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RECEIVER B28

Date of Design :-	1940 Modified 1941.
Frequency range :-	60 - 30,000 kc/s (with a gap from 420 - 500 kc/s).
Where used :-	With Type 65 (Portable set (B)) R.C.O's Cruisers and above.
Valves and method of coupling :-	One NU20. One NR68. One NR85. One VR99. Seven VR100.

(1) First R/F amplifier VR100 - Transformer - Tuned Secondary.
(2) Second R/F amplifier VR100 - Transformer - Tuned Secondary.
(3) Frequency Changer VR99 - Tuned choke - capacity.
(4) First Heterodyne Oscillator VR100.
(5) First I/F amplifier VR100 - Tuned transformer.
(6) Second I/F amplifier VR100 - Tuned Transformer.
(7) Third I/F amplifier VR100 - Tuned Transformer.
(8) Detector and First A/F amplifier NR68 - Resistance-Capacity.
(9) Second Heterodyne Oscillator VR100.
(10) Second A/F (Output) NR85.
(11) Rectifier NU20 .

Reference :- Admiralty Handbook of W/T (1938) Vol. II Section N para. 63.

2. Receiver B28 (Patt. W2835A) is a Marconi CR100/4 commercial superheterodyne receiver which is designed for the reception of either C.W. or modulated (I.C.W. or R/T) signals with or without A.V.C. In addition, a variable noise-suppressor for operation with Outfit R.I.S. is included in the first R/F stage.

The receiver consists of two tuned R/F stages, a frequency changer with separate oscillator, three stages of I/F amplification, a combined detector, first A/F amplifier and A.V.C. rectifier, an output stage, second heterodyne oscillator (for the reception of C.W. signals) and rectifier valve.

The frequency range of the receiver is from 60 to 30,000 kc/s, with a gap from 420 to 500 kc/s. This range is covered with six overlapping bands selected by means of a range switch, which selects the coils to be used and short-circuits the remainder.

Tuning within each frequency band is effected by means of a single tuning control, which operates the four tuning condensers simultaneously. A pointer controlled by the tuning control travels over a scale calibrated in approximate frequencies. This scale is changed by the operation of the range switch so that an appropriate calibration for the range in use is shown.

The receiver is arranged for connection either directly to a high impedance single-wire aerial (which may be the same as that used for Type 65) or to a remote single wire or dipole aerial through a low impedance screened feeder.

3. The receiver cabinet comprises four main members, i.e., chassis, side - back and top covers in one piece, front panel and bottom plate. All the components and sub-assemblies are mounted directly on the chassis. The top of the chassis carries the high-frequency tuning and calibration sub-assembly, the valves, the screened containers holding the I/F and A/F tuned circuits and parts of the supply circuits. The H/F tuning coil unit is carried beneath the chassis, together with the switch controls.

The main cover portion of the cabinet is screwed directly on to the chassis, access to the upper part of the chassis for valve replacements, etc., being provided with a hinged lid. The front panel screws on to the chassis and to the edges of the main container and may be removed after taking off the control knobs and the guard ring of the main "ON/OFF" switch. For checking H/F alignment and valve feeds the bottom cover of the chassis is easily removed by withdrawing the retaining screws.

OSCILLATORY CIRCUITS.

4. Receiver B28 comprises two tuned R/F amplifier stages, a frequency changer with separate first heterodyne oscillator, three stages of I/F amplification, combined diode detector - triode first amplifier - A.V.C. rectifier, second A/F amplifier and second heterodyne oscillator (for the reception of C.W. signals) as well as a rectifier valve.

RECEIVER B28

Tuning is effected by means of a single control which adjusts the three R/F tuned circuits and the first heterodyne oscillator simultaneously. The frequency range of 60 - 30,000 kc/s (with a gap from 420 - 500 kc/s) is covered in six steps by means of a multi-contact switch (14), which brings the appropriate inductances and trimming condensers into circuit and short-circuits the remaining inductances. The frequency bands covered in each position of the switch are as follows :-

Range 1	60	to	155 kc/s.
" 2	155	to	420 kc/s.
" 3	500	to	1,400 kc/s.
" 4	1,400	to	4,000 kc/s.
" 5	4,000	to	11,000 kc/s.
" 6	11,000	to	30,000 kc/s.

Provision is made for feeding the receiver from either a dipole or unipole aerial and the first tuned circuit is provided with a trimming control so that the circuit may be brought accurately into tune when the different aerials are used.

The selectivity of the receiver is adjustable in five steps, giving pass-bands of 6,000 cycles, 3,000 cycles, 1,200 cycles, 300 cycles and 100 cycles respectively. The first two adjustments are obtained by varying the coupling of the I/F amplifier valves, the next two steps by bringing into circuit a quartz crystal filter and varying the tuning of the associated circuit and the 100 cycles condition is obtained by means of an A/F filter in the output valve input circuit, tuned to the beat frequency obtained by using the second heterodyne oscillator. This highest selectivity condition is, therefore, obtainable only when C.W. signals are being received. It will usually be found that the frequency stability of H/F signals is insufficient to enable this setting of the Pass-Band control to be used (see Admiralty Handbook of W/T (1938) Vol. II N32 and 63).

The second heterodyne oscillator may be tuned by means of a control on the panel of the receiver, but once adjusted in accordance with the procedure laid down in the operating instructions it should not be altered unless it is thought to be off the optimum position.

An operating switch is provided on the receiver as well as the main ON/OFF switch (177). This operating switch has a central "Stand-by" position on either side of which are two "ON" positions, the first with A.V.C. and the second with manual H/F gain control only. The two positions to the left are for modulated signals, while those to the right bring the second heterodyne oscillator into operation for the reception of C.W. signals. In the "Stand-by" position the valve heaters are switched on but the H.T. supplies to all valves except the output stage are broken.

Separate H/F and L/F gain control potentiometers (166 and 127) are provided so that the required output volume may be obtained without overloading the detector stage.

Three outputs are provided one at an impedance of 3 ohms for feeding the moving coil of a loudspeaker, one at an impedance of 600 ohms for feeding a line to a remote position and one through a high resistance for supplying telephone receivers plugged into the set itself at reduced output level.

AERIAL CIRCUIT.

5. The aerial circuit is arranged for either a high-impedance input from an open wire aerial or for a low-impedance input from a remote aerial via a screened feeder line.

The high-impedance input terminal "A" is connected through a 10 mmfd. condenser (12) to the top of the first tuned circuit and through a 2 megohm protecting resistance (13) to earth.

The low-impedance input terminals "D" are connected via the range switch (14) to the appropriate coupling coil (15), which is coupled to the inductance (16) of the first tuned circuit. The input impedance at the terminals "D" is approximately 100 ohms to match the impedance of a screened feeder from a remote aerial. In the case of a balanced dipole aerial the two feeder lines are connected to the terminals "D.D." and the screen to the "E" terminal, while for an unbalanced concentric line the centre conductor is connected to the "D" terminal nearest the "A" terminal and the outer conductor is connected to the second "D" terminal and to the "E" terminal.

The earth terminal "E" should be efficiently earthed all the time the power supplies are connected to the receiver.

It may sometimes be found that better results are obtained with a single-wire aerial by connecting the aerial to one of the terminals "D" and earthing the other terminal "D".

If a screened low-impedance feeder is used it is important that the screening be continued as close to the output terminals as possible.

6. FIRST R/F AMPLIFIER CIRCUIT.

The grid circuit of the first R/F amplifier consists of one of the coils (16) tuned by the main condenser (17) and by the Aerial Trimming condenser (18). The tuning condenser (17) is one section of the 4-gang tuning condenser assembly which tunes the three R/F circuits and the first heterodyne oscillator circuit.

The top of the tuned circuit is connected to the aerial through the condenser (12) and to the grid of the first R/F valve (1) through a 10 ohm anti-parasitic resistance (19). The bottom of the inductance (16) is connected to earth through the 0.1 mfd. condenser (20) and to the A.V.C. line through the 50,000 ohm resistance (21). The inductances which are not in use are short circuited by the range switch (14).

The cathode of the valve (1) is connected to the manual gain control bias line through a 400 ohm resistance (23), which is by-passed to earth by a 0.1 mfd. condenser (22). The screen grid of the valve is decoupled to earth by a 0.1 mfd. condenser (24) and connected to the screen grid supply line through a 5000 ohm resistance (25).

The anode of the valve (1) is connected by the range switch (14) to the appropriate coupling coil (28). The other end of the coil is connected to earth through the 0.1 mfd. condenser (26) and to the H.T. line through a 2,000 ohm resistance (27). The unused coils are short-circuited by the range switch (14).

