SECTION H AMPLIFIERS

MODEL LB.

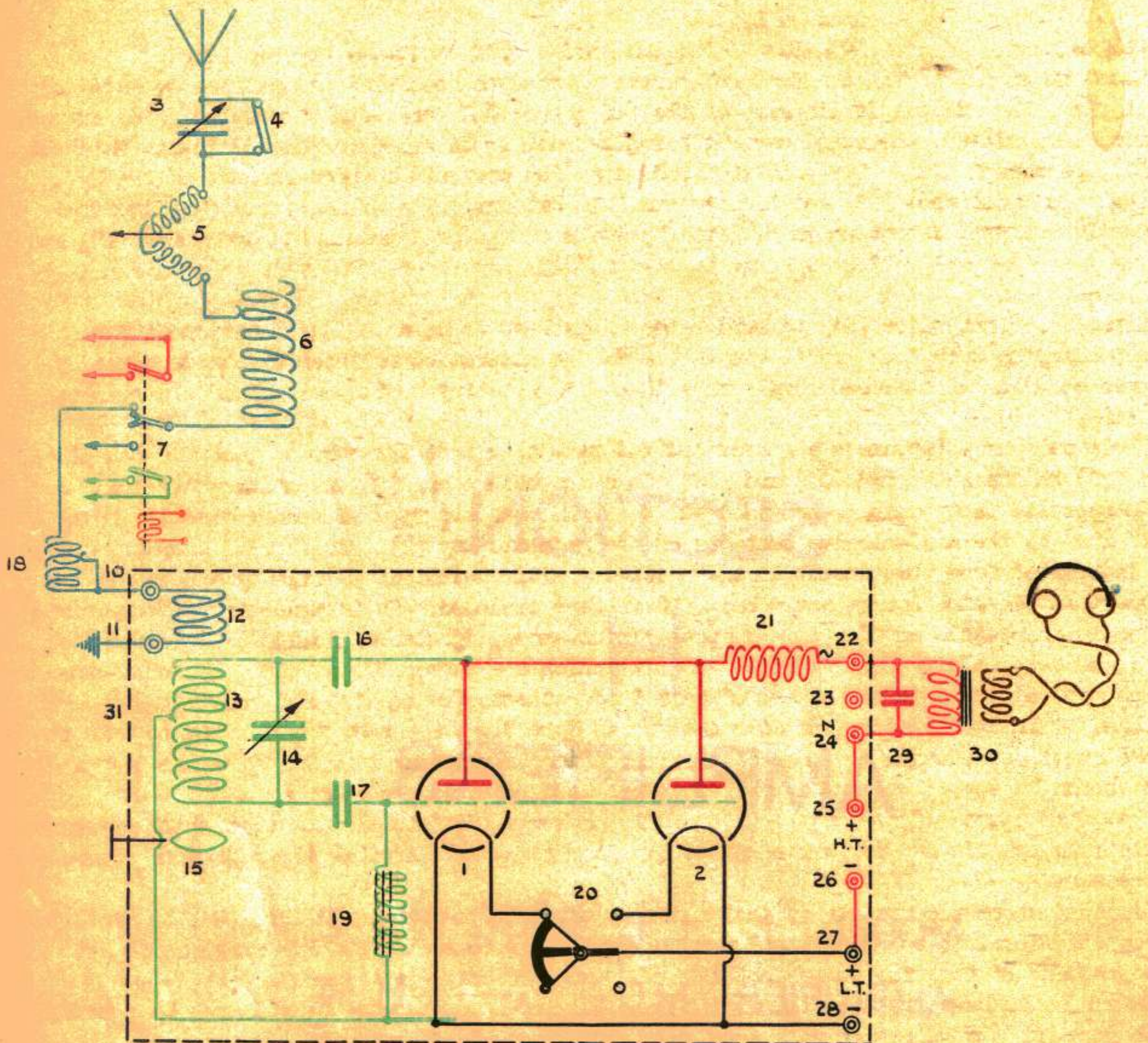


FIG. a.

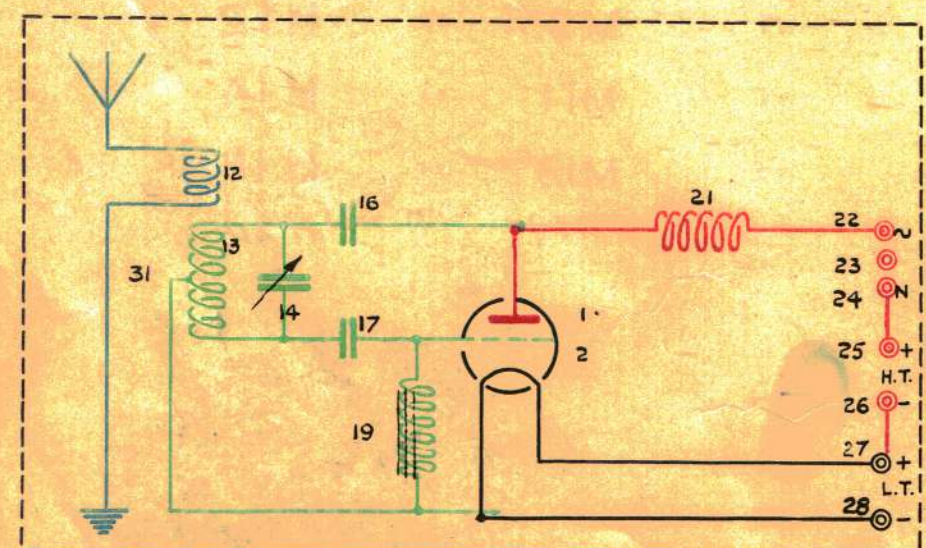


FIG. b.

MODEL L B.

Date of design:-	1917.
Frequency range:-	600 - 1,000 kc/s.
Where fitted:-	Receiver-Outfit LB in conjunction with Type 31 for gunnery control. (See section R). (Being replaced by Receiver-Outfit CH. See Section D).
Valves used:-	Two NR14. Two cumulative grid detectors (1) and (2).

Model LB is one of the earliest regenerative autodyne receivers and differs considerably from later types. The circuit is the same as that of a parallel feed, direct coupled grid, mutually coupled aerial transmitter, the tuned circuit being between anode and grid (see Admiralty Handbook of W/T (1931), paragraph 626). The blocking condenser (16) prevents a short-circuit of the H.T. supply through the inductance (13) and filament or L.T. battery. The filament tap (31) is fixed.

Cumulative grid detection is obtained by means of the grid insulating condenser (17) and the inductive grid leak (19) which is known as the musical inductance. Two valves (1) and (2) are provided, connected in parallel. A change-over switch (20) in the filament circuit enables either the left valve (1), right valve (2), or both valves together, to be used. Calibration differs slightly when changing over from one to two valves due to alteration of inter-electrode capacity. The fine tuner consists of a closed single wire loop (15) rotating inside one end of the primary inductance (13).

Three telephone terminals are provided and care should be taken to connect the telephone transformer (30) to the outer two (22) and (24) since the centre one (23) is a dummy terminal.

No separate tuner unit is provided and Model LB uses the Type 31 aerial circuit, being connected to this by the send-receive contacts of the magnetic key (7). The aerial coupling coil of Type 31 is omitted from the circuit in the receive position since it is tightly coupled to the primary circuit and damping losses would occur if it were included. It is necessary to compensate for this loss in inductance and for this purpose "Inductance, Adjustable, No. 18" (18) is inserted before the input terminals of Model LB (10) and (11) which are marked "Coupling". It would otherwise be necessary to have a different set of aerial adjustments for sending and receiving.

Model LB being fitted in the same cabinet as Type 31, the former may be used to tune the latter to the exact adjustments on which the senior officer's ship can be read. The receiver and transmitter should be spaced well apart and low power used to avoid swamping.

The "dead space" of the wave will probably be separated from the position which gives the best readable note by only two divisions of the fine tuner, which indicates the degree of accuracy which is necessary.

Limiting stops are usually fitted on the receiver in positions (32) and (33) to facilitate shifting from divisional to sub-divisional wave as rapidly as possible, but for convenience and speed the adjustment of the fine tuner should be the same for both waves.

Care must be taken to keep the aerial coupling loose - otherwise it will not be possible to hear both your own and your consort's wave on the same set of adjustments.

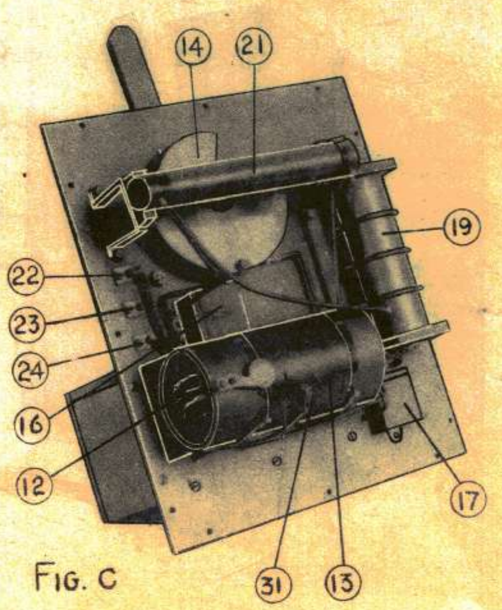


FIG. C

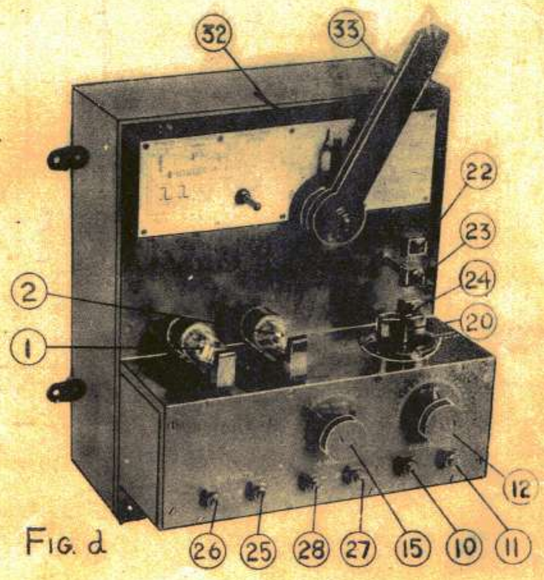


FIG. d

AMPLIFIER MD.

