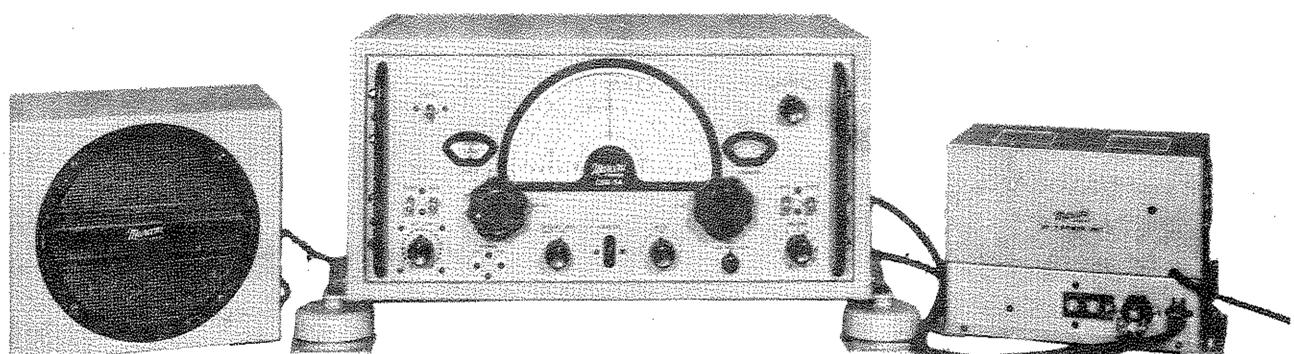
INSTALLING AND OPERATING INSTRUCTIONS FOR MARCONI CSR-5A RADIO RECEIVING EQUIPMENT

TYPE 110-930A

RCN. REF. No. 3A/107-1

FOLDER 110-434A RCN. REF. No. 3X/100-1



CSR-5A COMMUNICATIONS RECEIVER
COMPLETE WITH VP-3 POWER UNIT
AND TYPE No. 110-823 LOUDSPEAKER

FIG. 1

MANUFACTURED BY CANADIAN Marconi COMPANY

MARCONI BUILDING MONTREAL

Branches at : Vancouver, Winnipeg, Toronto, Halifax, St John's, Nfld.

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FIGURES

FIGURES

SPECIAL NOTICE

Owing to wartime material restrictions beyond our control it has been necessary, in many cases, to use components different from those listed in the Parts List of this Instruction Folder. The substitute components employed do not prejudice the operation of the unit in any way, but in some instances may detract from the neat appearance which was intended.

Should a replacement of any of these substitute components be necessary at any time, the proper types, as specified in the Parts List, should be ordered, and will be supplied if they are then available.

Canadian MARCONI Company,
Montreal

OPERATING INSTRUCTIONS

FOR

MARCONI CSR-5A RECEIVER TYPE 110-930A

R.C.N. REF. No. 3A/107-1

SECTION 1 — GENERAL

1-1 The Marconi CSR-5A receiver is a high-grade communications instrument especially designed to provide the maximum reliability for fixed and mobile station operation. The instrument is designed to provide the maximum sensitivity and stability under the most severe conditions of operation, such as vibration and high humidity. The wave range covered by the receiver is that most commonly used in communication work, viz.: from 79 to 518 kilocycles and from 1.5 to 30 megacycles. This spectrum is covered by six separate bands, which are individually calibrated with an accuracy of 0.5% at any frequency.

1-2 The receiver may be supplied in a sheet steel cabinet of pleasing appearance (see Fig. 2) or for rack mounting. All the controls are arranged on the front panel, so as to provide the maximum accessibility and ease in operation. The centre of the front panel is taken up by a large calibrated illuminated dial provided with a pointer that moves over seven scales. Six of these scales are colour coded so that the various bands can be identified and the pointer set to the frequency that is desired. The seventh scale, which is outside the others, is divided into a number of divisions, and in conjunction with the inertia-driven vernier drive and an additional calibrated scale on the vernier drive, provides a means of resetting to any predetermined reading with an accuracy that is better than the limit of audibility on any signal.

1-3 The receiver is equipped with the following additional features that will ensure that the maximum performance is realized from the capabilities of the instrument! Two stages of RF preselection, which ensures satisfactory image ratios, high gain antenna coils providing maximum signal to noise ratio. A crystal filter in the IF stages permits the selectivity to be varied over the full range. Crystal control of any spot frequency desired by means of additional plug in crystals, thus enabling fixed frequency working to be used when desired. Only one crystal at a time can be used, but as many crystals can be supplied as are required by the dictates of the service for which the receiver is required. Temperature compensation and voltage stabilization make the unit practically independent of any of the effects of these items on the overall calibration of the instrument. Adequate control of the volume of the signal is provided by means of a sensitivity control and audio volume control. To provide satisfactory operation in noisy locations an effective noise limiter is incorporated which may be set into operation by a panel-mounted switch. As an additional feature an output terminal is provided for panoramic adapters where this feature is desired. The receiver has exceptionally low radiation from the antenna and can therefore be used for marine service in hazardous locations.

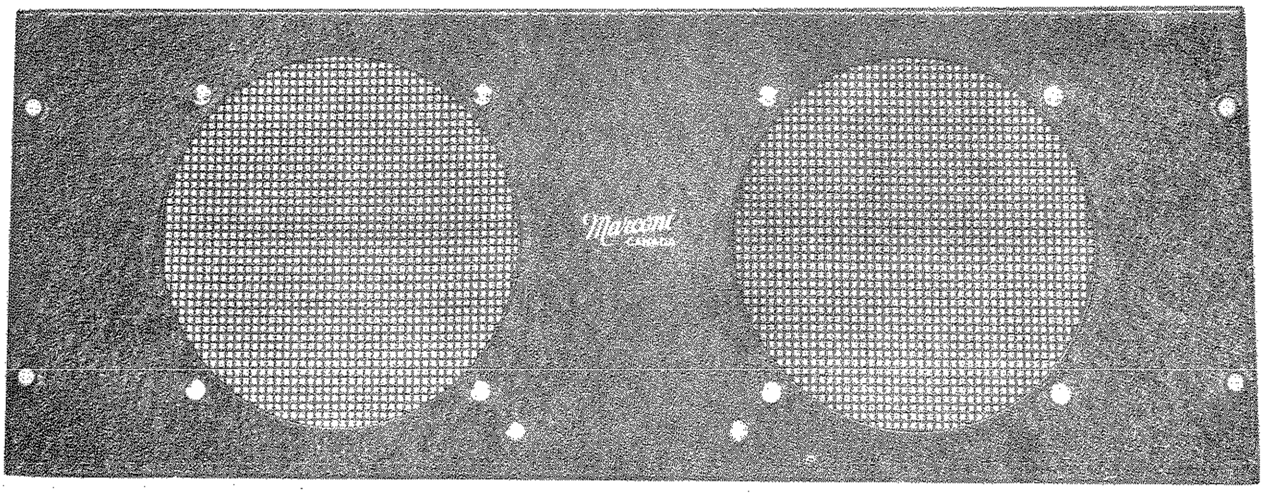
1-4 The frequency ranges covered by the various bands of the receiver are as follows:—

Band A colour "MAUVE"	14.9	to	30.3	megacycles
Band B colour "RED"	6.8	to	16.1	"
Band C colour "GREEN"	3.55	to	7.65	"
Band D colour "ORANGE"	1.5	to	3.5	"
Band E colour "BLUE"	195	to	518	kilocycles
Band F colour "BROWN"	79	to	207	"

1-5 The additional equipment required with this receiver is as follows:—

POWER SUPPLY

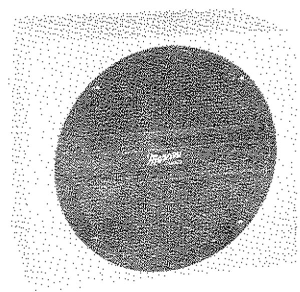
The power requirements of the receiver are 12 volts AC or DC at 2.3 amperes, for the low tension supply and 250 volts at 115 milliamperes for the high tension side. It is recommended that the Marconi VP3 (110-540) power unit be used with the receiver which will enable the input to be either 12 volts DC or 115 or 230 volts AC either 25 or 60 cycles. Where operation is only required from an AC source, the Marconi WE-11 power supply will deliver the required voltages to the receiver from either 115 or 230 volts 25 or 60 cycles. The VP3 is designed for table mounting; the WE11 may be supplied either for table or rack mounting.



RACK MOUNTED SPEAKER ASS'Y
TYPE No. 110-836
FIG. 16

LOUDSPEAKER

The receiver is equipped to match to any 10,000 ohm speaker as well as to low resistance or high resistance headphones, or a 500 ohm line. A suitable speaker for this application is the Marconi type 110-823 which has been especially designed for the use with this unit and will deliver a maximum of 4 watts. This loudspeaker is an 8″ permanent magnet dynamic type and is contained in a cabinet 12″ x 12″ x 6″ for table mounting. If desired a rack mounted speaker can be supplied on a standard 19″ panel 10¾″ high. This is the Marconi type 110-836 speaker.



LOUDSPEAKER ASS'Y.
TYPE No. 110-823
FIG. 18

SHOCK MOUNTS

If desired, shockproof mountings can be supplied for the cabinet mounted receiver. Marconi type 110-704 shock mounts are designed for this purpose, two being required for each set.

1-6 The dimensions of the receiver unit when supplied for cabinet mounting are:—

20¼″ wide
10½″ high
15¼″ deep
Weight 68 lbs., complete with shock mountings.

When used for rack mounting service, the dimensions are:—

19" wide
8¾" high
15¼" deep
Weight, 58 lbs.

1-7 The vacuum tube complement of the receiver is as follows:—

V1	R.V.C. 6SK7	1st RF amplifier.
V2	R.V.C. 6SG7	2nd RF amplifier.
V3	R.V.C. 6K8	Mixer and crystal controlled oscillator.
V4	R.V.C. 6SG7	1st IF amplifier.
V5	R.V.C. 6SK7	2nd IF amplifier.
V6	R.V.C. 6B8	Diode Detector.
V7	R.V.C. 6H6	Noise limiter rectifier—AVC rectifier.
V8	R.V.C. 9002	HF conversion oscillator.
V9	R.V.C. 6SK7	Beat frequency oscillator.
V10	R.V.C. VR150-30	Voltage regulator.
V11	R.V.C. 6F6	Pentode power output.

1-8 The antenna that may be used with this receiver can be any type that has an effective capacity of between 100 and 750 mmfds. Terminals are also provided for the use of transmission lines having surge impedances between 70 and 500 ohms. Terminals are provided on the rear of the receiver to accommodate various types of antennas and transmission lines (see Fig. 3). Particular care has been taken in the design of the unit to minimize the effects of radiation from the unit and the power delivered to a resistance connected between the antenna and ground terminals of the receiver will not be more than 400 micromicrowatts at any frequency covered by this receiver.

INSTALLATION

SECTION 2

2-1 When the receiver is first received at the final site, unpack the unit and examine it carefully for damage in transit. Check that all the vacuum tubes are in the correct sockets and that the condenser dial moves freely and that all the controls are operating smoothly. In cases where the unit will be used for mobile work and the shock mounting will be employed, the mountings will be secured to the bench or table on which the unit will be placed. The four shock absorbers should first be secured to the bench or table. The two angle brackets should then be released from the absorbers and secured to the receiver cabinet, and the unit placed on top of the absorbers and the screws re-inserted in the metal centres of the shock absorbers.

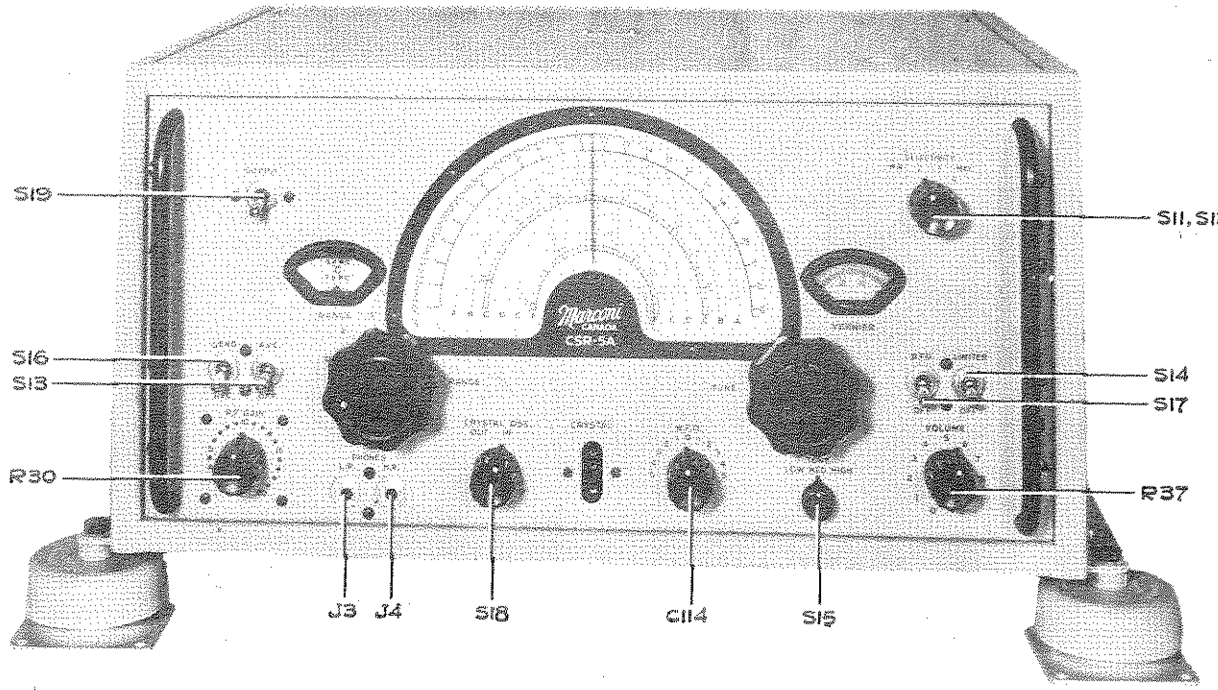
2-2 If the unit is to be used with the VP-3 or WE-11 power unit, the necessary cables will be supplied with the power units for connecting the two units together. These cables connect the CSR-5A and the power unit by way of appropriate sockets that are provided at the rear of the receiver and power pack units. When other types of power supplies are used with this unit, the connections to the receiver must be made via Jones P-303-CCT-L and Jones P-402-CCT plugs which should be connected as shown on the diagram of connections Fig. 41, to which reference should be made when connecting up. The two-connector plug will be used to control the power supply input to any such power unit, while the three-connector plug will bring in the low tension positive, common negative and high tension positive. The Power Units must be set and connected for the proper input supply voltage. See Paragraphs 4-3 and 4-4 of VP-3 instructions and paragraph 2-2 of WE-II instructions.

2-3 The aerial connections to the receiver will be made to the connections at the rear of the unit according to the type of aerial used with the unit. If a single wire aerial is used, having an effective capacity of 100 to 750 mmfds. the aerial should be connected to the terminal marked ANT and the two terminals marked E and E_1 should be connected together with a short jumper. When the unit is used in conjunction with a transmission line of the coaxial type the connections will be made to the LINE terminal and to E and E_1 connected together, with the outside of the line connected to the E side of the circuit. If the method of feeding the receiver is via a balanced line, the line should be connected to the terminals LINE and E_1 with the E terminal being left unconnected. The antenna connection should not be run adjacent to any power carrying wires or other pieces of apparatus which may be sources of RF interference. In particular this precaution must be strictly observed with regard to the battery cables from the power unit when operating from a vibrator power pack and also any wires that may be used to connect to charging panels or other auxiliary apparatus.

2-4 The earth connection to the receiver must be made with the greatest care, particularly in those locations where receiver radiation must be cut to the minimum and for this reason the large silver-plated terminal just above the input panel is provided. When at all possible, the lead from this terminal should not be more than two feet in length and should be made with heavy wire not less than No. 8 gauge. If the distance from the receiver to the ground is more than this, a heavy copper strip two or three inches wide should be run from the earth point and secured under the head of the terminal. It is essential that the greatest care be exercised in this connection as only by the most careful attention to detail will the receiver radiation be cut to a minimum. All joints both to the receiver and to the earth should be made with the utmost care and well soldered.

2-5 The receiver is equipped with four separate outputs. Two of these are for headphones and are located on the front panel of the unit, while the others are for a loud speaker and a 500-ohm line and are located at the rear of the unit. The 500-ohm centre tap connection is located on top of the chassis base; when shipped this terminal is connected to ground by a link. If an ungrounded line is required, the circuit should be broken by opening this link. An additional link is provided to ground, R-58. When the receiver is used in conjunction with CM-11A equipment, this link should be opened, i.e. R-58 is not grounded. The two headphone connections are provided for either high resistance phones (5000 ohms or more) or for low resistance phones (up to 1000 ohms) None of these terminals have any DC on them as they are fed via a transformer in the output stage of the unit which has a series of windings to match these various outputs. The power output from the speaker terminals is rated at 4 watts maximum but this will be cut in half if both the line and the speaker are used at the same time. If the headphones are plugged into the jacks while the speaker is connected, it will be rendered inoperative. The line output (if it is being used) will not be affected by the addition of the phones.

2-6 When the connections to the receiver have been made as noted above, the receiver can be placed in operation. Turn on the power and allow the tubes to heat up for a reasonable time. When the receiver has been in operation for some minutes it will be in order to proceed with the adjustment of the aerial trimmer condensers. These are the five variable trimmers located at the rear top left-hand corner of the chassis, which have the adjusting holes circled with black rings. For peak performance these should be adjusted for the particular antenna or transmission



CSR-5A COMMUNICATIONS RECEIVER
FRONT VIEW

FIG. 2

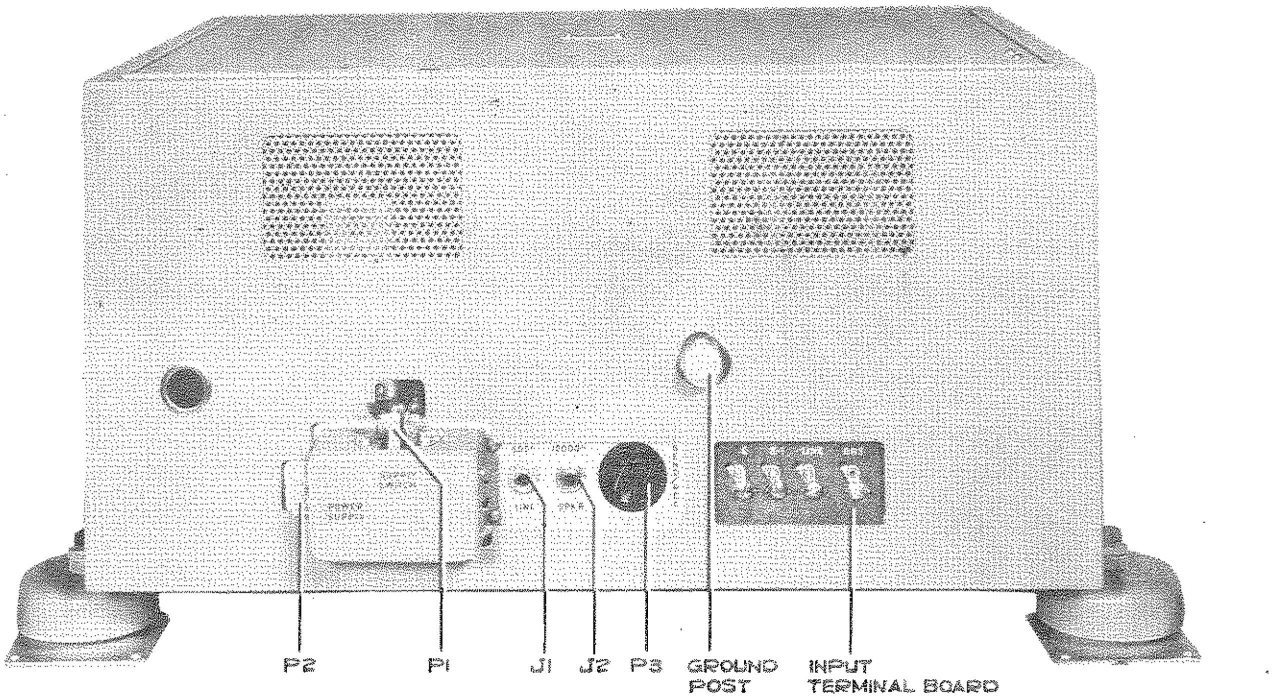
line that is being used. The method of adjusting these trimmers is as follows. Set the RF gain control to 20 and the volume to 10. Turn the selectivity control to 2 and make sure that the switches are as noted:—

AVC to "OFF", BFO to "OFF".
NOISE LIMITER to "OFF".
CRYSTAL OSCILLATOR to "OUT".
TONE to "HIGH".

Set the pointer to the high frequency end of the range, *i.e.*, about 21 on the outer logging dial for each of the bands in turn. With the headphones or loudspeaker connected it will be noted that the characteristic hiss of the receiver will be heard. Now adjust the trimmers for each of the six bands in turn until this hiss is at a maximum, when the receiver can be considered to be adjusted for the particular aerial in use. If the receiver is to be used with several aerials it is well to leave this adjustment untouched, as the factory adjustment is set to give good average performance with several types of possible aerials and the mean position set before shipping the unit.

2-7 The unit is now ready for operation and normal use, and the following are the functions of the various controls on the front of the receiver. An intelligent use of the various controls of this unit will greatly enhance its sphere of useful work, and for that reason the operation of the controls should be carefully studied so that the functions of each of the controls may be clearly understood, and the maximum use made of the capabilities of the unit. For the location of these controls, reference should be made to Fig. 2.

2-8 The SUPPLY ON AND OFF SWITCH (S19) controls the application of power to the receiver provided that the ON and OFF switch on the power unit (if either of the Marconi types are used) is in the OFF position.

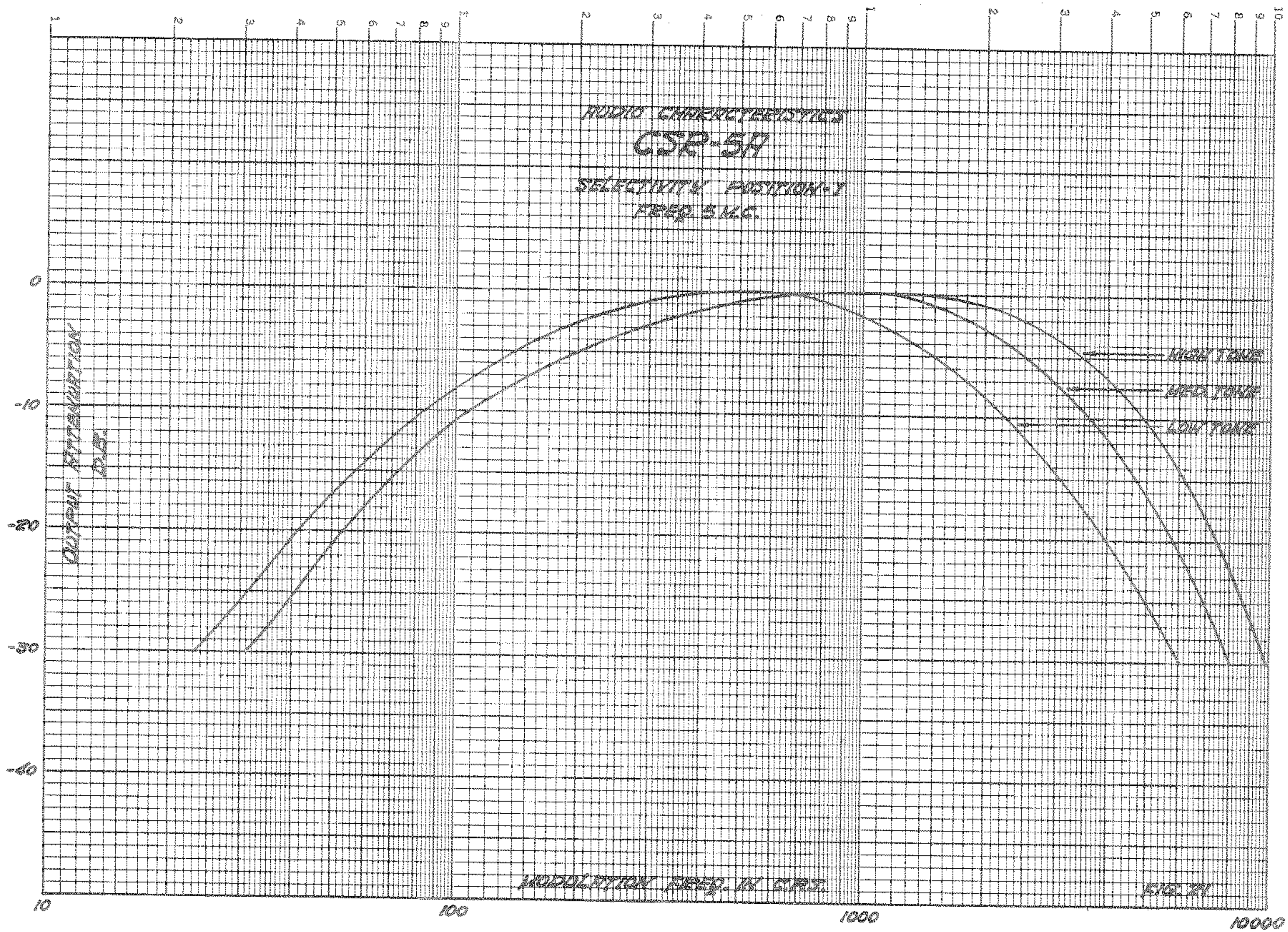


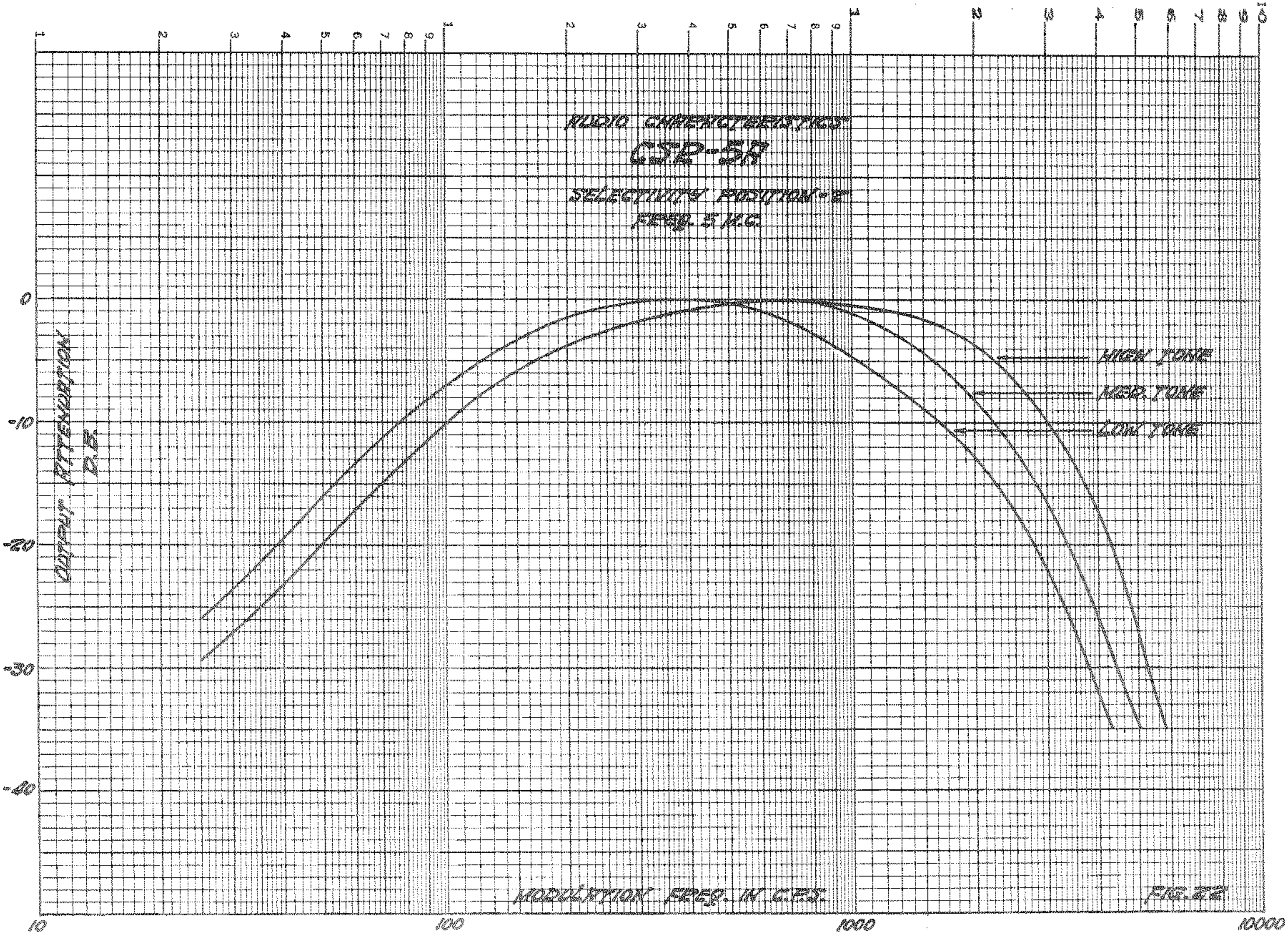
CSR-5A COMMUNICATIONS RECEIVER FIG. 3
REAR VIEW

2-9 The RANGE SWITCH (S1 to S10 incl.) controls the band on which it is desired to receive signals. Each position of the switch is defined by a letter as well as the colour coding which also applies to the dial. The frequency coverage of each of the ranges is shown in the window on the left of the tuning scale. The letters covering the ranges are also engraved on the control panel and a spot on the knob indicates which way the knob must be turned to arrive at the desired range.

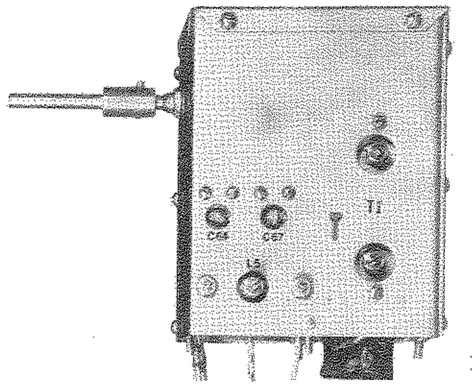
2-10 The MAIN TUNING DIAL consists of six coloured calibrated scales, each with its distinctive colour, and calibrated directly in frequency. An additional logging scale is provided around the periphery of these scales. The tuning scale pointer is controlled by the knob on the right of the main dial marked "TUNE". The calibration accuracy of the dial is such that when the pointer is set to any frequency on any of the six scales the frequency of the receiver will be within 0.5% of the frequency indicated.

2-11 The function of the outside and largest scale, known as the "LOGGING" scale is to provide, in conjunction with the vernier scale, an even more accurate means of setting the receiver to any predetermined frequency. The vernier dial is geared to the main dial and therefore bears a constant relation to it. The dial drive mechanism is such that one complete revolution of the vernier dial corresponds to one division of the main scale. The gear ratio between the main and the vernier scales is slightly more than 23 : 1 and the main scale therefore has 23 logging divisions. From this it will be seen that the combination of the main and vernier scales provides a logging scale of more than 2300 divisions. The backlash in the gear train is very small (less than one division on the vernier scale), thus once any setting for a given station has been found it can be logged and the receiver returned to the exact setting whenever desired. If extreme accuracy of resetting is not required, a good working adjustment may be obtained by marking the setting on the edge of the plastacell window with a soft pencil.

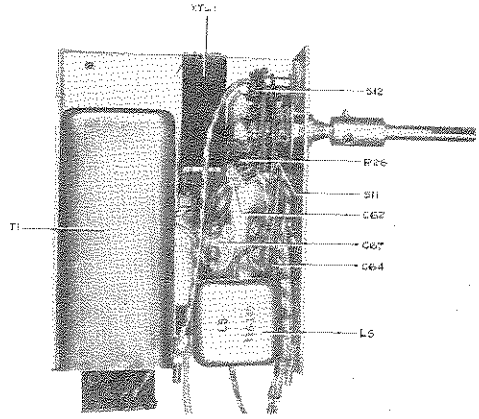

AUDIO CHARACTERISTICS
CSR-5A
SELECTIVITY POSITION-1
FREQ. 5 M.C.
HIGH TONE
MED. TONE
LOW TONE
OUTPUT ATTENUATION D.B.
0
-10
-20
-30
-40
10
100
1000
10000
MODULATION FREQ. IN C.P.S.
FIG. 21


AUDIO CHARACTERISTICS
CSR-5R
SELECTIVITY POSITION-"E"
FREQ. 5 M.C.
HIGH TONE
MED. TONE
LOW TONE
OUTPUT ATTENUATION D.B.
0
-10
-20
-30
-40
MODULATION FREQ. IN C.P.S.
10
100
1000
10000
FIG.

2-12 The SELECTIVITY SWITCH (S11-S12) is provided so that varying degrees of selectivity can be obtained. This control works in conjunction with the crystal filter unit, Fig. 9 and Fig. 10, to control the bandwidth of the receiver. In the first position (1) the bandwidth is widest and this position should be used for the reception of high quality speech or music as in this position the overall fidelity is down 3 db at 150 cycles and 8 db at 3000 cycles with the tone control set in the high position, while signals 19 kc off resonance are attenuated approx. 60 db. In the second position, which is normal for ordinary reception, the fidelity is down 5 db at 1700 cycles and signals 10 kc off resonance are attenuated approx. 60 db. Position 3 is a semi-sharp



I.F. CRYSTAL FILTER FIG. 9
TYPE No. 106-852



I.F. CRYSTAL FILTER COVERS REMOVED FIG. 10

position and on this position the crystal filter is connected in the circuit, and is intended to be used when adjacent channel interference is too severe for the normal position, but the overall fidelity is seriously impaired being down 5 db at 1200 cycles, while signals 7 kc off resonance are attenuated approx. 60 db. The fourth position is very sharp and should only be used for CW reception when interference is extremely bad. Signals 5 kc off resonance are attenuated more than 60 db.

2-13 Due to the fact that the last two positions of this switch make tuning of the receiver extremely sharp; positions 1 and 2 should be used when the receiver is used for searching and the last two positions used when the signal has been located. It will be found that the signal will not cover more than possibly one or two divisions on the vernier dial when the last two positions are used. It will also be found that the signal is louder on one side of the zero beat than on the other, and this side should be used. The pitch of the note can be varied by means of the BFO control. On the last two positions it will be found that the CW signal has the characteristic clear hollow note when the receiver has been tuned for maximum output.

2-14 The AVC SWITCH (S13), controls the action of the automatic volume control and may be used on either CW or MCW. In general the AVC should always be "ON" as this tends to modify the effects of fading to a large extent. When using the AVC the RF gain control should be set to the maximum, *i.e.*, to 20, and the volume control used to adjust the audio output required.

2-15 Under certain conditions the general case stated in 2.14 above will be modified. These are:—

(*a*) When on MCW during periods of very rapid fading. Then better results will be obtained with the AVC switch to "OFF" and the RF gain retarded to prevent the overloading of the RF amplifier.

(*b*) When receiving CW at speeds less than 15 WPM when the rush of back-ground noise during the spacing periods may be found to be annoying. Here also it will be necessary to retard the RF gain control to prevent the overloading of the RF amplifier and to switch the AVC control to "OFF".

(*c*) When receiving very strong signals on CW with the AVC "ON", it will be found that RF gain control has to be retarded to prevent the beat note "locking-in", near the zero beat note region.

2-16 The RF GAIN control (R-30) (Fig. 11) is a stepped type attenuator which changes the gain approximately 4 db per step, at the upper end (20) and 15 db per step, at the lower end (0). The VOLUME control (R37) is continuously variable and is used for the precise adjustment of the output of the receiver. These two controls should be used as follows:—

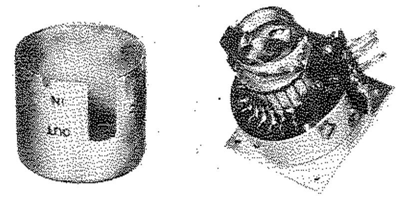


FIG. 11 R.F. GAIN CONTROL (R-30) TYPE No. 116-258

When on MCW with the AVC "ON", the RF gain control should be run in the maximum position and the output adjusted by means of the volume control. With the AVC "OFF", both the controls should be adjusted with the precaution that the RF gain be not too far advanced in order to prevent the overloading of the RF amplifier.

When used on CW with the AVC "ON", the RF gain should be run at the maximum position and the volume adjusted by means of the volume control. The only exception to this is in cases where an extremely strong signal causes "locking in" in the zero beat region. When operating with the AVC "OFF", the volume control should be left at 10 (maximum) and the receiver output adjusted by means of the RF gain control.

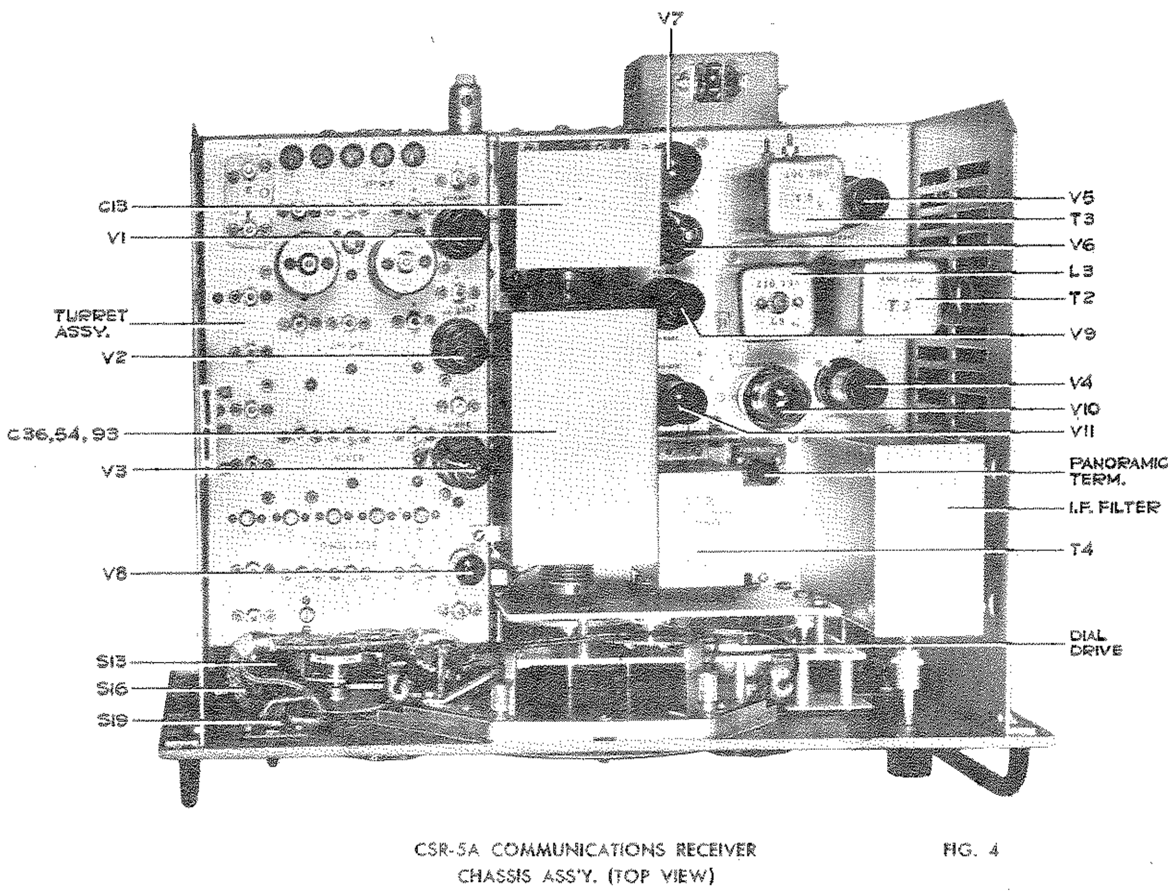
2-17 The TONE-CONTROL is a three-position switch which connects condensers across the output grid and thus changes the audio fidelity. For high quality reception the control should be set to "HIGH", while for all normal working the "MED" position will be found adequate. The tone control can be used with good effect in reducing the effect of hiss or background noise. The greatest benefit will be obtained with the control in the "LOW" position, but the fidelity will in consequence suffer to some extent.

2-18 The LIMITER SWITCH (S14) places into operation the noise limiter circuit which is most effective on interference of the ignition, or short pulse type and considerably less so on interference having a slowly changing amplitude. The best effect will be obtained from this control when the RF gain is well advanced and the volume control reduced, rather than the reverse condition with the volume up and the RF gain reduced.

2-19 The BFO PITCH CONTROL (C114) is provided to control the pitch of the note when receiving CW signals. When the signal is tuned in, it is advisable to work with this control at 0 and to tune the signal to the zero position on the main dial, and to then set the BFO pitch control to the desired frequency after all the adjustments are complete. The figures 1 to 5 on either side of the 0 position represent the approximate frequency of the note that will be heard. Under abnormal conditions when the selectivity is being used on positions 3 or 4, the tuning of the receiver should be carried out as described in paragraph 2.12.

2-20 For all normal working, the CRYSTAL OSCILLATOR, switch S-18, should be in the "OUT" position. When it is desired to use the receiver for fixed frequency working, the switch should be turned to "IN". It will be necessary to provide a crystal in a suitable holder such as the Marconi type 120-250. The crystal frequency should be 575 kcs plus or minus 1 kc higher or lower than the frequency on which it is desired to operate. For each frequency on which crystal control is desired, a separate crystal must be supplied and these can be plugged into the socket on the front panel as required. The crystal socket is designed to accommodate either ½″ or ¾″ crystal holders, three sockets so spaced being provided. When it is desired to receive on the crystal-controlled frequency, the crystal will be plugged into the front of the receiver and the crystal oscillator switch turned to "IN". The band switch should be turned to the band in which it is desired to receive the signal and the pointer on the tuning dial rotated to the approximate position on the dial. The correct setting of the pointer will be indicated by the maximum output of the incoming signal or by the maximum hiss output if the station is not radiating. It will be found that the tuning of the receiver is quite broad and not at all critical when using crystal-controlled reception. When working on a fixed frequency, using crystal control, the selectivity switch must always be in positions 1 or 2, as due to the accumulation of errors in the converter crystal frequency, the IF mid-frequency, and the transmitter frequency, reception is not possible on the two sharper positions of the selectivity switch, *i.e.*, 3 and 4. Due also to the same causes, when crystals operating on a harmonic are used, some small decrease in overall sensitivity of the unit will be noted.

2-21 An additional control is provided and is designated as SEND REC. This switch (S-16) mutes the receiver when it is in the "SEND" position and is often of use when working two-way communication. At the rear of the unit is a remote "SEND-RECEIVE" socket which will allow this function to be contolled from a remote point. If it is desired to use this feature, the switch on the front panel should be put to "SEND" and a pair of wires should be connected by means of a suitable plug to the switch at the remote point.



CSR-5A COMMUNICATIONS RECEIVER CHASSIS ASS'Y. (TOP VIEW) FIG. 4

TABLE 1

VOLTAGE READINGS FROM TUBE PINS TO CHASSIS

Tube No.	1	2	3	4	5	6	7	8	Cap.	Remarks
V1	0	6.3AC	4	0	4	110	0	245	...	
V2	0	6.3AC	3.5	0	3.5	109	12.6AC	245	0	
V3	0	0	245	38	0	153*	6.3AC	0.85	...	*Crystal Osc. switch "IN"
V4	0	6.3AC	4.5	0	2.5	100	0	245	...	
V5	0	6.3AC	5.6	0	5.6	110	12.6AC	248	...	
V6	0	6.3AC	55	0	0	100	12.6AC	8.5	0	
V7	0	0	0	0	0	0	6.3AC	1.7	...	
V8	152	0	0	6.3AC	152	0	0	....	...	
V9	0	0	4.8*	4.8*	27	6.3AC	45*	....	...	*BFO "ON"
V10	0	0	0	6.3AC	152	6.3AC	0	6.3AC	...	
V11	0	6.3AC	245	250	0	0	12.6AC	15	...	

The above readings were taken with a 5000 ohm per volt voltmeter from the pins of the tube sockets to ground. Except where noted, the controls were in the following positions:—RF and VOLUME full clockwise, SEND-REC. to "REC", AVC to "OFF", BFO to "OFF", LIMITER to "OFF", CRYSTAL OSC. to "OUT", TONE to "MED", RANGE SWITCH to "D", DIAL setting at 11 on LOGGING scale. The input voltage to the VP-3 power unit was 115 volts 60 cycles, and the inputs to the receiver were 12.6 volts AC and 250 volts DC.

MAINTENANCE

SECTION 3

3-1 The receiver will, in the normal course of events, maintain correct adjustments over long periods of time. Such troubles that occur can usually be located by following the procedure outlined below. It must be borne in mind that most troubles that occur in any receiver usually have a very simple explanation and, for that reason, it is suggested that an intensive study of the diagrams and illustrations of the unit in this folder be made, so that if trouble does occur, the search for the cause will be made with a sure knowledge of the locations of the various components and the function of each part of the receiver.

VACUUM TUBES

3-2 If the sensitivity of the receiver is noticeably poor, the most probable cause of the trouble is in one or more vacuum tubes. The tubes should be removed and tested in a reliable tube checker and any that are defective replaced. In the event that no tube checker is available, the spare set of tubes should be tried in the set, one at a time, until the defective ones have been located. If it is found that there are no defective tubes or that the insertion of a new set does not improve the condition, a check of the voltages throughout the set should be carried out. These voltages should agree very closely with the values given in Table 1, above. A tolerance of about 10% can be expected on all these values due to the tolerances on resistors and other parts. When replacing vacuum tubes, which are used in any part of the receiver circuit that has a tuning adjustment associated with it, that particular adjustment should be checked to alignment instructions given under this cover (see pars. 3-18.).

CAUTION

3-3 The Circuit alignment of this receiver has been done with great care before shipment and adjustments should not be made by unskilled personnel. It is absolutely essential that properly calibrated and maintained test equipment be available for aligning the various circuits of the receiver. The alignment procedure given in these instructions must be strictly followed in the correct order so that the performance of the receiver will be restored to normal at the conclusion of the adjustment.

