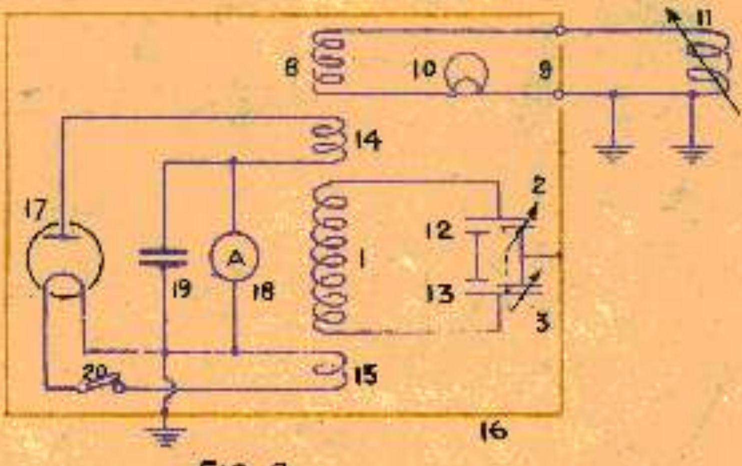

FIG. a

WAVE INDICATOR G52

Date of design:- 1931.
Frequency range:- 100 - 870 kc/s.
Reference:- Admiralty Handbook of W/T (1931) paragraph 822 (t).

G52 has been designed for the L/F transmitters of Type 46, and is permanently fitted in Panel OF Transmitting L/F Upper (see figure a. page R162). RK20)

It is used for checking the frequency transmitted by the L/F Transmitters.

The circuit is a closed oscillatory circuit, consisting of number one range coil (1), number two range coil (3), a variable 1 jar condenser (5), semi-adjustable condenser (6) and neon lamp (7). Either coil (1) or (3) (depending on the frequency range) is connected in the circuit by a four contact barrel switch (4).

The frequency range covered by each coil is:-

Range 1. 100 - 300 kc/s. Range 2. 272 - 870 kc/s.

The coupling coil (2) is connected to the secondary of a coupling unit (138), the primary of which is connected in the L/F transmitting aerial circuit (see figure 1. page R121). The secondary of the coupling unit (138) can be rotated inside the primary, thereby varying the degree of coupling, thus controlling the energy applied to the G52.

Resonance with the transmitted frequency is obtained by using the range coil applicable, and adjusting the variable condenser (5). When resonance is obtained the neon lamp (7) will glow. For accurate settings the least possible coupling in the coupling unit (138) should be used, so that only a very faint glow is obtained in the neon lamp (7).

Attached to the adjusting spindle of condenser (5) is a calibrated drum (8) which indicates the frequency as the condenser is adjusted.

The whole of the components are mounted on an aluminium panel (137) and are partially screened by copper across the top, back, and bottom of the instrument. Two windows are cut in the panel to allow the neon lamp (7) and calibrated drum (8) to be visible when adjusting the G52. The range switch (4) and the controls of the condenser (5) and coupling unit (138) are adjustable from the receiving cabinet.

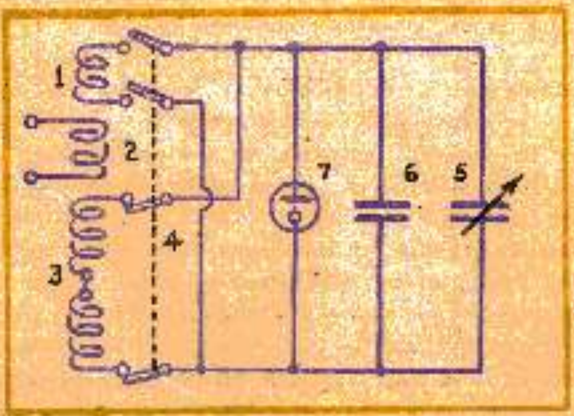

Fig. a.

Fig. b.

Fig. c.

WAVE INDICATOR G 53

Date of design:- 1931.
Frequency range:- 4200 - 28000 kc/s.
Reference:- Admiralty Handbook of W/T (1931) paragraph 823 (t).

G53 has been designed for the H/F transmitter of Type 48 and is permanently fitted in Panel SN Transmitting, H/F Right Upper (see figure a page [illegible]) It is used for checking the frequency of the H/F transmitter. The circuit is a closed oscillatory circuit which consists of three coils (1)(3)(6), a variable condenser (5) and a neon lamp (7). Either one, two or three coils can be connected in series by a five contact barrel switch (4). These three arrangements with the condenser (5) give the three frequency ranges. The position of the contact of the barrel switch (4) for each range is given in the table below.

The coupling coil (2) is connected to the secondary of a coupling unit (36), the primary of which is connected in the H/F transmitting aerial circuit (see figure 1. page R128). The secondary of the coupling unit (36) can be rotated inside the primary, thereby varying the degree of coupling, thus controlling the energy supplied to the G53.