7. SECOND R/F AMPLIFIER CIRCUIT.

The grid circuit of the second R/F amplifier consists of one of the coils (29) tuned by the main condenser (32) and by one of the preset trimming condensers (31). The coil for the range in use is selected by the range switch (14), which also short-circuits the unused coils. The coil for Range 6 is shunted by a 200,000 ohm resistance in order to flatten the tuning.

The top of the tuned circuit is connected to the second R/F valve (2) through a 10 ohm anti-parasitic resistance (33), while the bottom of the inductance is connected to earth through a 0.1 mfd. condenser (34) and to the A.V.C. bias line through a 50,000 ohm resistance (35).

The cathode of the valve is connected to earth by the 0.1 microfarad by-pass condenser (36) and to the manual gain control bias line through a 400 ohm resistance (37). The screen grid of the valve is connected to earth through a 0.1 microfarad by-pass condenser (38) and to the screen grid supply line through a 5000 ohm resistance (39).

The anode of the valve is connected by the range switch (14) to the appropriate coupling coil (42). The other end of the coil is connected to earth through a 0.1 mfd. condenser (40) and to the H.T. line through a 2000 ohm resistance (41). The unused coils are short-circuited by the range switch (14).

8. FREQUENCY CHANGER CIRCUIT.

The input tuned circuit of the frequency changer valve (3) consists of one of the coils (43) and the tuning condenser (46), which is shunted by one of the preset trimmers (45).

The coil for the range in use is selected by the range switch (14), which also short-circuits the unused coils. On range 6 the coil is shunted by a 200,000 ohm resistance (30) in order to flatten the tuning.

The top of the tuned circuit is connected to the grid of the valve through a 10 ohm anti-parasitic resistance (47), the bottom of the circuit being earthed.

The cathode of the valve is connected to earth through a 400 ohm bias resistance (49), which is shunted by a 0.1 mfd. by-pass condenser (48). The screen grid of the valve is by-passed to earth by a 0.1 mfd. condenser (50) and connected to the H.T. line through a 40,000 ohm resistance (51).

The injector grid of the valve is connected via a 50 ohm anti-parasitic resistance (54) to the grid of the first heterodyne oscillator valve (4), while the triode anode is earthed.

The anode of the valve is connected to the output tuned circuit, consisting of the coil (70) and 350 mmfd. condenser (71), which is tuned to the intermediate frequency of 465 kc/s. The bottom of the tuned circuit is connected to earth through a 0,1 mfd. condenser (52) and to the H.T. line through a 2000 ohm resistance (53). (See Admiralty Handbook of W/T (1938) Vol. II F51.)

9. FIRST HETERODYNE OSCILLATOR CIRCUIT.

The first heterodyne oscillator circuit comprises a VR100 valve (4) having its screen and suppressor grids connected to the anode so as to operate as a triode. The tuned circuit is connected between grid and cathode and inductive feedback from the anode is employed.

The tuned circuit consists of one of the coils (56) tuned by the condenser (66) and by one of the preset trimming condensers (57). Padding condensers (58) to (63) (shown as condenser (58) on Fig. A), of various capacities, are connected in series with the tuning condenser to provide the necessary frequency separation between the oscillator and the signal frequencies. In the case of ranges 1 and 2 damping resistances (65) (64) of 30,000 and 20,000 ohms respectively, are connected across the padding condensers in use.

The top of the tuned circuit is connected to the injector grid of the frequency changer valve through a 50 ohm anti-parasitic resistance (54). A 20,000 ohm resistance (55) is shunted across the tuned circuit.

The anode of the valve (4) is connected to the appropriate feedback coil (67) by the range switch (14), which short-circuits the unused coils. The other end of the coil is connected to earth through a 500 mmfd. by-pass condenser (68) and to the H.T. line through a 20,000 ohm resistance (69).

10. FIRST I/F AMPLIFIER CIRCUIT.

The input circuit of the first I/F amplifier varies according to the position of the Pass Band switch (79). The various conditions are shown in Fig. B (i) (ii) (iii) and (iv).

Fig. B (i) shows the input circuit when the Pass Band switch (79) is in the 6,000 cycles position. In this position of the switch the crystal (73) is short-circuited and the damping resistance (81) of 100,000 ohms is shunted across the tuned circuit, consisting of the coil (74) and condenser (75), which forms the input circuit of the valve (5). The 7 mmfd. condenser (80) also forms part of the tuning capacity of this circuit. Its lower end is, however, connected to earth and the circuit is completed through the decoupling condenser (82). The resulting circuit is a normal band-pass filter having a pass band of 6000 cycles. (See Admiralty Handbook of W/T (1938) Vol. II F37).

Fig. B. (ii) shows the input circuit when the Pass Band switch (79) is in the 3000 cycles position. In this position of the switch the circuit is the same as in the 6000 cycles position except for the omission of the damping resistance (81). The difference in pass-band is obtained in the later I/F stages.

Fig. B (iii) shows the input circuit in the 1200 cycles position of the switch (79). The 465 kc/s. crystal (73) is now included in the circuit. The capacity of the crystal mounting is neutralised by means of the coil (76), which is coupled to the output coil of the frequency changer valve (3). The neutralising ensures that coupling between the input and output circuits of the filter is obtained through the crystal only. The neutralising condensers (77) (78) have values of 20 mmfd. each and one of them (77) is preset and should not be altered except when a new crystal has to be inserted. (This ought never to occur and in any case as the replacement of the crystal necessitates the re-alignment of the whole of the I/F circuits it will never be carried out at sea). In this position of the selectivity switch the 7 mmfd. condenser (80) is effectively connected across the input inductance (70) of the filter through the blocking condenser (72) and the decoupling condenser (52).

As the preset trimming condensers of the input and output circuits are adjusted to the quartz frequency at this setting of the selectivity switch these circuits have the highest possible rejector impedance for this band width. This partially masks the high selectivity of the crystal and gives a bandwidth of 1200 c.p.s.

Fig. B (iv) shows the input circuit with the Pass Band switch (79) in the 300 or 100 cycles position. The circuit is similar to that in the 1200 cycles position except that the 7 mmfd condenser (80) is now effectively connected across the output inductance (74) through the decoupling condenser (82). Both the input and output circuits are therefore detuned from the crystal frequency, resulting in a reduction of their parallel impedances. This reduces the masking effect obtained in the 1200 cycles position, and the whole filter has the 300 c.p.s. pass band of the crystal itself. The further reduction of the bandwidth to 100 c.p.s. is obtained by the insertion of an A/F filter in the coupling between the first and second A/F amplifier valves.

The grid of the valve (5) is connected to a tapping on the coil (74) of the tuned circuit, the bottom end of which is connected to earth by a 0.1 mfd. condenser (82) and to the A.V.C. bias line through a 50,000 ohm resistance (83).