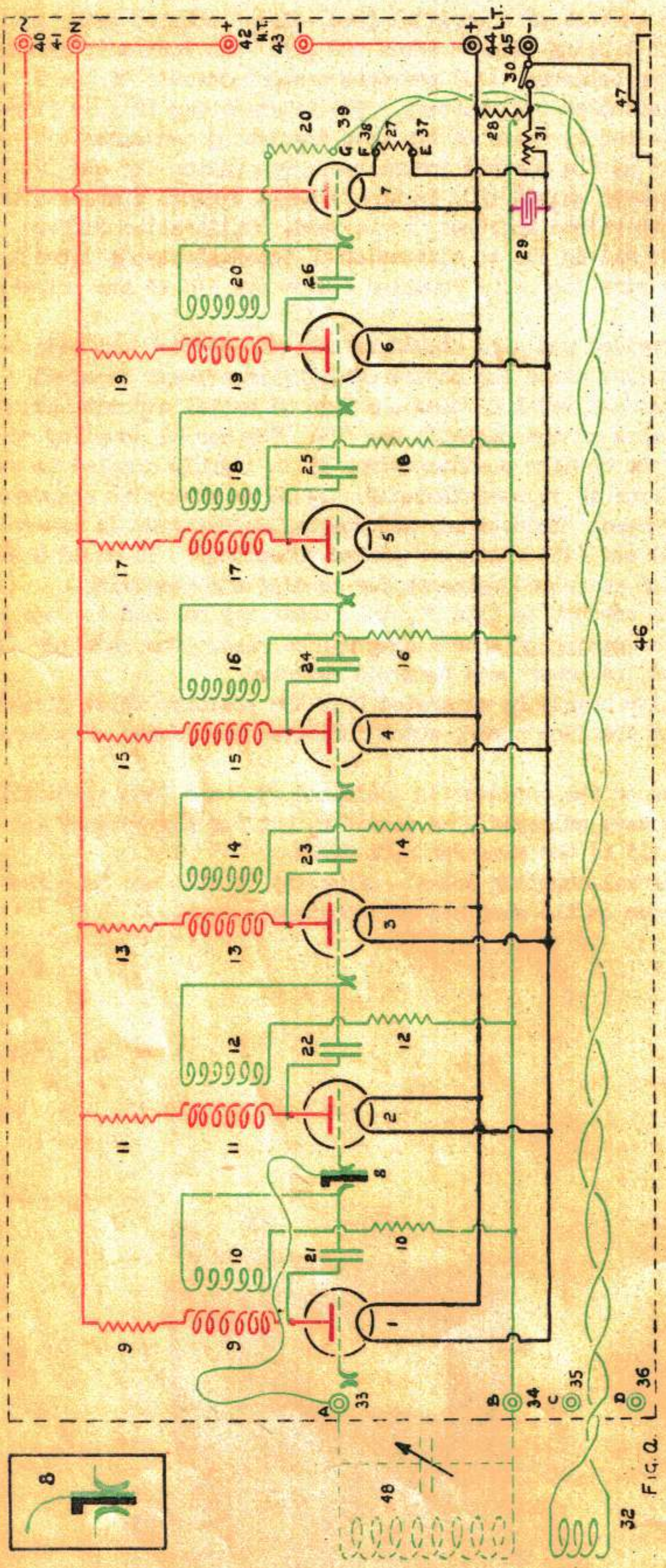


Fig. a

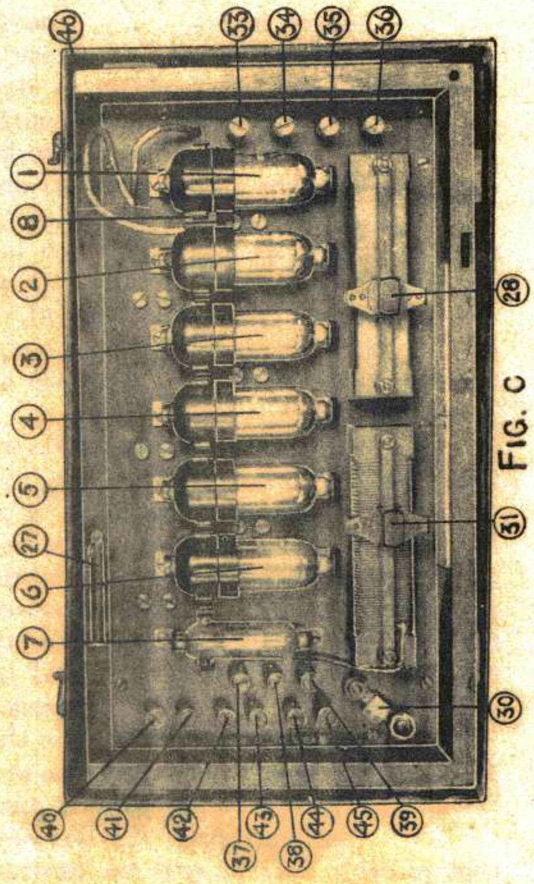


Fig. c

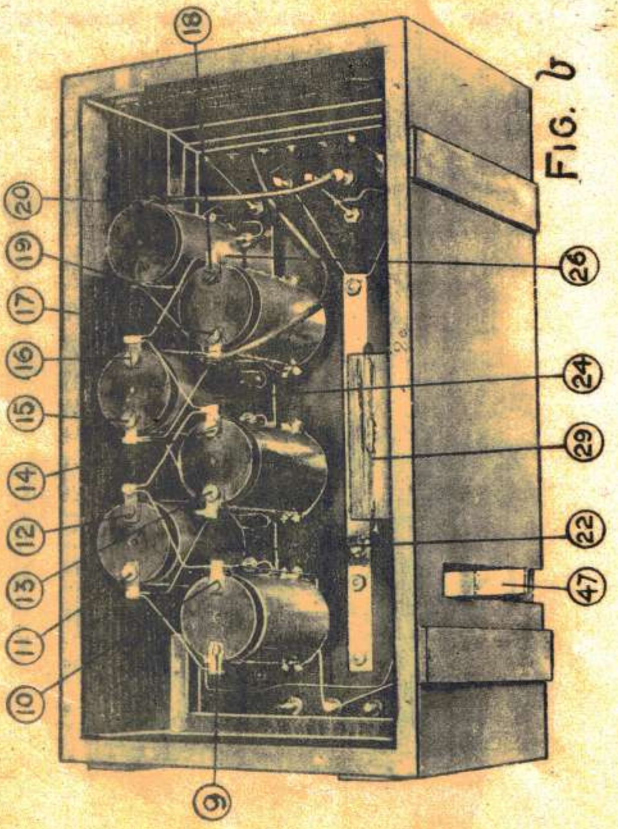


Fig. b

AMPLIFIER MD.

Date of design:- 1922.
Frequency range:- 60 - 500 kc/s.
Where fitted:- Receiver-Outfit MD, D/F Outfits SA, SD. (See Sub-sections DA and LA).
Being superseded by Amplifier M9.

Valves and methods of coupling:- Six NR14 and one NR18.
Six R/F amplifiers (1) to (6) - Choke transformer, resistance capacity.
One anode detector (7) (Upper bend).

* The main object of the instrument is to give high amplification over a large frequency range without a number of complicated adjustments, and with this end in view the amplification per valve has been reduced and the number of valves correspondingly increased to maintain the total amplification.

The number of valves in use and hence the amplification can be varied by shifting a contact on the end of a flexible lead (8) from one grid clip to another. This contact is backed with ebonite to insulate it from the grid clip, thus isolating the first R/F valve chosen from previous stages.

A japanned steel box (46) encloses the instrument for screening purposes, contact being made between negative L.T. and the screen by means of a spring (47) which bears on a bright copper plate fixed inside the steel screen.

The coupling between all R/F stages is identical. For convenience only the identity numbers applying to the coupling between valves (1) and (2) will be referred to in the text. The primaries (9) etc., and secondaries (10) etc., of the coupling transformers have a high resistance, and to indicate the function of these resistances they have been drawn as though separate from the windings to which they belong, but carry the same identity numbers (9) etc., (10) etc., These two closely coupled windings (9) etc., (10) etc., are joined together at one end by the 1.3-jar grid condensers (21) etc., and at the other end through the H.T. and L.T. Batteries, Filament Rheostat (31) and Potentiometer By-Pass Condenser (29). It will be noticed that the potentiometer (28) is in parallel with the latter part of this circuit. For radio-frequency, therefore, primary and secondary windings may be considered to be in parallel.

The high resistances (10) etc., of the secondaries act as grid leaks, necessitated by the presence of the grid coupling condensers (21) etc.

The radio-frequency resistance of these parallel coils (30,000 ohms each) will approximate to 15,000 ohms but as they are coupled together tightly (about 60 %) the inductance will not be halved and will still approximate to that of a single coil, namely 9,000 mics. Therefore, each transformer amounts to one coil of twice the cross section, i.e., the inductance is practically the same as for one winding but the R/F resistance is halved. The transformer (or equivalent coil) is shunted by the valve capacities and these make it a very poor rejector circuit tuning at about 300 kc/s. For frequencies above 300 kc/s. the system behaves as a capacity reactance, which reactance decreases as the frequency increases. For frequencies below 300 kc/s. the reactance effect is reduced and the resistance effect predominates and the transformer acts as a resistance-capacity coupling by virtue of the high resistance of the primaries (9) etc. Thus, due to a mixture of resistance capacity and choke capacity the efficiency of this coupling is considerable over a large range without any tuning of the chokes being necessary.

Terminals C (35) and D (36) on the amplifier are no longer used. A 5-ohm fixed resistance (27) is joined between terminals E (37) and F (38) to reduce the filament current of the detector valve to its correct value for anode detection. Terminals F (38) and G (39) in the grid circuit of the detector valve are connected to a movable reaction coil (32) which is coupled to the inductance of the oscillatory circuit (48).

For C.W. reception the set is made to oscillate by tightening the coupling of the reaction coil to the oscillatory circuit. It will not be possible to obtain oscillations if the reaction coupling is too loose or if it is in the wrong direction. The direction of reaction may have to be reversed if the number of valves in use is changed (See Admiralty Handbook of W/T (1931) paragraph 601 (4).

It should be noted the reaction coil is joined between grid and filament of the detector valve (7). Since the windings (19) and (20) are tightly coupled, joining the reaction coil (32) between filament and end of grid winding (20) is electrically very similar to joining it between end of anode winding (19) and H.T. Positive which is likewise at earthing potential for H/F. The reaction coil is therefore joined in the former position to avoid risk of damage to the H.T. Battery should an accidental earth develop on the external lead to the reaction coil. The burning-out of the ends of one of the transformers is a frequent cause of failure in this amplifier. Should no spare transformer be available the model can be brought into action again temporarily by short-circuiting the defective transformer, the clip (8) being moved to isolate this stage.

AMPLIFIER M3B.

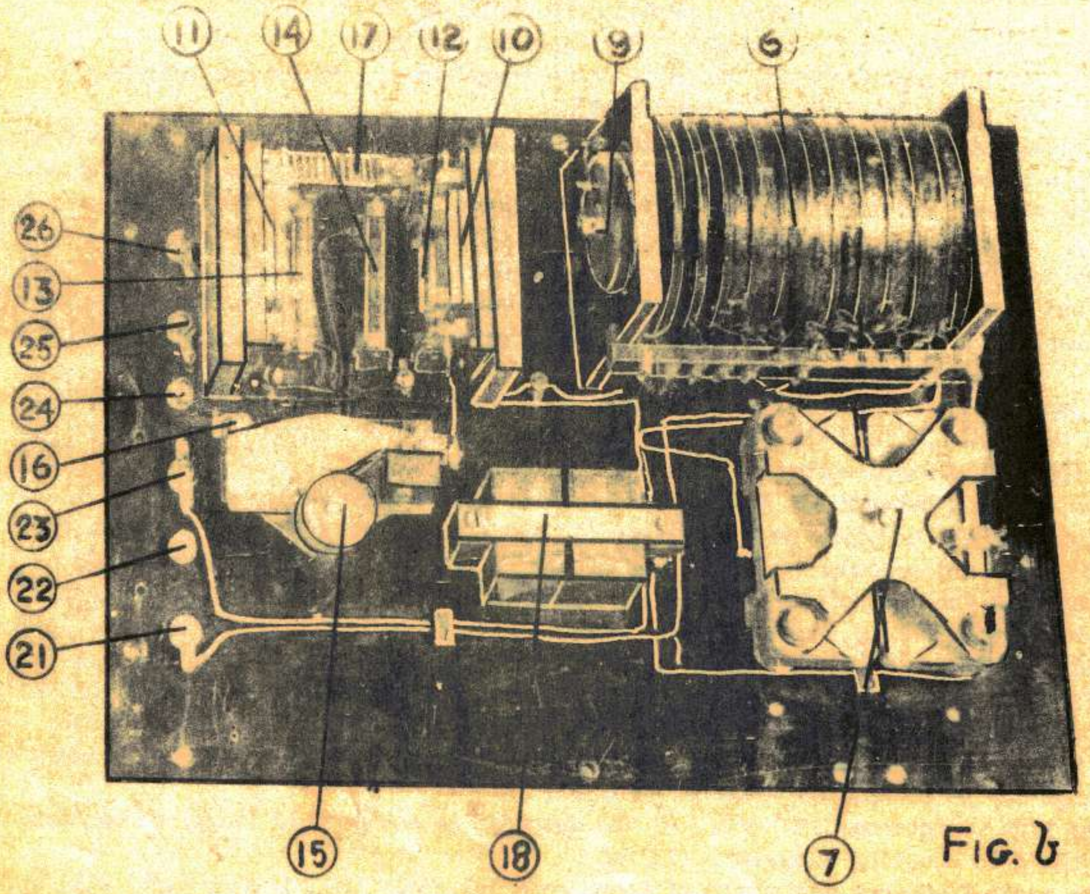


Fig. b

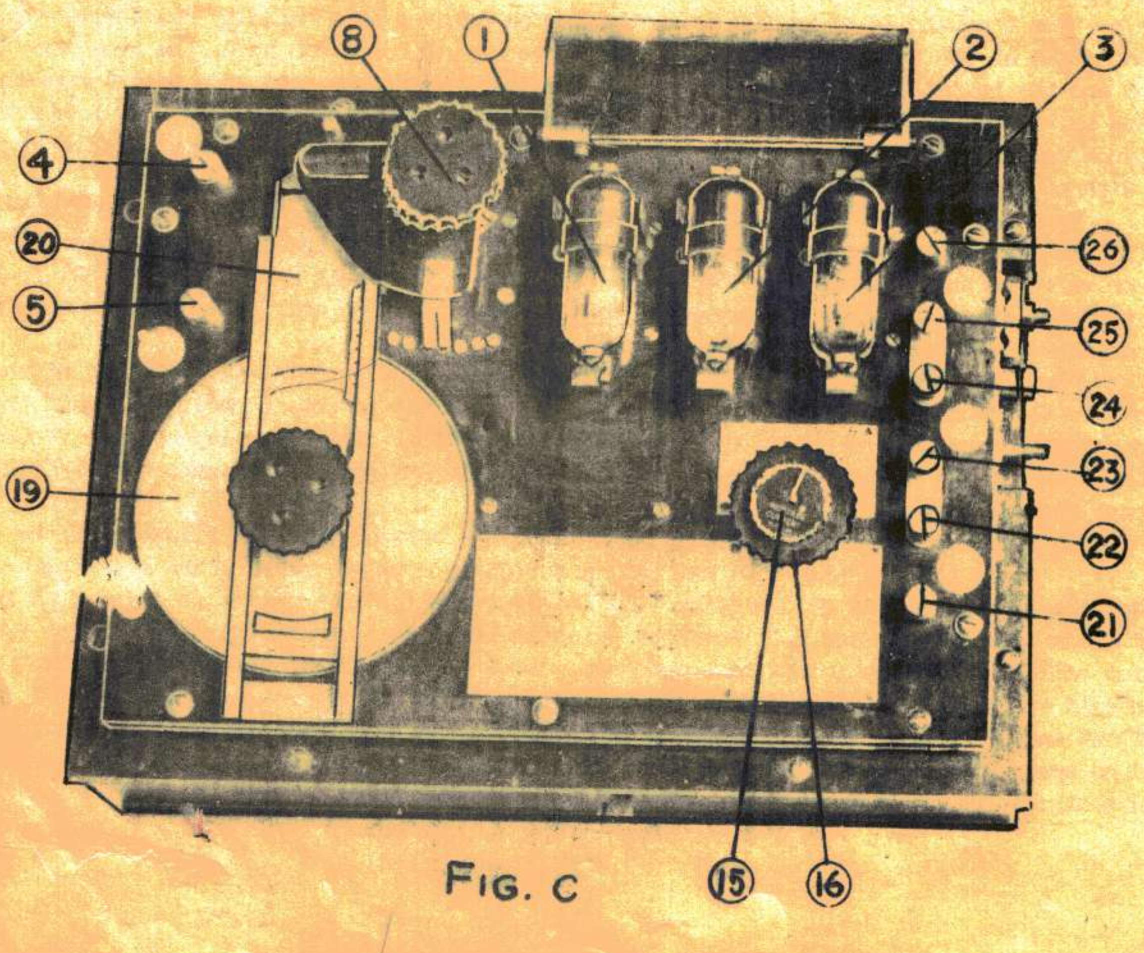


Fig. C

AMPLIFIER M 3 B.

Date of design:- 1923.
Frequency range:- 30 - 1,800 kc/s.
Where fitted:- Receiver-Outfits CI and MH (See Sub-section DA).
Valves and methods of coupling:- Three NR14.
Two R/F amplifiers (1) tuned choke capacity, (2) resistance capacity.
One anode detector (3) (upper bend).

The first valve (1) has a tuned anode circuit with a variable condenser (7). Attached to the condenser handle is an ivorine disc (19) roughly graduated in metres. The inductance (6) is adjustable in six stops lettered A to F and showing the wavelength range covered in each position. The range of frequencies covered is approximately as follows:-

F 30 - 60 kc/s.	D 110 - 250 kc/s.	B 350 - 850 kc/s.
E 55 - 120 "	C 215 - 500 "	A 715 - 1800 "

Mechanically connected to the inductance range switch (8) is a device (20) which moves an aperture over the ivorine disc so that a different scale becomes visible, according to the amount of inductance in circuit. Half the ivorine disc (19) is graduated, the other half is left blank for the operator to insert the correct adjustment.