Resonance with the transmitted frequency is obtained by using the range coil applicable and adjusting the variable condenser (5). When resonance is obtained the neon lamp (7) will glow. For accurate settings the least possible coupling of the coupling unit (36) should be used, so that only a very faint glow is obtained in the neon lamp (7).

Attached to the adjusting spindle of condenser (5), is a calibrated drum (8) which indicates the frequency as the condenser (5) is adjusted. The whole of the components are mounted on an aluminium panel (35) and are entirely enclosed by a copper screen. Two windows are cut in the panel to allow the neon lamp (7) and the calibrated drum (8) to be visible when adjusting the G53.

The range switch (4) and the controls of the condenser (5) and coupling unit (36) are adjustable from the receiving cabinet.

Range	Contacts		Frequency range.
	Made.	Broken.	
1	8	9, 10, 11, 12	4,200 - 8,500
2	9, 10	8, 11, 12	8,000 - 17,000
3	9, 11, 12	8, 10	16,000 - 28,000

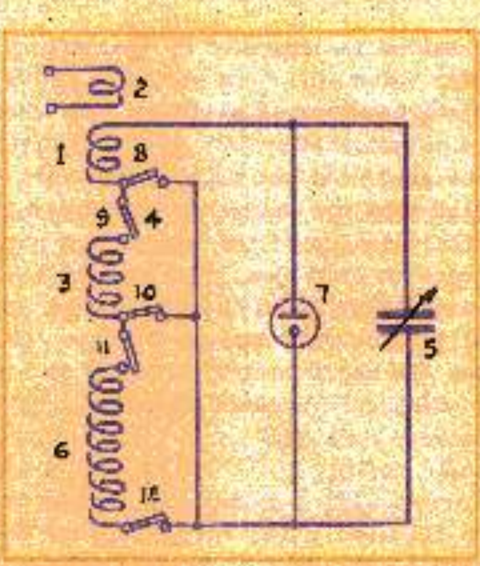

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Fig. a.

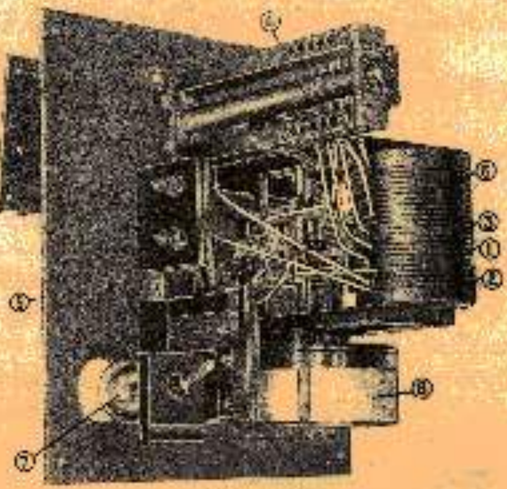


Fig. b

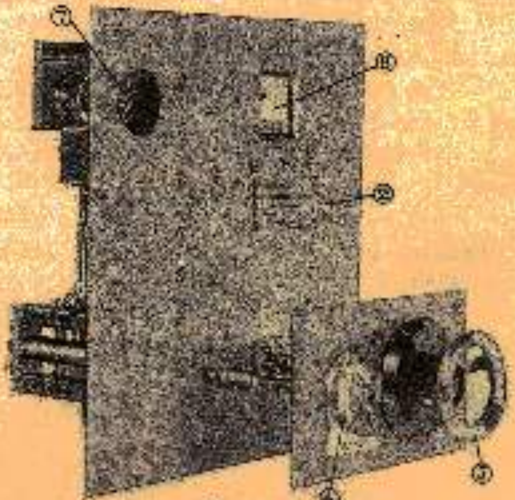


Fig. c

WAVEMETER G56

Date of design:- 1932.
Frequency range:- 15 - 24,000 kc/s.
Valves used:- 1 NR27 (coupling).
1 NR31 (detector).
Reference:- Admiralty Handbook of W/T (1937), Vol.II, Section W (6 and 13).

Wavemeter G56 has been designed for use as a portable absorption wavemeter for tuning transmitting sets or, in conjunction with Oscillator G33, as a heterodyne wavemeter for measuring the frequency of incoming signals and calibrating receiver outfits. (See page G05).

When G56 is used as a portable wavemeter, the H.T. and filament supplies for the valves can be taken from the ship's D.C. mains by using a filter unit as described below. When G56 is mounted in a rack with G33 the H.T. and filament supplies are obtained from the common receiver batteries or from the A.C. supply outfit. A diagram of the G56 circuit is shown in figure a.