1ST AND 2ND R/F AMPLIFIERS 1ST DETECTOR AND 1ST HETERODYNE OSCILLATOR

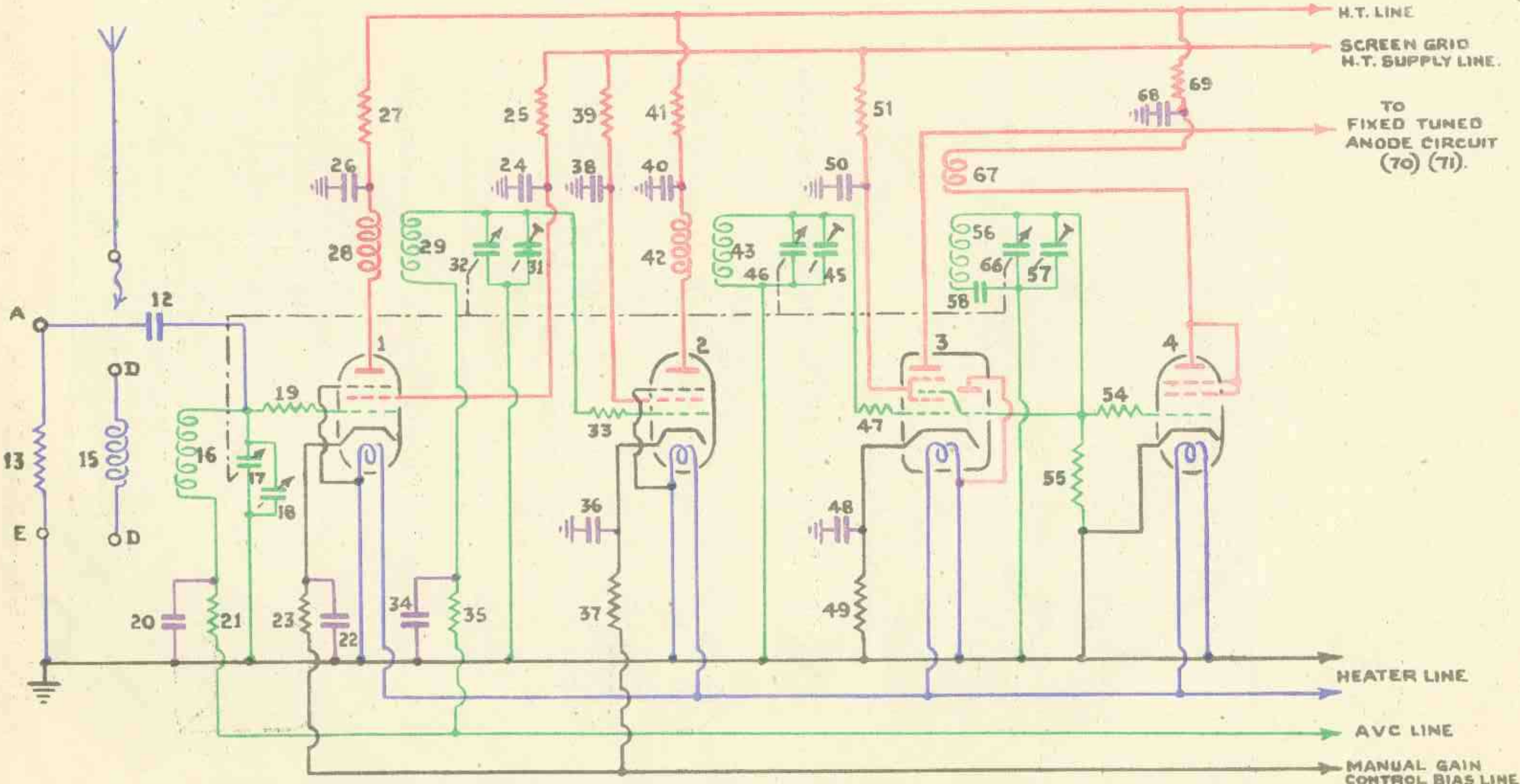

Fig. a.

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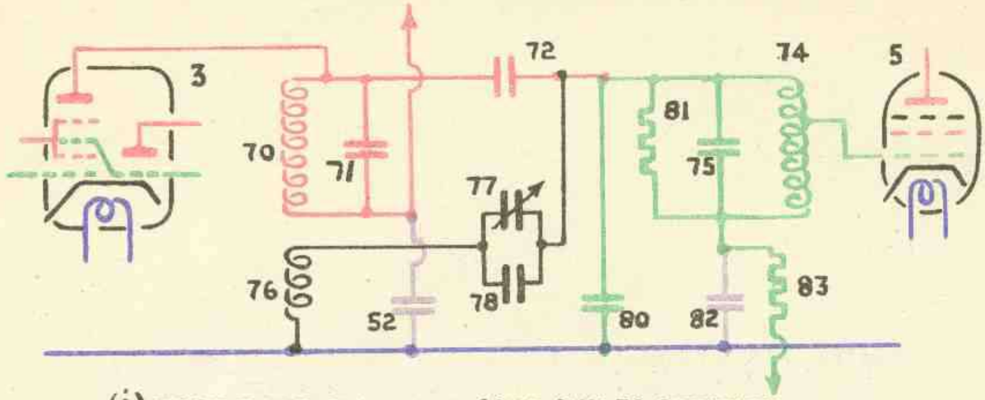
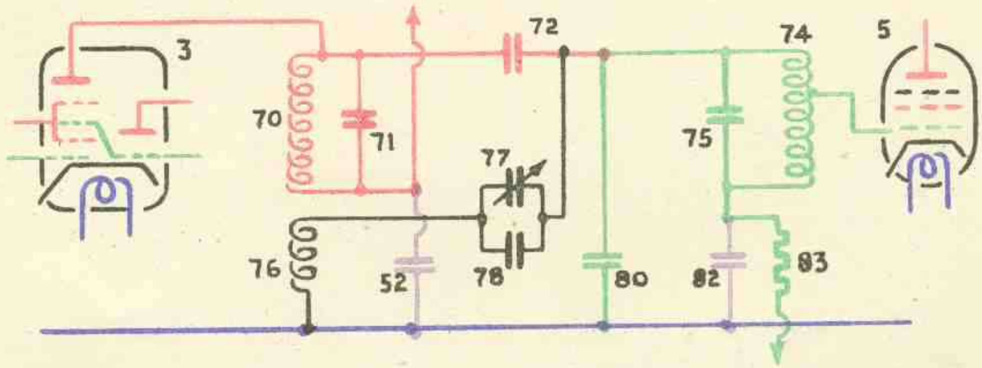
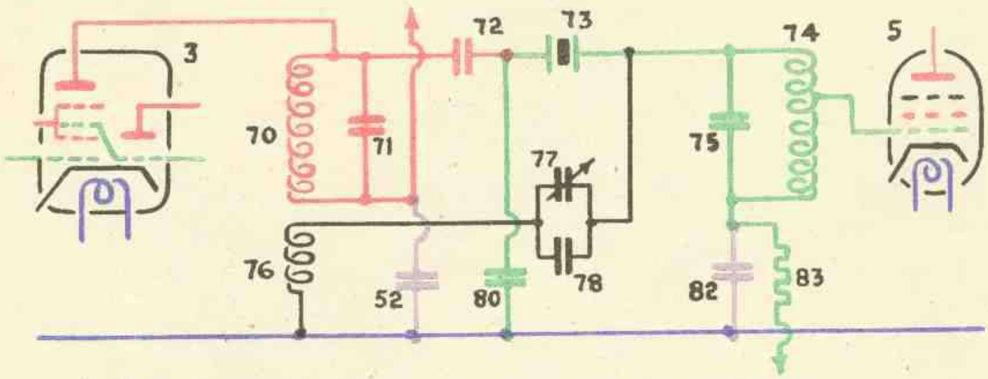
EQUIVALENT CIRCUITS OF FIRST I/F STAGE



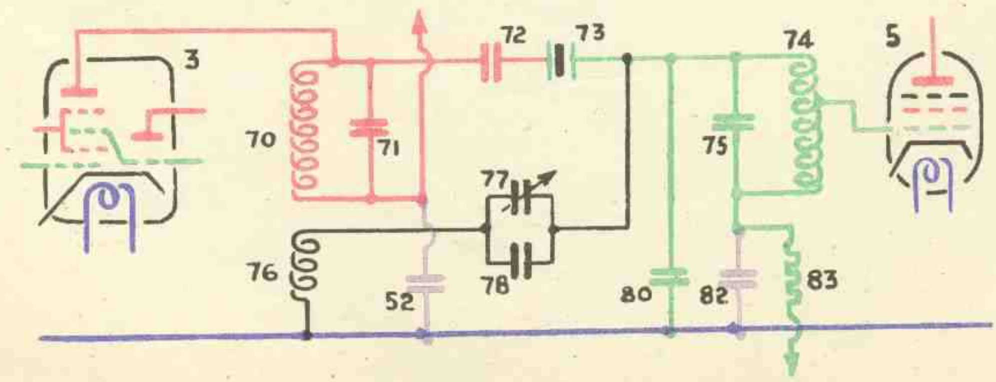
(i) PASS BAND SWITCH IN 6000 CYCLES POSITION



(ii) PASS BAND SWITCH IN 3000 CYCLES POSITION



(iii) PASS BAND SWITCH IN 1200 CYCLES POSITION



(iv) PASS BAND SWITCH IN 300 OR 100 CYCLES POSITION.

FIG. 6.

The cathode of the valve is connected to earth by a 0.1 mfd. condenser (84) and to the manual gain control bias line through a 400 ohm decoupling resistance (85). The screen grid of the valve is connected to the screen grid supply line through a 5000 ohm decoupling resistance (87) and by-passed to earth by a 0.1 mfd. condenser (86).

The anode of the valve is connected to a tapping on the coil (90) of the output tuned circuit. The coil is tuned by a 350 mmfd. condenser (91). The bottom end of the coil is connected to earth by a 0.1 mfd. condenser (88) and to the H.T. line through a 2000 ohm resistance (89).

11. SECOND I/F AMPLIFIER CIRCUIT.

The input circuit of the second I/F amplifier valve (6) VR100 consists of the coil (92) loosely coupled to the output inductance (90) of the first I/F valve (5) and a 350 mmfd. condenser (93) in parallel. When the Pass Band switch (79) is in the 6000 cycles position the coupling is increased by the addition of a coil (94) tightly coupled to the inductance (90). This broadens the pass band of the stage. The coil (94) is connected in series with the tuning coil (92).

The grid of the valve (6) is connected to a tapping on the coil (92) and the bottom end of the tuned circuit is connected to earth through a 0.1 mfd. condenser (95) and to the A.V.C. bias line through a 50,000 ohm resistance (96).