SWITCHES

3-4 It may be found that, after long periods of service on one band, switching to another will disclose that the sensitivity has become impaired. This is usually due to the formation of an oxide film on the unused contacts of the switch, and can very readily be cured by running the switch through all six positions several times. As the contacts of the switch are self-cleaning, the removal of the oxide film will restore the original operation of the receiver very readily.

ALIGNMENT

3-5 The instruments necessary to carry out the alignment of the receiver should be of the highest quality and be accurately calibrated. In particular this is true of the signal generator which must be fitted with an accurate output meter so that the input to the receiver can be known with certainty. For the alignment of the IF stages it is preferable to use an F.M. signal generator in conjunction with an oscilloscope in order that these stages can be properly adjusted. When working on the overall receiver, the use of a calibrated output meter equipped with the necessary auxiliary apparatus to match the headphone or loudspeaker load will be found to be of the utmost service. It is well to remember that in carrying out adjustments to the receiver that all the adjustments should be carried out in the order given and that frequent cross checks should be made to ensure that the previous adjustments have not been moved in error while aligning later stages. In all cases it is advisable to start with the IF stages and for this stage of the alignment it will be necessary to make connections to the receiver as shown in Table 2 below.

TABLE 2

3-6

CONNECTIONS FOR I.F. ALIGNMENT

A.V.C. "OFF".
R.F. GAIN AT 20.
CRYSTAL OSCILLATOR AT "OUT".
TONE AT "MED."
LIMITER AT "OFF".
VOLUME AT 10.
RANGE SWITCH AT "D".
DIAL POINTER AT 1.5 MC.
OUTPUT LOAD 10,000 OHMS AT LOUDSPEAKER JACK (J-2).
OUTPUT POWER ½ WATT. (All adjustments to be made at this level unless otherwise stated.)
SIGNAL GENERATOR CONNECTED TO THE GRID OF THE 6K8 (V3). THROUGH A .01 uf CONDENSER.
SIGNAL GENERATOR FREQUENCY 575 KCS. MOD 30% AT 400 C.P.S.

3-7 Proceed with the adjustment as follows:—Set the signal generator to the correct frequency and adjust the output of the generator to provide a signal strong enough to give an output of ½ watt and reduce the signal from the generator as the circuits are brought into tune, thus keeping the output power at ½ watt. In order to reach some of the test points mentioned in the procedure, it will be necessary to remove the small section of the base plate before commencing operations. Now with the SELECTIVITY control set at 2, adjust C64 so that the screwdriver slot is horizontal, and adjust the two iron cores of T3, the three iron cores of T2, the two iron cores of T1 and the iron cores of L5 for approximate maximum output. Now switch off the modulation on the signal generator, turn BFO switch on the receiver to "ON", and set BFO control to 0. Adjust the iron core of L3 for the zero beat, and check that the BFO control gives about plus or minus 4 kcs. change each side of the zero position. Now set the SELECTIVITY SWITCH to 4 and vary the signal generator frequency slowly over a small range and, by adjustment of the BFO, obtain the maximum output. Considerable care must be exercised in this operation as this position of the SELECTIVITY SWITCH is very sharp. When the point of maximum output has been obtained, the signal generator frequency will be exactly that of the crystal filter and will be left at this setting during the subsequent adjustments.

3-8 Next switch the BFO to "OFF" and turn on the modulation from the generator. Then carefully readjust the two iron cores of T3, the three iron cores of T2, the two iron cores of T1, and the iron core of L5 for maximum output. Small adjustments only will be required for this and the iron cores should be kept tight during the adjustment process so as to prevent the cores wobbling and spoiling the adjustment.

3-9 Remove the modulation from the signal generator and switch the BFO to "ON" and adjust the frequency of the generator to that of the crystal as has been described in paragraph 3.7 above. Next increase the signal generator output 10 times and alter the frequency of the signal generator down through zero beat and up the other side, continuing the process until the input from the signal generator has to be raised to keep the output from the receiver up. When the input from the generator has arisen to 0.1 volts and the output from the receiver is approximately 50 mw, it will be found that the beat note is approximately 5000 cycles. When this point has been reached, adjust C67 for the *minimum* output. This adjustment must be made with an insulated screwdriver.

3-10 The I.F crystal filter must now be rechecked as has been previously described in paragraph 3-7, setting the BFO control at zero and adjusting the core of L3 for zero beat. Check that the range of the BFO control is 4000 c.p.s. on either side of the "0" position. If this condition does not exist, loosen the BFO knob and reset it, so that it is at "0" when the zero beat is heard. Readjust the cores of the transformers T3, T2, T1 and L3 and then carefully lock these cores. At the conclusion of the adjustments to the I.F. stages the following inputs to the various stages should produce an output of ½ watt across the load.

OVERALL I.F. SENSITIVITY	40 uv − 50 + 50%	(at V3 grid 6K8)
2nd I.F. SENSITIVITY	500 uv − 20 + 20%	(at V4 grid 6SG7)
3rd I.F. SENSITIVITY	30,000 uv − 20 + 20%	(at V5 grid 6SK7)

Make a careful note of the exact figure for the overall I.F. sensitivity as this will be used later in the adjustment of the complete receiver.

3-11 Disconnect the signal generator from the grid of the 6K8 vacuum tube and substitute an FM signal generator if available, such as the RCA No. 150 Test Oscillator.* Connect the vertical plates of an oscilloscope between the junction of C86, R2, R40 and ground. Set the sweep of the oscillator to 25 kcs. and connect the output of the oscillator to the SYNC terminals of the oscillograph. All the leads for connection must be as short as possible. Adjust the centre frequency of the test oscillator so that the peaks of the two oscillograph traces overlap. The frequency of the test oscillator must not be altered after this adjustment has been made. Proceed with the adjustment of the receiver as follows:

* If no F.M. signal generator is available, the procedure in paragraphs 3-11 and 3-12 should be omitted.

3-12 Set the SELECTIVITY switch to position 1 and adjust the iron core of L5 to produce a symmetrical flat-topped curve, or as nearly so as can be obtained. In some cases an improvement to the curve can be obtained by a slight readjustment of the top core of T1. It is probable that the two traces will not precisely overlap, but this is acceptable. In general the shape of the curve should be substantially the same as that shown in Figure 19. Move the SELECTIVITY switch to position 2 and adjust condenser C64 for the maximum amplitude of the curve. When maximum amplitude has been obtained, the two curves should overlap. Both these operations should be repeated until the maximum amplitude and the closest approximation of the curves to that of Figure 19 has been obtained.

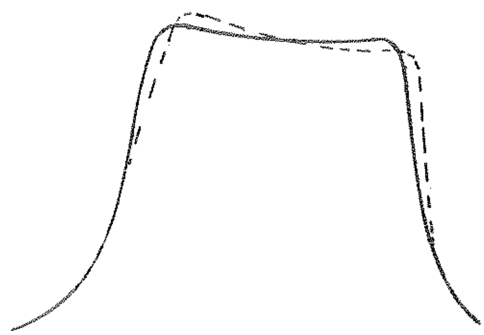


FIG. 19
CATHODE RAY DOUBLE OVERLAPPING PATTERN
FOR I.F. ADJUSTMENT

3-13 Disconnect the test oscillator and replace all the connections as enumerated in section 3.6. Measure the overall sensitivity of the IF stages with the SELECTIVITY switch in position 2; then the figures obtained in paragraph 3.10 should be realized. Switch the SELECTIVITY switch to position 1 and the sensitivity for an output of ½ watt should be 40 uv + or − 50%. Remove the modulation and switch the BFO to "ON" and adjust the signal generator and the BFO for the maximum output. In position 3 of the selectivity switch this should be 20 uv − 50% or + 50% and in position 4, 4 uv − 50% or + 50%. This concludes the adjustment of the IF stages.

3-14 The adjustment of the RF stages is a lengthy and laborious process, and is divided into two parts. The first part is the adjustment of the oscillator stage, while the second is that which takes in the RF stages. The connections to be made for adjustment of the oscillator stage are as shown on the following page :—

A.V.C. "OFF".

RF GAIN 20.

CRYSTAL OSC. "OUT".

SELECTIVITY 2.

LIMITER "OFF".

BFO "OFF".

VOLUME 10.

OUTPUT LOAD 10,000 ohms (at J2—loudspeaker jack).

OUTPUT POWER, ½ watt.

SIGNAL GENERATOR—Modulated 30% at 400 c.p.s.

SIGNAL GENERATOR—Connected to the grid of 6K8 (V3) through a 0.1 uf condenser.

The adjustments to be carried out are those tabulated in Table 3 and the adjusting trimmers and iron cores are those in the oscillator section of the coil compartment nearest to the front panel. (Figs. 5 and 7.)

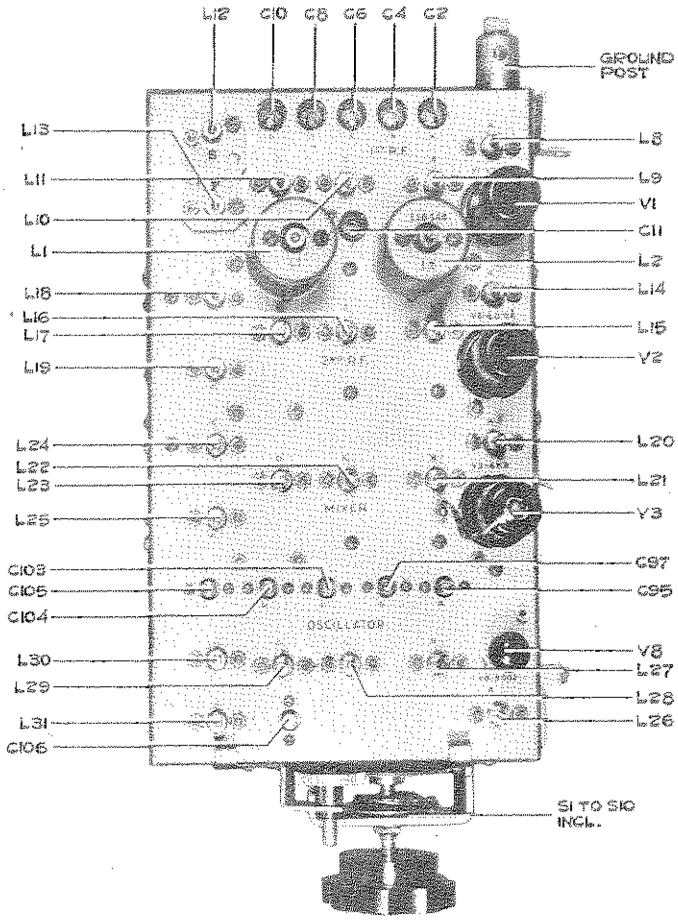


FIG. 5
TURRET ASS'Y (TOP VIEW)

TABLE 3
OSCILLATOR ADJUSTMENTS

Operation No.	Band	Dial and Generator Setting	Adjust Trimmers for Maximum Output	Approx. uv. Input	Function
1	Brown F.	190 kcs.	Trimmer "F" (C-106)	100	High end trim
2	Brown F.	85 kcs.	Iron Core "F" (L-31)	120	Low end track
3	Blue E.	470 kcs.	Trimmer "E" (C-105)	160	High end trim
4	Blue E.	210 kcs.	Iron Core "E" (L-30)	200	Low end track
5	Orange D.	3.3 mcs.	Trimmer "D" (C-104)	100	High end trim
6	Orange D.	1.6 mcs.	Iron Core "D" (L-29)	150	Low end track
7	Green C.	7.2 mcs.	Trimmer "C" (C-103)	70	High end trim
8	Green C.	3.6 mcs.	Iron Core "C" (L-28)	80	Low end track
9	Red A.	15.0 mcs.	Trimmer "B" (C-97)	60	High end trim
10	Red A.	7.4 mcs.	Iron Core "B" (L-27)	75	Low end track
11	Mauve B.	28.0 mcs.	Trimmer "A" (C-95)	50	High end trim
12	Mauve B.	15.6 mcs.	Iron Core "A" (L-26)	50	Low end track

On each of the bands the trim and track adjustments should be repeated until adjustment at one end of the range makes little or no difference at the other. After adjusting each range, check that the Image (signal frequency + 1150 kcs) is higher than the signal frequency, except on the "A" band. This check should be made at the high frequency end of the range. The Image frequency will not be apparent on the E and F ranges and on the A range it will be LOWER than the signal frequency. It should be checked at both ends of the range. This concludes the adjustment of the oscillator section of the RF stages, and it is necessary to point out that the accuracy of the calibration of the receiver depends to a very large extent upon the accuracy of the generator used for this process. The factory adjustment of the calibration of the receiver is carried out against precision standards, which have an accuracy far exceeding that of any signal generator available and it is therefore recommended that no adjustments be attempted to the oscillator stage unless it is absolutely necessary as otherwise the calibration will inevitably be impaired.

3-15 The adjustment of the RF stages can now be proceeded with. The connections and control positions for these adjustments are as noted below and the sequence of adjustments is tabulated in Table 4. The locations of the trimmers to be adjusted are the 1st RF stage, on the top of the compartment, while in the case of the second RF stage and the Mixer, the trimmers are located on the underside (see Figs. 4 and 6). All the coil cores are on the top of the compartments. It will be necessary for the Receiver to be removed from the cabinet in order to have access to the trimmers on the underside. During the process of adjustment, the Signal generator should be adjusted for maximum output as drift may be encountered due to line voltage changes, etc. The input in each case after adjustment should be less than 5 uv for the specified ½ watt output.

A.V.C. "OFF".
RF GAIN 20.
CRYSTAL OSC. "OUT".
SELECTIVITY 2.
LIMITER "OFF".
BFO "OFF".
VOLUME 10.
OUTPUT LOAD 10,000 ohms (at J2-Loudspeaker-Jack).
OUTPUT POWER—½ watt.

SIGNAL GENERATOR—modulated 30% at 400 c.p.s.
SIGNAL GENERATOR—connected to A and E via *STANDARD IRE UNIVERSAL DUMMY (Terminals E and E_1 connected together).

* Where a standard IRE dummy antenna is not available, an approximation may be obtained by using a 400-ohm resistor on Ranges A to D inclusive and 200 mmf., 25 ohms and 20 microheries in series on Ranges E and F.

The adjustment should be carried out in the order given in Table 4, and frequent checks should be made to ensure that no step has been omitted.

TABLE 4

R.F. ADJUSTMENTS

Operation No.	Band	Dial and Generator Setting	Adjust Trimmers for Maximum Output	Approx. uv. Input	Function
1	Brown F.	190 kcs.	3 Trimmers "F" (C52, C34, C11)	5	Mixer, RF, Trim
2	Brown F.	85 kcs.	3 Iron Cores "F" (L25, L19, L13)	5	Mixer, RF, Track
3	Blue E.	470 kcs.	3 Trimmers "E" (C50, C31, C10)	5	Mixer, RF, Trim
4	Blue E.	210 kcs.	3 Iron Cores "E" (L24, L18, L12)	5	Mixer, RF, Track
5	Orange D.	3.3 mcs.	3 Trimmers "D" (C47, C27, C8)	5	Mixer, RF, Trim
6	Orange D.	1.6 mcs.	3 Iron Cores "D" (L23, L17, L11)	5	Mixer, RF, Track
7	Green C.	7.2 mcs.	3 Trimmers "C" (C45, C25, C6)	5	Mixer, RF, Trim
8	Green C.	3.6 mcs.	3 Iron Cores "C" (L22, L16, L10)	5	Mixer, RF, Track
9	Red A.	15.0 mcs.	3 Trimmers "B" (C43, C23, C4)	5	Mixer, RF, Trim
10	Red A.	7.4 mcs.	3 Iron Cores "B" (L21, L15, L9)	5	Mixer, RF, Track
11	Mauve B.	28.0 mcs.	3 Trimmers "A" (C41, C21, C2)	5	Mixer, RF, Trim
12	Mauve B.	15.6 mcs.	3 Iron Cores "A" (L20, L14, L8)	5	Mixer, RF, Track

On each of the Bands the trim and track adjustments should be repeated until adjustment at one end of the Band makes little or no difference at the other.

3-16 After these adjustments have been completed, it may be found that the sensitivity on range "E" is down, which indicates that the IF traps will require adjustment. This is carried out by connecting the signal generator to the grid of V3 (6K8) through an 0.1 uf condenser and feeding approximately 575 kcs to the IF stages and adjusting the frequency of the signal generator until the maximum output is obtained. The signal generator is then connected to the input (antenna terminal) *without* touching the frequency of the generator. The dial of the receiver is then turned to 470 kcs on range "E", and the signal generator output adjusted until ½ watt is obtained in the load. The trap circuits L1 and L2 are now to be adjusted for minimum output taking care that the cores do not shift in the process of locking. When these adjustments have been made it will be found that to achieve an output of ½ watt the input at 575 kcs will be in excess of 0.1 volts. When these adjustments have been completed, it will be found that the sensitivity on this band will be normal, *i.e.*, 5 uv for ½ watt output.

3-17 The approximate sensitivities noted at the various grids are shown on Table 5. These can be used during the course of checking to ascertain whether the receiver is functioning in a normal manner. It will be found that these readings will be obtained with the receiver in normal operating condition. (For location of grid connections, see Fig. 8 following.)

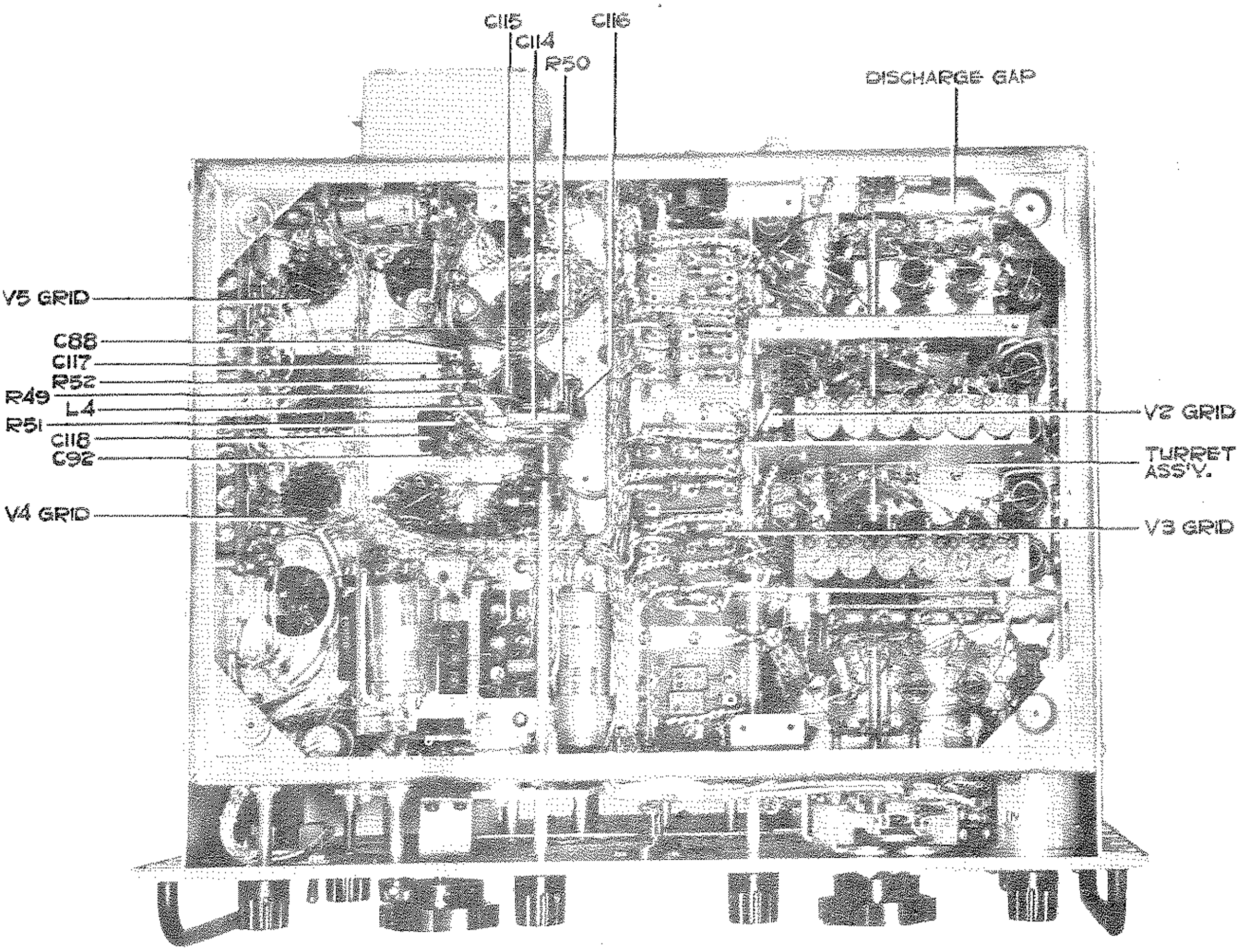


FIG. 8
CHASSIS ASSY. (BOTTOM VIEW) BASE PLATES & B.F.O. SHIELD REMOVED

TABLE 5

INTERSTAGE SENSITIVITIES

Range	Frequency	V1 Grid	V2 Grid	V3 Grid	V4 Grid	V5 Grid
		(Microvolts)				
Brown F..........	190 kcs.	50	60	100		
Blue E...........	470 kcs.	45	100	160		
Orange D.........	3.3 mcs.	10	25	100		
Green C..........	7.2 mcs.	7.5	20	70		
Red B............	15.0 mcs.	5.0	12	60		
Mauve A.........	28.0 mcs.	2.0	6.0	50		
IF..............	575 kcs.	....	...	40	500	30,000

The above sensitivities are those which will produce an output of ½ watt across a 10,000 ohm load at the loudspeaker jack, with the "R.F. Gain" and "Volume" controls at maximum.

Typical overall readings from the antenna using the "Standard Universal" or "Standard Ship's" dummy antennae are given in Table No. 6 and typical sensitivity curves are illustrated in Figs. 25 to 30 inclusive.

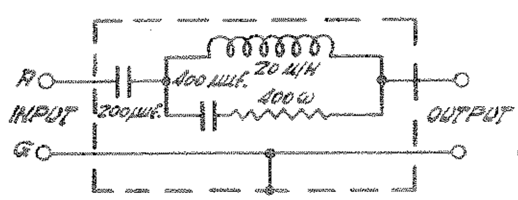
3-18 When carrying out routine adjustments to the receiver, if at any time a tube is changed, especially in the RF circuits, it will be found advisable to retrim the various adjustments on the circuit in which the tube was replaced. This will ensure maximum performance of the receiver. Such adjustments should only be carried out when properly calibrated test equipment is available. In cases where none is available, an attempt to adjust the various circuits will only result in impairing the performance of the unit still further.

3-19 After all the adjustments are complete and the receiver has been restored to normal performance, the adjustment of the antenna trimmers should be rechecked when the unit is placed back in service. As previously mentioned in paragraph 2.6, the trimmers should be adjusted so that the receiver exhibits the maximum hiss or loudest signal when connected to the aerial with which it will work.

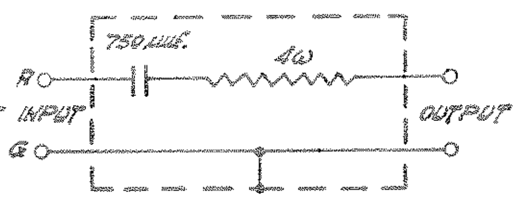
3-20 Routine maintenance should be carried out at frequent intervals. This should consist of a thorough cleaning of the interior of the unit to remove all dust and dirt, and a checking of all controls to see that they are functioning correctly. Where a tube tester is available, all tubes should be removed one by one from the sockets and replaced if any are found to be defective. If a signal generator is available, the sensitivity of the unit should be checked every few months in order to detect any incipient trouble before a breakdown occurs in service. If a rigid schedule for maintenance is adhered to, it will be found that the unit will be maintained at peak performance at all times and that the time lost in carrying out repairs will be cut to the minimum.

TYPICAL SENSITIVITY READINGS

		STANDARD UNIVERSAL DUMMY			STANDARD SHIPS DUMMY		
BAND	FREQ.	MCW ABSOLUTE	MCW 20 DB S TO N	C/W 20 DB S TO N	MCW ABSOLUTE	MCW 20 DB S TO N	C/W 20 DB S TO N
	28 M.C.	2.9 µ/V	11 µ/V	4.1 µ/V	.49 µ/V	5.2 µ/V	1.3 µ/V
A	20 M.C.	3.9 µ/V	13.5 µ/V	4.0 µ/V	.64 µ/V	8.8 µ/V	1.7 µ/V
	15.6 M.C.	1.9 µ/V	14.0 µ/V	4.3 µ/V	1.6 µ/V	9.5 µ/V	2.4 µ/V
	15 M.C.	2.7 µ/V	10 µ/V	3.4 µ/V	1.8 µ/V	5.1 µ/V	1.5 µ/V
B	11 M.C.	1.9 µ/V	13.8 µ/V	4.1 µ/V	.76 µ/V	7.0 µ/V	1.6 µ/V
	7.4 M.C.	2.5 µ/V	14.0 µ/V	3.5 µ/V	1.1 µ/V	8.8 µ/V	2.2 µ/V
	7.2 M.C.	2.7 µ/V	9.5 µ/V	2.1 µ/V	1.6 µ/V	5.4 µ/V	1.75 µ/V
C	5.0 M.C.	1.4 µ/V	8.5 µ/V	2.3 µ/V	.9 µ/V	5.4 µ/V	1.6 µ/V
	3.6 M.C.	1.75 µ/V	7.6 µ/V	2.6 µ/V	1.3 µ/V	5.4 µ/V	1.7 µ/V
	3.3 M.C.	2.4 µ/V	5.5 µ/V	1.7 µ/V	1.2 µ/V	4.1 µ/V	.95 µ/V
D	2.4 M.C.	1.7 µ/V	6.0 µ/V	1.6 µ/V	1.1 µ/V	3.9 µ/V	.78 µ/V
	1.6 M.C.	2.9 µ/V	8.5 µ/V	2.0 µ/V	2.1 µ/V	4.4 µ/V	.88 µ/V
	470 K.C.	2.5 µ/V	3.6 µ/V	.8 µ/V	2.0 µ/V	2.5 µ/V	.43 µ/V
E	300 K.C.	2.5 µ/V	6.0 µ/V	1.5 µ/V	1.6 µ/V	3.4 µ/V	.5 µ/V
	210 K.C.	4.0 µ/V	8.5 µ/V	2.0 µ/V	2.0 µ/V	3.3 µ/V	.48 µ/V
	190 K.C.	2.5 µ/V	5.0 µ/V	.85 µ/V	2.2 µ/V	2.5 µ/V	.48 µ/V
F	130 K.C.	3.5 µ/V	7.6 µ/V	1.0 µ/V	1.0 µ/V	2.4 µ/V	.7 µ/V
	85 K.C.	5 µ/V	15 µ/V	1.4 µ/V	1.5 µ/V	6 µ/V	1.0 µ/V



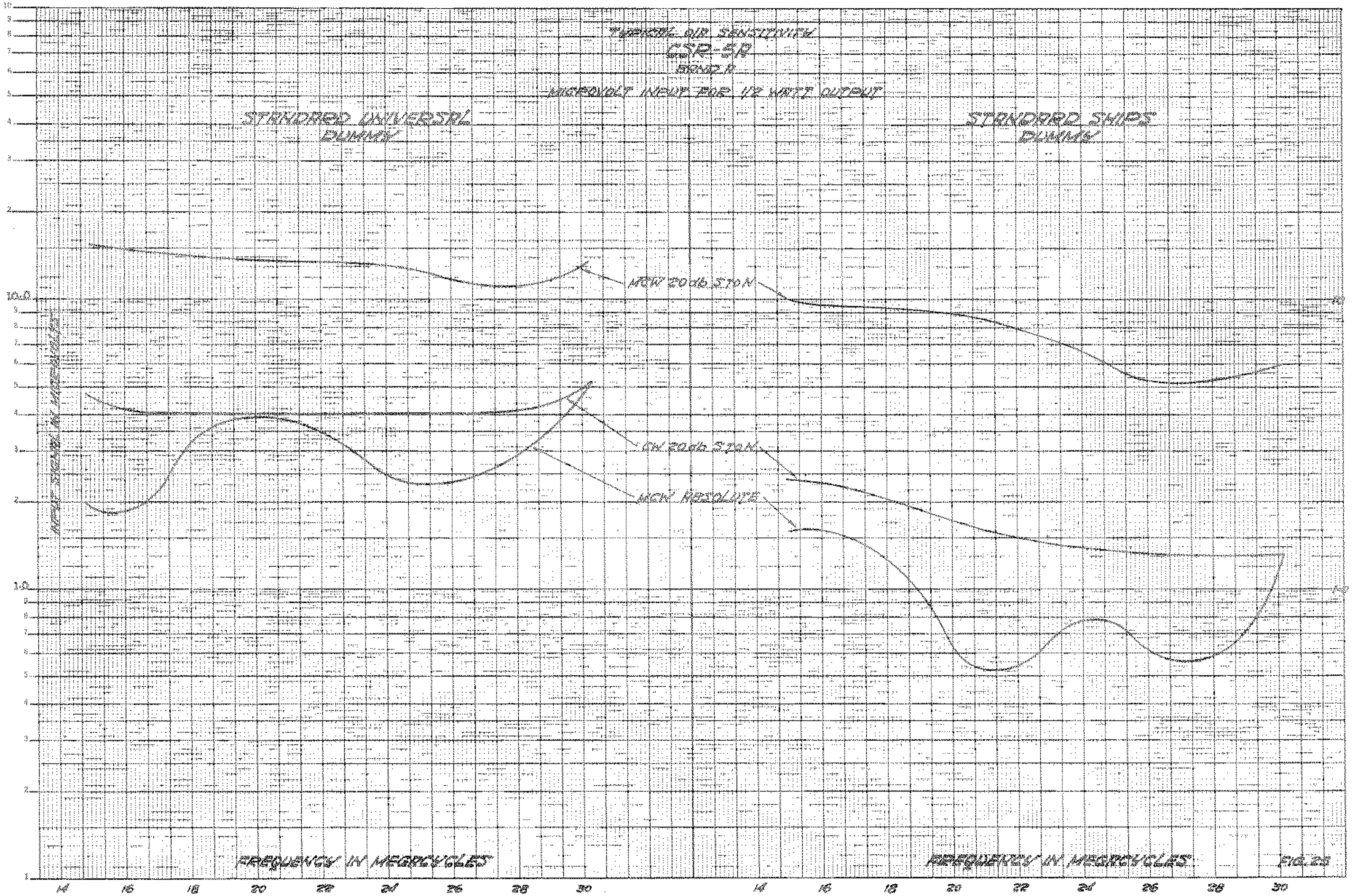
STANDARD UNIVERSAL DUMMY



STANDARD SHIPS DUMMY

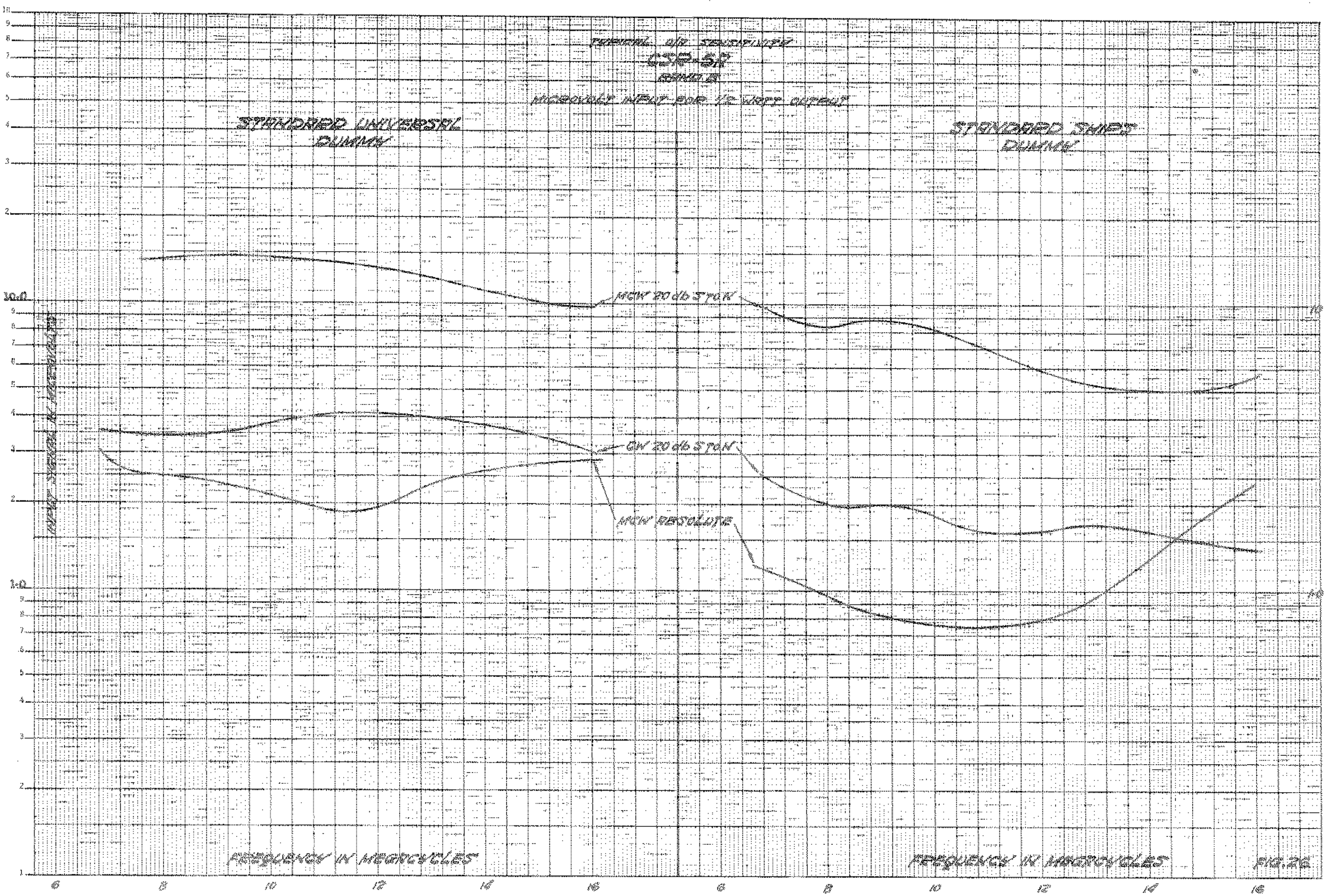
NOTE:- ABSOLUTE SENSITIVITY IS THE INPUT, MODULATED 30% AT 400 C.P.S., REQUIRED TO GIVE 500 MILLIWATTS AUDIO OUTPUT, AT 400 C.P.S., ABOVE THE NOISE OUTPUT WITH THE RECEIVER GAIN AND VOLUME CONTROLS AT MAXIMUM GAIN.

TABLE #6.



TYPICAL AIR SENSITIVITY
CSR-5R
BAND A
MICROVOLT INPUT FOR 1/2 WATT OUTPUT
STANDARD UNIVERSAL DUMMY
STANDARD SHIPS DUMMY
MCW 20db S to N
CW 20db S to N
MCW ABSOLUTE
INPUT SIGNAL IN MICROVOLTS
FREQUENCY IN MEGACYCLES
FREQUENCY IN MEGACYCLES
10.0
1.0
14
16
18
20
22
24
26
28
30

FIG. 23


TYPICAL O/A SENSITIVITY
CSR-5R
BAND B
MICROVOLT INPUT FOR 1/2 WATT OUTPUT
STANDARD UNIVERSAL DUMMY
STANDARD SHIPS DUMMY
MCW 20 db S TO N
CW 20 db S TO N
MCW RESOLUTE
INPUT SIGNAL IN MICROVOLTS
FREQUENCY IN MEGACYCLES
FREQUENCY IN MEGACYCLES
FIG. 26

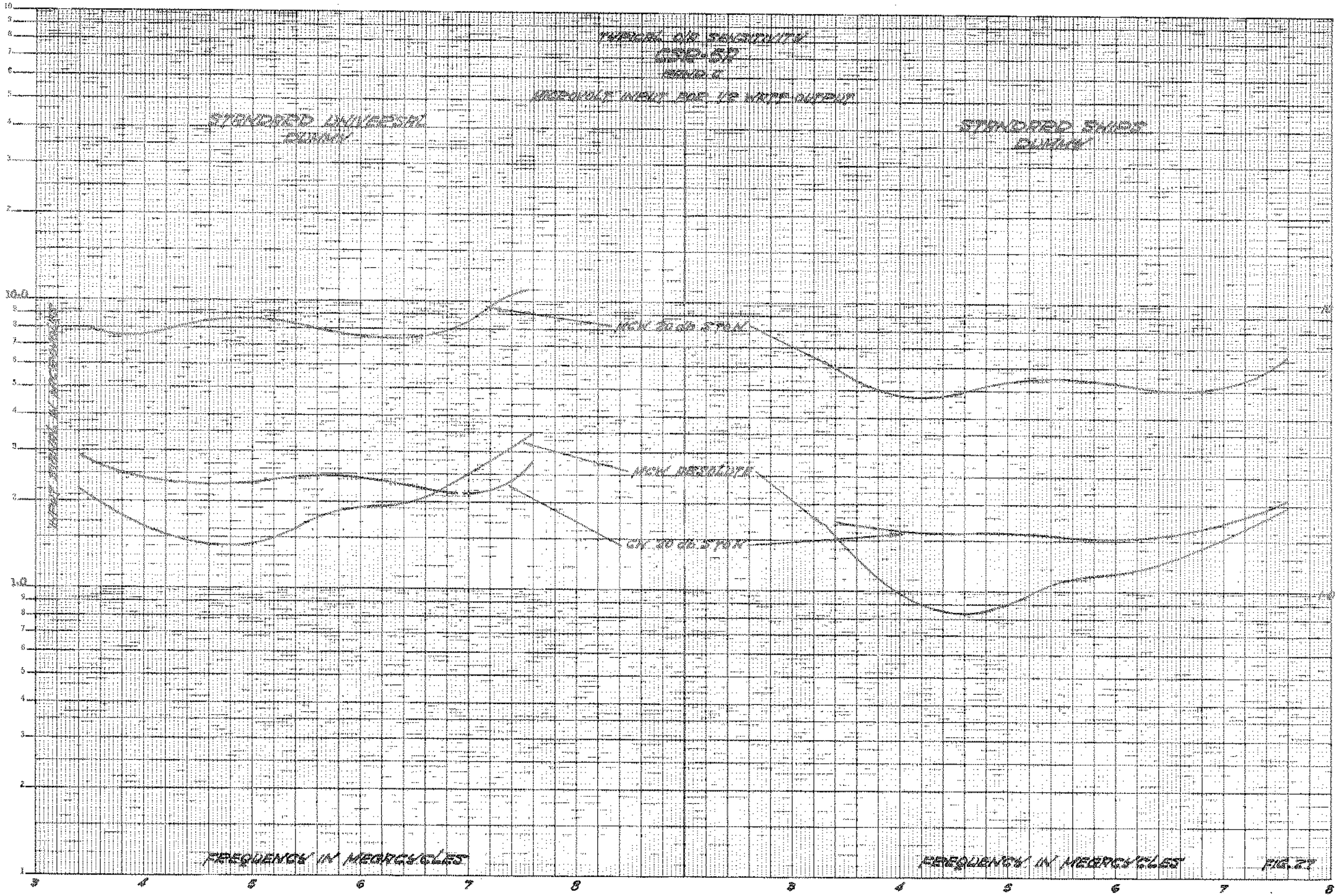
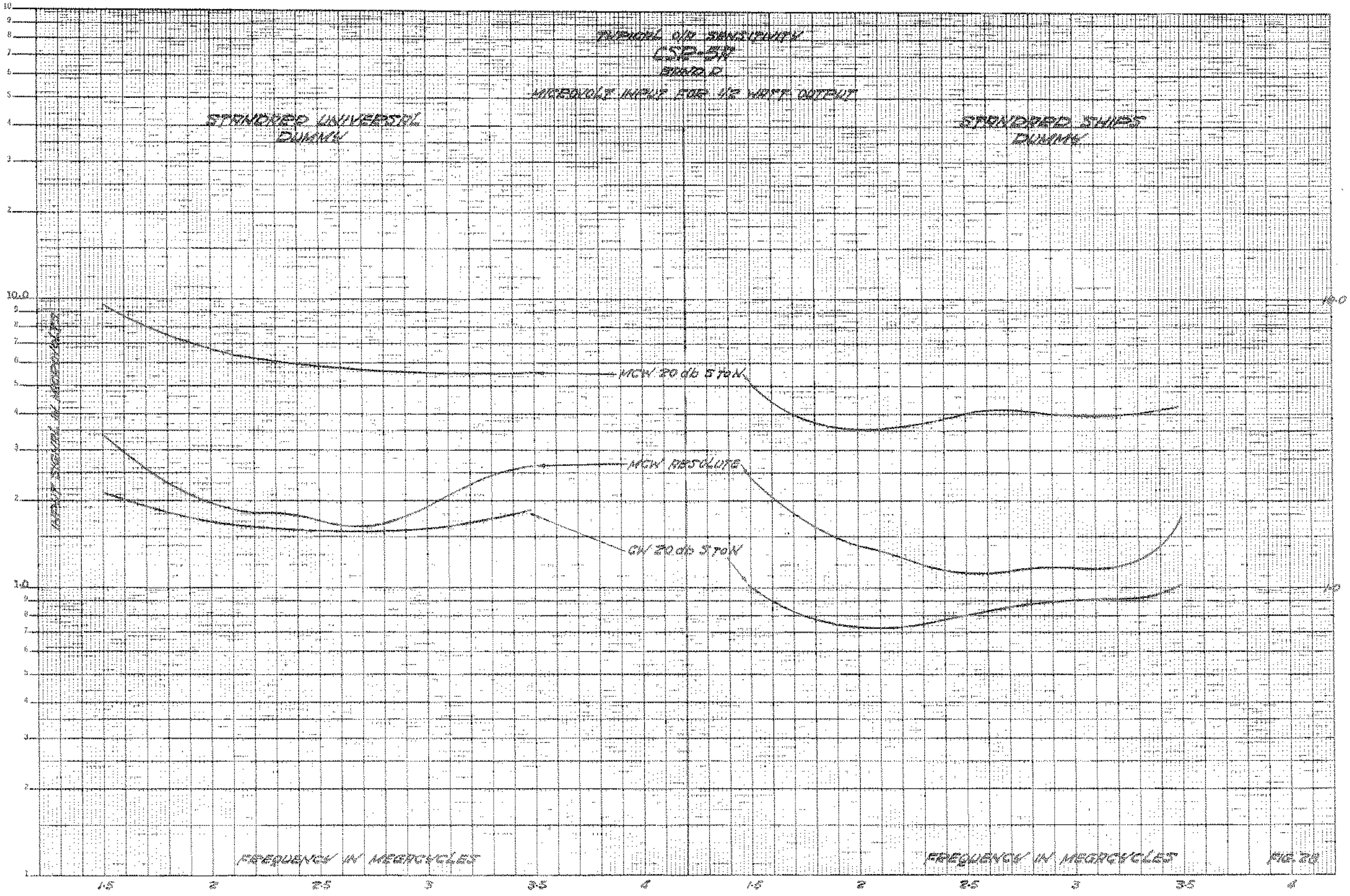
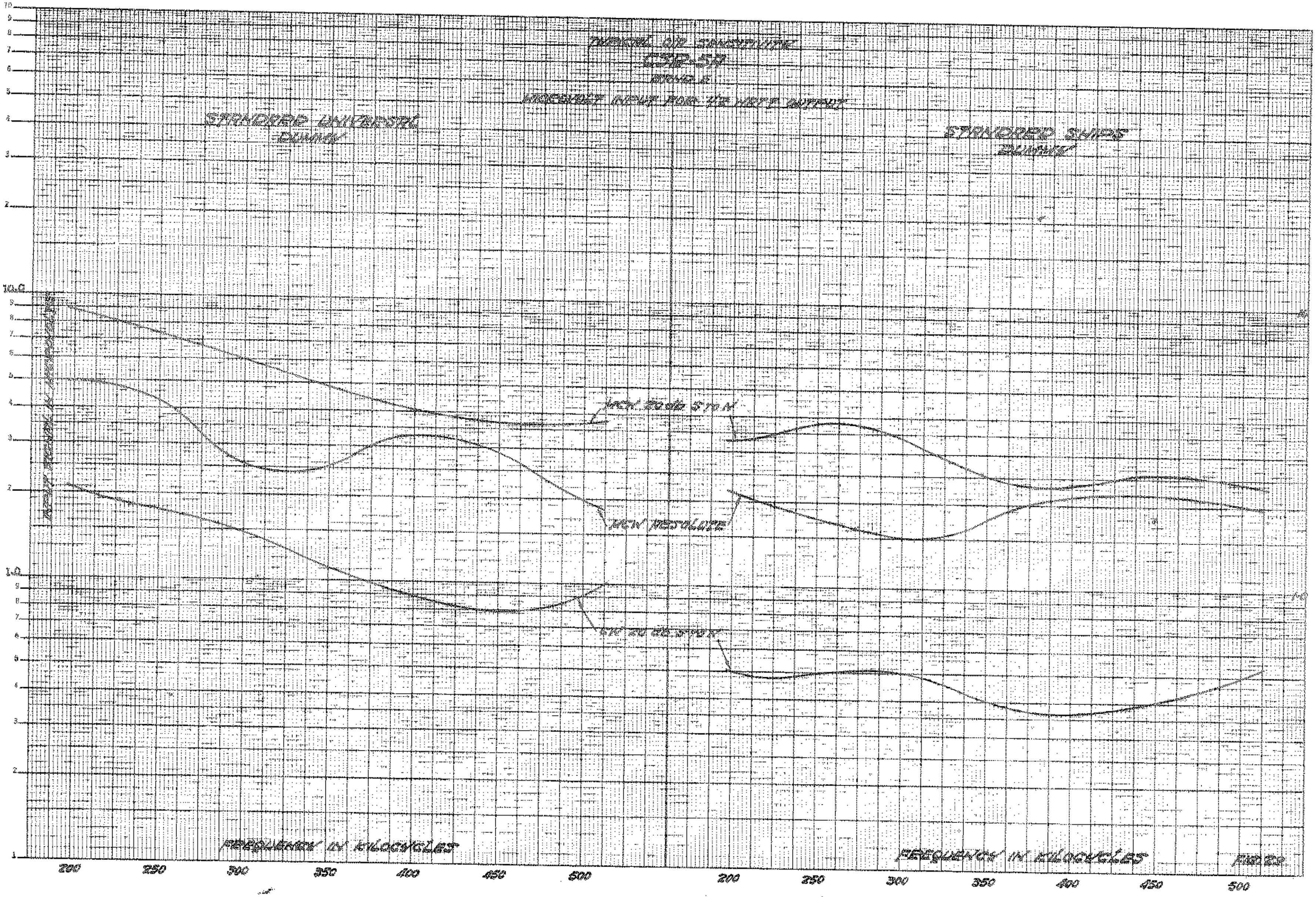
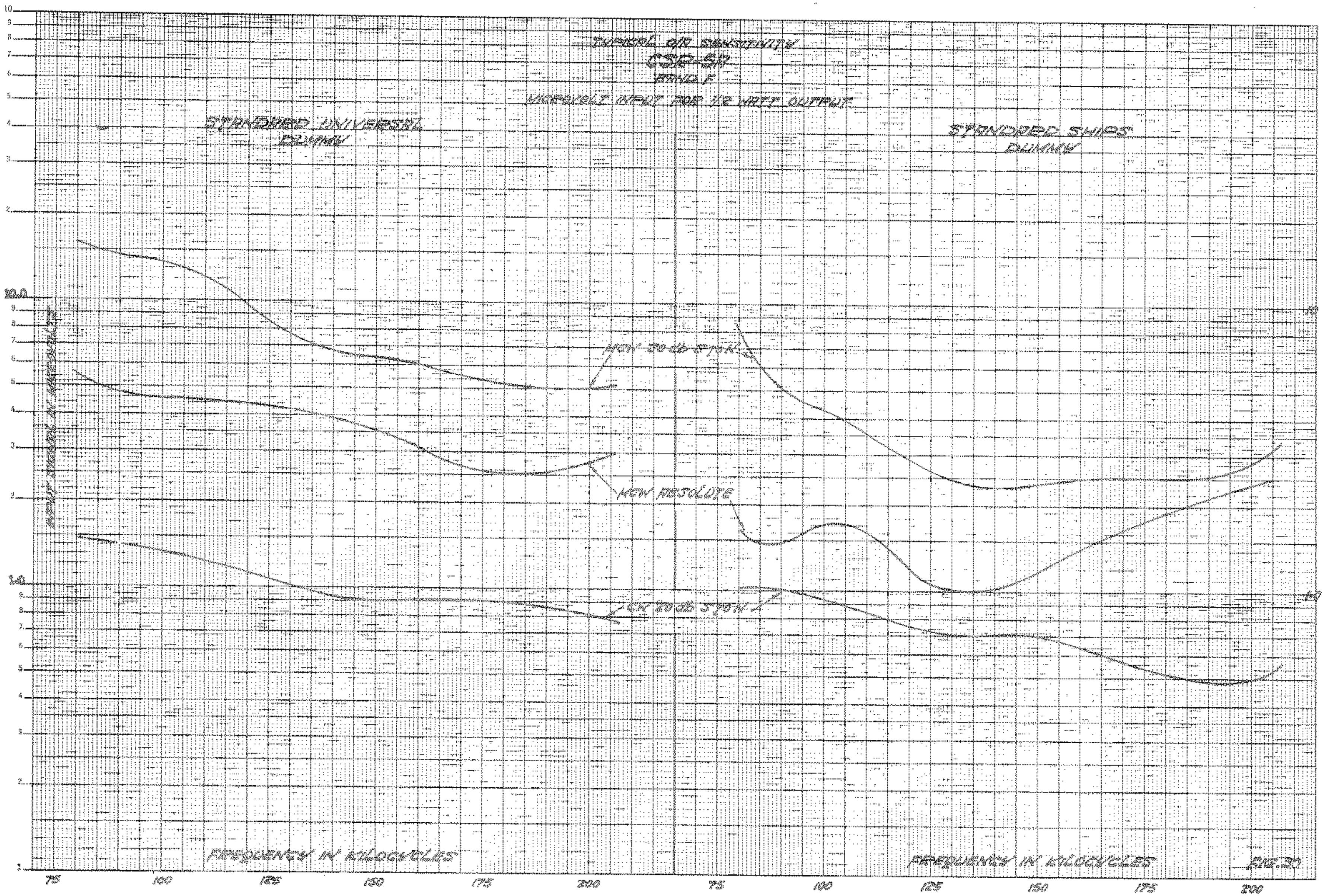

