AIR PUBLICATION

2555F

VOLUME I

2nd EDITION

RECEIVERS TYPE R1392

By Command of the Defence Council

(Ministry of Defence)

FOR USE IN THE ROYAL AIR FORCE

(Prepared by the Ministry of Technology)

(*AL5 April* 67)

LAYOUT OF A.P.2555 F

RECEIVERS R.1392A, B, D and E

Heavy type indicates the books being issued under this A.P. number; when issued, they will be listed in A.P.113

VOLUME 1 **Part 1** **Leading particulars and general information**

Part 2 **Technical information (minor servicing and alignment)**

VOLUME 2 **General orders and modifications**

VOLUME 3 **Part 1** **Schedule of spare parts**

VOLUME 3
Parts 2, 3 and 4 *Inapplicable*

VOLUME 4 *(Application to be decided later)*

VOLUME 5 **Part 1** **Basic reconditioning schedule**

VOLUME 5
Parts 2, 3, 4, 5 and 6 *Inapplicable*

VOLUME 6 *(Application to be decided later)*

RECEIVERS R.1392A, B, D and E

LIST OF PARTS

Note.—*A list of chapters appears at the beginning of each part*

PART I

LEADING PARTICULARS AND GENERAL INFORMATION

LIST OF CHAPTERS

***Note:**—A list of contents appears at the beginning of each chapter*

LEADING PARTICULARS

RECEIVERS, R1392 D and E

General ... ... *A 15-valve superheterodyne receiver, with crystal-controlled oscillator, designed to give R/T and CW communication and DF facilities over a frequency range of 100 to 156 Mc/s. AGC is provided for use when required.*

Intermediate frequency ... ... *4·86 Mc/s.*

Aerial input ... ... *100Ω co-axial feeder line*

Output impedance ... ... *600Ω, for use with telephones of this impedance*

Power supply ... ... *6·3 volts 4 amps., 240 to 250 volts at 80 mA supplied by power unit Type 234A. A power unit Type 138 may be used to operate the receiver from 6-volt DC supplies*

Dimensions ... ... *19 in. x 10½ in. x 10 in.*

Remarks ... ... *The R.1392D is the tropicalized version of this receiver, whilst R.1392E is non-tropicalized*

RECEIVERS, R1392 A and B

General ... ... *A receiver of exactly the same type as the R.1392 D or E but covering a frequency range of 100 to 150 Mc/s.*

Remarks ... ... *In this case, the R.1392B is the tropicalized version*

POWER UNIT TYPE 234A

General ... ... *This power unit is designed to provide LT and HT voltages to a number of receivers including the R.1132A, R.1481 and R.1392A, B, D or E. It provides 6·3 volts at 4 amps. and an HT supply of from 180 to 270 volts as required*

Power supply ... ... *AC mains, 230 volts, 40 to 60 c/s*

Dimensions ... ... *19 in. x 7 in. x 10 in.*

Remarks ... ... *The HT voltage required for any particular type of receiver amongst those named above are selected by a number of tapping points inside the power unit. Each tap is labelled with the type number of the appropriate receiver or receivers*

Chapter 1

RECEIVERS R.1392D and E

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

Introduction

1. Receivers R.1392D and E have been designed for use over the range of frequencies 100 to 156 Mc/s, and provide DF and communication facilities within this range. They are most generally used in conjunction with transmitters T.1131K and J, and T.1540. The Types D and E differ only in the fact that R.1392D is a tropicalized version, and the description which follows applies equally to either type.

2. The receiver employs a 15-valve super-heterodyne circuit designed for the reception of either CW or RT signals, and with or without automatic gain control as required. The power supplies necessary for the receiver are 6·3 volts at 4 amperes and 240 to 250 volts at 80 milliamperes ; these are generally supplied from 200 to 250 volts single-phase AC mains by a power unit Type 234A. For 6·3 volt DC supplies a power unit Type 138 is used.

3. The unit is built on a chassis 10 in. × 17 in. having a 19 in. panel ; it is designed for mounting in standard telephone racks or cabinets and is provided with a ventilated metal dust cover. The receiver is fitted into the rack by six fixing bolts ; two large handles are fitted on the front panel for ease of handling.

GENERAL DESCRIPTION

4. A front view of the receiver is shown in fig. 1 and in this illustration the various controls may be clearly seen. They are as follows :—

(1) TUNE OSC. This is the oscillator tuning control and is the four-ganged

variable condenser C3, C8, C9, C14. The scale is calibrated in Mc/s.

(2) TUNE SIGNAL. The tuning control of the RF amplifier stages, consisting of the three-gang condenser C2, C5, C11. This scale is also calibrated in Mc/s.

(3) METER SWITCH (S2, S3). A 3-position switch, which, being used in conjunction with the 0-1 milliammeter gives a visual tuning indication of the crystal chain, the amplifier stages, or AF output level, respectively.

(4) TONE FREQUENCY CONTROL. The condenser C16 tuning the beat frequency oscillator and giving control of the pitch of the beat note.

(5) TONE MAN. GC., MAN. GC., AGC. A 3-position system switch S1 in which the BFO is operative only in the first position, whilst AGC is switched in on the last-named position.

(6) RF GAIN. The manual gain control potentiometer VR1 which controls both RF and IF gain.

(7) LF GAIN. The manual gain control potentiometer VR2.

(8) MONITOR (J1). An attenuated output, for a pair of headphones, is provided by this jack ; it is a means of checking receiver operation.

(9) LINE (J2). If a jack-plug is inserted in this socket the output of the receiver, which normally passes via a Jones plug to the remote control lines, is open circuited. This is to enable these lines to be changed if required.

5. The input to the receiver consists of an aerial input circuit capable of matching the receiver to a co-axial feeder of 100-ohm characteristic impedance. Following this input circuit are two stages of RF amplification (CV1136) using three tuned circuits. The signal output from these stages, together with the output of the heterodyne oscillator, are applied to the control grid of the mixer valve which is again a CV1136 type.

6. The heterodyne oscillator is crystal controlled and the desired oscillator frequency is obtained by using a crystal of one-eighteenth of this frequency, and then providing the required degree of multiplication. The oscillator itself is a pentode CV1065 in which the cathode, control grid and screen grid of the valve operates as a Pierce oscillator, the output being electron-coupled to the anode circuit which contains a tuned circuit resonating at the third harmonic of the crystal

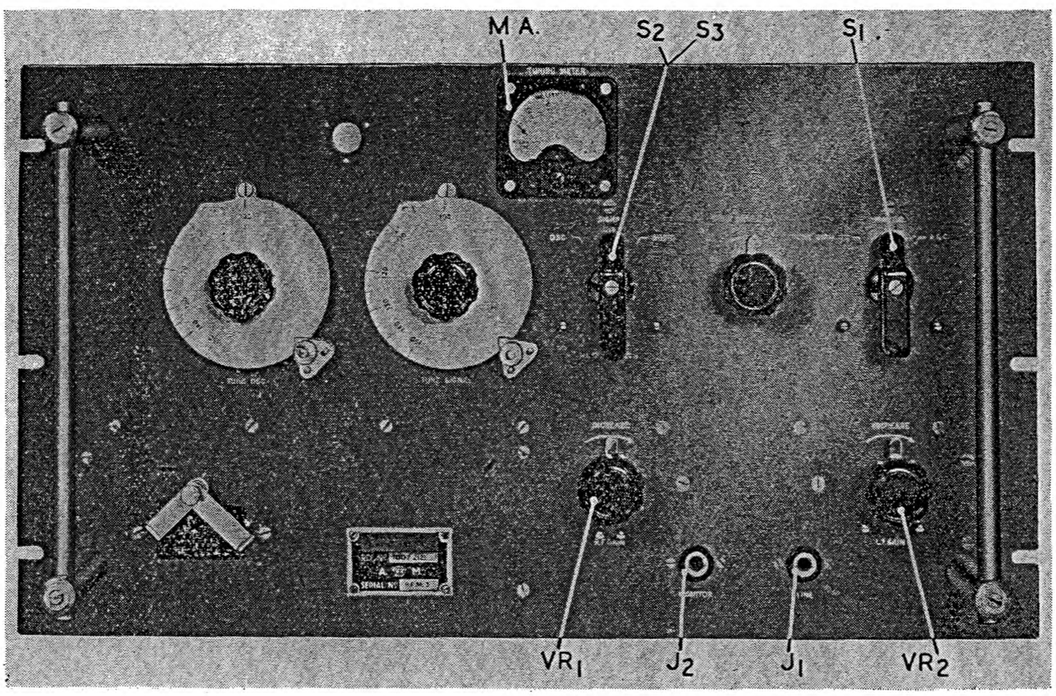


Fig. 1. Front view, receiver R.1392A, B, D and E

frequency. This trebled output is applied to a frequency multiplier stage (CV1136) which provides the remainder of the multiplication by having its anode circuit tuned to the eighteenth harmonic of the crystal. This output is fed to the control grid of the mixer valve via a buffer stage also using a CV1136 valve.

7. The IF amplifier chain, which has band-pass characteristics, consists of three stages in which valves of the CV1053 type are used. The IF output is applied to two separate circuits, both using a double-diode-triode valve, CV587. The first of these valves (with the diode anodes strapped to form a single diode) provides demodulation of the IF carrier in the diode section, the AF component then being amplified by the triode section of the valve before being passed to the grid of the output stage. By selecting suitable valves for the decoupling condenser of the cathode resistor of this valve, and for the coupling condenser to the grid of the output valve, attenuation of all frequencies below about 400 c/s is produced.

8. The second output from the IF amplifier is fed to the double-diode-triode which provides delayed amplified AGC. This operates at all frequencies covered by the receiver for signal input voltages of greater than 5μV. The RF amplifier stages and the first two stages of the IF amplifier are controlled by the AGC system.

9. A beat frequency oscillator is provided for the reception of CW signals, the working frequency being made variable by a small amount on either side of the intermediate frequency so that the beat note is adjustable.

10. The output of the final AF amplifier is matched to a line of 600-ohm characteristic impedance. A low-pass filter network is provided so that frequencies above some 3 kc/s are severely attenuated. The output from the secondary of the output transformer is taken to two contacts on a 6-pole Jones plug at the rear of the receiver. In addition, jacks are provided for line and monitoring facilities.

11. In the absence of a signal, extraneous site noises are reduced by including a muting circuit in the receiver. Additionally, a series diode limiter circuit gives some measure of protection against pulse transmissions or interference of a similar form.

CIRCUIT DESCRIPTION

Aerial input circuit and RF amplifiers

12. The signal input to the receiver is fed from the aerial system by a co-axial feeder of 100 ohms characteristic impedance. This is matched to the grid impedance of the first valve by an RF transformer L1, L18, the secondary of this transformer being tuned by condensers C1, C2 and C124.

13. The voltage developed by the signal across this tuned secondary is applied to the grid of V1 via condenser C19, and an amplified signal voltage will appear across the tuned circuit L2, C5, C6 which is shunt-connected to the valve by C36. This amplified signal is applied via C37 to the grid of an identical stage V2, where further amplification occurs. The signal is now applied to the control grid of the mixer valve V3.

14. The aerial input circuit, and the tuned circuits of the two RF stages are tuned by three variable, ganged, condensers C2, C5 and C11 respectively, each having a parallel connected trimmer condenser C1, 36 and C12.

15. When the receiver is operating in the MAN. GC condition the gain of the RF stages is controlled by varying the cathode potential of these two stages. This is effected by connecting the fixed cathode resistors (R9 and R16 respectively) to earth via the potentiometer VR1, so that variation of VR1 varies the effective cathode resistance of each valve. Under AGC conditions VR1 is short-circuited, R9 and R16 being connected to earth ; the action of the switch at the same time breaks the earth connection of the junction of R48 and R69 allowing the AGC system to become operative. The AGC voltage developed across R50 is now applied to the control grids of V1 and V2 via R49 and HFC6.

The heterodyne oscillator

16. In order to obtain a high degree of local oscillator stability, this receiver uses a crystal controlled local oscillator. The desired oscillator output frequency is obtained by using a crystal whose frequency is a sub-multiple of this, and then providing the necessary degree of multiplication. In this case the crystal frequency is one-eighteenth of the output frequency, and the heterodyne circuit consists of an oscillator trebler V4, a frequency multiplier V5, and a buffer stage V6.

17. The first stage V4 has a double function, being both oscillator and trebler. The screen grid, control grid and cathode of V4 form a modified type of Pierce oscillator, with the crystal connected in the grid circuit. Feedback occurs via the common cathode impedance formed by HFC2 and C22, the screen (which serves as the oscillator anode) being held at earth potential by condenser C25. The output from the oscillator section is electronically coupled (via the electron stream of the valve which passes through the screen grid) to the anode circuit of V4 which contains a tuned circuit L4, C3, C4; this circuit is tuned to the third harmonic of the crystal frequency. The frequency of the voltage applied to the grid of V5, via the condenser C27, is three times the crystal frequency.

18. The stage using the pentode V5 provides the remainder of the frequency multiplication, since its anode circuit L5, C7, C8, C43 (shunt-fed by C44) resonates at the eighteenth harmonic of the crystal (or, in other words, to the sixth harmonic of the signal being fed to its grid) and this is the desired oscillator frequency.

19. The anode tuned circuit of V5 is inductively coupled to another circuit L6, C9, C10, C45, tuned to the same frequency, in the grid circuit of valve V6. This stage serves as a buffer amplifier at the final oscillator frequency. Its anode circuit contains a shunt-fed tuned circuit L7, C14, C15, C66 and the voltage developed across this is fed by condenser C68 to the grid of the mixer valve.

20. The four condensers necessary for tuning the multiplying and amplifier stages C3, C8, C9 and C14 are ganged and controlled by the OSC TUNING knob on the front panel. Trimmer condensers C4, C7, C10 and C15 are connected in parallel with the respective variable condensers. All stages in the oscillator chain have automatic bias provided by the cathode resistors R4, R12 and R23 respectively.

Mixer and IF amplifier circuits

21. The output from the RF amplifier section, at signal frequency, and the output from the oscillator section, are both applied to the grid of the mixer valve. The oscillator frequency is lower than the signal frequency by the amount of the IF, and after rectification by V3, which works with zero standing bias, sum and difference components of the two original frequencies are produced in the anode circuit of the valve. The primary of the first IF transformer is tuned to the difference frequency which is the desired IF of 4·86 Mc/s, whilst the higher frequency unwanted signal is by-passed to earth.

22. L8 and L9 are the primary and secondary of the first IF transformer, and the IF voltage developed across L8 is inductively coupled into the grid circuit of V7. The stages containing valves V7, V8 and V9 are identical and provide a high degree of amplification to the IF carrier wave. The IF transformers of each stage are fixed-tuned to the correct frequency by parallel condensers and adjustable iron-dust cored inductances; the coupling coefficient is adjusted so as to give a band-pass response of 6 db down at ± 25 kc/s.

23. Standing bias on V7 and V8 is provided by cathode resistors R30 and R41 respectively. When the receiver is operating in the MAN. GC condition, the gain of the first two stages (V7 and V8) is controlled by VR1, similar to the RF stages, by switching VR1 in series with the earth connection of R30 and R41. Independently of this, the gain of V9 can be adjusted by the pre-set potentiometer VR3, this being primarily for the adjustment of the muting circuit. Under AGC conditions the switching arrangements (*as in para.* 15) allow the AGC circuit to become operative, and the voltage developed across R48 and R50 is applied to the control grids of V7 and V8 via their respective decoupling resistors and the grid windings of the respective IF transformers.

The beat frequency oscillator

24. This oscillator, which enables CW transmissions to be received, works at a centre frequency equal to the intermediate frequency. The circuit is a conventional one except that in this case the screen-grid of pentode V10 is used as the oscillator anode, it being maintained at earth potential as regards the operating frequency by the condenser C94. The frequency circuit determining circuit is L16, C95, C16 the last being variable in order that the oscillator frequency can be adjusted to some 1 kc/s on either side of the intermediate frequency. Feedback occurs from cathode to grid circuit via the coupling winding L17.

25. The oscillator output is coupled electronically to the anode circuit of V10 and the output voltage is developed across the load resistor R46, from whence it is injected via C98 into the primary L12 of the third IF transformer. Thus when the BFO is operating two voltages are combined in this circuit, that due to the signal, and that due to the BFO.

26. This oscillator operates only in the TONE MAN. GC position of switch S1 ; in all other positions of this switch the HT supply to V10 is open circuited.

The second detector and AF amplifier

27. The modulated IF carrier voltage developed across L14, the primary of the third IF transformer, is coupled inductively into the secondary winding L15 and is then applied to the diode section of V11. The two diode anodes of this valve are strapped together and work as a single diode. A rectified modulated carrier voltage appears across the diode anode load R54 and R55, the audio frequency component being passed via the diode V14 and condenser C107 to the potentiometer VR2. This is explained in more detail in para. 36, 37 and 38, covering the pulse limiter. A selected proportion of this voltage is applied to the grid of the triode section of V11, appearing in amplified form across the anode load of this section, R58. An HF filter is included in the anode circuit to remove any high-frequency carrier components which may remain.