The circuit consists of a coupling valve (7) loosely coupled to a tuned circuit (60)(61) which is in turn loosely coupled to a detector valve (8). The grid of the coupling valve (7) is connected to a transmitting set by connecting a lead between the transmitter and the input terminal (48) on the wavemeter. When G56 and G33 are fitted in a receiving rack the input terminal (48) is connected to Oscillator G33 by means of a link fitted on the front of G33.

The frequency band of 15 to 24,000 kc/s is covered in 11 ranges, identical with those of Oscillator G33, controlled by a range switch (57).

When the range switch (57) is set to any position from 1 to 10 the anode of the coupling valve (7) is connected to the wavemeter tuning circuit (60)(61) by a condenser (58)(see figure b.).

When the range switch (57) is set to position 11 the coupling valve is not used and the input terminal (48) is connected, through the coupling condensers (49)(50)(52), direct to the wavemeter tuning circuit (60)(61) (see figure c). The coupling valve (7) is by-passed in this manner as it is very inefficient on the highest frequency range and is liable to set up spurious oscillations.

The wavemeter tuning circuit consists of an inductance (61) with 10 tappings (i.e., eleven inductance coils) and a 0.5 jar variable condenser (60). This tuned circuit is loosely coupled to the first valve (7) by condensers (59) and (52) to (56)(depending on the range in use) and to the second valve (8) by condensers (59) and (62). This coupling system functions as if the tuning coil (61) were loosely coupled to a coil in the anode circuit of valve (7) and to another coil in the grid circuit of valve (8). The condenser coupling, however, prevents the complications which would arise if mutual coupling with coils were used. The selection of condensers (52) to (56) for each range position is equivalent to changing coupling coils in a system utilising mutual inductive coupling.

The wavemeter resonance tuning is indicated by the deflection of a D.C. milliammeter (64) in the anode circuit of the detector valve (8). The variable tuning condenser (60) is adjusted until a maximum deflection in the milliammeter is obtained. The detector valve (8) is used as a lower bend anode rectifier, with a potentiometer (63) connected across the H.T. supply for grid bias adjustment. By increasing the grid bias the milliammeter (64) can be prevented from running off the scale when the R/F potential from the wavemeter tuning circuit becomes excessive due to a very strong input signal. Clockwise rotation of the knob of the potentiometer (63), by which this adjustment is made, reduces the negative grid bias. The knob is marked "Increase Coupling".

If the wavemeter is severely overloaded by an excessive incoming signal the large grid swing on the detector valve (8) will cause grid current to flow. This grid current, passing through the grid leak (4) increases the negative grid bias and so limits the rectified anode current to a value (approximately) at which grid current commences. By this arrangement the milliammeter (64) is protected from a severe overload.

The milliammeter full scale deflection is 0.5 mA. but a special damped movement is fitted which prevents damage to the instrument with a sudden application of up to 4 milliamps.

A four position H.T. and filament supply switch (65) is mounted on the panel of the instrument, the positions are marked "OFF", "BATT", "Mains" and "A.C.".

The "OFF" position disconnects the supplies when the instrument is not in use.

The "BATT" position connects the valve heater filaments in parallel for use with 4-volt common battery supply to the receiving room.

The "Mains" position connects the filaments in series for use with a filter unit on the ship's D.C. mains as described later.

The "A.C." position connects the filaments in parallel when A.C. is used for filament heating of the receiver outfits.

If the supply switch (65) is set to the wrong position the heater filaments will not be harmed.

A flexible lead, with a 4-pin plug at one end and a 4 hole socket at the other, is used for connecting the G56 to the H.T. and filament supplies. The socket is pushed over a 4-pin plug which is fitted on the front panel of the instrument.

When G56 and G33 are fitted together in a rack the plug on the flexible lead is inserted in a socket on the G33 framework. This socket is connected to four terminals, mounted on the G33 framework, which are connected to the H.T. and filament supplies to the receiver outfits. When an A.C. supply outfit is fitted the filament heater supply for G56 must be taken from a heater circuit