The cathode of the valve is connected to earth by a 0.1 mfd. condenser (97) and to the manual gain control bias line through a 400 ohm resistance (98). The screen grid is connected to the screen grid supply line through a 5000 ohm resistance (100) and by-passed to earth by a 0.1 mfd. condenser (99).

The anode of the valve is connected to a tapping on the output tuned circuit coil (103) which is tuned by a 350 mmfd. condenser (104). The bottom end of the tuned circuit is connected to earth by a 0.1 mfd. condenser (101) and to the H.T. line through a 2000 ohm resistance (102).

12. THIRD I/F AMPLIFIER CIRCUIT.

The input circuit of the third I/F amplifier valve (7) VR100 consists of the coil (105) and 350 mmfd. condenser (106) in parallel and an additional coupling coil (107) which is introduced to broaden the pass band when the switch is in the 6000 cycles position.

The grid of the valve (7) is connected to a tapping on the coil (105) and the bottom end of the tuned circuit is connected to earth.

The cathode of the valve is connected to earth through a 400 ohm bias resistance (109) which is shunted by a 0.1 mfd. condenser (108). The screen grid of the valve is by-passed to earth by a 0.1 mfd. condenser (110) and connected to the screen grid supply line through a 5000 ohm resistance (111). A 1-mic. R/F choke (137) is connected in heater lead.

The anode of the valve is connected to the A.V.C. diode anode through a 100-mfd. condenser (116) and to a tapping on the coil (114), which is tuned by a 350 mfd.. condenser (115). The bottom end of the tuned circuit is connected to earth by a 0.1 mfd. condenser (112) and to the H.T. supply line through a 2000 ohm resistance (113).

13. DETECTOR CIRCUIT.

The detector comprises one diode section of the double-diode-triode NR68 valve (8). The diode anode is connected to a tapping coil (117) which is tuned by a 350 mmfd. condenser (118). The rectified A/F voltage is produced across a potentiometer consisting of a 200,000 ohm resistance (119) and a 100,000 ohm resistance (120) connected between the bottom of the tuned circuit and the cathode of the valve (8). This potentiometer is shunted by a 100 mmfd. R/F by pass condenser (123) and the tapping point, which feeds the A/F amplifier stages through a 0.1 mfd. condenser (126), is also shunted to earth by a 500 mmfd. by-pass condenser (125).

The cathode of the valve is connected to earth through a 1200 ohm resistance (121) and 10,000 ohm resistance (122) in series, which provide the necessary delay bias for the A.V.C. circuit. The resistances are shunted by a 25 mfd. electrolytic condenser (124). (See Admiralty Handbook of W/T (1938) Vol. II N37).

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1ST AND 3RD I/F AMPLIFIERS DETECTOR AND 1ST A/F AMPLIFIER

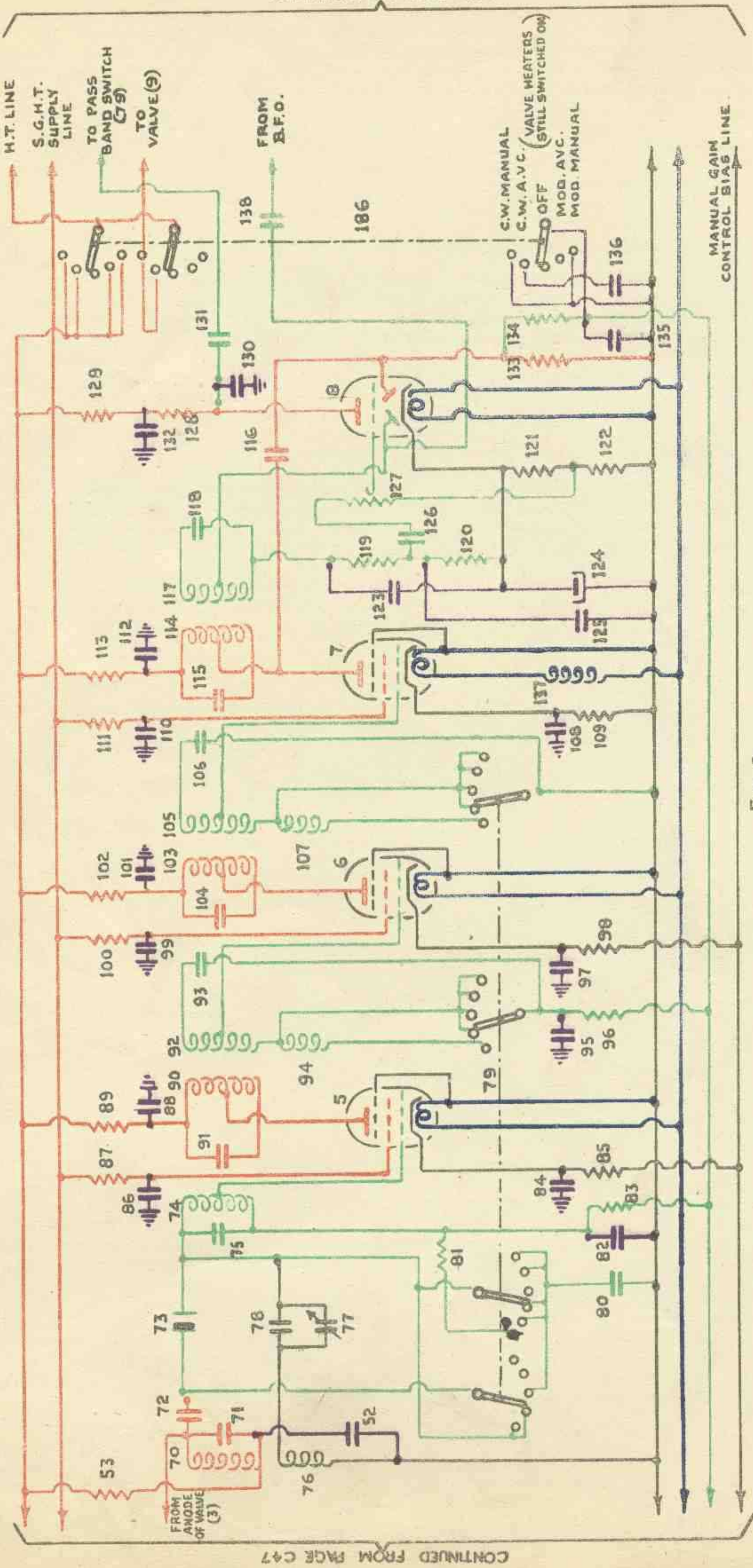

FIG. C.

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14. FIRST A/F AMPLIFIER CIRCUIT.

The first A/F amplifier comprises the triode portion of the valve (8). The grid is connected to the slider of a 500,000 ohms A/F Gain Control potentiometer (127), which is fed from the detector circuit through the condenser (126) and is returned to the tapping of the bias potentiometer (121)(122), so that only the bias voltage produced across the resistance (121) is applied to the grid of the valve.

The anode of the valve is connected through a 50,000 ohm anode load resistance (128) and 20,000 ohm decoupling resistance (129) to the H.T. supply line and through a 0.01 mfd. condenser (131) to the second A/F amplifier stage. An R/F by-pass condenser (130) of 500 mmfd. is connected between the anode and earth. A 1 mfd. decoupling condenser (132) is connected between the junction of the load and decoupling resistances and earth.

15. A.V.C. CIRCUIT.

The A.V.C. diode is fed from the anode of the third I/F valve through the 100 mmfd. condenser (116), the rectified voltage being produced across a 500,000 ohms resistance (133). As the cathode of the valve (8) is held at a considerable positive potential with respect to earth by the action of the biassing resistances (121)(122), the A.V.C. diode does not pass current until the peak value of the signal voltage applied to it exceeds this "delay" voltage. The object of the "Delayed A.V.C." is to prevent the operation of the A.V.C. action on weak signals. (See Admiralty Manual of W/T (1938) Vol. II, N37).

The A.V.C. voltage developed across resistance (133) is applied to the grids of valves (1)(2)(5) and (6) which have variable mu characteristics (see Admiralty Handbook of W/T (1938) Vol. II paras B32 and N36) via a low pass filter comprising a series resistance (134) of 1 megohm and a 0.1 mfd. condenser decoupling to earth. This arrangement prevents the A.V.C. voltage following changes in the modulation of the signal.

In the case of C.W. signals a 1 mfd. condenser (136) is connected in parallel with the condenser (135) by switch (186). This raises the time constant of the low pass filter circuit to the point where it is greater than the normal space intervals that occur in morse signalling. If this were not done, the complete absence of signals during spaces would cause an increase in receiver sensitivity with consequent undesirable back ground noise.