28. The output from V11 is resistance-capacity coupled to the grid of the AF amplifier V13, the amplified AF voltage being developed across the primary of the output transformer T1. This transformer is designed to match the optimum load impedance of V13 to a balanced line of 600 ohms characteristic impedance. The secondary of T1 is connected to a closed-circuit jack J1, two contacts of

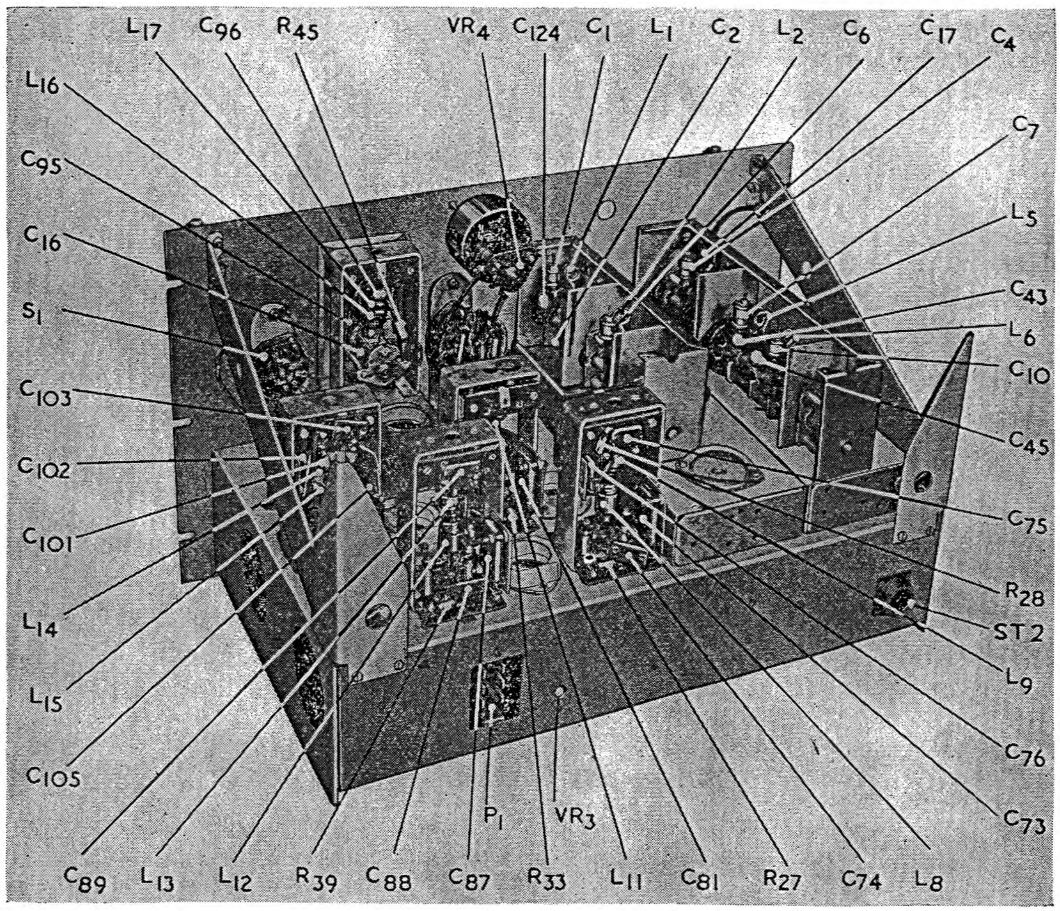


Fig. 2 Rear view, receiver R.1392A, B, D and E, with screening covers removed

which are taken away to pins 11 and 12 on the Jones plug P1. These are the connections to the external line, and when a jack plug is inserted into J1 the output from the receiver is disconnected from the line. Another jack J2 is connected in parallel with J1, output from the receiver appearing across it in attenuated form ; the attenuation is due to the inclusion of resistor R68.

29. The anode circuit of V13 also contains a filter network which in this case gives attenuation of the higher frequencies, particularly those above 3000 c/s. At the same time the value of the decoupling condenser of the cathode bias resistor R63 is so selected that degeneration occurs at the lower frequencies and more particularly at frequencies below 400 c/s. Thus the audio output of the receiver is restricted to a frequency range of between 400 c/s and 3000 c/s, which is adequate for communication purposes.

The AGC circuit

30. A double-diode-triode V12, is used for providing delayed, amplified AGC. The IF carrier is applied to one of the diode sections from the primary of the third IF transformer L14, via condenser C101. The other diode provides the actual AGC voltage under the control of the first diode. The triode portion of V12 is responsible for providing amplification of the AGC control voltages.

31. Under static conditions, with no signal input to the receiver, the following conditions apply. The HT current of all valves in the receiver passes through R67, which is connected between HT negative and earth, so that a voltage of some 50 volts negative to earth is set up across it. The triode grid of V12 is at almost cathode potential, whilst the anode has a high positive potential. This latter gives rise to a quite high value of anode current which will produce a voltage drop along R65 and make the cathode some 60 volts positive to earth. The resultant cathode potential is some 10 volts positive, and since the diode anode connected to R69 is at earth potential, it is held inoperative.

32. When a signal is received, a proportion of the IF carrier voltage is applied by C101 to the right-hand diode. During positive half cycles this diode will conduct, causing a current to flow through R64, and the diode anode becomes negative. The negative DC potential so produced, and which is proportional to the IF carrier strength, is applied

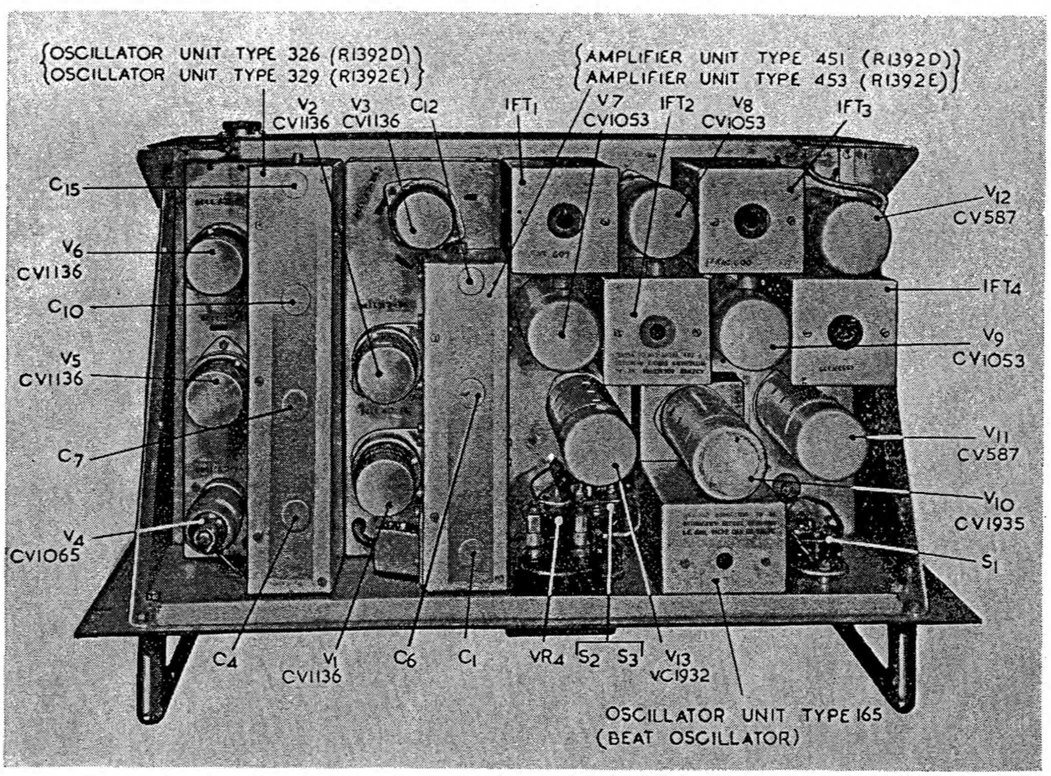


Fig. 3. Top view of chassis, receiver Type 1392D and E

to the triode grid via R62, stray IF components being by-passed by C114. The effect of the increase of negative grid potential is to cause a much larger change of anode voltage (due to the mutual conductance of the triode) and hence a large change of anode current. This amplified change causes the volts drop down R65 to decrease, and the cathode assumes a potential between +10 and —50 volts to earth, dependent upon signal strength.

33. For weak signals, therefore, the left-hand diode will remain inoperative, since the cathode will be above earth potential. For larger signals the delay voltage will be overcome and this diode will conduct, the diode potential above the cathode being proportional to the signal level. The current drawn by the diode, and hence the negative voltage across R48 and R50 must also, then, be proportional to the signal strength. These negative potentials are tapped off from R48 and R50 and fed to the grids of the controlled stages ; that across R50 to V1 and V2, and the voltage across R48 and R50 to V7 and V8.

The muting circuit

34. The diode V15 provides the receiver muting arrangement. Condenser C85 connects it directly across the potentiometer VR2, which is the audio input to the triode portion of V11. The anode of this diode is also connected via R71 to the cathode of V12. Under no-signal conditions, as has already been described in para. 31, this cathode is at a positive potential and hence the diode will be conductive. This shunts VR2 and consequently the input to V11 is cut off, or at least severely attenuated.

35. When a signal is received, the cathode of V11 takes up a negative potential, so that the anode of V15 also becomes negative. It ceases to conduct and the shunt-path across VR2 is now open circuited, allowing the audio frequency output from the second detector to be set up across VR2 without attenuation.

The pulse limiter

36. This circuit, using diode V14, limits pulse interferences whose amplitude is appreciably greater than that which corresponds to 100 per cent modulation of the carrier voltage being received. The diode section of V11 develops its output across the load resistance R54, R55, the centre point being connected to the anode of V14. The cathode of V14 is connected via a high resistance R70 and the filter circuit R44, C108, to the lower end of L15. Due to the slow time constant of R44 and C108, the potential due to the rectified IF carrier voltage is appreciably the same at the bottom of L15 and the cathode of V14.

37. When the modulation amplitude of the received signal is not greater than 100 per cent, the cathode potential of V14, and hence the audio output, follows the modulation envelope. This is due to the fact that since the instantaneous voltage at the diode anode is approximately one-half that of the bottom of L15 (due to the values of R54 and R55), while this point approximates the potential of the filter end of R70, the cathode is always more negative than the anode. Current flows through the diode, and since its anode resistance is much less than the high resistance of R44 and R70, the cathode potential will follow the anode potential, at the modulation frequencies. Under normal conditions then, the audio output from the second detector is passed through the relatively low resistance cathode-anode path of V14, developing an audio-frequency voltage across R70, C126, which has a time constant adjusted to follow the modulation frequencies. The AF output is then coupled by C107 to VR2.

38. As soon as a pulse interference peak exceeds the 100 per cent modulation level, the potential of V14 anode becomes more negative than the left-hand end of R70 and the diode ceases to conduct. The audio frequency output thus fails to reproduce the excess negative voltage, since the AF path is open circuited for the period of the pulse. These pulses are therefore suppressed.

Meter switching

39. The selector switch S2, S3 performs the following functions :—

(1) Switches the 0-1 milliammeter in parallel with a shunt resistor R10 in the anode HT to the mixer valve V3. The magnitude of the IF voltage in the anode circuit of this stage is indicated by the magnitude of the fall of observed anode current in the meter.

(2) Switches the meter in parallel with a shunt resistor R57 in the anode circuit of the first IF valve, V7. The fall of anode current in the meter is an indication of the magnitude

NOTES:—

S.L.1 = SCREENED LEAD ASSEMBLY No. 1
S.L.2 = " " " No. 2
S.L.4 = " " " No. 4
S.L.5 = " " " No. 5
S.L.C.1 = " " AND CLIP ASSEMBLY No. 1
S.L.C.2 = " " " No. 2

S2 AND S3 SWITCHING REFERENCE

POSITION A ADJUST AUDIO LEVEL
" B TUNE SIGNAL
" C TUNE OSC.

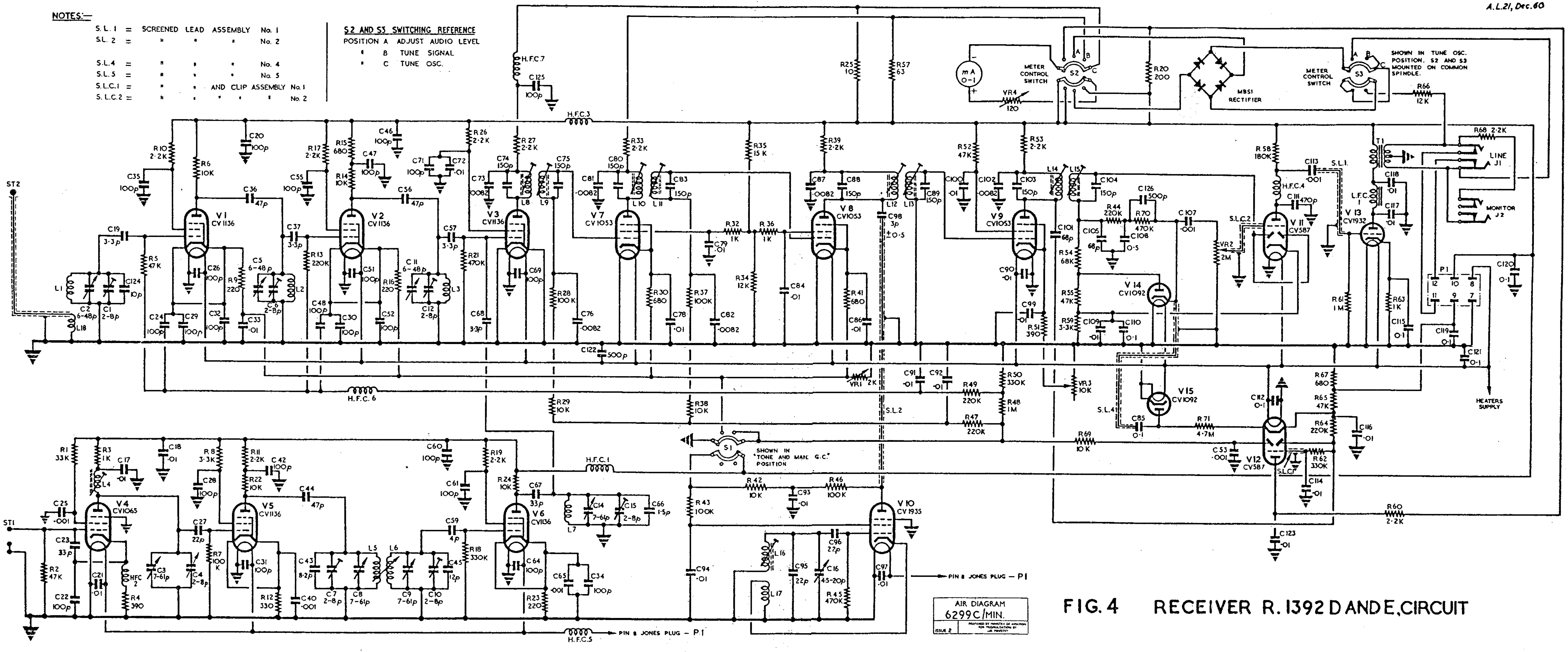


FIG. 4 RECEIVER R.1392 D AND E, CIRCUIT

of the AGC control voltage, which is itself directly proportional to signal strength. Whenever possible, the receiver should be tuned by the indication of the meter in this position.

(3) Switches the meter into a bridge rectifier circuit which is connected across the 600-ohm audio output of the receiver, thus giving an indication of the receiver output level.

(4) A fourth position, indicated on the circuit diagram fig. 4, gives an indication of the anode current of the AGC amplifier V12 by switching the meter in parallel with R20. This position is no longer used and the panel stops are arranged to prevent selection.

RECEIVER TUNING

40. To operate the R.1392A, B, D or E, with aerial connected and the receiver switched on, the following procedure should be used :—

(1) Insert a suitable crystal for the channel required, namely

$$f\ crystal = \frac{(f\ signal - 4{\cdot}86)\ Mc/s}{18}$$

the receiver crystal frequency being 0·27 Mc/s lower than the transmitter crystal.

(2) Set the meter switch to OSC.

(3) Set the system switch to AGC.

(4) Set the TUNE OSC. and TUNE SIGNAL dials to the required signal frequency as indicated by the calibration.

(5) Find the dip in the reading of the tuning meter which occurs when the TUNE OSC. dial is moved about ± 3 Mc/s from the frequency required. Adjust the TUNE OSC. dial to give maximum dip. The crystal oscillator harmonic selector will then be correctly tuned for the required channel.

(6) Set the meter switch to SIGNAL.

