SECTION
C
TUNER - AMPLIFIERS

TUNER AMPLIFIER B3

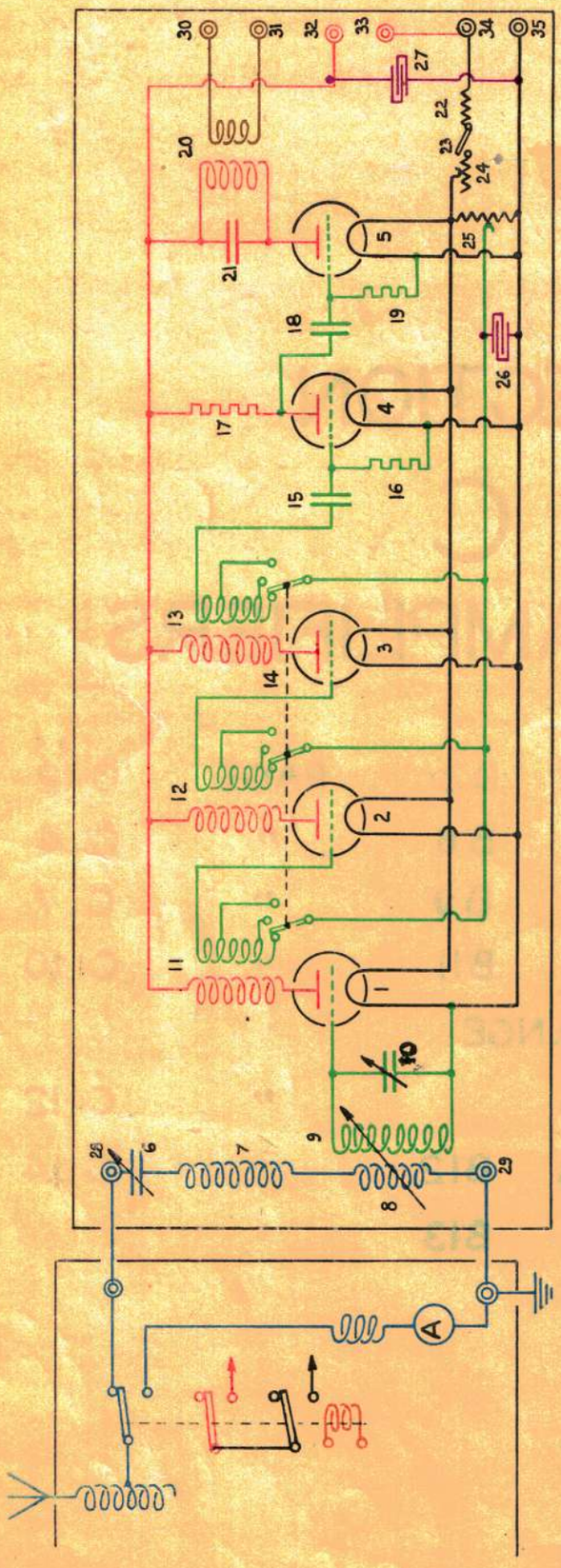


FIG. a.

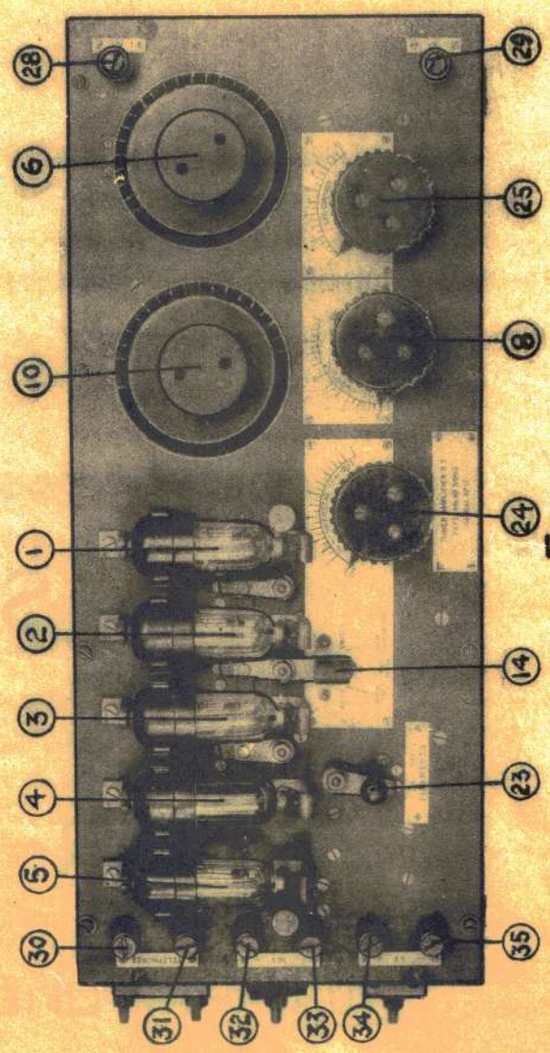


FIG. c

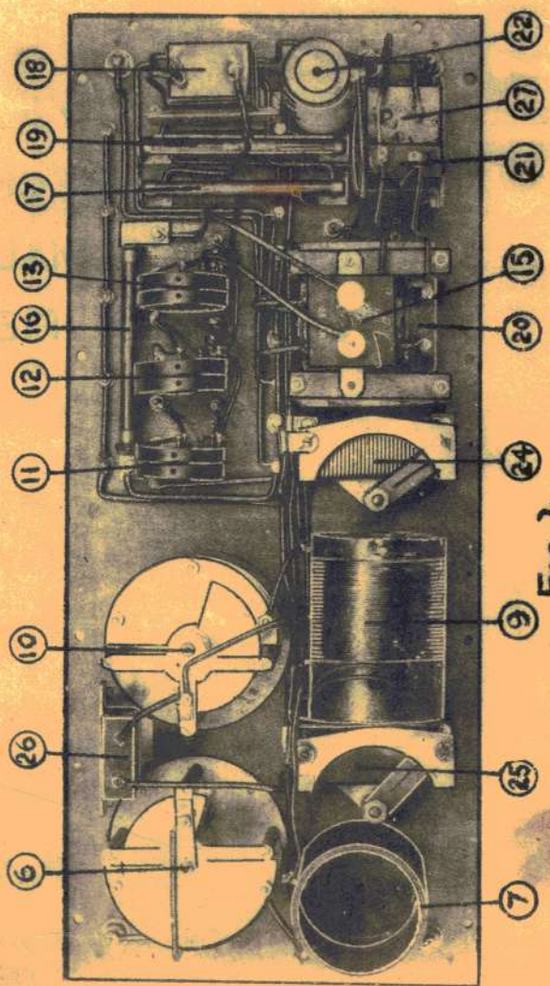


FIG. b

TUNER AMPLIFIER B3

Date of design:- 1923.
Frequency range:- 750 - 1,500 kc/s.
Where fitted:- Receiver-Outfit RA.
Valves used and methods of coupling:- Five NR7.
Three R/F amplifiers (1), (2) and (3) - tuned transformer coupled.
One detector (4) - (cumulative grid), resistance capacity coupled.
One A/F amplifier (5) (note magnifier).

Tuner-amplifier B3 is employed in conjunction with Type 81 as a receiver for fire control purposes. It is obsolescent and has not been converted to D.E. valves. The transmitting aerial is employed for reception, the circuit to the receiver being broken by the magnetic key, when the morse key is pressed.

The aerial tuning condenser (6) and the coupling between the aerial coupling coil (8) and the secondary inductance (9) can be varied as in the case of tuners A4, A5, etc., while the secondary circuit is also tuned in a similar manner by means of the condenser (10).

The secondaries of all three transformers (11), (12) and (13) in the R/F valve circuits are tapped in three positions by means of one switch (14). These three positions are marked A, B and C, the following ranges being covered:-

Stud "C" - 750 - 1,000 kc/s.
Stud "B" - 1,000 - 1,200 kc/s.
Stud "A" - 1,200 - 1,500 kc/s.

(The corresponding ranges in metres are marked on the instrument).

A grid potentiometer (25) is provided to enable self-oscillation to be damped out by making the grids of valves (2) and (3) more positive and hence introducing damping (see Admiralty Handbook of W/T (1931) paragraph 601 (5)). For convenience the grid of the detector valve (4) is also connected through a condenser (15) to the potentiometer. This however does not affect the valve since the grid potential depends solely on the value of the coupling condenser (15) and the grid leak (16), whose other end is connected to negative L.T.

The filament rheostat (24) is connected in series with a fixed resistance (22), this latter resistance being necessary as the filaments of both B3 and Type 81 are supplied from a common 6 volt battery. There is also a filament switch (23).

This model contains its own telephone condenser (21) and telephone transformer (20). Condenser (26) is merely the usual potentiometer by-pass condenser, which is fitted to prevent back oscillations due to resistance coupling by the potentiometer (see Admiralty Handbook of W/T (1931) paragraph 601 (2)). Condenser (27) is the usual H.T. by-pass condenser fitted for a similar reason.

C 4

TUNER AMPLIFIER B6

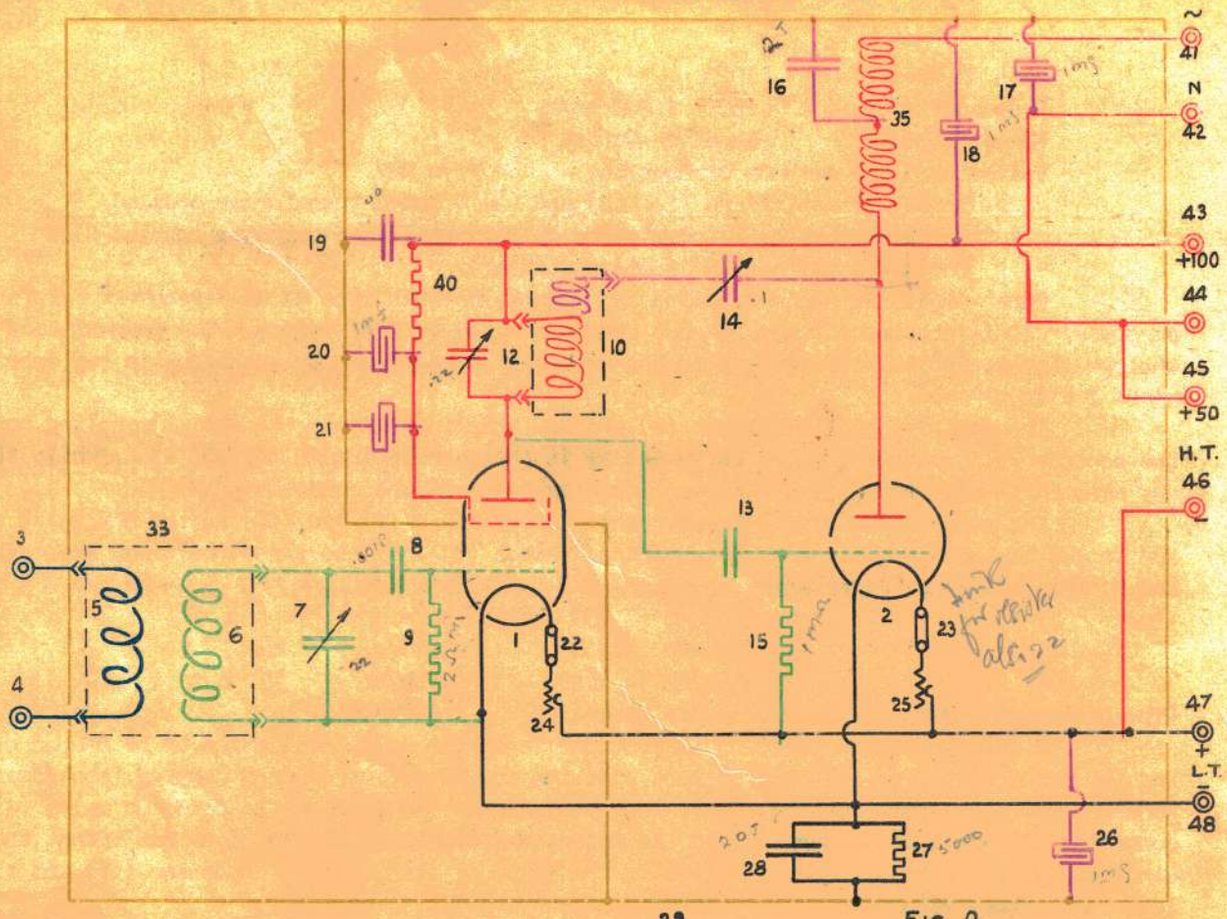


FIG. a.