WAVEMETER G56

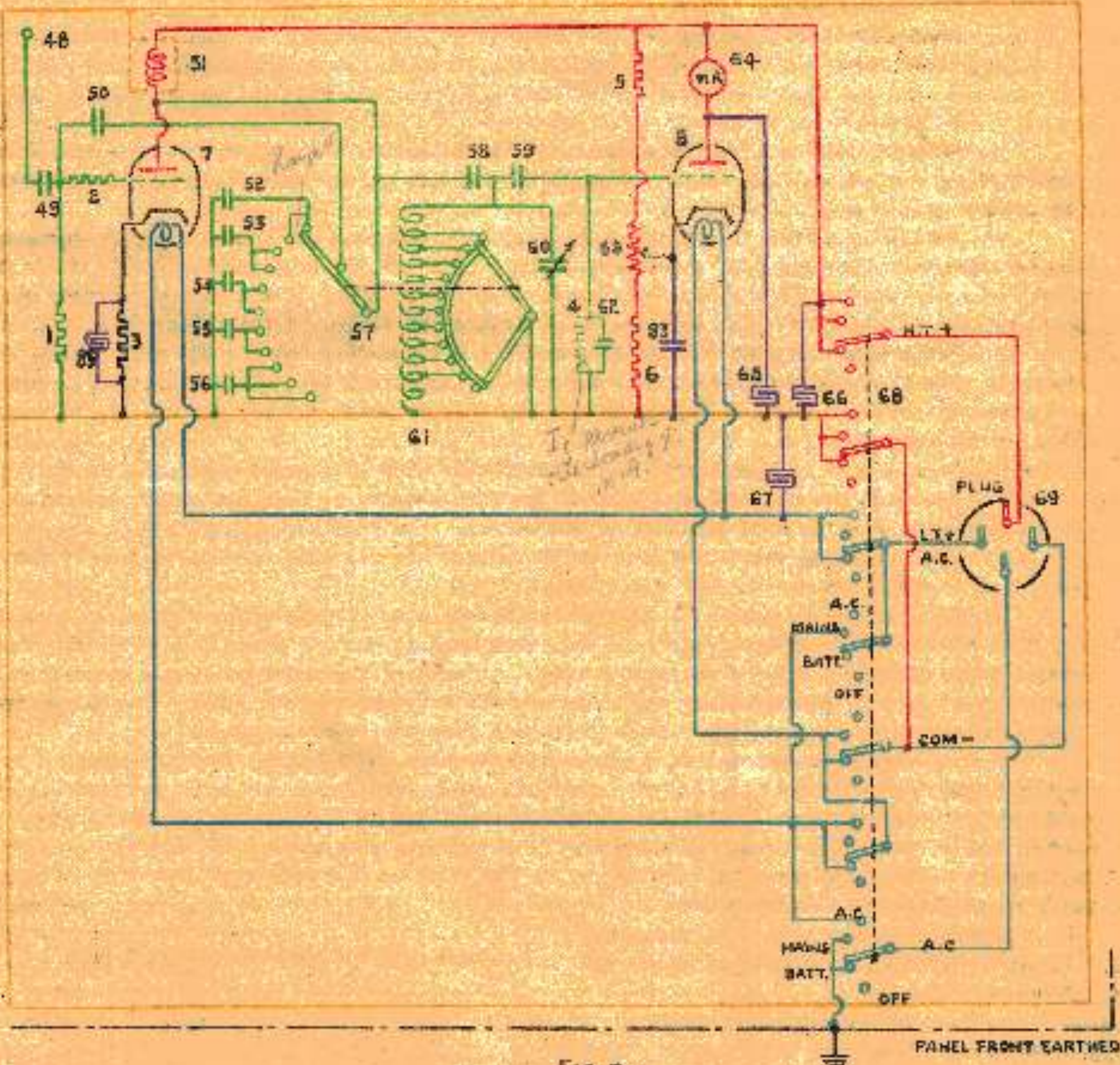


FIG. a.

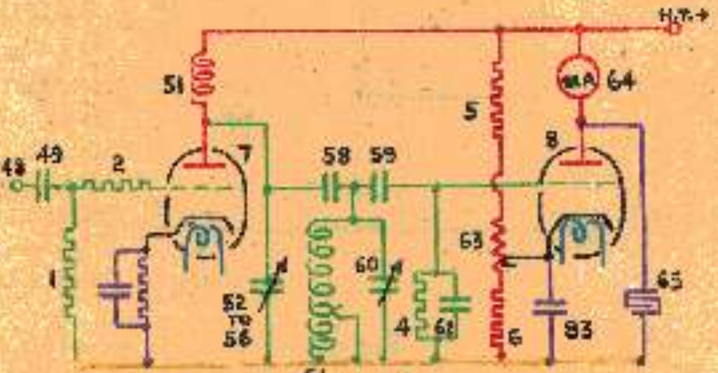


FIG. b.

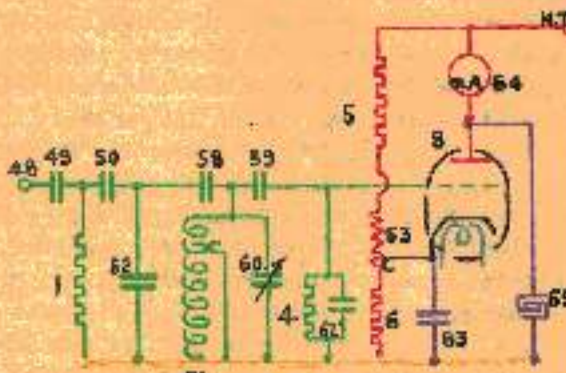


FIG. C.