16. THE SECOND HETERODYNE OSCILLATOR (OR "BEAT FREQUENCY OSCILLATOR"), is an electron-coupled Colpitts Circuit. The Colpitts Oscillator (See Admy. Manual of W/T (1938) - K9) comprises an inductance (139) tuned by an adjustable condenser (140) (labelled "B.F.O" on the front panel) in parallel with a capacity potentiometer made up of a 420 mmfd. condenser (143) and a 2000 mmfd. condenser (144). This tuned circuit is connected between the control grid of a VR100 valve (9) through coupling condenser (141) of 100mmfd. and earth. The screen grid is also taken to earth through a 0.1 mfd. condenser (147). The D.C. potential of the screen is provided from the H.T. positive line via a resistance (148) of 10,000 ohms. The cathode of the valve is connected directly to the junction of the condensers (143) and (144); also through a 10,000 ohms grid leak (142) to the control grid and through a 10,000 ohms resistance (145) to earth.

This arrangement makes the screen the "virtual anode" of a three electrode system associated with the Colpitts circuit, the cathode being the high oscillatory potential electrode (See Admy. Manual of W/T - K25).

The suppressor grid of valve (9) is earthed and the anode is connected to the H.T. line through a 100,000 ohms load resistance (149) and a 20,000 ohms decoupling resistance (151). The junction of these resistances is decoupled to earth by a 0.1 mfd. condenser (150).

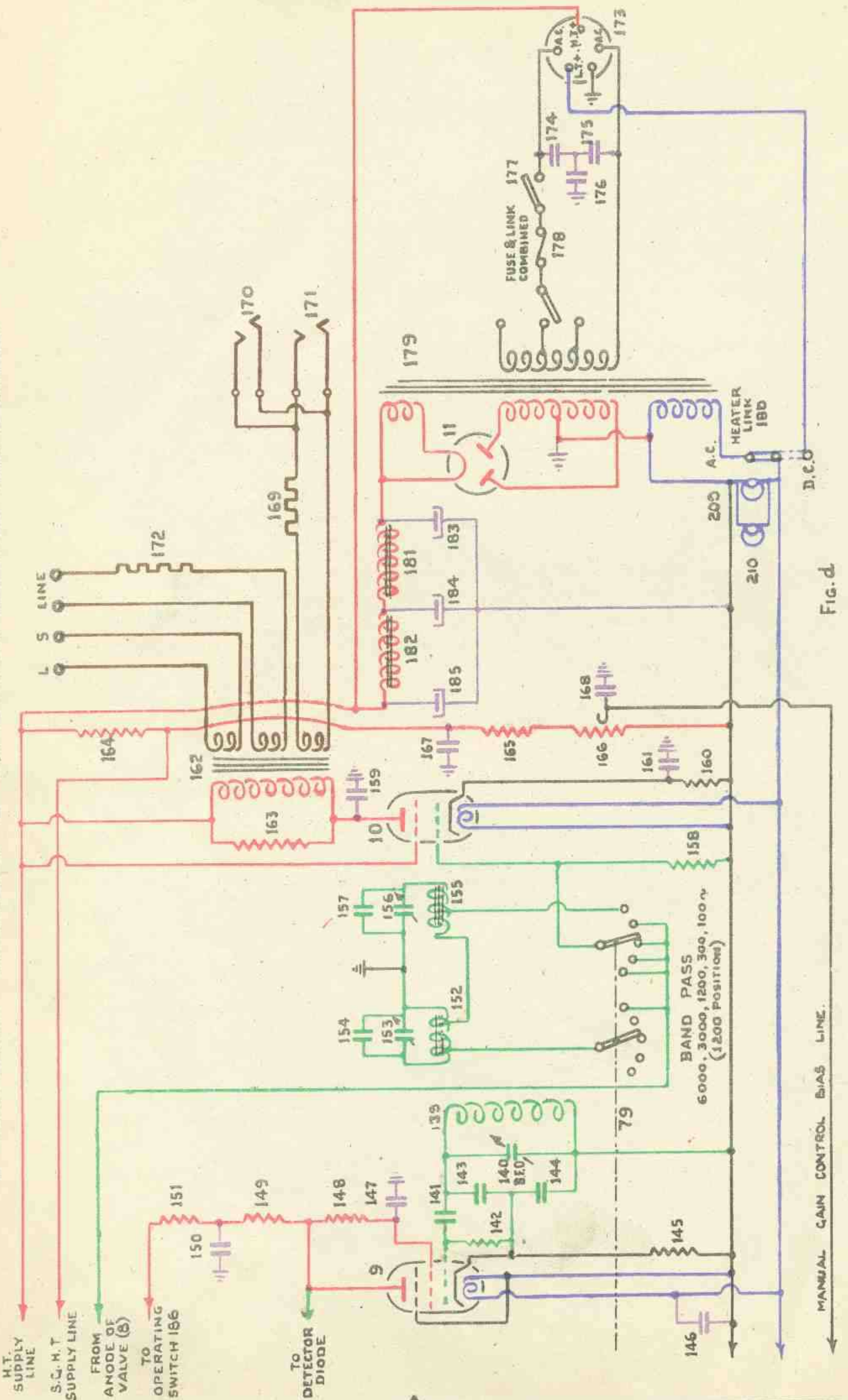
The Colpitts Oscillator is coupled via the electron stream of the valve to the anode circuit. The output voltage developed across load resistance (149) is applied to the detector diode through a 30 mmfd. condenser (138) to provide the necessary beat with C.W. signals.

17. SECOND A/F AMPLIFIER CIRCUIT.

The second A/F amplifier stage comprises an NR85 valve (10), which is normally resistance-capacity fed from the first A/F stage by a condenser (131) and 1 megohm grid leak resistance (158). When the Pass Band switch (79) is set to the 100 cycles position, however, the input circuit of the valve (10) is altered to include a filter having an optimum frequency of 1000 cycles.

RECEIVER B28

2ND HETERODYNE OSCILLATOR 2ND A/F (OUTPUT) AMPLIFIER AND RECTIFIER



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This filter consists of two special chokes (152) and (155) which are tuned to the appropriate frequency by 3100 mmfd. condensers (154) (157) and trimming condensers (153) (156). The second circuit of the filter is coupled to the first by returning the choke to a tapping near the bottom end of the first circuit choke.

The cathode of the valve is connected to earth through a 500 ohm bias resistance (160), which is shunted by a 25 mfd. electrolytic condenser (161). The anode of the valve is connected to earth by a 2000 mmfd. R/F by-pass condenser (159) and is connected to the H.T. line through the primary of the output transformer (162), which is shunted by a 20,000 ohm resistance (163). The screen grid of the valve is connected directly to the H.T. line.

There are three separate output windings on the output transformer (162). One of these feeds the "L.S." terminals at an impedance of 3 ohms, which is suitable for direct connection to the speech coil of a loudspeaker, another feeds the "Line" terminals at an impedance of 600 ohms, which is the standard value for A/F transmission lines. A 600 ohm resistance (172) is connected in series with this winding. The third winding feeds two telephone jacks (170) (171) through a 50,000 ohm resistance (169).

OPERATION AND TUNING.

18. OPERATION OF RECEIVER B28 FROM A.C. SUPPLY.

When the Receiver B28 is to be operated from an A.C. supply the power supply plug should be removed from the terminal board at the back of the set and the supply connected to the two diametrically opposite pins of the plug as shown in Fig. D.

The aerial and earth should then be connected to the receiver and the fuse plug (178) on top of the transformer (179) inserted in the correct position for the voltage of the supply.

The supply selector plug (180) should also be set to the "A.C. Mains" position.

The power supply plug may now be inserted in the power supply socket (173) on the terminal board and the ON/OFF switch on the front panel of the receiver made to "ON". After some 30 seconds or so the valve heaters will have warmed up and the receiver will be ready for use.

It should, however, be noted that the frequency of the first heterodyne oscillator will "drift" as the receiver heats up to its normal working temperature and that the best performance will not be obtained for some time after switching on. For this reason, if it is desired to silence the set for short periods, the "OFF" position of the operating switch (186) should be used, as this keeps the valve heaters alight.

To tune in a station of known frequency the following procedure should be adopted :-

(a) Set the operating switch (186) to "C.W. - A.V.C."

(b) Set the Pass-Band switch (79) to "100" or, for the higher frequencies, to "300". It is important to remember that the "100" position can only be used for C.W. reception.

(c) Set the range switch (14) to the appropriate frequency band.

(d) Set the pointer on the scale of approximate frequencies to the required frequency and tune slightly either side of the indicated position until the required signal is found.

It will be found that with the operating switch (186) in either of the A.V.C. positions tuning will appear broad, owing to the operation of the A.V.C. circuits. When necessary, the switch may be put to one of the "Man" positions and the signal strength reduced by the H/F Gain Control (166) until the signal is just audible, when fine adjustment of the tuning is facilitated. It is important to remember that strong signals will overload the later stages of the receiver if the H/F gain control is increased too much.

(e) Adjust the aerial trimmer control (18) to give maximum volume.