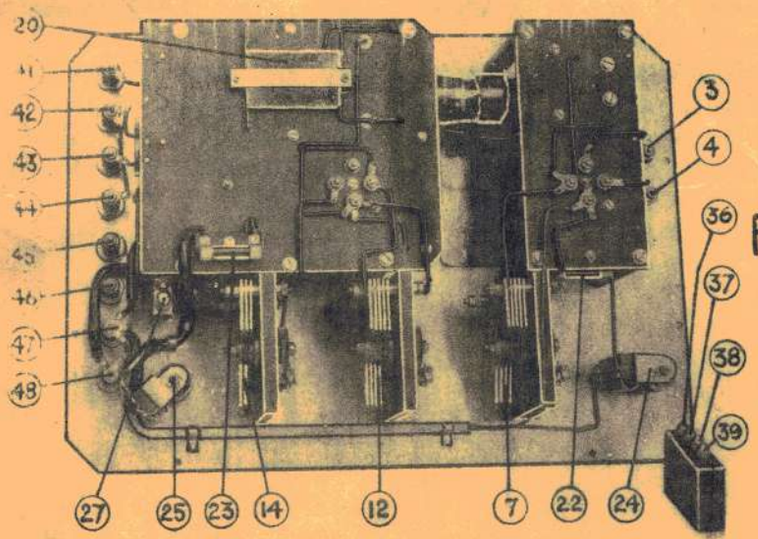


FIG. b

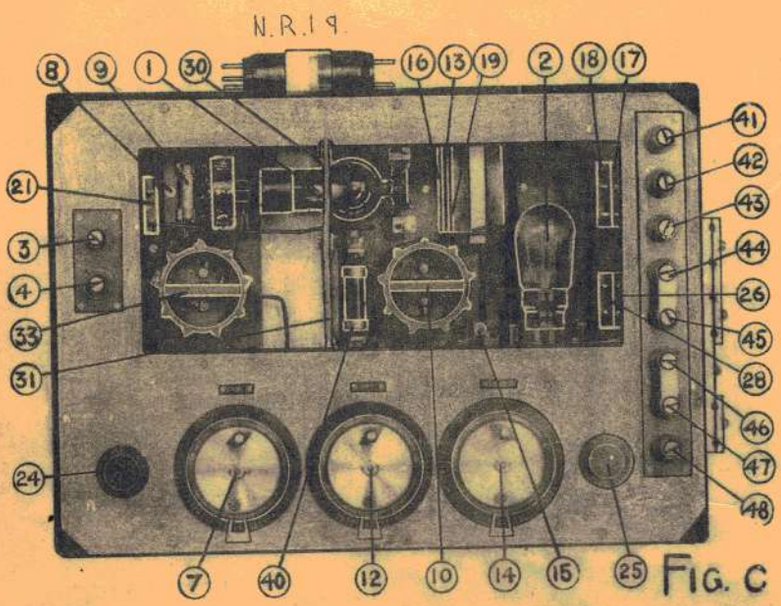


FIG. c

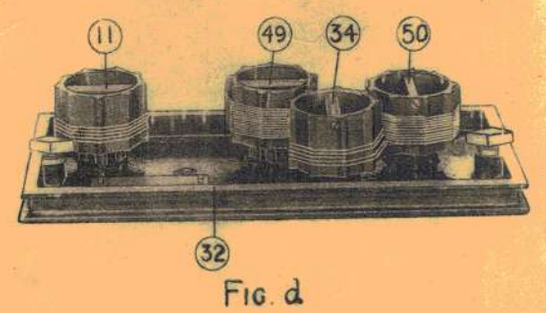


FIG. d

Date of design:- 1928.
Frequency range: 3500 ~~5,800~~ - 20,000 kc/s.
Where fitted:- Receiver-Outfit QK.
Valves and methods of coupling:- One ~~NR15A~~ NR15A and One NR22.
One R/F amplifier (screened grid) (1). Tuned anode.
One cumulative grid detector (2).

B6 is the H/F amplifier supplied for H/F work in all types of ships which work with the fleet. The screen grid valve prevents re-radiation and hence overcomes the difficulty of interference between ships in company experienced with B9. Where B6 is required to be used in remote control positions note-magnifier N9 must be used with it.

An aperiodic aerial circuit is used, coupling being effected to the tuned grid circuit of valve (1) by means of a plug-in coupling coil (5). The tuned grid circuit consists of a 0.22 jar variable condenser (7) and a plug-in coil (6), which is wound on the same former (33) as the aerial coupling coil (5).

The tuned grid circuit is loosely coupled to the first valve (1) by a small condenser (8) (0.018 jar). The grid leak (9) is fitted to prevent the grid running negative and closing the valve down completely.

The theory of the screen grid type of valve is fully dealt with in the Admiralty Handbook of W/T (1931), paragraph 555. The connections to this valve are made by a 4-pin valve holder situated in the left hand compartment of the model, the valve passing through a hole in the screen separating the two compartments. A sliding plate (30) completes the screen when the valve is in position, a rod with a flexible metal covering (31) making the necessary contact between this plate and the cover (32) which carries the spare coils. When packed for transit the cover is turned to carry the coils inside. When the valves are inserted and the instrument is in use, the cover must be reversed (bringing the spare coils to the outside in order to complete the screen connections. Three variable condensers (7), (12) and (14) are all operated by a worm drive from a handle on a dial graduated in ten divisions and one hundred sub-divisions. A follower (driven by gearing somewhat similar to epicyclic gearing) indicates the number of revolutions (up to thirty six) made by the dial carrying the handle, so that great accuracy of setting is obtainable. Condenser (7) is marked "H/F", condenser (12) is marked "DET.", condenser (14) is marked "REAC.".

The screen grid valve (1) now supplied is an NR22, but in many models still at sea an NR19 is fitted (see Sub-Section JA).

NR19. The connections to the anode and internal screen are brought out to two pins at the end of the valve remote from the ordinary filament and grid connections. Contact is made to these pins by two tubular sockets in a "U" shaped ebonite block, which is clamped in an inverted position to the base in the right hand compartment by two screws. These screws complete the anode and screen connections to the remainder of the circuit.

NR22. The "U" shaped block is reversed and only the anode connection is brought to it, the screen connection being brought to the 4-pin holder in a manner similar to that employed for the anode of an ordinary three-electrode valve. The anode terminal engages with a link connected to the "U" shaped block in the right hand compartment.

In both cases the "U" shaped block must be mounted so that the link is on the side of the block nearest the valve.

Capacity controlled magnetic reaction is employed to increase strength of signals in the tuned anode circuit of valve (1) and thus the grid circuit of valve (2). The amount of reaction is controlled by the 0.12 jar condenser (14) (see Admiralty Handbook of W/T (1931), paragraph 694). The tuned anode coil (10) of valve (1) has an additional winding for the reaction, the whole of which is made as a plug-in coil. There are thus two positions for plug-in coils and three sets of coils are provided for each position, making six in all. Coils (10) (11) and (50) which are marked in red, are supplied for the tuned anode circuit and formers (33) (34) and (49) which are marked in white, carrying the grid and aerial coupling coils. They cover the following ranges, and must be changed together, care being taken to insert the coils according to the colours marked on the guide rods:-

3,500 - 6,000 kc/s. 5,800 - 11,500 kc/s. 10,700 - 20,000 kc/s.

It should be noted that two different H.T. voltages are required for this model, 100 volts for the screen grid valve (1), 50 volts for the detector valve (2). There are two methods of achieving this. The new method is to supply from a 100 volt secondary battery connected between terminals (43) and (46) with a tapping for the 50 volt supply connected to terminal (45).

The old method is to supply from a 50 volt secondary battery connected between terminals (45) and (46), the 100 volt supply being obtained by adding a 50 volt dry battery in series between terminals (43) and (44).

The screen grid voltage (approximately 75 volts) is obtained from the 100 volt supply cut down by resistance (40).

TUNER AMPLIFIER B6 (CONT.D)

Separate rheostats (24) and (25) are provided for valves (1) and (2) respectively. Fixed resistors (36) and (37) are also supplied to enable the 4 volt valves to be fed from 6 volt batteries. Two further resistors (38) and (39) are supplied which may be used in place of (36) and (37), according to the make or type of valves in use. Two short-circuiting rods (22) and (23) are inserted in the resistor holders when the model is fed from 4 volt batteries. The resistors are each stamped with their value in ohms, the short-circuiting rods being marked "Z" or "O". Stowage for spare resistors is provided inside the model. The following table gives the filament resistors to be used with the 6 volt battery supply. The identity numbers are of course only used for these notes.

Type of Valve.	Mullard NR15	Marconi or Osram NR15.	All Makes NR15A.	Marconi or Osram NR19.	Marconi or Osram NR22
Resistor (Ohms).	(36) 30 ohms	(38) 20 ohms	(38) 20 ohms	(37) 5 ohms	(39) 20 ohms

In operating B6 the H/F (7) and detector condensers (12) are first adjusted approximately to the frequency required. The reaction condenser (14) is then set to the point where oscillations just commence. (This must not be confused with the point where self-quenching commences, which occurs at a much larger setting of the reaction condenser (14) and is accompanied by a click in the telephones.) The required signal is searched for by moving the detector condenser (12) and when found, the H/F condenser (7) is brought into tune. Owing to the fact that the screening of the valve is not perfect it may be found that oscillations are stopped or that the signal is lost as the H/F circuit comes into tune with the detector circuit. A slight re-adjustment of the reaction (14) and detector (12) condensers is then required. The reaction condenser should never be increased beyond the point where oscillations have just started, as this involves not only a decrease in signal strength but also a tendency to radiate from the aerial.

Note:- To remove the instrument from its box (for the purpose of changing resistors, etc.) the two countersunk-head screws that are tapped into the screen of the box must be removed as well as the ten round-head screws.