A 3 ohm fixed resistor (17) in the positive filament lead to the detector valve(3) makes it operate near the upper bend of its anode characteristic and so ensures "upper bend" anode rectification. The telephones are joined (via the usual external telephone transformer and condenser)to terminals (21) and (22) which brings them in the anode circuit of the last valve in series with the reaction coil (9).

The coupling between the reaction coil (9) and the tuned anode circuit of the first valve (1) is fixed, and the amount of reaction obtained is therefore only dependent on the current through the reaction coil, which can be varied by means of the filament rheostat. This rheostat is in two parts, one of 1 ohm (16) to give coarse adjustment and the other of 0.1 ohm (15) for fine adjustment. If the filament current is small, the current through the valve is small, and hence the value of reaction will also be small. Under these conditions the set will not oscillate and conditions are suitable for receiving I.C.W. or spark. If the value of filament current (and hence of reaction) be largely increased, oscillations will be maintained in the tuned anode circuit and the model can be used as an autodyne to receive C.W. When used as an autodyne, the anode circuit of the first valve must be slightly detuned (see Admiralty Handbook of W/T (1931), paragraph 570).

Reception of Low Frequency Waves.

In order to receive waves of the order of 16 kc/s. (e.g., Rugby) a No.7 condenser (27) (if necessary in parallel with a No.13) can be fitted between the anode clip of the first valve (1) of the M3B and the positive H.T. terminal (23) as shown in the sketch. This merely places the additional capacity in parallel with the variable condenser (7), hence increasing the range of L.C. values which can be covered by the tuned anode circuit.

In many cases it has been found that M3B will oscillate on 16 kc/s. and that the use of a separate heterodyne can therefore be dispensed with. It is pointed out, however, that if it is found necessary to over-run the valve filaments to make the model oscillate on this wave, the life of the valves will be shortened and a separate heterodyne should therefore be used. It will also be found that a separate heterodyne assists in cutting out interference, and in obtaining improved reception, since this obviates the necessity of detuning the tuned anode circuit, which is the disadvantage inherent in autodyning. When using a separate heterodyne the ring coupling coil of K5 should simply be laid on the top of the model.

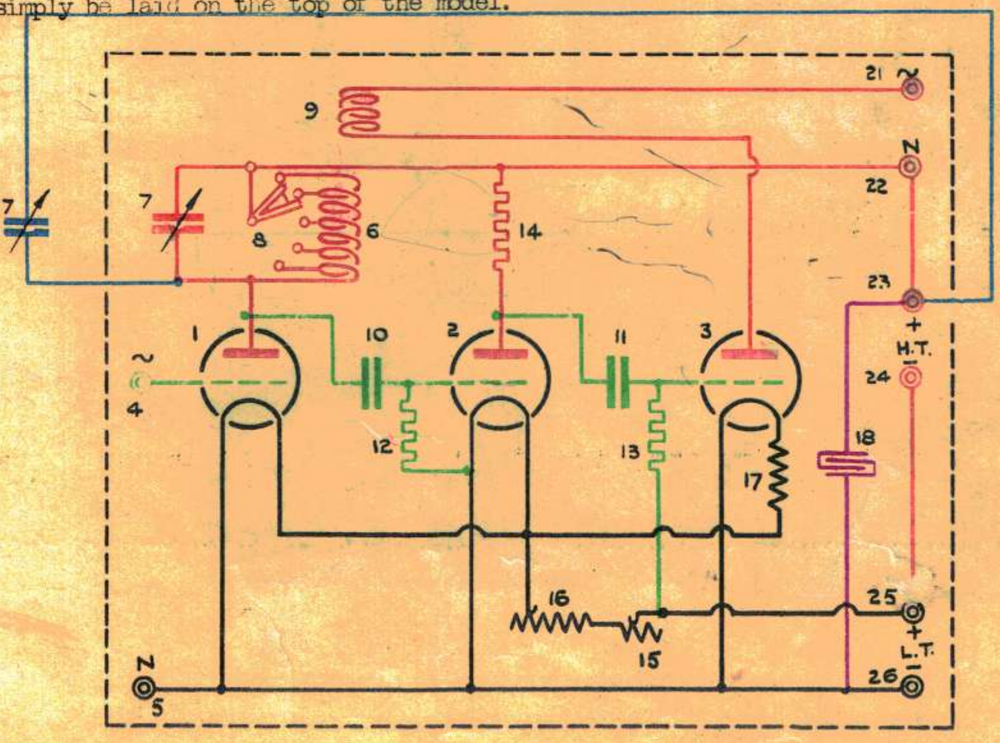


FIG. a

AMPLIFIER M 4.

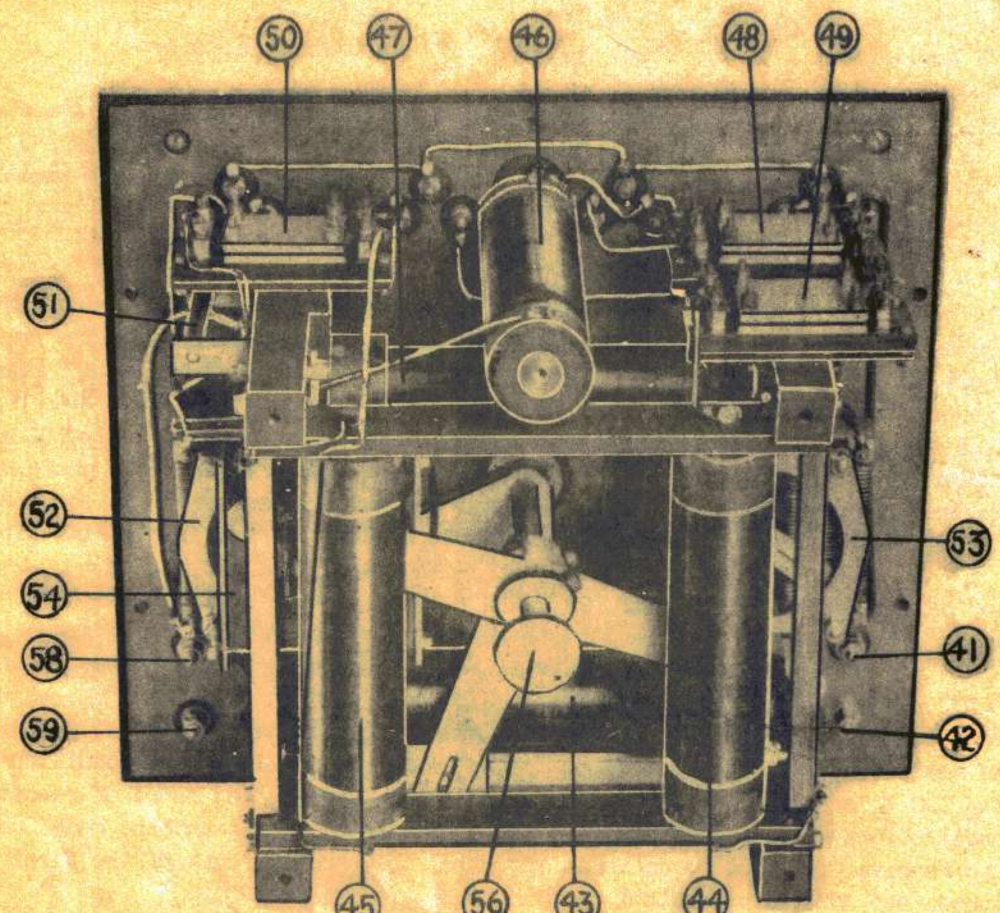


FIG. b

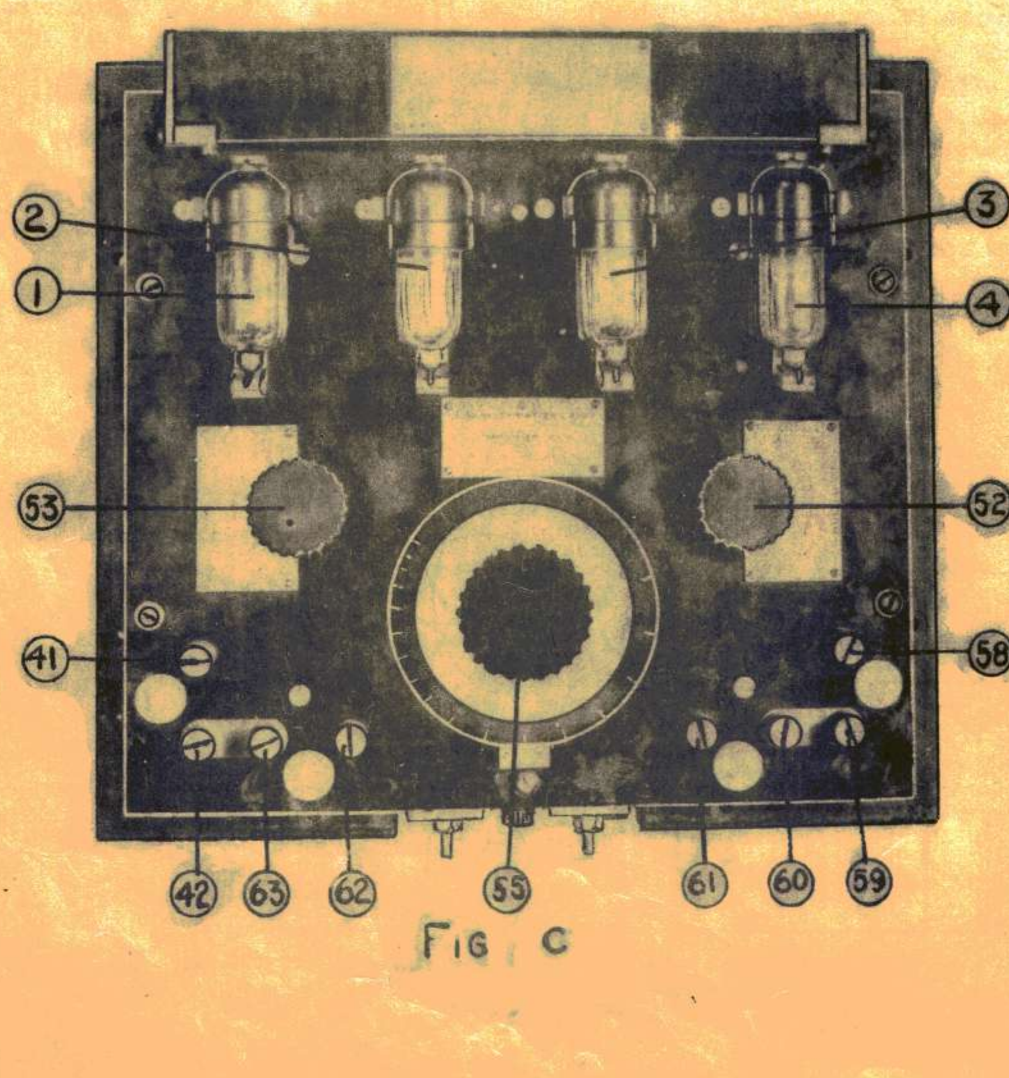


FIG C

AMPLIFIER M 4.

Aux Wave Destroyers F. C.

Replaced by B11

Date of design:- 1924.
Frequency range:- 1,500 - 6,000 kc/s.
Where fitted:- Receiver-Outfits CE and CG (See Sub-Section DA.)
Valves and methods of coupling:- Four NR14.
Three R/F amplifiers (1), (2) and (3) Tuned choke capacity.
One cumulative grid detector (4).

This amplifier is designed to receive spark, I.C.W. or R/T. It is not required to receive C.W., as at present C.W. is not used in the Service for frequencies within the range of the model. It should not be allowed to oscillate. Should oscillations occur, they must be suppressed by moving the potentiometer in the positive direction until the model is just off the point of oscillations. This introduces damping between the grids and filaments of valves (2) and (3) (See Admiralty Handbook of W/T (1931), paragraph 601 (5)).

Tuning of all three valves is effected by a single handle (55) (which operates the sliding contacts by means of a circular rack and pinion gearing (56) which is unsatisfactory for two reasons:-

(a) Backlash is unavoidable.
(b) The tuning of the third valve (3) is different from that of the first two (1) and (2) owing to the one-megohm non-inductive grid leak (51) being fitted in lieu of the inductance grid leaks (46) and (47).

Hence, it is never possible to get all three valves in tune together (See Admiralty Handbook of W/T (1931), paragraph 583).

This model gives practically no amplification on frequencies higher than 3,000 kc/s. and is being superseded by tuner-amplifier B11.

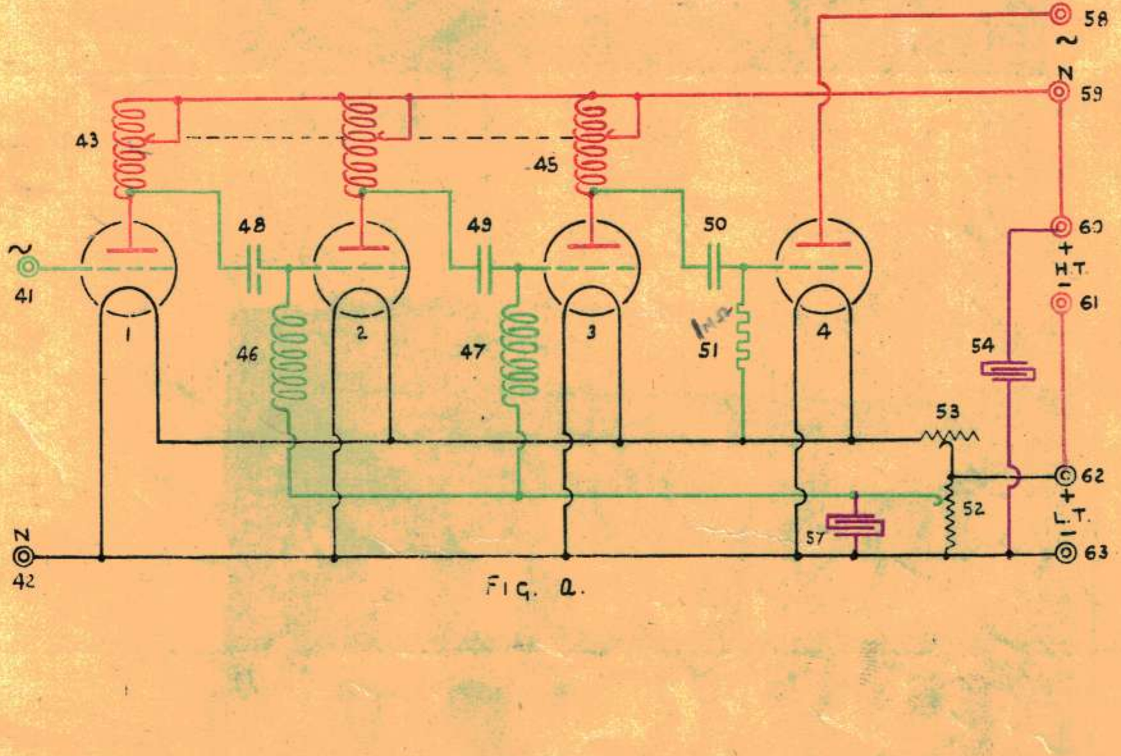


Fig. a.