(f) If a modulated signal is being received, set the operating switch (186) to the appropriate position and, if necessary, set the Pass Band switch (79) to the position which gives the best compromise between quality and selectivity.

(g) Adjust the A/F gain control (127) to give the required volume.

19. TUNING OF SECOND HETERODYNE OSCILLATOR.

To adjust the second heterodyne oscillator on first putting the Receiver B28 into operation the following procedure should be adopted :-

(a) Switch on the receiver.

(b) Set the Range Switch (14) to Range 4.

(c) Set the Operating Switch (186) to "C.W. - A.V.C.".

(d) Set the H.F. Gain Control (166) to maximum.

(e) Set the A.F. Gain control to give a comfortable volume with the Pass-Band switch (79) in "6000" position.

(f) Set the Pass-Band switch (79) to "100".

(g) Adjust the "B.F.O." control (140) to either of the positions at which the maximum of receiver noise is obtained, with the characteristic "ringing" tone which is associated with the narrow pass-band. It may be necessary to increase the A.F. Gain Control to do this, and it may also be necessary to adjust the main tuning control to a silent point where no signal is being received.

(h) Tune in a C.W. Signal using Main Tuning Control (17), and check that a "single signal" effect is being obtained, i.e. that a beat note is heard on one side only of the dead space. If a signal is heard both sides of the dead space the procedure detailed in items (b) to (g) above should be repeated.

The setting of the B.F.O. should not be altered once the correct adjustment as described above has been obtained. With the B.F.O. correctly set the signal passed to the I/F Amplifier when tuning on the Main Tuning Control (17) is at the optimum frequency for the amplifier, and the beat frequency produced by the 2nd Het. is the optimum frequency for the A/F filter.

It should be appreciated that unless the procedure detailed in items (a) to (h) is carried out, it is possible to get a 1000 cycle note without the receiver being properly in tune. Both the first and second Het. Oscillators may be off the optimum frequencies, and the two errors may combine to produce a 1000 cycle note, but with a reduction in selectivity and signal strength.

20. OPERATION OF RECEIVER B28 FROM D.C. SUPPLY.

When the Receiver B28 is to be operated from a 6-volt battery and the Patt. W2702 Rotary Converter Unit the short leads from the converter unit are connected to the battery, care being taken to observe the correct polarity, and the power supply plug is inserted into the socket (173) on the terminal board. The supply selector plug (180) should also be set to the D.C. position.

The remainder of the operation and tuning of the receiver are as for A.C. operation except that the ON/OFF switch (189) on the converter unit is used instead of that on the Receiver B28.

POWER SUPPLIES.

21. Receiver B28 is designed to operate either directly from a 200-250-volt, 50-cycle A.C. supply or from 6-volt and 160-volt D.C. supplies.

Where the receiver is supplied as part of Type 65 W/T Set a Patt. W2258 Transformer, 100-130/200-250 volts is supplied as part of the accessories to enable the receiver to be operated from either 100-130 volt mains or, in emergency, from the 110-volt output of the Chore-horse petrol-driven generator forming part of the equipment of Type 65.

In Type 65 when A.C. mains are not available the receiver obtains its H.T. supply from a Patt. W2702 Rotary Converter Unit, the input to which is from a 6-volt battery which also supplies the filaments of the valves in the receiver.

When the receiver is operated from an A.C. supply the H.T. voltage is approximately 250, instead of the 160 volts available from the Rotary Converter Unit and the performance of the receiver is somewhat better than when the D.C. supplies are used.

When operating the Receiver as part of Type 65, the use of the 110-volt output to operate the receiver when the Transmitter 5G is in use is allowable only when the 6-volt battery is unusable as the bad regulation of the petrol driven generator may give rise to difficulties.

22. The A.C. supply is fed to two pins of the power supply socket (173) as shown in Fig. D. These pins are bridged by a pair of interference-suppressing condensers (174) (175) the junction of which is earthed through a third condenser (176).

The A.C. supply is controlled by the receiver ON/OFF switch (177) and passes to the primary winding of the transformer (179) through a fuse plug (178), fitted with a 2-amp fuse. This plug has three positions, one for 200/215 volts, one for 220/230 volts and the last for 240/250 volts. Care should be taken that the plug is in the correct position for the voltage of the supply before the set is switched on. The plug can be seen when the receiver lid is raised.

The transformer (179) has three secondary windings designed to give the following outputs:-

(i) 5 volts, 2.5 amps, for the rectifier valve (11) filament.

(ii) 300-0-300 volts, 120 mA, for the rectifier valve anodes.

(iii) 6.3 volts, 5 amps, for the valve heaters.

The NU20 rectifier valve (11) is connected in a normal full-wave rectifier circuit, the centre point of the H.T. secondary winding of the transformer (179) being earthed and the filament of the valve feeding the H.T. smoothing circuits, which consist of two 8-henry chokes (181) (182) and three 8-mfd. electrolytic condensers (183) (184) (185) connected in the usual manner.

23. A potentiometer, consisting of two 10,000-ohm resistances (164) (165) and a 2,000-ohm variable potentiometer (166) is connected across the H.T. supply to the receiver. The screen grids of the valves are supplied from the junction of the two 10,000 ohm resistances, this point being by-passed to earth by a 0.1 mfd. condenser (167).

The slider of the 2,000-ohm potentiometer (166) is also connected to earth through a 0.1 mfd. by-pass condenser (168) and to it the cathodes of the valves (1) (2) (5) and (6) are returned, so that the gain of these valves may be controlled by the operation of the potentiometer (166) which is labelled "H.F. Gain" on the front panel of the receiver.

FILAMENT SUPPLIES.

24. The heaters of the indirectly heated receiver valves (1) - (10) all have one leg earthed. The other leg of each heater is connected to either the L.T.+ pin of the power supply socket (173) or to the 6.3 volt secondary winding of the transformer (179) according to the position of the link in the supply selector plug board (180).

It is important that this link be set to the correct position ("A.C. Mains" or "D.C.") according to the power supply available. The link can be seen when the receiver lid is raised.

ROTARY CONVERTER UNIT.

25. The Patt. W2702 Rotary Converter Unit consists of a small motor-generator, the input of which is supplied from the 6-volt battery and the output of which supplies the H.T. supply to the Receiver B28 at 160 volts, 60 mA. The circuit diagram of the converter unit is shown in Fig.e.

The Patt. W1469, 6-volt battery is connected to the motor side of the rotary converter (194) via a 15-amp battery fuse (188). ON/OFF switch (189) and an interference-suppression filter (consisting of two chokes (190) (191) and two 4 mfd. condensers (192) (193) which effectively prevents electrical interference either on the B28 itself or on other receivers working on frequencies up to 30,000 kc/s.

The output from the rotary converter is fed to the receiver via a smoothing filter consisting of three chokes (195)(196)(197) and three 1 mfd. condensers (198) (199)(200) and a 5 ohm resistance (201).

The converter itself is enclosed in an earthed screening box, within the main enclosure of the Rotary Converter Unit. The components comprising the unit are mounted on a shallow inverted tray, over which fits a lid forming the necessary screening compartments. A hinged flap gives access to the stowage compartment for the connecting leads.

Spare fuse wire for the battery fuse (186) is provided in an envelope (Patt. W2708). The removable portion of the fuse holder should be slid vertically upwards to replace the fuse. The total drain from the battery when using the rotary converter unit is approximately 8 amps.

POWER SUPPLY CONNECTIONS.

26. The power supplies are fed into the receiver by means of the power supply plug which fits into the socket (173) on the terminal board at the back of the receiver. Each receiver is provided with a 5-pin plug, and another plug is included in the box of spares. When the receiver is to be operated from A.C. mains, the A.C. supply leads should be connected to the two diametrically opposite pins of the plug, as shown in Fig. D. At the same time, when the receiver is to be A.C. mains operated the link on the supply selector plug board (180) should be set to "A.C. Mains" and the fuse plug (178) on the mains transformer (179) should be set to the correct voltage.

When the receiver is to be operated from the 6-volt battery, the short leads from the Rotary Converter Unit, Patt. W2702, are connected to the battery, care being taken to observe the correct polarity, and the power supply plug on the long lead is plugged into the socket (173) on the set (See Fig. (1)).

In all cases the earth connection should be kept on the set while the power supply is connected, to avoid risk of shock.

