Date of Design:- 1938.
Frequency Range:- 15 to 600 kc/s.
Valves and method of coupling. Three NR51, two NR52.

First R/F amplifier, indirectly heated variable mu R/F pentode, NR51 (1). Coupled by transformer with tuned secondary.

Second R/F amplifier, indirectly heated variable mu R/F pentode, NR51 (2). Coupled by transformer with tuned secondary.

Detector, indirectly heated variable mu R/F pentode, NR51 (3). Coupled by choke-capacity.

Heterodyne, indirectly heated triode, NR52 (4). Capacity coupled to cathode circuit of detector.

A/F amplifier, indirectly heated triode, NR52 (5).

Receiver Outfit CAA, consisting of Tuner A50 and Amplifier M50, has been designed for general purpose reception covering 15 to 600 kc/s in the VL/F, L/F, and M/F ranges, and will supersede receiver outfit CN and aerial filter units in ships fitted with separated aerials.

Tuner A50 and Amplifier M50 together also constitute the VL/F and L/F part of the "All-Wave" receiver outfit (i.e., Receiver Outfit CAB) and the VL/F, L/F and M/F part of the Receiver Outfit CAC.

A circuit diagram of Tuner A50 is given in Fig. A and of Amplifier M50 in Fig.B.

Photographs of Tuner A50 and Amplifier M50 are given in Figs. C to C.

Tuner A50 and Amplifier M50 are mounted together in a standard receiving rack.

The frequency range in both the Tuner A50 and Amplifier M50 is covered in five steps by five separate sets of inductance coils.

The connections to the coils in each model are controlled by ganged switches (83) (84).

The frequency ranges of individual positions of the switches are:-

Range.	Kc/s.
1	15 - 31
2	31 - 64
3	64 - 135
4	135 - 280
5	280 - 600

A sixth position of the range switches marked "O" disconnects all the inductances for the purpose of adjusting the tuning condensers for ganging and trimming.

All the tuned inductance coils in Tuner A50 and Amplifier M50 have adjustable iron dust cores which, besides allowing efficient inductances to be obtained in a small space, are used to set up the inductances to the correct values before the models are issued. These adjustments should on no account be altered.

The values of the tuning inductances in mics. are as follows:-

TUNER A50-AMPLIFIER M50

Range	Heterodyne Inductance in M50.	All Tuning Inductances in A50 and M50.
1	130,000	112,000
2	31,000	28,000
3	6,700	6,330
4	1,520	1,430
5	360	330

The four tuning condensers (9), (12), (16), (22), for the four circuits in Tuner A50 and the two tuning condensers (31), (40) for the two R/F amplifier circuits in Amplifier M50 are ganged together in pairs and marked "Stages 1-2", "Stages 3-4" and "R/F", respectively. The condensers of each pair are set to have equal maximum capacities by means of adjustable couplings between the condensers. The minimum capacities are set up to equal values by means of separate fixed and adjustable trimming condensers. The values are approximately as follows:-

At 10° on scale - 0.001 mfd.
At 90° on scale - 0.0002 mfd.

These settings are made with a bridge before the models are issued and, except for the last trimming condenser in Tuner A50, which is connected to the first grid circuit of Amplifier M50, they should need no further adjustment.

The trimming condensers are not shown in the simplified circuit diagram shown in Fig. a.

2. Tuner Circuits. (See Figs. A, C and D). Tuner A50 has four tuned circuits of which 1, 2 or all four may be used as follows:-

For searching (stand-by)	- 1 circuit.
For normal reception without local interference	- 2 circuits.
For reception when own ship is transmitting	- 4 circuits.

Three circuits would be insufficient when own ship is transmitting, and more than necessary for normal reception. For this reason provision is not made to use three circuits.

The four tuned circuits consisting of coils (8) (11) (15) and (21) tuned by condensers (9) (12) (16) and (22) respectively are inductively coupled by fixed coupling coils (7), (10), (14), (20). The coupling between the last two circuits is increased by a small capacity, i.e. two 10 micro-microfarad condensers (17), (18) in series. This has the effect of giving a more uniform coupling over the whole frequency range.

The aerial is connected to the tuner by a screened lead and plug which is inserted into the appropriate jack in the tuner marked "Aerial 1 Stage" (19) "Aerial 2 Stages" (13) and "Aerial 4 Stages" (6) corresponding to the number of tuned circuits in use.