(7) Using a test signal of the desired frequency, or the actual desired incoming signal, find the dip in the reading of the tuning meter which occurs when the TUNE SIGNAL dial is moved about ± 3 Mc/s from the frequency required. Adjust the TUNE SIGNAL dial to give maximum dip. The signal amplifier is then correctly tuned for the required channel.

41. With very weak signals (less than some 5μV) it may not be possible to tune the signal amplifier in this way, since the signal will, in all probability, be too weak to operate the AGC system. If this is so, the alternative procedure is as follows :—

(1) Set the meter switch to AUDIO.

(2) Set the LF gain control to maximum (and the RF gain control to maximum under MAN. GC conditions) and adjust TUNE SIGNAL dial to provide the maximum signal output as indicated in the meter.

(3) If no signal is available, plug headphones into the MONITOR jack and adjust the TUNE SIGNAL dial for maximum background noise, keeping within ± 3 Mc/s of the frequency required.

42. When working on MAN. GC, always set the AF gain control to some three-quarters of maximum for high audio levels, and adjust the overall gain of the receiver by means of the RF gain control. For lower audio levels the AF control should be adjusted to give a reasonable output.

43. When using the receiver for the reception of CW signals, it should be tuned in the usual manner, as already described, and the following procedure carried out :—

(1) Set the system switch to TONE MAN. GC.

(2) Adjust the beat frequency oscillator control to give the desired audio beat note in the headphones.

CONSTRUCTIONAL DETAILS

44. The R.1392 series are all constructed with a 17 in. by 10 in. silver-plated chassis which is bolted to a front panel of dimensions 19 in. by 10½ in. To strengthen the unit the chassis is also supported by a pair of brackets bolted to the front panel. The receiver is designed for mounting in a standard 19 in. rack, six slots being provided in the front panel to take the fixing bolts. In addition two large vertical handles are fitted on the panel. A large metal dust cover, with louvres to allow of good ventilation, gives protection to the interior of the receiver ; it is locked in position by two wing nuts (Dzus fasteners) at the rear of the cover. The general construction is clearly seen from fig. 2 and 5.

Sub-assemblies

45. Mounted on the upper side of the main chassis are a number of self-contained and completely screened sub-assemblies (*fig.* 3). The units used for the tropicalized R.1392D and the non-tropicalized R.1392E have different serial numbers and these are given where necessary. The sub-assemblies are as follows :—

(1) Oscillator unit, (Type 326, 10V/640 for R.1392D and Type 329, 10V/641 for R.1392E). This is a self-contained unit, with its own chassis, and contains the valves and components of the crystal oscillator and the crystal harmonic amplifier (V4, V5 and V6).

(2) Amplifier unit, (Type 451, 10V/16580 for R.1392D and Type 453, 10V/16581 for R.1392E). Another self-contained unit, with its own chassis, which carries the valves and components of the signal frequency amplifier stages V1, V2 and the mixer stage V3.

(3) Transformer unit Type 91 (10K/1689) IFT1.

(4) Transformer unit Type 92 (10K/1690) IFT2.

(5) Transformer unit Type 93 (10K/1691) IFT3.

(6) Transformer unit Type 94 (10K/1692) IFT4.

(7) Oscillator unit Type 165 (10V/585). Again this is a self-contained sub-chassis which

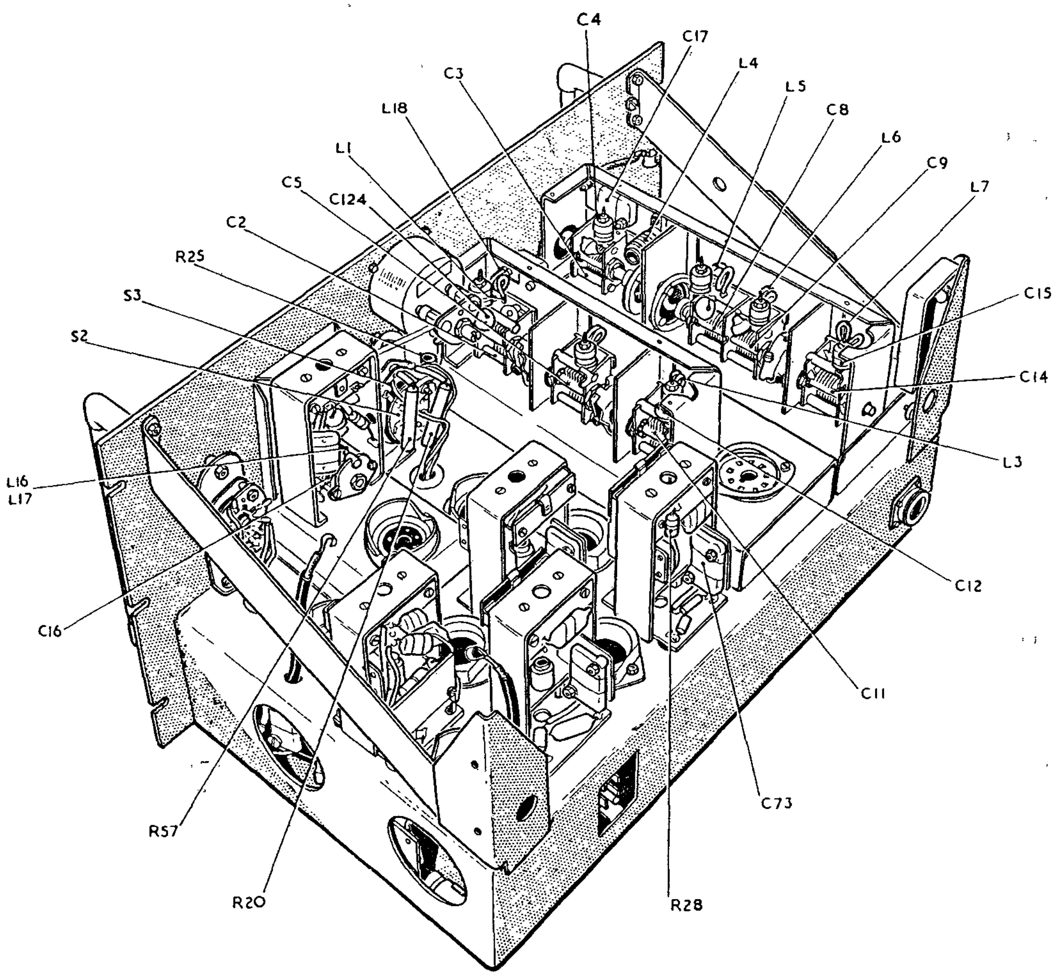


Fig. 5. Rear view, receiver R.1392A, B, D and E

carries the single valve (V10) and the components of the beat frequency oscillator stage.

46. In fig. 2 and 5 the receiver is shown from the rear with the screening boxes and the valves removed. On the extreme right of the main chassis is the oscillator unit, and in these illustrations the removal of the screens shows the three separate compartments each containing the variable tuning condensers and coils of the tuned circuits of V4, V5 and V6 respectively; the oscillator anode condenser is C3, that nearest the front panel. It should be noted that the middle compartment has a twin-section condenser C8, C9, this being the tuning of the RF transformer coupling V5 to V6. The variable condensers are ganged together by flexible couplers and each has a pre-set trimmer condenser mounted on it and connected in parallel.

47. The amplifier unit, situated adjacent to, and to the left of, the oscillator unit is very similar in appearance. This has a screened three-section metal box which contains the variable condensers, trimmers and coils of the aerial input circuit and the tuned anode circuits of the two RF amplifiers V1 and V2. The three valves mounted on this sub-assembly are V1, V2 and the mixer valve V3. The variable condensers are ganged by flexible couplers.

48. The right-hand rear portion of the main chassis (*fig.* 3) has mounted upon it the three IF valves V7, V8 and V9, the second detector and AF amplifier V12 and the IF transformers associated with these valves. These transformers are completely screened, holes being provided for access to the iron-dust cores used for adjusting the inductance of the IF tuned circuits. The valves are completely screened by removable metal screening-cans. The connections from the IF transformers to the valve top-caps pass through screwed metal connectors which are joined to the IF screening cover and to the top of the valve screening can.

49. The internal construction of the IF transformers is shown in fig. 5. They are built up on a U-shaped metal frame, the primary and secondary windings being mounted co-axially and each being tuned by an iron-dust core. The tuning condensers for primary and secondary windings are silver-mica fixed condensers; also mounted inside the screening cover are the anode decoupling resistor and condenser for the respective stages.

50. The beat-frequency oscillator unit is located toward the left-hand edge of the main chassis, mounted very near to the front panel (*fig.* 5). On its small sub-chassis are mounted the base of the valve V10 and a screened box closely resembling the IF transformer covers. In fig. 5 the cover of this box is removed; the main components it contains are the two coils L16 and L17 which are the grid winding and the coupling winding of the oscillator respectively, the main tuning condenser C16, and the fixed condenser C95 which is in parallel with it. The shaft of condenser C16 is taken through the screen of the sub-unit and the front panel, so that it is accessible from the front of the receiver. This is the TONE FREQUENCY control.

Main chassis

51. On the rear of the main chassis are two sockets P1 and ST2. P1 is the male portion of the Jones plug which carries the connections to the power supply unit and to the external line. The other socket ST2 is the low-loss connector into which the plug on the co-axial feeder from the aerial system is fitted. It should be noted that on each side of the chassis two large circular holes have been cut to give additional access to the components mounted on the underside.

52. Two switches are mounted on brackets bolted to the front panel; they are the system switch S1, mounted at the extreme left of the panel (*fig.* 5), and the meter switch S2, S3 mounted adjacent to the meter itself. A small sub-assembly is fitted to the meter terminals consisting of a triangular-shaped piece of insulating material on the back of which is mounted the potentiometer VR4. The shaft of this potentiometer passes through the insulating strip and permits VR4 to be adjusted from the rear of the receiver.

53. Fig. 6 and 7 illustrate the underside of the main chassis where the majority of the small components are mounted. It will be seen that on the right-hand side of the main chassis are six square-shaped holes; these allow access to the underside of the oscillator and amplifier sub-assembly chassis.

54. The small components of these sub-assembly units, both resistors and condensers are mounted on tag panels close to their respective valve bases. Components which are connected from pins on the valve base to

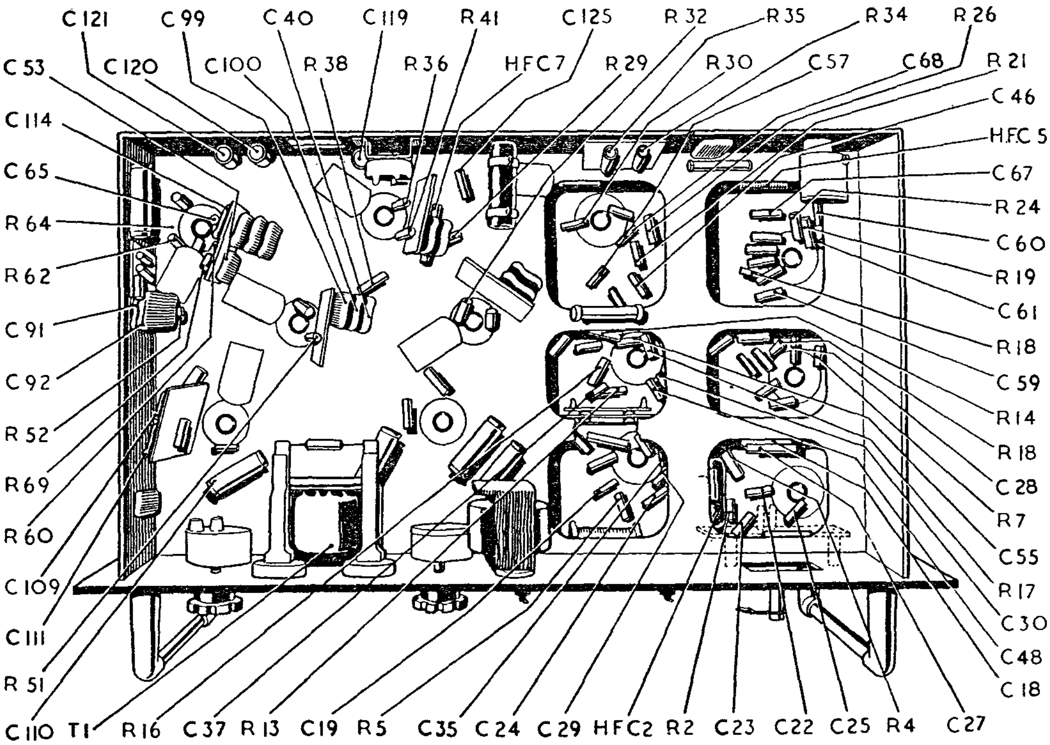


Fig. 6. Receiver Type R.1392D and E, underside view

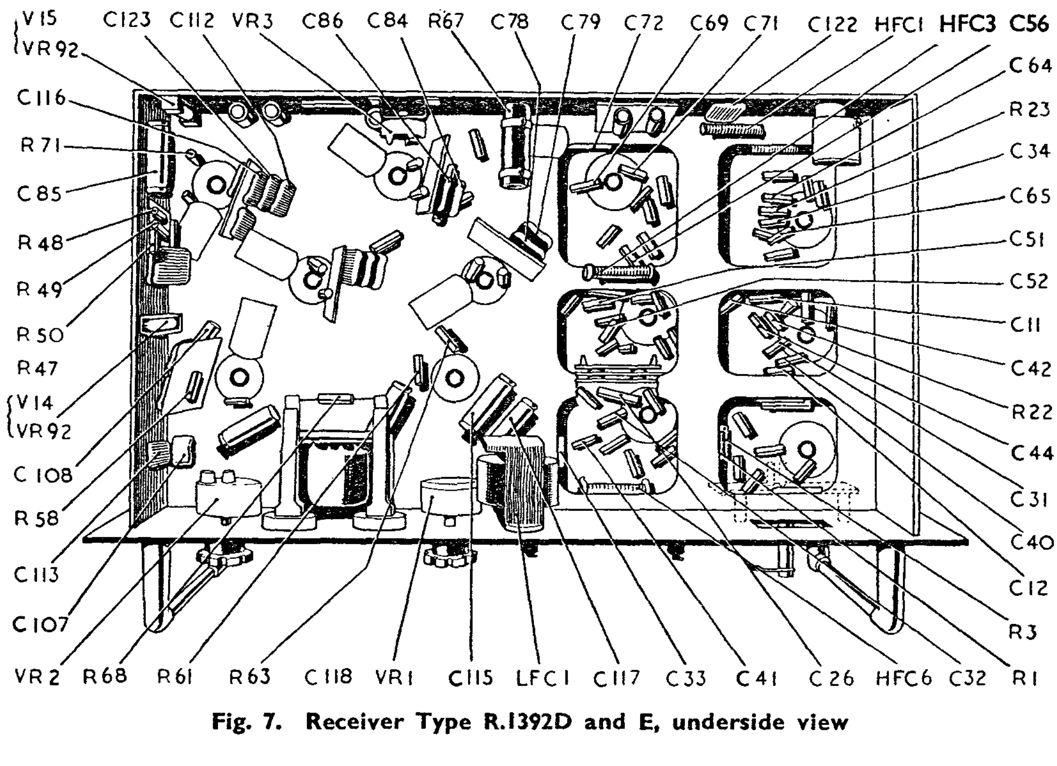


Fig. 7. Receiver Type R.1392D and E, underside view

the chassis, such as decoupling condensers, are connected to earth tags arranged as closely as possible to the valve base itself. Thus all wiring is kept short and rigid, and the possibility of stray capacity effects is minimized. All the condensers used in these sub-units are of the ceramic type.

55. On the underside of the main chassis proper, shown on the left of fig. 6 and 7, are the valve bases of V7, V8, V9, V10 and V11. Condensers and resistors associated with each stage are mounted on rectangular tag boards which are mounted vertically over the valve base itself. The front panel carries some of the heavier components such as the choke LFC1 and transformer T1, together with potentiometer VR1 and VR2. On the rear edge of the chassis are mounted various components on small tag strips, the vitreous resistor R67 and the potentiometer VR3. This component is mounted on a metal bracket so that its shaft is accessible through a small hole cut in the chassis edge.

Chapter 2

RECEIVERS R.1392A and B

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

Introduction

1. The R.1392A and B receivers are the original models of this series in Service use, and it is intended that they will be superseded in time by the R.1392D and E. The R.1392D, which is a tropicalized version of the R.1392E, is to be the ultimate type in use.

2. The differences between the two categories of receiver (Types A and B, and Types D and E) are due to changes made in order to extend the frequency coverage of the R.1392D and E to be 100 to 156 Mc/s. The heterodyne oscillator and frequency multiplier stages are slightly modified, but the remainder of the circuit is unchanged. In this description of the R.1392A and B, it will only be necessary to cover the parts of the circuit which differ from the R.1392D and E. The remainder of the circuit is unchanged and the circuit description of Chap. 1 applies equally to the R.1392A and B.