AMPLIFIER M5.

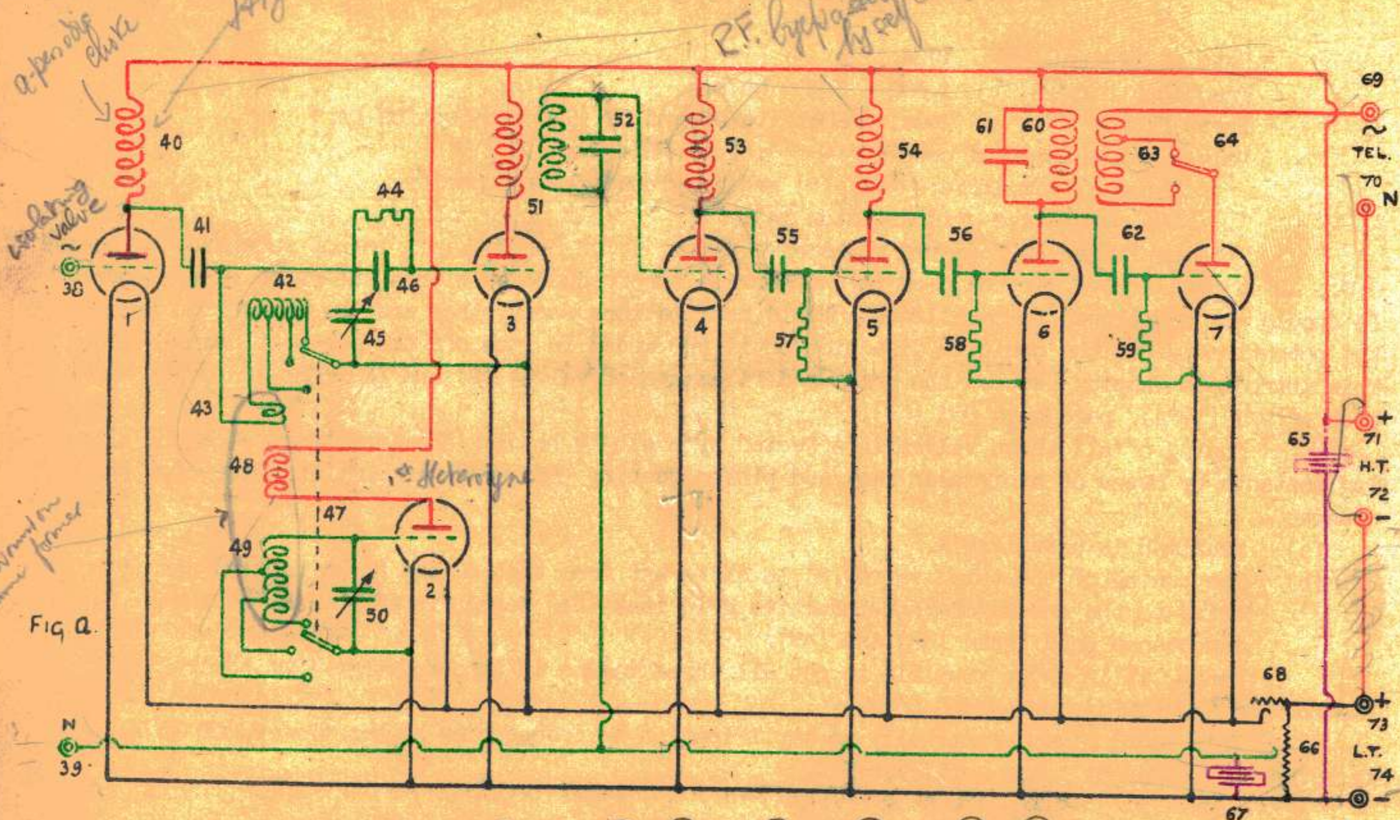


FIG a.

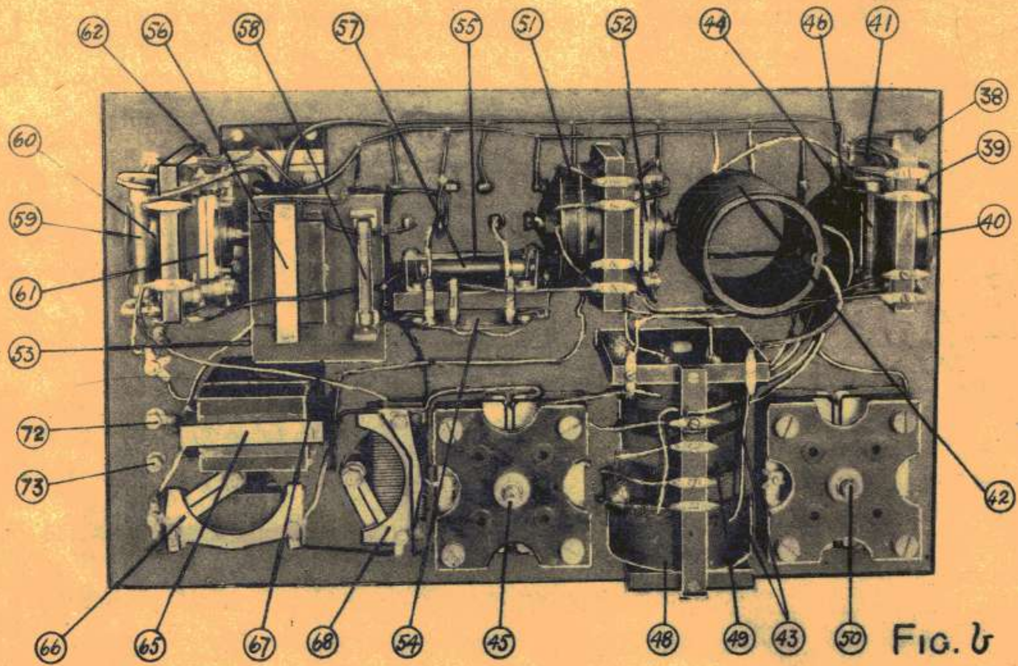


FIG. b

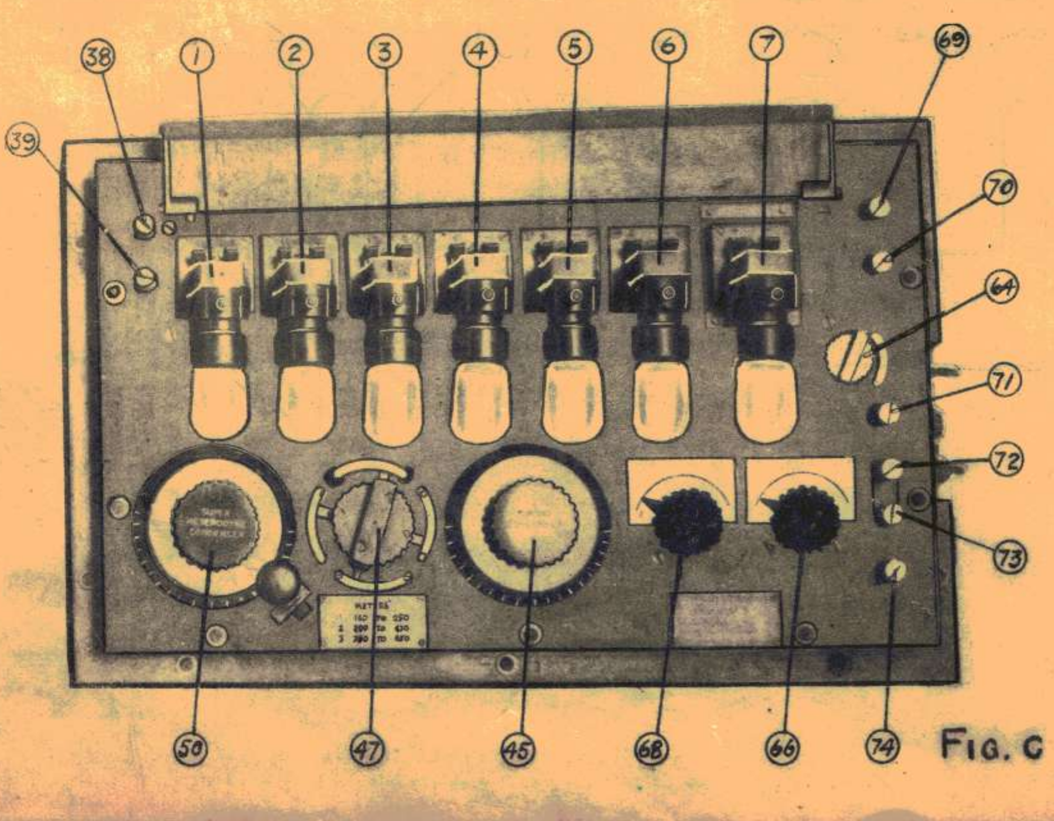


FIG. c

AMPLIFIER M5.

Date of design:- 1926.
Frequency range:- 450 - 2,000 kc/s.
Where fitted:- Receiver-Outfits CH, CI, CL (see ~~Sub~~-Section DA).
Valves and methods of coupling:- Seven NR17.

One isolating valve (1). Choke capacity.
One super-heterodyne (2) oscillator.
First cumulative grid detector (3). Tuned transformer.
Two S/F amplifiers (4) and (5). Choke capacity.
One S/F amplifier (6). Tuned choke capacity.
Second cumulative grid detector (7). (Autodyne for C.W.)

M5 has been designed on the super-heterodyne principle, full details of which will be found in the Admiralty Handbook of W/T (1931), paragraphs 697 and 699.

The range switch (47) varies in three steps the inductance (42) of the tuned grid circuit of valve (3) and also the inductance (49) of the tuned grid circuit of the super-heterodyne valve (2). The last-named inductance (49), the anode coupling coil (48) of valve (2) and the grid coupling coil (43) of valve (3) are all wound on one former, set at right angles to the remainder of the inductance (42) in the tuned grid circuit of valve (3) to prevent the amount of coupling being affected by the position of the range switch. The two tapped inductances are varied together, as the necessary frequency difference (40 kc/s. approximately) is obtained by varying the tuning of the super-heterodyne (50) and tuning (45) condensers and the inductance in both grid circuits therefore varies equally according to the incoming frequency. The three positions of the range switch (47) correspond to the following frequencies:-

Range 3. 450 - 790 kc/s. Range 2. 700 - 1,500 kc/s. Range 1. 1,200 - 2,000 kc/s.

Since the frequency of the note heard depends upon the tuning of the heterodyne circuit only, any variation of the grid tuning condenser (45) of valve (3) should merely alter the strength of signals but actually this adjustment slightly alters the heterodyne frequency also, giving a change in note.

Owing to the heterodyne coupling being tight and fixed, it happens that on some waves when the grid circuit of valve (3) is brought into resonance with the super-heterodyne frequency the damping on the super-heterodyne valve grid circuit may become so great as to damp out oscillations in the super-heterodyne circuit (49) (50). Owing to the tight coupling the tuning of the tuned grid circuits of valves (2) and (3) are not entirely independent and trouble may occur if the incoming signal is very strong by the oscillations in the tuned circuit of valve (3) "pulling" the super-heterodyne oscillations in to their own frequency. Nothing will then be heard as the supersonic frequency will be 0, owing to there being no difference between these two frequencies. It is therefore necessary to keep the tuning condenser (45) moving when searching for signals. The heterodyne coupling has been fixed in a position which gives an amplitude of heterodyne oscillation best suited for weak signals. Should self-oscillation tend to occur the oscillations must be suppressed by moving the potentiometer (66) in the positive direction until the model is just off the point of oscillation. This introduces damping into the tuned grid circuits of valves (1) and (2) (see Admiralty Handbook of W/T (1931), paragraph 601 (5)). The sketch of Receiver-outfit CH in sub section DA makes it clear how grid bias on valve (1) is effected in the stand-by and tune positions of tuner A5.

The condenser in the tuned anode (65) and transformer circuits (66) are semi-variable, ~~having a fixed and a variable section.~~ These are set in Signal School and should not be altered.

In the I.C.W. position, a portion of the inductance (63) in the anode circuit of the last valve is cut out by the C.W. - I.C.W. switch (64) and hence only regenerative amplification is obtained.

In the C.W. position all the inductance (63) is switched into circuit and maintains oscillations in the tuned anode circuit of valve (6), (See Admiralty Handbook of W/T (1931) paragraph 569).

AMPLIFIER M.9.