TYPICAL C/S SENSITIVITY
GSR-57
BAND I
USEABLE INPUT FOR 1/2 WATT OUTPUT
STANDARD UNIVERSAL DUMMY
STANDARD SHIP DUMMY
MCW 20 db S TO N
MCW ABSOLUTE
CW 20 db S TO N
FREQUENCY IN MEGACYCLES
FREQUENCY IN MEGACYCLES

FIG. 27


TYPICAL O/A SENSITIVITY
MICROVOLT INPUT FOR 1/2 WATT OUTPUT
STANDARD UNIVERSAL DUMMY
STANDARD SHIPS DUMMY
MCW 20 db S to N
MCW ABSOLUTE
CW 20 db S to N
INPUT SIGNAL IN MICROVOLTS
FREQUENCY IN MEGACYCLES
FREQUENCY IN MEGACYCLES
10.0
1.0
1.5
2
2.5
3
3.5
4


CSR-5A
MICROVOLT INPUT FOR 1/2 WATT OUTPUT
STANDARD UNIVERSAL DUMMY
STANDARD SHIPS DUMMY
MCW 20 db S TO N
CW 20 db S TO N
FREQUENCY IN KILOCYCLES
FREQUENCY IN KILOCYCLES


TYPICAL O/R SENSITIVITY
CSR-5R
BAND F
MICROVOLT INPUT FOR 1/2 WATT OUTPUT
STANDARD UNIVERSAL DUMMY
STANDARD SHIPS DUMMY
FREQUENCY IN KILOCYCLES
FREQUENCY IN KILOCYCLES
FIG. 30

3-21 The mechanical construction of the receiver is such that the majority of the parts can be readily removed from the unit in cases where it is necessary to effect a repair. The only parts rivetted to the chassis are the tube sockets, all others being mounted with screws. The RF coil assembly is made as a separate unit and can be removed from the remainder of the receiver for service or replacement purposes. If at any time it is necessary to remove this section of the receiver, proceed as follows:—

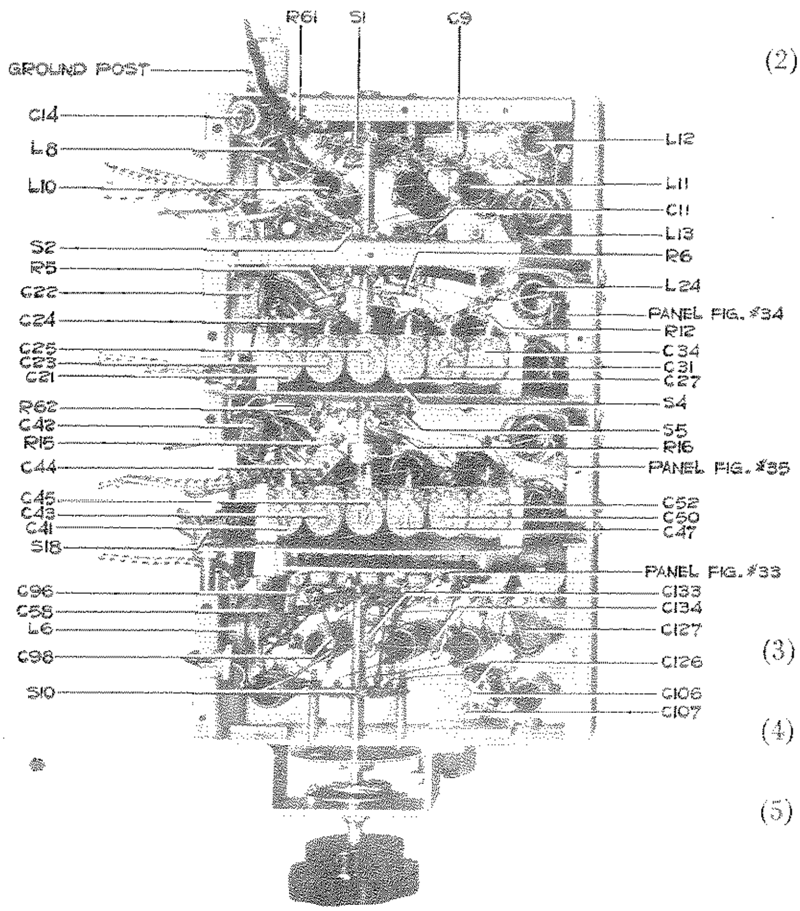


FIG. 7
TURRET ASSY. (BOTTOM VIEW)

(1) Remove the front panel, and the two base plates from the unit.

(2) Unsolder the following connections to the RF unit:—

Three connections to the antenna terminal panel.

Eight connections to the rear resistor panel (Fig. No. 31).

Nine connections to the middle resistor panel (Fig. No. 32).

Two connections to the front resistor panel (Fig. No. 6).

Five connections to the gang condenser.

One connection to the copper pipe connecting to the panoramic output terminal.

(3) Remove the ground connection to the gang condenser.

(4) Take off the coupling to the crystal oscillator switch.

(5) Remove the cable clamps that hold the ON and OFF switch cable to the front of the RF unit.

(6) Remove three screws holding the front of the RF unit.

(7) Remove 15 screws holding the RF unit to the chassis.

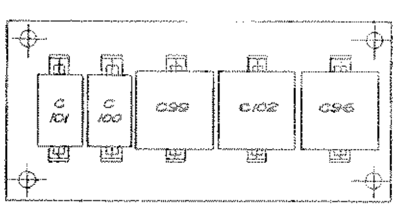


FIG. 33
OSCILLATOR TRACKING PANEL ASSY.

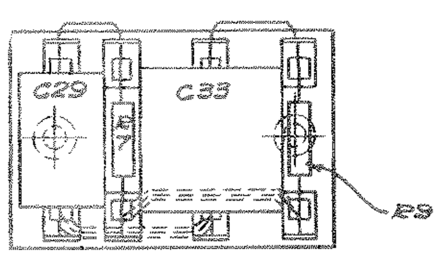


FIG. 34
1st R.F. PLATE SHUNT PANEL ASS'Y.

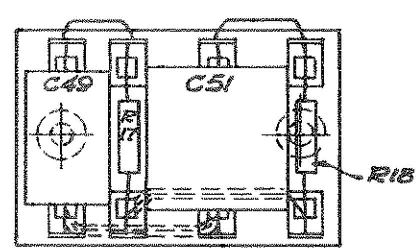
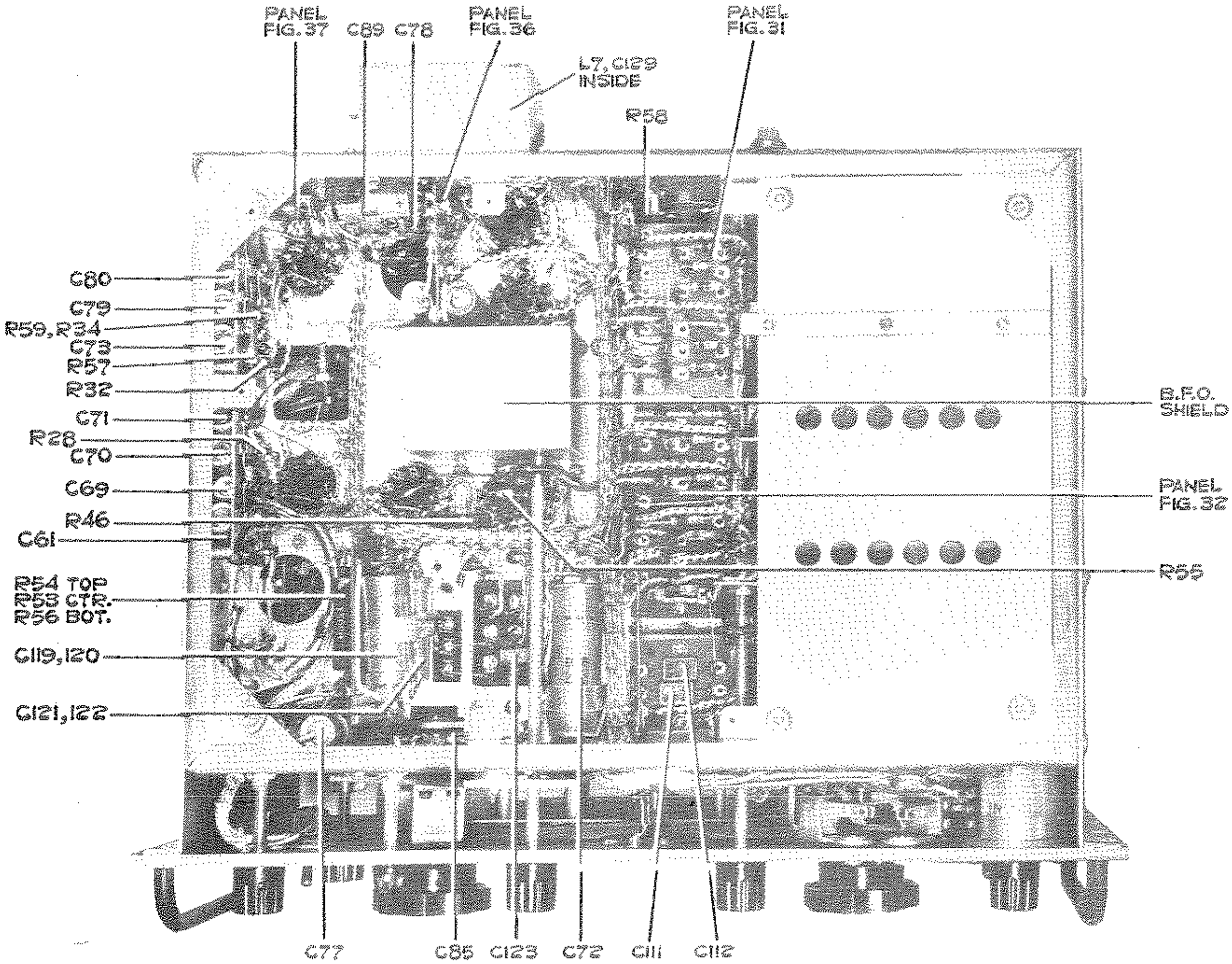
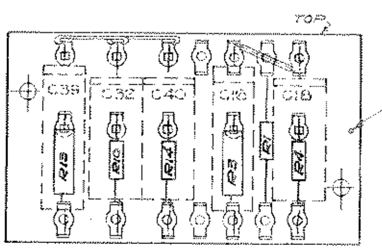


FIG. 35
2nd R.F. PLATE SHUNT PANEL ASSY.



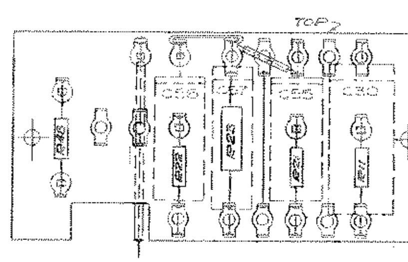
CHASSIS ASSY. (BOTTOM VIEW) MAIN BASE PLATE REMOVED

FIG. 6



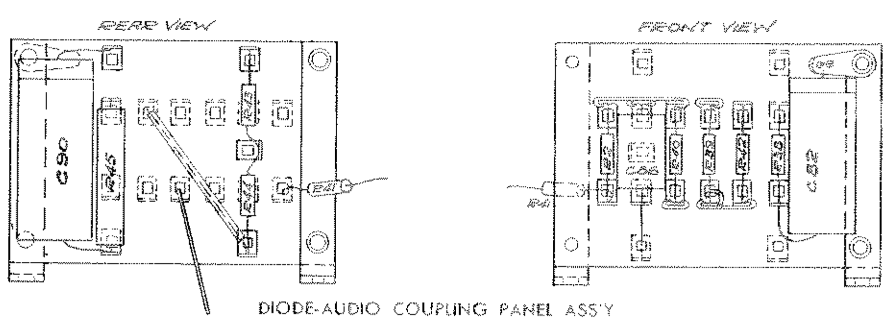
1st R.F. FILTER PANEL ASSEMBLY

FIG. 31



2nd R.F. and DET FILTER PANEL ASSEMBLY

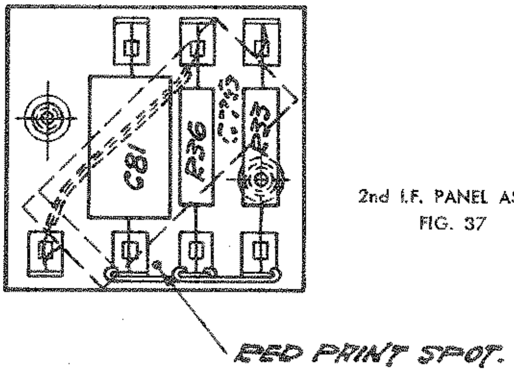
FIG. 32



DIODE-AUDIO COUPLING PANEL ASS'Y

FIG. 36

The RF unit can then be removed from the rest of the receiver and any necessary repairs effected. When these have been completed, replace the unit in the receiver in the reverse order from that given for its removal. The wires that connect between the RF unit and the rest of the receiver are colour coded for the insulated wires, but the major connections are made with bare wire and for this reason it will be necessary to make a careful note of the correct connections to the receiver proper. After removal and repair of the RF unit, it will be essential to realign the RF circuits of the receiver as described in the foregoing pages.



2nd I.F. PANEL ASS'Y.
FIG. 37

TYPICAL IMAGE ATTENUATION READINGS

BAND	SIGNAL FREQUENCY	IMAGE FREQUENCY	IMAGE ATTENUATION DB
	28 M.C.	26·85 M.C.	40
A	20 M.C.	18·85 M.C.	50
	15·6 M.C.	14·45 M.C.	55
	15 M.C.	16·15 M.C.	35
B	11 M.C.	12·15 M.C.	70
	7·4 M.C.	8·55 M.C.	80
	7·2 M.C.	8·35 M.C.	75
C	5·0 M.C.	6·15 M.C.	90
	3·6 M.C.	4·75 M.C.	100
	3·3 M.C.	4·45 M.C.	90
D	2·4 M.C.	3·55 M.C.	100
	1·6 M.C.	2·75 M.C.	115
	470 K.C.	1620 K.C.	120
E	300 K.C.	1450 K.C.	120
	210 K.C.	1360 K.C.	120
	190 K.C.	1340 K.C.	120
F	130 K.C.	1280 K.C.	120
	85 K.C.	1235 K.C.	120

TYPICAL I.F. ATTENUATION READINGS

BAND	SIGNAL FREQUENCY	I.F. ATTENUATION D.B.
A	20 M.C.	120
B	10 M.C.	120
C	5·0 M.C.	120
D	2·2 M.C.	120
E	470 K.C.	100
F	150 K.C.	120

TABLE 7

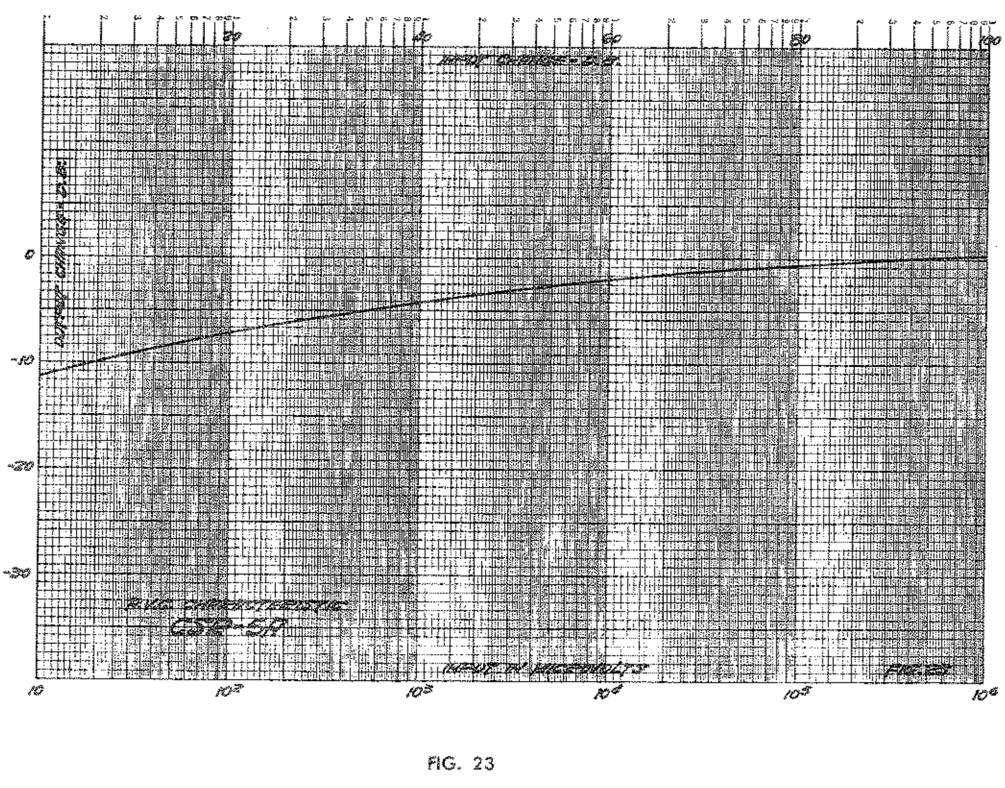
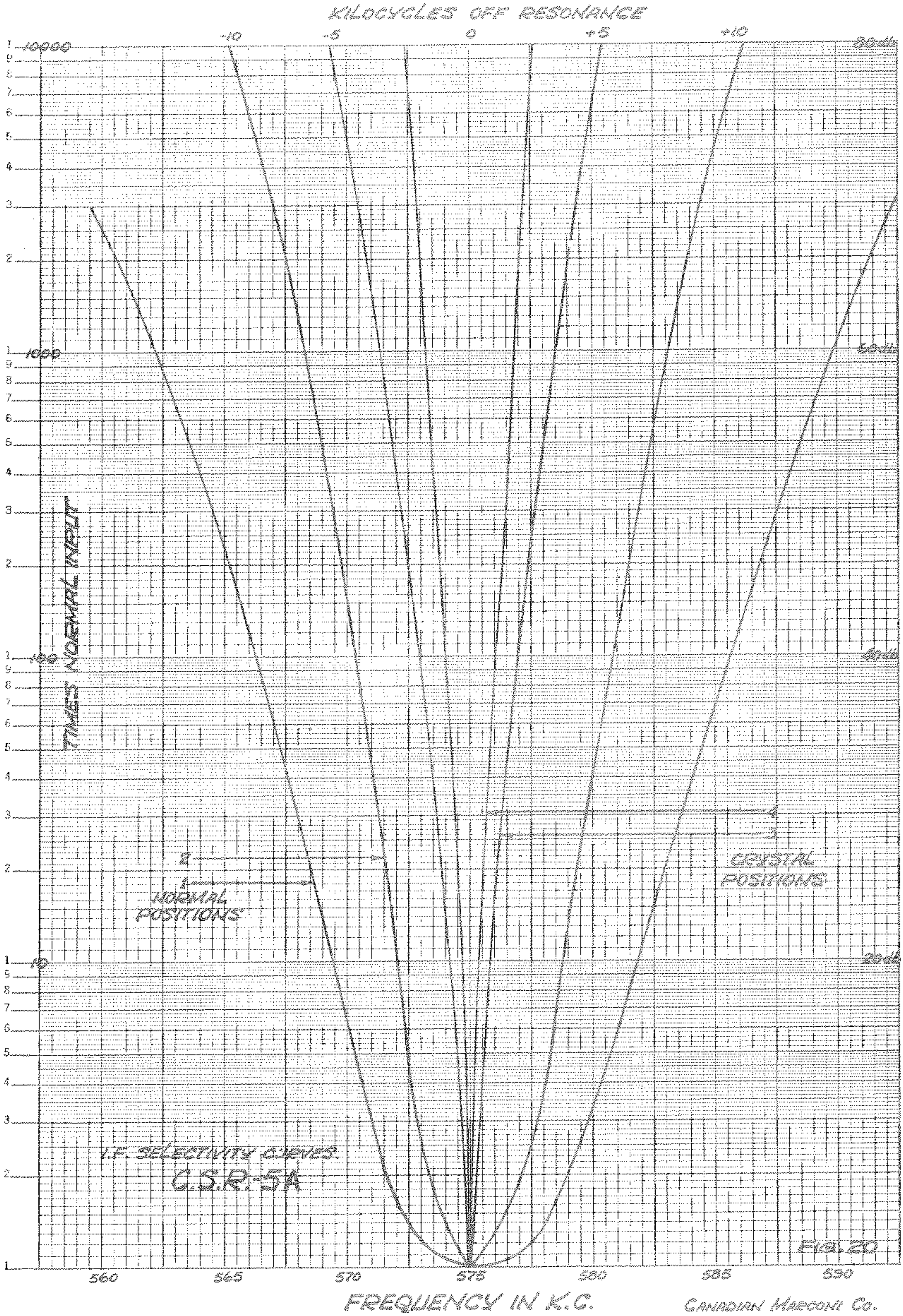
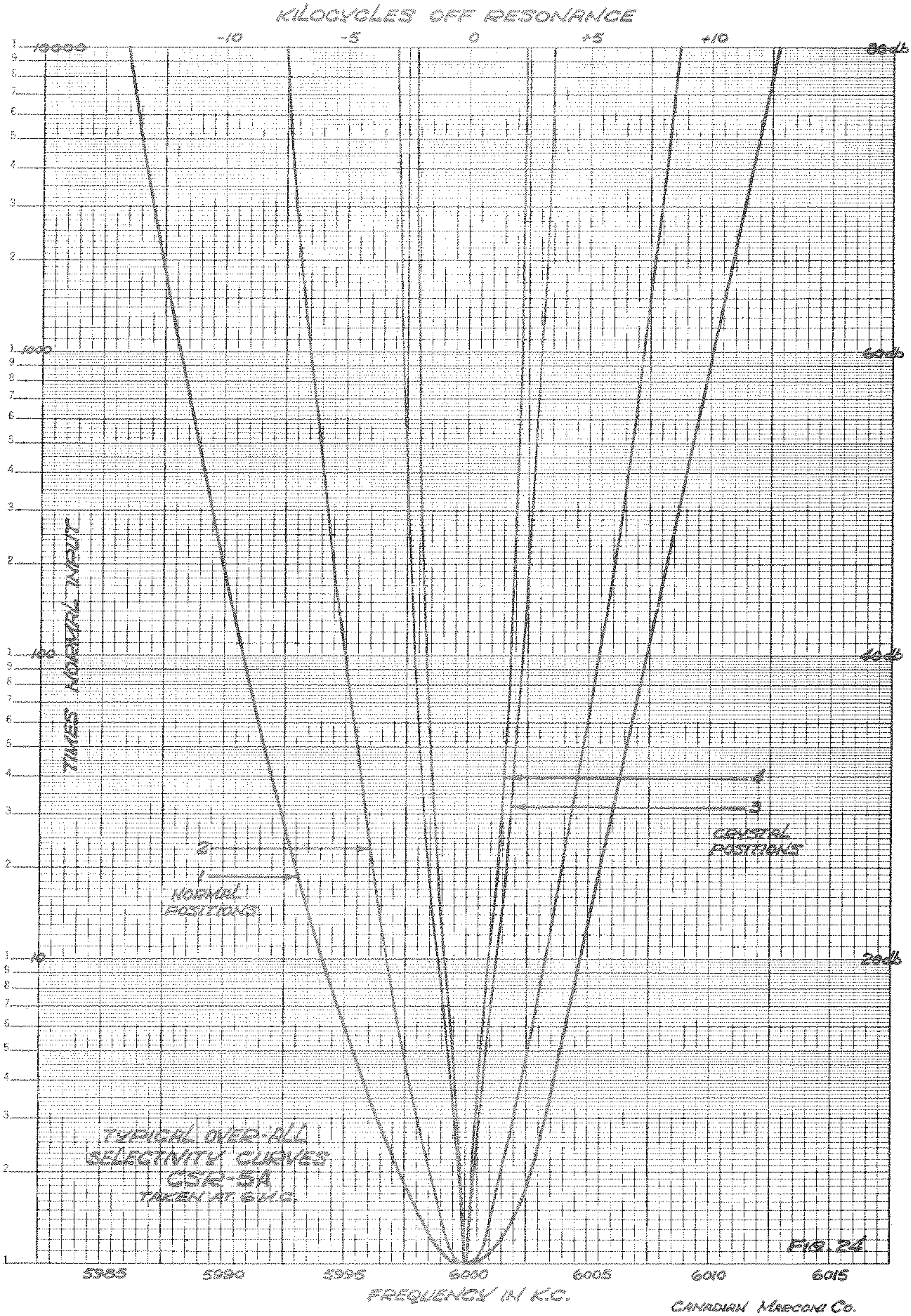


FIG. 23


KILOCYCLES OFF RESONANCE
-10
-5
0
+5
+10
10000
1000
100
10
TIMES NORMAL INPUT
2
1
NORMAL POSITIONS
4
3
CRYSTAL POSITIONS
I.F. SELECTIVITY CURVES
C.S.R.-5A
FIG. 20
560
565
570
575
580
585
590
FREQUENCY IN K.C.
CANADIAN MARCONI CO.



CANADIAN MARCONI CO.

TECHNICAL DESCRIPTION

SECTION 4

4-1 The basic circuit of this receiver, that of the superheterodyne, has been especially adapted for the services for which the unit is intended. To that end the chassis of the instrument has been constructed of heavy gauge sheet steel, reinforced where necessary. Heavy cadmium plating and aluminum spray and bake have been applied to all parts to resist corrosion. The gang condenser has wide plate spacing and has been reinforced by additional back plates, to provide the maximum stability of the oscillator section. Every care has been taken to isolate the 1st RF or antenna section so that the radiation from the receiver is as low as possible, thus enabling the unit to be used in locations where the radiation would be a hazard. All small components, such as condensers and resistors, have, wherever possible, been mounted on small sub-panels to ensure rigidity of construction, and to ensure that the receiver will maintain stability under conditions of heavy vibration or tilting. The RF coils are contained in a separate compartment which can be readily removed from the receiver for service purposes. All the RF coils are wound on high grade low loss bakelite formers impregnated with a non-hygroscopic bakelite varnish and baked, as also are the edges of all the sub-panels and other parts where the entrance of moisture would have an adverse effect. All the condensers used in the oscillator circuits are temperature compensated and to further increase the stability of this section a stabilized voltage supply is incorporated in the receiver. These precautions in the oscillator circuits, permit the receiver to be precision calibrated at the factory, thus ensuring that the calibration is better than .5% at any frequency.

4-2 Among the special features of this receiver are the use of two stages of RF preselection ahead of the mixer stage which provide the required degree of selectivity to minimize cross modulation and blocking ahead of the mixer stage. The use of two stages in the RF section also results in a high degree of image suppression. The use of two stages in the RF section permits the gain of the first vacuum tube to be made much higher than those following and thus reduces the inherent noise in the receiver and gives an extremely high signal to noise ratio. The tracking and trimming adjustments of the RF stages are carried out by a combination of high grade permeability iron cores and stabilized variable condensers. These with the low loss silver mica fixed tracking condensers ensure that the maximum performance is achieved over the specified bands.

4-3 An efficient noise limiter circuit is employed which ensures that reception is possible under conditions where an extremely high local noise level is encountered. This coupled with the full AVC permits reception of signals to be carried out under the most adverse conditions. To further facilitate this, the IF stages are provided with a crystal filter which enables the band width to be varied over several ranges. When this filter is switched into circuit on the two sharpest conditions adjacent channel interference is cut to a minimum, and in consequence of this the noise picked up from external sources is also attenuated to a marked degree

4-4 The tuning of the main condenser is accomplished by rotating a single knob on the front panel, which by means of an inertia driven flywheel type gear train, moves a knife edge pointer over the large semicircular, calibrated, illuminated dial. This dial has six coloured scales which correspond to the various bands each calibrated in either kilocycles or megacycles. In addition to the six calibrated scales there is, on the outside edge of the dial, an additional LOGGING scale. This scale is used in conjunction with the calibrated dial on the vernier tuning knob, to provide a ready means of resetting the receiver to any predetermined frequency. The dial directly above, and coupled to, the main tuning knob, is calibrated 0-100 and as the gear train between the main pointer on the center dial and the tuning knob is slightly more than 23-1 the LOGGING scale is divided into 23 parts. The combination of the vernier and the main dials provides a scale which is in effect 2300 divisions long, which may be applied to any of the six bands on the receiver. As there is practically no backlash in the gear trains (less than 1 division on the vernier scale), the dial may be reset with great accuracy. The accuracy is such that the receiver can be tuned to any frequency, the dial setting logged, the volume turned off, and the dial and wave change rotated through all the six bands and the original setting returned to, and the volume turned up again with the certainty that the signal will be within the limits of audibility. The resetability of the receiver, when using the logging scale, is better than 0.03% at any frequency in the bands covered by the receiver. This feature will be found to be of great use in locations where the dictates of the service demand that several stations on different frequencies be worked in quick rotation.

4-5 For the reception of CW signals, a Beat Frequency Oscillator is provided in the IF stages. The oscillator is fitted with a switch on the front panel which permits the feature to be switched on when desired. An additional control, also on the front panel, is provided so that the frequency of the note may be varied to suit conditions of reception. When the BFO is used in conjunction with the sharper positions of the crystal filter, the band width is so reduced that signals differing by as little as 2 kilocycles from the desired signal can be read with ease. Due to the sharpness of this adjustment, the overall sensitivity as well as the signal to noise ratio of the receiver is considerably better than when working on modulated signals.

4-6 Provision is also made for the operation of the receiver as a crystal controlled unit. A socket is provided on the front panel and into this, a crystal whose frequency is 575 kilocycles higher in frequency than the channel on which it is desired to receive, is plugged. The crystal switch on the front panel is thrown to the crystal which then oscillates in the mixer valve in a modified Pierce circuit. The receiver tuning is then set to approximately the correct frequency on the correct band and signals will be received. The frequency of the crystal must be within + or − 1 kcs. of the frequency on which reception is required, otherwise the sensitivity of the unit will be sub-normal. Only one crystal socket is provided, but as many crystals can be used as the dictates of the service require. The sensitivity of the receiver when used for crystal controlled spot frequency working is approximately the same as that obtaining when the unit is used as a conventional tuned receiver, except when harmonic frequencies of the crystal must be used.

4-7 An adapter is fitted to the receiver to permit operation with a panoramic adapter if so required. This connection is mounted inside the unit and is connected ahead of the IF stages. Provision is also made for additional output connections to feed 500 ohm lines as well as high and low resistance phones and the loudspeaker. All these conditions are fed from the secondary windings of the output transformer, and as they are isolated, carry no direct current in any of them.

4-8 The aerial connections to the unit are made at the back and are so arranged that the user of the receiver has a choice of several methods of feeding the signal to the receiver. A small terminal panel carrying three terminals provides for the receiver to be used on either the conventional aerial and ground system or with transmission lines between the aerial and the receiver. Two types of transmission lines can be accommodated, either balanced to ground or concentric. By rearranging the connections on the aerial panel, the input can be made to match any of the above-mentioned combinations. In addition to the connections, each band on the receiver is provided with a separate antenna trimmer condenser which is mounted on the RF section of the chassis and is screwdriver adjusted at the time of installation. The combination of these adjustments provides for the most efficient use of the signal received from the distant point and contributes materially to the overall performance of the unit.

4-9 The following general description of the functions and locations of the various components will assist technical personnel in the maintenance of the receiver at the maximum performance at all times.

4-10 The RF section of the receiver, Fig. 5, is assembled on its separate sub chassis and comprises the two RF vacuum tubes, a mixer tube, and the oscillator tube. All the associated coils, and padding and trimming condensers, as well as the resistors for some of the circuits, are contained on this chassis. The wavechange switch passes through the centre of the unit and is suitably insulated in the centre section to decrease radiation from the receiver as a whole. It will be noted that the gang condenser is mounted on the main chassis, and is shielded to further obviate the radiation from the receiver. The connections from the RF coil unit to the gang condenser are made in buss wire and are taken as directly as possible.

4-11 The antenna panel is located on the rear of the chassis and the connections from various terminals are taken direct to the RF unit. Mounted on this panel will be found the gas gap. This gap (Admiralty Pattern 8431) is connected in parallel with the RF input transformer primary and breaks down at 100 volts, offering a lowered impedance path. This relieves the RF circuit coils of some of the stress when an abnormal voltage is impressed.

4-12 The first section of the band switch (S-1), Fig. 41, selects one of the six antenna coils. These coils are especially constructed as high gain RF transformers and contribute to the high amplification of the first RF stage. The gain of this stage which employs a 6SK7 vacuum tube is made as high as possible to counteract the effect of tube and set noise in the subsequent stages. This has a very considerable effect in reducing the noise in the receiver as a whole and thus gives a very high signal to noise ratio.

4-13 The tuned secondaries of these antenna coils are selected by the second section of the switch (S-2) which connects them to the grid of the first RF tube. The base of the secondary windings is connected through the isolating resistor R1 to the automatic volume control circuits. The gang condenser C-13 provides the tuning for the circuit in conjunction with the trimmer condensers C2, C4, C6, C8, C10 and C11. These are the aerial trimmers and have to be set for each aerial in accordance with the instructions given in paragraph 2.6. C14 is used to complete the tuned circuit. On range A, in order to reduce the frequency ratio, the condenser C12 is switched into circuit. The cathode of the first valve is taken through the I.F. rejection filter L2 to the RF gain control, R30, which is a stepped type resistance attenuator. L2 is an IF wave trap and is connected in series with the cathode and its biasing circuits.

4-14 The output of this first vacuum tube is fed through the third section of the wavechange switch (S-3) of the second RF tube which is a 6SG7. The secondaries of the interstage transformers are tuned by the second section of the gang condenser C36 and by the trimmer condensers C21, C23, C25, C27, C29 and C31. The condenser C30 completes the circuit for the secondary of the RF transformers. C32 and R10 serve as a plate filter circuit for the 1st RF tube (V-1). The IF rejection filter is connected in the plate circuit of V-1 on the band where this type of interference is most liable to be encountered. R13 and C29 are the cathode bypass elements of V-2 and the screen circuit is similarly bypassed by R14 and C40.

4-15 The output of the 2nd RF vacuum tube is fed to the mixer tube input through the fifth section of the switch (S-5), and the primaries of the six detector coils, the secondaries of which are selected by the sixth section of the switch (S-6) and are tuned by C34. The trimmer condensers C41, C43, C45, C47, C50 and C52 perform the trimming functions for this circuit which is completed through the fixed condenser C55. The vacuum tube used in this circuit is a 6K8 and performs a variety of functions. When used with the receiver as a normal tuned stage, it performs the function of a mixer where incoming signals are mixed with those from the local oscillator. When used as crystal controlled receiver, the mixer tube functions as a pentagrid converter, incorporating a high frequency crystal controlled oscillator, the circuit elements being controlled by means of the switch (S-18), which places the crystal in the circuit along with R48, the plate supply resistance, C111 the plate coupler, and C112 the plate reactance. When used as a conventional tuned receiver, the crystal is disconnected from the circuit entirely. The crystal used for this service must be 575 kilocycles higher than the frequency of the desired signal. As crystals are not usually available in standard commercial cuts for frequencies much higher than 7 mcs., it will be necessary to provide harmonic crystals for frequencies higher than 7 megacycles. The crystal frequency must be such that the frequency of the multiplication of the crystal frequency differs from the desired signal by 575 kcs. If the crystal frequency is multiplied three times, the frequency required will be the Signal frequency plus 575 kcs./3. This is of course only true on five of the bands, as the oscillator frequency is lower on the highest frequency or "A" band, and in consequence the crystal frequency will be signal frequency minus 575 kcs./mult. factor.

4-16 Under normal conditions, with the receiver operating as a conventional tuned superheterodyne, a separate oscillator vacuum tube is used. This tube, which is a 9002 miniature type triode, is used with six separate oscillator coils tuned by the variable condenser C93 and selected by means of the seventh (S-7), eighth (S-8), ninth (S-9), and tenth (S-10) sections of the band switch, the trimmer condensers C95, C97, C103, C104, C105, and C106, being mounted close to each pertinent coil. To ensure that the stability of the oscillator is maintained as accurately as possible, all the trimmer condensers are temperature compensated and the plate supply is stabilized by means of a voltage stabilizing tube type VR-150-30 (V10). The tuned oscillator circuits are designed to tune to a frequency 575 kc. higher than the RF circuit except on Range "A", where the oscillator tunes to a frequency 575 kcs. lower than the RF circuits. The tracking condensers C94, C96, C99, C100, C101 and C102 ensure that this frequency difference is exact at three positions on each range and approximately maintained at intervening points. The oscillations set up in these circuits are applied to the anode grid of the 6K8 converter tube through the coupling condenser C-58.

4-17 From the signals appearing at the plate of the converter tube (V-3), those at 575 kc. are selected by the 1st IF transformer T-1 which has, as an integral part of it, a crystal filter section so arranged as to provide four degrees of selectivity. The various degrees of selectivity are selected by S11 and S12. The whole crystal filter circuit is conventional in design, and has been modified for the particular uses of this receiver. The accuracy of the calibration depends to a large extent on the accuracy of the crystal employed and it is not recommended that adjustments be attempted to this unit unless the crystal has become inoperative. The IF transformer is permeability tuned and feeds into the grid of the first IF tube (V-4) which is a 6SG7 used as a conventional amplifier. The circuit elements for this tube are the cathode biasing resistance R27 and its bypass capacity C70 and the screen supply resistance R28 and its bypass capacity C71. The crystal filter consists of the condensers C66, C65 and C67 associated with the crystal and the resistor R26. C67 is the phasing capacity which is adjusted to suppress one side of the selectivity curve.

4-18 The output of the first IF stage is fed to another 6SK7 vacuum tube (V-5) through the second IF transformer (T-2). The circuit of this stage is that of a straight IF amplifier, the circuit components being R34 and C79 the cathode bypass, R35 and C80 the screen bypass, with C81 and R36 being the feed to the AVC section of the diode (V7). The output of the second IF amplifier is fed through the third IF transformer to the diode input of the 6B8 audio and second detector tube (V-6). The detector circuit consists of the diode section of V-6 and the diode load R40, R49, and R42. R40 in conjunction wth C86 acts as an RF filter and prevents RF voltage from going into the audio system. The audio component is fed from the junction of R40 and R39 through coupling condenser C77 to the top of the audio volume control (R37). When the noise limiter circuit is in operation, however, the audio component is first taken through the noise limiter section of V-6, then through C77.

4-19 The noise limiter consists of a resistor condenser network which, in conjunction with the diode tube, limits the transient noise picked up by the receiver. This circuit is most effective against interference of the short pulse type with a steep wave front.

4-20 In parallel with the input to the second detector is the beat frequency oscillator which is used for the reception of CW signals. This oscillator, which also consists of a 6SK7 vacuum tube, (V-9) is tuned to the frequency of the IF stages and is fitted with a variable condenser C114, which varies the frequency of the oscillator over a range of some 10 kilocycles. The BFO is so adjusted at the factory that the frequency of the oscillator is exactly the same as the IF frequency when the condenser is half meshed, and by this means a variation of the beat note from 0 to 5000 cycles on either side of the tune point is achieved. The BFO circuit used is of the positive "MU" type and is very stable. Care has been taken to completely suppress harmonics and to adequately shield all associate components to prevent radiation. This is particularly important when the receiver is used in hazardous locations.

4-21 The output of the 6B8 is resistance capacity coupled to the final power amplifier tube. The circuit elements of the resistance capacity coupling network consist of the resistors R45 and R55 and the coupling condenser C90. The audio volume control R37 is connected between the output of the diode section of this tube as previously described. In addition, the volume control R37 acts as a grid leak for the 6B8..

4-22 Across the grid input of the final power amplifier tube (V-11) is connected a tone control actuated by means of the switch S15. This switch connects, in the MED. and LOW tone positions, condensers C84 and C85 across the grid of the final tube, thus attenuating the higher frequencies. The output tube is a 6F6 pentode and is connected to T4, the output audio transformer. This transformer is equipped with two secondary windings which are tapped for various impedance matching combinations. The various taps and connections from the secondaries are brought out to jacks on the front panel for telephones of either high or low impedance. At the rear of the unit two other jacks are provided to accommodate either a loudspeaker or a 500 ohm line. The centre tap terminal of the 500 ohm winding is located on the chassis top beside the IF filter unit, and may be grounded or isolated as desired.

4-23 A send-receive switch is provided which, when actuated, disconnects the HT from the first and second RF tubes, the last IF stage and the plate circuit of the first audio tube and the screen of the output tube. This effectively silences the receiver, and protects if from the effects of feedback when being used for phone reception and transmission at the same site. The full power output of the receiver (4 watts) can be taken from the loudspeaker jack when the other jacks are not used. If any of the other jacks are used at the same time, the output will be proportional to the load on each circuit.