3. Very small changes in the constructional details occur in the two categories, but these are of a minor nature and are shown in the respective illustrations of this chapter and Chap. 1. The dial of the R.1392D and E has, of course, an additional calibration mark at 156 Mc/s.

4. Receiver R.1392A and B (B being the tropicalized version) is a 15-valve superheterodyne receiver designed for the reception of CW and R/T signals in the frequency range 100 to 150 Mc/s. Automatic or manual gain control may be used, and the receiver includes a muting circuit and a pulse interference limiter. As with the R.1392D and E, the power supplies are derived from a power unit Type 234A.

CIRCUIT DESCRIPTION

RF amplifier stages

5. The operation of these stages is covered already in Chap. 1 and need not be repeated. One small change in the circuit diagram should, however, be noted. The interstage coupling condensers C36 and C56 are of a slightly larger value in the R.1392A and B, being 50 pF instead of 47 pF, as in the D and E types.

The heterodyne oscillator

6. The circuit of the heterodyne oscillator V4 (*fig.* 1) shows that a slightly different

NOTES:—

S.L.1 = SCREENED LEAD ASSEMBLY No. 1
S.L.2 = " " " No. 2
S.L.4 = " " " No. 4
S.L.5 = " " " No. 5
S.L.C.1 = " " AND CLIP ASSEMBLY No. 1
S.L.C.2 = " " " " " No. 2

S2 AND S3 SWITCHING REFERENCE
POSITION A ADJUST AUDIO LEVEL
" B TUNE SIGNAL
" C TUNE OSC.

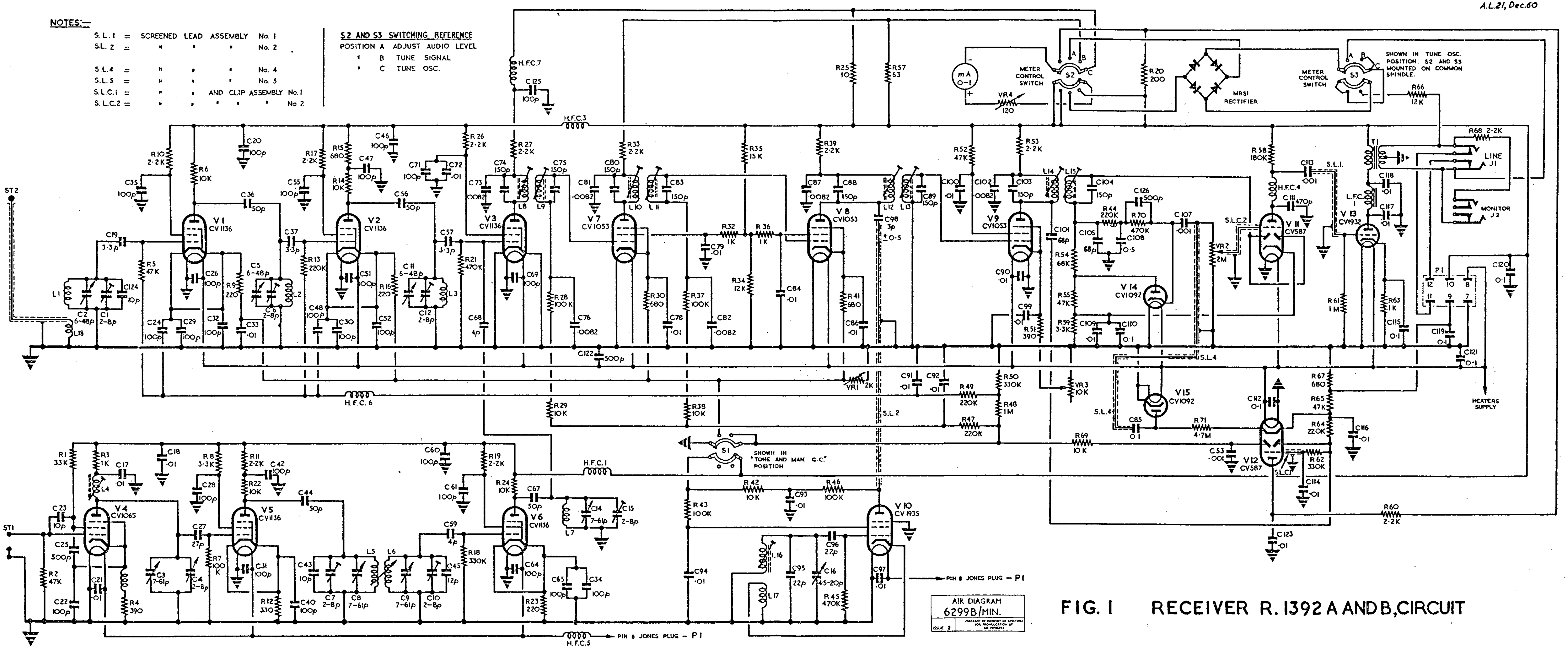


FIG. 1 RECEIVER R. 1392 A AND B, CIRCUIT

oscillator circuit is used in the R.1392A and B. It is basically the same as the oscillator used in the R.1392D and E, being a modified Pierce circuit, but the higher frequencies required in the R.1392D and E have necessitated some changes. These can be seen in Chap. 1, fig. 4.

7. Referring again to fig. 1 of this chapter it will be seen that the screen-grid, control grid and cathode form a triode oscillator, the screen serving as oscillator anode. The crystal is connected in the grid circuit of the valve, feedback occurring across the common cathode impedance HFC2 and C22. The screen-grid is tied to the cathode via C25, whilst a small condenser C23 provides additional feedback from cathode to grid circuits. The output from the oscillator section is coupled into the anode circuit through the electron stream of the valve. The tuned circuit in the anode of V4 is tuned to the third harmonic of the crystal frequency so that the output from this stage is at three times the crystal frequency.

8. The operation of the remainder of the heterodyne oscillator chain is identical with that described in para. 18, 19 and 20 of Chap. 1, but there are some small differences in component values. These are mainly in the values of the interstage coupling condensers and are most easily seen from a comparison of the respective circuit diagrams.

General

9. The whole of the remainder of the circuit is identical with that of the R.1392D and E, so that the description already given for these types applies equally well to R.1392A and B.

CONSTRUCTIONAL DETAILS

Introduction

10. The variation in the constructional details of the different types of the R.1392 are small, and do not affect the main structural or layout arrangements of the receiver. The description of the method of construction given in Chap. 1, together with fig. 1, 2 and 5 of that chapter, may be taken as applying to R.1392A, B, D or E.

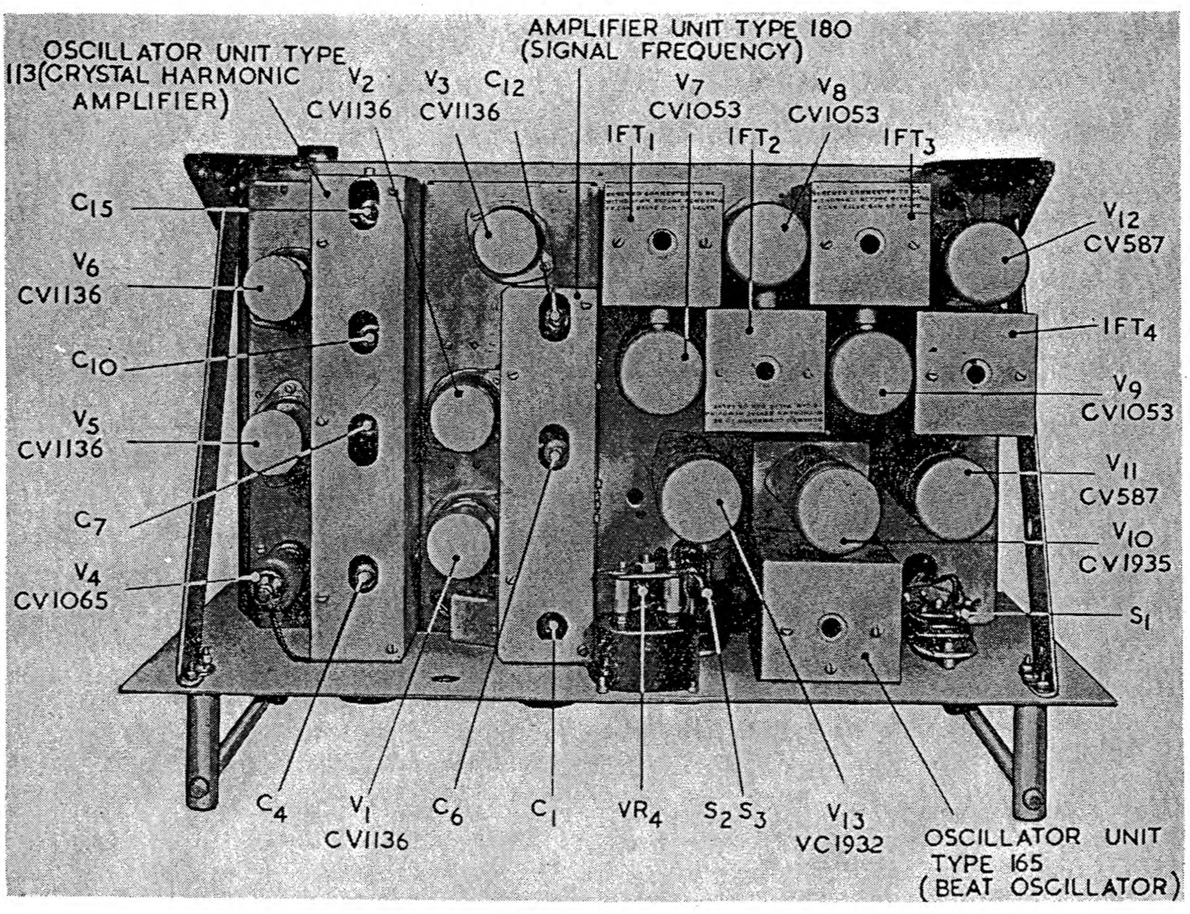


Fig. 2. Top view of chassis, receiver Type R.1392A and B

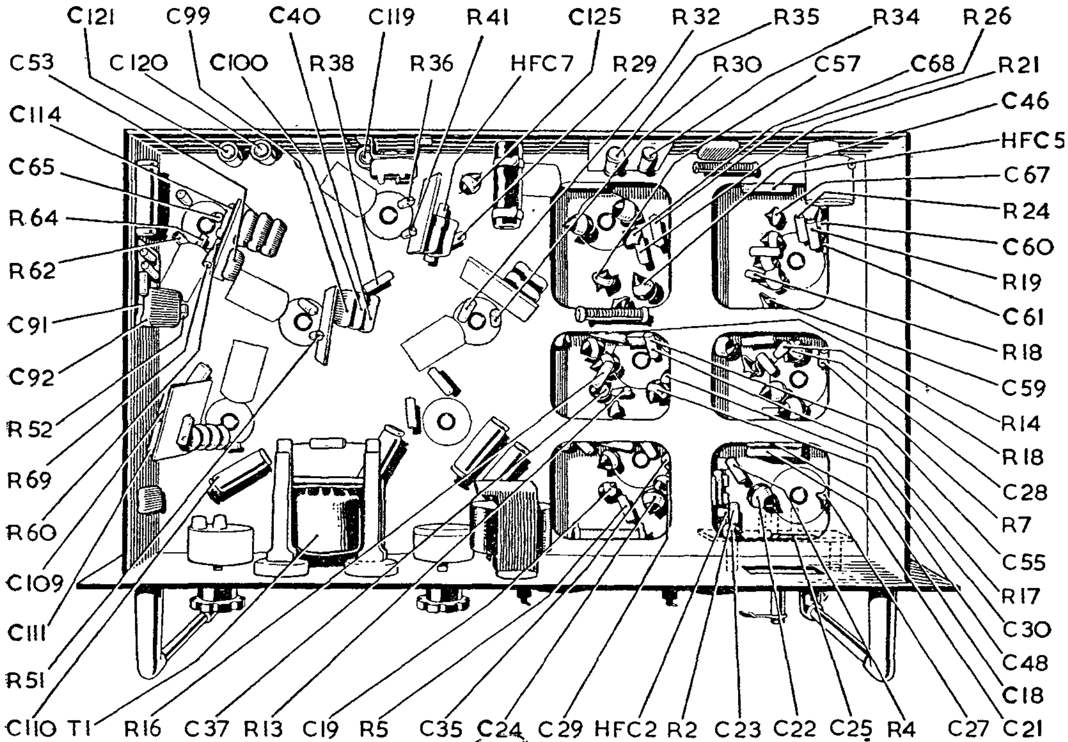


Fig. 3. Receiver R.1932A and B, underside view

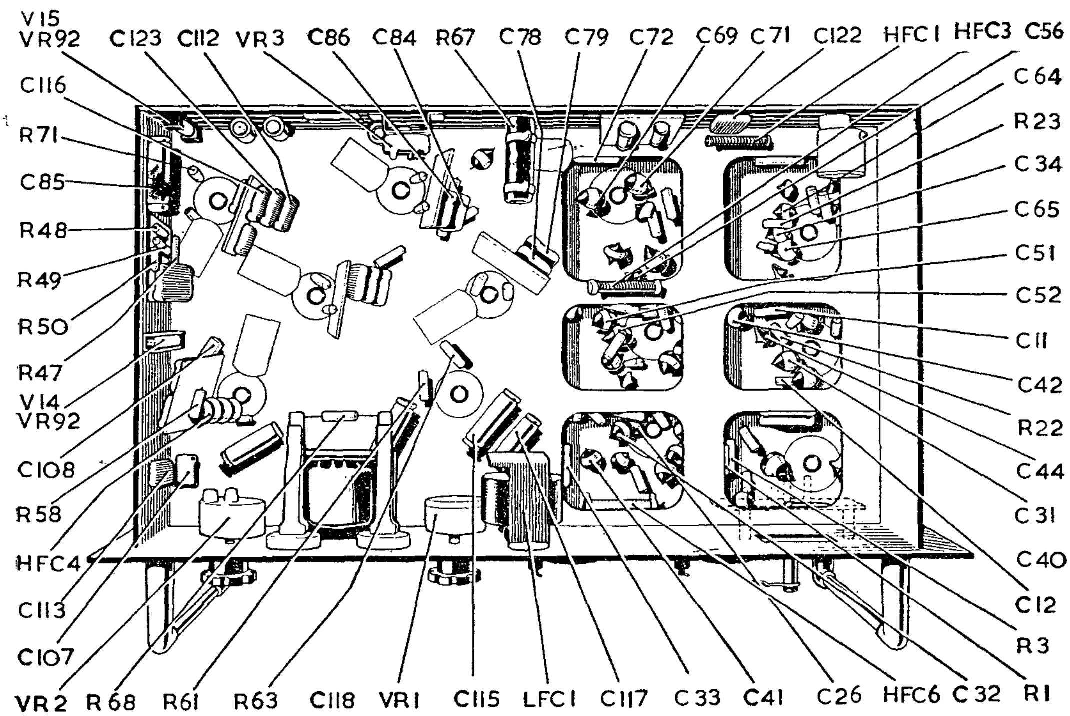


Fig. 4. Receiver R.1392A and B, underside view

Sub-assemblies

11. The changes of components which occur in the R.1392D and E are in the RF amplifier and heterodyne oscillator portions of the receiver. These two sections of the receiver are built into sub-assemblies which are mounted on the main chassis, and since the sub-assembly for each type is slightly different, they are known by different type and reference numbers. Fig. 2 shows the top view of the R.1392A and B with these units in position, the sub-assemblies being in this case oscillator unit Type 113 and amplifier unit Type 180.

Main chassis

12. The underside of the receiver main chassis is illustrated in fig. 3 and 4. On the right-hand side, six square holes are cut in the main chassis so that the underside of the oscillator unit and amplifier unit are accessible. The components of these units are grouped on tag panels close to their respective valve bases so that the wiring may be kept as short as possible.

13. The same procedure is used on the main chassis and in fig. 3 and 4 the valve bases of V7, V8, V9, V10 and V11 may be seen, with the tag panel carrying the small components mounted close beside them. The front panel carries some of the heavier components, such as the choke LFC1 and output transformer T1, together with the potentiometer VR1 and VR2. The position of the crystal holder is shown by dotted lines.

14. As before, the differences between R.1392A and B, and R.1392D and E are very small and may be seen by comparing fig. 3 and 4 with fig. 6 and 7 of Chap. 1.

G4536 M45192 1950 6/52 AB539/3 5769

ERRATA

in chapter 3

Note . . .

In some cases the fuses, shown in fig. 1, are not wired as shown in the diagram and, reading from left to right, the annotations should read :—

F 4 F 3 F 2 F I

not F 3 F 4 F 1 F 2 as shown.