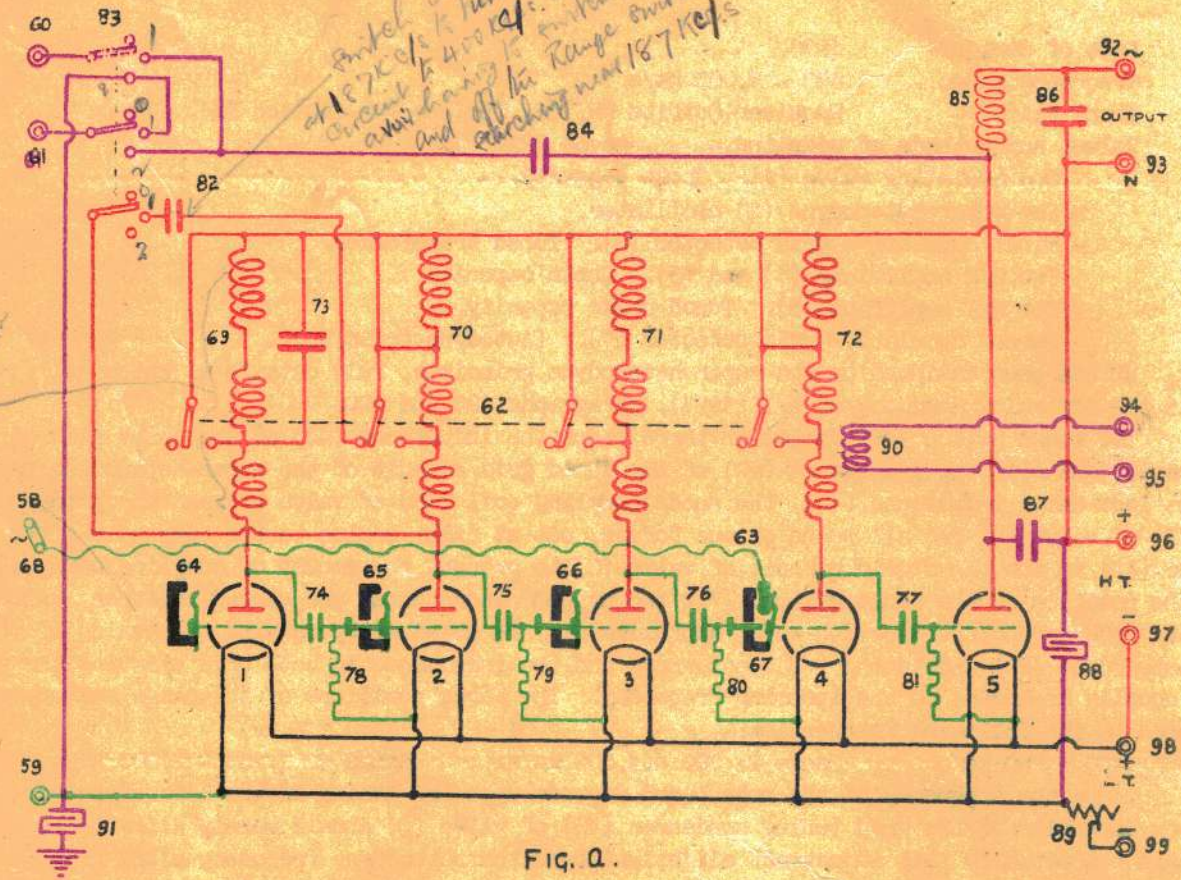


FIG. a.

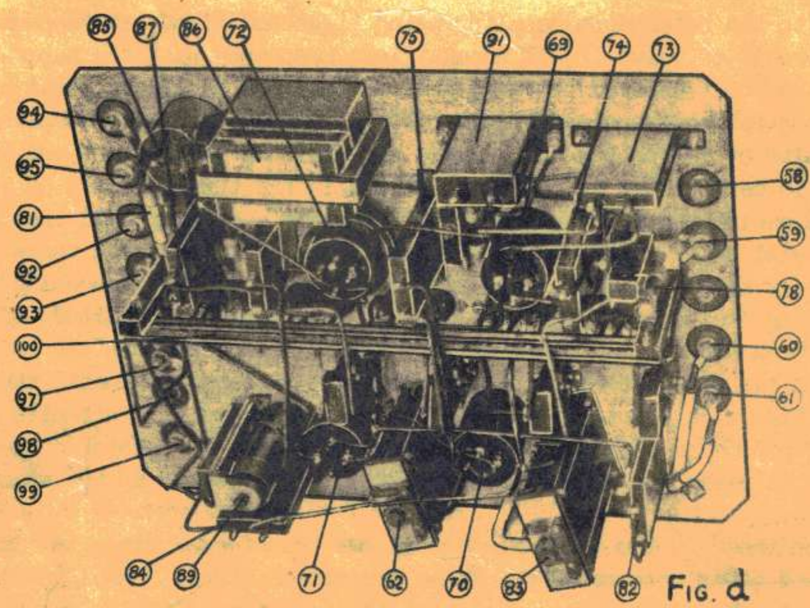


FIG. d

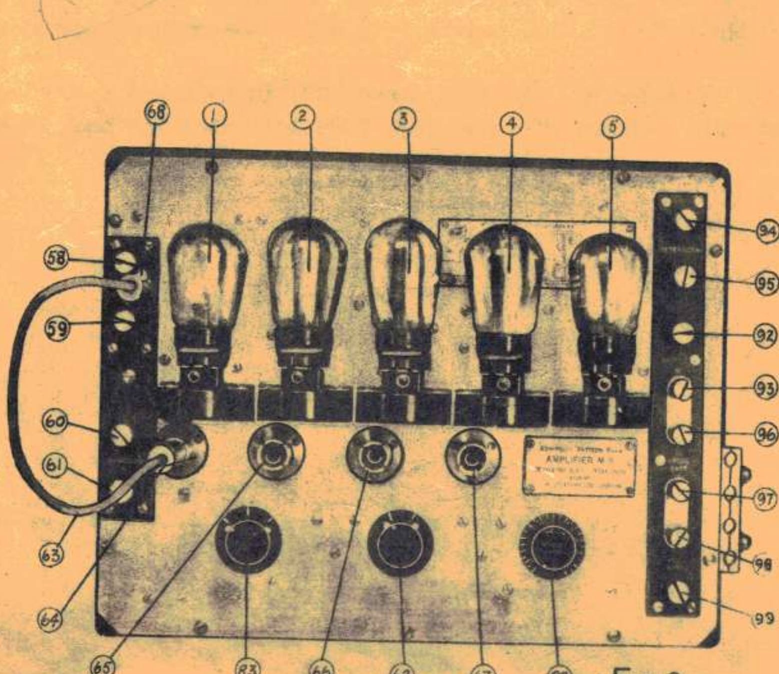


FIG. e

AMPLIFIER M9. Flotilla Leaders and some D/F Offices.

Date of design:- 1928.
Frequency range:- 60 - 670 kc/s.
Where fitted:- Receiver-Outfits CK, CL, D/F Outfits SA, SD, SF, SGX. (See Sub-Sections DA and LA).
Valves and methods of coupling:- Five ~~NR16A~~ NR15A
Four R/F amplifiers (1) to (4), choke capacity.
One cumulative grid detector (5).
Reference:- Admiralty Handbook of W/T (1931), paragraph 810.

Amplifier M9 has been designed to replace amplifier MD for D/F work with tuners A41, A42, A43 and with tuners A7 and A9 for normal reception.

A range switch (62), with two positions, is fitted, which varies the values of the anode chokes (69) to (72).

Range 2. 60 - 430 kc/s. Range 1. 430 - 670 kc/s.

The connection from the input terminal (58) of the amplifier to the first valve in use is made by means of a flexible lead with plug (63) fitting into one of four jacks (64) to (67). When the plug is inserted it only makes contact with the side of the jack connected directly to the grid of the next valve and is insulated from the other side of the jack, thus isolating all previous stages. When the plug is removed, the two parts of the jack close together and make contact, as shown in figures b and c. The other end of the flexible lead is inserted in a socket (68) which is permanently connected to input terminal (58) and which enables the flexible lead to be renewed if the connections become frayed.

The anode chokes are all similar in design, each being wound in three sections. To prevent all chokes tuning to the same frequency, one section of those in the anode circuits of valves (2) and (4) is permanently short-circuited. This increases the damping and therefore the flatness of the total amplification. The amplifier is therefore practically non-selective over its whole range of frequencies.

A separate heterodyne must always be used for C.W. reception and M9 may only be used as an autodyne for D/F. When using a separate heterodyne, K5 is connected to the terminals (94) and (95) marked "Heterodyne". Reaction may, however, be used with tuner A7 - or for D/F - to increase the strength of signals by regenerative amplification (see Admiralty Handbook of W/T (1931) paragraph 569).

Reaction leads are provided in the output circuit of valve (5) and a three-way switch (83) is provided for reversing the direction of or disconnecting the reaction.

It may be necessary to alter the direction of reaction:-

(a) When altering the number of valves in use.
(b) At 187 kc/s. approximately, since this point is the resonant frequency of the model, i.e., the point at which the reactance changes from inductive to capacitative - a change of phase of about 180°. This is a characteristic of the tuned choke type of intervalve coupling.

When altering the number of valves in use, the direction of reaction is normally changed on tuner A41 where a handle is provided for this purpose. (See Sub-section BB). It is seldom necessary to reduce the number of valves in use except for D/F.

With the range switch (62) in position 2 and the reaction switch (83) in position 1, a third contact on the reaction switch (83) inserts a 0.2 jar condenser (82) in parallel with the anode choke (70) of valve (2). The 0.2 jar condenser tunes the anode choke of this valve, and hence the whole model, to a frequency well clear of 187 kc/s. to avoid a constant reversal of the reaction switch when searching for signals about this critical frequency.

Assuming all valves are in use:-

The reaction switch should be set to 0 for R/T, I.C.W., or spark and C.W. separate heterodyne.
" " " " " " " 1 " C.W. autodyne between 187 - 670 kc/s.
" " " " " " " 2 " C.W. autodyne between 60 - 187 kc/s.

When fitted with tuner A9, the reaction terminals are to be left disconnected and the reaction switch in position 0. The filaments of each valve are fed from positive and negative L.T. busbars (100).

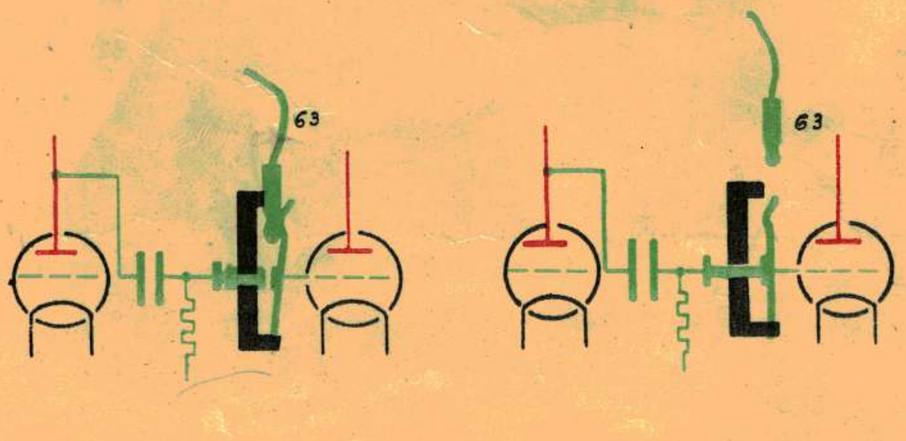


FIG. b. FIG. c.

AMPLIFIER M II.

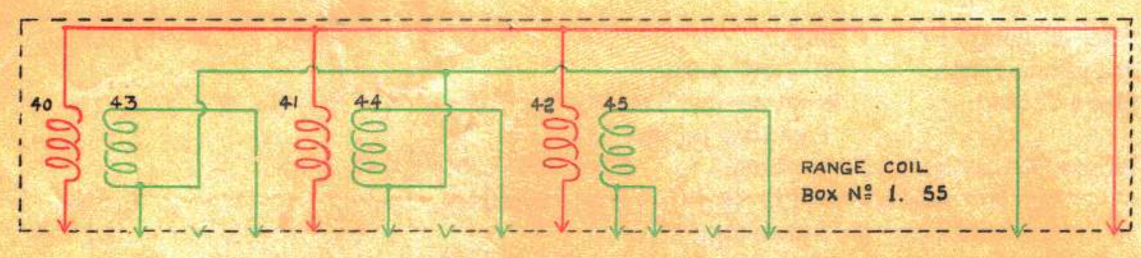


Fig. b.

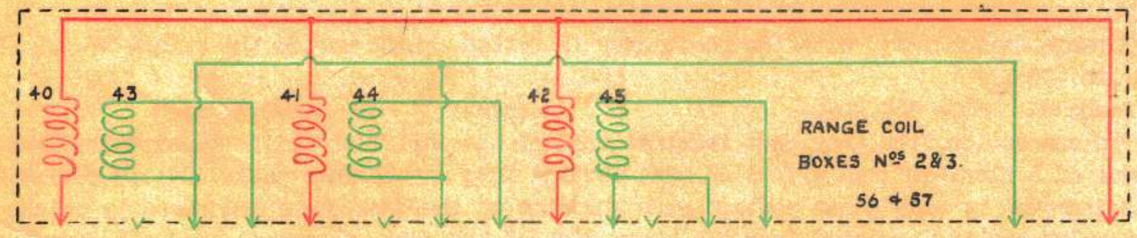


Fig. C.

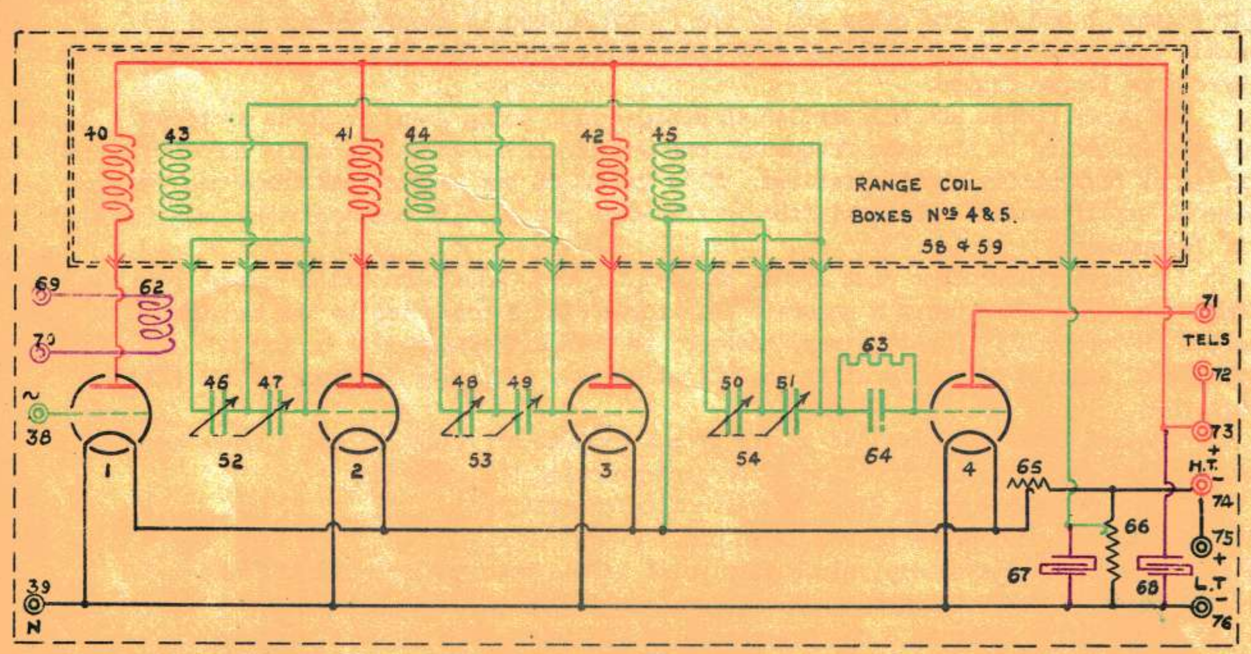


Fig. a.