PARTS LIST

SECTION 5

5.1 CONDENSERS

Circuit Symbol	Function	Specification	Type No.	Mfr.	R.C.N. Ref. No.
C1	Line Coupling	625 uufd ±5% 500v	MOW .5-3625-5	Solar	3C/20250E
C2	Ant. Trimmer	7-45 uufds N500	TS2A	Erie	3C/77000
C3	Ant. Padder	30 uufds N500 ±1 uufd	"K"	Erie	3C/7003C
C4	Ant. Trimmer	7-45 uufds N500	TS2A	Erie	3C/77000
C5	Ant. Padder	25 uufds N500 ±1 uufd	"K"	Erie	3C/6504D
C6	Ant. Trimmer	7-45 uufds N500	TS2A	Erie	3C/77000
C7	Ant. Padder	25 uufds N500 ±1 uufd	"K"	Erie	3C/6504D
C8	Ant. Trimmer	7-45 uufds N500	TS2A	Erie	3C/77000
C9	Ant. Padder	25 uufds N500 ±1 uufd	"K"	Erie	3C/6504D
C10	Ant. Trimmer	4-30 uufds N500	TS2A	Erie	3C/74002
C11	Ant. Trimmer	4-30 uufds N500	TS2A	Erie	3C/74002
C12	Bandspreader	450 uufds ±1%	MOW.5-345-1	Solar	3C/18500A
C13	Ant. Tune	400 uufds	106-590	Marconi	3C/92505
C14	AVC Bypass	.05 ufds 200v ±20%	M289	Aerovox	3C/39003T
C15	Wave Trap Tune	200 uufds ±2½% Temp. Coeff. −0.00075	Class C 15%/mmf./° Cent.	Centralab	3C/16005B
C16	Cathode Bypass	.01 ufd 400v ±20%	489	Aerovox	3C/35052T
C17	Wave Trap Tune	.01 ufd ±2%	MWDW or MWCW .5-11-2	Solar	3C/35044B
C18	Screen Bypass	.01 ufds ±20% 400v	M489	Aerovox	3C/35024T
C19	Primary Shorting	.01 ufds ±20% 400v	M489	Aerovox	3C/35024T
C20	Grid Coupling	7 uufds ±½ uufd	MOSW .5-57-10	Solar	3C/3001H
C21	RF Trimmer	7-45 uufds N500	TS2A	Erie	3C/77000
C22	RF Padder	20 uufds N500 ±1 uufd	"K"	Erie	3C/6001E
C23	RF Trimmer	7-45 uufds N500	TS2A	Erie	3C/77000
C24	RF Padder	25 uufds N500 ±1 uufd	"K"	Erie	3C/6504D
C25	RF Trimmer	7-45 uufds N500	TS2A	Erie	3C/77000
C26	RF Padder	25 uufds N500 ±1 uufd	"K"	Erie	3C/6504D
C27	RF Trimmer	7-45 uufds N500	TS2A	Erie	3C/77000
C28	RF Padder	25 uufds N500 ±1 uufd	"K"	Erie	3C/6504D
C29	Prim. Resonator	500 uufds ±5%	MOW .5-35-5	Solar	3C/19009D
C30	AVC Bypass	.05 ufds ±20% 200v	M289	Aerovox	3C/39003T
C31	RF Trimmer	4-30 uufds N500	TS2A	Erie	3C/74002
C32	Plate Bypass	.01 ufds ±20% 400v	M489	Aerovox	3C/35024T
C33	Prim. Resonator	1000 uufds ±5%	MWW .5-21-5	Solar	3C/25008E
C34	RF Trimmer	4-30 uufds N500	TS2A	Erie	3C/74002
C35	Bandspreader	450 uufds ±1%	MOSW .5-345-1	Solar	3C/18500A
C36	RF Tuning	400 uufds 3 gang	106-585	Marconi	3C/92500
C37	Primary Shorting	.01 ufd ±20% 400V	M489	Aerovox	3C/35024T
C38	HF Coupling	7 uufds ±½ uufd	MOSW .5-57-10	Solar	3C/3001H
C39	Cathode Bypass	.01 ufds ±20% 400v	489	Aerovox	3C/35024T
C40	Screen Bypass	.01 ufds ±20% 400v	M489	Aerovox	3C/35024T
C41	RF Trimmer	7-45 uufds N500	TS2A	Erie	3C/77000
C42	RF Padder	20 uufds N500 ±1 uufd	"K"	Erie	3C/6001E
C43	RF Trimmer	7-45 uufds N500	TS2A	Erie	3C/77000
C44	RF Padder	25 uufds N500 ±1 uufd	"K"	Erie	3C/6504D
C45	RF Trimmer	7-45 uufds N500	TS2A	Erie	3C/77000

Circuit Symbol	Function	Specification	Type No.	Mfr.	R.C.N. Ref. No.
C46	RF Padder	25 uufds N500 ±1 uufd	"K"	Erie	3C/6504D
C47	RF Trimmer	7-45 uufds N500	TS2A	Erie	3C/77000
C48	RF Padder	25 uufds ±1 uufd N500	"K"	Erie	3C/6504D
C49	Prim. Resonator	500 uufds ±5%	MOW .5-21-5	Solar	3C/19009E
C50	RF Trimmer	4-30 uufds N500	TS2A	Erie	3C/79002
C51	Prim. Resonator	1000 uufds ±5%	MWW .5-21-5	Solar	3C/25008E
C52	RF Trimmer	4-30 uufds N500	TS2A	Erie	3C/74002
C53	Bandspreader	450 uufds ±1%	MOSW .5-345-1	Solar	3C/18500A
C54	RF Tuning	400 uufds (Part of C36)	106-585	Marconi	3C/92500
C55	Plate Bypass	.01 ufds ±20% 400v	M489	Aerovox	3C/35024T
C56	Screen Bypass	.01 ufds ±20% 400v	M489	Aerovox	3C/35024T
C57	Cathode Bypass	.01 ufds ±20% 400v	M489	Aerovox	3C/35024T
C58	Osc. Grid Coupling	100 uufds ±20%	MOBW .5-31-20	Solar	3C/15009T
C59	Filter Bypass	4 uufds ±½ uufd 0 Temp. Coeff.	"D"	Centralab	3C/1503T
C60	IF Tune	350 uufds ±2%	MOSW .5-335-2	Solar	3C/17501B
C61	Plate Bypass	.05 ufds ±20% 400v	M489	Aerovox	3C/39004T
C62	IF Coupling	4 uufds ±½ uufd 0 Temp. Coeff.	"D"	Centralab	3C/1503T
C63	IF Tune	140 uufds ±2%	MOSW .5-314-2	Solar	3C/15401B
C64	Crystal Phasing	4-30 uufds N500	TS2A	Erie	3C/74002
C65	IF Tune	350 uufds ±2%	MOSW .5-335-2	Solar	3C/17501B
C66	IF Tune	350 uufds ±2%	MOSW .5-335-2	Solar	3C/17501B
C67	Crystal Tune	4-30 uufds N500	TS2A	Erie	3C/74002
C68	IF Grid Tune	300 uufds ±2%	MOSW .5-33-2	Solar	3C/17004B
C69	AVC Bypass	.01 ufd ±20% 400v	M489	Aerovox	3C/35024T
C70	Cathode Bypass	.05 ufds ±20% 200v	M289	Aerovox	3C/39003T
C71	Screen Bypass	.05 ufds ±20% 400v	M489	Aerovox	3C/39004T
C72	RF Filter	100 ufds 50v Wkg	111-287	Marconi	3C/67001
C73	Plate Bypass	.05 ufds ±20% 400v	M489	Aerovox	3C/39004T
C74	IF Tune	140 uufds ±2%	MOSW .5-314-2	Solar	3C/15401B
C75	IF Tune	140 uufds ±2%	MOSW .5-314-2	Solar	3C/15401B
C76	AVC Condenser	.05 ufds ±20% 200v	M289	Aerovox	3C/39003T
C77	Audio Coupling	.1 ufds ±20% 200v	M289	Aerovox	3C/45012T
C78	RF Bypass	.1 ufds ±20% 200v	M289	Aerovox	3C/45012T
C79	Cathode Bypass	.05 ufds ±20% 200v	M289	Aerovox	3C/39003T
C80	Screen Bypass	.05 ufds ±20% 400v	M489	Aerovox	3C/39004T
C81	AVC Coupling	25 uufds ±1 uufd	MOSW .5-425-4	Solar	3C/6503D
C82	Plate Bypass	.05 ufds ±20% 400v	M489	Aerovox	3C/39004T
C83	IF Tune	350 uufds ±2%	MOSW .5-335-2	Solar	3C/17501B
C84	Low-Tone	.004 ufds −20%+30%, 300v	1467S	Aerovox	3C/28011
C85	Med. Tone	.001 ufds ±20%	MWW .5-21-20	Solar	3C/25008T
C86	RF Bypass	250 uufds ±10%	MOBW .5-325-10	Solar	3C/16508J
C87	IF Tune	620 uufds ±2%	MOSW .5-362-2	Solar	3C/20200B
C88	BFO Coupling	5 uufds ±½ uufd	MOSW .5-55-10	Solar	3C/2000T
C89	Cathode Bypass	10 ufds 15v	111-224	Marconi	3C/64005
C90	Audio Coupling	.1 ufds ±20% 400v	M489	Aerovox	3C/45013T
C91	Filament Bypass	.01 ufds ±20%	MWW .5-11-20	Solar	3C/35021T
C92	Filament Bypass	.01 ufds ±20% 300v	1467S	Aerovox	3C/35059T
C93	Osc. Tune	400 uufds (Part of C-36)	106-585	Marconi	3C/92500
C94	Osc. Tracker	475 uufds ±1%	MOSW .5-3475-1	Solar	3C/18750A
C95	Osc. Trimmer	15 uufds variable	111-139	Marconi	3C/85004
C96	Osc. Tracker	3700 uufds ±1%	MWSW .5-237-1	Solar	3C/27700A

CONDENSERS—(Cont'd.)

Circuit Symbol	Function	Specification	Type No.	Mfr.	R.C.N. Ref. No.
C97	Osc. Trimmer	15 uufds variable	111-139	Marconi	3C/85004
C98	Osc. Padder	30 uufds ±1 uufd	N220-L	Erie	3C/7008E
C99	Osc. Tracker	1150 uufds ±1%	MWSW .5-2115-1	Solar	3C/25115A
C100	Osc. Tracker	232 uufds ±1%	MOSW .5-3232-1	Solar	3C/16320A
C101	Osc. Tracker	150 uufds ±1%	MOSW .5-315-1	Solar	3C/15506A
C102	Osc. Tracker	2414 uufds ±1%	MWSW .5-22414-1	Solar	3C/26414A
C103	Osc. Trimmer	50 uufds variable	91435	Marconi	3C/73900
C104	Osc. Trimmer	50 uufds variable	91435	Marconi	3C/73900
C105	Osc. Trimmer	50 uufds variable	91435	Marconi	3C/73900
C106	Osc. Trimmer	50 uufds variable	91435	Marconi	3C/73900
C107	Osc. Padder	54 uufds ±5%	"C"	Centralab	3C/9400E
C108	Osc. Padder	21 uufds ±½ uufd	N750K	Erie	3C/6100E
C109	Grid Coupling	100 uufds ±5%	MOSW .5-31-5	Solar	3C/15018E
C110	Plate Bypass	.01 ufds ±20%	MWW .5-11-20	Solar	3C/35021T
C111	Plate Coupling	250 uufds ±10%	MOBW .5-325-10	Solar	3C/16508J
C112	Crystal Reaction	15 uufds ±½ uufd	MOW .5-415-3	Solar	3C/5503C
C113	BFO Padder	420 uufds ±2%	MOSW .5-342-2	Solar	3C/18200B
C114	BFO Tune	15 uufds variable	HF-15	Hammarlund	3C/72600
C115	BFO Coupling	2000 uufds ±10%	MWSW .5-22-10	Solar	3C/26020J
C116	Cathode Bypass	.01 ufds ±20% 300v	1467S	Aerovox	3C/35059T
C117	Plate Bypass	100 uufds ±2%	MOSW .5-31-2	Solar	3C/15018B
C118	Screen Bypass	.01 ufds ±20% 300v	1467S	Aerovox	3C/35059T
C119	H.T. Filter	10 ufds 150v	111-140	Marconi	3C/64007
C120	H.T. Filter	10 ufds 110v	(Part of C119)	Marconi	3C/64007
C121	Cathode Bypass	10 ufds 20v	111-280	Marconi	3C/64008
C122	HT Filter	10 ufds 250v	(Part of C121)	Marconi	3C/64008
C123	Plate Bypass	2000 uufds ±20%	MWBW .5-22-20	Solar	3C/26021T
C124	Grid Coupling	5 uufds ±½ uufd	MOSW .5-55-10	Solar	3C/2000T
C125	Grid Coupling	5 uufds ±½ uufd	MOSW .5-55-10	Solar	3C/2000T
C126	Osc. Padder	54 uufds ±5%	Class "C"	Centralab	3C/9400E
C127	Osc. Padder	25 uufds ±1 uufd	MOSW .5-425-4	Solar	3C/6503E
C128	H.T. Bypass	.1 ufds ±20% 400v	M489	Aerovox	3C/45013T
C129	H.T. Bypass	.01 ufds ±20%	MWW .5-11-20	Solar	3C/35021T
C130	Filament Bypass	500 uufds ±20%	MOW .5-35-20	Solar	3C/19010T
C131	L.T. Filter	500 uufds ±20%	MOW .5-35-20	Solar	3C/19010T
C133	Compensator	10 uufds ±½ uufd	N750K	Erie	3C/5006E
C134	Compensator	10 uufds ±½ uufd	N750K	Erie	3C/5006E

5.2 JACKS

J1	500 ohm line	No. 1 short insulated	Carter	3S/536
J2	Loudspeaker	2A short	Carter	3S/537
J3	Low R. Phones	No. 705 Junior	Mallory Yaxley	3S/538
J4	High R Phones	No. 705 Junior	Mallory Yaxley	3S/538

5.3 INDUCTANCES

L1	Wave Trap	116-147	Marconi	3L/136
L2	Wave Trap	116-146	Marconi	3L/137
L3	BFO Assembly	116-148	Marconi	3L/155
L4	BFO Oscillator Choke	116-254	Marconi	3L/162
L5	IF Filter Grid Coil	116-149	Marconi	3L/153
L6	Conversion Oscillator Choke	116-172	Marconi	3L/163

Circuit Symbol	Function	Specification	Type No.	Mfr.	R.C.N. Ref. No.
L7	H.T. Supply Choke		116–259	Marconi	3L/514
L8	1st RF Coil "A"		116–130	Marconi	3L/138
L9	1st RF Coil "B"		116–131	Marconi	3L/139
L10	1st RF Coil "C"		116–132	Marconi	3L/140
L11	1st RF Coil "D"		116–133	Marconi	3L/141
L12	1st RF Coil "E"		106–692	Marconi	3L/367
L13	1st RF Coil "F"		106–693	Marconi	3L/368
L14	2nd RF Coil "A"		116–134	Marconi	3L/144
L15	2nd RF Coil "B"		116–135	Marconi	3L/145
L16	2nd RF Coil "C"		116–136	Marconi	3L/146
L17	2nd RF Coil "D"		116–137	Marconi	3L/147
L18	2nd RF Coil "E"		116–138	Marconi	3L/148
L19	2nd RF Coil "F"		116–139	Marconi	3L/149
L20	Detector Coil "A"		116–140	Marconi	3L/150
L21	Detector Coil "B"		116–141	Marconi	3L/151
L22	Detector Coil "C"		116–136	Marconi	3L/146
L23	Detector Coil "D"		116–137	Marconi	3L/147
L24	Detector Coil "E"		116–138	Marconi	3L/148
L25	Detector Coil "F"		116–139	Marconi	3L/149
L26	Oscillator Coil "A"		116–142	Marconi	3L/156
L27	Oscillator Coil "B"		116–143	Marconi	3L/157
L28	Oscillator Coil "C"		116–144	Marconi	3L/158
L29	Oscillator Coil "D"		116–145	Marconi	3L/159
L30	Oscillator Coil "E"		106–588	Marconi	3L/160
L31	Oscillator Coil "F"		106–589	Marconi	3L/161

5.4 PILOT LIGHTS

PL1	Dial Light	12-16 volts	Mazda No. 57	C.G.E.	3T/1000
			or No. 53	C.G.E.	3T/1031
PL2	Dial Light	12-16 volts	Mazda No. 57	C.G.E.	3T/1000
			or No. 53	C.G.E.	3T/1031
PL3	Dial Light	12-16 volts	Mazda No. 57	C.G.E.	3T/1000
			or No. 53	C.G.E.	3T/1031
PL4	Dial Light	12-16 volts	Mazda No. 57	C.G.E.	3T/1000
			or No. 53	C.G.E.	3T/1031

5.5 RESISTORS

R1	1st RF AVC Supply	100,000 ohms ±10%	BT½	½ watt	I.R.C.	3R/51003J
R2	Noise Limiter	1 meg. ± 10%	BT½	½ watt	I.R.C.	3R/61001J
R3	1st RF Bias	300 ohms ±10%	BT½	½ watt	I.R.C.	3R/23000J
R4	1st RF Screen Grid Supply	1000 ohms ±10%	BT½	½ watt	I.R.C.	3R/31001J
R5	No. 2 RF Damping	2000 ohms ±5%	BT½	½ watt	I.R.C.	3R/32005E
R6	No. 2 RF Damping	1000 omns ± 5%	BT½	½ watt	I.R.C.	3R/31001E
R7	No. 2 RF Damping	900 ohms ±5%	BT½	½ watt	I.R.C.	3R/29000E
R8	No. 2 RF Damping	250,000 ohms ±5%	BT½	½ watt	I.R.C.	3R/52400E
R9	No. 2 RF Damping	1500 ohms ±5%	BT½	½ watt	I.R.C.	3R/31501E
R10	No. 1 RF Plate Filter	1000 ohms ±10%	BT½	½ watt	I.R.C.	3R/31001J
R11	No. 2 RF AVC Supply	100,000 ohms ±10%	BT½	½ watt	I.R.C.	3R/51003J
R12	No. 2 RF Damping	100,000 ohms ±5%	BT½	½ watt	I.R.C.	3R/51003E
R13	No. 2 RF Bias	300 ohms ±10%	BT½	½ watt	I.R.C.	3R/23000J

RESISTORS—(Cont'd.)

Circuit Symbol	Function	Specification	Type No.	Mfr.	R.C.N. Ref. No.
R14	No. 2 RF Screen Grid Supply	1000 ohms ±10%	BT½ ½ watt	I.R.C.	3R/31001J
R15	Det Damping	2000 ohms ±5%	BT½ ½ watt	I.R.C.	3R/32005E
R16	Det Damping	1000 ohms ±5%	BT½ ½ watt	I.R.C.	3R/31001E
R17	Det Damping	900 ohms ±5%	BT½ ½ watt	I.R.C.	3R/29000E
R18	Det Damping	1500 ohms ±5%	BT½ ½ watt	I.R.C.	3R/31501E
R19	Det Damping	250,000 ohms ±5%	BT½ ½ watt	I.R.C.	3R/52400E
R20	Det Damping	100,000 ohms ±5%	BT½ ½ watt	I.R.C.	3R/51003E
R21	No. 2 RF Plate Filter	1000 ohms ±10%	BT½ ½ watt	I.R.C.	3R/31001J
R22	Det Screen Grid Supply	25,000 ohms ±5%	BT½ ½ watt	I.R.C.	3R/42501E
R23	Det Bias	300 ohms ±10%	BT½ ½ watt	I.R.C.	3R/23000J
R24	Crystal Osc. Grid Leak	50,000 ohms ± 10%	BT½ ½ watt	I.R.C.	3R/45002J
R25	Converter Plate Filter	1000 ohms ±10%	BT½ ½ watt	I.R.C.	3R/31001J
R26	Crystal Filter	7500 ohms ±5%	BT½ ½ watt	I.R.C.	3R/37508E
R27	No. 1 IF Bias	100 ohms to 400 ohms ±10%	BT½ ½ watt	I.R.C.	3R/21006J
R28	No. 1 IF Screen Grid Supply	1000 ohms ±10%	BT½ ½ watt	I.R.C.	3R/31001J
R29	No. 1 RF AVC Supply	100,000 ohms ±10%	BT½ ½ watt	I.R.C.	3R/51003J
R30	RF Gain	15,000 ohms	116-258	Marconi	3R/76503
R31	Voltage Divider	50,000 ohms ±10%	BT½ ½ watt	I.R.C.	3R/45002J
R32	No. 1 IF Plate Filter	1000 ohms ±10%	BT½ ½ watt	I.R.C.	3R/31001J
R33	AVC Supply	1 megohm ±10%	BT½ ½ watt	I.R.C.	3R/61001J
R34	No. 2 IF Bias	400 ohms ±10%	BT½ ½ watt	I.R.C.	3R/24001J
R35	No. 2 IF Screen Grid Supply	1000 ohms ±10%	BT½ ½ watt	I.R.C.	3R/31001J
R36	AVC Resistor	1 megohm ±10%	BT½ ½ watt	I.R.C.	3R/61001J
R37	Volume control	1 megohm	111-147	Marconi	3R/86000J
R38	No. 2 IF Plate Filter	1000 ohms ±10%	BT½ ½ watt	I.R.C.	3R/31001J
R39	Diode Load	100,000 ohms ±10%	BT½ ½ watt	I.R.C.	3R/51003J
R40	Diode Load	100,000 ohms ±10%	BT½ ½ watt	I.R.C.	3R/51003J
R41	Noise Limiter	500,000 ohms ±10%	BT½ ½ watt	I.R.C.	3R/55001J
R42	Diode Load	250,000 ohms ±10%	BT½ ½ watt	I.R.C.	3R/52400J
R43	Audio Bias	1000 ohms ±10%	BT½ ½ watt	I.R.C.	3R/31001E
R44	Audio Bias	4000 ohms ±5%	BT½ ½ watt	I.R.C.	3R/34011E
R45	Audio Plate Supply	150,000 ohms ±5%	BT1 1 watt	I.R.C.	3R/51500E
R46	Filament Shunt	120 ohms ±5%	BT1 1 watt	I.R.C.	3R/21200E
R47	Osc. Grid Leak	50,000 ohms ±10%	BT½ ½ watt	I.R.C.	3R/45002J
R48	Conv. Plate Supply	50,000 ohms ±10%	BT½ ½ watt	I.R.C.	3R/45002J
R49	BFO Screen Grid Supply	100,000 ohms ±5%	BT½ ½ watt	I.R.C.	3R/51003E
R50	BFO Bias	2000 ohms ±5%	BT½ ½ watt	I.R.C.	3R/32005E
R51	Voltage Divider	10,000 ohms ±5%	BT½ ½ watt	I.R.C.	3R/41006E
R52	BFO Plate Filter	50,000 ohms ±5%	BT½ ½ watt	I.R.C.	3R/45002E
R53	HT Voltage Divider	3000 ohms ± 5%	"MB" C. Coating 10 watts	Marsland	3R/33006E
R54	HT Voltage Divider	15,000 ohms ±5%	"MB" C Coating 10 watts	Marsland	3R/41510E
R55	Output Grid Leak	500,000 ohms ±10%	BT½ ½ watt	I.R.C.	3R/55001J
R56	Output Bias	400 ohms ±5%	"MB" C Coating 10 watts	Marsland	3R/24006E
R57	Audio Screen Grid Supply	60,000 ohms ±10%	BT1 1 watt	I.R.C.	3R/46004J
R58	Output Load Matching	10,000 ohms ±10%	"MB" C Coating 10 watts	Marsland	3R/41014J
R59	No. 2 IF Bias	400 ohms ±10%	BT½ ½ watt	I.R.C.	3R/24001J
R60	HT Voltage Divider	10,000 ohms ±10%	BT½ ½ watt	I.R.C.	3R/41006J
R61	Anti Radiation	1000 ohms ±5%	504 (Carbon)	Erie	3R/21005E
R62	Det Damping	10,000 ohms ±20%	BT½ ½ watt	I.R.C.	3R/41006T

5.6 SWITCHES

Circuit Symbol	Function	Specification	Type No.	Mfr.	R.C.N. Ref. No.
S1	Band Switch	1st section (rear)	111-904 (Part)	Marconi	3F/920
S2	Band Switch	2nd section	111-904 (Part)	Marconi	3F/920
S3	Band Switch	3rd section	111-904 (Part)	Marconi	3F/920
S4	Band Switch	4th section	111-904 (Part)	Marconi	3F/920
S5	Band Switch	5th section	111-904 (Part)	Marconi	3F/920
S6	Band Switch	6th section	111-904 (Part)	Marconi	3F/920
S7	Band Switch	7th section	111-904 (Part)	Marconi	3F/920
S8	Band Switch	8th section	111-904 (Part)	Marconi	3F/920
S9	Band Switch	9th section	111-904 (Part)	Marconi	3F/920
S10	Band Switch	10th section (front)	111-904 (Part)	Marconi	3F/920
S11	IF Filter	1st section	111-905	Marconi	3F/919
S12	IF Filter	2nd section	111-905	Marconi	3F/919
S13	AVC	S.P.D.T. 3A 125v. Bat Handle, Lugs, 3/8" Bushing		AH&H	3F/921
S14	Noise Limiter	S.P.D.T. 3A 125v. Bat Handle, Lugs, 3/8" Bushing		AH&H	3F/921
S15	Tone Control		111-145	Marconi	3F/923
S16	Send Receive		85984	Marconi	3F/922
S17	BFO		85984	Marconi	3F/922
S18	Converter Oscillator		111-146	Marconi	3F/924
S19	On and Off		85984	Marconi	3F/922

5.7 TRANSFORMERS

Circuit Symbol	Function	Specification	Type No.	Mfr.	R.C.N. Ref. No.
T1	1st IF Transformer		106-591	Marconi	3L/152
T2	2nd IF Transformer		106-592	Marconi	3L/154
T3	3rd IF Transformer		106-593	Marconi	3L/164
T4	Output Transformer		97690A	Marconi	3U/90-1

5.8 VACUUM TUBES

Circuit Symbol	Function	Specification	Type No.	Mfr.	R.C.N. Ref. No.
V1	1st RF Tube		6SK7	Marconi R.V.C.	
V2	2nd RF Tube		6SG7	Marconi R.V.C.	
V3	Mixer Tube		6K8	Marconi R.V.C.	
V4	1st IF Tube		6SG7	Marconi R.V.C.	
V5	2nd IF Tube		6SK7	Marconi R.V.C.	
V6	2nd Detector and 1st Audio Tube		6B8	Marconi R.V.C.	
V7	AVC and Noise Limiter Diode Tube		6H6	Marconi R.V.C.	
V8	Oscillator Tube		9002	Marconi R.V.C.	
V9	Beat Frequency Oscillator Tube		6SK7	Marconi R.V.C.	
V10	Voltage Regulator Tube		VR-150-30	Marconi R.B.C.	
V11	Power Output Tube		6F6	Marconi R.V.C.	

Circuit Symbol	Function	Specification	Type No.	Mfr.	R.C.N. Ref. No.
5.9 VACUUM TUBE SOCKETS					
V1			SS8	Amphenol	3S/21
V2			SS8	Amphenol	3S/21
V3			SS8	Amphenol	3S/21
V4			68087	Marconi	3S/18
V5			68087	Marconi	3S/18
V6			68087	Marconi	3S/18
V7			68087	Marconi	3S/18
V8			55-A2	Franklin	3S/96
V9			68087	Marconi	3S/18
V10			68087	Marconi	3S/18
V11			68087	Marconi	3S/18
5.10 MISCELLANEOUS PARTS					
	IF Filter Unit		106–852	Marconi	3Z/1092
XTL	IF Filter Control		116–128	Marconi	3Z/1033
P1	Switch Connector		P-402-AB	B. H. Jones	3S/539
P2	Power Connector		P-303-AB	B. H. Jones	3S/540
PLS1	Pilot Light Socket		116–603	Marconi	3S/61
PLS2	Pilot Light Socket		116–603	Marconi	3S/61
PLS3	Pilot Light Socket		116–604	Marconi	3S/62
PLS4	Pilot Light Socket		116–604	Marconi	3S/62
	Socket Crystal		116–524	Marconi	3S/108
	Antenna Discharge Gap, Admiralty Patt		8431	C.G.E.	3F/131
	Socket (Remote Send-Rec. Switch)		7723	AH&H	3S/20
	Socket Crystal		33–2	Amphenol	3S/23

5

INSTALLING

AND

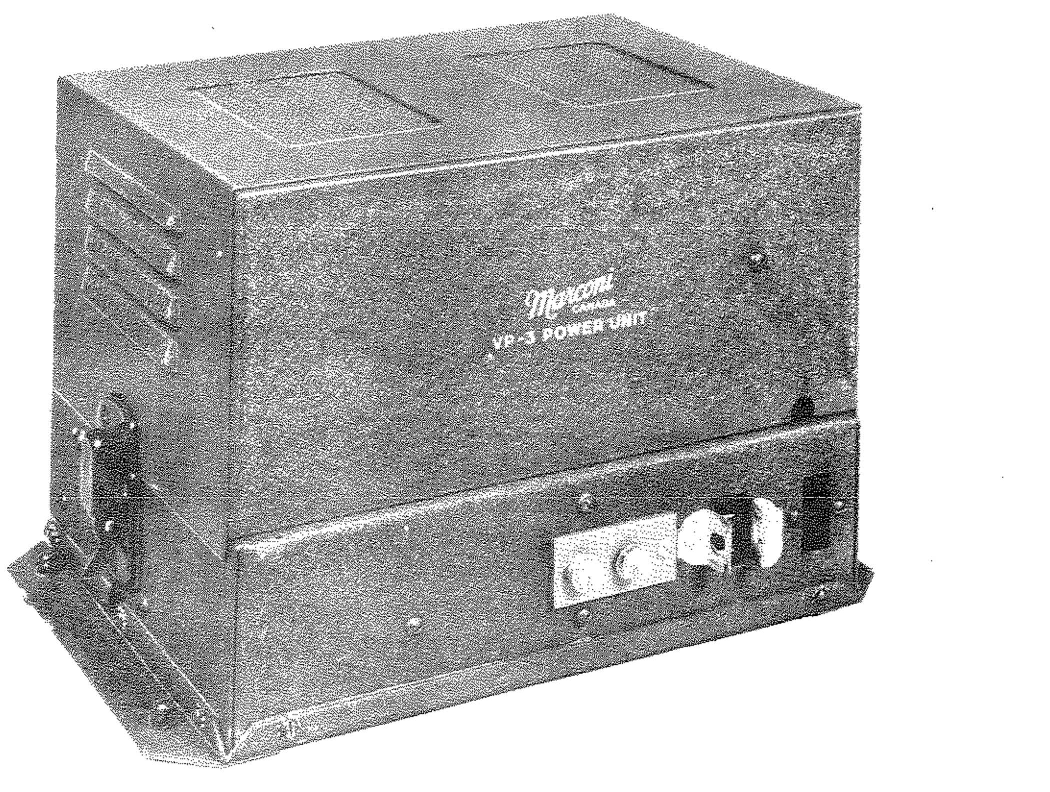
OPERATING INSTRUCTIONS

FOR

Marconi

TYPE VP-3
POWER UNIT

R.C.N REF. No. 3D/101



VP-3 POWER UNIT
TYPE No. 110-540

FIG. 12

GENERAL

SECTION 1

1-1 The Marconi VP-3 Power Unit is a general purpose power supply designed to operate from either an A.C. or D.C. input source. Primarily designed to supply power for Marconi CSR-5 receivers, it will also operate with any other type of receiver whose requirements are not in excess of the total power available from the Unit. The Unit is contained in a chassis fitted with a removable cover which protects all the components, and is perforated to permit adequate ventilation. The exterior of the chassis is finished in standard colors to the Customer's specification, while the interior is heavily cadmium plated and copper plated in additional areas to provide increased hash absorption.

1-2 The input voltages of the VP-3 power unit are as follows:—

12 volts D.C., which may be from a storage battery or generator source.
115 volts, 60 cycles or 115 volts, 25 cycles.
230 volts, 60 cycles or 230 volts, 25 cycles.

The output voltages in all cases are the same, namely:—

12.6 volts at 2.7 amperes, either A.C. or D.C., depending on the primary supply.
250 volts at 115 milliamperes D.C.

The voltages are the normal requirements of the Marconi CSR-5 Receiver but will supply any other type of receiver having the same power requirements, provided that the HT negative and one side of the filaments are common to ground.

1-3 The power unit is shipped out from the factory complete with all the necessary tubes and interconnecting cables for installation with the Marconi CSR-5 Receiver, either on the normal bench mounting chassis or attached to a panel suitable for mounting on a standard relay rack. In either case the electrical characteristics of the unit are identical. Two interconnecting cables are provided with the unit as well as the customary line cord for connection to an A.C. supply. The following vacuum tubes are used in the unit and are shipped mounted in the correct sockets:—

V1........R.V.C. 6X5GT/G
V2........R.V.C. 6X5GT/G

One vibrator unit is shipped in the unit and a spare vibrator is attached to the inside of the cover by means of clips.

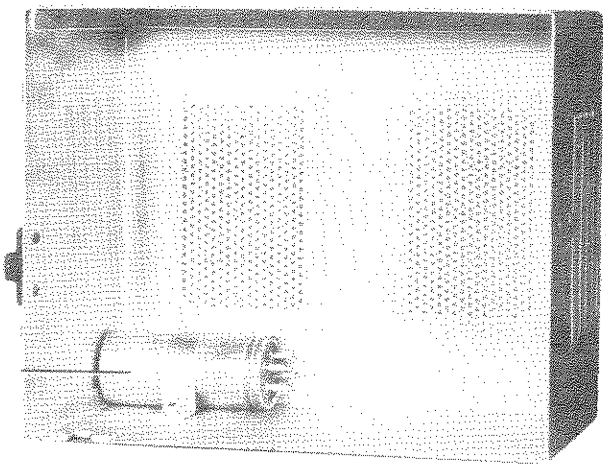
1-4 The unit is equipped with switches to control the power input and the voltage of the supply line. Also supplied are connection plugs to permit the operation of the unit on either A.C. or D.C. and to protect the unit against the accidental misconnection of the power supply to the wrong source. All the switches and the plug connections are so arranged that it is impossible to make any misconnection in error, and even if this is done, that no damage will result from such connection. From serial No. 1201 and up, certain modifications were made in the VP-3; these are as follows:—

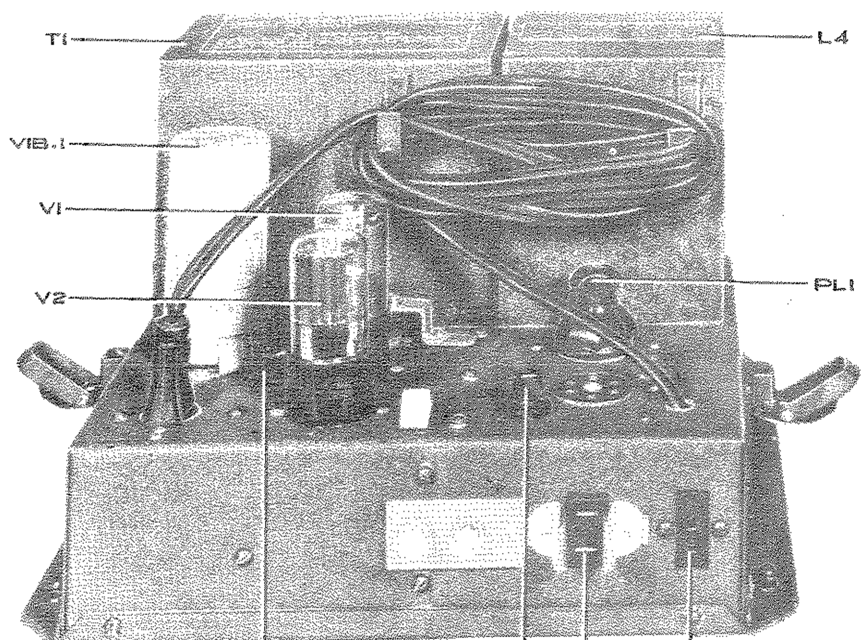
(1) Fuse F-2 was relocated, now being placed in the A.C. input circuit.
(2) Type of F-2 was changed to 3 amp. 250 volt type.
(3) OFF-ON switch S-1 was relocated, now being placed in the front of the unit's chassis instead of at the rear.

INSTALLATION

SECTION 2

2-1 When the unit is received it should be examined for damage in transit, and all screws and nuts tightened up. Any loose packing material should be removed from the unit before it is installed in service. Before installing the unit, the voltage of the power supply should be checked and the line switch set to the appropriate value. If the unit is to be operated from an A.C. supply the six-prong plug must be inserted in the socket marked "AC" and the line cord removed from the socket on the chassis. The lock holding the line voltage switch should be loosened and the line voltage switch moved from the position in which it was shipped to the correct voltage (either 115 or 230 volts). The unit is shipped with the line voltage switch in the 230 volt position





VP-3 POWER UNIT COVER REMOVED — FIG. 13

so that no untoward effect will be noted if the unit is plugged into a 115 volt supply. If the unit was shipped with the switch in the other position, the unit might be damaged if it was connected to a 230 volt supply.

2-2 If the unit is to be used for 12 volt battery operation, the six prong plug must be inserted in the socket marked "DC" and the line cord must be wound around the hooks provided and inserted in the socket on the chassis. Heavy cables should be run from the battery to the terminals on the unit, and the ends of the cables terminated in the lugs provided. Due to the high current and the low voltage in the primary supply when operating from batteries, every effort should be made to ensure that the connections are clean and well made and that the conductor size is as large as possible. Under no circumstances should any wire size less than No. 12 be used for this purpose, and it is preferable to use either No. 8 or No. 6 where the length of these leads is over five feet.

2-3 The connection cables from the power unit to the CSR-5 Receiver will be inserted in the correct sockets on both the power unit and the receiver. Reference to the connection diagram will show that the two conductor cable connects across the ON-OFF switch of the power unit and when used with the CSR-5 Receiver, is connected across an additional switch on the front panel of the receiver. It will be seen that this method allows the operation of the power pack to be controlled from the receiver. The three conductor cable connects both the high voltage plate supply and the low voltage filament supply to the receiver, with the two negative ends of the supplies connected in a common lead. It will be noted that both these cables are terminated in plugs that cannot be inserted in the wrong sockets at either end and once these connections have been made no further adjustment is required to bring the unit into operation other than the operation of the ON-OFF switch on the panel of the receiver.

MAINTENANCE

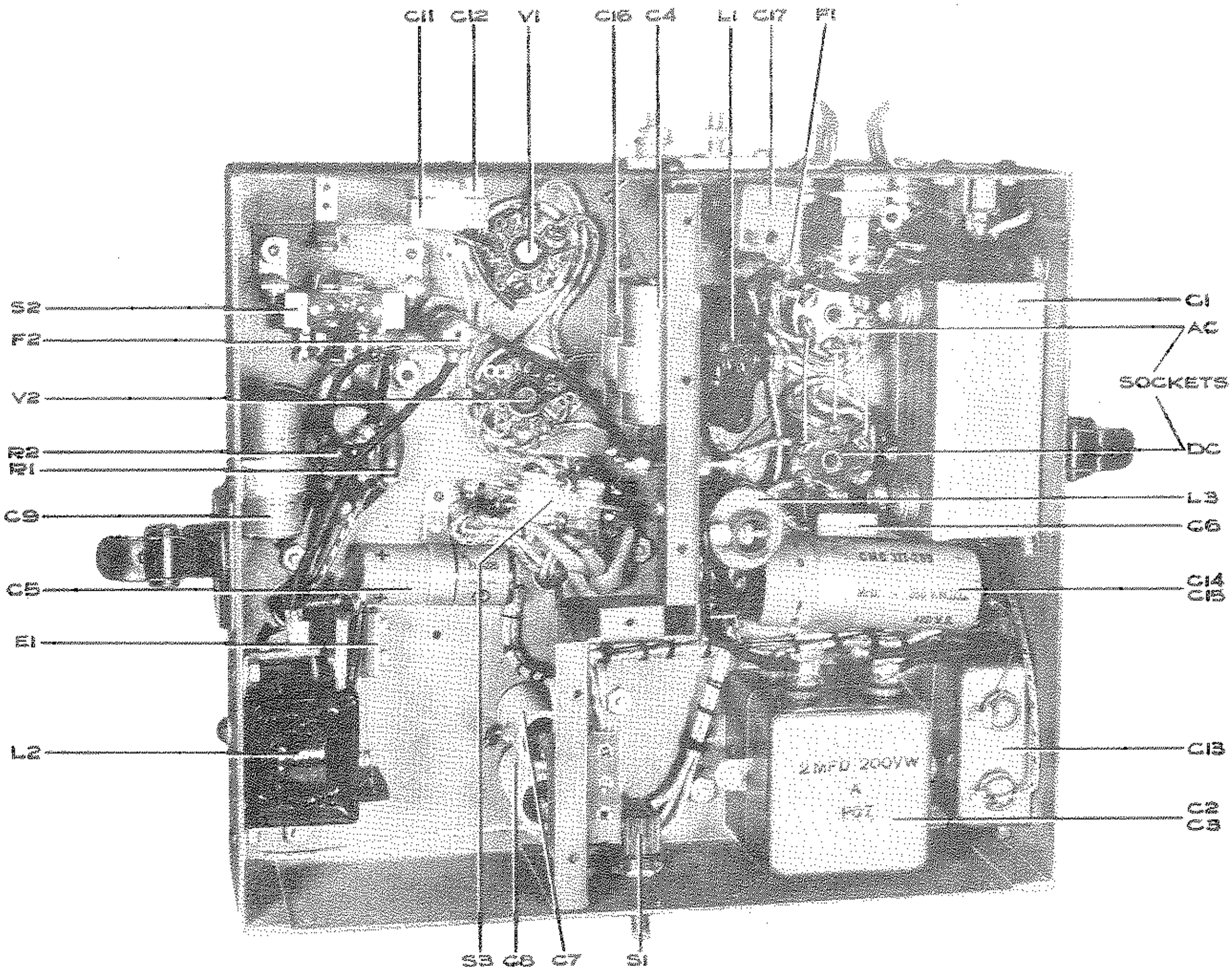
SECTION 3

3-1 This power supply is, as previously stated, a combination "AC-DC" design. Considerable care has been taken in its design to give as near trouble-free performance as possible. However, as troubles might develop, a discussion of the troubles most likely to be encountered is given below, along with the best means of determining the exact trouble and the method of elimination.

NO "B" VOLTAGE:

3-2 If the unit is set for "DC" operation, and with the vibrator operating there is no "B" voltage on the receiver, disconnect the unit from the receiver and check HT voltage across pins 3 and 1 of CC-2. If "B" voltage becomes much higher than normal (250 volts), the trouble is in the receiver proper and can be located by the usual methods. If, however, there is still no "B" voltage, the trouble is in the power unit. Before investigating probable causes, the unit should be tried on A.C., if this is possible. If it is still shown that there is no "B" voltage, check the following for possible defects, in the order shown:—

(1) Shorted filter condenser, C-14 or C-15.
(2) Shorted buffer condenser, C-11 or C-12.
(3) Shorted rectifier tube, V-1 or V-2.
(4) Grounded filter condenser.
(5) Shorted HT by-pass, C-13.
(6) Shorted transformer secondary.
(7) Ground in wiring.



VP-3 POWER UNIT FIG. 14
BOTTOM VIEW-BASE PLATE REMOVED

LOW "B" VOLTAGE:

3-3 Check the points below:

(1) "A" battery voltage low.
(2) Corroded fuse clips.
(3) High resistance in the OFF-ON switch.
(4) Weak rectifier tubes.
(5) Defective buffer condensers.
(6) Defective filter condensers.
(7) Worn vibrator.
(8) Partial short circuit in receiver.

VIBRATOR:

3-4 If the vibrator should fail to operate, remove the vibrator and check for the following circuit defects:

(1) Low battery voltage.
(2) Blown fuse F-1 or F-2.
(3) Burned switch.
(4) Broken "A" switch.

All these points can be quickly checked by measuring the voltage between the centre tap of the transformer and ground at the vibrator socket. This voltage should be 11.2 volts. If this check is satisfactory, the vibrator should be checked either in a vibrator tester or by substitution of a new vibrator of the same type. (A spare is supplied in the lid of the unit).

3-5 It should be noted that vibrators can only be damaged by two causes:—

(1) Serious overloads from short circuits and/or
(2) Defective buffer condensers.

Rarely if ever do transformers give any trouble. The vibrators should never need replacement until the contacts are worn to such an extent that the output of the power unit is unsteady, or the vibrator fails to start on a low "A" battery.

3-6 Sticking or shorted vibrators are usually caused by "projections" being built up on the contact points. This contact transfer is the result of an unbalanced condition in the circuit. A careful check of the buffer or timing capacities, C-11 and C-12, should be made. If either of these capacities are open or the capacity not as specified, they should be replaced with high voltage condensers as specified on the parts list.

NEVER CHANGE THE SPECIFIED CAPACITY OF THESE CONDENSERS UNLESS SPECIFICALLY INSTRUCTED TO DO SO.

TECHNICAL DESCRIPTION

SECTION 4

4-1 The following technical description is intended to provide the technical personnel charged with the maintenance of this equipment with the necessary information to carry out all repairs with a sure knowledge of the locations and functions of the various components that make up the unit. It is not intended that this section will be used for instructional purposes for personnel who are not well grounded in the basic theory of radio communication work. It will be found that a careful study of the diagrams and illustrations attached to this folder will prove to be of considerable assistance in locating and identifying the various component parts and the functions of each.

4-2 From an examination of the circuit diagram of the VP-3 power unit it will be seen that basically it consists of a full wave high vacuum rectifier employing 2 6X5GT vacuum tubes, the plates of which are supplied from the transformer T-1 with the necessary high voltages The cathodes of these tubes are connected together and deliver the rectified voltage to the smoothing filter which consists of the air core choke L-3, the iron core choke L-4 and the condensers C-13, C-14 and C-15. The output of this filter is fed to the correct terminal on the output plug on the chassis. It will be seen that the filaments of these tubes are connected in series and are operated from a separate winding of the transformer when the unit is operating as an A.C. power pack.