Dmd 4326 160565 3250 2/57 AB539/3 1348

Chapter 3

POWER UNIT TYPE 234A

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

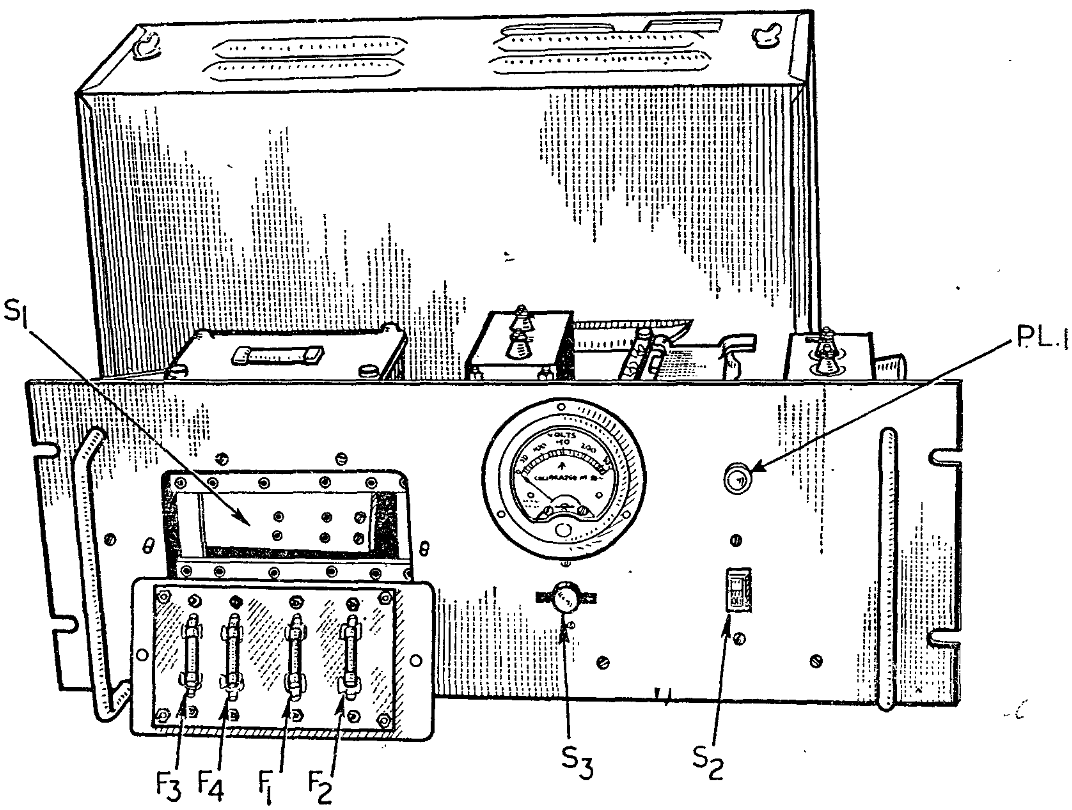


Fig. 1. Power unit Type 234A, front view, fuses exposed

Introduction

1. This power unit is designed to supply both HT and LT voltages to a number of receivers, including the R.1132A, R.1481 and R.1382A, B, D or E. It is built on a 17 in. × 10 in. chassis, with a front panel 19 in. × 7 in. intended for mounting in a standard 19 in. rack assembly. A dust cover is provided for the unit, with louvres to give adequate ventilation.

2. The output voltage of the power unit may be varied for the particular type of receiver being used by a pre-set switch which varies the primary tappings of the mains transformer. In addition, a tapping switch S4 in the secondary of this transformer gives a high-voltage input to the rectifier when maximum HT output is required. The range of voltages obtained from the unit is of the order of 180 to 270 volts. A moving-iron meter on the front panel normally reads the AC input to the unit, but by means of a lever switch S3 (marked PRESS TO READ HT) it may be switched to read the smoothed HT output.

Circuit description

3. The circuit diagram of the power unit is given in fig. 2 and it will be seen that it is basically a conventional full-wave rectifier circuit with a condenser-input smoothing filter. The 230 volts 50 c/s input is applied to the primary of the mains transformer T1 via the mains on-off switch S2, double-pole fuses F1 and F2, and the tapping switch S1. The secondary of T1 has three windings; the centre-tapped HT winding feeds the anodes of the full-wave rectifier V1. The other two windings provide, respectively, 5 volts at 2 amps for the heater of V1, and 6·5 volts at 4·3 amps for the heaters of the valves in the receiver. The latter winding is connected to pins 7 and 8 on the output socket P2, whilst connected directly across the winding are the resistor R1 and the indicator lamp PL1. The output voltage of 6·5 is intended to give 6·3 volts at the receiver after making allowance for the voltage drop along the line connecting power unit and receiver.

4. The HT winding of T1 is provided with a tapping switch S4. In the position shown in fig. 2 only a part of the secondary turns are in use and the input to the rectifier is reduced. When S4 is set to the left-hand position the secondary input voltage to the rectifier is increased, due to the increased number of turns, and, consequently the HT output from V1 is correspondingly increased. The HT negative line from the centre-tap of this winding, which is not earthed, is connected to the smoothing network and also to pin 9 on socket P2 via the fuse F3.

5. The HT positive line from the cathode of V1 is connected to the choke L1 of the smoothing network. This is a two-section filter comprising L1, L2 and the condensers

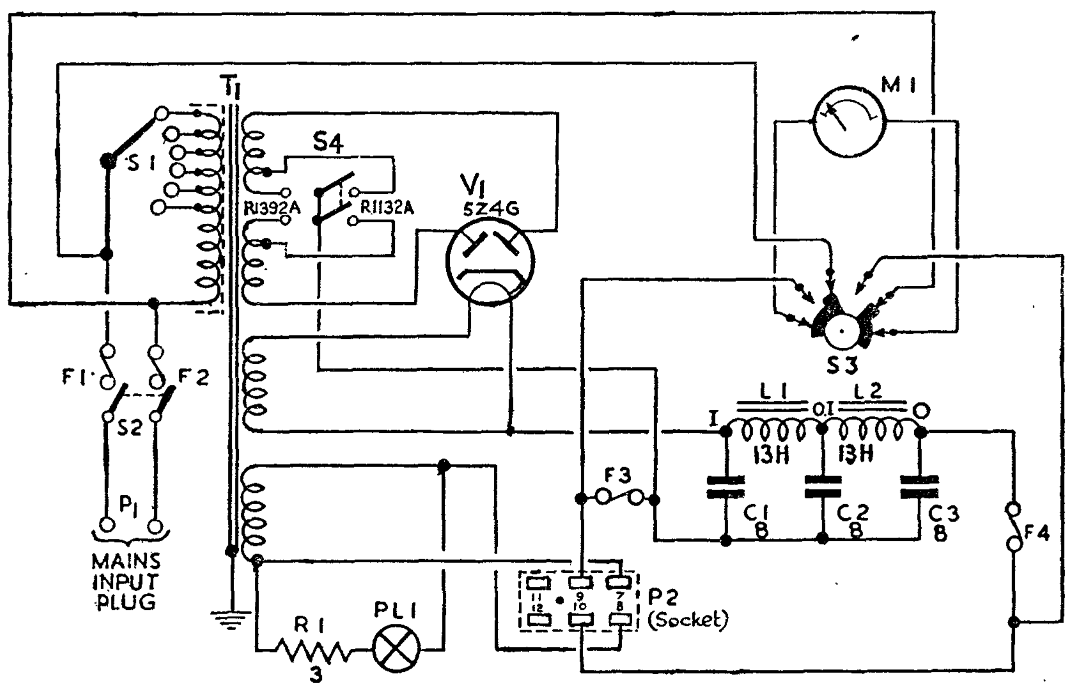


Fig. 2. Power unit Type 234A, circuit

C1, C2 and C3 and its efficiency is such that the HT ripple is of the order of 0·01 per cent. The output from the filter is connected to pin 10 on the socket P2 via the HT fuse F4.

6. Switch S3 is the meter selector switch previously mentioned. The meter* itself is a moving-iron type having a range of 0–300 volts and in the position shown in the diagram it is connected directly across the primary of the mains transformer. In the other position of the switch, the meter is connected directly across the HT output of the unit.

Constructional details

7. The general layout of the unit may be seen from fig. 1 and 3. The front view (*fig.* 1) gives the location of the controls on the front panel, including the meter M1 and the PRESS TO READ HT switch S3. The fuse panel is shown removed from the unit to illustrate the method of mounting of the fuses; they are held in clips on an insulated panel mounted on the rear of the outside metal panel, each clip being connected to a metal pin. Inside the unit are two insulated strips carrying sockets to which the circuit connections are made. When the fuse panel is in position, the metal pins plug into these sockets and connect the fuses into circuit, the panel then being locked in position by two wing-nuts. The primary tapping switch S1 is a link plug fitting into the sockets indicated in fig. 1.

8. Fig. 3 gives a view of the power unit from the rear and shows the mechanical construction. The metal chassis carrying the heavy components is strengthened by bracing it to the front panel by two brackets at either side.

9. The wiring of the unit, except for the smoothing circuit components and the valve base, is by a cableform, all leads except the LT supply using Unicel 4c. The heavier requirements of the LT circuits are met by using Unicel 19.

Operation of power unit

10. Before use it is advisable to check the unit for superficial damage. The tappings

* But see Vol 2. Leaflet 5. (AL 9.)

(AL 10)

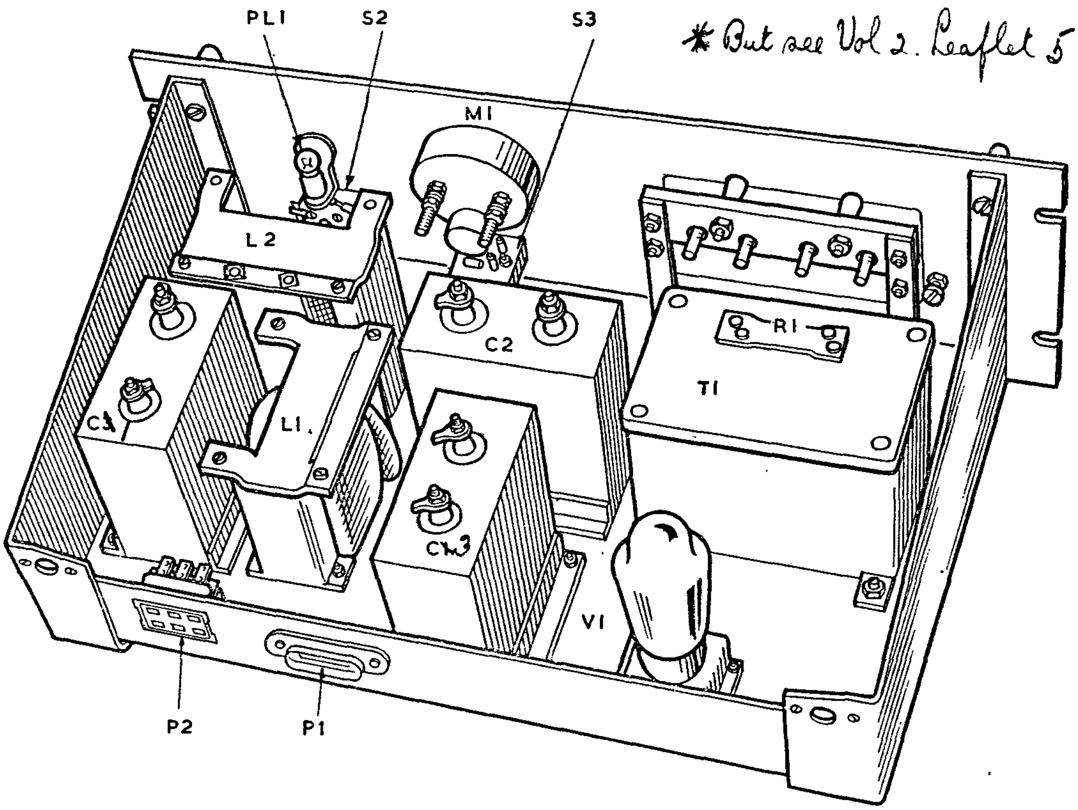


Fig. 3. Power unit Type 234A, top view

on the mains transformer should then be adjusted and to do this it is necessary to remove the fuse panel. When this has been done the primary tappings and the link-plug will be seen and the link switch can be set to the correct voltage by pulling it out and plugging it into the appropriate position. The output adjustment S4 should be set in the position "R.1392A" when used with receivers R.1392A, B, D or E.

11. Prior to replacing the fuse cover, examine the fuses located upon it and check that they are of the correct value. The mains input fuses should be of 1 amp rating and the fuses in the HT positive and negative lines of 150mA.

Chapter 4

RECEIVER 62 H

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

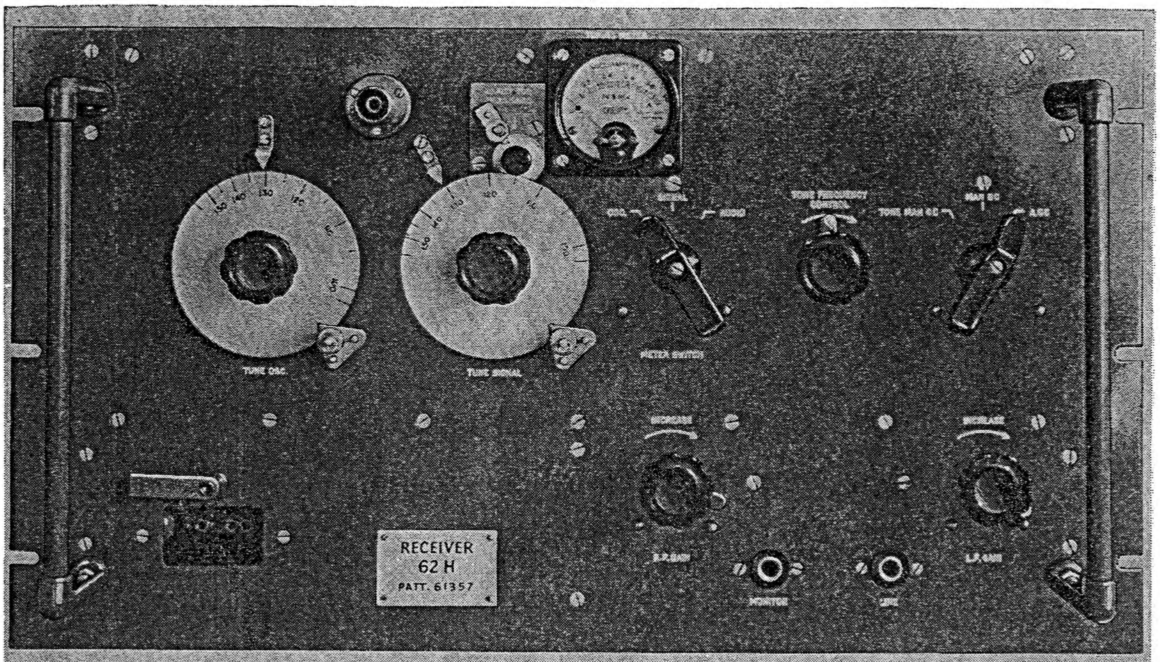


Fig. 1. Receiver 62H

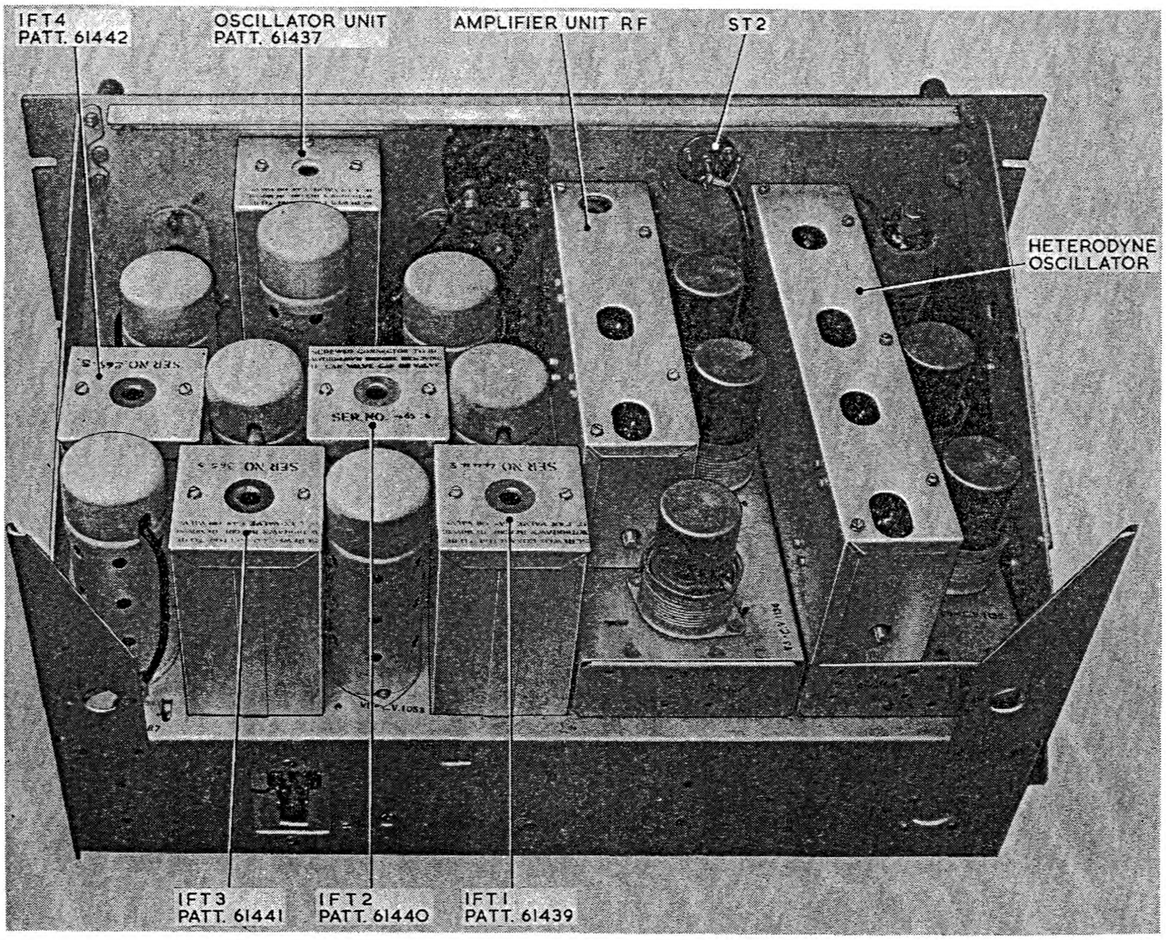


Fig. 2. Top view of chassis

Introduction

1. The Receiver 62H is a VHF ship-borne and ground station VHF receiver, designed for the reception of R/T and CW signals, in the frequency range 100 to 156 Mc/s. The equipment obtains its voltage supplies from power unit Pattern W8356A, which operates from single phase AC supply of 230 volts 50 c/s. The power unit provides 260 volts DC for HT and 6·3 volts at 4·3 amps AC for LT. The power consumption is approximately 60 watts.