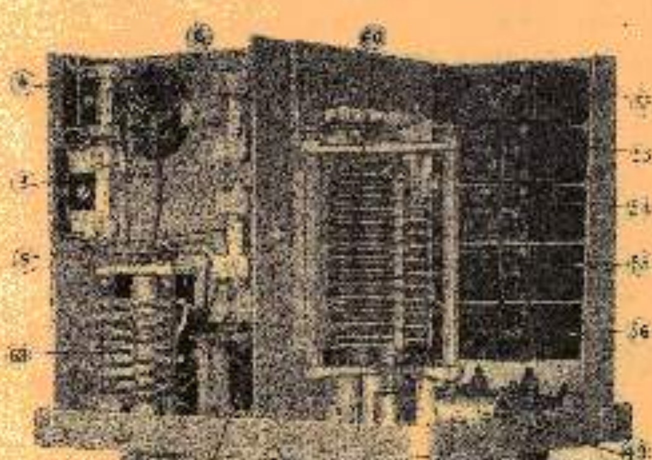


Fig. d.

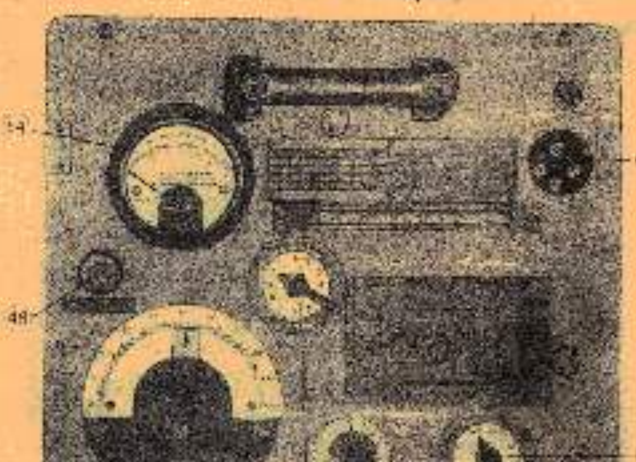


Fig. e

WAVEMETER G56

which is not connected to any other unit. This precaution is necessary in order to prevent the heater winding from being short circuited through the earth on the hum potentiometer fitted in modern receivers and the earth on the filament supply switch (69) when the switch (69) is moved from "A.C." to "OFF" or vice versa.

When G56 is used as a portable wavemeter the socket on the flexible lead is withdrawn from the G56 and a flexible lead, which is supplied with the filter unit, is used for connecting the G56 to the filter unit.

The filter unit (see figure f) is supplied in a separate box with a flexible connecting lead and a bayonet joint plug (81) for inserting in a lamp fitting connected to D.C. mains. The plug (81) must be inserted in the lamp fitting so that the polarity of the supply is correct. The correct position is found by trial as there is no indicating device in the filter unit. If the polarity is correct when the plug (81) is inserted the milliammeter (64) in G56 will give a slight forward kick when the filter switch (80) is made and a backward kick if the polarity is incorrect.

The filter unit has a screwed plug and two sockets which enables the unit to be used with 110-volt or 220-volt supplies.

When the filter is used with 110-volt mains the plug (77) is screwed into the socket marked "110-volts" and the positive supply from the ship's mains is then connected through a 0.88 henry R/F choke (71), to the H.T. terminal of the socket. The positive supply is also connected through a 102 ohms reducing resistance (74) (which reduces the filament current to 1 amp) and thence to the L.T. + terminal of the socket.

When the filter is used with 220 volt mains the plug (77) is screwed into the socket marked "220-volts". The positive supply is then connected to the R/F choke coil (71) and reducing resistance (74) through a 110 ohm resistance (82). In both of the above positions the H.T. supply from the filter unit is approximately 100 volts and the filament current 1 amp. The filter unit must only be used with G56 when the latter is removed from the receiving rack.

The wavemeter is enclosed in a screening box which is insulated from the panel front to prevent earthing the ship's D.C. mains when using the filter unit with the supply switch (69) set to "Mains". When the wavemeter is fitted in a rack with G33 the screening box and the panel front are earthed. It is necessary to remove the screen from the back of the instrument to gain access to the valves. The wavemeter does NOT require re-calibration when new valves are fitted.

G56 is supplied with a carrying box when it is to be used as a portable wavemeter for direct measurement of transmitter frequencies. A book of calibration curves is provided in the lid of the carrying box. This book also contains instructions for using the wavemeter and the necessary corrections to be made for the slight variations of calibration due to temperature changes. A thermometer is fitted on the front of the instrument.