4-3 The primary side of this transformer carries three windings, two of which are used when the power unit is being used on A.C. while the other is used for battery operation, and will be discussed later. The two windings used for A.C. operation are connected so that when the supply voltage is 230 volts they can be operated in series and in the 115 volt position in parallel. By this means the output voltages of the transformer are kept at the correct values for the two line voltages. Across the primary circuit of the transformer are C-7 and C-8 which act as line filters, while C-10 is provided for the same purpose on the secondary side of the filament winding. It will be noted that the primary circuit of the transformer is interrupted by the plug marked

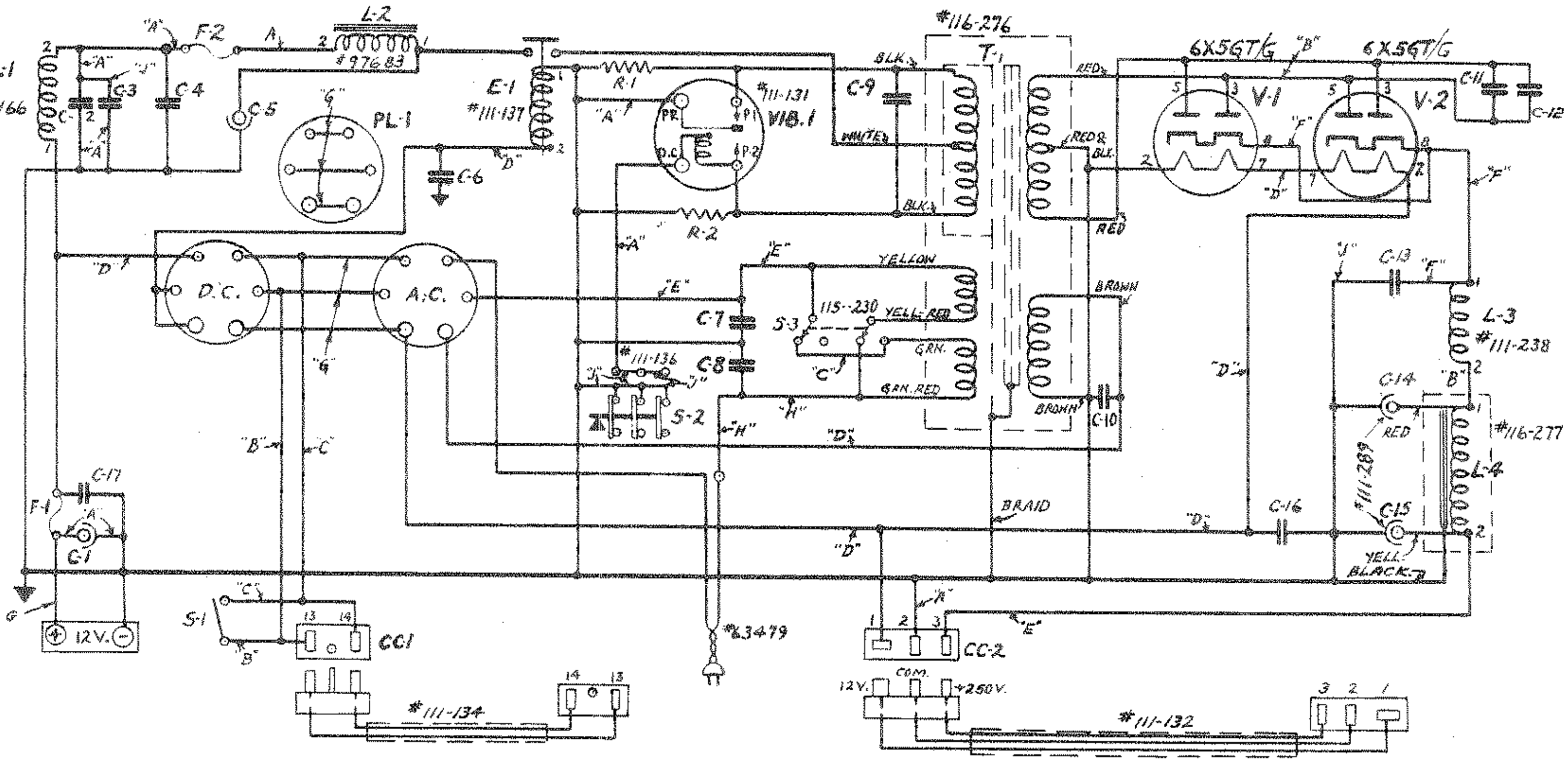
"AC" and an examination of the circuit will show that when this plug is inserted it will complete the circuit to the line plus via the ON-OFF switch and the parallel socket. This plug also completes the filament circuit for the secondary winding, thus making it possible to apply filament voltage from the secondary winding of the transformer when operating on A.C.

4-4 When the unit is used for battery operation, the plug PL-1 is shifted to the socket marked "DC" and the line cord is coiled up and the plug inserted in the socket in the chassis. The insertion of the line plug in the chassis operates the switch S-2 and connects the driver coil of the vibrator to ground. This function is provided for two reasons. First, to protect the unit should both A.C. and D.C. inputs be connected simultaneously, and secondly, to prevent operation of the vibrator when A.C. input is used. The vibrator may therefore be left in the circuit at all times. The shifting of PL-1 connects the vibrator winding in the circuit in place of the two that are used when the unit is operating on A.C. It will now be seen that the input circuit to the transformer is from the battery supply through the hash filter components of L-1 and L-2 and the condensers C-1, C-2, C-3, C-4, C-5 and C-17 to the contacts of the relay E-1 which are controlled by the coil circuit of the relay which is in turn controlled by the ON-OFF switch either on the unit or the panel of the receiver. The D.C. input voltage of the battery supply is interrupted by means of the vibrator VIB-1, and the transformer then functions in the same manner as it would with the application of A.C. to the primary. It will be seen that the filament winding of the transformer has also been disconnected by the removal of the plug PL-1 and the filaments of the 6X5G/GT tubes are now fed in series from the 12 volt battery supply. It will be well to note carefully that the power unit will not operate on either source of supply unless the plug PL-1 is in the correct position and the line cord is either plugged into the line outlet or the socket on the chassis. Unless the correct connections are made for each type of supply, the unit will be inoperative. These precautions will prevent any damage to the unit if by any chance the unit is connected to the wrong type of primary supply. A fuse F-1 is provided in the primary line from the batteries to protect the unit from damage should any part of the receiver circuit cease to function. F-2 is provided in series with the vibrator winding centre tap to protect the power transformer should the vibrator become shorted. Condensers C-11 and C-12 are the timing capacities, their values being so chosen as to produce the utmost of overall efficiency and to give the longest possible life to the vibrator VIB-1. The latter is a non synchronous type operating at a frequency of 115 cycles. It is sealed and designed to withstand the extremes of temperature and humidity for which the rest of the unit is designed.

PARTS LIST — VP-3 POWER UNIT

SECTION 5

Circuit Symbol	Function	Specification	Type No.	Mfr.	R.C.N. Ref. No.
5.1 CONDENSERS					
C-1	Input Smoothing	400 uf 18v. dry electrolytic	105-269	Marconi	3C/67005
C-2	Hash Filter	2 uf 200 volts DC ±20%	230	Aerovox	3C/56006
C-3	Hash Filter	2 uf ±20% 200 volts D.C.	230	Aerovox	3C/56006
C-4	Hash Filter	0.5 uf ± 20% 50 volts DC	B205658	Mallory	3C/49036
C-5	Input Smoothing	100 uf 15 volts dry electrolytic	111-225	Marconi	3C/67002
C-6	LT By-pass	0.01 uf ±20% 300 volts DC	1467	Aerovox	3C/35016
C-7	AC By-pass	0.02 uf 240 volts AC	5540	Sprague	3C/36005
C-8	AC By-pass	0.02 uf 240 volts AC	5540	Sprague	3C/36005
C-9	Primary Buffer	0.5 uf 50 volts DC	B205658	Mallory	3C/49036
C10	LT By-Pass	0.01 uf 300 volts DC	1467	Aerovox	3C/35016
C11	Timing Capacity	.004 uf 1600 volts DC	A-205659	Mallory	3C/28005
C12	Timing Capacity	.0075 uf 1600 volts DC	VB470	Mallory	3C/31501
C13	HT Hash Filter	1.0 uf 400 volts DC	430	Aerovox	3C/55007
C14	HT Smoothing	16 uf 350 v. dry electrolytic	111-289	Marconi	3C/64036
C15	HT Smoothing	Part of C14	111-289	Marconi	3C/64036
C16	Primary Buffer	0.5 uf 50 volts DC	B205658	Mallory	3C/49036
C17	LT By-Pass	0.01 uf 300 volts DC	1467	Aerovox	3C/35016
5.2 RESISTORS					
R1	Primary Resistor	300 ohms ±5%, ½ watt	BT½	I.R.C.	3R/23000
R2	Primary Resistor	300 ohms ±5%, ½ watt	BT½	I.R.C.	3R/23000
5.3 INDUCTANCES					
L1	LT RF Filter	50 Microhenries	111-166	Marconi	3L/167
L2	LT Filter	650 Microhenries	97683	Marconi	3U/91
L3	HT RF Filter	1000 Microhenries	111-238	Marconi	3L/165
L4	HT Audio Filter	13 Henries	97704	Marconi	3U/211
5.4 SWITCHES					
S1	ON/OFF	S.P.S.T. Toggle Switch	116-282	Marconi	3F/916
S2	Safety Switch	T.P.D.T. Slide Switch	111-136	Marconi	3F/918
S3	115/230 V. AC	D.P.D.T. Toggle Switch	116-281	Marconi	3F/917
5.5 VACUUM TUBES					
V1	Rectifier	Full wave, High vacuum	6X5GT/G	Marconi	
V2	Rectifier	Full wave, High vacuum	6X5GT/G	Marconi	
5.6 MISCELLANEOUS					
F1	LT Fuse	10 amp. 25 volt	1081	Littelfuse	3F/78
F2	Vibrator Fuse	Up to serial 1200, 10 amp. 25 volt	1081	Littelfuse	3F/78
F2	AC Fuse	Serial 1201 and up, 3 amp. 250 volt	1043	Littelfuse	3F/67
E1	Control Relay	S.P.S.T.	111-137	Marconi	3F/483
V1B1	Vibrator	Nonsynchronous 115 cycle	111-131	Marconi	3T/801
T1	Transformer	Composite Power Dual purpose	116-276	Marconi	3U/149
PL1	DC/AC Switching	6 prong plug	986	Alden	3S/501
	Socket, V1	Octal Base	68087	Marconi	3S/18
	Socket, V2	Octal Base	68087	Marconi	3S/18
	Socket, V1B1	4 Prong, 1½″ Mtg. ctrs	TBS-4P	H. B. Jones	3S/533
DC	Socket, PL1	6 Prong, 1-27/32″ Mtg. ctrs	TBS-6P	H. B. Jones	3S/532
AC	Socket, PL1	6 Prong, 1-27/32″ Mtg. ctrs	TBS-6P	H. B. Jones	3S/532
CC1	Remote Control	2 Prong Socket	S-402-AB	H. B. Jones	3S/535
CC2	Output	3 Prong Socket	S-303-AB	H. B. Jones	3S/534
		AC Line Cord	63479	Marconi	3W/102
		Interunit Cable	111-132	Marconi	3W/50
		Interunit Cable	111-134	Marconi	3W/51



NOTES

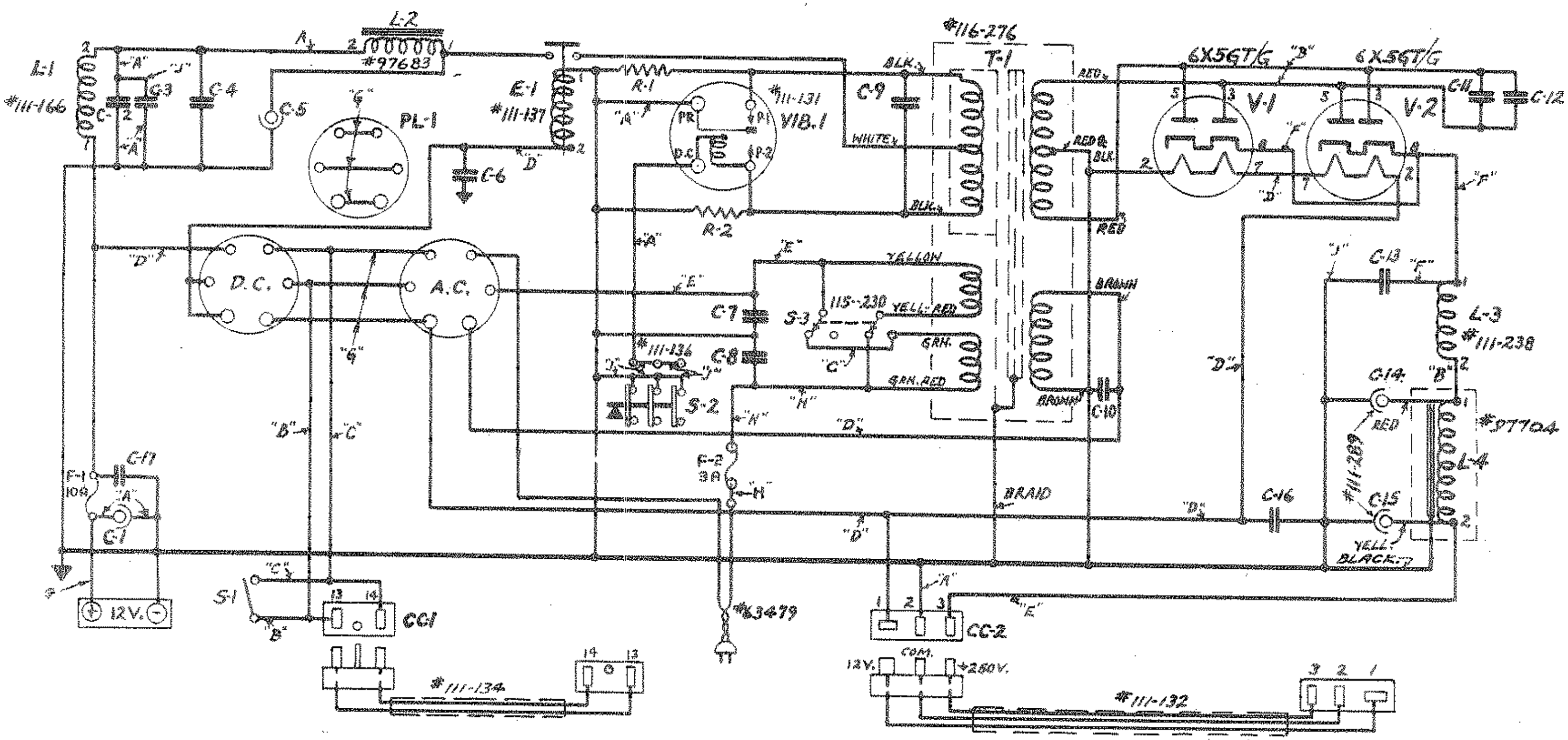
(1) ⏚ DENOTES CHASSIS.
(2) "ODD" NUMBERS START, "EVEN" NUMBERS FINISH.
(3) VALVE SOCKETS & PLUGS SHOWN BOTTOM VIEW
(4) D.C & A.C SOCKETS SHOWN TOP VIEW.

WIRE LEGEND

"A" = #14 FLEX. SING. C. SING. BRAID, NO RUBBER, BLACK.
"B" = #20 FLEX. #108-528, CODE #256 (RED-YELLOW)
"C" = #20 " " , " #268 (GRN-YELLOW)
"D" = #20 " " , " #273 (YELLOW-BRN.)
"E" = #20 " " , " #244 (YELLOW)
"F" = #20 " " , " #257 (RED-BLACK)
"G" = #14 BARE, TINNED, SOLID CU. WIRE.
"H" = #20 FLEX. #108-528, CODE #264 (GRN-BROWN)
"J" = #18 BARE, TINNED, SOLID, CU. WIRE.

DIAGRAM OF CONNECTIONS
VP-3 POWER UNIT
FOR SERIAL #101 TO #1200 ONLY

FIG. 38



NOTES

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"H" = #20 FLEX. #108-528, CODE #264 (GRN-BROWN)
"J" = #18 BARE, TINNED, SOLID, CU. WIRE.

DIAGRAM OF CONNECTIONS
VP-3 POWER UNIT
FOR SERIAL #1201 & UPWARDS

FIG. 40

INSTALLING

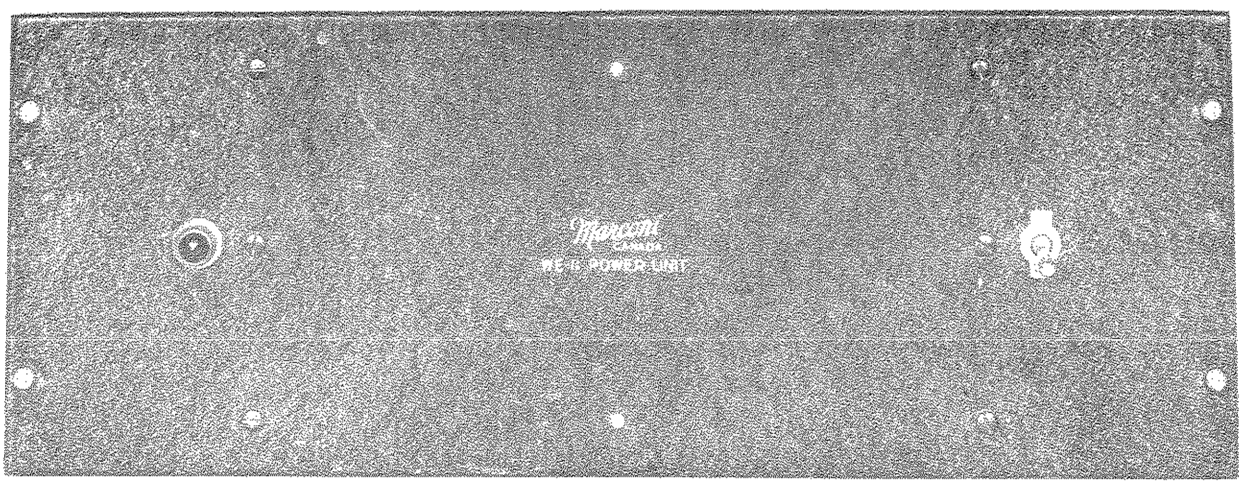
AND

OPERATING INSTRUCTIONS

FOR

Marconi

WE-11 POWER UNIT TYPE 110-973



WE-11 POWER UNIT RACK MOUNTED FIG. 15
TYPE No. 110-973

SECTION 1—GENERAL

1-1 The Marconi WE-11 power unit is designed to be used in conjunction with CSR-5 receivers in locations where the primary source of power is either 115 or 230 volt, 60 or 25 cycle mains. The unit is contained on a sheet metal chassis fitted with a cover to protect the internal parts of the unit from dust, dirt, and to prevent the operating personnel from coming in contact with parts that may be carrying high voltages.

1-2 The power unit supplies the following outputs, which are the normal input voltage requirements for the CSR-5 receiver:—

Low Voltage supply..........................12.6 volts 2.5 amps.
High Voltage supply.......................... 250 volts 115 ma D.C.

These voltages are primarily intended to supply Marconi CSR-5 receivers but will, of course, supply any receiver having requirements not exceeding the maximum output of the unit given above.

1-3 The following vacuum tubes are used in the unit and are shipped out installed in the correct sockets:—

V-1—R.V.C. 5Z4

Two cables are also supplied with the unit for connection to the CSR-5 receiver. These cables are fitted with plugs which plug into sockets at the rear of the unit, while the other ends are fitted with sockets that connect to plugs on the CSR-5 chassis. One of these cables carries the HT and LT voltages while the other is intended to effect a parallel arrangement of the ON-OFF switch on the receiver so that the power unit can be controlled from the front panel of the unit.

1-4 The unit is supplied in two forms, one for bench mounting in a cabinet which can be placed upon a bench or shelf, and the other designed to mount on a standard telephone rack, in locations where the receiver is of the rack mounted type. The weight of the cabinet mounted unit is approximately 30 lbs. complete, while that of the rack model is approximately 32 lbs. complete. Both units are finished in standard paint colors to match other units of the particular installation for which they will be used.

INSTALLATION

SECTION 2

2-1 On receipt of the unit, it should be removed from the packing case and examined for damage in transit. The unit was carefully tested and inspected before shipment, and any claims for damage should be entered with the transportation company before returning the instrument for repairs. Examine the unit for loose nuts, screws and broken connections, before placing in service, and repair any that require attention.

2-2 Place the rectifier tube in the socket and make the external connections to the receiver. It will now be necessary to set the line voltage switch to the correct tap for the line voltage at the site. Remove the lock on the line voltage switch and set the switch to either 115 or 230 volts, depending upon the supply voltage available. Lock the switch in the desired position and connect the line cord to the source of supply.

2-3 Turn the ON-OFF switch to ON and voltages will be applied to the receiver. It will be noted from the connection diagram that the ON-OFF switch is connected in parallel with a two conductor cable. When the WE-11 power unit is used in conjunction with the CSR-5 receiver, the ON-OFF switch on the power unit may be left at the OFF position and the power unit controlled by the switch on the front panel of the receiver. When the unit is used with other receivers, special connections will have to be made to incorporate this feature.

2-4 Once the power unit has been placed in service, the normal operation of the unit will be obtained and the receiver will operate in the normal manner. If the power unit is used with any other receiver than the CSR-5, care must be taken to see that it is of the type that has a common negative supply, as the three conductor cable supplied has a common lead for the negative HT and one side of the filament. This is entirely suitable for the CSR-5, but in some other types of receiver modifications to the receiver may be required.

MAINTENANCE

SECTION 3

3-1 The WE-11 power unit is a straightforward AC power supply and, as all components are rated in excess of any voltage or current likely to be encountered, the unit should not give any trouble unless its output is shorted by shorts or partial shorts in the receiver.

3-2 Should at any time the H.T. or low tension voltages on the receiver measure lower than normal, disconnect the power unit and check as follows:—

Connect a 2500 ohm resistance across pins No. 2 and No. 3 of the chassis connector CC-2 and a 5 ohm resistance across pins No. 1 and No. 2.

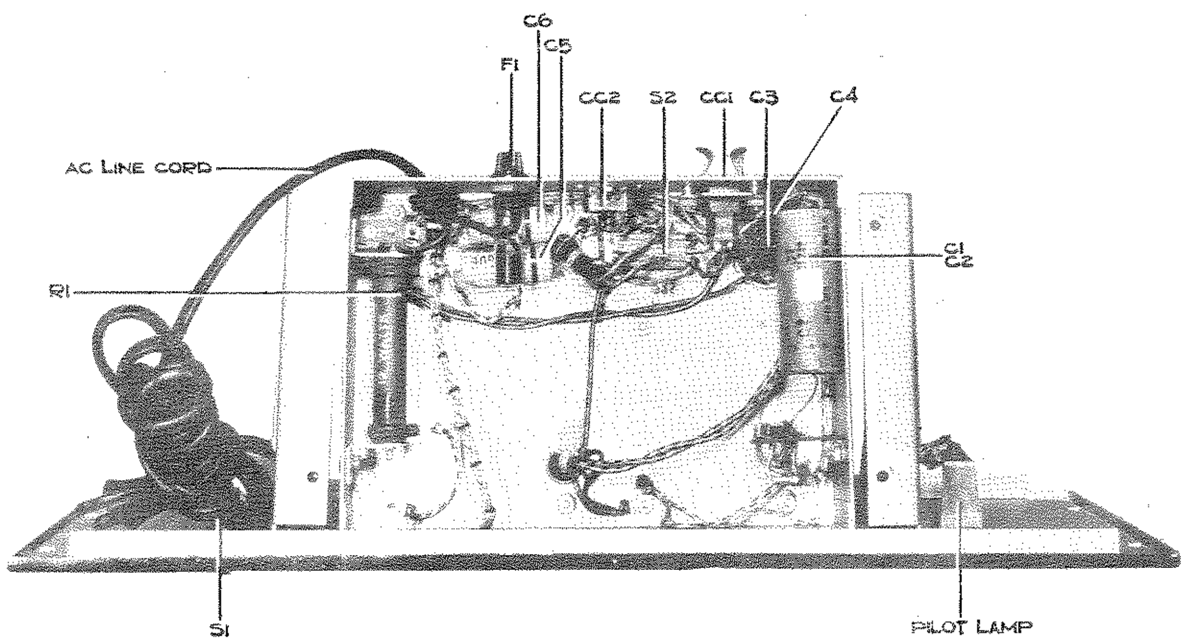
With the input voltage adjusted to 115 volts A.C. or 230 volts A.C., the D.C. voltage across the 2500 ohm resistance should be 275 volts, plus or minus 10% and the A.C. voltage across the 5 ohm resistance should be 12 volts, plus or minus 10%.

3-3 If the D.C. output voltage is low when measured as per 3.2 above, check the rectifier tube V-1 in a reliable tube checker or by replacing it with one known to be satisfactory If the voltage is still low, check the value of condensers C-1 and C-2 and replace if below the values indicated in the Parts List.

TECHNICAL DESCRIPTION

SECTION 4

4-1 The following technical description is intended to provide the technical personnel charged with the maintenance of the equipment with the necessary information to carry out all repairs with a sure knowledge of the locations and functions of the various com-



WE-11 POWER UNIT FIG. 17
BOTTOM VIEW WITH BASE PLATE REMOVED

ponents that make up the unit. It is not intended that this section will be used for instruction purposes for personnel who are not well grounded in the basic theory of radio communication. It will be found that a careful study of the diagrams and illustrations attached to this folder will prove to be of considerable assistance in locating and identifying the various component parts and the functions of each.

4-2 From an examination of the circuit diagram of the WE-11 power unit (Fig. 39), it will be seen that basically it consists of a full wave high vacuum rectifier, a 5Z4 or 5Z4GT vacuum tube. The plates of this rectifier are fed from the secondary winding of the transformer T-1 with the necessary high voltages. The cathode of the tube delivers the rectified voltage to the smoothing filter consisting of the choke L-1 and the condensers C-1 and C-2. A bleeder resistance is provided across the output and is designated as R-1. The output of the filter is fed to the correct terminal on the output plug on the chassis. It will be seen that a separate filament winding is also connected to this plug and this supplies the filaments of the receiver. The filament of the rectifier tube is fed from a separate winding which is adequately insulated to withstand the high voltage.

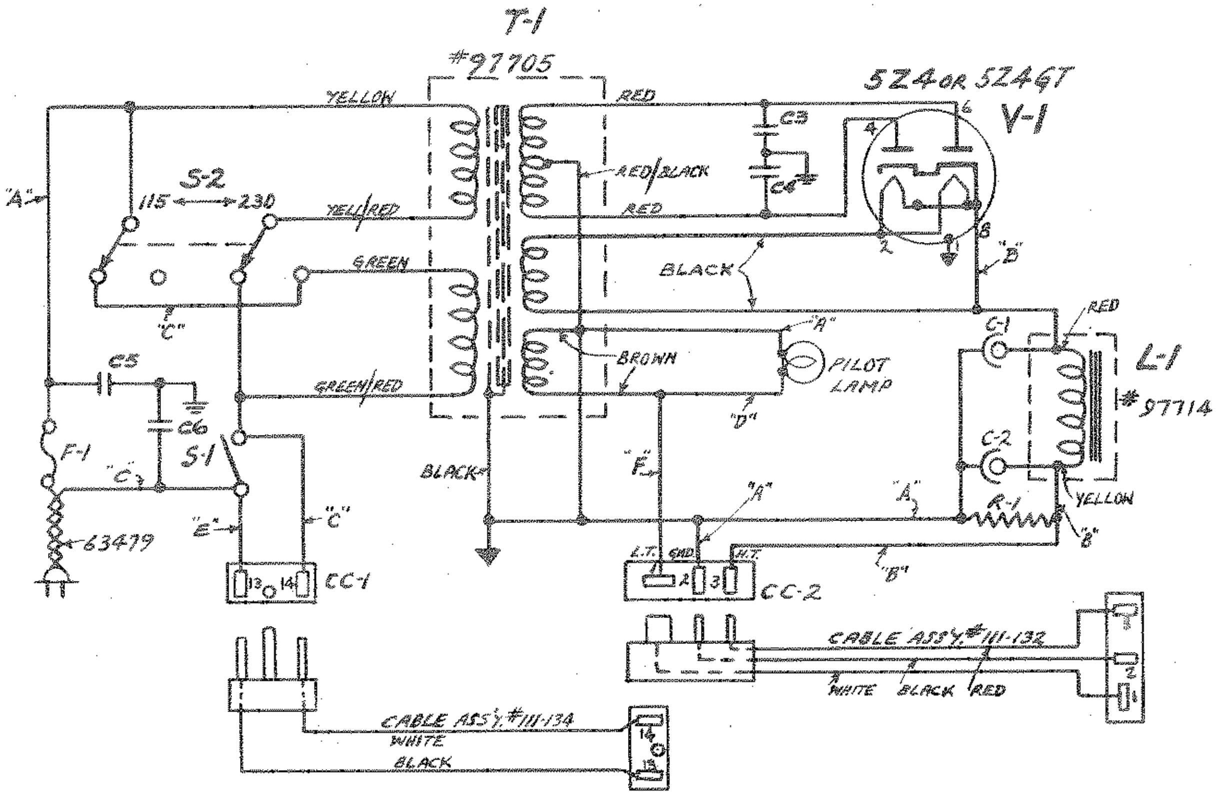
4-3 The primary circuit of the power unit is arranged so that a choice of two input voltages can be obtained. It will be seen from the diagram that there are two primary windings on the transformer which are connected either in series or parallel by means of the switch S-2. When the windings are connected in series, the unit is arranged for an input voltage of 230 volts, while when in the parallel position the input voltage is 115 volts. A fuse is provided in the primary circuit to protect the unit from damage due to incorrect line connections or shorts on the output side of the unit.

4-4 An ON-OFF switch is provided, and in parallel with it a parallel connected plug which with its associated connecting cable is intended to be used to connect to a remote switch connected on the receiver. A three conductor cable is also provided to connect the HT and LT supplies to the receiver, which plugs into the appropriate socket on the chassis.

SECTION 5

PARTS LIST

Part	Function	Specification	Type No.	Maker
C-1	H.T. Smoothing	16 uf 350v. dry electrolytic	111-289	Marconi
C-2	H.T. Smoothing	Part of C-1	111-289	Marconi
C-3	RF Filter	500 uuf ± 10%	1468	Aerovox
C-4	RF Filter	500 uuf ± 10%	1468	Aerovox
C-5	AC Bypass	.02 uf ± 20%, 240 volts AC	5540	Sprague
C-6	AC Bypass	.02 uf ± 20%, 240 volts AC	5540	Sprague
R-1	Bleeder	50,000 ohms ±5%, term. No. 2 "C" coat "DD" Brackets	DJ	I.R.C.
V-1	Rectifier	Full wave high vacuum	5Z4/GT	R.V.C., Marconi
L-1	H.T. Choke	13 Henries	97714	Marconi
T-1	Transformer	Composite power	97705	Marconi
S-1	OFF/ON	S.P.S.T. Toggle	116-282	Marconi
S-2	115-230 v.	D.P.D.T. Toggle	116-281	Marconi
CC-1	Remote Switching	2 Prong Socket	S-402-AB	H. B. Jones
CC-2	Output	3 Prong Socket	S-303-AB	H. B. Jones
F-1	Fuse	3 amp. 250 volt	1043	Littelfuse
P-1	Pilot Lamp	12 volt, min. tub. Bayonet base	T-3¼	Mazda
	AC Input	Line Cord	63479	Marconi
	Socket	For V-1	68087	Marconi
	Socket	For P-1	20 Red	Drake
	Cable	Interunit, 2 wire	111-134	Marconi
	Cable	Interunit, 3 wire	111-132	Marconi
	Fuse Holder	Fuse Holder	1075	Littelfuse



WIRE LEGEND

"A" = 108-528 WIRE SPEC. #240 (BLACK)
"B" = 108-528 " " #242 (RED)
"C" = 108-528 " " #244 (GREEN)
"D" = 108-528 " " #241 (BROWN)
"E" = 108-528 " " #246 (BLUE)
"F" = 108-528 " " #257 (RED/BLACK)

NOTES

(1) ⏚ DENOTES CHASSIS.

DIAGRAM OF CONNECTIONS WE-11 POWER UNIT

FIG. 39

SIGNAL ESTABLISHMENT LIST

S. E. 129 ISSUE No. 1

CANADIAN MARCONI CSR-5A RADIO RECEIVING EQUIPMENT

ROYAL CANADIAN NAVY

DIRECTOR OF SIGNALS DIVISION

1st MAY, 1944

Item No.	Description	Qty.	Manufacturer's Reference No.	R.C.N. Reference No.	Case No.
3.0	**EQUIPMENT LIST**				
1	Canadian Marconi CSR-5A cabinet type Radio Receiver including:	1	110-930-AZ	3A/107-1	
2	3—6SK7 2–6SG7 vacuum tubes				
3	1—6K8 vacuum tube				
4	1—6B8 vacuum tube				
5	1—6H6 vacuum tube				
6	1—6F6 vacuum tube				
7	1—9002 vacuum tube				
8	1—VR150/30 vacuum tube				
9	4 pilot lamps No. 53 Mazda (12-16 volts)			3T/1031	
10	Canadian Marconi VP-3 Power Unit including:	1	110-540-Z	3D/101	
11	1—Alden plug No. 986			3S/501	
12	2—6X5GT/G vacuum tubes				
13	2—Vibrators (includes one spare shipped inside cover of VP-3 Power Unit)		111-131	3T/801	
14	2—Littelfuses No. 1081 10 Amp.			3F/78	
15	2—Littelfuses No. 1043 3 Amp.				
16	1—bag of wood screws for mounting				
17	Loudspeaker Assembly, cabinet type complete with 6″ cable and plug	1	110-823-Z	3M/100	
18	Cable assembly, 6″ long	1	111-132	3W/50	
19	Cable assembly 6′ long	1	111-134	3W/51	
20	Headset telephones complete with headband, two low impedance (250-300 ohms at 1000 cycles/sc) receivers connected in series and including:	1	122-195	3M/251	
21	1—Plug PL-55			3S/658	
22	Shock mountings complete with mounting screws	2	110-704-Z	3E/823	
23	CSR-5A instruction book including:		110-434-A	3X/100-1	
24	1—VP-3 instructions				
25	Spare set of vacuum tubes, pilot lamps and fuses including:	1		3J/39-2	
26	3—6SK7 2–6SG7 vacuum tubes				
27	1—6K8 vacuum tube				
28	1—6B8 vacuum tube				
29	1—6H6 vacuum tube				
30	1—6F6 vacuum tube				
31	1—9002 vacuum tube				
32	1—VR150/30 vacuum tube				
33	2—6X5GT/G vacuum tubes				
34	4—pilot lamps No. 53 Mazda (12-16 volts)			3T/1031	
35	1—Littelfuse No. 1081 10 Amp.			3F/78	
36	1—Littelfuse No. 1043 3 Amp.			3F/67	

TABLE A
PLUGS, SOCKET, AND CONNECTORS FOR R.1155

Single receiver with visual indicator, type 1

Points	SOCKET P_3 FROM LOOP AERIAL	PLUG P_2 TO VISUAL INDICATOR (*when only one fitted*)	PLUG P_2 TO VISUAL INDICATOR (*when two are fitted*)	PLUG P_1 FROM TRANSMITTER
1	—	To V.I. terminal A (Green)	To V.I. terminal A (Green)	F.Ae. (H.F. Ranges)
2	—	To V.I. terminal D (Red)	To V.I. terminal D (Red)	T.Ae. (H.F. Ranges)
3	—	To V.I. terminals B, C (Blue)	To V.I. terminal F (Blue)	L.T.+
4	—	To V.I. screening earth	To V.I. screening earth	L.T.— and screen earth
5	—	—	—	H.T.+ through interlock
6	—	—	—	Telephone+
7	—	—	—	H.T.+ 220-v.
8	—	—	TERMINAL CONNECTIONS FOR ADDITIONAL CONNECTOR	H.T.—
13	Earth	—	First V.I. / Colour / Second V.I.	—
14	Earth	—	B / Green / A C / Red / D F / Blue / BC	—
15	MS_{ef} contact 5 and loop	—		—
16	MS_{ef} contact 11 and loop			
	CONNECTOR Plug, type 209 Duradio No. 20 Socket, type 63 or Cable end eye (to matching unit)	CONNECTOR Socket, type 137 Trimet 4 Cable end eye	ADDITIONAL CONNECTOR (Between visual indicators) Cable end eye Trimet 4 Cable end eye	CONNECTOR Socket, type 137 Octocoremet No. 2 Plug, type 210

Two receivers with two indicators

W.T. operator's receiver

SOCKET P_3	PLUG P_2	PLUG P_1
Dummy socket block inserted		As above
		CONNECTOR As above

Navigator's receiver

SOCKET P_3	PLUG P_2	PLUG P_1
Points and connector detail as for single receiver (above)		CONNECTOR Socket, type 299 Dumet 4 and 7 (to power unit) Plug, type 358 Ducel 4 (to telephones) Terminal block B (2-way) Unicel 4 (to aerial) Cable end eye

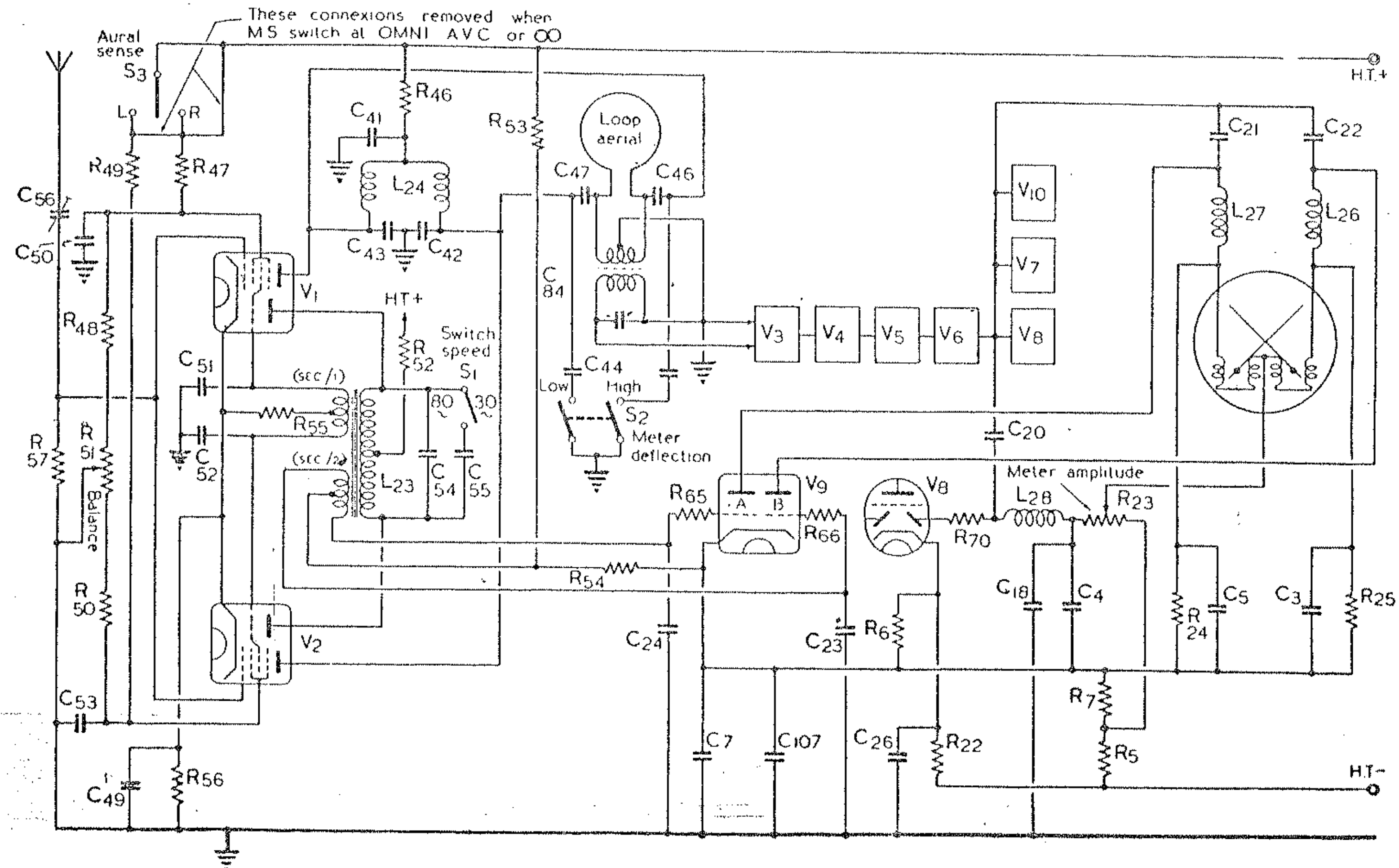


FIG. 10.—SIMPLIFIED VISUAL D.F. CIRCUIT

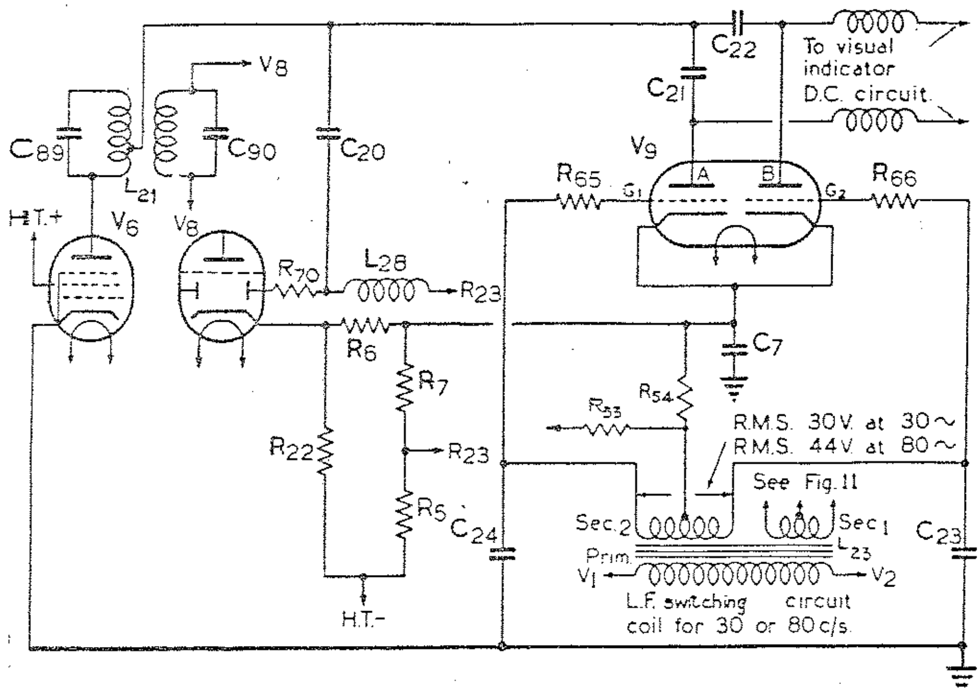


FIG. 12.—VISUAL INDICATOR SWITCHING CIRCUIT

45. It will be seen from fig. 13 that the diodes A and B rectify the signal impulses, but owing to the switching voltage applied to the grids of V_9 from the L.F. transformer L_{23} they are alternately conducting and non-conducting according to the condition of the grid. Since this switching is synchronised with the aerial switching the output of one diode will be proportional to the fixed aerial voltage plus the loop voltage, and the output of the other diode will be proportional to the fixed aerial voltage minus the loop voltage as stated in para. 39. The pulsating D.C. output produced through diode A will tend to charge the fixed condenser C_5 which is across the anode load resistor R_{24} and will at the same time flow through the two left-hand coils of the visual indicator and the variable resistor R_{23}. The effect will be to actuate the needle which points to the right, causing it to rise. Collapse of the needle during the alternate (negative) half-cycle of the switching voltage is prevented by the charge on C_5, which tends to discharge through the circuit VPZW. In a similar manner the needle which points to the left is operated by diode B and its associated load R_{25} and condenser C_3, with the common resistor R_{23}. When the charges on the condensers C_5 and C_3 are equal the needles will rise by equal amounts and will therefore intersect on the central line marked on the instrument, but when the charges are unequal the needles will rise to different heights giving an intersection to left or right of the centre line according to which section is passing the greater current. In addition, when the charges on C_5 and C_3 are unequal there is a tendency for current to flow between V and X via P (see fig. 13), a circumstance which assists the differential action of the needles.

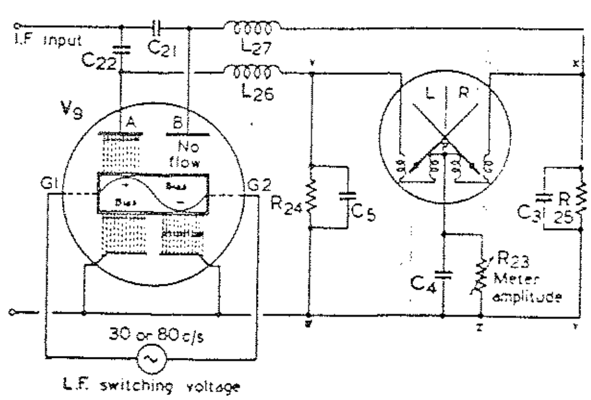


FIG. 13.—SIMPLIFIED VISUAL INDICATOR SWITCHING CIRCUIT

Meter amplitude

46. The sharpness of a bearing is determined by the relative amplitudes of the fixed and loop aerial voltages. When these are equal the sharp minimum shown in curve C of fig. 14 is obtained.