(OLD) TUNER AMPLIFIER B9 (PATT 8408) C7

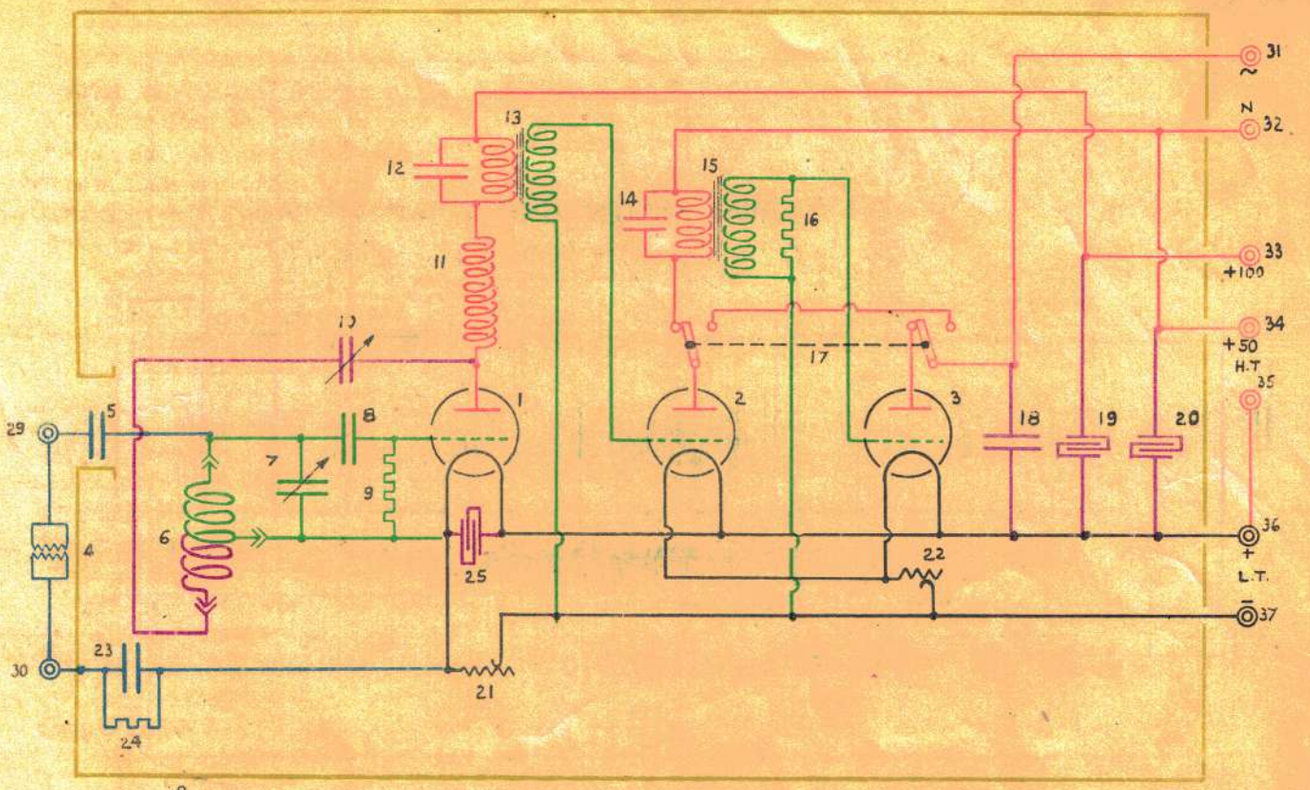


Fig. a.

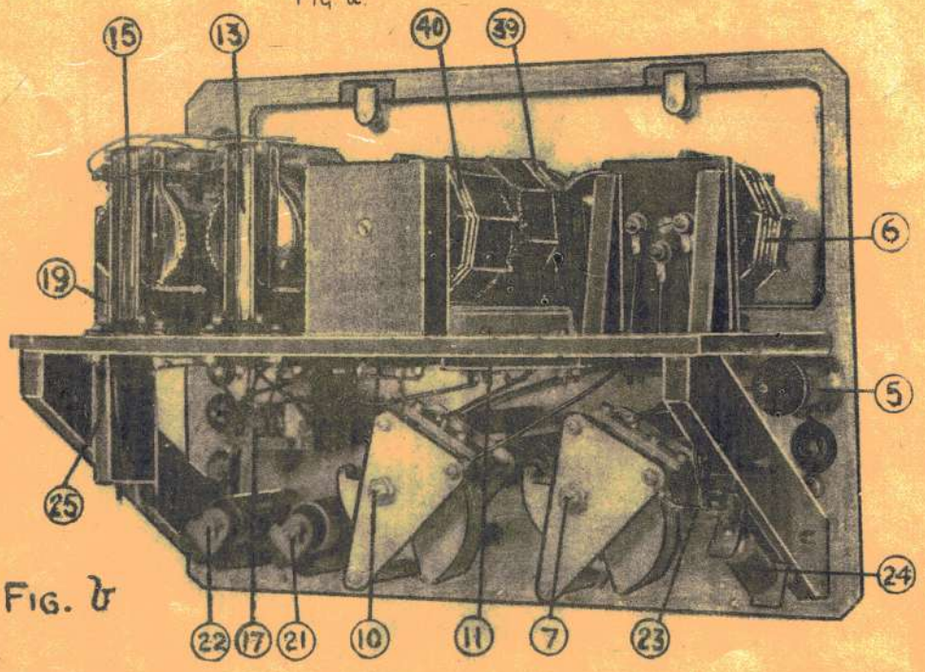


Fig. b

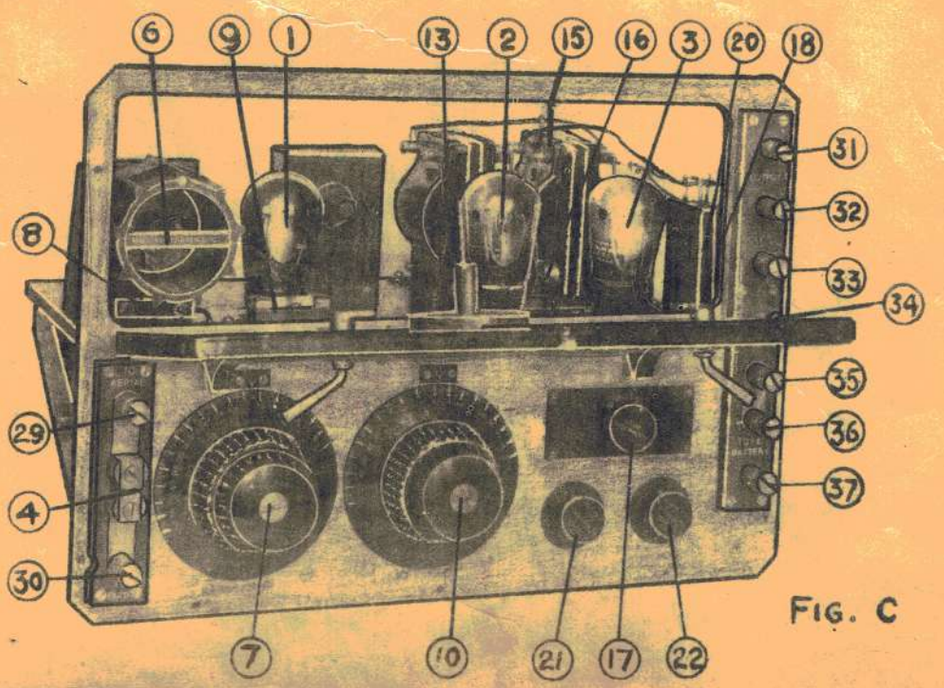


Fig. c

(NEW) TUNER AMPLIFIER B9 (PATT 8408A)