The insertion of the aerial plug into any aerial jack disconnects the coupling from the previous tuner circuit and connects the aerial to the following one through a coupling coil which matches the impedance of the aerial cable (approximately 80 ohms).

The coupling coils from the aerial input and between the tuner circuits are on the same formers as the tuning inductances in adjacent slots. The numbers of turns have been chosen to give the correct input impedance and to maintain a high degree of selectivity without indue loss. The approximate loss is signal strength in changing from one to two circuits is half a signal strength. In changing from one to four circuits the additional loss does not exceed two signal strengths, except on Range 5, where the loss is approximately 3 strengths.

The high potential side of the last tuner circuit is connected directly to the grid of the first R/F amplifying valve (1) in Amplifier M50 by a screened lead from the output terminal of Tuner A50. Allowance is made for the capacity of this lead when setting up and ganging the tuning condensers by a small condenser (90) of 50 micro-microfarads capacity which is automatically connected across the last circuit when the range switch is set to the position "0". This condenser is accessible to a screwdriver from the front of the panel after removing a small circular cover plate (89) so that the final adjustment can be made on signals when the outfit is assembled in the receiving rack.

SIMPLIFIED CIRCUIT DIAGRAM

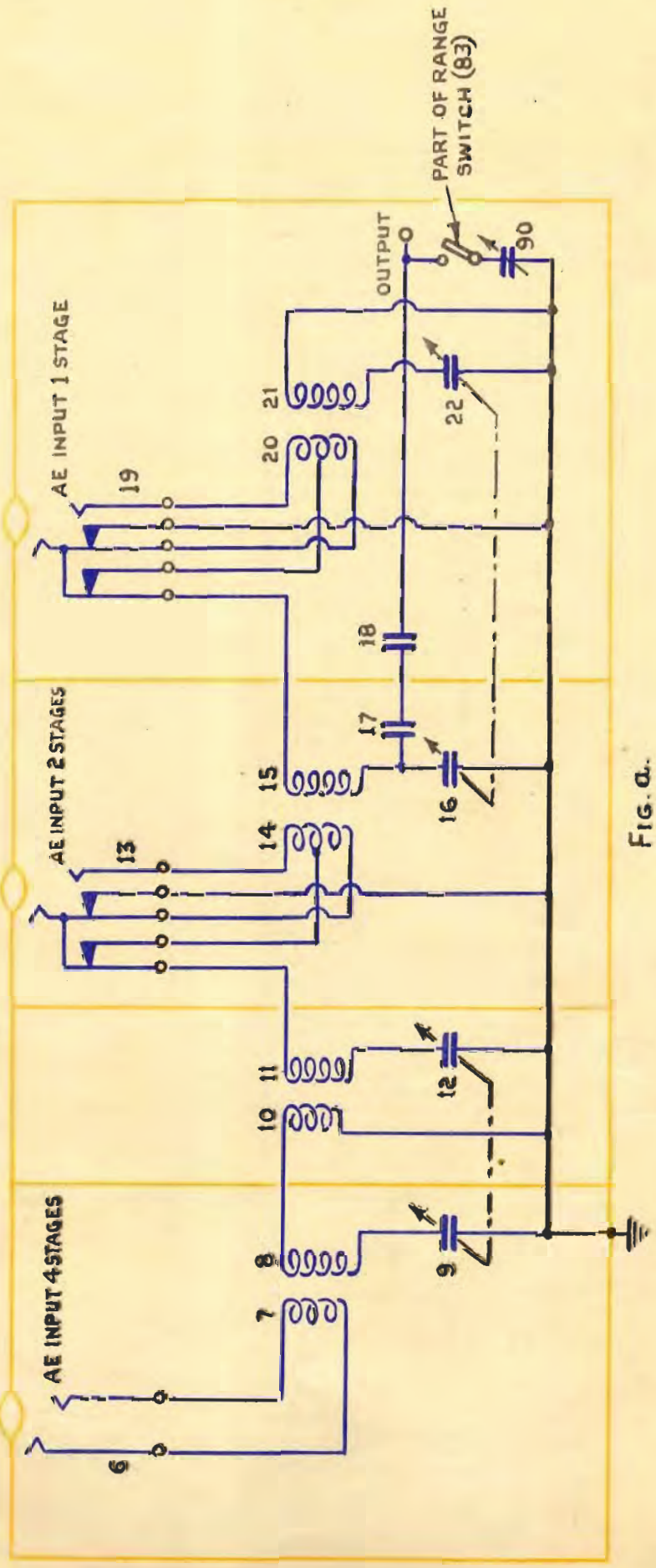
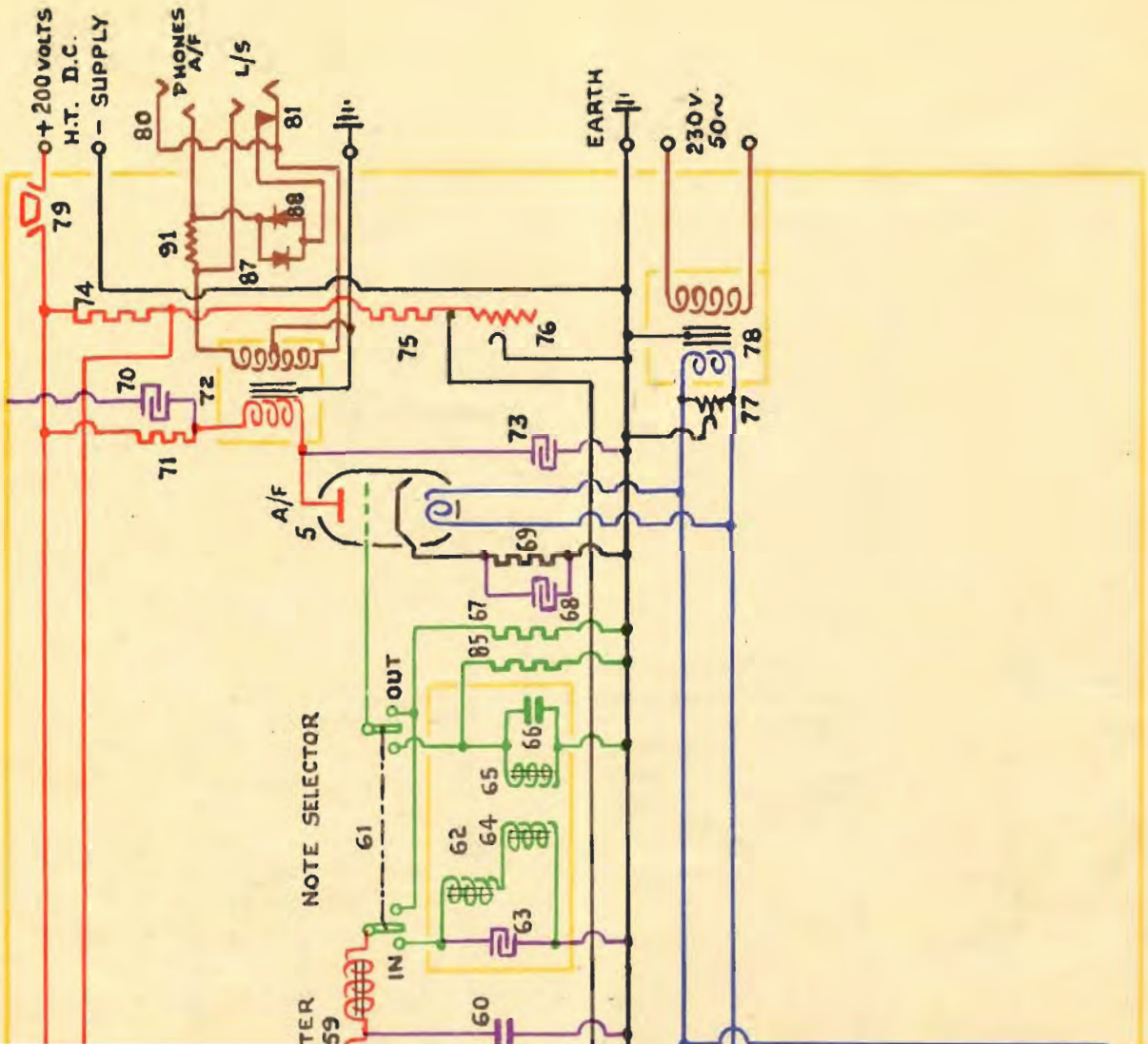
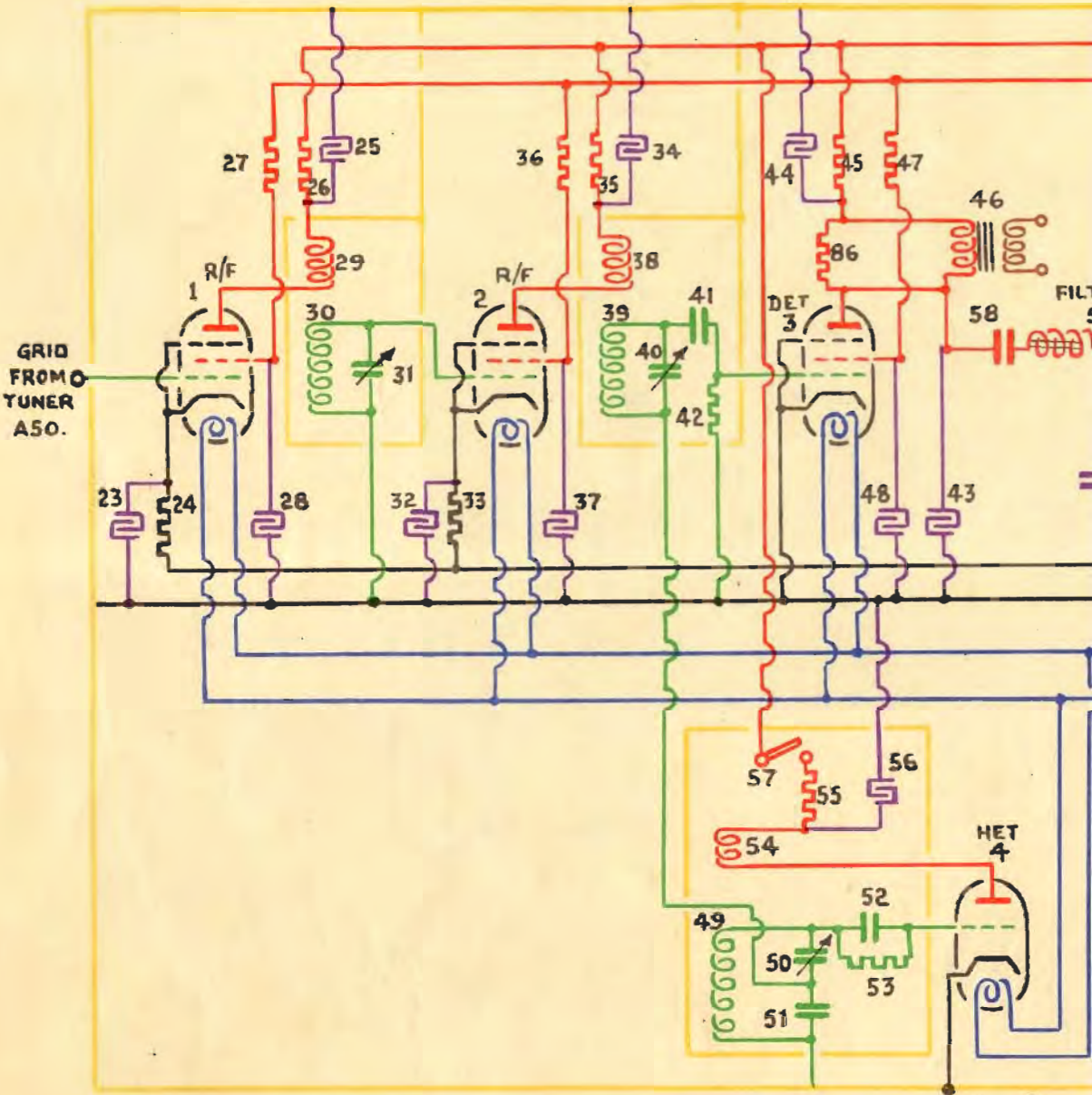