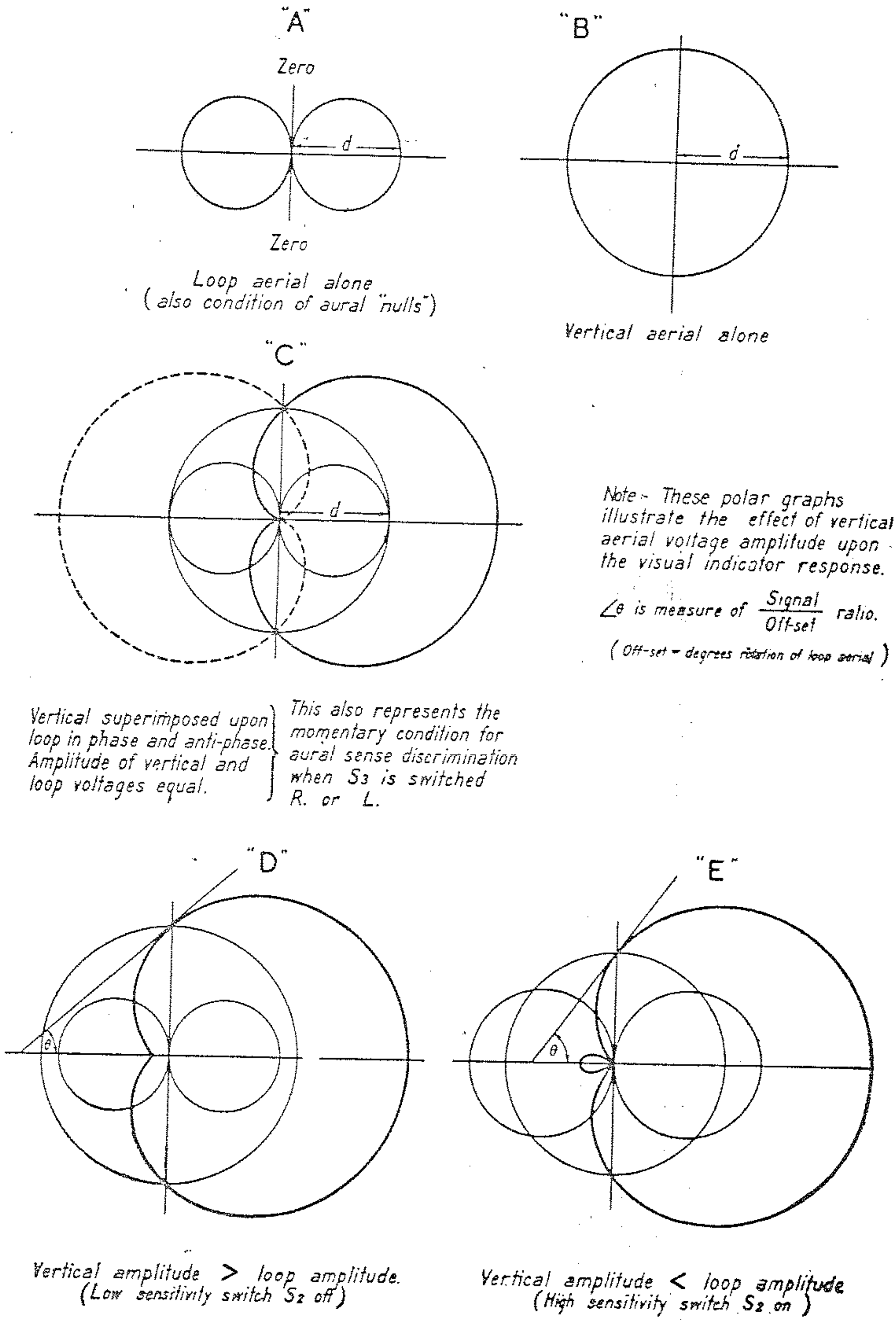


FIG. 14.—POLAR DIAGRAMS

When the fixed aerial voltage is greater than the loop aerial voltage the minimum is less sharp, as will be seen by the flattening of the cardioid curve D of fig. 14. When the loop voltage is the greater an additional lobe is introduced into the polar diagram, and two minima are obtainable (curve E of fig. 14). The two condensers C_{42} and C_{43} are provided to reduce the amplitude of the fixed aerial voltages to the correct value for a sharp minimum.

47. When using the visual indicator for homing this sharp minimum is a disadvantage, as a very small deviation off course causes a considerable movement of the needles, with consequent strain upon the pilot in maintaining course. To eliminate this difficulty a meter sensitivity switch is provided. This switch has two positions HIGH and LOW, indicating high and low sensitivity respectively. In the LOW position the switch introduces the further condensers C_{44} and C_{45} in parallel with C_{42} and C_{43} respectively, reducing the fixed aerial voltage relative to the loop voltage. This results in a less sharp minimum and homing is therefore simplified.

The diode limiter valve

48. It has already been explained that the pulsating D.C. output from V_5 is fed through the R.F. chokes L_{26} and L_{27} to the actuating coils of the visual indicator. In order to prevent the needles rising due to noise output in the absence of a signal, a delay bias is provided between cathode and anode. One diode of the double-diode-triode valve V_6 is fed through a condenser C_{30} from a tapping on the primary winding of the I.F. transformer L_{21}. The rectified output from V_6 flows via a swamp resistor R_{70}, and the R.F. choke L_{28} to the meter amplitude control, which is the variable resistor R_{23}. The cathode of V_6 is biased by the resistor R_{22}. Any current injected at R_{23} tends to drive both needles downwards without interfering with the differential action of the circuit. The action of the normal A.V.C. alone is insufficient to keep the intersection point of the needles on the scale for the possible range of signal variation.

49. The limiter delay voltage is supplied across the resistors R_6 and R_7 and is about 4 volts. It does not come into action until the peak voltage applied to the common point of C_{20}, C_{21}, and C_{22} exceeds the delay voltage. This limiter device is effective for changes up to 80 db and, given a correct setting of R_{23}, the point of intersection will not move beyond the limits of the scale.

Visual indicator balancing circuit

50. Accuracy of indication depends on the balancing of the two input switching valves V_1 and V_2 and their associated circuits. Balance is achieved by the potentiometer R_{51}. When the master switch MS is in the BALANCE position the loop aerial is disconnected and earthed by MS_{el} and a dummy loop consisting of a coil L_7 and condenser C_{99} is connected in its place (see fig. 3). As the dummy loop does not pick up signals any deflection of the point of intersection of the visual indicator needles is due to lack of symmetry in the circuit. To correct this the potentiometer R_{51} is adjusted until the intersection point coincides with the central indicating line of the instrument.

51. After renewal of one of the valves V_1 or V_2 it may be found to be impossible in some receivers to effect balance within the limits of the balance control knob. In such a case it will be necessary to replace one of the valves with another whose characteristics are such that they will permit a balance. The unmatched valve displaced is not to be discarded but is to be matched with another V.R.99A for future use.

Visual sense determination

52. The direction of movement of the visual indicator needles reflects the angle of the plane of the loop aerial relative to the path of the incident wave. Orientation of the loop is such that, having obtained a bearing by turning it so that the needles cross on the white line, a reduction in loop reading by a few degrees will cause the needles to fall to the *right* if the sense is *correct*. If the needles fall to the left when the loop reading is reduced the bearing is 180° out, i.e. it is a reciprocal. For homing the sense test is to swing off course to the left. If the needles move to the *right* the sense is *correct*.

Aural D.F.

53. For aural D.F. the fixed aerial is disconnected by the master switch MS_{bf}, and the loop aerial gives a figure-of-eight polar diagram as shown in curve A of fig. 14. The switch section MS_{cr} breaks the H.T. supply to the L.F. oscillator, rendering the switching circuits inoperative. The volume control is switched, changed from automatic to manual by MS_{al} and MS_{cl}. To overcome the 180° ambiguity which results from the use of a loop aerial alone, the three-position switch S_3 is operated. This switch applies H.T. to the screens of one or other of the hexode portions of V_1 or V_2 thus coupling the fixed aerial through to the loop circuit, and producing a cardioid polar diagram. Sense determination by aural means is described in paras. 104 to 106.

CONSTRUCTIONAL DETAILS

54. The control panel of a receiver, type R.1155N is shown in fig. 1. Illustrations of the R.1155 are given in fig. 15, which is a view of the upper deck of the chassis, and fig. 16 which shows the chassis underside view. The diagram of fig. 17 gives the location of components. To facilitate search this diagram is gridded and a reference table is provided. The additional filtering components incorporated in later models may be seen from figs. 18 and 19, which are illustrations of a R.1155B. The receiver is removed from its case by loosening the four screws at the corners and by pulling the handles. All cable connections to the receiver are terminated in plugs and sockets which are non-reversible and non-interchangeable. Cables are, wherever possible, metal braided, the braiding being earthed to reduce interference from external sources. Details of the cables and connections are given in Table A overleaf. The receiver case, chassis, and panel are of metal, and are earthed to the main bonding system of the aircraft.

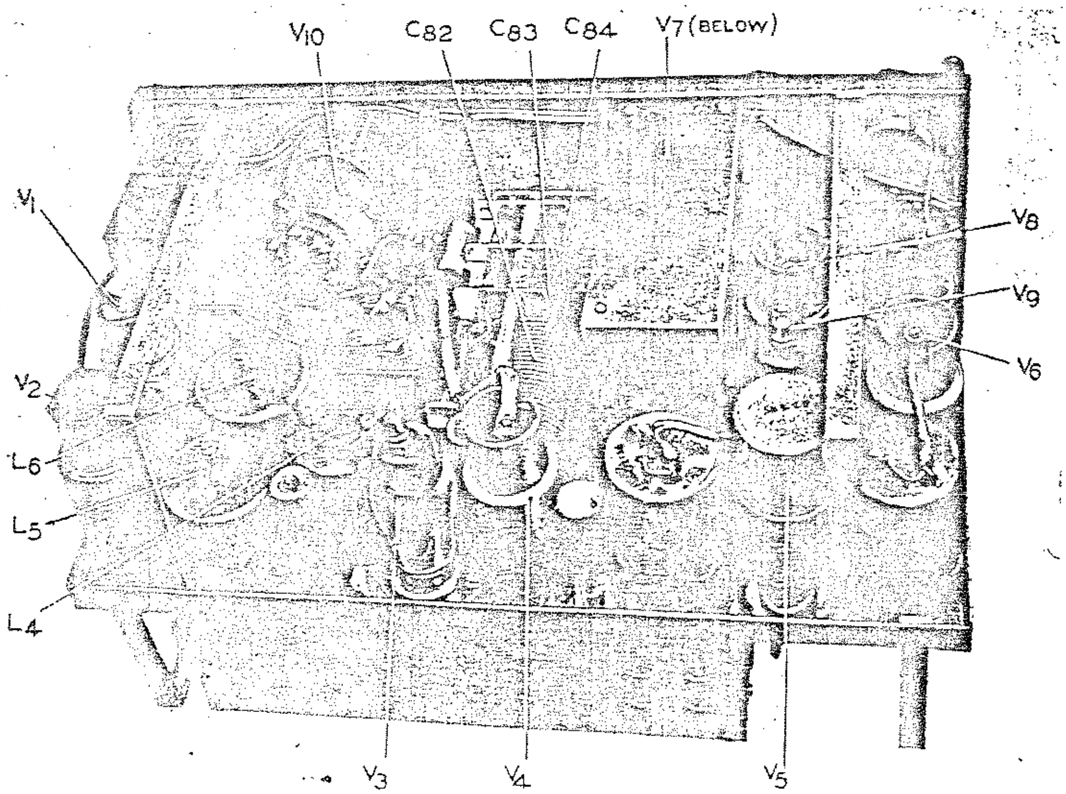


FIG. 15.—R.1155 CHASSIS, UPPER DECK

Front panel controls

55. Referring to fig. 1, a metal strip and metal posts hold the cable connector plug and sockets securely to the receiver. The calibrated tuning dial, which differs as to type in certain models, shows the frequency to which the receiver is tuned by a pointer. The tuning control has two speeds, and is coupled to a three-gang condenser comprising C_{82}, C_{83}, and C_{84}. In some models the drive used is the Drive, slow motion, Type 13, in which instance the outer knob gives a direct drive and the inner knob a 100:1 ratio drive for fine tuning. Other models have a Type 35 drive with 4·5:1 (inner knob) and 80:1 (outer knob) ratios. The exact point of correct tuning is shown by minimum shadow in the tuning indicator, V_{10}, located at the top right-hand side of the tuning scale.

56. The tuning dial has five scales: one for each of the five ranges, each scale being calibrated in Mc/s or kc/s. Originally, the tuning scales of the R.1155 were coloured over those portions which corresponded to the blue, red, and yellow colouring of the controls of the three ranges of the T.1154.

As a result of the introduction of new ranges in later models of both the receiver and the transmitter it may be found that this correspondence of colour does not exist between the receiver and transmitter of some installations. In some models of the receiver all the scales are printed in black.

57. The master switch MS has five positions labelled ⊗ ("OMNI"), A.V.C., BALANCE, VISUAL, and ∞ ("FIGURE-OF-EIGHT"). Details of these positions are given in paras. 9 and 91.

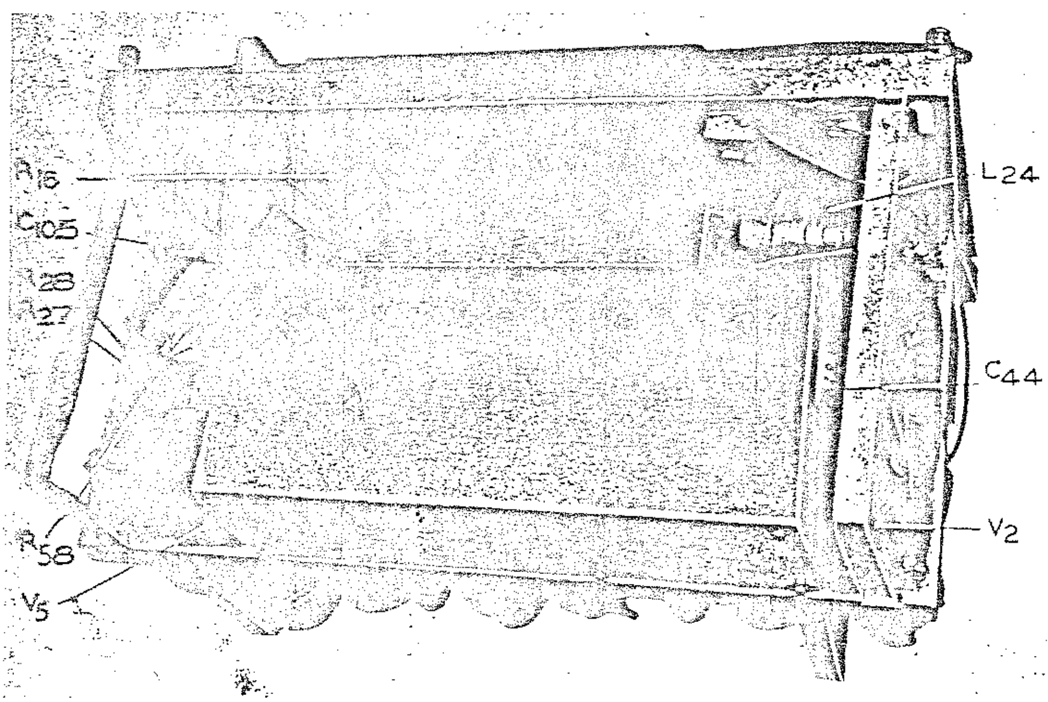


FIG. 16.—R.1155 CHASSIS, UNDERSIDE

58. The frequency range switch FS is at the lower left-hand side of the tuning scale and selects the five frequency ranges. Its five positions are engraved with the numerical band coverage, it is composed of one switch type 368 for oscillator wafer, one switch type 369 for anode wafer, one switch type 370 for aerial wafer, and one switch type 371 for the loop aerial wafer.

59. The remaining front panel controls include the L.F. filter switch S_5, the meter amplitude control R_{23}, the heterodyne switch S_4, the meter sensitivity switch S_2, and the meter frequency switch S_1. The aural sense switch S_3 has three positions and is spring-loaded to cause it to revert to the centre position when not held to the left or to the right.

60. Screwdriver adjustment is provided for the condensers C_{13} and C_{56}. The condenser C_{13} varies the B.F.O. frequency and is adjustable between capacitance limits of from 5 $\mu\mu F$ to 60 $\mu\mu F$. The fixed aerial input to the switching valves V_1 and V_2 and thence to the loop aerial is adjusted when the receiver is installed, by means of C_{56} which is variable between 8 $\mu\mu F$ and 115 $\mu\mu F$.

Chassis layout

61. The panel is attached to a metal tray, braced top and bottom by strips returned to the panel upper and lower edges. The strips provide an equalising fit into the receiver container. The upper deck view in fig. 15 shows the chassis with valves in position. For the purposes of this illustration the screening container of the valve V_3 has been removed. The disposition of the components can be seen in the location diagram of fig. 17, which is drawn from the R.1155 chassis. This diagram, when studied in conjunction with figs. 15, 16, 18, and 19 and the relevant portions of the text, should serve also for the later models of the receiver.

62. An underside view of the chassis is given in fig. 16. The aerial circuit, anode circuit, and local oscillator coils, associated condensers and resistances, and the wafers wr–wf, xr–xf, yr–yf, and zr–zf of the frequency range switch FS are contained inside the large screening case at the bottom of fig. 16. Near the top edge of this container and, reading from left to right, are the adjustment ports for the trimmer condensers C_{69}, C_{70}, C_{68}, C_{71}, C_{72}, C_{63}, C_{64}, C_{65}, C_{62}, C_{66}, C_{59}, C_{60}, C_{61}, C_{58}, and C_{57}. The location of components on the underside of the chassis and within the screening can is shown in detail in fig. 17.

63. The additional filtering components included in the receivers types R.1155A and R.1155B are shown in the two illustrations, figs. 18 and 19. These illustrations are respectively, chassis upper deck and chassis underside views of the R.1155B and show the complete arrangements for suppression of M.F. broadcasting and radar interference. There is only a limited number of receivers in service containing M.F. suppression only and as the components, with one exception, are in the same relative positions in both types it is unnecessary to give illustrations of both.

64. Referring to fig. 18 the screening can (1), mounted over the three D.F. aerial coil assemblies on the upper side of the deck, contains the grid rejector filter unit, comprising a coil L_{33}, with a condenser C_{113}. In the R.1155A this can also contains a condenser C_{112}, and a resistance R_{71}. In the R.1155B these two components are located in the H.F. coil box under the deck and are connected between the choke HFC_6 and the switch section FS_{xr}. The choke HFC_5 connected between the aerial tuning condenser C_{56} and the control grids of V_1 and V_2 is mounted on a bracket adjacent to the top caps of V_1 and V_2. The illustration of fig. 19 shows the H.F. coil box with the cover removed to enable the positions of these components to be indicated.

65. When using figs. 15 to 19 in connection with the R.1155L and R.1155N, paras. 34 and 35 should be consulted with regard to the removal, re-positioning, or addition of the items affected by the altered frequency ranges of these models.

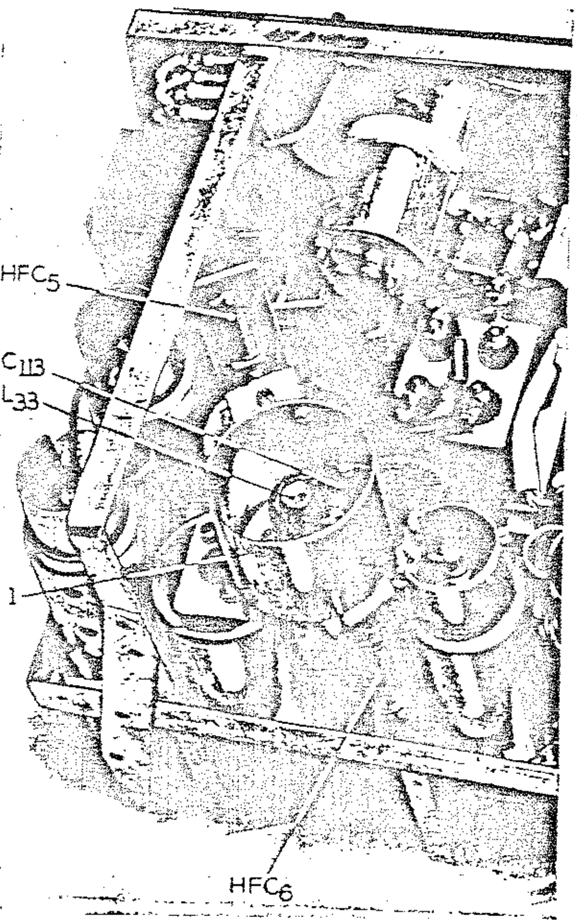


FIG. 18.—R.1155B CHASSIS, UPPER DECK

INSTALLATION

66. The following notes on the installation of the receiver duplicate, to some extent, the installation paragraphs included in Chap. 1, on the transmitter T.1154. This is unavoidably due to the interdependence of the transmitter and receiver when used in aircraft. From the typical installation diagram given in fig. 21 it will be realised that the transmitter is the main focal point of the wiring. The power unit connectors, and also the fixed and trailing aerials and connections from the receiver, plug into the transmitter. In laying out the equipment in the aircraft the receiver is placed in a convenient position for operation and where possible it is at desk level. The transmitter is mounted above or to one side of the receiver. The tuning scales of the receiver are to be easily visible and the controls accessible to the operator.

Receiver position

67. The receiver is normally positioned horizontally, but if space is limited it may bemounted vertically. The receiver is secured by mountings, type 54, and as these will be 90 deg. out when the

CHAPTER 2

RECEIVERS, Types R.1155, R.1155A, B, C, D, E, F, L, M, and N

LIST OF CONTENTS

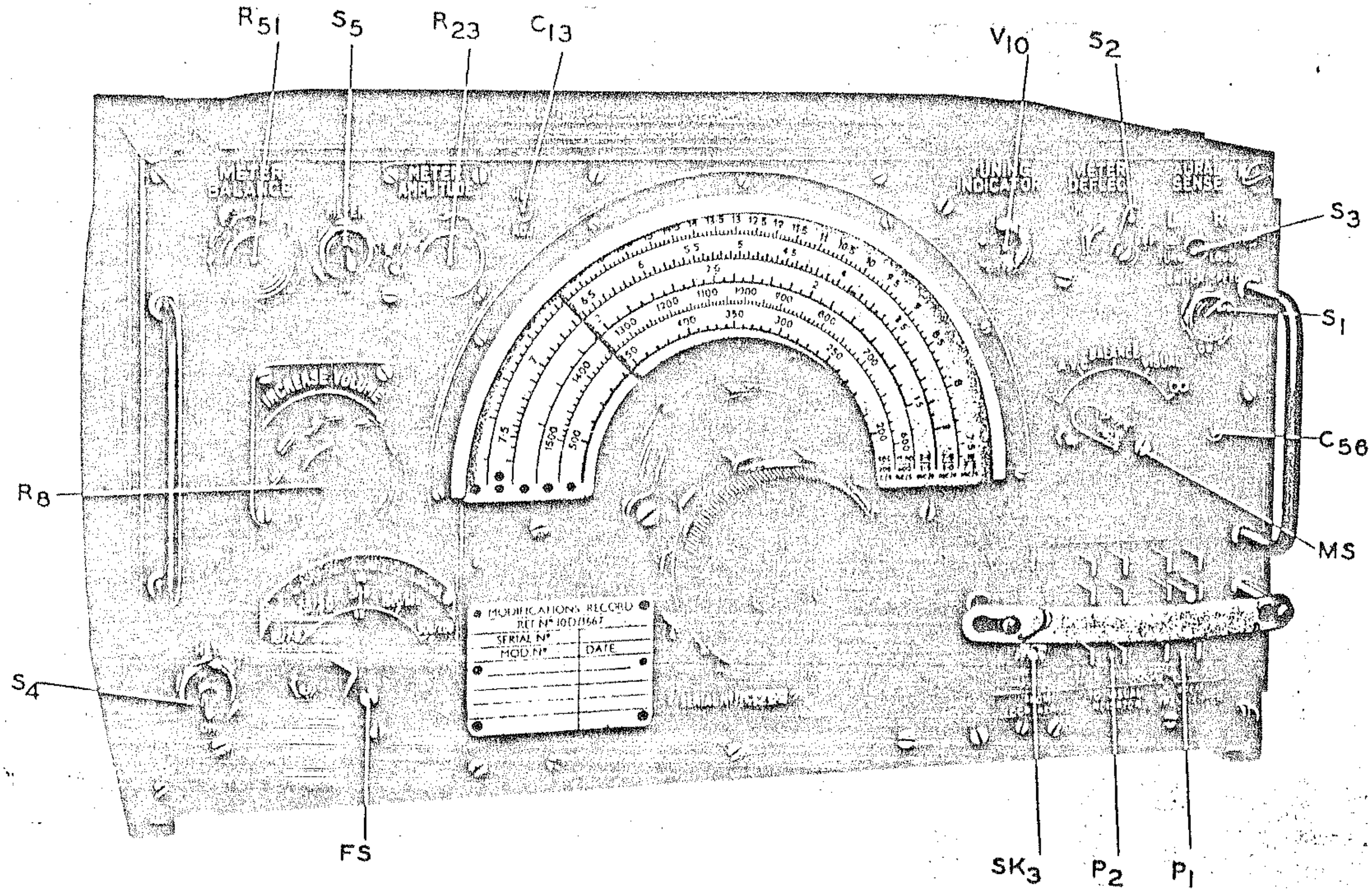


Fig. 1.—Receiver R.1155N

TABLE A
PLUGS, SOCKET, AND CONNECTORS FOR R.1155

Single receiver with visual indicator, type 1

Points	SOCKET P_3 FROM LOOP AERIAL	PLUG P_2 TO VISUAL INDICATOR (*when only one fitted*)	PLUG P_2 TO VISUAL INDICATOR (*when two are fitted*)	PLUG P_1 FROM TRANSMITTER
1	—	To V.I. terminal A (Green)	To V.I. terminal A (Green)	F.Ae. (H.F. Ranges)
2	—	To V.I. terminal D (Red)	To V.I. terminal D (Red)	T.Ae. (H.F. Ranges)
3	—	To V.I. terminals B, C (Blue)	To V.I. terminal F (Blue)	L.T.+
4	—	To V.I. screening earth	To V.I. screening earth	L.T.— and screen earth
5	—	—	—	H.T.+ through interlock
6	—	—	—	Telephone+
7	—	—	—	H.T.+ 220-v.
8	—	—	TERMINAL CONNECTIONS FOR ADDITIONAL CONNECTOR	H.T.—
13	Earth	—	First V.I. / Colour / Second V.I.	—
14	Earth	—	B / Green / A	—
15	MS_{ef} contact 5 and loop	—	C / Red / D	—
16	MS_{ef} contact 11 and loop		F / Blue / BC	
	CONNECTOR Plug, type 209 Duradio No. 20 Socket, type 63 or Cable end eye (to matching unit)	CONNECTOR Socket, type 137 Trimet 4 Cable end eye	ADDITIONAL CONNECTOR (Between visual indicators) Cable end eye Trimet 4 Cable end eye	CONNECTOR Socket, type 137 Octocoremet No. 2 Plug, type 210

Two receivers with two indicators

W.T. operator's receiver

SOCKET P_3	PLUG P_2	PLUG P_1
Dummy socket block inserted		As above
		CONNECTOR As above

Navigator's receiver

SOCKET P_3	PLUG P_2	PLUG P_1
Points and connector detail as for single receiver (above)		CONNECTOR Socket, type 299 Dumet 4 and 7 (to power unit) Plug, type 358 Ducel 4 (to telephones) Terminal block B (2-way) Unicel 4 (to aerial) Cable end eye

LOCATION OF COMPONENTS (GRID REFERENCES)

This table should be read in conjunction with fig. 17

CONDENSERS

Component	Grid Ref.	Component	Grid Ref.	Component	Grid Ref.	Component	Grid Ref.
C_{1}	Cb	C_{29}	Dc	C_{57}	Ah	C_{85}	Dc
C_{2}	Db	C_{30}	Dc	C_{58}	Ah	C_{86}	Dc
C_{3}	Ab, Dc	C_{31}	Dc	C_{59}	Ag	C_{87}	Dd
C_{4}	Ab, Dc	C_{32}	Db	C_{60}	Ag	C_{88}	Dd
C_{5}	Ab, Dc	C_{33}	Db	C_{61}	Ag, Ah	C_{89}	Cd
C_{6}	Ce	C_{34}	Bc	C_{62}	Ag	C_{90}	Cd
C_{7}	Cf	C_{35}	Bf	C_{63}	Af	C_{91}	Ac
C_{8}	Cd	C_{36}	Db	C_{64}	Af	C_{92}	Cb
C_{9}	Cd	C_{37}	Ag	C_{65}	Af, Ag	C_{93}	Ca, Db
C_{10}	Cd	C_{38}	Ag, Bg	C_{66}	Ag	C_{94}	Cb
C_{11}	Ce	C_{39}	Bf, Db	C_{67}	Ag	C_{95}	Da
C_{12}	Bc	C_{40}	Ag	C_{68}	Af	C_{96}	Cd
C_{13}	Ac, Cc	C_{41}	Da	C_{69}	Ae	C_{97}	Dc
C_{14}	Bc	C_{42}	Cg	C_{70}	Ae, Af	C_{98}	Dd
C_{15}	Ac	C_{43}	Cg	C_{71}	Af	C_{99}	Ah
C_{16}	Cc	C_{44}	Cg	C_{72}	Af	C_{100}	Ca
C_{17}	Ac	C_{45}	Dg, Dh	C_{73}	Ae, Af	C_{101}	Cd
C_{18}	Ab	C_{46}	Dg	C_{74}	Ae, Af	C_{102}	Ca
C_{19}	Dc	C_{47}	Cg	C_{75}	Ae, Af	C_{103}	Cc
C_{20}	Ab	C_{48}	Ca	C_{76}	Bc, Bf, Af	C_{104}	Plug type
C_{21}	Ab	C_{49}	Da	C_{77}	Bc, Bf		209
C_{22}	Ab	C_{50}	Da	C_{78}	Af	C_{105}	Dc
C_{23}	Ce, Cf	C_{51}	Da	C_{79}	Af	C_{106}	Plug type
C_{24}	Ce, Cf	C_{52}	Da	C_{80}	Af		209
C_{25}	Dc, Df	C_{53}	Da	C_{81}	Bf	C_{107}	Ab
C_{26}	Cd, Cc	C_{54}	Cb	C_{82}	Db, Cb	C_{108}	Cc
C_{27}	Cd, Cc	C_{55}	Ca	C_{83}	Cb	C_{109}	Ah
C_{28}	Cd, Cc	C_{56}	Ca	C_{84}	Cb	C_{110}	Ag, Ah

RESISTANCES

R_{1}	Cb	R_{19}	Ac	R_{37}	Bf	R_{55}	Cb
R_{2}	Ca	R_{20}	Ce, De	R_{38}	Bf	R_{56}	Dg
R_{3}	Ce, De	R_{21}	Ce	R_{39}	Bf	R_{57}	Ca
R_{4}	Ce	R_{22}	De	R_{40}	Ae	R_{58}	Df
R_{5}	Cd	R_{23}	Cc	R_{41}	Ae	R_{59}	Af, Ag
R_{6}	Cf, Df	R_{24}	Ac, Bc	R_{42}	Ae	R_{60}	Af
R_{7}	Cd	R_{25}	Bc	R_{43}	Bf	R_{61}	Af
R_{8}	Cc	R_{26}	De	R_{44}	Bg	R_{62}	Dh
R_{9}	Ce	R_{27}	Df	R_{45}	Bf	R_{63}	Dh
R_{10}	Bf	R_{28}	De	R_{46}	Ch	R_{64}	Ce
R_{11}	Df	R_{29}	Dd	R_{47}	Ca	R_{65}	Cf, Df
R_{12}	Df	R_{30}	Dd	R_{48}	Ca	R_{66}	Cc
R_{13}	Ca	R_{31}	Df	R_{49}	Ca	R_{67}	Cd
R_{14}	Bc	R_{32}	Df	R_{50}	Ca	R_{68}	Ce
R_{15}	Cc	R_{33}	Dc	R_{51}	Cd	R_{69}	Bh (if used)
R_{16}	Ce	R_{34}	Dc	R_{52}	Cb	R_{70}	Cf
R_{17}	Bc	R_{35}	Ae	R_{53}	Cb		
R_{18}	Ac, Bc	R_{36}	Bf	R_{54}	Ca		

COILS AND CHOKES

L_{1}	Ah	L_{9}	Af	L_{17}	Af	L_{25}	Ce
L_{2}	Ag	L_{10}	Af	L_{18}	Af	L_{26}	Ab
L_{3}	Ag	L_{11}	Af, Ag	L_{19}	Dc, Be	L_{27}	Ab, Cc
L_{4}	Db	L_{12}	Ag	L_{20}	Dd	L_{28}	Bb
L_{5}	Da	L_{13}	Af	L_{21}	De	L_{29}	Cd
L_{6}	Ca	L_{14}	Af	L_{22}	Ac	L_{30}	Cc
L_{7}	Ag	L_{15}	Ae	L_{23}	Ch		
L_{8}	Af, Ag	L_{16}	Ae	L_{24}	Ch		

VALVES

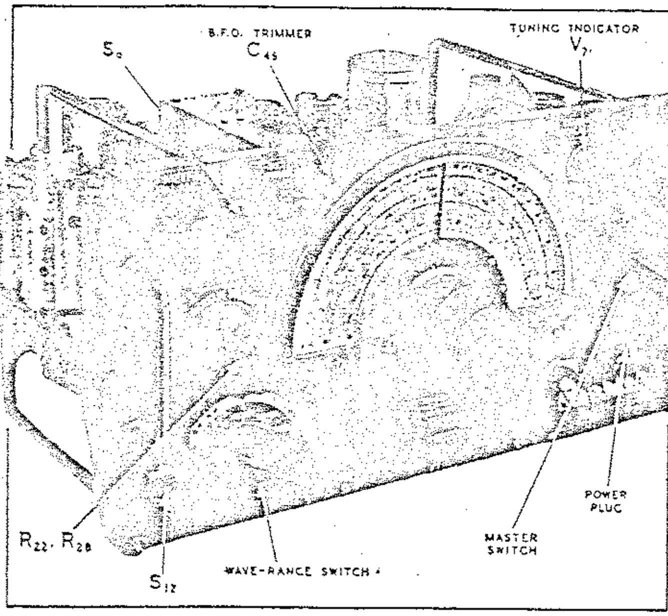
V_{1}	Ca, Dh	V_{4}	Db, Bf	V_{6}	Dd, De, Df	V_{8}	Cc
V_{2}	Da, Dg	V_{5}	Dc, Df			V_{9}	Dc, Df
V_{3}	Db, Bf, Bg			V_{7}	Bc, Cc	V_{10}	Ca

SWITCHES

S_{1}	Ba	S_{3}	Ba	S_{5}	Bc	F.S.	Af to Ah,
S_{2}	Ba	S_{4}	Ce	M.S.	Ca		Cf

EX-R.A

Type R1155 Descr



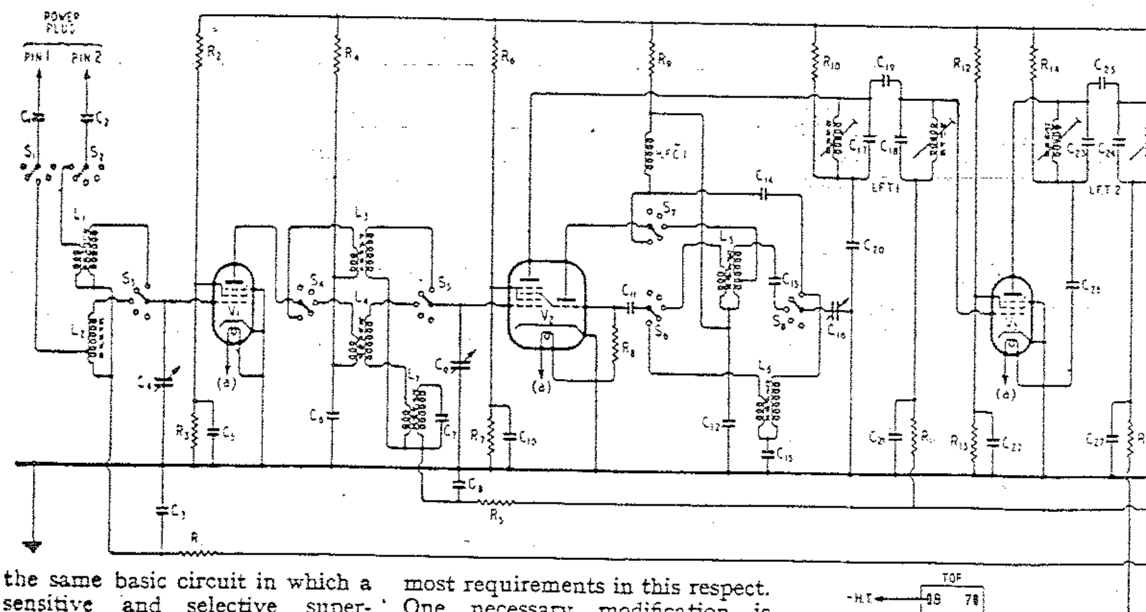
Front view of the R1155, showing the location of the communication receiver controls and the power plug.

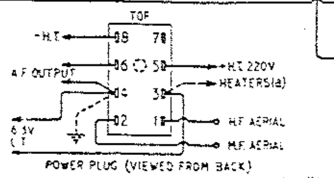
THE R.A.F. receiver Type R1155 was designed for use with the companion transmitter, the T1154, and at one time provided all the radio facilities needed in the air. Several modified versions of the set were produced, such as the R1155A, R1155B, etc., but they all embody the same basic circuit in which a sensitive and selective superheterodyne receiver is combined with facilities—generally unwanted for civilian ground use—for direction finding.

Its potentialities as a communication receiver have not yet been fully explored, but from the behaviour so far the writer feels confident that very little modification will be needed to satisfy most requirements in this respect. One necessary modification is a standby switch for breaking the H.T. supply to mute the set during transmission periods. This will eventually be fitted when space has been made by removing some of the redundant D components. Fortunately, th circuits are quite independe of the main communication ceiver; moreover, the remo of the D.F. valves will result in considerable saving in L.T. c rent.

As the highest frequen covered by the set is or 18.5 Mc/s a converter will required for the 10-metre amate band, where the high sensitivi and selectivity of the R11 should prove very useful. use may well be extended to ta in the 5-metre band also, thou the set's narrow bandwidth, whi a great asset on all other amate frequencies, may prove a lit embarrassing owing to frequen stability problems at both tran mitting and receiving stations.

Of the ten valves in the R11 three are used in the D.F. circui one is a "magic-eye" tuni indicator and the remaining s





COMMUNICATIONS RECEIVER

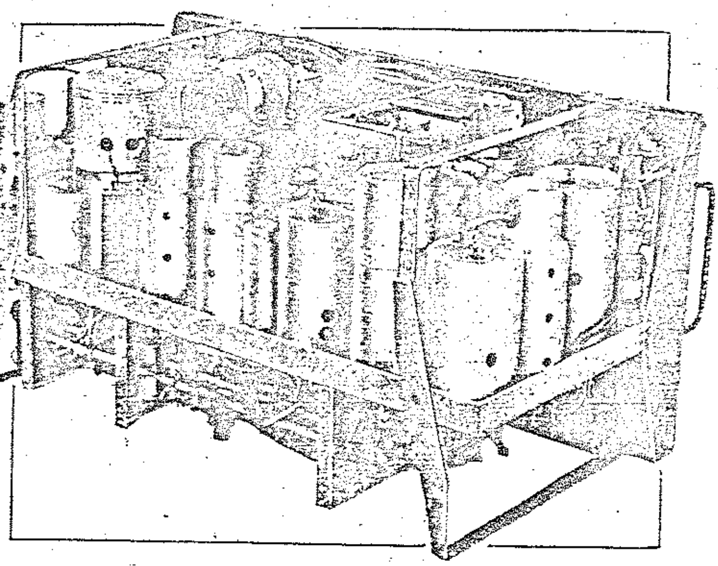
Modifications for Civil Use

By "EX-SIGNALS"

are in the main receiver. Their functions are: signal frequency amplifier, frequency changer, two I.F. amplifiers operating at 560 kc/s, a double - diode - triode for second detector and output stage and another similar valve for A.V.C. and B.F.O. The B.F.O. incidentally, operates at half the intermediate frequency, e.g., 280 kc/s.

By omitting the D.F. circuits, all the D.F. switching and the less important receiver switching it is possible to produce a reasonably simple circuit showing its main features. This is reproduced here in Fig. 1.

Further simplification has been possible by including the coils for ranges 1 and 3 only, range 2 coils being the same design as for range 1, while those for ranges 4 and 5 are the same as for range 3.



The accessibility of all valves is a feature of the receiver.

The full coverage of these five ranges is given in an accompanying table.

When used in aircraft the R1155 can be operated on any one of three different aerials. One is a loop, another is a short fixed aerial and the third is a long trailing wire, which is let out only when the aircraft is airborne.

The switching selects the appropriate aerial of these three for the type of operation required; thus the loop is used for D.F., the fixed aerial on ranges 1 and 2, while the trailing wire comes into use on the lower frequency ranges 3, 4 and 5.

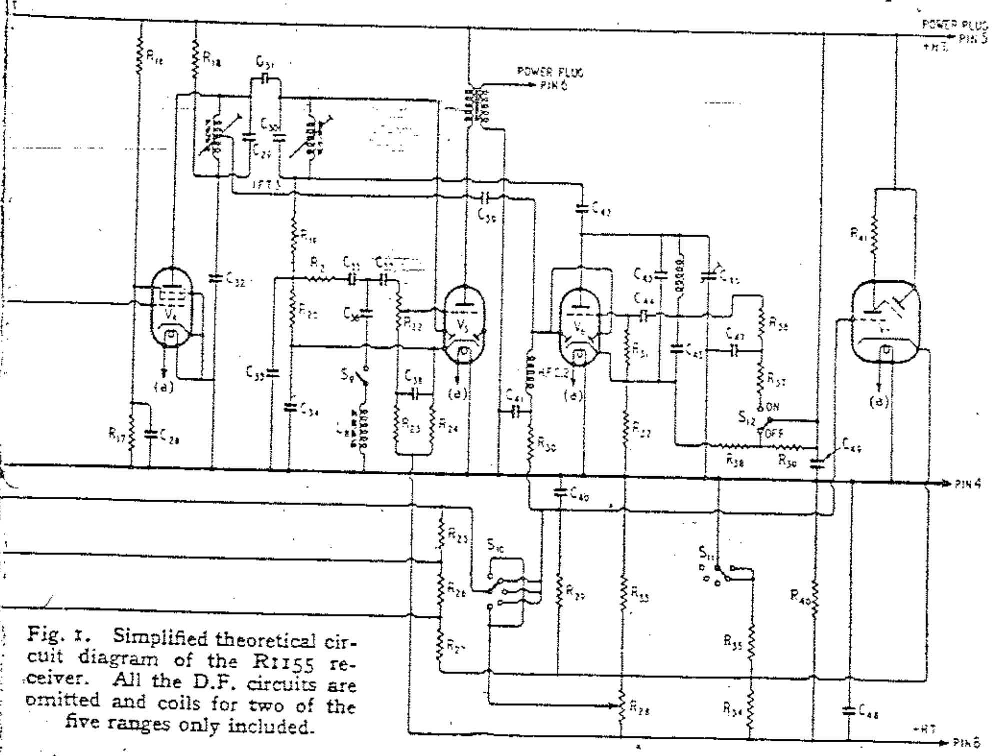


Fig. 1. Simplified theoretical circuit diagram of the R1155 receiver. All the D.F. circuits are omitted and coils for two of the five ranges only included.

From the circuit diagram it will be seen that the two open aerials feed into the set via pins No. 1 and No. 2 on the power plug located at the bottom right-hand corner of the front panel. This is marked "From Transmitter." The position of these pins is as seen from the back, where the identifying markings are to be found. For normal reception the No. 1 and No. 2 pins can be joined together and taken to the aerial.

The simplified circuit

Ex-R.A.F. Communication Receiver— diagram is largely self-explanatory although there are a few features that might well be amplified. For example, the tuned circuit L_7, C_7, which is an I.F. trap, has been included in the R.F. coupling on range 3 to prevent any tendency towards instability due to I.F. feedback via the signal circuits when these circuits are tuned close to the intermediate frequency.

All the R.F. and I.F. coils have iron dust cores with provision for adjustment. In the signal circuits these inductance trimmers are supplemented by small capacitor trimmers, but in the I.F. circuits trimming is effected solely by the adjustment of the cores. Furthermore, the I.F. couplings are mainly capacitative, the coupling capacitors being C_{19}, C_{25} and C_{31}.

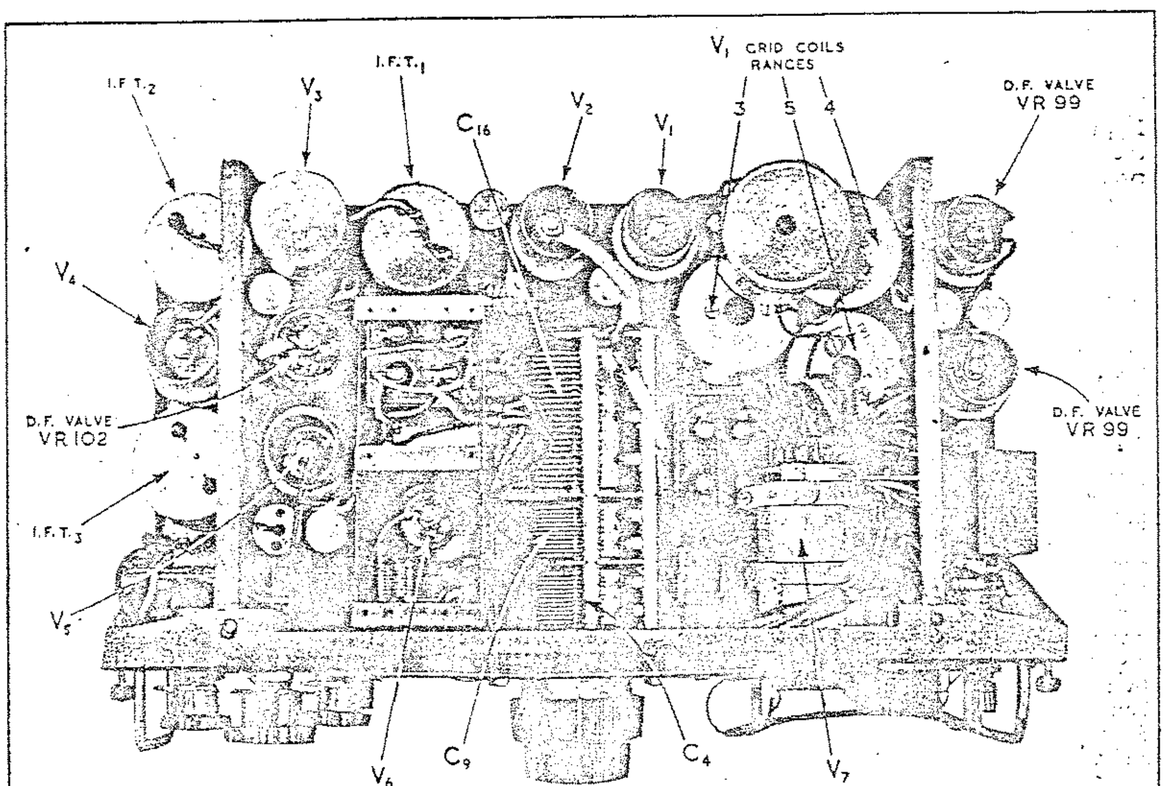
The frequency changer oscillator is a little more complicated than usual, but it can be resolved into a tuned anode circuit with a loosely coupled grid coil. On ranges 1 and 2 the circuit is parallel fed and the associated R.F. chokes are arranged to resonate just outside the low frequency end of their respective bands. Not shown in the circuit, but included in the set, are amplitude limiting resistors. These different circuit arrangements are adopted in order to render the calibration as independent as possible of valve characteristics.