2. Receiver 62H is a 15 valve superheterodyne receiver designed for reception in the frequency range 100 to 156 Mc/s. Automatic or manual gain control may be used, and the receiver includes a muting circuit and pulse interference limiter.

Circuit description

Input circuit

3. The input circuit is designed for connection to an unbalanced co-axial feeder cable having a surge impedance of 75 ohms.

Signal frequency amplifier

4. The input circuit is followed by two stages of signal frequency amplification embodying 3 tuned circuits.

Mixer stage

5. Frequency changing is effected by control grid modulation of the mixer valve. The heterodyne oscillator is crystal controlled, the crystal frequency being 1/18th of the desired output frequency less the IF ($F_{XTL} = \frac{Fs - IF}{}$). Frequency multiplication is obtained as follows:—

(1) Crystal oscillator and frequency trebler circuit.

(2) Frequency amplifier stage selecting the 18th harmonic of the crystal frequency at the anode.

(3) A tuned amplifier stage, the output of which is applied to the control grid of the mixer valve.

Intermediate frequency amplifier

6. The intermediate frequency amplifier consists of three amplifying stages. Intermediate circuits have band-pass characteristics and are tuned to a mid-band frequency of 9·72 Mc/s and a nominal bandwidth of 80 kc/s at 6dB down.

Second detector and audio stages

7. Rectification at the output of the IF amplifier is provided by the use of double diode triode valve. The audio frequency component of the rectified current is amplified first by the triode portion of the above valve and then by the output valve. Resistance capacity inter-valve coupling is employed. The output of the amplifier is designed for connection to balanced lines having a surge impedance of 600 ohms. The 600-ohm output of the receiver is jack terminated, provision being made for line and monitoring facilities.

Automatic gain control

8. Delayed amplified automatic gain control is provided using a second double diode triode valve, capacity coupled to the final IF amplifier. The control is designed to be fully operative with an input signal voltage of the order of 10μV at frequencies between 100 to 156 Mc/s. Gain control is provided in the form of additional negative bias to the control grids and the two frequency amplifying valves, and the first and second stages of the IF amplifier.

Beat oscillator

9. A beat oscillator is provided for the reception of unmodulated incoming signals, provision being made for tone adjustment.

Muting circuit

10. A muting or noise suppressor circuit is provided whose function is to mute the receiver in the absence of an incoming carrier. In the presence of an incoming carrier, the muting is automatically removed by the suppressor circuit and the receiver becomes operational. The maximum signal level required to remove the muting is not greater than 6μV.

Pulse limiter circuit

11. For action of this circuit see Part 1, Chapter 1, para. 36. The whole of the remainder of the circuits are identical with that of R.1392D/E.

Constructional details

12. The receiver chassis is of dimensions 19 in. × 12 in. × 10½ in. weighing 35 lbs. The following units replace those detailed in receiver R.1392D in Part 1, Chapter 1, para. 45, in order to increase the intermediate frequency from 4·86 to 9·72 Mc/s.

(1) Amplifier unit R/F 43D Pattern 61436

(2) Oscillator unit Design 7 Pattern 61437

(3) Transformer unit I/F Design 23 Oscillator Pattern 61438

(4) Transformer I/F Design 24 Pattern 61439

(5) Transformer unit I/F Design 25 Pattern 61440

(6) Transformer unit I/F Design 26 Pattern 61441

(7) Transformer unit I/F Design 27 Pattern 61442

13. The following alterations have also been made:—

(1) The fitting of an aerial trimmer, capable of manual control, on the front of the equipment.

(2) The re-positioning of the aerial socket ST2 on the front panel instead of the rear.

(3) The coil HFC4 in the anode circuit of V11, is replaced by a 10K, ¾ watt resistor.

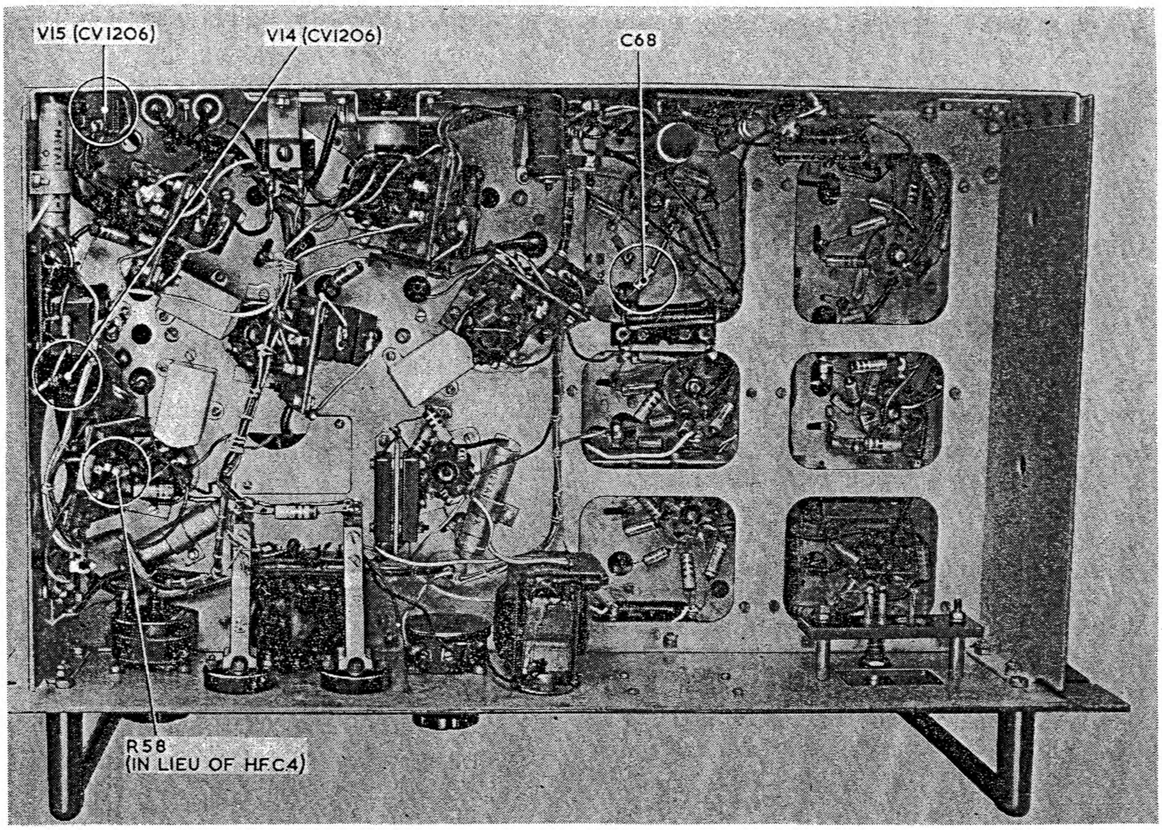


Fig. 3. Underside view of chassis

Adjustment with common aerial working

14. Throughout the instructions the tuning meter will normally be the meter fitted to the receiver, but in cases where this is not visible when tuning the resonator, an AF wattmeter or a pair of telephones on an extension lead may be used.

The receiver should, whenever possible, be warmed up for at least two hours.

(*a*) *Normal method, using signal generator CT378*

(1) Select the receiver to be used and ensure that the C.A.W. junction box socket to which it is connected is suitable for the required frequency. Switch on the CT378.

(2) Disconnect the input connection from the receiver and connect the CT378 to the input socket using connectors A.P.60861 and 60866.

(3) Insert the correct crystal into the receiver, set the oscillator and signal dials to the approximate frequency and set the gain controls to maximum.
Set the gain control switch to TONE MAN. G.C. and the meter switch to OSC.

(4) Adjust the oscillator dial for a dip in the reading in the tuning meter.

(5) Set the meter switch to AUDIO and adjust the signal dial for maximum reading in the tuning meter. The tone frequency control may require adjustment during this operation.
Set the gain control switch to MAN. G.C.

(6) Set the CT378 to the approximate frequency, set to INT A.M., adjust carrier to the correct level, set RF attenuator to X1 microvolt on the coarse scale and to 20 on the fine scale.

(7) Adjust the CT378 frequency control for a maximum reading on the tuning meter, reducing the RF gain of the receiver to keep the reading in the centre of the meter scale.

(8) Reduce the CT378 output to 10 on the fine scale and adjust the CT378 frequency control and all the receiver controls for maximum reading on the tuning meter.

(9) Disconnect the CT378 from the receiver and plug the lead from the resonator into the receiver input socket.

(10) (i) When no other receiver is in use:—
Disconnect the aerial connection from the C.A.W. junction box and plug the CT378 into the aerial socket. Ensure that no other resonators are adjusted to the required frequency.

(ii) When other receivers are in use:—
Remove the connector between the C.A.W. junction box and the required resonator *removing the junction box end first*, and plug the CT378 into the free socket of the resonator.

(11) Increase the receiver gain to maximum. Increase the CT378 output to 20 on the fine scale and adjust the resonator for maximum reading on the tuning meter or the loudest signal in the phones. Adjust the receiver gain as necessary.

(12) Reduce the CT378 output to 10 on the fine scale and readjust the resonator and receiver trimmer for maximum output. Lock the resonator and receiver controls.

(13) Disconnect the CT378 and replace the aerial connection or connector; if the latter, the *resonator end must be connected first*.

Note . . .

Should the receiver not have warmed up for at least two hours, a slight readjustment of the oscillator control on a weak incoming signal may be necessary.

(*b*) *Emergency method, using a transmitter*

Errors may arise by this method due to the excessive strength of the incoming signal and the final adjustment must be done on a received signal. This method must not be used during periods of W/T silence.

(1) Select the receiver to be used and ensure that the C.A.W. junction box socket to which it is connected is suitable for the required frequency.

(2) Insert the correct crystal into the receiver, set the oscillator and signal dials to the approximate frequency and set the gain controls to maximum. Set the gain control switch to TONE MAN G.C. and the meter switch to OSC.

(3) Adjust the oscillator dial for a dip in the reading on the tuning meter. Set the meter switch to AUDIO.

(4) Adjust the signal dial for maximum reading on the tuning meter. Set the meter switch to SIGNAL. Set the gain control to A.G.C.

(5) Set the transmitter on the required frequency and radiate the carrier on the lowest possible power.

(6) Adjust the resonator for maximum dip in the tuning meter. Readjust the receiver dials and the trimmer for maximum dip in the tuning meter.

Lock the resonator and receiver controls.

(7) Switch off the transmitter

PART 2

TECHNICAL INFORMATION (MINOR SERVICING AND ALIGNMENT)

PART 2

TECHNICAL INFORMATION (MINOR SERVICING AND ALIGNMENT)

LIST OF CHAPTERS

Note.—*A list of contents appears at the beginning of each chapter*

CHAPTER 1

MINOR SERVICING, RECEIVERS R.1392A, B, D and E

LIST OF CONTENTS

Valves

1. A table of the valves, and their functions, used in the series of receivers R.1392A, B, D and E is given below:

Valve No.	Function	General Classification	Type
V_1	1st RF amplifier	Pentode	CV1136
V_2	2nd RF amplifier	Pentode	CV1136
V_3	Mixer	Pentode	CV1136
V_4	Crystal oscillator and trebler	Pentode	CV1065
V_5	Frequency multiplier (Crystal freq. $\times$ 18)	Pentode	CV1136
V_6	Buffer amplifier	Pentode	CV1136
V_7	1st IF amplifier	Pentode	CV1053
V_8	2nd IF amplifier	Pentode	CV1053
V_9	3rd IF amplifier	Pentode	CV1053
V_{10}	Beat frequency oscillator	Pentode	CV1935
V_{11}	Detector and AF amplifier	Double-diode-triode	CV587
V_{12}	AGC rectifier and DC amplifier	Double-diode-triode	CV587
V_{13}	AF output stage	Triode	CV1932
V_{14}	Pulse interference limiter	Diode	CV1092
V_{15}	Muting valve	Diode	CV1092

Valve replacements

2. As all valves in the receiver are not readily accessible, the following procedure should be followed when it is required to replace valves in the following units.

Signal amplifier unit (V_1, V_2, V_3)

3. The two RF amplifiers V_1 and V_2, and the mixer valve V_3 are all mounted on the signal amplifier unit sub-assembly. These three valves are all easily removable after the

receiver dust-cover has been taken off by using the simple valve removal tool available for this purpose.

Crystal oscillator and multiplier stages (V_4, V_5, V_6)

4. The crystal oscillator/trebler V_4, the frequency multiplier V_5, and the buffer amplifier V_6 are all mounted on the oscillator unit sub-assembly. The two CV1136 valves, V_5 and V_6, may be removed with the tool mentioned above, whilst V_4, a CV1065, can be pulled from its base in the normal manner.

IF amplifier section (V_7, V_8, V_9, V_{10})

5. The first, second and third IF amplifiers V_7, V_8 and V_9 can be removed in the normal manner after first removing the cap of the valve screening can and then unscrewing the removable insulated grid connector fitted to each IF can. The valve screening can itself is then removed.

6. The beat oscillator V_{10} is removed in a similar manner, the screwed grid connector mounted in the coil chamber being fitted in the same manner as those in the IF transformers. It should be noted that this connector is insulated with plastic sleeving and not Frequentite R ; the two types should not be confused.

Audio and AGC section (V_{11}, V_{12}, V_{13})

7. The detector and AGC amplifier valves V_{11} and V_{12} and the output valve V_{13} can be removed in the normal manner.

Pulse limiter and muting valves (V_{14}, V_{15})

8. The pulse limiter diode V_{14} is situated below the chassis near IFT4, whilst the muting diode V_{15} is located near the AGC valve V_{12} at the rear of the chassis. Great care should be taken when removing these valves from their holders since there is a danger of breaking the glass pinch at the anode connection when lifting the valves from the contacts of the holder.

Unit replacements

Introduction

9. It should be noted that the types of oscillator unit and signal amplifier unit for the various models of the R.1392 are slightly different ; they are then given different type numbers, these numbers being as follows :—

R.1392A and B	Oscillator unit Type 113
	Amplifier unit Type 180
R.1392D	Oscillator unit Type 326
	Amplifier unit Type 451
R.1392E	Oscillator unit Type 329
	Amplifier unit Type 453

The method of mounting these sub-assemblies to the main chassis is identical, and so the following paragraphs on the removal of these units apply to the R.1392A, B, D or E.

10. When, for the purpose of servicing, it is necessary to detach the various units and sub-assemblies of the receiver the following method should be adopted after all valves have been removed :—

(1) The oscillator unit should be removed by withdrawing the six screws fixing it to the chassis. The dial must first be removed and the two leads taking supplies from the chassis, the two connections to the crystal socket, and the output lead must be disconnected.

(2) The signal amplifier unit should be removed in a similar way.