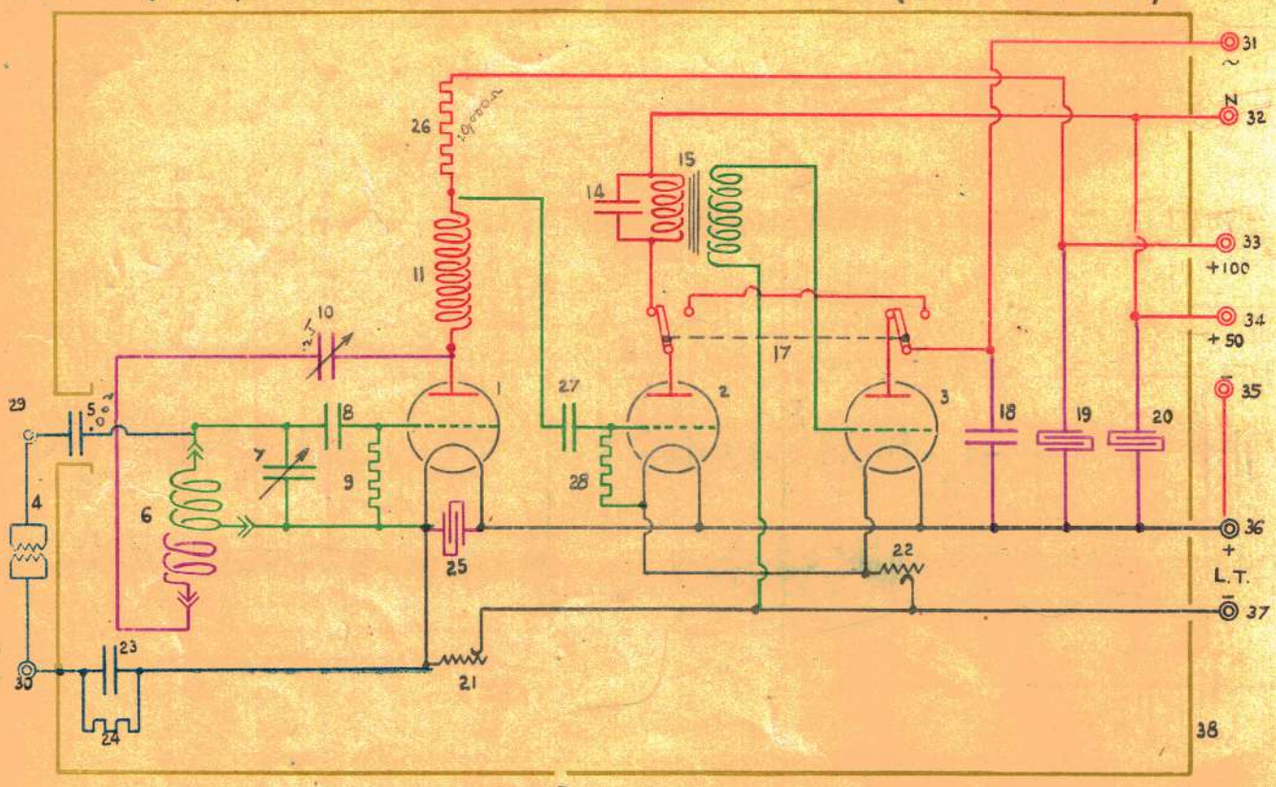


FIG. d

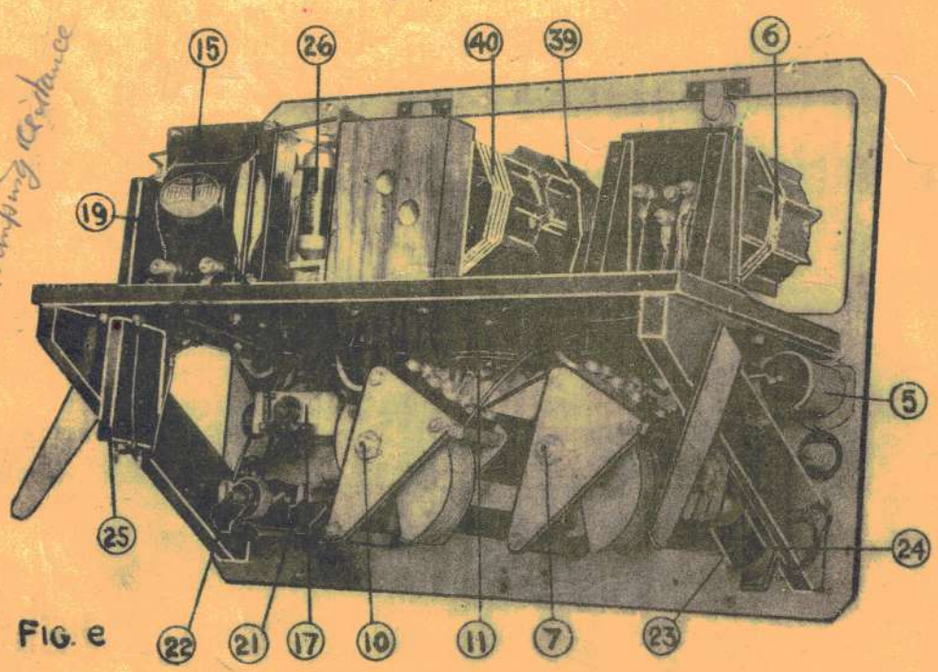


FIG. e

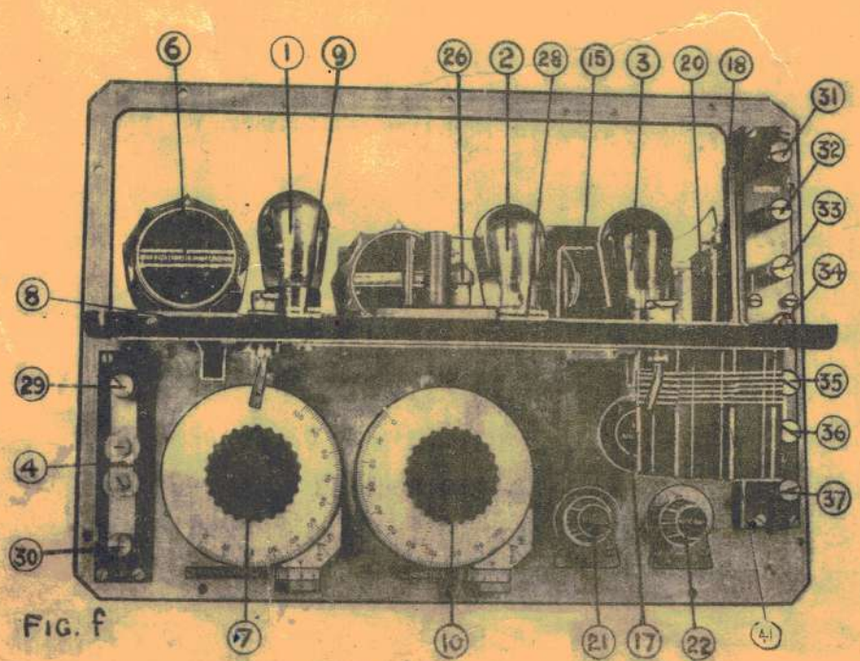


FIG. f

TUNER AMPLIFIER B9

Date of design:- 1928.
Frequency range:- 3000 ~~5,455~~ - 25,000 kc/s.
Where fitted:- Receiver-Outfit QL.
Valves and methods of coupling:- Three ~~R1132~~ NR15A

One cumulative grid detector (1). Resistance capacity coupled in Pattern 8408A. Transformer coupled in Pattern 8408.

Two note magnifiers (2) and (3). (2) may be transformer coupled to (3) or connected to output.

B9 is designed as the H/F receiver for sloops, etc., normally employed on detached service. It is no use for Fleet work owing to the fact that the amplifier is designed to oscillate and hence re-radiation takes place (see Admiralty Handbook of W/T (1931), paragraph 693 (1)).

There are two pattern numbers of Tuner-amplifier B9 in existence. The old model(Pattern 8408) is illustrated in figures a, b and c. The new model (Pattern 8408 A, is illustrated in figures d, e and f. The difference between the models consists in the method of coupling between valves (1) and (2), as already stated and in the type of slow motion dials (7) and (10) fitted.

An aperiodic aerial circuit is used coupling being effected to the tuned grid circuit of valve (1) by means of a 0.002 jar condenser (5). This condenser is very small as it is desirable to have a very loose coupling to the aerial (see Admiralty Handbook of W/T (1931), paragraph 693 (2)) for the following reasons. The grid circuit is thus less affected by interference, atmospherics, etc., or by the variations in capacity of the aerial (due to its swaying about, etc.)than would be the case with a tightly coupled aerial. Loose coupling also reduces the radiation.

Capacity controlled magnetic reaction is employed to increase strength of signals in the grid circuit, the amount of reaction being controlled by the ~~0.05~~ 0.2 jar variable condenser (10)(see Admiralty Handbook of W/T (1931) paragraph 694).

The tuned grid circuit consists of a 0.2 jar variable condenser (7) and part of a plug-in coil (6). The reaction condenser (10) is connected to the end of the part of coil (6) which is not in the tuned grid circuit. Three other interchangeable plug-in coils (39) (40) and (41) are provided which are stowed on wooden pins in the model when not in use. The plug-in coils (6),(39), (40) and (41) give the following ranges:-

3,000 - 6,000 kc/s. 5,450 - 10,000 kc/s. 8,350 - 15,000 kc/s. 14,300 - 25,000 kc/s.

The R/F choke (11) in the anode lead of the first valve is provided to ensure that the R/F passes back to the tuned grid circuit and not to the A/F note magnifying valves (2) and (3).

It should be noted that two different H.T. voltages are required for this model: 100 volts for the detector valve (1) and 50 volts for the A/F valves (2) and (3). There are two methods of achieving this. The new method is to supply from 100 volt secondary battery,connected between terminals (33) and (35),with a tapping for the 50 volt supply connected to terminal (34). The old method is to supply from a 50 volt secondary battery, connected between terminals (34) and (35), the 100 volt supply being obtained by adding a 50 volt dry battery in series, between terminals (33) and (34).

Separate rheostats (21) and (22) are provided to give the correct voltages for R/F and A/F stages respectively, the former requiring the slightly higher voltage (3 - 3.4 volts). The A/F valves (2) and (3) only require 3 volts.

The earth terminal (30) of the model is connected to the case (33) and thence through a 10 jar condenser (23) shunted by a 5,000 ohm resistance (24) to a common earth point inside the case to which all important points which should be at earth potential are connected. The external earth lead should also be as short as possible.

The new model (Pattern 8408A) gives less overall amplification due to resistance (26) capacity (27) coupling being employed between valves (1) and (2) instead of transformer (13) coupling. The resistance capacity coupling, however, also causes a considerable reduction in the background of noise, which more than compensates for this loss of amplification, in so far as ease of reading signals is concerned. This reduction of amplification and noises has enabled the 100,000 ohm damping resistance (16) across the secondary of the coupling transformer (15) between valves (2) and (3) to be omitted.

In both models, a switch (17) is provided to enable one or both stages of note magnification to be employed.

The condenser (25) across the detector valve filament is provided to give greater stability and acts as a by-pass for the L.T. battery.

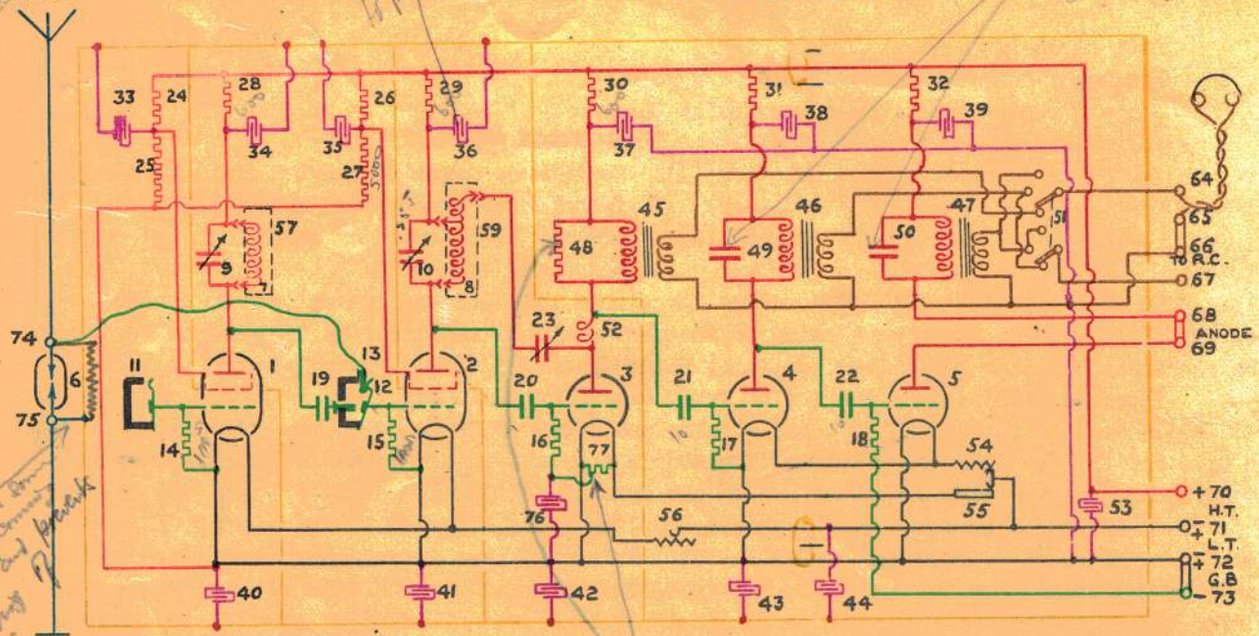
Operation of the Model.

(a) Set the tuning condenser (7) approximately to the frequency required and the reaction condenser (10) to a point where oscillations just commence. (This must not be confused with the point where self-quenching commences which occurs at a much larger setting of the reaction condenser (10) and is accompanied by a click in the telephones.)

(b) The required signal is searched for by moving the tuning condenser (7) while keeping the receiver just oscillating with the reaction condenser (10). The reaction condenser must never be moved far beyond the oscillating point as this reduces the signal strength and increases re-radiation.

C10.

TUNER—AMPLIFIER B11.



THESE LEADS ARE RUN TOGETHER IN A SEPARATE SCREEN.

FIG. a.