Coupling to a transmitter is made by a single lead from the coupling terminal on the G56 to a suitable point on the transmitter. Modern transmitters are supplied with a wavemeter coupling terminal, but in cases where this terminal is not fitted a suitable position for the coupling lead must be determined. The coupling required is by capacity only and in very low power sets this can be obtained by twisting a few inches of insulated coupling lead round the aerial wire. In general, however, it is necessary to tie the coupling lead inside the transmitter cage somewhere in the vicinity of the aerial or tuning coil, but at a safe distance to avoid damage to the wavemeter.

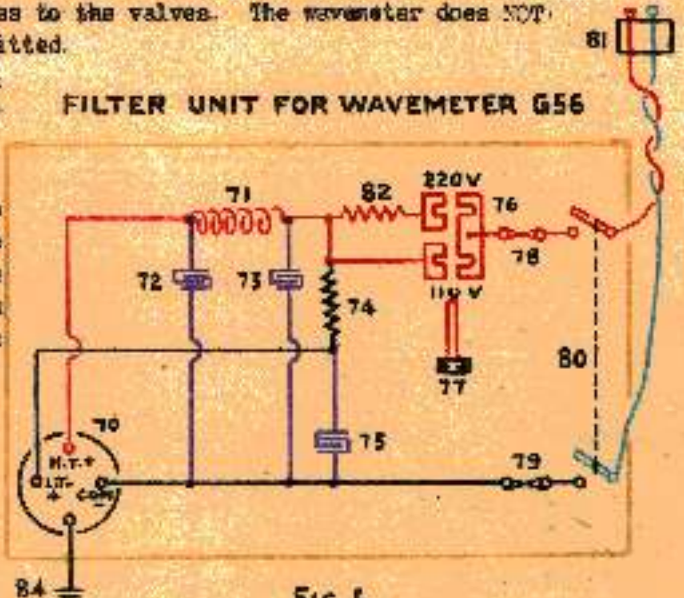


FIG. f.

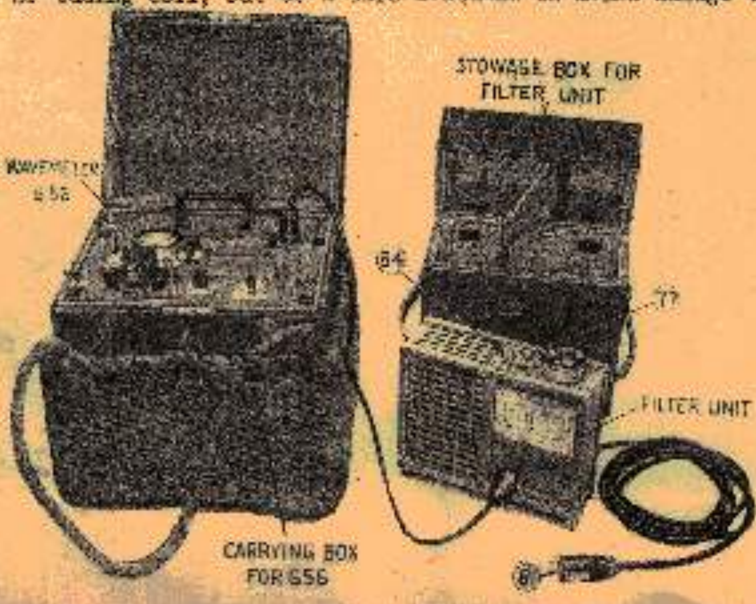


FIG. g.

WAVEMETER G57

Date of design:-	1932.
Frequency range:-	100 - 24,000 kc/s.
Valves used:-	1 NR27 (coupling).
	1 NR31 (detector).

Wavemeter G57 has been produced for use with all transmitters which require a wavemeter as part of the set, and is designed for panel mounting. To prevent the wavemeter case being in direct contact with the negative lead of the ships D.C. supply, the wavemeter is suspended by insulators from an outside panel, which is bolted to the metal frame work of the transmitter. The ship's voltage has been utilized to supply the H.T. to the indirectly heated valves, a filter (see figure d.) being supplied which enables the wavemeter to be used in either a 100 volt or 220 volt ship. The filament supply to the valves is taken from the secondary of a step down transformer, fitted on the filter, the primary of the transformer being supplied from the filament machines of the transmitter. The filaments of the valves are connected in series. The instrument is enclosed in an aluminium box, and an additional screen (31) (see figure e.) is fitted between the valves, which can be opened to facilitate the removal or insertion of a valve.

The circuit consists of the coupling valve (1) and detector valve (2), a tuned circuit consisting of the coil(16) and the variable condenser(19), and a series of coupling condensers (4) (11)(12)(13)(14). The range switch (15) selects the appropriate tuning coil and coupling condenser for the frequency range required. The wavemeter tuning is indicated by the deflection of the needle of the milliammeter (28), in the anode lead of the detector valve (2). The milliammeter (28) will show a maximum reading when the wavemeter is in resonance with the transmitter.