Associated with the audio stage, V_5, is a low-pass filter comprising the capacitors C_{35}, C_{36} and C_{37} and the inductor L_8. Its function is to filter out interference generated in the many electrical devices fitted in an aircraft. It has a cut-off at about 300 c/s.

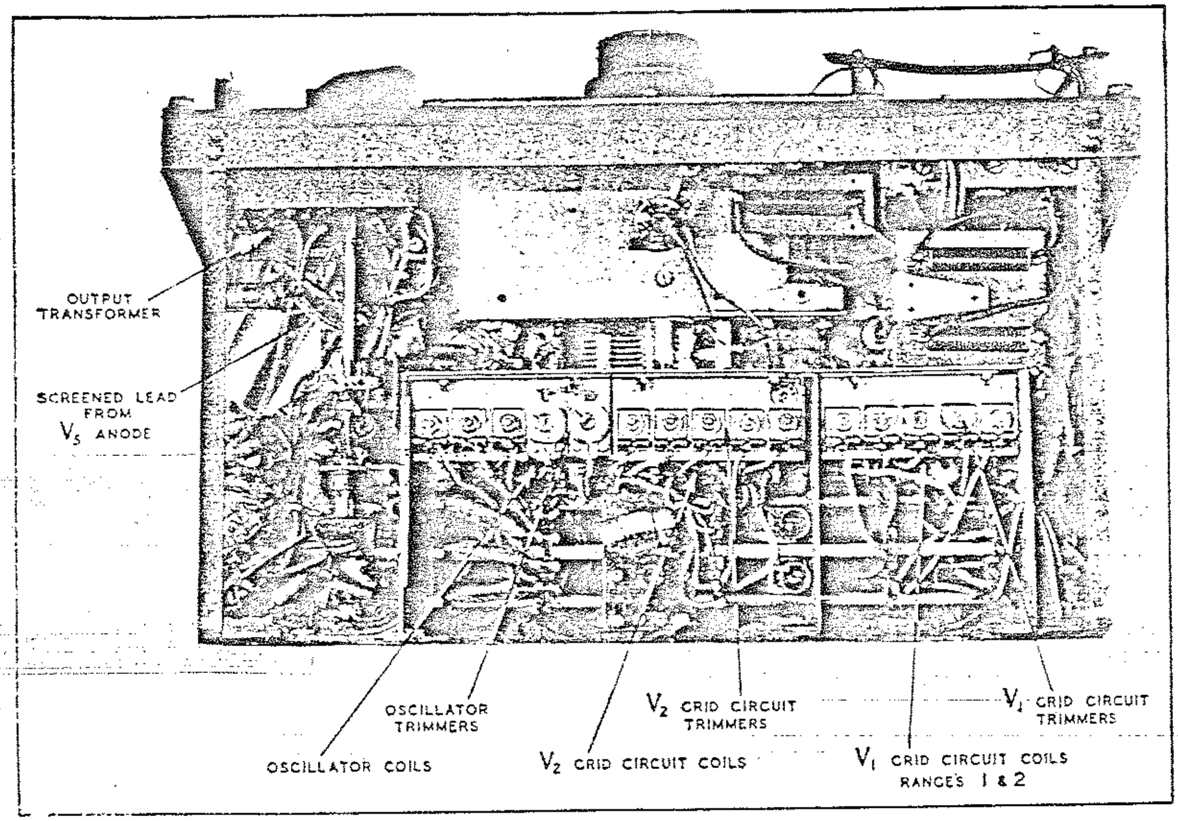
Although there is provision for A.V.C. its use is optional and dependent on the position of the master switch, of which S_{18} is one unit. When in the extreme anti-clockwise position, marked "O," A.V.C. is inoperative and the gain of the R.F. and I.F. stages is controlled by the amount of negative bias applied by R_{28}. This bias is graded according to the requirements of these valves

VALVE POSITIONS

Circuit Position	Service No.	Type	Function	Nearest Commercial Equivalents
V_1	VR100	R.F. Pentode	Sig. Freq. Amp.	Osram KTW63
V_2	VR99	Triode-Hexode	Freq. Changer	„ X65
V_3	VR100	R.F. Pentode	1st I.F. Amp.	„ KTW63
V_4	VR100	R.F. Pentode	2nd I.F. Amp.	„ KTW63
V_5	VR101	D.D. Triode	Det; A.F. Amp.	„ DL63
V_6	VR101	D.D. Triode	A.V.C.; B.F.O.	„ DL63
V_7	VI103	C.R. Tuning Indicator	Tuning Indicator	„ Y61



This view of the receiver shows the position of the valves and most of the larger components. The annotation agrees with that on the theoretical circuit diagram.



With the cover of the coil unit, which is below the chassis, removed the wavechange switches and all the trimming capacitors are accessible. Inductance trimmers are located on the vertical side of the coil box, facing the front panel.

by the resistance network R_{25}, R_{26} and R_{27} and is obtained from the resistor R_{40} connected between the H.T. negative and the earth line.

Ganged with R_{28} is another volume control potentiometer R_{22}, which functions on the A.F. signal only.

When the master switch is moved to the "A.V.C." position the gain of the R.F. and I.F. stages is controlled solely by the A.V.C. system, which has a standing delay of approximately 13 volts. The manual volume control then functions on R_{22} only, R_{28} being put out of action by S_{10}.

A minimum bias of between 3 and 4 volts is provided by R_{33}, but this is reduced slightly on the high frequency ranges 1 and 2 by bringing another resistor, R_{35}, in parallel with it. This is effected by S_{11}, which is part of the waveband switching comprising S_1 to S_8 inclusive. There are some additional switches, not included in Fig. 1, for short-circuiting all the idle coils in the signal and oscillator stages.

The remaining three positions of the master switch relate to direction finding so we are not concerned with them here.

When used in an aircraft the

RECEIVER CIRCUIT VALUES (FIG. 1)

Resistors	
120 Ω	R_{33}
200 Ω	R_{34}
1,000 Ω	R_{24}, R_{32}
1.2 kΩ	R_{34}
1.5 kΩ	R_{37}
2 kΩ	R_{40}
2.2 kΩ	R_4, R_{10}, R_{16}, R_{18}
10 kΩ	R_{36}
22 kΩ	R_3, R_7, R_9, R_{13}, R_{17}, R_{21}
27 kΩ	R_2, R_6, R_{12}, R_{16}, R_{27}, R_{39}
30 kΩ	R_{38}
56 kΩ	R_8, R_{19}, R_{30}, R_{31}
100 kΩ	R_1, R_5, R_{11}, R_{15}, R_{23}
150 kΩ	R_{25}, R_{26}
470 kΩ	R_{29}
1 MΩ	R_{41}
2 MΩ	R_{19}

Potentiometers	
50 kΩ	R_{28}
500 kΩ	R_{22}

Capacitors	
2 pF	C_{19}, C_{25}
4 pF	C_{31}
15 pF	C_{14}
75 pF	C_{46} (pre-set)
100 pF	C_{33}, C_{42}, C_{44}
200 pF	C_1, C_{11}, C_{41}
300 pF	C_{17}, C_{18}, C_{23}, C_{24}, C_{30}
537 pF	C_{13}
600 pF	C_{29}
0.001 μF	C_2, C_{35}, C_{37}, C_{38}
1,600 pF	C_{43}
0.002 μF	C_7
0.004 μF	C_{36}
4,550 pF	C_{45}
0.005 μF	C_{40}
6,170 pF	C_{15}
0.05 μF	C_5
0.1 μF	C_3, C_6, C_8, C_{10}, C_{12}, C_{20}, C_{21}, C_{22}, C_{26}, C_{27}, C_{28}, C_{32}, C_{34}, C_{38}, C_{47}
2.5 μF	C_{45}
4 μF	C_{49}
Tuning Gang.	C_4, C_9, C_{16}

Ex-R.A.F. Communication Receiver— R1155 obtains its working voltages from a motor-generator, but for fixed station use a conventional-type mains supply unit is more practical.

This unit must give about 4 amps at 6.3 volt L.T. and 230 volts H.T. at between 60 and 70 mA. As the audio output is for headphones only it might be worth while to include a power output valve for operating a loudspeaker.

A saving of about 1.9 amps can be made in the L.T. supply if the three D.F. valves are removed. There will be no corresponding saving in H.T. current as these valves are virtually inoperative until the master switch is turned to one of the three D.F. positions.

The circuit diagram of a power unit found suitable for the R1155 is given in Fig. 2 and it includes a small tetrode for loudspeaker operation. Provision is also made for using headphones when required.

If a metal chassis is used for this power unit some precautions must be taken in its construction. In the receiver H.T. negative is not connected to the chassis as usual, but has the bias resistor R_{40} interposed. Thus if H.T. negative is joined to chassis in the power unit and the two chassis accidentally touch each other this resistor will be short-circuited.

The three smoothing electrolytic capacitors C_3, C_4 and C_5 should be, therefore, either the waxed cardboard type or if assembled in metal cases be of the pattern in which the metal case is not connected to either of the capacitor leads.

It will be seen that two resistors, R_5 and R_6 are used in parallel for the grid bias supply to the KT63 valve. This is an expedient adopted to enable standard resistors to be employed as the optimum bias resistor value for this valve is 420 ohms.

As shown in this circuit the input for the KT63 is taken from pin No. 6 on the power plug in

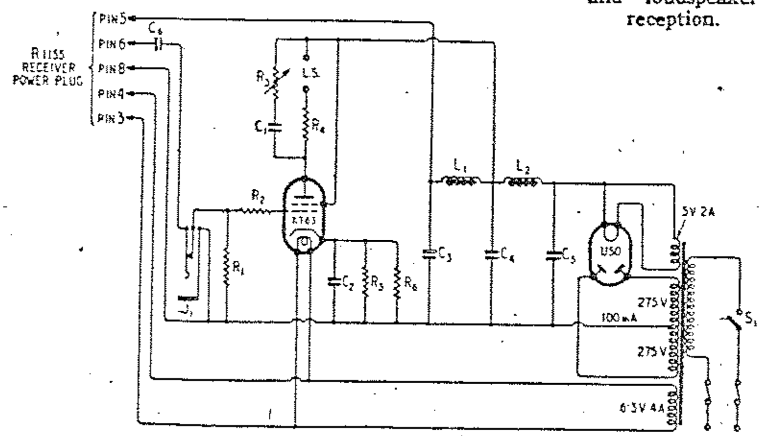


Fig. 2. Circuit diagram of a power supply unit for operating the R1155 from A.C. mains. Provision is made for headphones and loudspeaker reception.

the R1155. This joins to the secondary of the telephone transformer, which in the writer's receiver has a ratio of approximately 1 to 1. It is to be found on the back of the front panel,

POWER UNIT CIRCUIT VALUES (FIG. 2)

R_1	25 kΩ ½ W
R_2	5 kΩ ½ W
R_3	25 kΩ var.
R_4	100 Ω ½ W
R_5	680 Ω 1 W
R_6	1,200 Ω 1 W
C_1	0.01 µF
C_2	25 µF (25-V wkg.)
C_3	16 µF (450-V wkg.)
C_4 C_5	8 µF (450-V wkg.)
C_6	1 µF (250-V wkg.)
L_1	20-30H 75MA 250Ω
L_2	10-20H 120MA 150Ω

between the B.F.O. switch, S_{13}, and the spindle operating the wavechange switches.

This may not be the ideal method of connecting a power amplifier stage but it seems to be quite satisfactory from the performance point of view and has the advantage that no modification will be needed. The resistor R_1 is included to prevent the grid of the KT63 being "left in the air" when headphones are in use.

WAVE-BAND COVERAGE

Range	Frequency	Wavelength (Metres)
1	18.5 Mc/s–7.5 Mc/s	16.2–40
2	7.5 Mc/s–3.0 Mc/s	40–100
3	1,500 kc/s–600 kc/s	200–500
4	500 kc/s–200 kc/s	600–1,500
5	200 kc/s–75 kc/s	1,500–4,000

A simple form of tone control consisting of C_1 and R_3 is also included.

The blocking condenser C_6 is required to ensure that the correct grid bias is applied to the KT63 valve. Without it there would be two alternative grid return paths, one via R_1 to the H.T. negative and the other via the secondary of the telephone transformer in the R1155 to the chassis of that set.

As the chassis is at a positive voltage with respect to the H.T. negative line the actual bias on the grid of the KT63 would be the difference of these two voltages.

There is an alternative to the inclusion of C_6, however, and this is to disconnect the secondary of the telephone transformer from the chassis and join it to the H.T. negative line in the R1155.

Acknowledgment is due to the Controller of H.M. Stationery Office for making available technical literature giving circuit details and component values.

LOCATION OF COMPONENTS (GRID REFERENCES)

This table should be read in conjunction with fig. 17

Component	Grid Ref.	Component	Grid Ref.	Component	Grid Ref.	Component	Grid Ref.
CONDENSERS							
C_1	Cb	C_{29}	Dc	C_{57}	Ah	C_{85}	Dc
C_2	Db	C_{30}	Dc	C_{58}	Ah	C_{86}	Dc
C_3	Ab, Dc	C_{31}	Dc	C_{59}	Ag	C_{87}	Dd
C_4	Ab, Dc	C_{32}	Db	C_{60}	Ag	C_{88}	Dd
C_5	Ab, Dc	C_{33}	Db	C_{61}	Ag, Ah	C_{89}	Cd
C_6	Ce	C_{34}	Be	C_{62}	Ag	C_{90}	Cd
C_7	Cf	C_{35}	Bf	C_{63}	Af	C_{91}	Ac
C_8	Cd	C_{36}	Db	C_{64}	Af	C_{92}	Cb
C_9	Cd	C_{37}	Ag	C_{65}	Af, Ag	C_{93}	Ca, Dh
C_{10}	Cd	C_{38}	Ag, Bg	C_{66}	Ag	C_{94}	Cb
C_{11}	Ce	C_{39}	Bf, Db	C_{67}	Ag	C_{95}	Da
C_{12}	Bc	C_{40}	Ag	C_{68}	Af	C_{96}	Cd
C_{13}	Ac, Cc	C_{41}	Da	C_{69}	Ae	C_{97}	Dc
C_{14}	Bc	C_{42}	Cg	C_{70}	Ae, Af	C_{98}	Dd
C_{15}	Ac	C_{43}	Cg	C_{71}	Af	C_{99}	Ah
C_{16}	Cc	C_{44}	Cg	C_{72}	Af	C_{100}	Ca
C_{17}	Ac	C_{45}	Dg, Dh	C_{73}	Ae, Af	C_{101}	Cd
C_{18}	Ab	C_{46}	Dg	C_{74}	Ae, Af	C_{102}	Ca
C_{19}	De	C_{47}	Cg	C_{75}	Ae, Af	C_{103}	Ce
C_{20}	Ab	C_{48}	Ca	C_{76}	Be, Bf, Af	C_{104}	Plug type 209
C_{21}	Ab	C_{49}	Da	C_{77}	Be, Bf		
C_{22}	Ab	C_{50}	Da	C_{78}	Af	C_{105}	Dc
C_{23}	Ce, Cf	C_{51}	Da	C_{79}	Af	C_{106}	Plug type 209
C_{24}	Ce, Cf	C_{52}	Da	C_{80}	Af		
C_{25}	Dc, Df	C_{53}	Da	C_{81}	Bf	C_{107}	Ab
C_{26}	Cd, Cc	C_{54}	Cb	C_{82}	Db, Cb	C_{108}	Ce
C_{27}	Cd, Cc	C_{55}	Ca	C_{83}	Cb	C_{109}	Ah
C_{28}	Cd, Cc	C_{56}	Ca	C_{84}	Cb	C_{110}	Ag, Ah
RESISTANCES							
R_1	Cb	R_{19}	Ac	R_{37}	Bf	R_{55}	Cb
R_2	Ca	R_{20}	Ce, De	R_{38}	Bf	R_{56}	Dg
R_3	Ce, De	R_{21}	Ce	R_{39}	Bf	R_{57}	Ca
R_4	Ce	R_{22}	De	R_{40}	Ae	R_{58}	Df
R_5	Cd	R_{23}	Cc	R_{41}	Ae	R_{59}	Af, Ag
R_6	Cf, Df	R_{24}	Ac, Bc	R_{42}	Ae	R_{60}	Af
R_7	Cd	R_{25}	Bc	R_{43}	Bf	R_{61}	Af
R_8	Cc	R_{26}	De	R_{44}	Bg	R_{62}	Dh
R_9	Ce	R_{27}	Df	R_{45}	Bf	R_{63}	Dh
R_{10}	Bf	R_{28}	De	R_{46}	Ch	R_{64}	Ce
R_{11}	Df	R_{29}	Dd	R_{47}	Ca	R_{65}	Cf, Df
R_{12}	Df	R_{30}	Dd	R_{48}	Ca	R_{66}	Cc
R_{13}	Ca	R_{31}	Df	R_{49}	Ca	R_{67}	Cd
R_{14}	Bc	R_{32}	Df	R_{50}	Ca	R_{68}	Ce
R_{15}	Cc	R_{33}	Dc	R_{51}	Cd	R_{69}	Bh (if used)
R_{16}	Ce	R_{34}	Dc	R_{52}	Cb	R_{70}	Cf
R_{17}	Bc	R_{35}	Ae	R_{53}	Cb		
R_{18}	Ac, Bc	R_{36}	Bf	R_{54}	Ca		
COILS AND CHOKES							
L_1	Ah	L_9	Af	L_{17}	Af	L_{25}	Ce
L_2	Ag	L_{10}	Af	L_{18}	Af	L_{26}	Ab
L_3	Ag	L_{11}	Af, Ag	L_{19}	Dc, Be	L_{27}	Ab, Cc
L_4	Db	L_{12}	Ag	L_{20}	Dd	L_{28}	Bb
L_5	Da	L_{13}	Af	L_{21}	De	L_{29}	Cd
L_6	Ca	L_{14}	Af	L_{22}	Ac	L_{30}	Cc
L_7	Ag	L_{15}	Ae	L_{23}	Ch		
L_8	Af, Ag	L_{16}	Ae	L_{24}	Ch		
VALVES							
V_1	Ca, Dh	V_4	Db, Bf	V_6	Dd, De, Df	V_8	Cc
V_2	Da, Dg	V_5	Dc, Df			V_9	Dc, Df
V_3	Db, Bf, Bg			V_7	Bc, Cc	V_{10}	Ca
SWITCHES							
S_1	Ba	S_3	Ba	S_5	Bc	F.S.	Af to Ah, Cf
S_2	Ba	S_4	Ce	M.S.	Ca		

62. An underside view of the chassis is given in fig. 16. The aerial circuit, anode circuit, and local oscillator coils, associated condensers and resistances, and the wafers wr–wf, xr–xf, yr–yf, and zr–zf of the frequency range switch FS are contained inside the large screening case at the bottom of fig. 16. Near the top edge of this container and, reading from left to right, are the adjustment ports for the trimmer condensers C_{69}, C_{70}, C_{68}, C_{71}, C_{72}, C_{63}, C_{64}, C_{65}, C_{62}, C_{66}, C_{59}, C_{60}, C_{61}, C_{58}, and C_{57}. The location of components on the underside of the chassis and within the screening can is shown in detail in fig. 17.

63. The additional filtering components included in the receivers types R.1155A and R.1155B are shown in the two illustrations, figs. 18 and 19. These illustrations are respectively, chassis upper deck and chassis underside views of the R.1155B and show the complete arrangements for suppression of M.F. broadcasting and radar interference. There is only a limited number of receivers in service containing M.F. suppression only and as the components, with one exception, are in the same relative positions in both types it is unnecessary to give illustrations of both.

64. Referring to fig. 18 the screening can (1), mounted over the three D.F. aerial coil assemblies on the upper side of the deck, contains the grid rejector filter unit, comprising a coil L_{33}, with a condenser C_{113}. In the R.1155A this can also contains a condenser C_{112}, and a resistance R_{71}. In the R.1155B these two components are located in the H.F. coil box under the deck and are connected between the choke HFC_6 and the switch section FS_{II}. The choke HFC_5 connected between the aerial tuning condenser C_{58} and the control grids of V_1 and V_2 is mounted on a bracket adjacent to the top caps of V_1 and V_2. The illustration of fig. 19 shows the H.F. coil box with the cover removed to enable the positions of these components to be indicated.

65. When using figs. 15 to 19 in connection with the R.1155L and R.1155N, paras. 34 and 35 should be consulted with regard to the removal, re-positioning, or addition of the items affected by the altered frequency ranges of these models.

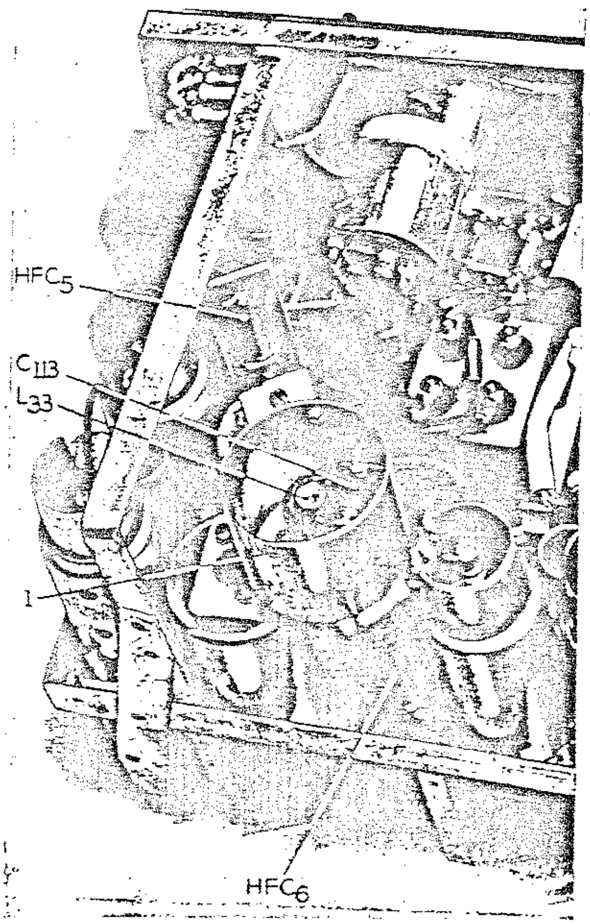


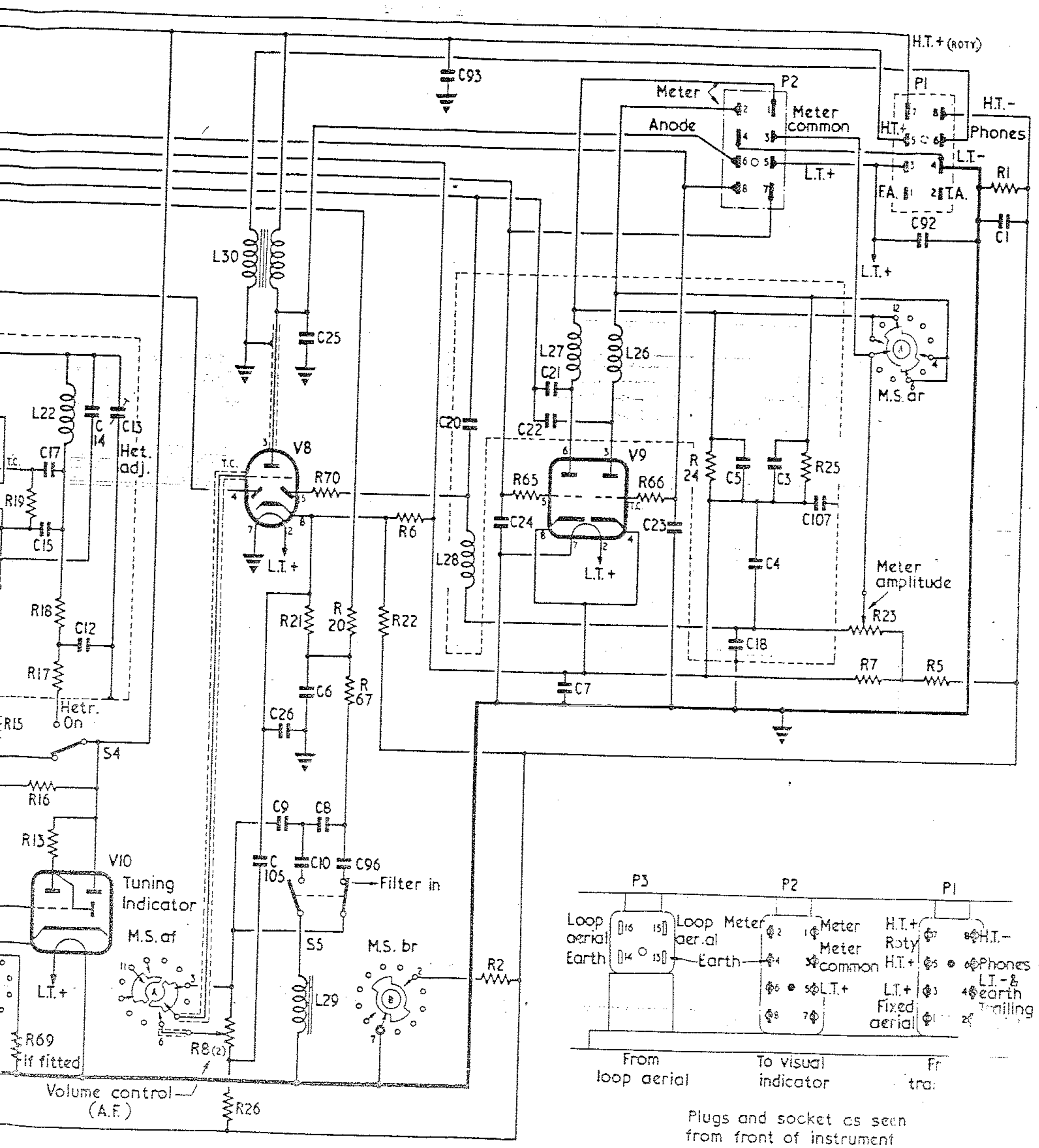
FIG. 18.—R.1155B CHASSIS, UPPER DECK

INSTALLATION

66. The following notes on the installation of the receiver duplicate, to some extent, the installation paragraphs included in Chap. 1, on the transmitter T.1154. This is unavoidably due to the interdependence of the transmitter and receiver when used in aircraft. From the typical installation diagram given in fig. 21 it will be realised that the transmitter is the main focal point of the wiring. The power unit connectors, and also the fixed and trailing aerials and connections from the receiver, plug into the transmitter. In laying out the equipment in the aircraft the receiver is placed in a convenient position for operation and where possible it is at desk level. The transmitter is mounted above or to one side of the receiver. The tuning scales of the receiver are to be easily visible and the controls accessible to the operator.

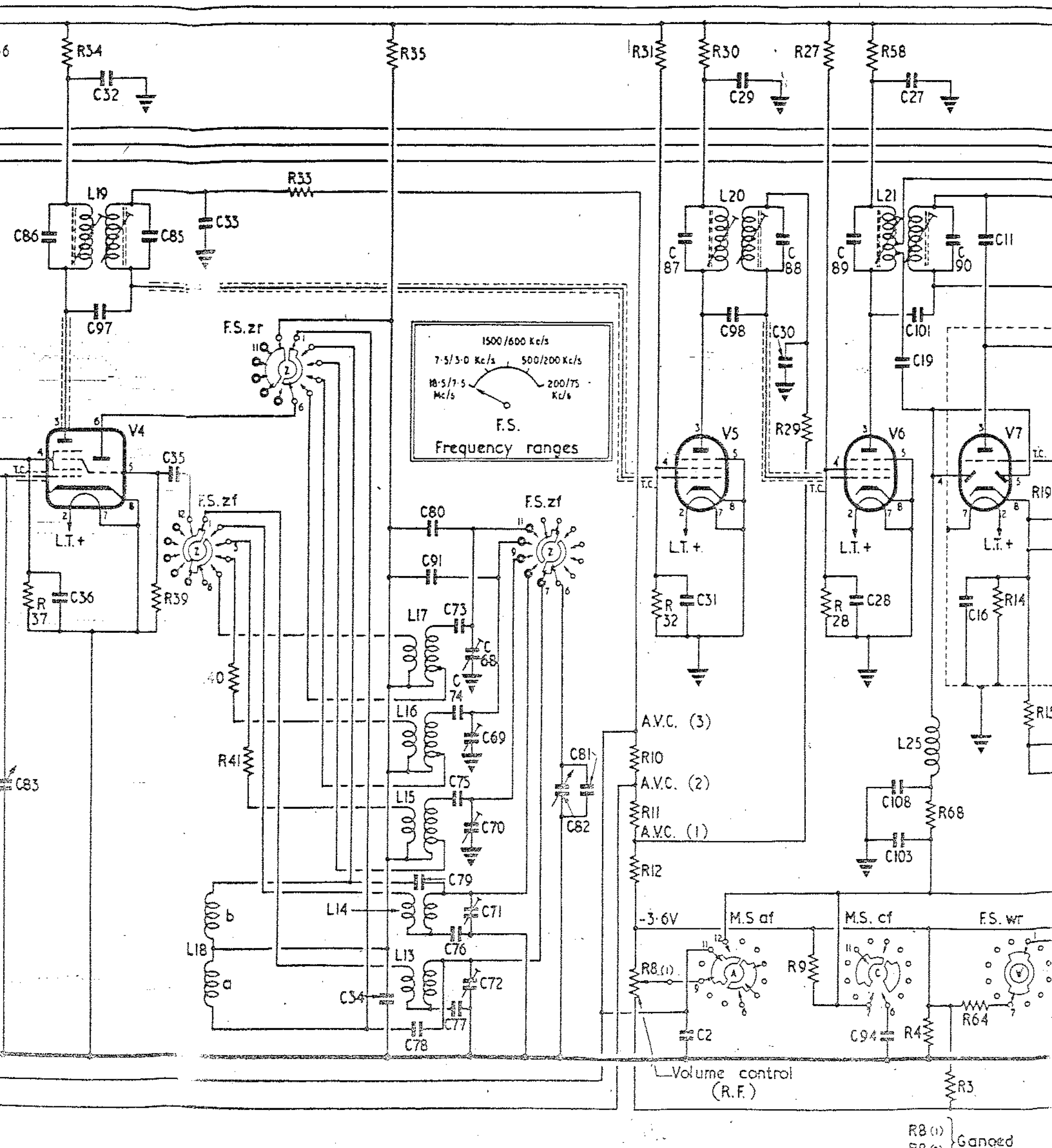
Receiver position

67. The receiver is normally positioned horizontally, but if space is limited it may bemounted vertically. The receiver is secured by mountings, type 54, and as these will be 90 deg. out when the

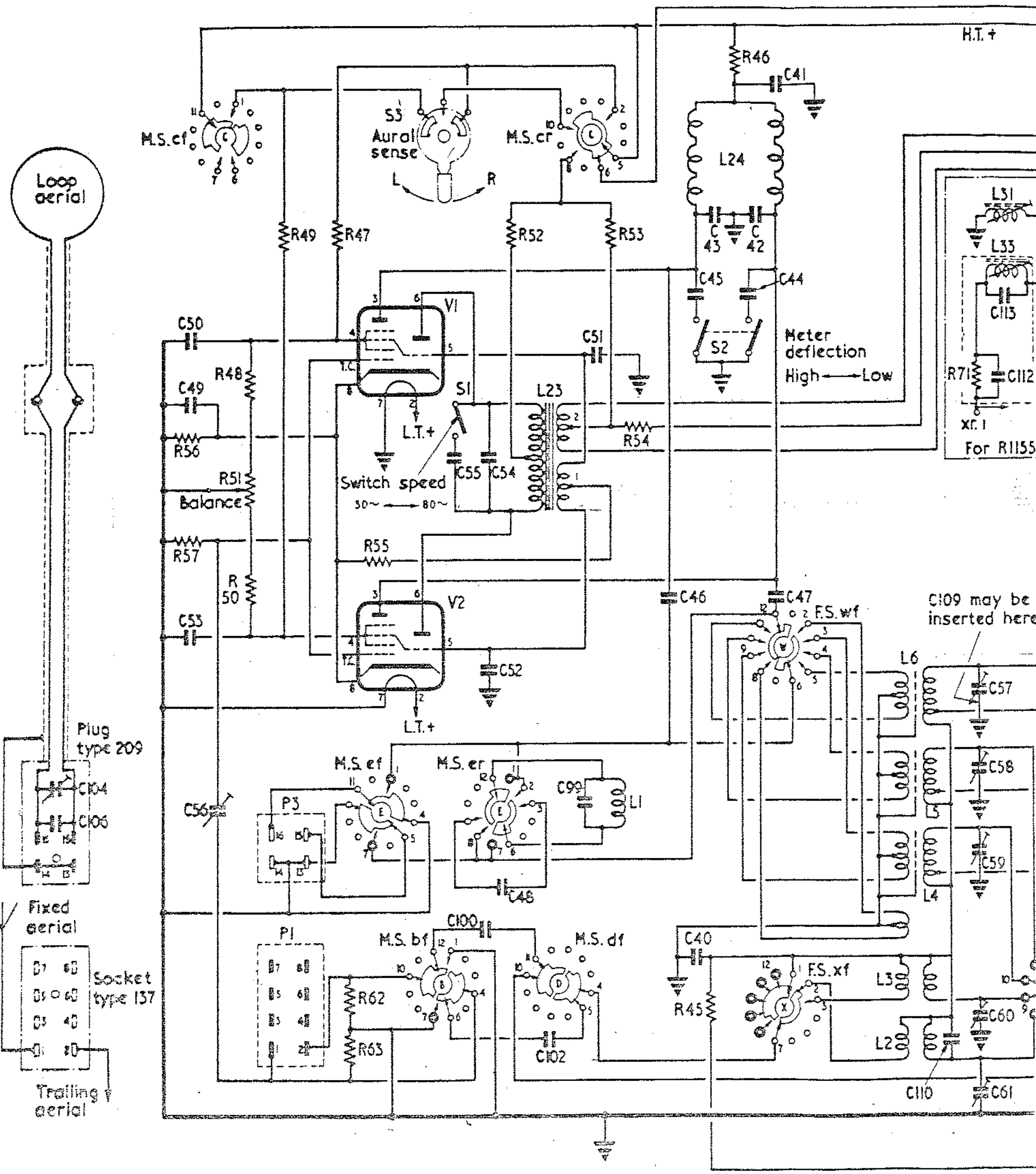


H.T.+ (ROTY)
C93
Meter
P2
P1
H.T.-
Meter common
Phones
Anode
H.T.+
L.T.-
L.T.+
R1
F.A.
T.A.
C92
C1
L30
L.T.+
C25
L27
L26
M.S. ar
L22
C21
C 14
C13
C22
C20
Het. adj.
C17
V8
V9
R70
R65
R66
R19
R24
C5
C3
R25
C24
C23
C107
C15
R6
L28
L.T.+
C4
Meter amplitude
R18
R21
R 20
R22
R23
C12
C18
R17
R7
R5
C6
R 67
C7
Hetr. On
R15
C26
S4
R16
C9
C8
R13
C 105
C10
C96
V10
Tuning Indicator
Filter in
M.S. af
S5
M.S. br
L29
R2
L.T.+
R69 if fitted
R8(2)
Volume control (A.F.)
R26
P3
Loop aerial Earth
Loop aerial Earth
Meter
Meter
Meter common
L.T.+
H.T.+ Roty
H.T.+
L.T.+
Fixed aerial
H.T.-
Phones
L.T.- & earth
Trailing
From loop aerial
To visual indicator
Plugs and socket as seen from front of instrument

FIG. 3

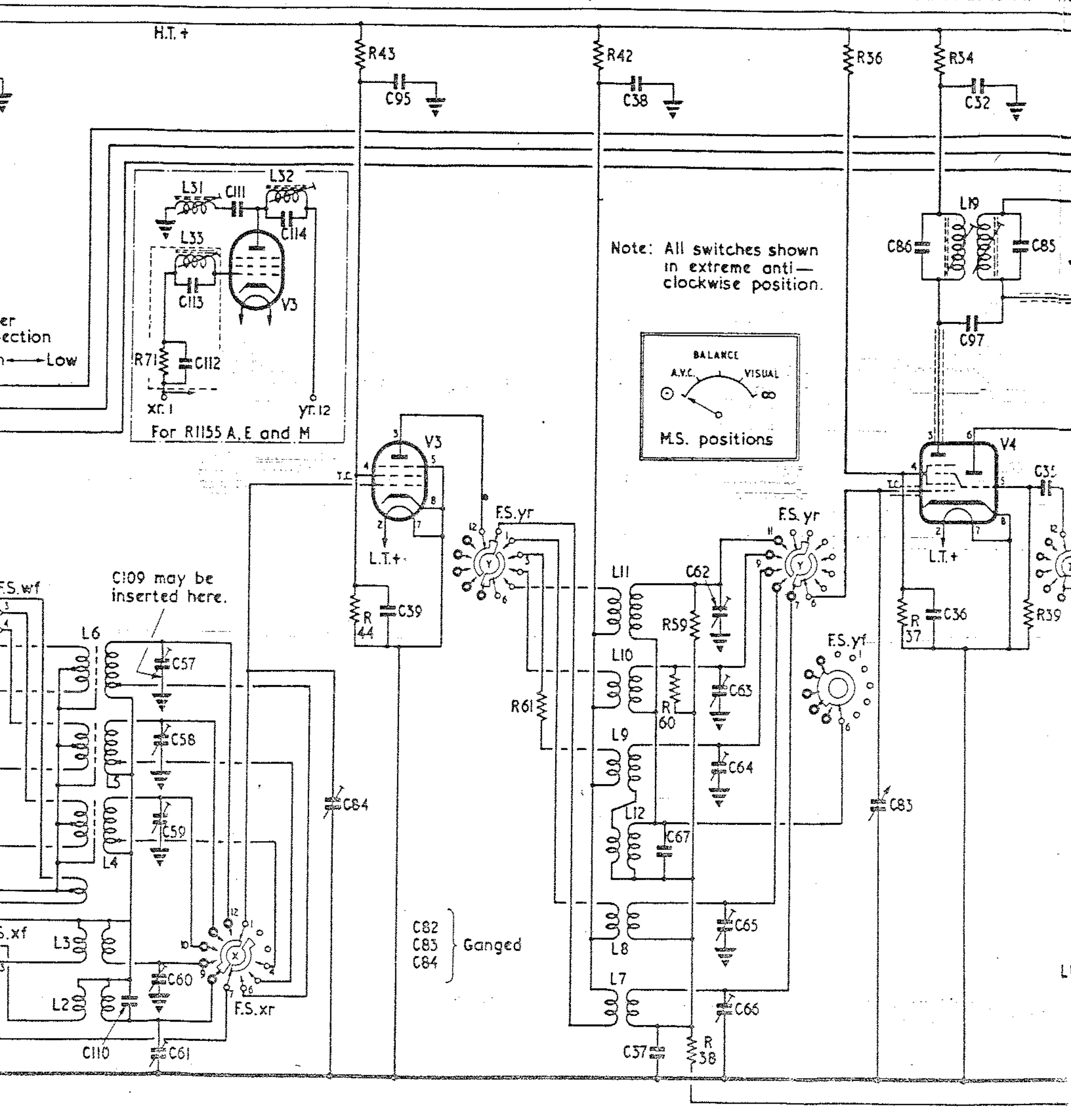


AND R.1155 D CIRCUIT DIAGRAM INCLUDING R.1155 A. R.1155 E. AND R1155 M MODIFICATIONS



Note. Switch contacts shown thus ⊙, denote front(f) & rear(r) contacts connected.
Important. In order to avoid excessive crossing c
wires certain switch wafers have been dupli

FIG. 3



hown thus ⊙, denote
ntacts connected.
oid excessive crossing of connecting
n wafers have been duplicated.

R.1155 AND R.115
R1155 A, R.

This leaf issued in reprint
September, 1947

CHAPTER 2

RECEIVERS, Types R.1155, R.1155A, B, C, D, E, F, L, M, and N

INTRODUCTION

1. The receivers of the R.1155 class have been designed primarily for use in aircraft, in conjunction with transmitters of the T.1154 class described in Chapter 1 of this publication. A separate publication (A.P.2548B) deals with the installation of the receivers R.1155L and R.1155N in Air-sea rescue launches. The parent type is the receiver R.1155, and later developments are indicated by the use of a suffix letter. The main points of difference are shown in the following table:—

Receiver type	*Type of case*	*Remarks*	*Frequency coverage*
R.1155	Aluminium	—	18·5 Mc/s to 3 Mc/s 1,500 kc/s to 600 kc/s 500 kc/s to 75 kc/s
R.1155D	Steel		
R.1155A	Aluminium	Filters fitted to prevent interference from M.F. transmitters (R.1155M is for use only at ground schools)	
R.1155E	Steel		
R.1155M	Aluminium		
R.1155B	Aluminium	As A or E, but H.F chokes added to prevent interference from radar transmitters	
R.1155F	Steel		
R.1155C	Aluminium	As A, but modified for H.F. D.F. Obsolete	
R.1155L	Aluminium	As B or F, but frequency ranges altered	18·5 Mc/s to 600 kc/s 500 kc/s to 200 kc/s
R.1155N	Steel		

Facilities

2. Provision is made for the reception of signals over a wide frequency band which is covered in five ranges. These ranges are as follows:—

Range No.	*Receivers R.1155 and R.1155A, B, C, D, E, F, M*	*Receivers R.1155L and R.1155N*
1 (H.F.)	18·5 Mc/s to 7·5 Mc/s	18·5 Mc/s to 7·5 Mc/s
2 (H.F.)	7·5 Mc/s to 3·0 Mc/s	7·5 Mc/s to 3·0 Mc/s
2A (H.F.)	not applicable	3·0 Mc/s to 1·5 Mc/s
3 (M.F.)	1,500 kc/s to 600 kc/s	1,500 kc/s to 600 kc/s
4 (M.F.)	500 kc/s to 200 kc/s	500 kc/s to 200 kc/s
5 (M.F.)	200 kc/s to 75 kc/s	not applicable

Modulated and unmodulated signals can be received on all ranges. Direction finding and homing on certain ranges (mentioned in para. 36) may be carried out by aural or visual means.

Power supplies

3. Detailed descriptions of the airborne power units are given in A.P.1186D, Vol. I, Sect. 8, and the ground power units are described in A.P.1186E, Vol. I, Sect. 6. When airborne, the power supplies are provided by a rotary transformer power unit driven from the aircraft electrical system. This power unit is also the L.T. supply for the associated transmitter of the T.1154 class. Switching on and off the receiver power supplies of a T.1154/R.1155 installation is normally effected by the *transmitter* master switch. The several types of power unit available for inputs of 12 volts and 24 volts are listed in para. 88 of this chapter.

4. For ground installations, a power unit type 114 may be used. This operates directly from 230-volt 50 c/s mains. Alternatively, a power unit type 115 may be used to provide, from 230-volt 50 c/s mains, the input for the power unit type 34, or 34A. On mobile installations, e.g., W.T. portable stations and radio vehicles, the L.T. supply is usually from accumulators and the H.T. supply from a power unit type 380.

Aerials

5. The receivers may be worked on either fixed or trailing aerials for communications; a fixed aerial, is normally used for the H.F. ranges, and a trailing aerial for the M.F. ranges. A suitable loop aerial, such as type 3, is required for direction finding purposes. Aerial switching is interlocked with that of the associated transmitter by a separate switching device, normally the aerial switching unit, type J. In some installations an aerial plug board may be used instead of the type J switch.

VALVE TYPES							
V_1	VR.99 A	V_4	VR.99	V_7	VR.101	V_{10}	V.I 103
V_2	VR.99 A	V_5	VR.100	V_8	VR.101		
V_3	VR.100	V_6	VR.100	V_9	VR.102		

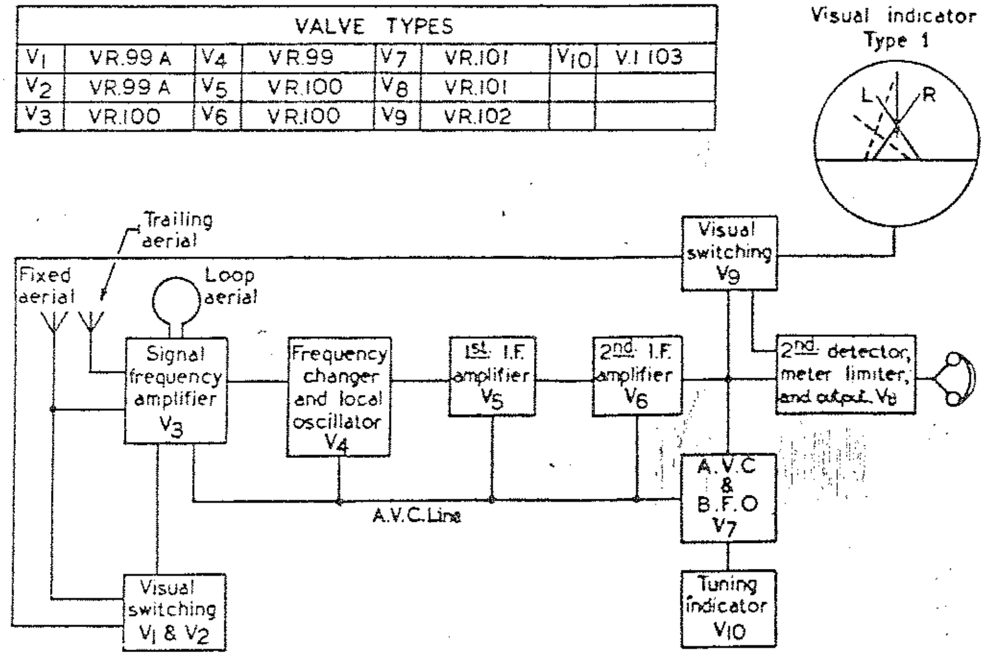


Fig. 2.—Schematic diagram

GENERAL DESCRIPTION

6. A ten-valve super-heterodyne circuit is employed, a schematic diagram of which is shown in fig. 2. The communications circuit comprises the valves V_3, V_4, V_5, V_6, V_7, V_8, and V_{10}. For direction finding the valves V_1, V_2, and V_9 are brought into use. The triode-hexode valves V_1 and V_2 electronically switch the input from the H.F. aerial into phase and antiphase relationship with the loop aerial at a predetermined frequency. Valve V_9 switches the rectified output to a visual indicator, type 1, in synchronism with the aerial switching. The input to the visual indicator is limited by one of the diode portions of the double-diode-triode valve V_8. More detailed information is given in paras. 7 to 53, which should be read in conjunction with figs. 3 to 14.