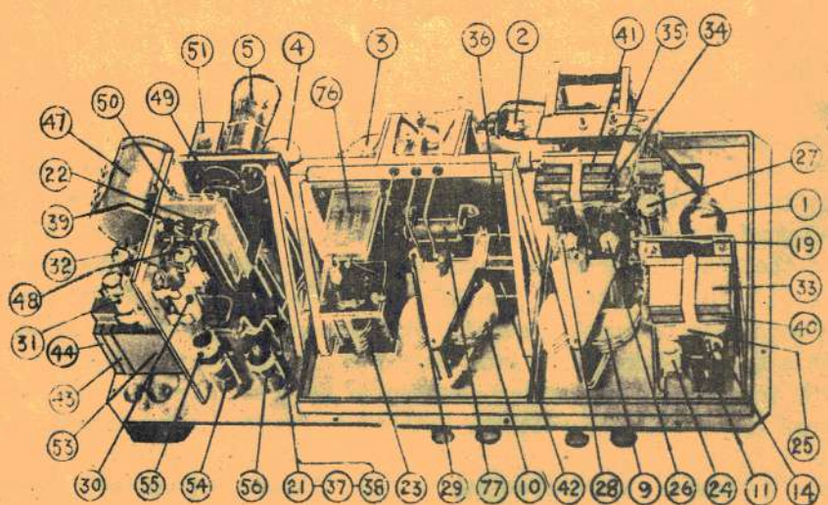


FIG. b.

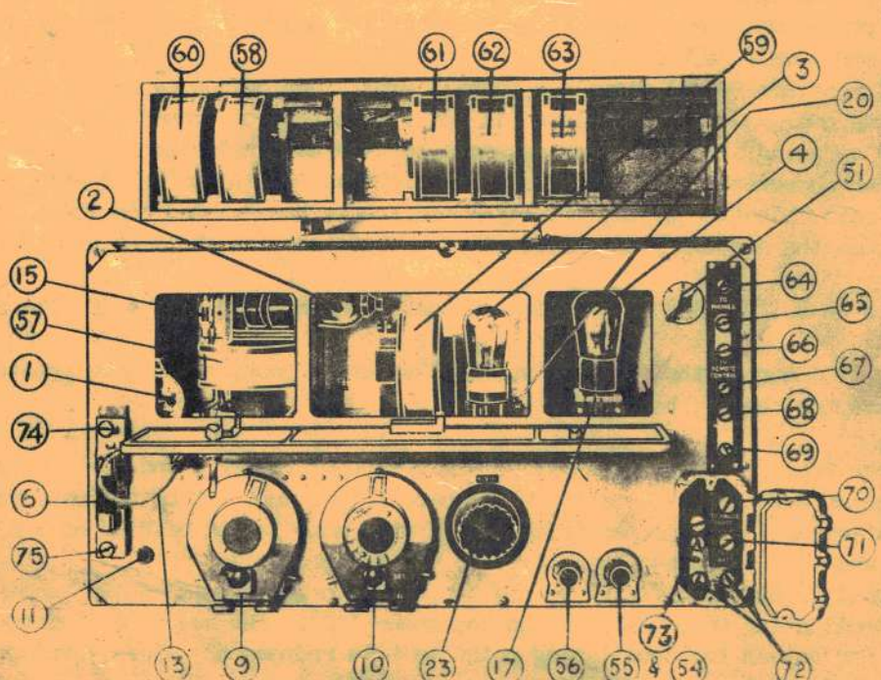


FIG. c.

TUNER AMPLIFIER BII. F/C

Date of design:- 1930. approx.
Frequency range:- ~~1,500~~ 600 - 23,000 kc/s.
Valves and methods of coupling:- Two R/F amplifiers (1)(2) NR22 or NR23 - Tuned choke capacity.
One detector (3) NR15 or NR15A (cumulative grid) - choke capacity.
Two A/F amplifiers (4)(5) NR15 or NR15A (note magnifiers) - choke capacity.
Reference:- Admiralty Handbook of W/T (1931) paragraph 696.

B11 has been designed to replace the following units:-

(a) A4 M4 when fitted with types 48 and 83.
(b) B6 for long distance H/F reception.

It consists of two R/F stages (1)(2) (screen-grid valves) in separate screened compartments, a detector valve (3) (with reaction) and two A/F amplifiers (4)(5). One or both A/F valves may be cut out by means of a switch (51).

The aerial circuit is untuned in order to reduce reradiation and make the tuning of the circuits independent of the aerial. A lightning arrester (gas-gap type) (6) is fitted between aerial and earth terminals (74)(75), and a resistance is fitted in parallel with the Spark Gap.

Above 5,000 kc/s, one R/F stage only is employed (See Admiralty Handbook of W/T (1931) paragraphs 691 and 696) - at lower frequencies either one or both may be used - Connection is made by plug and jack fittings (11)(12)(13)(similar to those used for amplifier M9) (See figures b and c page H13) and when one R/F valve only is in use, the previous stage is isolated.

The range of frequencies is covered by plug-in coils for the R/F stages, as follows:-

600 - 1500 (58)(60) 1500 - 2500 kc/s. (57)(59) 2500 - 5000 kc/s.

Above 5000 kc/s, only one R/F stage is used. Consequently, for the remaining ranges a plug in coil for the second R/F stage only, is provided as follows:-

(61) 5000 - 7500 kc/s., (62) 7500 - 13000 kc/s., (63) 13000 - 23000 kc/s.

Resistances (24)(25) and (26)(27) are connected between H.T. positive and L.T. negative and are used as potentiometers in order to obtain the correct voltage on the screens of the screened grid valves (1)(2). The values of the resistances (24)(25) are so arranged that this correct voltage is obtained by taking the tapping from the point where they join - similarly with resistances (26)(27). These resistances are shunted to the case by 0.1 microfarad condensers (33)(35). Resistances of 600 ohms (28)(29) are also inserted in the anode leads of the R/F valves and these resistances are also shunted to the case by condensers (34)(36) which have the following values respectively (34) 0.1 microfarad, (36) 1.0 microfarad. The condenser (36) is of a larger value in the second case to avoid any liability of passing on low-frequency impulses to the detector valve(3).

The values of the resistances (24)(26)(28)(29)(30)(31)(32) in the anode and screen leads of all valves may be adjusted according to the H.T. voltage available as explained in the "Book of Instructions" issued with the set.

The third valve (3) is a cumulative grid detector. The grid leak (16) is connected towards the negative end of a potentiometer (77) connected across the filament in order to reduce the liability to "threshold howl" (See Admiralty Handbook of W/T (1931) paragraph 695) - for the same reason, the choke (45) in the anode lead of this valve is shunted by a resistance of 20,000 ohms (48). Reaction is obtained via a variable condenser (23) to the tuned anode circuit of the second R/F valve (2).

The A/F stages are choke-capacity coupled and the chokes (45)(46)(47) are fitted with secondary windings which perform the function of telephone transformers when their particular valve is connected directly to output. This telephone connection is made by means of an output switch (51) on the face of the model. No external telephone condenser or transformer is therefore required.

The anode of the last valve is brought to a link between terminals (68) (69), which is normally kept closed, but may be opened to allow for a separate anode supply to the last valve if required for a loud speaker.

Terminals (72)(73) are provided for grid bias should it be required to use a "power" valve in the last stage. These grid bias terminals are normally closed by a link.

The L.T. supply is 4-volts and separate rheostats are provided as follows:-

(56) For the screen grid stages.
(54) For the A/F valves. This rheostat also breaks the detector valve's filament circuit in the "OFF" position by means of a sliding contact (55).

C12. QUICK WAVE CHANGE CONDENSER DIALS.

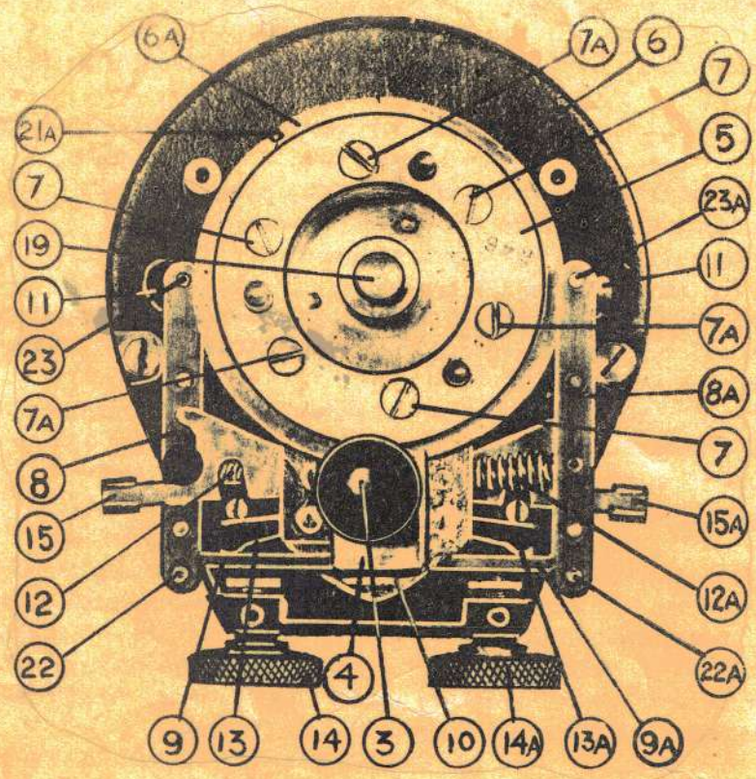


FIG. a

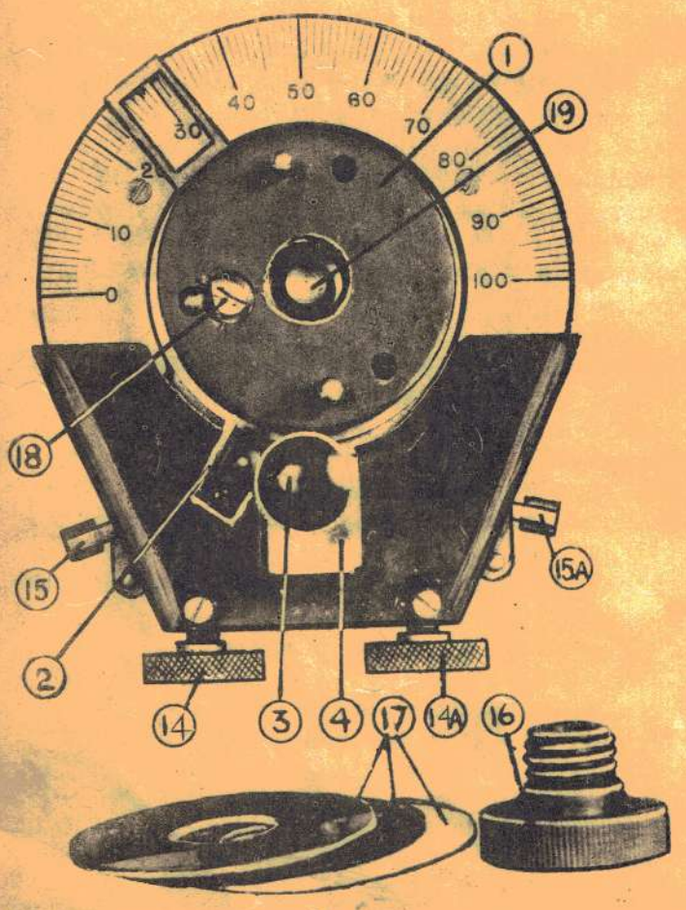


FIG. b

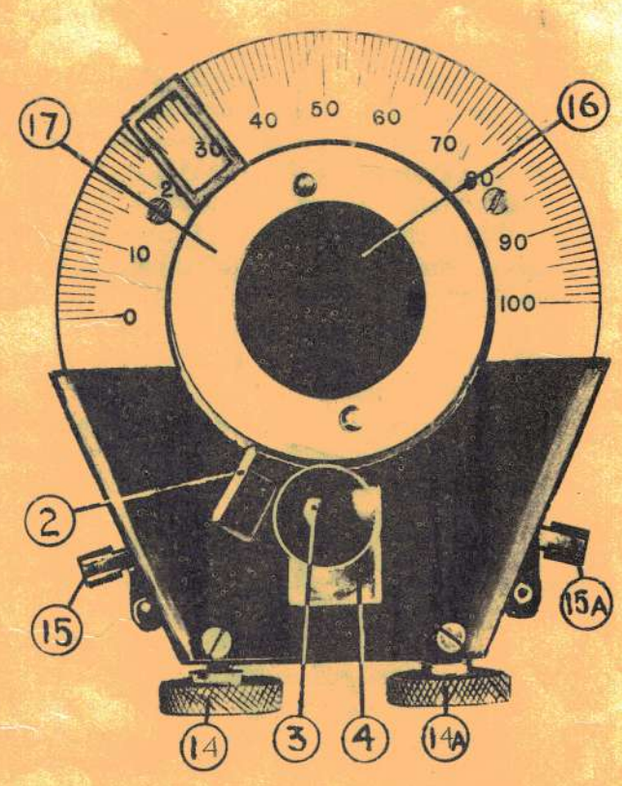


FIG. C

QUICK WAVE CHANGE CONDENSER DIALS. C13.