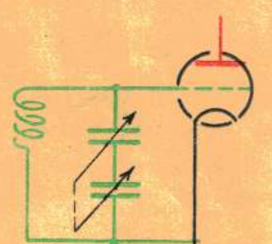


Fig. d.

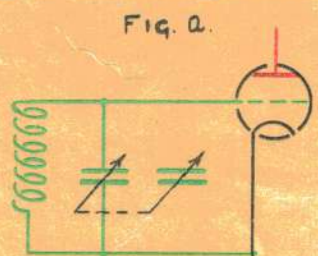


Fig. e

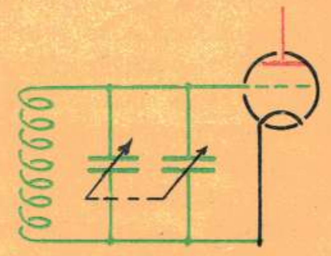


Fig. f.

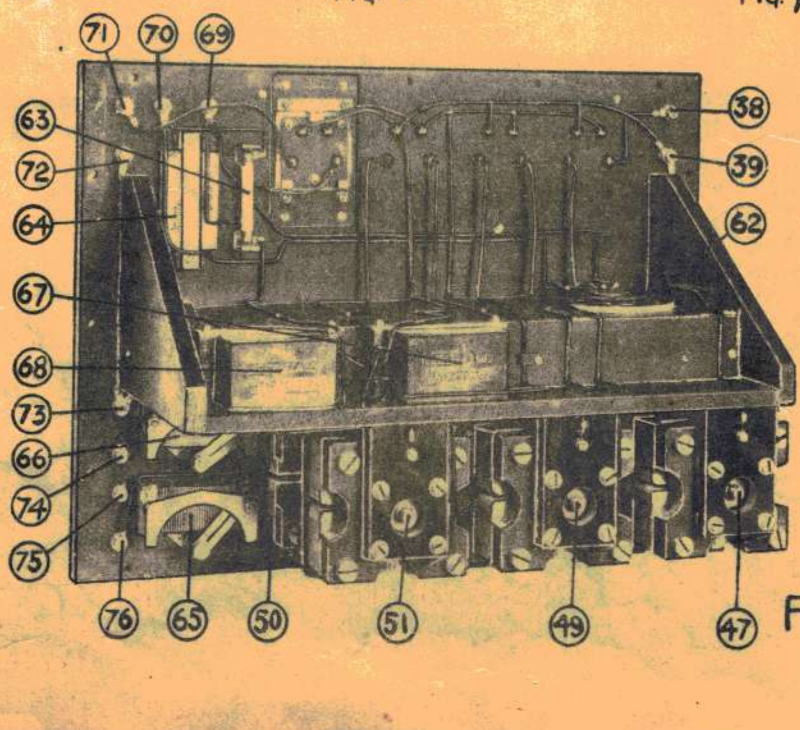


Fig. h

AMPLIFIER M11.

Main Offices / BS & CR.
2nd Main Offices - Destroyed

Date of design:- 1926.
Frequency range:- 12 - 550 kc/s.
Where fitted:- Receiver-Outfits CI and CJ (See Sub-Section DA).
Valves and methods of coupling:- Four NR17 valves.
Three R/F Amplifiers (1) (2) and (3). Tuned transformer. One cumulative grid detector (4).
Reference:- Admiralty Handbook of W/T (1931), paragraph 589.

The primaries of the transformers (40)(41)(42) are inserted in the anode circuits of valves (1)(2) and (3) respectively. The secondaries of these transformers (43)(44)(45) are tuned by pairs of one-jar variable condensers (46)(47) and (48)(49) and (50)(51) respectively. These pairs of condensers are mounted on the same shaft controlled by handles (52)(53) and (54) respectively. The grid circuits of valves (2)(3) and (4) are therefore tuned in the amplifier.

The total range of frequencies is covered in five ranges, each range necessitating the use of three pairs of anode and grid coils for the three R/F valves. The three pairs of coils are collected into a range box which fits into the amplifier, the necessary electrical contacts being made by studs on the range box and spring studs on the amplifier. Later models have the spring studs on the range box and solid contacts on the amplifier. The new type of range box will fit into the old type amplifier but an old type range box will not fit a new type amplifier.

In order to obtain suitable stiffness in the tunable grid circuits over the whole range of frequencies the two one-jar condensers are electrically connected in different ways for the different ranges by contacts on the range boxes.

Range.	Kc/s.	Anode Inductance.	Grid Inductance.	Grid Condensers.	Maximum Value.
5	12 - 30	116,000 mics.	95,000 mics.	Two in parallel.	2 jars.
4	25 - 75	34,000 mics.	178,000 mics.	Two in parallel.	2 jars.
3	63 - 160	13,000 mics.	5,500 mics.	One only.	1 jar.
2	140 - 335	2,020 mics.	1,000 mics.	One only.	1 jar.
1	310 - 550	1,120 mics.	385 mics.	Two in series.	½ jar.

A separate stowage position (77) is provided for No.5 range box (59). Only one such range box is provided to each ship, irrespective of the number of Amplifiers M11 borne.

The amplifier should always be used with a separate external heterodyne (K5) for receiving C.W. signals and on frequencies where the amplifier is capable of generating oscillations and behaving as an autodyne the oscillations must be suppressed by moving the potentiometer in the positive direction until the model is just off the point of oscillation. This introduces damping into the tuned grid circuits of valves (2) and (3), (See Admiralty Handbook of W/T(1931), paragraph 601 (5)).

Coupling between K5 and M11 is made by means of the quadrant coupling coil which is joined to two terminals on the amplifier marked "Het." (69) and (70). These terminals are connected to a fixed coil inside the amplifier (62), which is coupled to the anode circuit of valve (1).

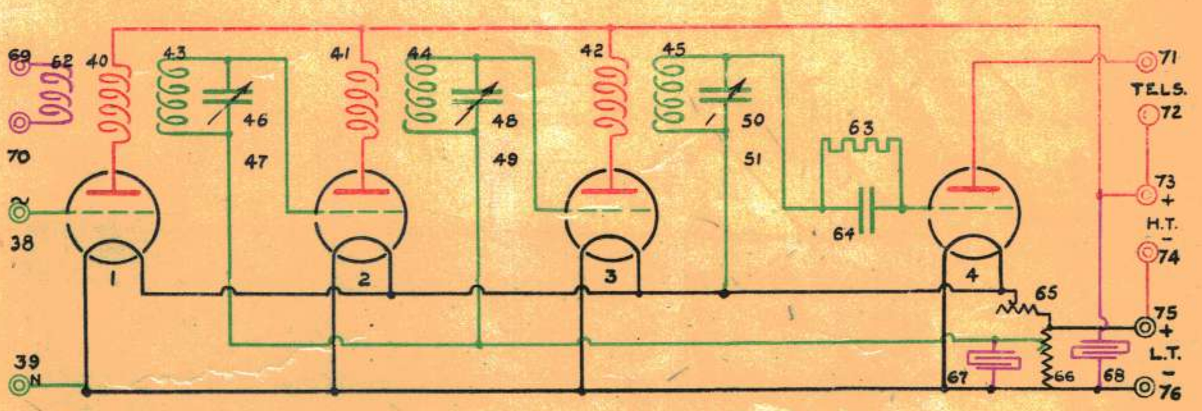


FIG. g.

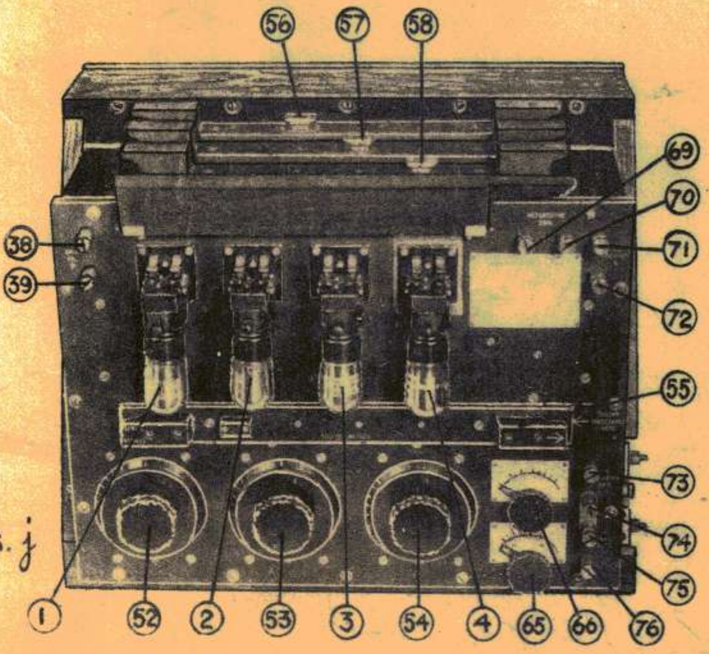


FIG. j

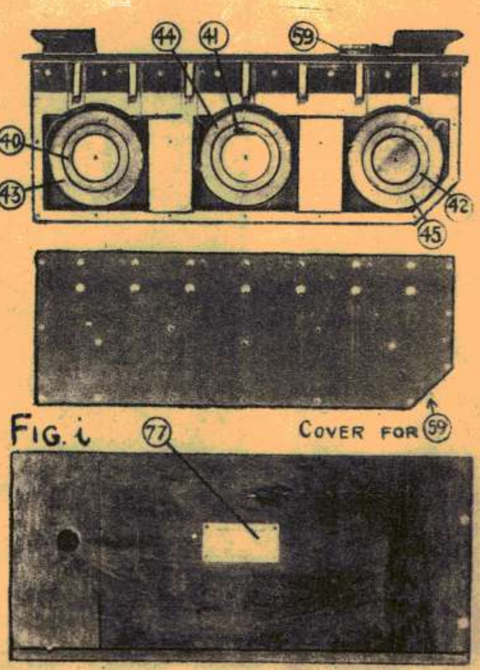


FIG. i

AMPLIFIER M 13.