FIG. a.

AMPLIFIER M50



DIAGRAM


GRID FROM TUNER A50.
R/F
R/F
DET
HET
1
2
3
4
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
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43
44
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46
47
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49
50
51
52
53
54
55
56
57
58
86

Fig. 6.

3. Amplifier Circuits. (See Figs. B, E and F).
Amplifier M50 has two stages of R/F amplification with tuned transformer coupling, a detector, a separate heterodyne for C.W. reception and one A/F stage which can be connected either as a note magnifier or a note selector. When connected as a note selector there is come measure of amplification.

The coupling transformers between the R/F stages in the Amplifier M50 have untuned primaries (anode windings) (29) (38) and tuned secondaries (30) (39), the latter being tuned by variable tuning condensers (31) and (40) which are ganged and controlled by a single slow motion dial marked "R/F" on the front of the model.

In the first stage the tuned circuit is connected directly between the grid of the second R/F valve and earth, but in the second stage the high potential end of the circuit is connected to the grid of the detector valve (3) through a grid cond enser (41) with a grid leak resistance (42) for detection, while the low potential end is connected to earth through a condenser (51) which forms part of the heterodyne tuning condenser so that part of the heterodyne oscillatory potential is applied to the detector grid input at this point for C.W. reception.

4. Heterodyne. The heterodyne oscillator has a tuned grid circuit with a grid leak resistance (53) and a grid condenser (52) the anode coil (54) completes the self oscillatory circuit (see Admiralty handbook Vol.II, D33). The tuning capacity consists of a variable condenser (50) with a small fixed trimmer condenser in parallel which are connected in series with the 0.1 mfd. fixed condenser (51) mentioned above. The variable condenser is similar to the others in the set, but the inductance values (49) are different and have been chosen, together with the value of the trimmer condenser, to give approximately the same calibration as the other tunings.

5. Volume Control. The R/F amplification is controlled by varying the grid bias of the variable mu R/F amplifying valves (1) (2), the cathodes of which areraided above earth potential by an amount depending upon the setting of the volume control potentiometer (76).

6. Detector. The detector anode circuit is provided with a telephone transformer (46) the secondary winding of which is not, however, now used. The primary winding of this transformer normally acts as a coupling choke to the output stage in conjunction with the coupling condenser (58). This choke is shunted by a resistance (86) to reduce key click interference. A 2-stage low pass filter (59) and (60) is interposed between the detector and the output valve to prevent radio-frequencies from passing into the final stage; in addition an R/F by-pass condenser (43) is also fitted. With the note selector switch in the "OUT" position this filter is connected direct to the grid of the output valve.

7. Note Selector. The note selector consists of two circuits tuned to a frequency of 1100 cycles/sec. with optimum inductive coupling provided by a fixed coupling coil (64) wound on the same former as the second inductance. The inductances (62) (65) are enclosed in iron screens and have laminated iron cores with small gaps adjusted during manufacture to give the correct inductance values. An adjustable trimming condenser allows the second circuit to be finally tuned during test. Resistance (85) acts as a clamping resistance.

8. Output Limiter Telephone and Loudspeaker Jacks. The telephone transformer (72) in the output circuit of the A/F valve (5) has a screened secondary winding which is earthed at the centre point and connected by screened leads to the two output jacks (80) (81) in parallel. These jacks are marked "Phones A/F" and "L/S" respectively. Two metal rectifiers (87) (88) are connected in opposition between the 'tip' contact and the opposite inside contact spring of the L/S jack (81) in such a way that they are disconnected when a plug is inserted in this jack but connected across the output when the plug is removed. These rectifiers act as a limiting device to reduce the loudness of interfering key clicks or pulse interference to to cut down the output from local transmissions when listening through without reducing the strength of weak signals. They can be connected or disconnected at will by plugging the telephones either into the "Phones A/F" jack (80) or the "L/S" jack (81) A 100 ohm resistance (91) connected in series with the transformer secondary and one of the leads to the telephone jack (80) increases the efficiency of the limiting device. The L/S jack can be used to drive a small loudspeaker of 600 ohms impedance at a maximum output of 200 milliwatts. A 3-point output plug must always be used for connecting phones or loudspeaker to either of these jacks; if a 2-point plug is used half the secondary winding of the output transformer will be short-circuited owing to the sleeve contacts of the jacks being earthed through the frame of the model. When a 3-point plug is used with a screened output lead the screening of this lead should be connected to the sleeve contact.

9. H.T. and Heater Supplies and biassing arrangements. L.T. supply for the heaters of the valves is obtained from 230/4 volt stepdown transformer (78) fitted in the model. The 230 volts is obtained from the 50 cycle supply of the rectifier unit design "B" used with the outfit. This rectifier also provides a stabilised 200 bolt D.C. supply for the H.T. of the amplifier.

The H.T. supplies to all the valves are decoupled by series resistances (26) (35) (45) (55) (71) and shunt condensers (25) (34) (44) (56) (70). The H.T. supply to the screens of the R/F amplifying and detector valves is obtained from a fixed point on a potentiometer connected across the H.T. supply and consisting of two fixed resistances (74) (75) and a variable resistance (76) which also provides the variable grid bias to the R/F amplifying valves, these supplies to the screens are decoupled by resistances (27) (36) (47) in conjunction with condensers (28) (37) and (48). The variable resistance (76) is controlled from the front of the model by a knob marked "Volume Control".