Quick wave change condenser dials are fitted in B11, B12 and modern receiving gear. These may be used in a number of different ways:-

(a) For quick search over the whole scale.

The main handle (1) is rigidly connected to the condenser spindle (19) and this consequently enables quick search to be carried out provided that the knob (3) is pulled out and the slow motion device so disengaged (see paragraph (b)). The gear for setting to determined readings can be disengaged by depressing the catch plates (15)(15a). It is not of great importance to do this, but if it is not done a catch will be felt every time the predetermined readings are passed.

The main handle (1) carries a pack of coloured and reversible discs (17) (which can be marked) and are read off against the pointer (2).

(b) For slow motion search or fine tuning.

A knob (3) is fitted below the main handle (1) and is attached to a secondary spindle which carries a scroll at its inner end. The condenser spindle (19) carries a crown wheel. By pushing up on the detent plate (4) the knob (3) is allowed to spring in, thus engaging the scroll with the crown wheel (11). The knob (3) thus turns the condenser at a reduced rate according to the ratio of scroll to crown wheel (100/1). The scroll is disengaged from the crown wheel (11) by pulling out the knob (3) held there by the detent plate (4) which is pushed down by a spring and engages a shoulder on the secondary spindle.

(c) For quick wave change to either of two predetermined readings.

A plate (5) keyed to the condenser spindle (19) carries two steel rings (6) (6a) one above the other, which can be rotated and clamped independently at any position by the screws (7)(7a). A notch (21) (21a) is cut in each ring.

Pivoted at the centre (10) are two links (9) (9a) which carry at their ends frames (8)(8a) which are free to rotate about the points (22)(22a). At the top ends of the frames rollers (23) (23a) are fitted which snap into the notches (21)(21a) on the rings (6)(6a). Springs (12)(12a)are provided which pull the frames inwards and so keep the rollers (23)(23a) pressed up against the edges of the rings (6)(6a). Two catch plates (15)(15a) are fitted which, when pressed down, hold the frames (8)(8a) out and so free the rollers (23)(23a) from the rings (6)(6a) when it is desired to put the quick change device out of action. Further springs (13)(13a) hold the links (9)(9a) down on to the points of the screws (14)(14a). Turning these screws thus moves the links (9) (9a) and hence the frames (8) (8a) which push round the rings (6) (6a) and turn the condenser spindle, thus providing fine adjustment for the settings of the quick change device. Care should be taken that, before setting the predetermined readings, the screws (14)(14a) are about half way along their travel.

In order to use the quick change device it is therefore necessary to:-

(a) Lift the catch plates (15)(15a) to allow the rollers (23)(23a) to bear on the rings (6)(6a).
(b) Pull out the knob (3) to disengage the slow motion device.

To set the predetermined readings.

(a) Remove the ebonite screw (16) and the coloured discs (17).
(b) Turn the latch screw (18) and draw off the main handle (1).
(c) Push up on the catch plates (15)(15a).
(d) Turn and engage the left hand roller (23) in its notch (21).
(e) Slack the screws (7). Rotation of the dial should now leave the lower ring (6) engaged with the roller (23).
(f) Replace the main handle (1).
(g) Set the condenser to the required reading. (This can be obtained by tuning the instrument.)
(h) Remove the handle (1) and tighten the screws (7).
(i) Repeat the operation with the right hand roller (23a) and the screws (7a) to set for the second predetermined reading.
(j) Replace the handle (1). Tighten the latch screw (18).
(k) Replace the coloured discs (17) and ebonite screw (16).

TUNER-AMPLIFIER B12.

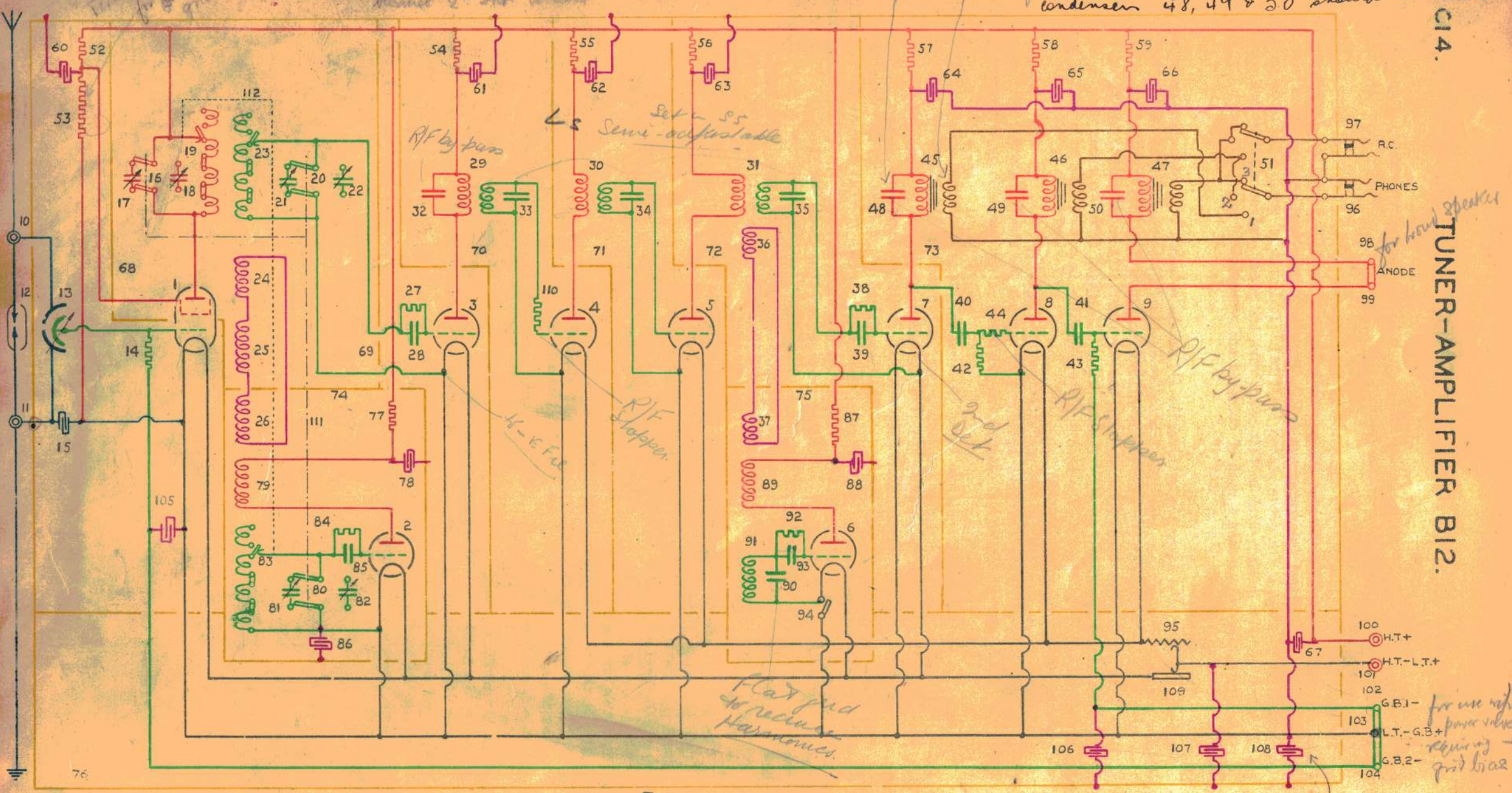


FIG a.

TUNER AMPLIFIER B12.

Date of design:- 1931.
Frequency range:- 150 - 1500 kc/s.
Valves and Methods of coupling:- One NR22 or NR23, eight NR15 or NR15A.
One isolating valve (1) - tuned transformer.
First heterodyne oscillator (2).
First detector (3) (cumulative grid) - transformer.
Two S/F Amplifiers (4)(5) - transformer.
Second heterodyne oscillator (6).
Second detector (7) (cumulative grid) - tuned choke capacity.
Two A/F Amplifiers (8)(9) - tuned choke capacity.
Reference:- Admiralty Handbook of W/T (1931) paragraph 698.

B12 is a tuner-amplifier, working on the Supersonic Heterodyne principle, and has been designed to replace A5 M5 . Special arrangements for quick wave-changing have been incorporated; these include the fitting of alternative condensers (17 or 18, 21 or 22, 81 or 82) in some of the tuned circuits.

The receiver consists of one isolating stage (screen grid valve) (1), the first Heterodyne (2), the first detector (3), two S/F amplifying stages (4)(5), the second heterodyne (6), which is only required when receiving C.W., the second detector (7) and two A/F stages (8)(9).

The aerial circuit is untuned, and is coupled to the grid of the isolating valve (1) through a differential condenser (13) (See Admiralty Handbook of W/T (1931) paragraph 698) which is fitted so that the coupling may be varied in order to prevent swamping of the first valve when a neighbouring aerial is transmitting. This type of condenser is used, as it gives a wide coupling range with a small condenser; its dial (113) is fitted with a slow-motion device (114). This condenser (13) and the grid leak (14) of the isolating valve (1) are protected by a gas gap arrester (12).

The isolating valve is coupled to the detector by tuned-transformer coupling; the tuned-anode circuit of the isolating valve is thus the primary of the tuner, while the tuned grid circuit of the detector valve is the secondary. The coupling is fixed and the variable condensers in use (17)(21) or (18)(22) are gang-controlled, this simplification being made possible by the use of the screened-grid valve (1), which ensures that the tuning of neither circuit is appreciably affected by the type or size of aerial used.

The first heterodyne (2), has a tuned-grid and coupled anode circuit, and is coupled to the tuner secondary (23) by a link circuit, consisting of two coupling coils (26)(24) and a small loading inductance (25), which prevents over coupling on the highest frequencies.

Both the tuner and the tuned circuit of the first heterodyne (2) cover the frequency range in four steps by means of the range switch (112). The position of this switch varies the inductance of the tuner primary (19), the tuner secondary (23) and the heterodyne tuned-grid circuit inductance (83) to cover the following frequencies:-

1.	150 - 250 kc/s.	3.	375 - 750 kc/s.
2.	250 - 375 kc/s.	4.	750 - 1500 kc/s.