Oscillator unit and amplifier unit

11. (1) Remove valve extractor from rear corner post of the chassis. Remove loose parts of dial clamp and screening cover from tuning unit. (5 screws 6BA).

(2) Slacken 2 grub screws (visible inside tuning unit) securing slow-motion drive to condenser spindle and withdraw complete dial assembly.

(3) Disconnect wire from crystal holder ST1, heater input (green) from C122 (500 pF) and HT input (red) from tag of HFC1.

(4) Identify the polythene insulated wire from tag of variable condenser C14 (to which C67 is connected) in rear of V_6 compartment of oscillator unit, to tagboard and C68 in rear of V_3 compartment of amplifier unit. Disconnect this wire at tagboard in amplifier unit, draw back carefully through chassis hole, and stow in oscillator unit for protection. Similarly stow the wires mentioned in sub-para. (3).

(5) Remove complete oscillator unit from chassis (8 screws 6BA). The anchor pin for the slow-motion drive will not foul the front panel if the front of the unit is swung upwards from the receiver chassis. The amplifier unit may be removed in a similar manner to the oscillator unit.

Note . . .

Wiring in polythene-braided insulation (usually blue) on these and other units must not be replaced by ordinary sleeving, or the performance of the receiver may be impaired.

IF transformer units

12. These should be removed by disconnecting the leads to the terminals projecting through the ½ in. diameter holes in the chassis, then removing the small screens over certain associated leads, and finally withdrawing the four cheese-head screws which hold the transformer to the chassis. The transformers will then come away as units, with the screening covers fixed to the frames. These covers may be removed from the transformer units, either when mounted or unmounted, by undoing the two 6BA cheese-head screws on the top of each can.

13. A number of components in the IF transformers are accessible after removing the screening cans, without taking the units from the chassis.

Beat oscillator Type 165

14. This should be removed complete by disconnecting the three leads under the chassis which are taken into the unit, after first removing the flat screening cover and removing the six bolts which fix the base of the unit to the chassis. Some of the components in the coil chamber of this unit may be replaced, if necessary, by simply removing the screening cover, it being unnecessary to unbolt the whole unit.

IF amplifier, detector and AGC amplifier valve circuit assemblies

15. These should be removed complete by detaching the few leads which take supplies, etc., to these assemblies, and removing the 6BA half-nuts which fix each assembly, with the associated valve screening can base, to the chassis. It will be found that the 6BA screws which fix the sockets to the brackets of each assembly are tapped into the feet of each bracket and locked. This makes it possible to remove the screening can base, and then the complete assembly, as a unit. It is, of course, necessary to remove the valve concerned before attempting to remove any of the valve circuit assemblies.

Meter switch and rectifier unit

16. These two components are mounted on a single bracket fixed by 4BA bolts to the chassis. To renew either the switch or the rectifier, it will be necessary to remove the output valve. The RF gain control should be unfastened from the front panel and withdrawn into the chassis, without unsoldering the leads, sufficiently to allow access to the 4BA nuts with a box spanner. The switch and rectifier unit should then be removed complete, after disconnecting the associated leads.

System switch

17. This is most easily removed by unscrewing with a thin flat spanner the hexagonal nut fixing the switch to its bracket.

18. When fitting a new switch it is important not to omit the locking washer behind the nut, otherwise the switch may work loose in operation. This will be evident before the spindle actually becomes loose, since there is appreciable clearance between the locating peg and its corresponding hole. This rule also applies to the fitting of the meter switch on its bracket.

Voltage measurements

19. The following table shows the approximate voltages using a testmeter Type F (Stores Ref. 10S/1, Avo Model 7), which should exist between the points listed and earth.

Valve	Cathode		Screen	Anode
V_1	1·6		195	135
V_2	1·6		195	135
V_3	0	(no crystal)	150	160
		(with crystal)	195	185
V_4	1·8	(no crystal)	150	200
	1·6-2·0	(with crystal)	140-160	190-210
Measured across R4, not from cathode to chassis.				
V_5	1·7	(no crystal)	—	130
	1·3	(with crystal)	—	150
V_6	1·6		200	130
V_7	2·2		74	195
V_8	2·2		74	195
V_9	3·8		115	188
V_{10}	—		88	38
V_{11}	1·5		—	80
V_{12}	—		—	130
V_{13}	6		—	200

20. In addition, the following voltages are important. AGC negative supply voltage—50 volts (pin 9 of plug P1 and chassis, or across ends of R67). HT supply voltage—250 volts (pins 10 and 9 of plug P1). HT line voltage—200 volts (pin 10 of plug P1 and chassis).

Chapter 2

ALIGNMENT, RECEIVERS R.1392A and B

LIST OF CONTENTS

Introduction

1. In order to align the receiver R.1392A and B, the following test apparatus is required :—

(1) Signal generator Type 12, Stores Ref. 10SB/17, Connector Type 965, Stores Ref. 10H/13501 } (TF390F/4)

OR

Signal generator Type 31, Stores Ref. 10S/66, Power unit Type 139, Stores Ref. 10K/482, Connector Type 965, Stores Ref. 10H/13501 } (TF390G/4)

(2) Output meter, Type 2, Stores Ref. 10S/11934 (TF340)

(3) To check the AF response, a variable-frequency source is required, a suitable instrument and coupling transformer being :—

Oscillator unit Type 25, Stores Ref. 10V/11940 (TF195L)

Transformer Type 309, Stores Ref. 10K/195 (PO.48A, ratio 1-1)

2. Allow the receiver and test apparatus to stabilize over a warming-up period of not less than 10 minutes. Input to the aerial socket of the receiver is from the 14-ohm terminal of signal generator via a resistance of 100 ohms. The RF gain control should be set always at maximum, and the LF gain control set to a suitable level. Adjust output meter to 600 ohms impedance. Test frequencies 999 : 115·02 : 125·1 : 140·13 : 150·12 Mc/s. Crystal frequencies 5280 : 6120 : 6680 : 7515 : 8070 kc/s.

Note . . .

In the following description various references are made to specific valves and components. The location of these valves and components will be made easier by referring to fig. 2 and 5 of Chap. 1, Part 1, and to fig 1, 2, 3 and 4 of Chap. 2, Part 1.

IF alignment

3. To align the IF circuits proceed as follows :—

(1) Remove the muting valve V15 from its holder. Connect the 14-ohm terminal of the signal generator to the control grid of V9 direct.

(2) Apply a signal of 40 mV at 4·86 Mc/s, referred to crystal standards, with 30 per cent modulation at 1,000 c/s. The frequency difference between transmitter and receiver crystals on any channel may be used to calibrate the signal generator accurately at 4·86 Mc/s. Alternatively, a crystal 4·86 Mc/s, inserted in holder

ST1 will provide adequate output to beat against signal generator.

(3) Adjust the cores of IFT4, for peak output, using the screwdriver end of tuning tool (Stores Ref. 10A/13505) (*para.* 15-18).

(4) Detune the signal generator and observe the frequency deviation required on either side of resonance to cause a reduction in output of 1·5 dB. If the frequency deviation on each side of resonance is not the same, re-adjust L14 and L15 by approximately equal amounts, as observed on the output meter, until symmetry of resonance is obtained. The frequency deviation should be about ± 25 kc/s.

(5) Apply a signal of 4 mV at 4·86 Mc/s to the control grid of V8 and adjust IFT3 for peak output. Observe the frequency deviation required on each side of resonance to cause a reduction in output of 3 dB. Re-adjust L12 and L13 by approximately equal amounts until symmetry of resonance is obtained. The frequency deviation should be about ±25 kc/s.

(6) Apply a signal of 400 μV at 4·86 Mc/s to the control grid of V7, and adjust IFT2 for peak output. Observe the frequency deviation required on each side of resonance to cause a reduction in output of 4·5 dB. Re-adjust L10 and L11 by approximately equal amounts until symmetry of resonance is obtained. The frequency deviation should be again about ±25 kc/s.

(7) Identify the wire from tag on variable condenser C14 (to which C67 is also connected in rear of V6 compartment of oscillator unit Type 113) connected to tagboard and C68 in rear of V3 compartment of amplifier unit Type 180. Disconnect this wire at tagboard in amplifier unit and connect the 14-ohm terminal of signal generator to the control grid of V3 via C68.

(8) Apply a signal of 40 μV and adjust IFT1 for peak output. Observe the frequency deviation required on each side of resonance to cause a reduction in output of 6dB. Re-adjust L8 and L9 for symmetry of resonance and check that the final frequency deviation is not less than ±25 kc/s for an attentuation of 6 dB and not more than ±90 kc/s for an attentuation of 60 dB.

(9) Replace muting valve and connection to C68.

Beat oscillator alignment

4. The heterodyne oscillator should be aligned as follows :—

(1) Bring the oscillator into operation by switching the system switch to the TONE MAN. GC position.

(2) Set the TONE FREQUENCY CONTROL to the central position, when the condenser C16 should be at half its maximum value.

(3) Apply a signal of 10 μV at 4·8 Mc/s unmodulated from the 14-ohm terminal of the signal generator via C68 as described in para. 3 sub-para. 7. Then adjust the core of L16 to give zero beat, using the tuning tool. (*para.* 15-18.)

(4) Set the TONE FREQUENCY CONTROL to approximately 1,000 c/s and note the output level. This should be at least three times (+10 dB) the output obtained by applying 30 per cent modulation at 1,000 c/s to the injected signal with the switch turned to MAN. GC.

Crystal oscillator and harmonic amplifier adjustment

5. The sequence is as follows :—

(1) Disconnect chassis end of R7 and insert a milliammeter 0-1 with positive to chassis and remove cover from tuning unit.

(2) During subsequent work, maintain the TUNE SIGNAL dial at the approximate setting of the TUNE OSC. dial.

(3) Insert a crystal 8,070 kc/s in ST1, and set TUNE OSC. and TUNE SIGNAL dials to 150.

(4) Adjust trimmer C4, using hexagon end of tuning tool to give maximum reading on the external milliammeter.

(5) Set meter switch to OSC. and RF GAIN control at maximum.

(6) Identify the tag of variable condenser C11 to which C57 is connected. Connect the 14-ohm terminal of signal generator to this point, via a condenser of 50-100 pF. Apply a signal at 150 Mc/s, modulated 30 per cent at 1,000 c/s, and adjust

the output of the signal generator so that the signal is just audible. As the alignment is improved, the output of the signal generator will need to be reduced.

(7) Adjust trimmers C7, C10, C15 to give maximum audio output, or maximum dip on receiver tuning meter. The signal generator tuning may require slight re-adjustment for maximum output.

(8) Insert a crystal 5,280 kc/s; set both dials at 100 and adjust iron dust core of L4 to give maximum reading on the external milliammeter (*para.* 15-18).

(9) Set signal generator at 100 Mc/s and increase output until the signal is just audible as in (5). If necessary adjust inductance of L5, L6, L7 in turn, to give maximum audio output, or maximum dip on receiver tuning meter. This is accomplished by varying slightly the turn spacing of these coils, using the wedge end, or tweezer action, of tuning tool. The signal generator will require adjustment as in (5) and (6).

Note . . .

Once set by the makers, it is unlikely that L5, L6, L7 will need further adjustment when re-aligning the receiver.

(10) Repeat the above adjustments (2) to (8) until neither set of adjustments affects the other. As the circuits come more closely into line, it is preferable to dispense with the signal generator and to adjust for maximum reading on the external milliammeter and maximum dip on the receiver tuning meter.

(11) Replace cover of tuning unit and secure by centre screw only. Cut sealing film midway between two centre trimmer apertures and turn back the four ends to gain access to trimmers. Repeat (3) and (6) and note final readings on meters. Remove cover and seal trimmers with a small quantity of wax (Philityne, Stores Ref.33C/1084). If not available, sealing wax may be used, but no other substance. Replace cover and check that the original meter readings are repeated, indicating that trimmers have not altered during sealing.

(12) Maximum dip on the tuning meter will now coincide with maximum reading on the external milliammeter at 150 Mc/s and 100 Mc/s. Check that this condition is maintained at 140, 125 and 115 Mc/s (crystal frequencies of 7,515, 6,680 and 6,120 kc/s respectively). A slight error in tracking, shown by a divergence between maximum dip and peak readings on the two meters, may be permitted providing that a dip on the tuning meter of not less than 0·3 mA is obtained at each test frequency. If this is not the case, the condenser alignment will have to be corrected by split end vane adjustment (*para.* 15, 16). V4 grid current may be measured, if desired, by disconnecting chassis end of R2 and inserting milliammeter 0-1 or suitable micro-ammeter.

(13) Check the oscillator unit for stability by rotating TUNE OSC. dial slowly, with crystal absent and meter switch at OSC. noting that no dip is shown on the tuning meter at any setting of dial.

(14) Typical readings are shown in the following table. The valve V5 grid current with crystal removed should not exceed 20μA. The tuning meter, with switch at OSC. is in parallel with a shunt in the anode circuit of V3. The standing current indication, with no crystal, should be 0·65 mA approximately (*para.* 13).

Nominal frequency Mc/s.	Crystal kc/s.	Grid Current, tuned V4 μA	Grid Current, tuned V5 μA	Tuning meter dip with switch at osc. mA
150	8,070	50–80	250–350	0·35–0·45
140	7,515	60–100	250–350	0·35–0·45
125	6,680	80–120	300–400	0·37–0·47
115	6,120	100–150	300–400	0·37–0·47
100	5,280	100–150	300–400	0·4 –0·5

Amplifier unit (signal frequency) alignment

6. The sequence is as follows :—

(1) Remove cover from tuning unit, set meter switch to OSC. and system switch at MAN. GC.

(2) Set the tune signal dial at 150. Insert a crystal 8,070 kc/s in ST1, and tune the oscillator to resonance at calibration of 150 by obtaining maximum dip on tuning meter.

(3) Connect the signal generator to the aerial socket as in para. 2 and apply a signal at 150 Mc/s modulated 30 per cent at 1,000 c/s. Adjust the output of the signal generator so that the signal is just audible. As the alignment is improved, the output of the signal generator will need to be reduced.

(4) Adjust trimmers C1, C6, C12, using hexagon end of tuning tool, to give maximum audio output. The signal generator tuning may require slight re-adjustment.

(5) Insert a crystal, 5,280 kc/s, set TUNE SIGNAL dial at 100, and tune the oscillator for maximum resonance at calibration of 100 by obtaining maximum dip on tuning meter.

(6) Set signal generator at 100 Mc/s and increase output until the signal is just audible as in (3). If necessary, adjust inductance of L1, L2, L3 in turn, to give maximum output. This is accomplished by varying slightly the turn spacing of these coils, using the wedge end of the tuning tool. The signal generator will require re-adjustment as in (4).

Note . . .

Once set by the makers, it is unlikely that L1, L2, L3 will need further adjustment when re-aligning the receiver.

(7) Repeat the above adjustments (1) to (6) until neither set of adjustments affects the other. A signal of 5μV at 150 Mc/s and 100 Mc/s, modulated 30 per cent at 1,000 c/s, should give an output of not less than 1 mW + 15 dB into 600 ohms.

(8) Replace cover of tuning unit and secure by one centre screw only. Cut sealing film at rear of centre trimmer aperture and turn back ends to gain access to trimmers. Apply a signal of 5μV at 150 Mc/s as in (7), adjust C1, C6, C12 to give maximum output and note final reading on output meter. Remove cover and seal trimmers with a small quantity of wax. If not available, sealing wax may be used, but no other substance. Replace cover and check that the original meter readings are repeated, indicating that trimmers have not altered during sealing.

(9) Check that the sensitivity obtained in (7) is maintained at 140, 125 and 115 Mc/s.. If not, and the oscillator unit is known to be correctly aligned as in para. 5, the condenser alignment will have to be corrected by split end vane adjustment (*para* 15, 16).

(10) The amplifier unit should be checked for instability near the minimum capacitance position of the TUNE SIG. control (150 Mc/s) with the crystal removed. This is indicated by a fall of the reading of the tuning meter (set to OSC.) when TUNE OSC. and TUNE SIGNAL controls are rotated. If this is found to be the case, check that the cathode condensers are not defective and that their leads are very short. They should also be placed as near the chassis as practicable.

AGC characteristics

7. The AGC threshold is defined as the input required to produce a dip in the tuning meter reading of 0·1 mA with meter switch at SIGNAL and receiver correctly tuned (*para.* 13).

(1) *Threshold*

Set the system switch at AGC. Connect the signal generator to the aerial socket as in para. 2, and apply an input of 5μV unmodulated at the five test frequencies in para. 2. The difference in reading of the tuning meter, off-tune, with meter switch at SIGNAL should be not less than 0·1 mA.

(2) *AGC noise*

With the equipment set up as in (1) apply an input of 5μV at 99·9 Mc/s unmodulated. Increase the input level by 40 dB (100 times) and check that the output noise level falls not less than 25 dB (18 times). The noise measurements are made by tuning the unmodulated carrier to peak.