A safety switch (79) on the door of the Amplifier M50 disconnects the H.T. while changing valves or resistances.

A potentiometer (77) with variable earth tap is connected across the 4-volt winding of the transformer supplying the heaters for the cathodes of the valves. This is adjusted to reduce the hum from the A.C. supply to a minimum.

The conventional arrangements for cathode biassing are provided for the R/F and R/F valves by resistances (24) (33) (69) and condensers (23) (32) (68).

The total H.T. current required by Amplifier M50 is approximately 35 milliamps. The 230 volt A.C. supply for the heater transformer requires 0.13 amp.

10. Operation.

(1) TO SET THE HUM POTENTIOMETER (77):-

(a) Switch on the power supplies.
(b) Disconnect the aerial.
(c) Switch off heterodyne.
(d) Set Note Selector switch (61) to "OUT".
(e) Set Volume Control (76) to full on.
(f) Adjust hum potentiometer to silent point
This adjustment should thereafter require very little alteration.

(2) TO TUNE IN A C.W. SIGNAL (OR WAVEMETER OSCILLATOR) ON A WAVEFREQUENCY FOR WHICH THE ADJUSTMENTS ARE NOT EXACTLY KNOWN:-

(a) Plug aerial into "Aerial 1 Stage".
(b) Switch (57) on heterodyne.
(c) Set range switches (83) (84) to appropriate range.
(d) Set all tuning condensers to approximate calibration.
(e) Set Note Selector switch (61) to "OUT"
(f) Increase Volume Control to give an appreciable noise level. in telephones.
(g) Search for signal with heterodyne (50) and amplifier condensers (31) (40) occasionally bringing the right hand tuner condenser (16) (22) into line.

When required signal is found:-

(h) Plug aerial into "Aerial 2 Stages".
(j) Carefully retune (a) amplifier, (b) right hand tuner condenser, reducing the volume control as necessary.

When interference is observed from frequency very close to required signal.

(k) Set the Note Selector switch to "IN".
(l) Carefully readjust heterodyne tuning to give best signal reducing volume control as necessary.

(NOTE :- When tuning in a signal it is preferable to plug the telephones into the L/S jack (81) so as to disconnect "Phones A/F" jack (80) the limiter tends to reduce all strong signals to the same level as any interference, with the result that the selectivity of the receiver will appear to be poor and the tuning will be flat, also the noise level in the morse spacing may be excessive. To avoid this effect it is essential when tuning in a wanted signal to turn back the volume control until the signal strength is slightly below the limiting value. This point is indicated by a sudden decrease in strength as the volume control is moved gradually from maximum towards the "Off" position).

When powerful interference is breaking through:-

(m) Plug aerial into "Aerial 4 Stages" and tune left hand condenser (9) (12) of Tuner A50 slightly increasing volume control if necessary.

It will be seen that only slight variations in the above procedure are necessary when receiving I.C.W. or when the receiving adjustments are already known.

It should be noted that increased selectivity and "readability" will always be obtained by reducing the volume control when the signal has once been found. Except for loudspeaker reception full volume is never required when the circuits are properly in tune.

11. METAL DUST IN TRIMMING CONDENSERS. Failures have occurred in Receivers A50 and M50 owing to metal dust particles collecting between the plates of trimming condensers.

These particles are caused by chemical action which is due to the method used for "tinning" the plates in manufacture. Arrangements are being made for a better method of "tinning" to be adopted.

The attention of W/T staffs is called to this possible reason for failure of a receiver.

To remove these particles the following procedure should be adopted:-

(i) Remove the receiver from the rack and open it up.

(ii) Disconnect one side of each condenser (See below).

(iii) Take the normal H.T. supply to the receiver from the rectifier and put it across the plates of the condenser. This will "burn out" the metal dust particles.

(iv) If the "burning out" process is not satisfactory the condenser will have to be removed from the receiver, stripped and cleaned.

No H.T. supply other than that from the rectifier is to be used and care is to be taken that no damage is caused to the receiver by allowing the bare ends of these H.T. wires to touch parts of the receiver other than the plates of these disconnected condensers.

The condensers found chiefly to be affected:-

Tuner A50 - Handbook SS79 - Nos. 90* and trimmers of 9*, 12*, and 16*.

Amplifier M50 - Handbook SS79 - Trimmers of 31*, 40* and 66.

Condensers marked * may be disconnected by setting the range switch of A50 or M50 to O. The other condensers must be disconnected by unsoldering one lead.