A reasonable overlap is allowed for on all ranges.

The first detector (3) is of the cumulative grid type; the reason why the grid lead is taken to filament negative, contrary to normal practice, is that any signal voltage added to that introduced by the heterodyne gives enough "grid swing" to produce the necessary variations of grid current.

The Supersonic frequency used is 120 kc/s., to which the output circuits of valves (3)(4) and (5) are therefore permanently tuned. These stages are transformer-coupled, the secondaries consisting of the 1 jar condensers (33)(34)(35) fitted across semi-adjustable inductances, which are adjusted in Signal School and should not be altered. An R/F by-pass condenser (32) is connected across the primary of the output transformer of the first detector.

The second heterodyne (6) is of the tuned grid and coupled anode type; its grid inductance is adjusted in Signal School to give a 1200 cycle note (when beating with 120 kc/s) and should not be altered. As this valve is only required when receiving C.W., a switch (94) is fitted in the filament lead and is labelled "IN - C.W. OUT - I.C.W.". To reduce harmonics, and consequently interference between the two heterodynes as much as possible, a flat grid circuit is used, the tuning condenser (90) being 4 jars fixed.

The second detector (7) is also of the cumulative grid type, and is coupled by tuned choke capacity coupling to the first A/F stage (8), the latter being similarly coupled to the second stage (9). H.F. by-pass condensers (48) 4 jars, (49) 2 jars, (50) 2 jars, which also act as telephone condensers, are connected across these chokes. The latter also perform the functions of telephone transformers, each choke having a secondary winding with a $6\frac{1}{2}$: 1 step down ratio. An output switch (51) connects any one of these three secondary windings to a plug fitting (96) marked "To Phones" into which a jack connected to the telephones is pushed. This switch (51) therefore controls the number of stages of A/F amplification in use and, when in position "1" or "2", is also wired to another plug fitting (97) marked "To Remote Control" in such a way that the Remote Control Operator has one more stage than the operator at the local position. When in position "3", both obtain full amplification. No external telephone transformer is required.

TUNER AMPLIFIER B12.

The anode of the last valve (9) is brought out to a terminal (99) and thence through a link to a terminal (98) connected to the final choke transformer (47). This link is normally closed but may be opened to connect up a loud speaker. If a "power" valve is employed in place of the last valve (9) a separate anode supply will be necessary and should be inserted in series with the loud speaker. Grid bias terminals (102)(103) normally closed by a link are also provided for use with this type of valve. The necessary leads are fitted so that grid bias may be applied to the isolating valve (1) should this be necessary with future types of screen grid valve. These leads are also normally short circuited by a link between terminals (108)(104).

The L.T. supply is 4 volts and a rheostat (95) is provided for the S/F and A/F valves. This rheostat also breaks the filament circuits of all the remaining valves by means of a sliding contact (109).

The screen of the isolating valve (1) is connected to H.T. positive through a fixed potentiometer(52)(53), consisting of a 5000 ohm resistance (52) in series with a 10,000 ohm resistance(53), connected between H.T. positive and L.T. negative. The tapping to the screen of the valve (1) is taken from the common point of these resistances (52)(53). The screen is also shunted to the case by a 0.1 mfd. condenser (60).

In order to prevent S/F and A/F currents in the various anode circuits from passing through the Anode Supply System the impedance of which forms a coupling common to all the valves, the anode supplies to all except the isolating valve (1) are separately decoupled by means of 1.0 mfd. shunt condensers (78)(61)(62)(63)(88)(64)(65)(66) and series resistances (77)(54)(55)(56)(87)(57)(58)(59). These resistances also serve to cut down the H.T. potential to a suitable value for each valve. The H.T. supply may be 100 or 150 volts. The values of the resistances to be used for various H.T. voltages are given in the Book of Instructions issued with the set.

A resistance (110)is fitted to prevent the R/F component from the 1st. detector(3)from reaching the grid of the first S/F valve (4). A similar resistance(44) prevents S/F from reaching the first A/F valve (8).

Quick Wave-Changing.

The ganged control of condensers (17)(21)is marked "Tuner A"; that of the alternative condensers (18)(22) is marked "Tuner B". Similarly, the dial controlling condenser (81) is marked "Het. A", that controlling condenser (82) "Het. B". A change-over switch(111) puts either Tuner A and Het. A. or Tuner B and Het. B. into circuit. Each of the above four condenser controls is fitted with the special quick wave-change dial (see page C12).

Two distinct types of wave-change are thus arranged for -

(a) Between Divisional and Subdivisional wave.

As this is only a small change of frequency, the dials of the Tuner and Het. in use are set to click into either of the two predetermined readings (see page C12 paragraph c).

(b) Between destroyer and flotilla or reconnaissance and destroyer waves.

These changes may entail a change of range switch (112). The adjustments for one wave are set on Tuner A. and Het. A. those for the other wave on Tuner B. and Het. B. the range switch (112) being set to the appropriate range in each case.

The wave-change is now done by moving switch (111) between "A" and "B", and moving range-switch (112) as necessary.

It should be noted that it is possible to set the quick wavechange devices to two positions on each condenser thus making four positions in all, any one of which can be obtained by means of the quick wavechange dials, the change over switch (111) and the range switch (112).

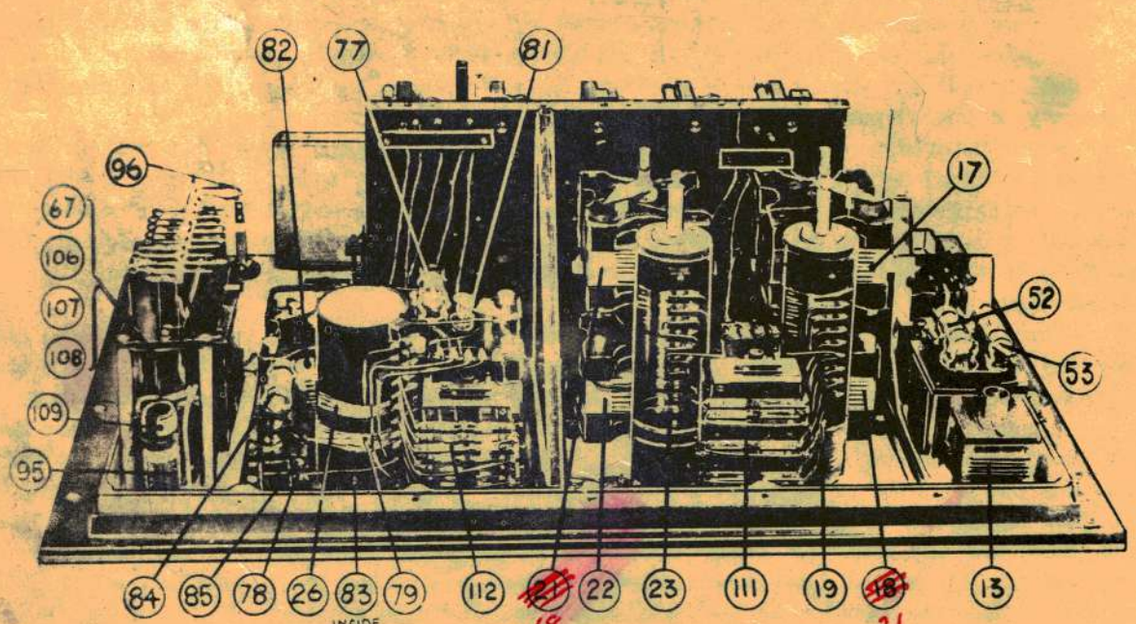


FIG. 6

TUNER AMPLIFIER B12.