Note.—Paras. 10 to 29 deal with the basic communications circuit of the R.1155 and R.1155D (fig. 3). Variations in the communications circuits of later types are dealt with in paras. 30 to 35. In later sections of the chapter variations in different types are dealt with as they arise.

Frequency range switch

7. This switch is designated FS on the circuit diagrams and illustrations in this chapter. It is an Oak-pattern switch with four wafers, each having front and rear contacts. In the diagrams the individual wafers are annotated "w", "x", "y", and "z", with "f" or "r" added to indicate respectively the "front" or "rear" section of the wafer. Thus FS_{xf} indicates the front section of wafer "x" of the frequency range switch. The functions of this switch are to select the appropriate aerial for the range in use, to select the correct coils for the grid and anode circuits of the R.F. amplifier valve V_3 and the R.F. oscillator portion of the triode-hexode valve V_4, and to regulate the grid bias on the H.F. ranges to preserve constant amplification. The individual wafers involved are "w" (loop aerial input and grid bias adjustment), "x" (aerial and grid coils of valve V_3), "y" (anode coils of valve V_3 and grid coils of hexode portion of valve V_4) and "z" (grid and anode coils of triode portion of valve V_4).

Master switch

8. This switch is designated MS on the circuit diagrams and illustrations, and the wafer sections are denoted by subscripts used in the same manner as already described for the frequency range switch. There are five wafers, "a" (visual indicator, and manual and automatic volume control switching), "b" (fixed and trailing aerial circuits and D.F. biasing), "c" (D.F. switching valves), "d" (communications aerial input) and "e" (loop aerial).

9. The five positions of the master switch provide the following facilities:—

(i) ⦿ ("OMNI") .Normal reception for communications purposes. The gain of the R.F. amplifier, frequency-changer and I.F. stages is manually controlled by a potentiometer $R_{8(1)}$. The A.V.C. circuit is inoperative.

(ii) A.V.C. The automatic volume control operates on the R.F. amplifier, frequency-changer and I.F stages. Manual volume control is by the potentiometer $R_{8(2)}$ which controls the audio input to the output stage.

(iii) BALANCE. This position is used when balancing the two needles of the visual indicator used for D.F. purposes to allow for slight differences in the constants of the switching valves and associated circuits.

(iv) VISUAL. The visual indicator circuits, including valves V_1, V_2, and V_9 are switched into circuit. A.V.C. is provided.

(v) ∞ ("FIGURE-OF-EIGHT"). In this position bearings may be taken aurally, using the switch S_2 for the determination of sense. A.V.C. is disconnected.

COMMUNICATIONS CIRCUITS, R.1155 and R.1155D

Aerial connections

10. The fixed aerial is connected to pin 1 of the 8-pin plug P_1, and the trailing aerial to pin 2 of the same plug. The fixed resistors R_{62} and R_{63} are connected across the aerials and earthed at their junction to provide leaks to prevent static charges accumulating on the aerials.

R.F. amplifier stage

11. The communications circuit commences at the R.F. amplifier stage, the basis of which is a variable-mu H.F. pentode valve V_3. For ranges 1 and 2 the fixed aerial is connected through the condenser C_{105} and coil L_2 or L_3 to the control grid of V_3. Similarly, the trailing aerial is connected through condenser C_{106} and coil L_4, L_5, or L_6 on ranges 3, 4, and 5. Switch sections MS_{bf}, MS_{df}, FS_{1f} and FS_{2f} perform the necessary switching. On all ranges the coils are tuned by a variable condenser C_{84}, which is ganged with condensers C_{83} and C_{82} for ease of operation. Each grid coil has a pre-set trimmer condenser. These condensers are numbered C_{57} to C_{61}, and in addition C_{116} is used on range 1 (coil L_2) and in certain circumstances C_{105} is fitted on range 5 (coil L_6).

12. The variable-mu characteristic of the valve V_3 enables the gain to be controlled by varying the grid bias. In certain positions of the master switch this is done manually, and in others automatic volume control is provided. The screen voltage of V_3 is obtained from a potential divider comprising the resistors R_{43}, R_{44}, and R_1. Associated with these are the by-pass condensers C_{95}, C_{39}, and C_1. Bias for the control grid of the valve V_3 is provided by a resistance network in the A.V.C. circuit. By returning this network to the junction of R_5 and R_4, which are across R_1, a standing negative bias of 3·6 volts is provided during no-signal periods.

Frequency-changer stage

Hexode section

13. The triode-hexode valve V_4 operates as a frequency-changer. The output of the R.F. amplifier stage is inductively coupled to the signal grid of the hexode portion by one of the R.F. transformers L_7, L_8, L_9, L_{10} or L_{11}. Selection of the appropriate circuit for each range is made by the switch sections FS_{3f} and FS_{3r}. On all ranges the tuning of the grid circuit is effected by the variable condenser C_{83}. The secondary of each R.F. transformer is trimmed by one of the pre-set condensers C_{62} to C_{66}. A coil L_{12} and condenser C_6 form a filter tuned to the I.F. of 560 kc/s. This filter is included in the circuit on ranges 3, 4, and 5, to eliminate possible instability due to feedback at the I.F.

14. The incoming signal frequency is admitted at the signal grid G_1 of the hexode portion. The screen grids G_2 and G_4 are connected and form a screening electrode for the injector grid which is internally joined to the grid of the triode portion. This triode functions as an R.F. oscillator at a frequency greater than the signal frequency by 560 kc/s. The signal and oscillator frequencies are

electronically mixed in the hexode portion and voltages at the difference frequency (560 kc/s) are developed across the anode load, which consists of the coil L_{19} and the condenser C_{86}. The screen derives its voltage from the potential divider comprised of R_{26}, R_{27}, and R_1, with the associated condensers C_{36} and C_1.

Triode section

15. The triode section of the valve operates as an R.F. oscillator and consists of a tuned anode circuit loosely coupled to an untuned grid circuit. The grid windings of the coils L_{13}, L_{14}, L_{15}, L_{16}, and L_{17} are selected for each range by the switch FS_{II}. The anode windings of L_{13} to L_{17} are similarly switched into the anode circuit by switch sections FS_{II} and FS_{II}. On ranges 3, 4, and 5 the oscillator is series-fed, the anode being connected to a tap on the secondary of the coil L_{15}, L_{16}, or L_{17}. On ranges 1 and 2 the oscillator is parallel-fed through the choke L_{18a} or L_{18b} and coupling condenser C_{78} or C_{79}. L_{18a} and L_{18b} resonate at a frequency just below the lowest frequency in their respective bands. Each tuned circuit is tracked to the signal circuits with pre-set parallel trimming condensers C_{68} to C_{72}, and fixed series padding condensers C_{73} to C_{77}. C_{81} determines the minimum capacitance of C_{82}.

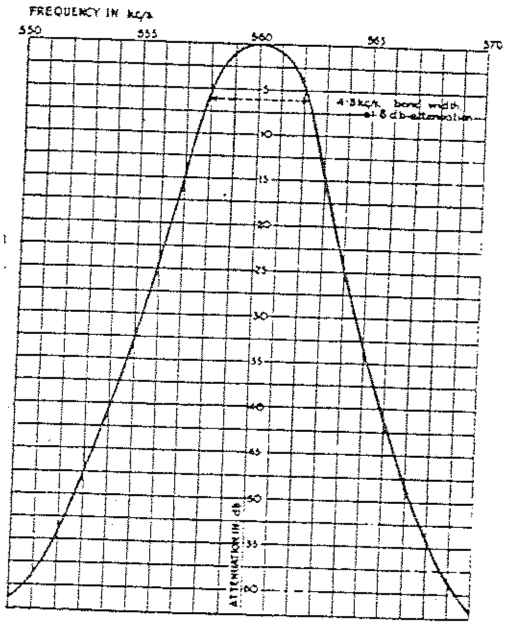


FIG. 6.—I.F. RESPONSE CURVE

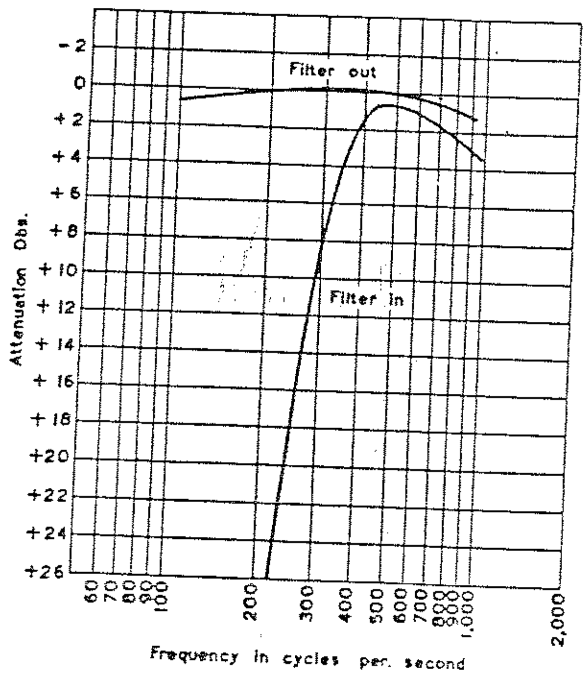


FIG. 7.—A.F. FILTER CHARACTERISTICS

I.F. stages

16. The receiver includes two stages of I.F. amplification employing three band-pass coupling units. The peaked response of this coupling is shown in the curve in fig. 6. Very little inductive coupling exists between the tuned circuits of the band-pass units, the coupling being effected by the small condensers C_{97}, C_{98}, and C_{101}. The coils are adjusted to the I.F. of 560 kc/s by means of iron-dust cores. The primary of the first I.F. transformer, with its associated fixed condenser C_{86} forms the anode load of the hexode portion of the valve V_4. Decoupling is effected by the resistor R_{34} and condenser C_{32}. The secondary is connected as the grid circuit of V_5, the resistor R_{33} and condenser C_{33} providing decoupling of the grid bias. The two I.F. valves, V_5 and V_6, are variable-mu H.F. pentodes, and on A.V.C. their control grids are biased to full and one-tenth A.V.C. voltages respectively. The I.F. transformer units between V_5 and V_6 and between V_6 and V_8 are similar to that already described for the V_4–V_5 coupling.

Detector and output stages

17. The output from the I.F. amplifier valve V_6 passes to the I.F. transformer unit L_{21} and is taken to one diode of a double-diode-triode valve V_8. This diode acts as a detector, and the triode section functions as the output valve. The use of a second diode will be dealt with in describing the D.F circuits (see para. 48). The rectified voltage from the diode detector is developed across two resistors R_{20} and R_{21}. The resistor R_{20}, in conjunction with a condenser C_6, forms part of a

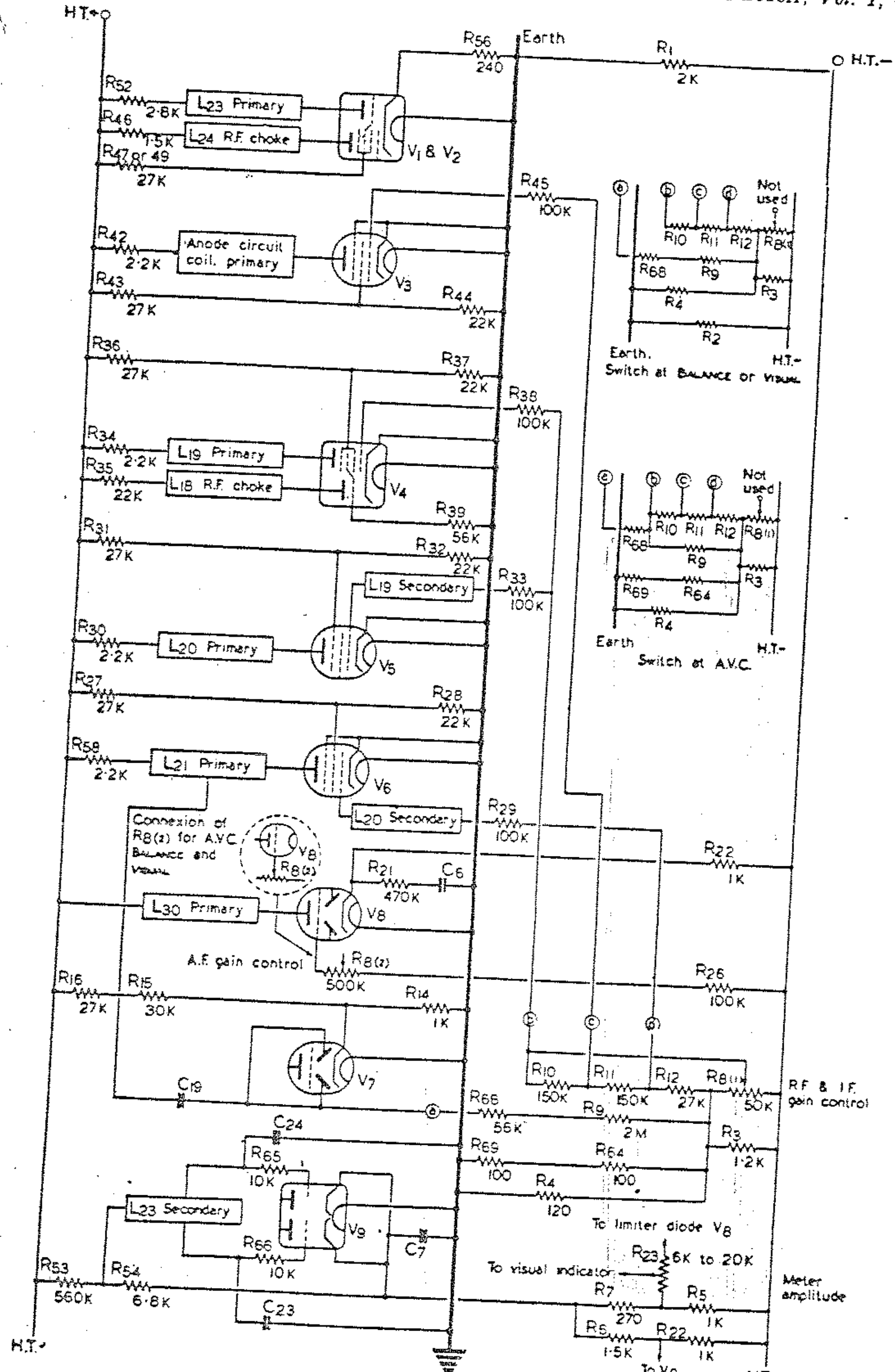


Fig. 8.—Biasing and feed arrangements

R.F. filter system to prevent R.F. being passed to the A.F. circuit. A condenser C_{24} with R_{22} decouples the cathode. The A.F. passes through a network comprising the resistor R_{87} and two series condensers C_8 and C_9 to a potentiometer $R_{8(2)}$, the moving contact of which is connected to the grid of the valve V_8. The voltage developed across $R_{8(2)}$ is admitted at the grid of V_8, the anode load of which is the primary of the output transformer L_{30}, by-passed by a condenser C_{25} and connected direct to the H.T. positive input pin 5 of plug P_1.

18. Before the potentiometer $R_{8(2)}$ there is an A.F. filter network composed of the condenser C_{10}, and an A.F. choke coil L_{29}. The A.F. filter network, which may be switched in or out of circuit by the switch S_5, prevents the greater proportion of the frequencies below 300 c/s from reaching the volume control $R_{8(2)}$ and the output stage. The filter removes part of the noises due to the aircraft electrical and ignition systems. The A.F. filter characteristics are given in fig. 7 and the input/output characteristics in fig. 9.

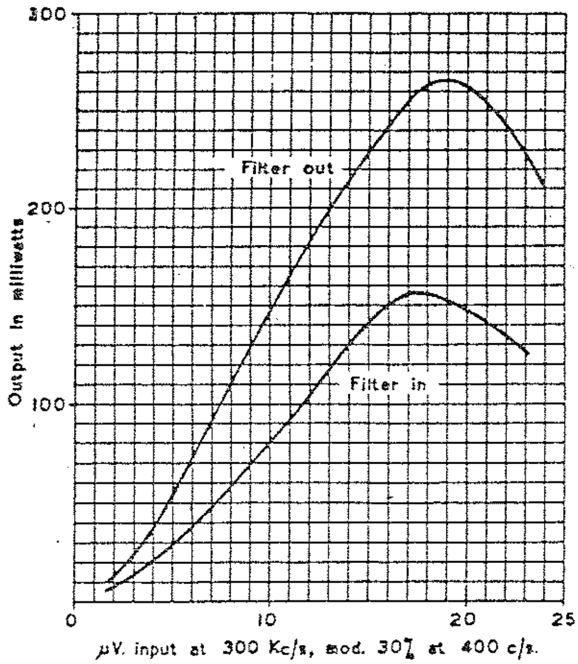


FIG. 9.—INPUT/OUTPUT CHARACTERISTICS

Manual volume control

19. Manual control of the gain of the R.F. and I.F. valves V_3, V_4, V_5, and V_6 is effected by the application of varying degrees of grid bias to their respective grids by the potentiometer $R_{8(1)}$. When the master switch MS is in the OMNI position the grid of the output valve V_8 is joined through the section MS_{af} to the top end, that is, further from the H.T. negative, of the A.F. volume control $R_{8(2)}$ and the variable slider is out of circuit. The full A.F. voltage is therefore applied to the grid of V_8. The automatic volume control (A.V.C.) system is inoperative.

20. With the switch at OMNI the circuits are:—

(i) A fixed potentiometer, consisting of the resistors R_{10}, R_{11}, and R_{12}, is connected, through the switch contacts MS_{af}, to the slider of the manual R.F. gain control $R_{8(1)}$.

(ii) The A.V.C. diodes of V_7 (strapped together) are connected, through the load resistor R_9, to a point 3·6 volts negative along the resistors R_3 and R_4, the rectified voltage across R_9 operating the tuning indicator V_{10}.

(iii) On ranges 1 and 2 the switch FS_{WT} connects R_{64}, (and R_{69} if fitted) across R_4 to reduce the minimum bias voltage and also the delay on the operating voltage of the indicator V_{10}.

21. The chassis is approximately 30 volts positive with respect to H.T. negative. The method by which this figure and that of the 3·6 volts negative, previously mentioned, are assessed may be understood from fig. 8. The effective resistance of the potentiometer networks across the supply, having regard to the switch positions, gives a basis for calculation. (Effective resistance should not be confused with the values given in the list of components.) The resistor R_1 has, at a minimum, $R_3 + R_4$ in parallel with it and these form a potential divider so that 26·4 volts are across R_3 and 3·6

volts across R_4. The manual volume control $R_{8(1)}$ is connected across R_3 and any voltage between −3·6 and −30 can be applied to V_5 and V_4 for grid bias. This voltage is broken down by means of the potential divider R_{10}, R_{11}, and R_{12} for connection to V_6 and V_3.

Automatic volume control

22. Automatic control of the gain of the valves V_3, V_4, V_5, and V_6, is effected by the strength of the received signals when the master switch MS is in the A.V.C. position. Manual control of the A.F. from the detector diode of V_8 to the output valve, that is, the triode of V_8, is also provided from the potentiometer $R_{8(2)}$. The controls of $R_{8(1)}$ and $R_{8(2)}$ are ganged for operation and the panel knob is labelled VOLUME CONTROL. The position of the master switch MS determines which of the potentiometers is operative:—OMNI for $R_{8(1)}$, A.V.C. for $R_{8(2)}$. The received signal applied to the grid of the R.F. amplifier valve V_3 is amplified by the I.F. amplifier valves V_5 and V_6. The amplified I.F. voltage appears across the primary winding of the third I.F. transformer L_{21}. This primary winding is tapped, and a proportion of the R.F. voltage is led to the strapped diodes of the double-diode-triode valve V_7. Rectification takes place and the rectified current flows through a series R.F. choke L_{25}, and a resistance-capacitance filter and decoupling circuit composed of R_{68} and the condensers C_{108} and C_{103}.

23. At the A.V.C., BALANCE, and VISUAL positions, the switch section MS_{2f} disconnects the slider of $R_{8(1)}$ and connects the fixed potentiometer R_{10}, R_{11}, and R_{12} across the A.V.C. diode load resistor R_9. This diode has a delay of 3·6 volts due to the drop across R_4 in series with R_3. On ranges 1 and 2 this delay is reduced to 2·4 volts by switching R_{64} (and R_{69}, if fitted) across R_4. The rectified current flows through R_{10}, R_{11}, and R_{12}, with R_9 in parallel, back to the cathode *via* R_4. The voltage developed across R_9 and the network R_{10}, R_{11}, and R_{12}, is divided to suit V_3 and V_5. On BALANCE and VISUAL, C_{94} is shunted across R_9 to give a longer time constant and reduce the flicker of the tuning indicator V_{10}.

24. Approximately one-half the full value of the biasing voltage is applied to the R.F. amplifier valve V_3 through the line A.V.C.2, tapping the junction of R_{10} and R_{11}. The grid-return circuit includes the resistance-capacitance circuit of R_{46} and C_{40} to prevent back-coupling between V_3, and V_4, V_5, and V_6, and has a time-constant which is much longer than the lowest incoming signal frequency. The frequency-changer V_4 and the first I.F. amplifier V_5 receive full A.V.C. bias voltage from the top end of the resistor R_{10} through the line A.V.C.3 and decoupling combinations R_{38}–C_{37} and R_{32}–C_{33} respectively. The second I.F. valve V_6 receives approximately one-tenth of the bias voltage through the circuit R_{29}–C_{30}.

25. The A.V.C. is subjected to a voltage delay of approximately 13 volts, that is, it does not come into operation until the received carrier reaches the predetermined level of strength represented by 13 volts. This delay is partly accomplished by running the cathode of V_7 positive with respect to its diode anodes by means of resistors R_{14} and R_{15} which are connected between H.T. positive and earth. An additional resistor R_{16} is introduced for C.W. reception (i.e. when the switch S_4 is ON) to reduce this delay voltage. The full delay voltage is a composition of the voltage produced here and the standing bias on the R.F. valves (see para. 26). The voltage delay assists in giving an A.V.C. characteristic which, for a change in input signal of 80 db. results in a change in output of approximately 8 db.

26. None of the A.V.C. controlled valves is automatically biased by cathode resistors. To preserve a standing bias during no-signal periods, therefore, the resistance network of R_{12}, R_{11}, and R_{10} is returned to a point which is 3·6 volts negative with respect to the cathodes. On ranges 1 and 2 (H.F.) this standing bias is reduced by approximately 2·4 volts in order to preserve reasonably constant amplification over all ranges. This is done by introducing the resistors R_{64}, (and R_{69}, if fitted) into the circuit by means of switch section FS_{WT}.

Beat frequency oscillator

27. In addition to providing A.V.C. the valve V_7 also acts as a beat frequency oscillator, the triode section of the valve being used for this purpose. The oscillatory circuit is of the series-fed Colpitts type, and consists of a coil L_{22} and the condensers C_{14} and C_{15}. The frequency of this oscillator can be varied over a range of approximately 3 kc/s by means of a pre-set trimming condenser C_{12}. This condenser can be adjusted by inserting a screwdriver through a small port in the front panel. Automatic bias is developed across the grid leak resistor R_{19}. The grid coupling condenser is C_{17}. The oscillatory circuit is tuned to approximately half the I.F., that is, to 280 kc/s, and the second harmonic of this is used to heterodyne the I.F. signal. The use of the second harmonic prevents the oscillator from being locked by incoming I.F. signal. The output from the oscillator is coupled through the condenser C_{11} to the signal diode of the valve V_8. The I.F. signal is also applied to this diode and the A.F. beat frequency voltage appears across the load resistor R_{21}.

Tuning indicator

28. Correct tuning of the receiver is indicated by a minimum angle of shadow in the tuning indicator valve V_{10}. This indicator gives a varying angle of shadow on a fluorescent "target" anode, the angle being dependent upon the voltage developed across the resistor R_9, which is the A.V.C. diode load.

29. The tuning indicator valve operates as follows:—Connected to the triode anode is a "deflector" wire which protrudes into the path of the electron stream between the cathode and the target anode. In the absence of a signal the voltage across the resistor R_9 is small, and therefore the negative voltage applied to the grid of the indicator valve is small, resulting in a high current through the valve. This current produces a large voltage drop across R_{13}, in consequence of which the potential of the triode anode is considerably less than that of the target anode. The deflector wire therefore has a repelling action on the electrons approaching the target anode, and a V-shaped shadow is produced. When the receiver is correctly tuned, the voltage across R_9 reaches a maximum, the grid bias increases and the anode current falls. The reduced current results in a smaller volts drop across R_{13} and the potential of the triode anode rises to a voltage comparable with that of the target anode. In this condition, therefore, the deflector wire has a much smaller influence on the electron stream, and the V-shaped shadow on the target anode narrows to a minimum.

COMMUNICATIONS CIRCUITS, OTHER VERSIONS

R.1155A, R.1155E, and R.1155M

30. These types differ from the R.1155 and R.1155D in the R.F. amplifier stage, where filters have been introduced to prevent interference from certain M.F. broadcasting stations having a carrier frequency near to the I.F. of the receiver (560 kc/s). Receivers bearing the suffix letter M are identical with the R.1155A except that a corrosive flux was used in error during production. Receivers type R.1155M are to be used at ground schools only.

31. The three filters are the grid rejector circuit, L_{33} and C_{113}, the anode rejector circuit, L_{33} and C_{114}, and the anode acceptor circuit L_{31} and C_{111}. In addition, an assembly consisting of the resistor R_{71} in parallel with condenser C_{112} is inserted to minimise the effects of the added capacitance introduced by the grid rejector circuit. The circuit changes will be seen by reference to fig. 3, where the modifications are shown as an inset on the full circuit diagram of the R.1155.

R.1155B and R.1155F

32. The circuit of these types incorporates the filter circuits of the R.1155A and, in addition, the six R.F. chokes annotated HFC_1 to HFC_6 in fig. 3A. These chokes are introduced to filter unwanted frequencies due to certain radar transmitters. As will be seen by reference to the circuit, fig. 3A, HFC_1 to HFC_4 are in series with the aerial leads, HFC_5 is in the common grid circuit of the L.F. switching valves V_1 and V_2, and HFC_6 in the grid lead to the R.F. amplifier valve V_3. A further slight alteration to the circuit is involved by the fitting of the condenser C_{115} in parallel with the resistor R_{72} between contact 3 of switch section FS_{2f} and the primary of L_3.

R.1155C

33. The R.1155C was a modified version of the R.1155A and was produced for use in Coastal Command aircraft engaged on certain duties necessitating D.F. facilities on Range 1. As this special requirement no longer exists the receivers have been declared obsolete, but some may still be found in service for normal communications purposes. The R.1155C required a special loop aerial in addition to that normally used, and the receiver embodied a new dummy loop circuit for ranges 1 and 2 in addition to the L_1 and C_{99} combinations used on the other ranges. These changes involved alterations also to the switching circuits. In view of the small number of receivers affected and the fact that they are obsolete, no circuit diagram is given.

R.1155L and R.1155N

34. The R.1155L and R.1155N are developments from the R.1155B and R.1155F to meet requirements for reception on the 1·5 to 3·0 Mc/s band. The frequency coverage therefore differs from that of the rest of the R.1155 series, range 5 (200 kc/s to 75 kc/s) having been omitted and range 2A (3·0 Mc/s to 1·5 Mc/s) inserted. Thus these types have a continuous frequency coverage from 18·5 Mc/s to 200 kc/s with the exception of the band between 600 kc/s and 500 kc/s. The changes have necessitated considerable alterations in the R.F. amplifier, frequency-changer, and R.F. oscillator stages, and a circuit diagram is given in fig. 4. Apart from the changes in these stages the circuit remains basically that of the R.1155B.

35. It will be seen that the coils L_6, L_{11}, and L_{17} (range 5) have been removed from the circuit of the R.1155B. Range 3 and 4 coils have been repositioned in the circuit diagram and alterations

have been made in the wiring of the switch sections FS_{xf}, FS_{zf}, FS_{xr}, FS_{yf}, FS_{yr}, and FS_{zf}. Three new coils L_{40}, L_{41}, and L_{42} have been introduced for the new range 2A. Other components re-positioned are the resistors R_{40}, R_{41}, R_{60}, and R_{61}, and the condensers C_{74}, C_{75}, C_{80}, and C_{91}. New resistors, R_{73} and R_{74}, and a condenser C_{116} have been added, and R_{59} and C_{73} have been removed.

THE DIRECTION-FINDING CIRCUITS

36. The change from the communications circuit to the direction-finding circuit is made by the master switch MS, of whose five positions the three labelled BALANCE, VISUAL, and ∞ (figure-of-eight) are for this purpose. Simplified diagrams of the D.F. circuits are given in figs. 10 to 13. The receiver may be used for direction finding on ranges 2, 3, 4, and 5. The D.F. ranges of the L and N versions are ranges 2, 3, and 4. On the R.1155C (now obsolete) D.F. was possible on ranges 1, 2, 3, 4, and 5. With a suitable loop aerial used in conjunction with the H.F. aerials the following facilities are available:—

(i) Determination of bearing of a given transmitter, with sense discrimination by visual or aural means.

(ii) Homing on to a transmitter by fixing the loop aerial in relation to the aircraft and maintaining course so that the two needles of the visual indicator type 1 intersect on a line marked centrally on the face of the instrument.

37. The loop aerial normally used is the type 3, which has a nominal inductance of 100 μH, and self-capacitance when installed of 20 $\mu\mu$F. In order to effect a match between this aerial and the receiver a small pre-set condenser C_{104} is built into the loop lead terminating plug. When the total loop and lead capacitance is too small to enable tuning to be effected by C_{104} alone, the fixed condenser C_{106} may be inserted in parallel with C_{104}. The procedure to be adopted for matching is described in para. 72. When a loop aerial other than type 3 is employed a suitable impedance matching unit, such as the type 12, 13, or 15 should be used to enable the input tuned circuits to gang correctly with the other tuned circuits. These units are dealt with in Appendix 1.

General principles

38. Direction finding is accomplished either by visual or aural means. The aural method used follows the well-known practice of swinging the loop for a minimum, and then sensing by superimposing fixed aerial voltages on the loop voltages. (The theory of this system of direction finding is covered in Chapter XVI of A.P.1093.) The method used for direction-finding by visual means employs a principle known as the "switched heart". Before the circuit is dealt with in detail this principle should be understood; its features are briefly as follows.

39. A push-pull oscillator operating at either 30 c/s or 80 c/s is used to switch the fixed aerial in such a manner that its voltages are applied alternately in phase and in anti-phase with the instantaneous voltage due to the loop. The same oscillator simultaneously switches the rectified output from the detector stage alternately to the two pairs of moving coils which operate the indicator needles of a visual indicator. Thus one needle is moved to an extent proportional to the fixed aerial voltage plus the loop voltage, and movement of the other is proportional to the fixed aerial voltage minus the loop aerial voltage. Therefore, when the loop aerial is swung until the voltage induced in it is nil, both the needles will rise to the same extent. This will be when the loop is at right-angles to the bearing of the transmitter. This state of affairs is indicated by the point at which the crossed needles intersect falling on a vertical white line painted on the face of the instrument. For homing, the loop is set in relation to the aircraft—usually athwartships—(see para. 103 with regard to other settings) and the pilot swings the aircraft until the two needles cross on the vertical line, thereafter maintaining course by keeping the point of intersection of the needles on this line. Since the voltage actuating each needle is represented by a cardioid curve (see diagram C of fig. 14) it will be clear that any deviations from course will cause one needle to fall and the other to rise, as a result of which the point of intersection will move off the vertical line. The significance and use of such movements for sense determination is explained in paras. 52 and 99.

L.F. oscillator for D.F. switching

40. The triode portions of the triode-hexode valves V_1 and V_2 are connected as a push-pull oscillator. The frequency of this oscillator is determined by the constants of the tuned circuit consisting of the primary winding of the L.F. transformer L_{23} and the two fixed condensers C_{54} and C_{55}. When the switch S_1 is open the oscillatory frequency is 80 c/s. Closing the switch S_1 throws the condenser C_{55} into circuit and thereby lowers the frequency to 30 c/s. The higher frequency is used when D.F. is being carried out on a W.T. signal, and the lower frequency when R.T. signals are being used. The lower frequency causes negligible interference with R.T. intelligibility but is too low a switching frequency for W.T. signals.

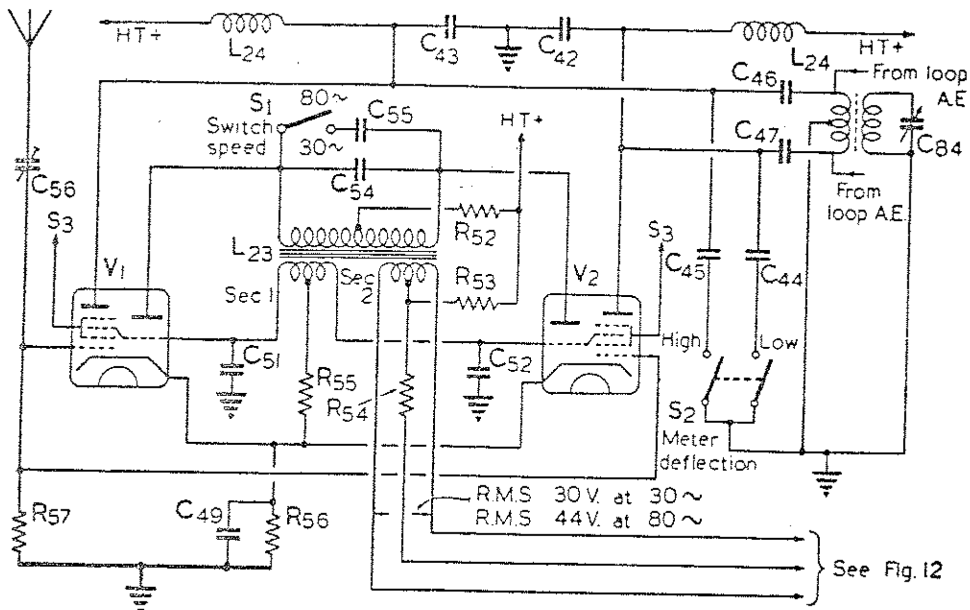


FIG. 11.—L.F. OSCILLATOR SWITCHING CIRCUIT

Aerial switching

41. The use of the centre-tapped secondary winding SEC 1 of L_{23} has the effect of simultaneously applying equal, but anti-phase, voltages to the oscillator grids of V_1 and V_2. During a positive half-cycle the grid is held only slightly positive due to grid current developing a biasing voltage across the resistor R_{55}. In the negative half-cycle the full secondary voltage is applied to the oscillator grids. Since these grids are connected to the injector grids (G_3) of the respective hexode portions, the effect is to bias the hexodes to cut-off during alternate half-cycles at the oscillator frequency. The fixed-aerial voltage is therefore applied through V_1 to C_{46} during one half-cycle, and during the next half-cycle, when the valve V_1 cuts off, the aerial voltage is applied through V_2 to C_{47}. As the two condensers C_{46} and C_{47} are at opposite ends of the loop aerial (and of the coil across it, which forms the primary of an R.F. transformer) the oscillator serves to switch the fixed aerial voltages at the oscillator frequency alternately into phase and anti-phase with the loop aerial input. The resultant voltages are applied to the grid of V_3 by inductive coupling to the grid circuit of the range in use.

42. The H.T. positive feed to the anodes of the triode sections is via a voltage dropping resistor R_{52} and the centre tap of the primary winding of L_{23}. The hexode anodes are fed through the R.F. choke assembly L_{24} and the dropping resistor R_{46}. The associated by-pass condensers are C_{41}, C_{42}, and C_{43}. A suitable screen voltage is provided by the two potentiometers R_{47}, R_{48}, and R_{51}, or R_{49}, R_{50}, and R_{51}, the by-pass condensers being C_{50} and C_{53}. The cathode bias is provided by the resistor R_{56} by-passed by C_{49}. R_{57} provides a grid return for the hexodes.

Visual indicator switching

43. The basic principles of operation of the visual indicator have been explained in paras. 38 and 39, and the switching circuit employed to operate the visual indicator, type 1, will now be dealt with in detail. Simplified circuits are given in figs. 12 and 13.

44. The amplified signal voltages are applied to the anodes of the double-triode valve V_9. It is convenient to regard the two sections A and B of V_9 as diodes which are switched into and out of operation by the grids G_1 and G_2. The grids are connected to a secondary winding SEC 2 of the L.F. transformer L_{23} and, by a similar arrangement to that used in the oscillator stage, equal but anti-phase voltages are applied to the two grids of V_9 in synchronism with the aerial switching. The voltage applied to the grids of V_9 is approximately 30 volts (R.M.S.) at 30 c/s or 44 volts at 80 c/s. The resistors R_{53} and R_{54} constitute a potentiometer connected between H.T. positive and the cathode of V_9. The grid returns of V_9 are connected to the junction of these two resistors and consequently the grids are at a potential positive with respect to the cathode, reducing the valve impedance and increasing sensitivity.

3

LIST OF ILLUSTRATIONS

This leaf issued in reprint
September, 1947

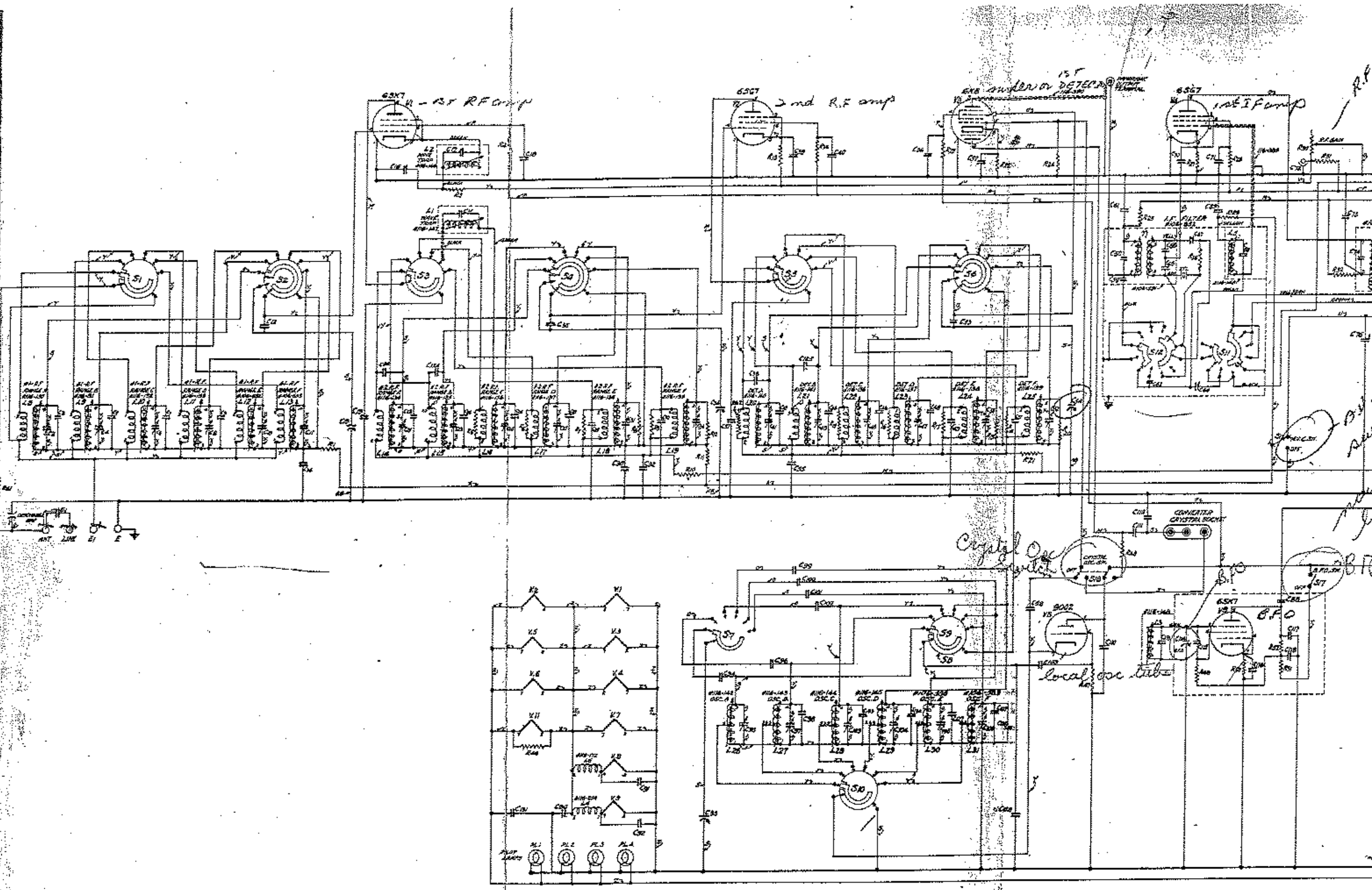
CONCISE DETAILS OF RECEIVERS, Types R.1155, R.1155A, B, C, D, E, F, L, M, and N

Purpose of Equipment ...	Designed for use in aircraft with transmitters of the T.1154 class. Also used in some A.S.R. launches, radio vehicles, and ground installations. Provides communications and direction-finding facilities.
Type of Wave	C.W., M.C.W., and R.T.
Frequency Range ...	18·5 Mc/s to 3·0 Mc/s 1,500 kc/s to 600 kc/s 500 kc/s to 75 kc/s *Types R.1155L and N only* 18·5 Mc/s to 600 kc/s 500 kc/s to 200 kc/s All versions use an I.F. of 560 kc/s
Maximum Sensitivity ...	Input of 10 micro-volts at 210 kc/s gives output in excess of 50 milliwatts Input of 9 micro-volts at 16 Mc/s gives an equivalent output
Selectivity	Approximately 4 kc/s to 6 kc/s total bandwidth for 6 db attenuation
Output Impedance ...	5,000 ohms

Valves ... ...

Function	*Description*	*Type*	*Stores Ref.*	
Visual D/F switching	Two triode-hexodes	V.R.99A	10E/757	– 6F8
R.F. amplifier	Variable-mu pentode	V.R.100	10E/278	– 6J7
Frequency-changer	Triode-hexode	V.R.99	10E/277	– 6K8?
I.F. amplifier	Two variable-mu pentodes	V.R.100	10E/278	– 6J7
A.V.C. and B.F.O.	Double diode triode	V.R.101	10E/280	– 6R7 or 6Q7.
Speech diode, visual meter limiter and output	Double diode triode	V.R.101	10E/280	–
Visual meter switching	Double triode	V.R.102	10E/279	– 6F8
Tuning indicator		V.I.103	10E/305	

Power Input	Omni and A.V.C. approx. 45 watts Visual D.F. approx. 50 watts
Power Output	Max. 200 milliwatts into 5,000 ohms impedance
Stores Ref.	R.1155, 10D/98; R.1155A, 10D/820; R.1155B, 10D/13045; R.1155C, 10D/1105; R.1155D, 10D/1331; R.1155E, 10D/1332; R.1155F, 10D/1333 R.1155L, 10D/1477; R.1155M, 10D/1597; R.1155N, 10D/1667
Approx. Overall Dimensions	*Length* $16\frac{7}{16}$ in. ... *Width* $9\frac{3}{8}$ in. ... *Height* $11\frac{3}{8}$ in.
Weight	Aluminium versions approx. 26 lb. Steel versions approx. 32 lb.
Associated Equipment ...	Transmitters, T.1154 series Resistance units, types 47 and 52 and 52A Aerial switch unit, type J Visual indicator, type 1 Impedance matching units, type 12, 13 or 15 Power units, types 32, 32A, 32B, 33, 33A, 33B, 34, 34A, 35, 35A, 114, 115, 268, and 380



WIRE LEGEND.

A – CABLE #111-250
B – " #111-251
C – " #111-252
D – " #111-253
E – "
F – " #111-255
G – " #111-256
H – " #111-257
J – " #111-258
K – " #111-259
L – #108-528, WIRE SPEC #240 (BLACK)
M – " " " #246 (BLUE)
N – " " " #242 (RED)
O – #20 BARE, TINNED, SOLID, CU. WIRE, SOFT.
P – #108-528, WIRE SPEC #244 (YELLOW)
Q – " " " #256 (RED-YELL)
R – " " " #268 (GREEN-YELL)
S – #14 BARE, TINNED, SOLID, CU WIRE, SOFT
T – #108-528, WIRE SPEC #254 (RED-WHITE)
U – #108-528, WIRE SPEC #245 (GREEN)
V – " " " #248 (GRAY)
W – " " " #251 (BLACK-RED)
X – " " " #241 (BROWN)
Y – #22 BARE, TINNED, SOLID, C.U. WIRE, SOFT.
Z – #108-528 WIRE SPEC #120-B (BLACK)
RB – #108 #34 (105/40) FLEX. COTTON WRAP, SING. BRAID, NO RUBBER, BLACK.

NOTES

1. INTERMEDIATE FREQUENCY 575 KC.
2. RANGE SWITCH (S1 TO S10) SHOWN IN COUNTER CLOCKWISE POSITION (RANGE A) LOOKING FROM KNOB END.
3. SELECTIVITY SWITCH (S11 & S12) SHOWN IN COUNTER CLOCKWISE POSITION (MIN. SEL.) LOOKING FROM KNOB END.
4. ⏚ DENOTES CHASSIS

BOTTOM VIEW OF SOCKETS

OCTAL BASE
7 PRONG (1/8)

DIAG
CSR