The frequencies covered, together with the coupling condenser used, in each position of the range switch (15), are shown in the following table:-

Range Switch position.		Frequency kc/s.	Coupling condenser.
1.	2.	100 - 400	14
3.	4.	400 - 1600	13
5.	6.	1600 - 6000	12
	7.	6000 - 12000	11
	8.	12000 - 24000	4 and 11

Coupling to the transmitter is made by a single lead from the coupling terminal (30) to some point of high potential in the R/F circuit on the transmitter, to which it is loosely coupled by a very small capacity. This condenser is fitted in the transmitter and is not part of wavemeter G57. With a powerful transmitter, the stray capacity of a few inches of lead is sometimes sufficient without making direct connection to the transmitting circuit, in which case the additional condenser is not required. A fixed condenser (3) of very small capacity is connected in the grid lead of the coupling valve (1) to limit any changes of the effective capacity of the wavemeter circuit, which would be caused by any change of capacity to earth of the coupling lead from the terminal (30) to the transmitter. Coupling between valve (1) and the tuned circuit (16 - 19) is effected by means of fixed condensers. These are shown as condenser (17) in figures b. and c. and one selected by the range switch from the group 11, 12, 13 and 14, the values of which are 200, 300, 600 and 1500 micro micro farads respectively. Tuned circuit (16)(19) is coupled to the detector valve (2) by means of a capacity potentiometer consisting of the fixed condensers (18)(20). To prevent V.H/F harmonics being produced in the coupling valve (1) when measuring frequencies above 12,000 kc/s it is necessary to couple the transmitting circuit directly to the tuned grid circuit (16)(19) of valve (2) instead of the grid of valve (1). The coupling is obtained by the range switch (15), which, in position eight, connects the 0.03 jar condenser (4) between the grid and anode of valve (1) (see figure c.). The coupling terminal (30) will then be connected through condensers (3)(4) and (17) to the tuned grid circuit (16)(19) of valve (2). The 1000 ohm resistance (5) is an additional preventative against the production of V.H/F harmonics on the higher frequencies.

Automatic grid bias for the coupling valve (1) is provided by the 300 ohm resistance (7) the 0.1 mfd by-pass condenser (8) being fitted as an R/F by-pass.

The valve (2) is a detector and anode bend rectification is used. Grid bias is provided to prevent grid current flowing in normal use.

A potentiometer consisting of the resistances (22)(24)(25) provides the grid bias for the detector valve (2) and is controlled by the switch (10). By increasing the grid bias on valve (2) a stronger signal is required on the grid to give a deflection on the milliammeter (28). This provides a coupling control in the wavemeter. The R/F choke (9) is screened, and the screen connected to the casing of the instrument. R/F by-pass condensers (23)(27)(28)(29) are all connected to the casing of the instrument. The grid leak resistances (6)(21) are 20,000 and 250,000 ohms respectively. For accurate readings the variable condenser (19) is fitted with a slow motion device, the condenser scale being sub-divided into thousandths. The plates of the condenser are so shaped that the greatest possible accuracy is obtained when reading the calibration curves.