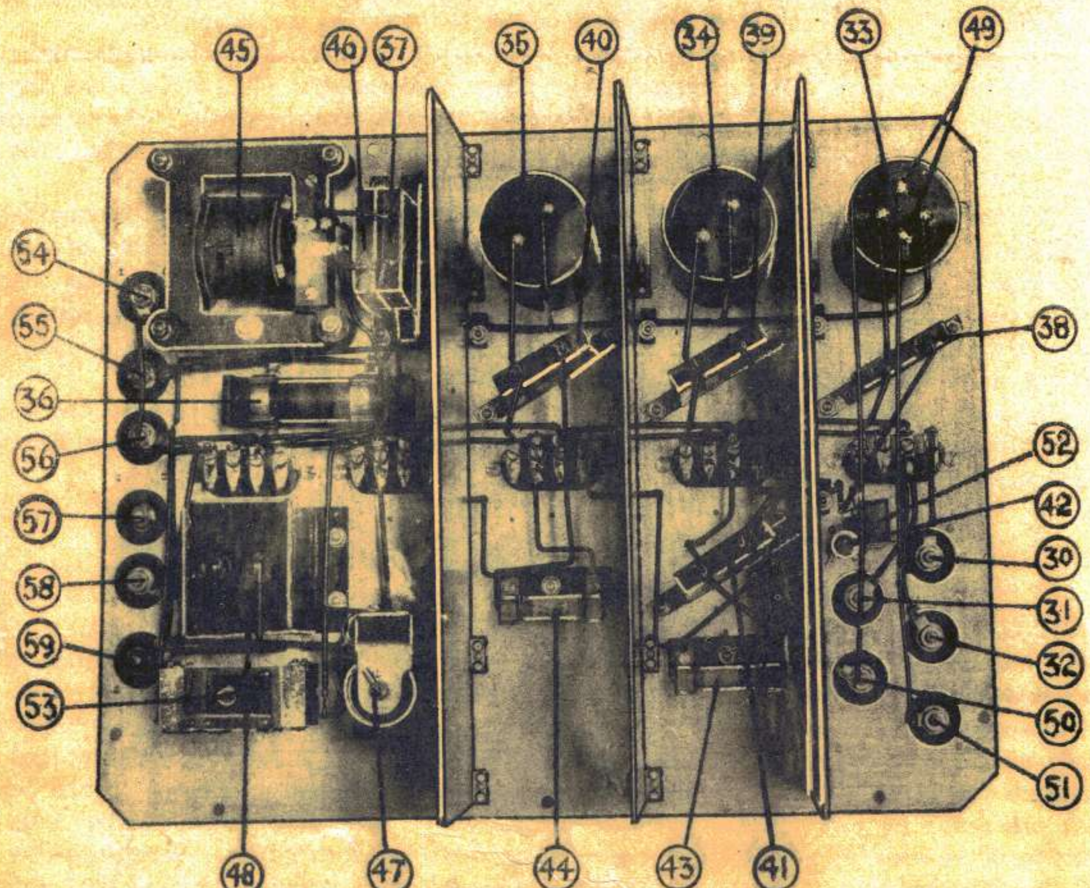


FIG. b

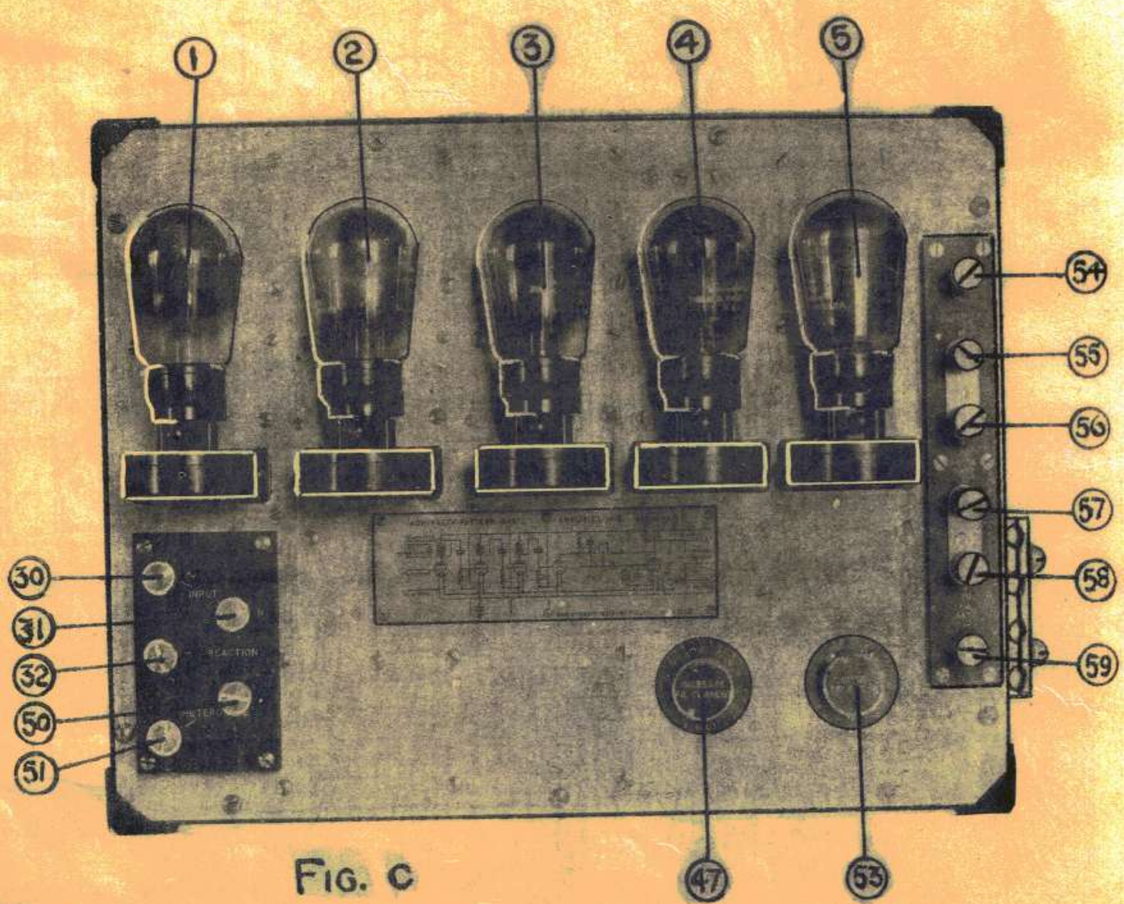


FIG. C

AMPLIFIER M 13.

Date of design:- 1929.
Frequency range:- 15 - 60 kc/s.
Where fitted:- Receiver-Outfit SF. (See Sub-Section LA).
Valves and methods of coupling:- Five ~~BRIGHT~~ Valves. NR15A
Three R/F amplifiers (1), (2) and (3). Fixed choke capacity.
One cumulative grid detector (4). Resistance capacity.
One note selector (5).

M13 is used in conjunction with tuner A8 for reception on a vertical loop aerial. It gives good R/F amplification over the whole of its frequency range and considerable A/F selectivity can be obtained by the use of the note selector stage. The coupling condensers (38), (39) and (40), between the R/F valves, are of very small capacity (0.1 jar) as, although this reduces the efficiency of the total amplification, it provides a high impedance to the A/F noises which would otherwise be amplified to such an extent as to render reception very difficult. This amplification on A/F noises is due to the fact that the chokes (33), (34) and (35) have to be of high resistance in order to obtain flat tuning, and hence the model tends to behave as a resistance capacity coupled note-magnifier. Detection is arranged simply by connecting the grid leak (44) of the fourth valve (4) to positive L.T. which gives the grid of that valve the correct bias for rectification.

A switch (53) is provided in the anode lead of the detector valve (4) which either connects that valve direct to the "Output" terminal (54) or switches in the note selector valve (5). In the latter position, the detector valve (4) is "resistance capacity" coupled to the note-selector valve (5), the 10-jar condenser (37) across the resistance (36) acting as an R/F by-pass. The coupling condenser (41) is of small value (0.2 jar), to avoid increased amplification and hence give greater selectivity without additional risk of the model breaking into oscillation. In the note selector stage a rejector circuit, consisting of the inductance (45) and capacity (46), tuned to 1.25 kc/s. is used as a grid leak; consequently the only frequency to which the impedance of the rejector circuit is high enough to ensure the signal causing the necessary voltage variations between grid and filament is a note of 1,250 cycles/sec. (A8 M13 is only employed with C.W., this note is obtained by the adjustment of K5). All unwanted note frequencies are passed direct to the filament (see Admiralty Handbook of W/T (1931), paragraph 608).

For receiving C.W. K5 should be connected to the heterodyne terminals (50) and (51). The reaction control must never be used to make the model oscillate and act as an autodyne but is only to be used for regenerative amplification (see Admiralty Handbook of W/T (1931), paragraph 569 and notes on Tuner A8, sub-ection BA).

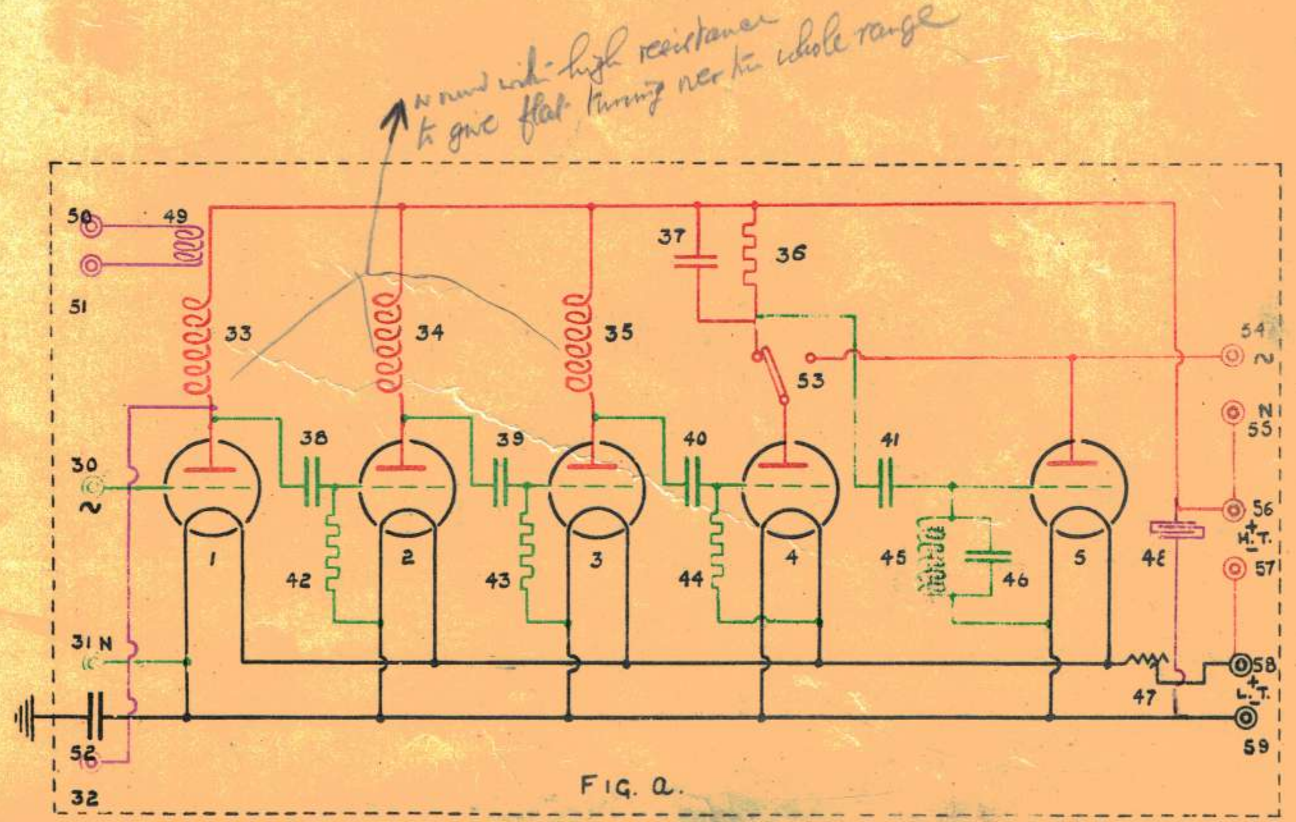
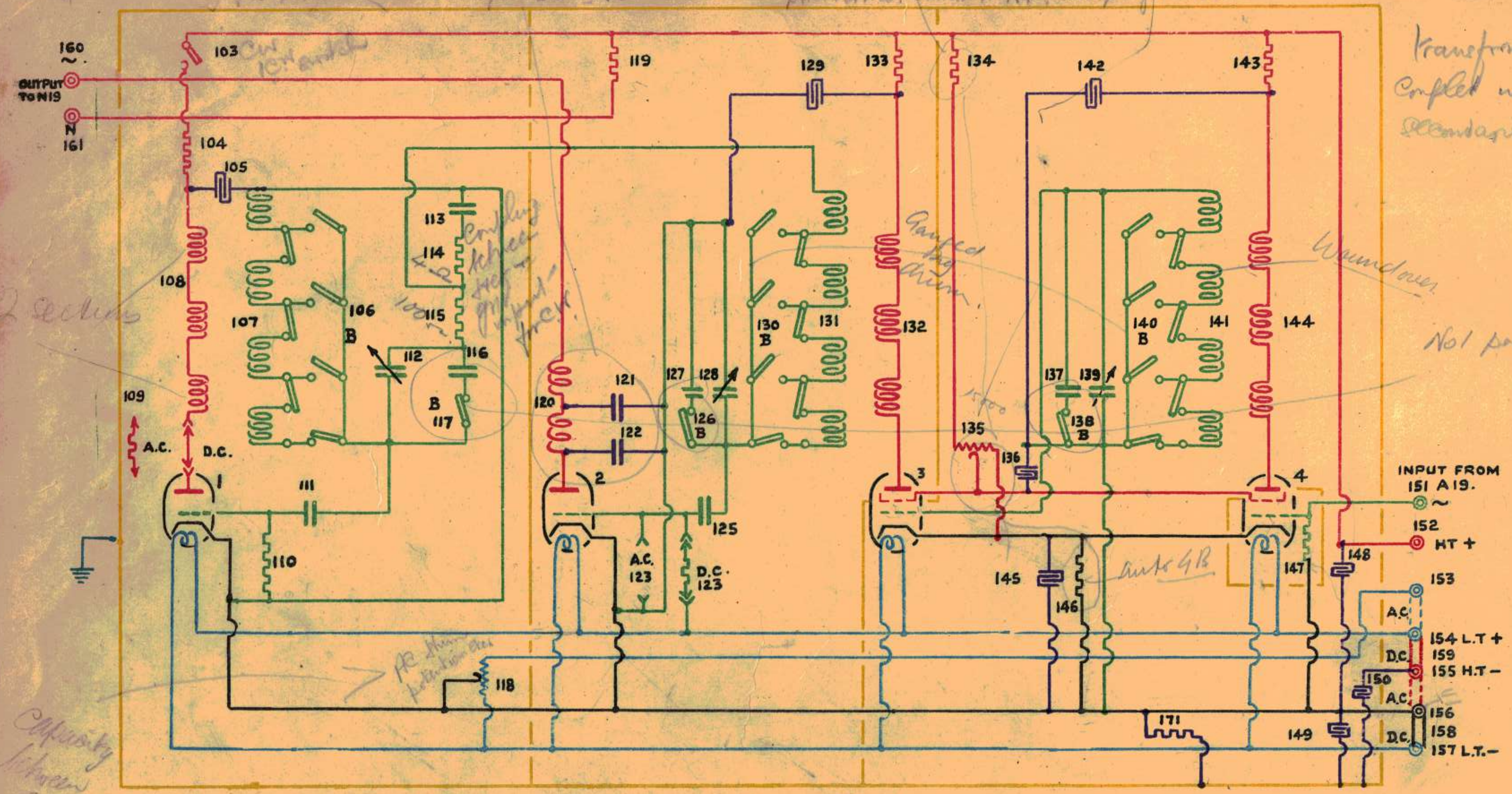


FIG. a.

4-18 TO 4-23
MISSING

AMPLIFIER M19



SWITCHES MARKED B ARE GANGED.

FIG. 2.

IT WILL BE NOTICED THE SKETCH (a) IS LAID OUT ON DIFFERENT LINES TO OTHERS IN BR 222.

THIS IS DUE TO THE AMPLIFIER BEING DESIGNED FOR RACK MOUNTING IN CONJUNCTION WITH A19 & N19.

THE INPUT TO THE AMPLIFIER FROM THE TUNER COMES IN ON THE RIGHT & THE OUTPUT TO THE NOTE MAGNIFIER GOES OUT ON THE LEFT.

AMPLIFIER M19

Iso V. BMS4 AC. N19 NR27 R/F M19. MS4 NR26 Det. NR27 Het.

Date of design:-	1932.
Frequency range:-	15 - 550 kc/s.
Where fitted:-	Receiver Outfits CM and CN.
Valves and method of coupling:-	(A.C.) One NR26, One NR27, Two MS4.
	(D.C.) One NR15 or 15A, One NR16 or 16A, Two NR22 or 23.
	Two R/F Amplifiers (3)(4) - tuned transformer.
	One detector (2) (Cumulative grid) - tuned transformer.
	One heterodyne oscillator (1).

Amplifier M19 is used in conjunction with Tuner A19 (see page BA12) and Note Magnifier N19 (see page I5) and is designed to replace amplifier M11 (see page H15).