ROTARY CONVERTER UNIT

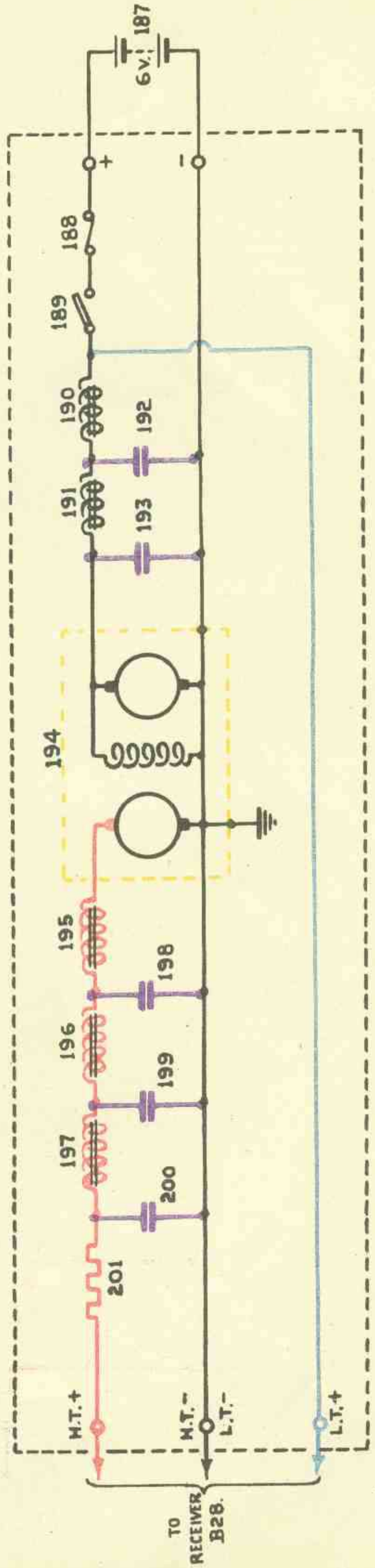


FIG. 2.

RECEIVER B28

B28 (MODEL OUTFIT C.D.C.)
SCHEMATIC DIAGRAM

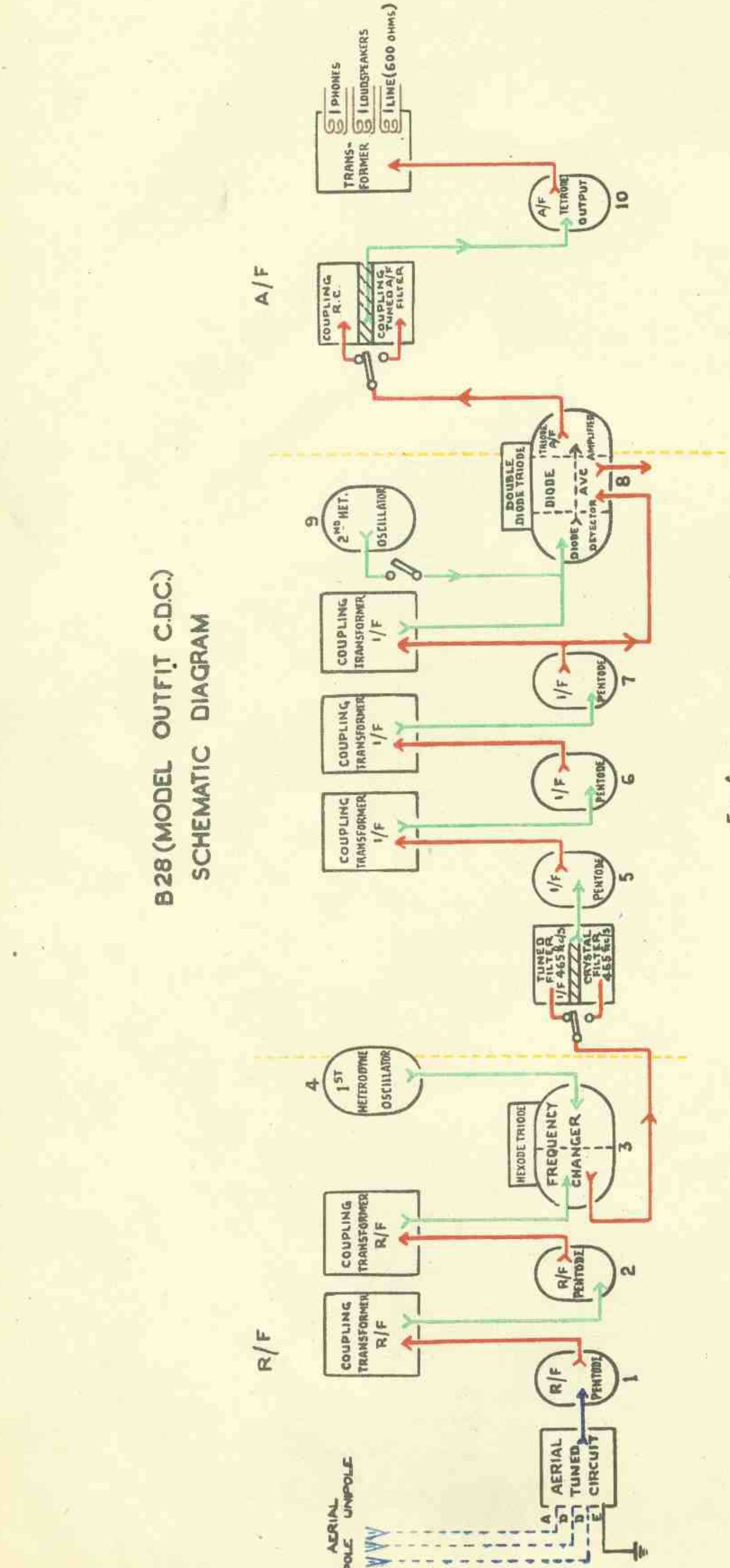
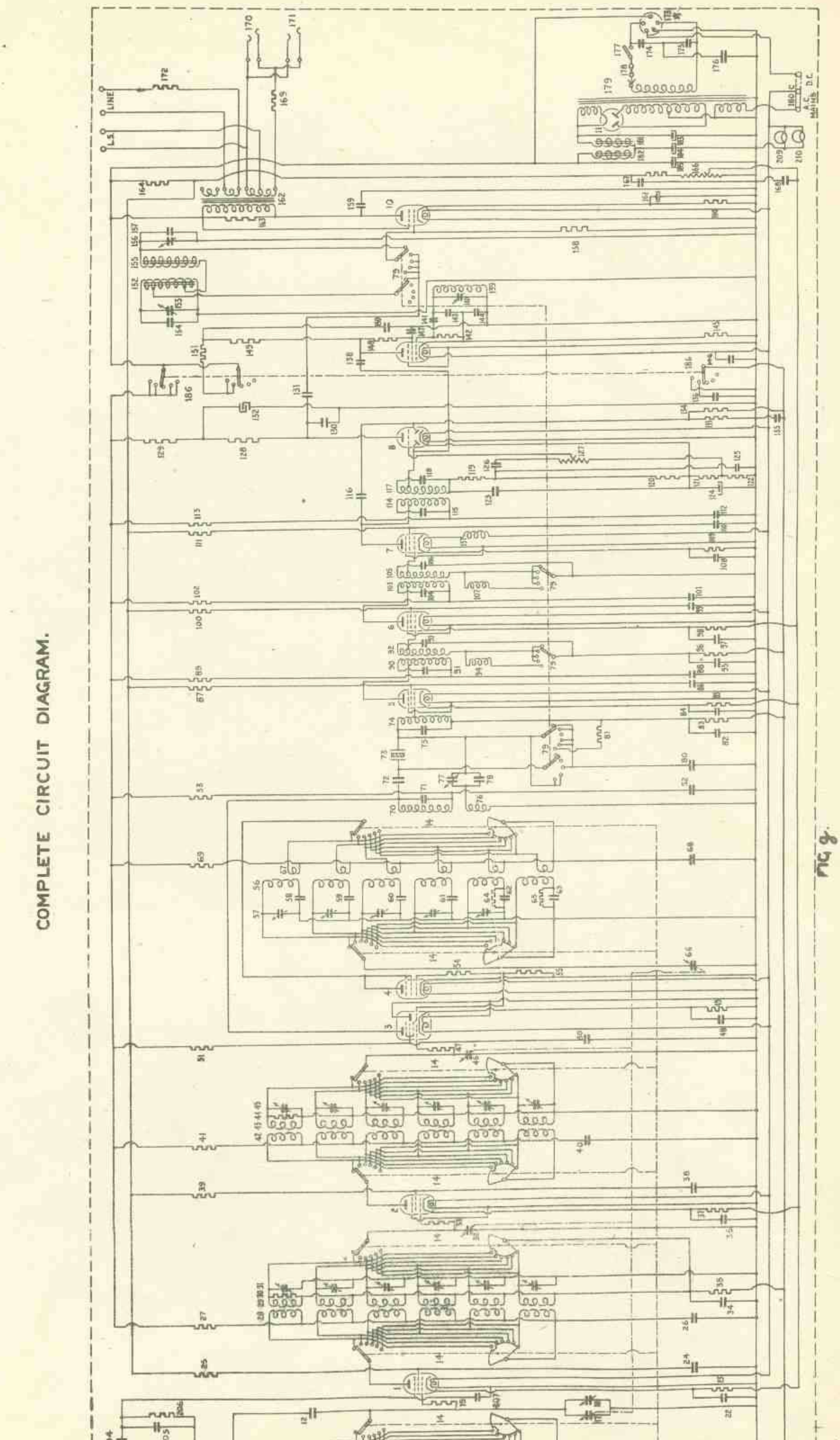


Fig. f

COMPLETE CIRCUIT DIAGRAM.