WAVEMETER G57

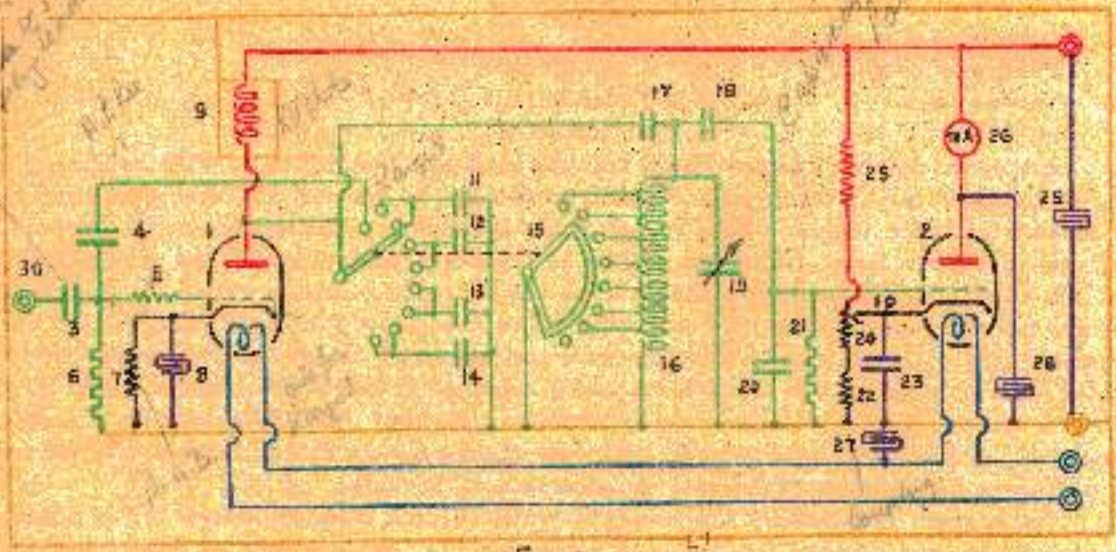
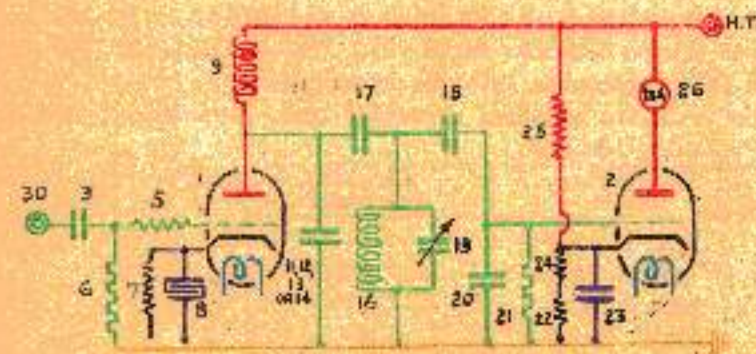
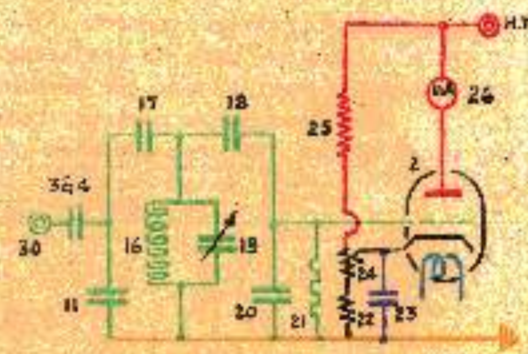


Fig. a



SWITCH POSITIONS 1 TO 7.
Fig. b.



SWITCH POSITION 8.
Fig. C.

FILTER BOARD FOR WAVEMETER G57.

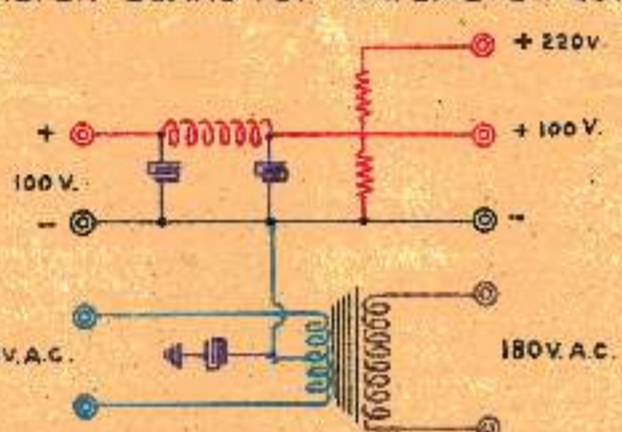


Fig. d.

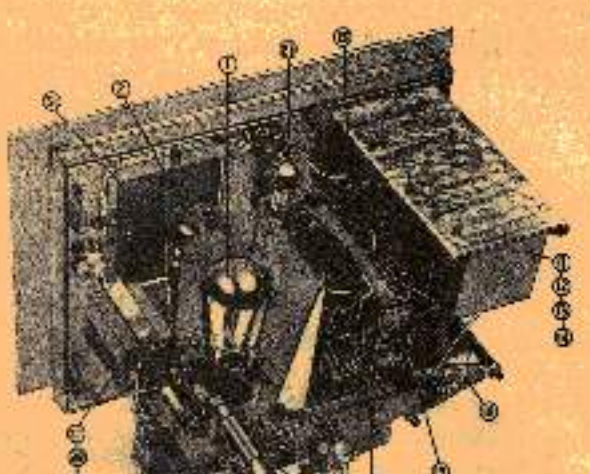


Fig. e.

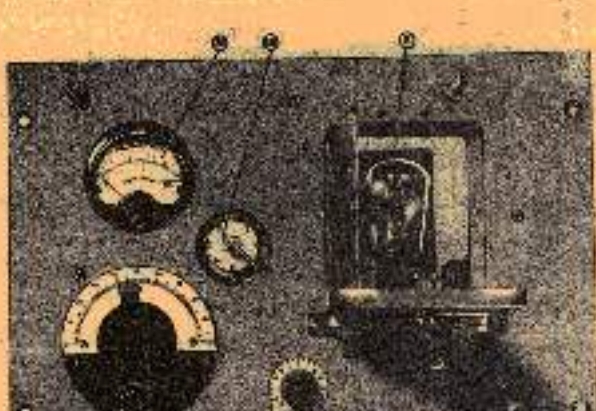


Fig. f.