Amplifier M19 is contained in an aluminium box, which is divided into three screened compartments (see figure e.). The first R/F screened grid valve (4) and grid resistance (147) are also contained in a separate internal screen.

The input from Tuner A19 is connected via the terminal (151) to the grid of the first R/F screened grid valve (4). The R/F stages are transformer coupled with the secondaries tuned; a secondary thus forms the tuned grid circuit of the succeeding valve. The tuned grid units including the ganged switches (140)(130) are similar to the primary and secondary circuits of the Tuner A19. The different switching positions of the coils (141)(131) are fully described on page BA13. The frequency ranges of the five switch positions of the grid coils are marked on the dial and are:-

(1) 15 - 20 kc/s. (3) 45 - 110 kc/s. (5) 200 - 550 kc/s.
(2) 20 - 55 kc/s. (4) 90 - 230 kc/s.

The primaries (144)(132) of the coupling transformers are wound over the secondaries in three sections permanently connected in series, and spaced to give an approximately equal amplification over the five ranges of the secondaries (141)(131).

The H.T. supply for the R/F valves (3)(4) is taken through the 600 ohm resistances (133)(143) which are decoupled by the condensers (129)(142) respectively. The supply for the screens of the R/F valves is controlled by a 15,000 ohm potentiometer (135) which is a volume control. It is connected in series with a 5000 ohm fixed resistance (134) and both are decoupled by the condenser (136).

The detector valve (2) operates on the cumulative grid principle. When using A.C. indirectly heated valves, the grid leak (123) is of course inserted between the grid and cathode, and when using D.C. valves, between the grid and the positive side of the heater circuit which has now become the normal filament supply. A two stage low pass filter (120)(121)(122), with cut off at 7000 cycles, is inserted in the output from the detector valve(2)(See Admiralty Handbook of W/T(1931), para. 607).

The H.T. supply for the detector is through the resistance (119), the coupling coil(66) or the anode choke (65) in the N19 (see page I5) and low pass filter choke (120).

The heterodyne valve (1) employs a tuned grid and coupled anode. The grid unit is similar to those used in the R/F stages, with the exception that the condenser (112) has a slow motion dial.

The anode coil (108) is also similar to those used in the R/F stages but is wound in two sections and spaced to give approximately constant heterodyne strength on all ranges. When using A.C. valves a 1,000 ohm resistance (109) is connected in the output of the heterodyne valve (1) to increase the effective A.C. resistance of the valve.

The method of coupling the heterodyne to the detector valve (2) grid circuit is as follows:- The resistances (115) and (114) of 100 ohms and 4 ohms respectively, and a 0.5 microfarad condenser (113) are connected in series with the tuned grid circuit to the heterodyne valve (see figure b.). The 4 ohm resistance (114) and the condenser (113) are also common to the tuned grid circuit of the detector valve. This gives a weak heterodyne coupling on the higher frequencies. On the lower frequencies the percentage difference in tuning between the heterodyne and detector tuned circuits is considerable (see Admiralty Handbook of W/T (1931) paragraph 523). The consequent necessary increase in heterodyne coupling is given by the rise in impedance of the condenser (113) as the frequency is decreased. The 100 ohm resistance (115) prevents serious interaction in the tuning of the heterodyne and detector grid circuits due to their being coupled.

The H.T. supply to the heterodyne valve (1) is taken through the resistance (104) and anode inductance (108) and the additional resistance (109) if using A.C. valves. The switch (103) makes or breaks the H.T. supply, thereby putting the heterodyne stage in or out of action, and is therefore labelled "C.W. - I.C.W.". The resistance (104) is decoupled by the condenser (105).

A.C. and D.C. supplies. Amplifier M19 has been designed to work either with D.C. valves from battery supplies or with indirectly heated valves from an A.C. supply. The H.T. supply is 100 volts, and, if using A.C. valves, is obtained from a rectifier with smoothing circuits.

Certain additional adjustments are necessary when using A.C. supply, and alterations in connections when changing from one type of valve to the other.

The supply terminals (153) to (157) are provided with a pair of links (158)(159) which may be connected in positions A.C. or D.C. With the links in the A.C. position, the terminal (156) (with which all decoupling and earthing condensers, and the cathodes of the A.C. valves are common) is connected to negative H.T. (155). The terminal (153) is connected to the positive L.T. (154) which connects the "hum potentiometer" (118) across the heater supply. This potentiometer is adjusted until the hum due to the A.C. supply is reduced to a minimum. (see figure j. page I9).

AMPLIFIER M19

With the links in the D.C. position the common earthing terminal (156) is connected to negative L.T. (157) and the terminal (153) is disconnected from the L.T. supply thus disconnecting the A.C. "hum potentiometer" (118). ~~The negative H.T. (155) is also now made common with the positive L.T. (154).~~

When changing from A.C. to D.C. valves the grid leak (123) of the detector valve (2) and the short circuiting link (109) in the anode supply of the heterodyne valve (1) are changed to the D.C. positions as previously described.

One advantage of indirectly heated valves is the possibility of obtaining "free" grid bias by inserting a resistance in the cathode lead. In amplifier M19 this has been used for the two R/F valves (3)(4). A 1000 ohm resistance (146) with by-pass condenser (145) is connected between the cathodes of the R/F valves (3)(4) and the negative H.T. and so this resistance is in the H.T. circuit. Consequently there is a voltage drop across the resistance (146), the amount of the drop depending on the anode current. As the cathodes are connected to the high potential end and the grids to the low potential end of the resistance (146), the grids are at a negative potential, (depending on the voltage drop) with respect to the cathodes.

EQUIVALENT CIRCUIT

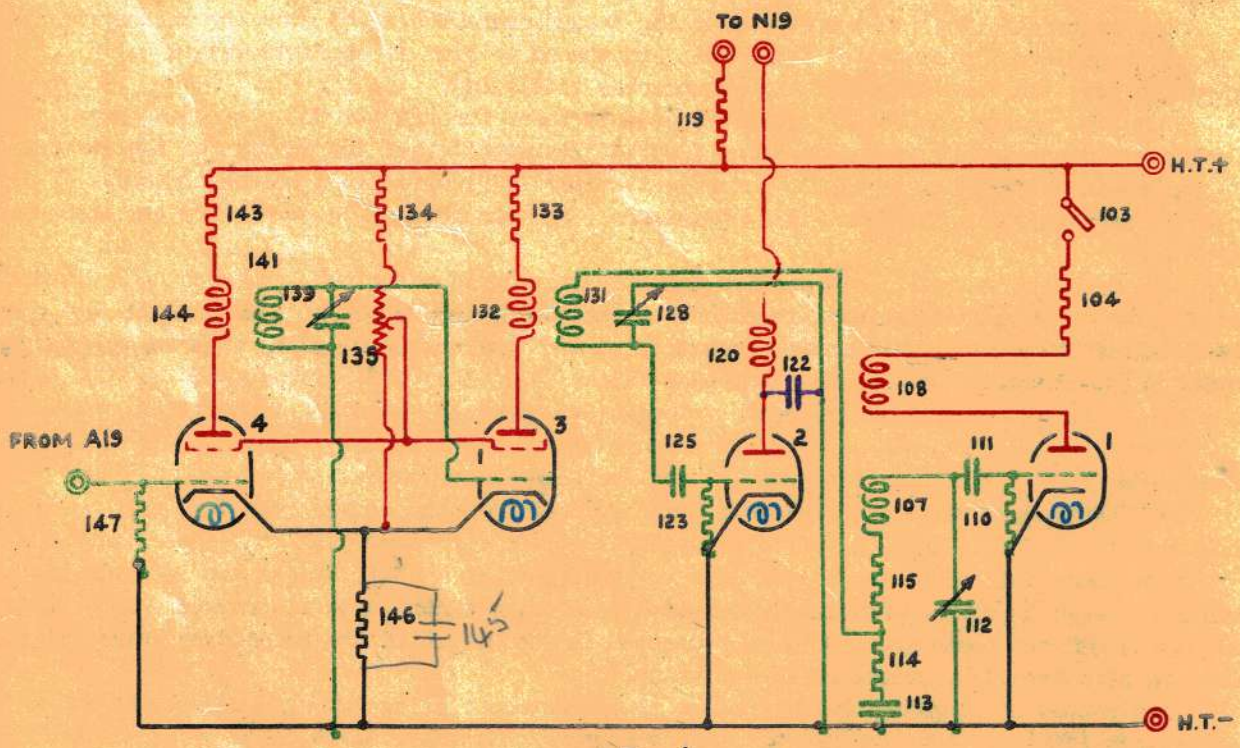


Fig. b.

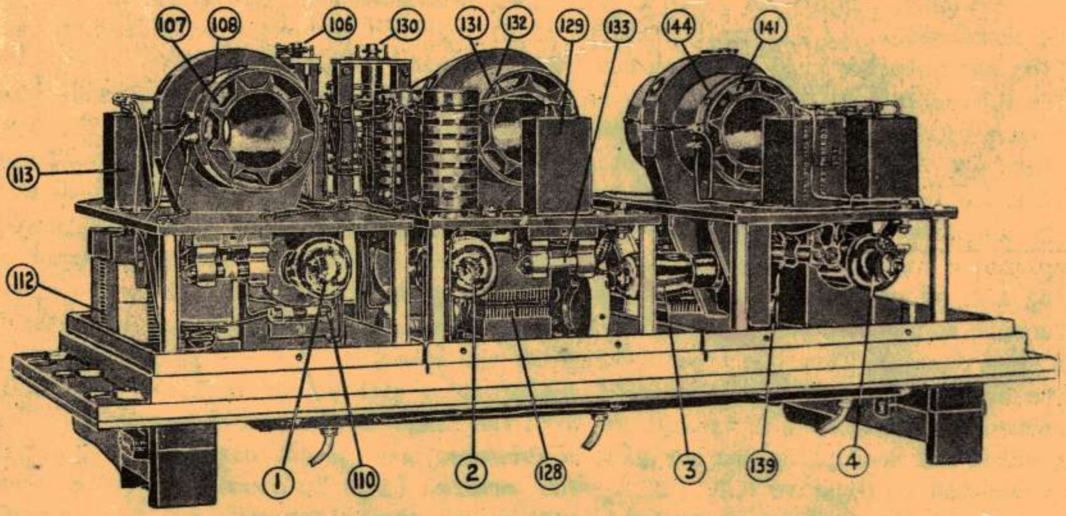


Fig. c.

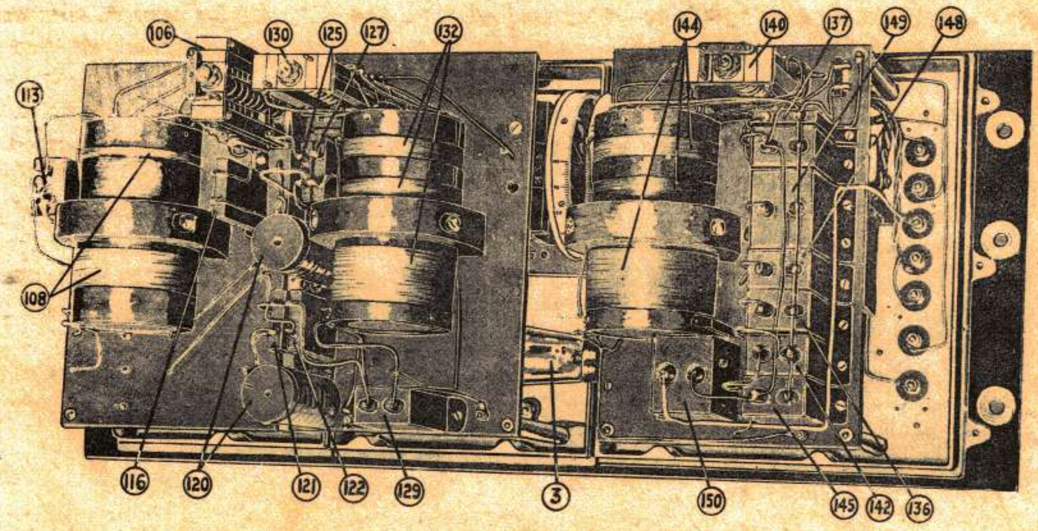


Fig. d.

The reversal of the normal arrangements of the valves (1)(2)(3) and (4) is to simplify connecting the models in the rack and also to bring the heterodyne condenser (112) opposite the operator's left hand.

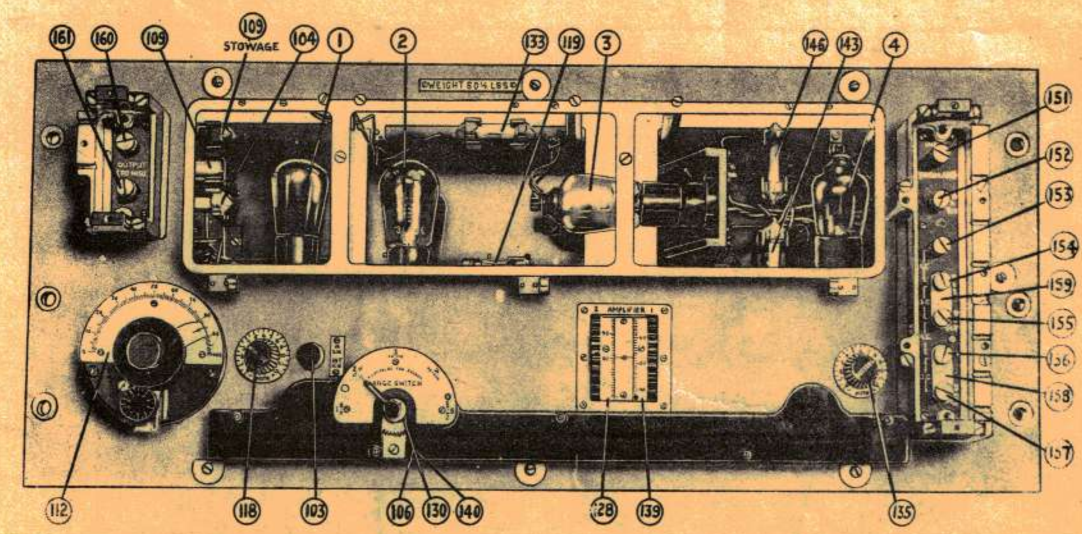


Fig. e.