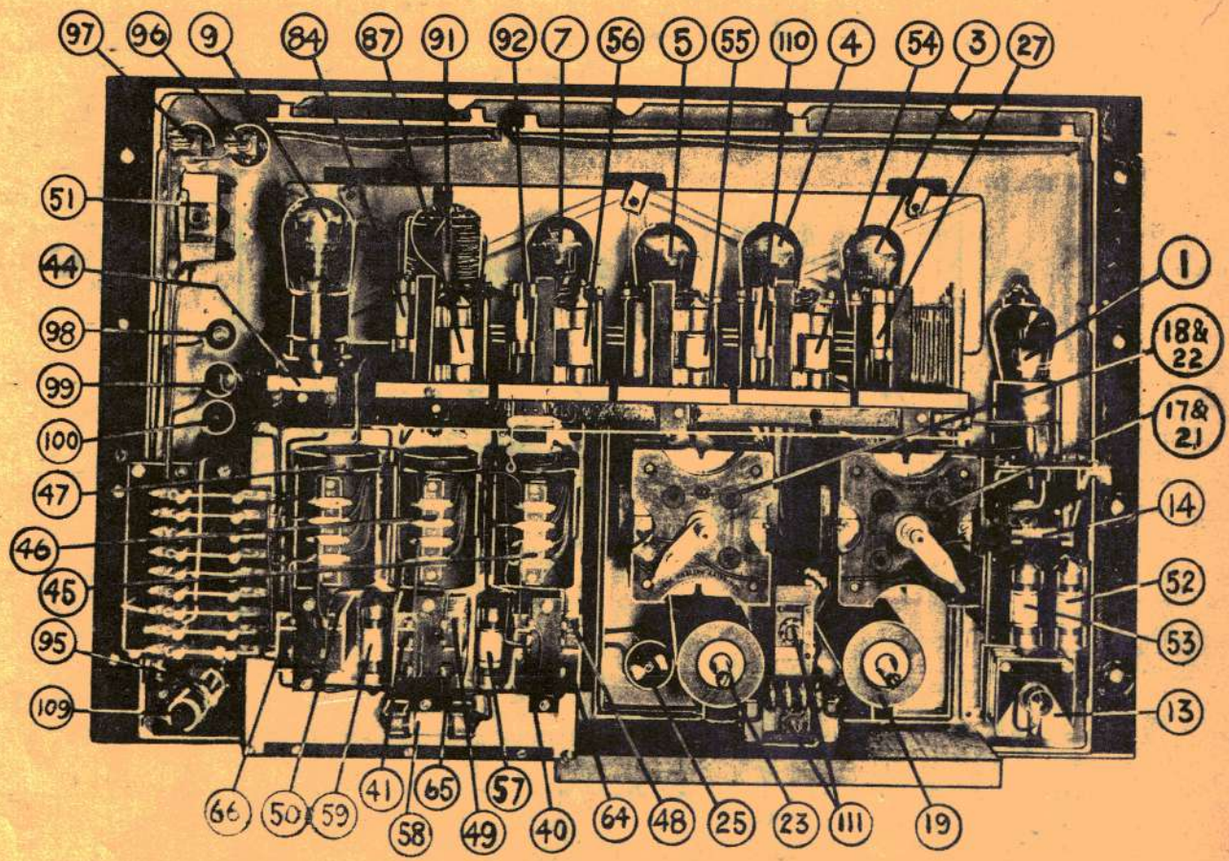


FIG. C

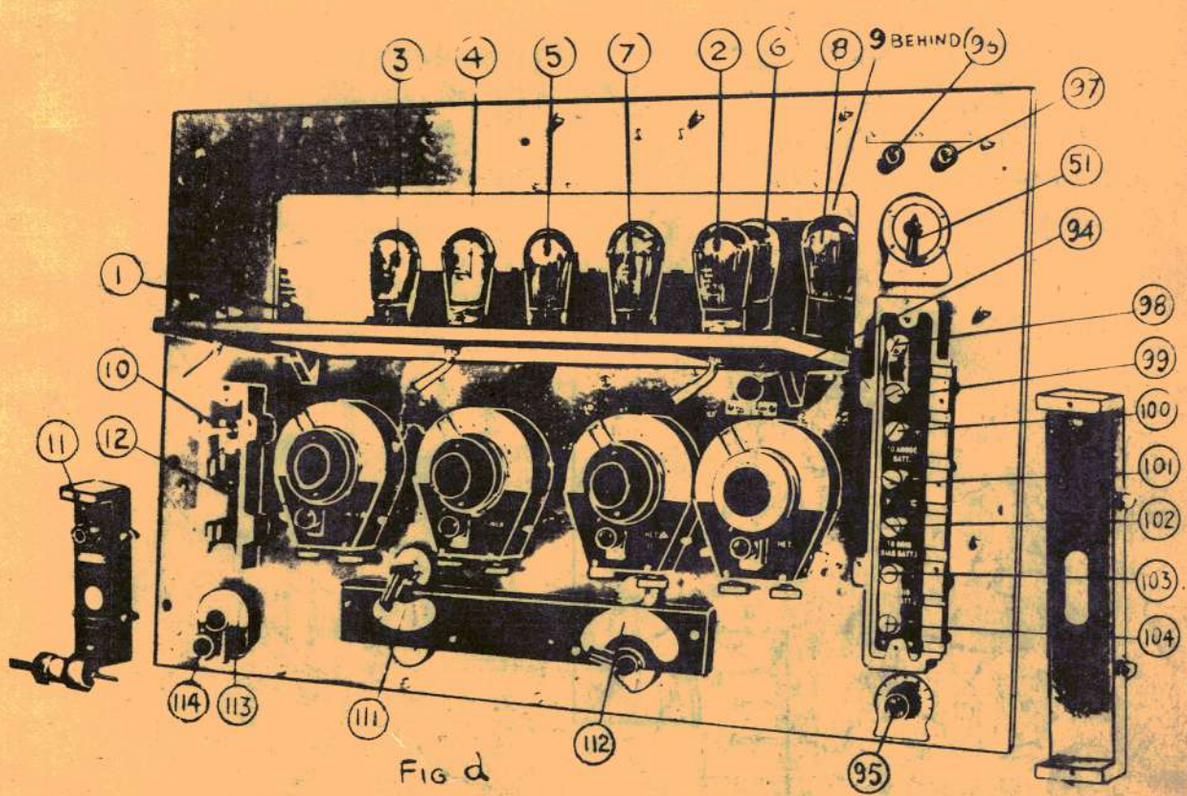


FIG d

TUNER AMPLIFIER B13

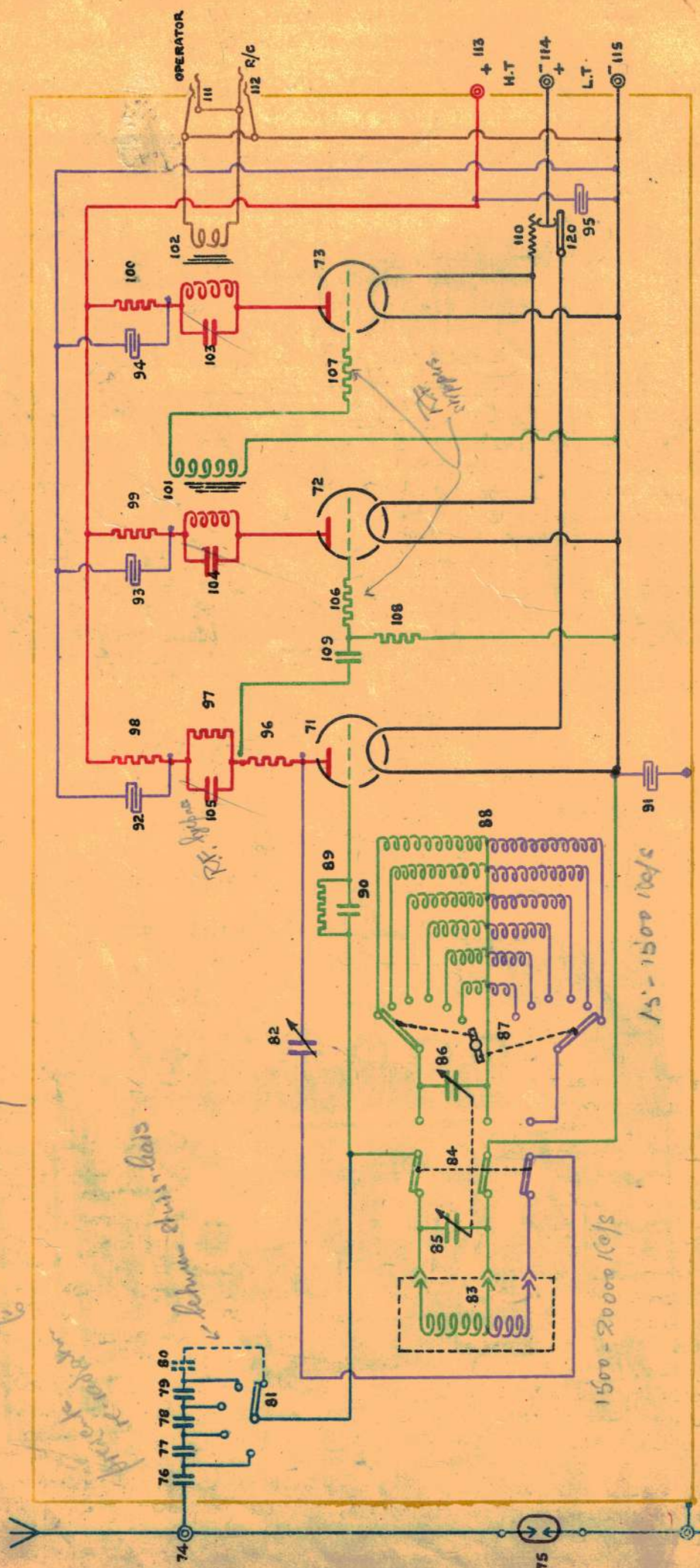


FIG. 4.

TUNER AMPLIFIER B13

Date of design:- 1932.
Frequency range:- 15 - 20,000 kc/s.
Valves and method of coupling:- Three NR15A.
One cumulative grid detector (71) - Resistance capacity.
Two note magnifiers (72) and (73) - Transformer.
Reference:- Admiralty Handbook of W/T (1931) paragraph 694.

Tuner Amplifier B13 has been designed as a stand-by receiver to replace any other receiving set (except V.H/F receivers) and as the only receiver in certain small ships. Plug-in coils (83)(117)(118)(119) are used for frequencies between 1500 and 20000 kc/s. All the components are supported from an aluminium panel, and are encased in a metal box. A stowage position for the plug-in coils not in use is provided inside the instrument. The aerial is capacity coupled to the tuned grid circuit of the detector, the coupling being varied by means of the switch (81) which connects one or more of the fixed condensers (76)(77)(78)(79) in series. In the first position of the switch (81) the coupling is through the natural capacity of the switch (81) and the leads, and is represented in figure 1. by the dotted line condenser (80). The coupling condensers (76)(77)(78)(79) have values of 0.3, 0.2, 0.05 and 0.01 jar respectively, which give the following effective coupling capacities for the five positions of the switch (81).

Switch Position.	1	2	3	4	5
Capacity (Jars).	Very small	0.008	0.035	0.12	0.3

Capacity controlled magnetic reaction, on both H/F and L/F, is employed, the amount of reaction being controlled by the variable condenser (82).

The tuned grid circuit consists of either the six fixed coils (88) and the variable condenser (86), for frequencies from 15 to 1500 kc/s, or the plug-in coils (83) and the variable condenser (85) for the higher frequencies. Four plug-in coils (83)(117)(118)(119) are provided to cover the frequency range of 1500 - 20000 kc/s. The change over switch (84) effects the change in grid circuit from H/F to L/F reception. Any one of the six coils (88) depending on the frequency required, can be brought into use by means of a six way switch (87) which also connects the appropriate reaction coil in the circuit at the same time. The two tuning condensers (85)(86) are ganged together, and have values of 0.25 jar, and 1.2 jars respectively. The frequencies covered by the range switch (87) for L/F and the coils (83)(117)(118)(119) are as follows:-

L/F

Switch Position.	Frequency.
1	15 - 32
2	32 - 70
3	70 - 150
4	150 - 320
5	320 - 700
6	700 - 1500

H/F Ranges.

Range Coil.	Frequency.
1	1500 - 3000
2	3000 - 6000
3	6000 - 11000
4	11000 - 20000

It should be noted that the actual frequency range covered by each coil will vary slightly from the above ranges since they depend upon the value of the aerial coupling used, as well as upon the size of the aerial and the capacity of the trunk or cable.

The 10,000 ohm resistance (96) takes the place of the R/F choke usually employed with this type of circuit, owing to the difficulty of designing a choke to give smooth reaction over the large range of frequencies required. Resistance capacity coupling is used between the detector (71) and first A/F valve (72), with an anode coupling resistance (97) of 50,000 ohms. The 0.1 jar condenser (105) is a R/F by-pass. The second A/F valve (73) is transformer coupled, the primary winding being shunted by a 2 jar by-pass condenser (104). The output of the second A/F valve (73) is connected to a telephone transformer, the output of which is connected to telephone jacks for operators or remote control. Resistances (106)(107) have values of 100,000 ohms, and are used to prevent R/F currents from the detector being passed on to the output of A/F valves (72)(73). The A/F valves(72)(73) are decoupled by resistances (99)(100) and condensers (93)(94). The detector valve anode supply being decoupled by the resistance (98) and the condenser (92). The rheostat (110) allows the filament voltage to the valves (72)(73) to be varied, while that to the detector valve (71) remains unaltered. This also breaks the filament circuit of the detector valve by means of a sliding contact (120).

Operation. When used as a L/F receiver, and a large value of the tuning condenser (86) is being used, (i.e., when the condenser is towards zero on the condenser scale) position five on the aerial coupling switch (81) may be used, but in order to cover the nominal ranges, and to obtain an overlap between the ranges, the coupling switch (81) must be brought back to position three when the tuning condenser (86) approaches the minimum setting (100 on the condenser scale).

TUNER AMPLIFIER B13

For H/F reception the aerial coupling switch (81) should never be turned beyond the third stop. Position two of this switch gives the best coupling for normal use, although for the highest frequencies and for small settings of the tuning condenser (85) position one may be preferable.

To ensure the best selectivity and the least aerial radiation, the smallest aerial coupling consistent with reasonable signal strength should be used. It should be noted that an appreciable alteration in the position of the tuning condenser may be necessary when altering the aerial coupling.

For H/F and C.W. reception the reaction should be increased until oscillations just commence. For reception of I.C.W. the reaction may be decreased just below the oscillating point in order to preserve the characteristic note frequency of the transmission.

If, on any H/F or L/F range it is found impossible to make the circuit oscillate on any part of the condenser scale, the aerial coupling should be reduced.