TUNER AMPLIFIER B28

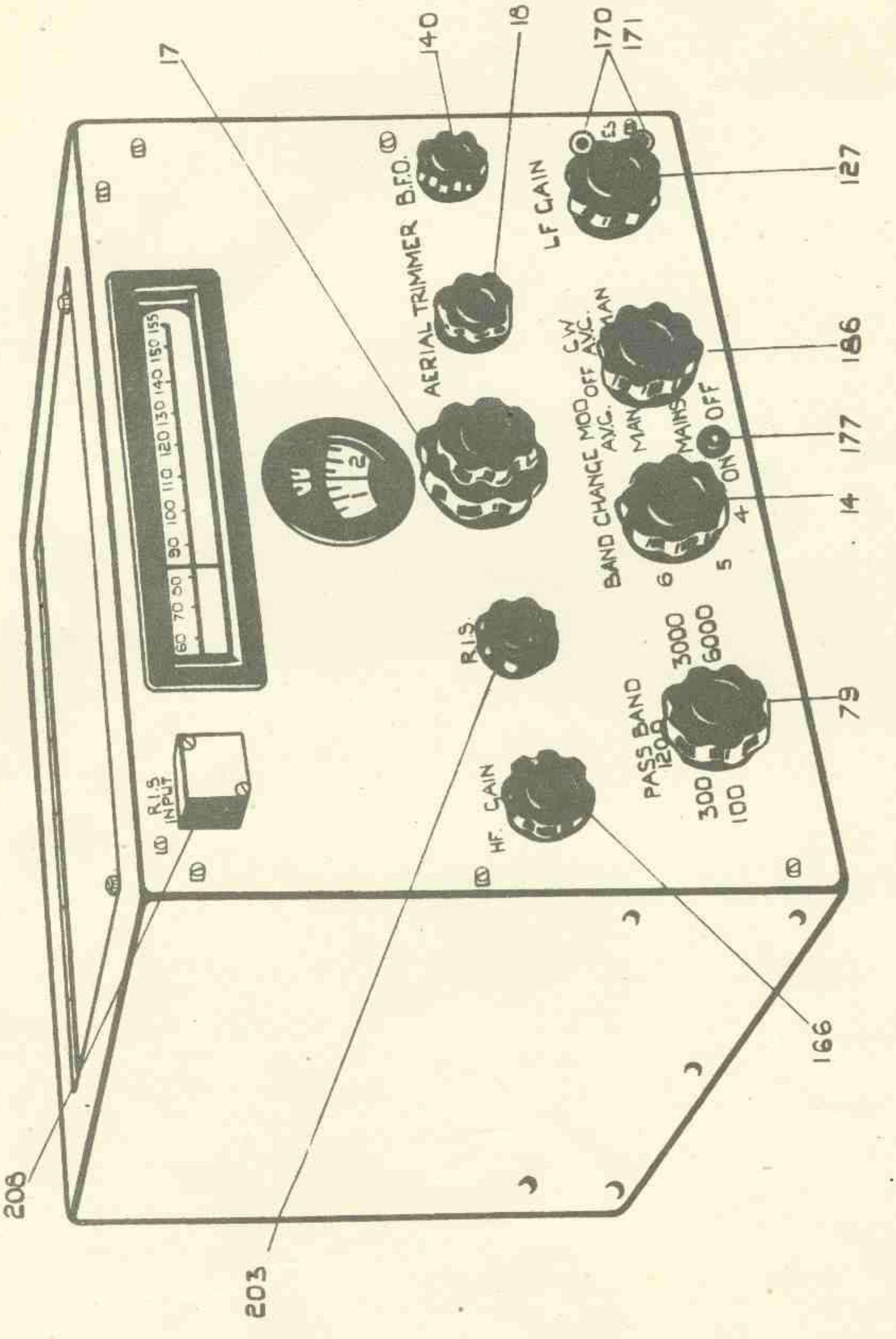
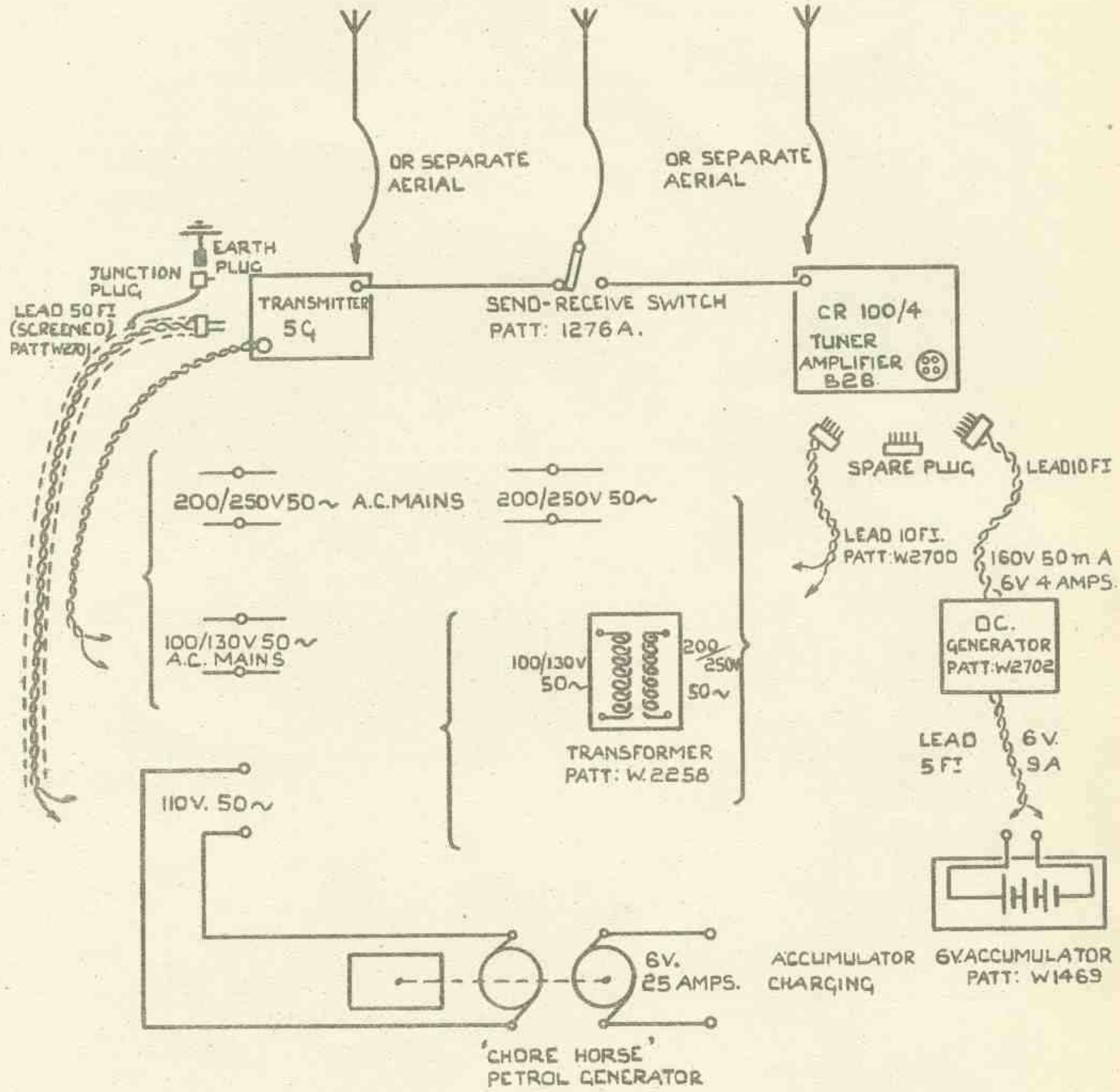


Fig. 2

RECEIVER B 28.

CONNECTIONS TO B28 WHEN USED IN TYPE 65.

SHOWING ALTERNATIVE SOURCE OF SUPPLY.



IN LATER SETS A PETROL GENERATOR GIVING 220 VOLTS INSTEAD OF 110V. MAY BE SUPPLIED, AND THE B28 ROTARY CONVERTER MAY BE REPLACED BY A VIBRATOR UNIT.

FIG. 1