(3) *AGC*

With the equipment set up as in (1)

apply a signal of 5 μV at 99·9 Mc/s, modulated 30 per cent at 1,000 c/s, and adjust the AF gain control to provide an output of 1 mW. Increase the input from the signal generator by amounts up to 80 dB (10,000 times). The AF output should not increase more than 6 dB (2 times).

Muting adjustment

8. This circuit must be adjusted so that when the noise or signal input to the receiver aerial socket is less than 3 μV the audio output from the receiver is attenuated, whereas noise or signals above 3 μV produce an unattenuated AF output. The " critical voltage," at which the muting diode commences to conduct and produce AF attenuation, is fixed by the setting of the pre-set IF gain control VR3 mounted on the rear of the chassis.

9. When VR3 is set for maximum output from the receiver only noise or signals below approximately 1 μV will be attenuated, so that the muting circuit is effectively inoperative and there will be a high level of noise output. When VR3 is adjusted to give a lower receiver output, the " critical voltage " will increase and so a higher level of noise and signals received will produce an attenuated output.

10. This test may be performed with the receiver tuned to the normal frequency in use. The procedure for setting-up the muting circuit is as follows :—

(1) Disconnect aerial from the receiver and to the aerial socket connect the signal generator Type 31 using the 14-ohm terminal with a 100-ohm non-inductive resistor in series with it (as in *para.* 2).

(2) Connect output meter Type 2, adjusted to 600-ohm impedance, to the LINE socket of the receiver.

(3) Set the receiver RF and AF gain controls to maximum, system switch to MAN GC. and meter switch to SIGNAL. VR3 should be turned fully counter-clockwise to give maximum output. It will be of assistance to connect a pair of high-resistance telephones to the MONITOR socket of the receiver.

(4) Set the signal generator to the receiver frequency. It should be set to give a 4 μV modulated signal and adjusted so that maximum output is indicated on the output meter.

(5) Using a screwdriver, turn VR3 very slowly in a clockwise direction so that the output is gradually decreased, audibly in the telephones and visually on the output meter. Continue to rotate VR3 until the output of the receiver falls sharply. This will be indicated by the output meter and heard in the decrease of noise in the telephones.

(6) Rotate VR3 very slowly counter-clockwise until the output suddenly rises. The correct setting of VR3 is between these two points and it will be found that the " critical voltage " position of VR3 is easily decided ; the instant when the muting diode V15 has commenced to conduct, producing the rapid attenuation in visual and aural output, is quite obvious.

11. It is possible to adjust VR3 so that the receiver is rendered so insensitive that it does not satisfy the sensitivity requirements. The muting adjustment should not then be carried out unless the proper equipment is available to check the sensitivity after the muting adjustment has been made.

AF response checking

12. The method detailed below is arranged to check the overall fidelity of the receiver.

(1) Set the system switch at AGC. Connect the signal generator to the aerial socket as in para. 2, and apply an input of 1,000 μV at 99·9 Mc/s unmodulated. Tune for maximum dip on tuning meter, with meter switch at SIGNAL.

(2) Couple the oscillator unit Type 25, by means of transformer Type 309, for external modulation of the signal generator. Set the output switch of the oscillator unit at 600 ohms, and set the frequency at 1,000 c/s. Ascertain, from the A.P. or handbook issued with the signal generator, the voltage required for 30 per cent modulation, and adjust the OUTPUT CONTROL of oscillator to provide this voltage.

(3) Adjust the AF gain control of the receiver to provide an output of 10 mW.

(4) Vary the modulation frequency, keeping the modulation depth constant at 30 per cent and find the peak frequency and output, usually between 700 and 1,000 c/s. The attenuation from this peak at frequencies of 300 and 3,000 c/s should be not greater than 6 dB.

(5) The extended frequency response should satisfy the limits given below, relative to the level at 1,000 c/s.

Modulation frequency c/s	120	5000	7000
Attenuation dB	Not less than 10	Not less than 20	Not less than 30

(6) If the output control of oscillator does not provide smooth control at low frequencies, connect a loading resistor of 500 to 700 ohms across oscillator output terminals, and repeat whole sequence of test.

13. The pre-set control VR4 at the rear of the tuning meter is set by the makers so that the combined resistance of meter and control is approximately 200 ohms to enable meters of different internal resistance to be used with the same shunts (R25, R57). The adjustment should not be disturbed, but if it is suspected, or if it becomes necessary to replace the tuning meter, it may be checked as follows :—

(1) Stand receiver in normal position, with front panel vertical. Set meter switch at OSC., system switch at TONE MAN. GC. and RF GAIN control at maximum.

(2) With no crystal in circuit, the tuning meter should read 0·65 mA. If a reading is found below 0·6 or above 0·7 mA, adjust VR4 and seal with a small quantity of wax or sealing wax.

Typical performance characteristics

14. In making the measurements which follow, generator leakage was balanced out at each frequency by placing the signal generator output lead in such a position that no signal was heard in the headphones when the signal generator gave a nominal zero output. The signal generator was made to represent a resistive source of 100 ohms. Tuning meter, with switch at SIGNAL, is in parallel with a shunt in anode circuit of V7. The standing meter current with system switch at AGC and no signal is 0·7 to 0·8 mA.

	System switch at	Man. GC	AGC	
Signal frequency Mc/s	Crystal frequency kc/s	Sensitivity. Input for signal/noise = 20 dB. µV	AGC threshold (para. 6) µV	Tuning meter dip with switch at SIGNAL, for input of 5 µV mA
150	8,070	3·0	2·0	0·3
140	7,515	3·0	2·0	0·35
125	6,680	3·5	2·5	0·4
115	6,120	4·0	2·5	0·35
100	5,280	4·5	3·0	0·25

Note . . .

Some receivers have sensitivities up to 10µV for signal/noise = 20 dB, and AGC threshold up to 5 µV.

Variable condensers and circuit alignment

15. The variable condenser assemblies incorporated in the crystal harmonic amplifier and signal amplifier units consist of individual variable condensers, mechanically ganged by means of self-aligning flexible couplings designed to eliminate angular rotational errors. The condensers are accurately matched to 0·25 pF at six angular positions, after being ganged together mechanically at the maximum capacity position.

16. The alignment of the circuits of the receiver can be carried out as previously described. It is recommended, however, that the adjustment of the variable condensers and the alignment of the signal amplifier circuits is only attempted by a competent technician. In most cases it will be far preferable to fit a new unit complete.

17. The 1st multiplier, IF transformer and beat oscillator employ iron dust cores controlling inductances L4. These cores will only need re-setting if an associated component is replaced, or during general re-alignment. ~~The cores are unthreaded, and have a single fluting~~ in which is cemented a combined elastic and silk filament. When in use the coil former compresses and forms a thread on the surface of the filament which serves to locate and retain in position the iron dust core. Since the surface area of the thread is small, care must be taken not to exert excessive end pressure when using the screwdriver end of the tuning tool, or the core may be displaced one or more complete threads or forced right through the former. In the case of L4, should this happen and the core is displaced considerably, it is preferable to screw right through and re-insert at the nearer end of the former rather than attempt to unscrew for a long distance against tool pressure. The space available in ~~the other units will not permit this procedure without dismantling, hence the need for care.~~

18. An earlier type of iron dust core may be found in use. This is threaded and may be recognized in position by the presence of a white filler preparation around the core. This preparation fills the clearance between the thread on the core and that in the former. Its stability is such that the settings are maintained under all working conditions, but after some time it sets fairly firmly making adjustment difficult. If it is necessary to re-set any of these cores, it is advisable to warm each core with a narrow soldering-iron bit, so shaped that it will enter the adjusting slot, since the dust cores are rather brittle. If this is made about 4 in. long, and not more than $\frac{3}{16}$ in. diameter, it will not be too hot when fitted to the usual 40 or 80 watt soldering-iron heater. The cores should then be adjusted with the appropriate tool. All replacement cores should be of the unthreaded type as in para. 17, irrespective of the type found to be in use.

AL 10

Chapter 3

ALIGNMENT, RECEIVERS R.1392D AND E

LIST OF CONTENTS

Introduction

1. In order to align the receiver R.1392D and E, the following test apparatus is required:—

(1) Signal generator Type 12, Stores Ref. 10SB/17; Connector Type 965, Stores Ref. 10H/13501 (TF390F/4)

or

Signal generator Type 31, Stores Ref. 10S/66; Power unit Type 139, Stores Ref. 10K/482; Connector Type 965, Stores Ref. 10H/13501 (TF390G/4)

(2) Output meter, Type 2, Stores Ref. 10S/11934 (TF340)

(3) To check the AF response, a variable-frequency source is required, a suitable instrument and coupling transformer being:—
Oscillator unit Type 25, Stores Ref. 10V/11940 (TF195L)
Transformer Type 309, Stores Ref. 10K/195 (PO.48A, ratio 1-1).

2. Allow the receiver and test apparatus to stabilize over a warming up period of not less than 10 minutes. Input to the aerial socket of the receiver is from the 14-ohm terminal of the signal generator via a resistance of 100-ohms. The RF gain control should be set always at maximum, and the LF gain control set to a suitable level. Adjust output meter to 600 ohms impedance. Test frequencies 999: 115·02: 125·1: 140·13: 150·12: 156 Mc/s. Crystal frequencies 5280: 6120: 6680: 7515: 8070: 8400 kc/s.

Note . . .

In the following description various references are made to specific valves and components. The location of these valves and components will be made easier by referring to fig. 1 to 7 of Chap. 1, Part 1.

IF alignment

3. To align the IF circuits proceed as follows:—

(1) Remove the muting valve V15 from its holder. Connect the 14-ohm terminal of the signal generator to the control grid of V9 direct.

(2) Apply a signal of 40 mV at 4·86 Mc/s, referred to crystal standards, with 30 per cent modulation at 1,000 c/s. The frequency difference between transmitter and receiver crystals on any channel may be used to calibrate the signal generator accurately at 4·86 Mc/s. Alternatively, a crystal, 4·86 Mc/s, inserted in holder ST1 will provide adequate output to beat against signal generator.

(3) Adjust the cores of IFT4 for peak output, using the screwdriver end of tuning

tool, Stores Ref. 10A/13505 (*para.* 15-18).

(4) Detune the signal generator and observe the frequency deviation required on either side of resonance to cause a reduction in output of 1·5 dB. If the frequency deviation on each side of resonance is not the same, readjust L14 and L15 by approximately equal amounts, as observed on the output meter, until symmetry of resonance is obtained. The frequency deviation should be about ± 25 kc/s.

(5) Apply a signal of 4 mV at 4·86 Mc/s to the control grid of V8 and adjust IFT3 for peak output. Observe the frequency deviation required on each side of resonance to cause a reduction in output of 3 dB. Readjust L12 and L13 by approximately equal amounts until symmetry of resonance is obtained. The frequency deviation should be about ± 25 kc/s.

(6) Apply a signal of 400 µV at 4·86 Mc/s to the control grid of V7, and adjust IFT2 for peak output. Observe the frequency deviation required on each side of resonance to cause a reduction in output of 4·5 dB. Re-adjust L10 and L11 by approximately equal amounts until symmetry of resonance is obtained. The frequency deviation should be again about ± 25 kc/s.

(7) Identify the wire from tag on variable condenser C14 (to which C67 is also connected in rear of V6 compartment of oscillator unit Type 326 or 329) connected to tagboard and C68 in rear of V3 compartment of amplifier unit Type 451 or 453. Disconnect this wire at tagboard in amplifier unit and connect the 14-ohm terminal of signal generator to the control grid of V3 via C68.

Note . . .

As stated in Part 2, Chap. 1, para. 9, the oscillator and signal frequency amplifier sub-assemblies for R.1392D and R.1392E, respectively, have different serial numbers. Amplifier unit Type 451 and oscillator unit Type 326 are used in the R.1392D, whilst the R1392E uses amplifier unit Type 453 and oscillator unit Type 329.

(8) Apply a signal of 40µV and adjust IFT1 for peak output. Observe the frequency deviation required on each side of resonance to cause a reduction in output of 6 dB. Re-adjust L8 and L9 for symmetry of resonance and check that the final frequency deviation is not less than ± 25 kc/s for an attenuation of 6 dB and not more than ± 90 kc/s for an attenuation of 60 dB.

(9) Replace muting valve and connection to C68.

Beat oscillator alignment

4. The heterodyne oscillator should be aligned as follows:—

(1) Bring the oscillator into operation by switching the system switch to the TONE MAN. GC position.

(2) Set the TONE FREQUENCY CONTROL to the central position, when the condenser C16 should be at half its maximum value.

(3) Apply a signal of 10µV at 4·8 Mc/s unmodulated from the 14-ohm terminal of the signal generator via C68 as described in para. 3, sub-para. 7. Then adjust the core of L16 to give zero beat, using the tuning tool (*para.* 15-18).

(4) Set the TONE FREQUENCY CONTROL to approximately 1,000 c/s and note the output level. This should be at least three times (+ 10 dB) the output obtained by applying 30 per cent. modulation at 1,000 c/s to the injected signal with the switch turned to MAN. GC.

Crystal oscillator and harmonic amplifier adjustment

5. The sequence is as follows:—

(1) Disconnect chassis end of R7 and insert a milliammeter 0-1 with positive to chassis and remove cover from tuning unit.

(2) During subsequent work, maintain the TUNE SIGNAL dial at the approximate setting of the TUNE OSC. dial.

(3) Insert a crystal 8·070 kc/s in ST1, and set TUNE OSC. and TUNE SIGNAL dials to 150.

(4) Adjust trimmer C4, using hexagon end of tuning tool to give maximum reading on the external milliammeter.

(5) Set meter switch to OSC. and RF GAIN CONTROL at maximum.

(6) Identify the tag of variable condenser C11 to which C57 is connected. Connect

the 14-ohm terminal of signal generator to this point via a condenser of 50-100 pF. Apply a signal at 150 Mc/s, modulated 30 per cent at 1,000 c/s, and adjust the output of the signal generator so that the signal is just audible. As the alignment is improved, the output of the signal generator will need to be reduced.

(7) Adjust trimmers C7, C10, C15 to give maximum audio output, or maximum dip on receiver tuning meter. The signal generator tuning may require slight re-adjustment for maximum output.

(8) Insert a crystal 5,280 kc/s ; set both dials at 100 and adjust iron dust core of L4 to give maximum reading on the external milliammeter (*para.* 15-18).

(9) Set signal generator at 100 Mc/s and increase output until the signal is just audible as in (5). If necessary, adjust inductance of L5, L6, L7 in turn to give maximum audio output, or maximum dip on receiver tuning meter. This is accomplished by varying slightly the turn spacing of these coils, using the wedge end, or tweezer action, of tuning tool. The signal generator will require adjustment as in (5) and (6).

Note . . .

Once set by the makers, it is unlikely that L5, L6, L7 will need further adjustment when re-aligning the receiver.

(10) Repeat the above adjustments (2) to (8) until neither set of adjustments affects the other. As the circuits come more closely into line, it is preferable to dispense with the signal generator and to adjust for maximum reading on the external milliammeter and maximum dip on the receiver tuning meter.

(11) Replace cover of tuning unit and secure by centre screw only. Cut sealing film midway between two centre trimmer apertures, and turn back the four ends to gain access to trimmers. Repeat (3) and (6) and note final readings on meters. Remove cover and seal trimmers with a small quantity of wax (Philityne, Stores Ref. 33C/1084). If not available, sealing wax may be used but no other substance. Replace cover and check that the original meter readings are repeated, indicating that trimmers have not altered during sealing.

(12) Maximum dip on the tuning meter will now coincide with maximum reading on the external milliammeter at 150 Mc/s and 100 Mc/s. Check that this condition is maintained at 140, 125 and 115 Mc/s (crystal frequencies of 7,515, 6,680 and 6,120 kc/s respectively). A slight error in tracking, shown by a divergence between maximum dip and peak readings on the two meters, may be permitted providing that a dip on the tuning meter of not less than 0·3 mA is obtained at each test frequency. If this is not the case, the condenser alignment will have to be corrected by split end vane adjustment (*para.* 15-16). V4 grid current may be measured, if desired, by disconnecting chassis end of R2, and inserting milliammeter O-1 or suitable microammeter.

(13) Check the oscillator unit for stability by rotating TUNE OSC. dial slowly, with crystal absent and meter switch at OSC., noting that no dip is shown on the tuning meter at any setting of dial.

(14) Typical readings are shown in the table below. The valve V5 grid current with crystal removed should not exceed 20 μA. The tuning meter with switch at OSC. is in parallel with a shunt in the anode circuit of V3. The standing current indication with no crystal should be 0·65 mA approximately (*para.* 13).

Nominal frequency Mc/s.	Crystal kc/s.	Grid current, tuned V4 μA	V5 μA	Tuning meter dip with switch at osc. mA
156	8,400	50–80	250–350	0·34–0·44
150	8,070	50–80	250–350	0·35–0·45
140	7,515	60–100	250–350	0·35–0·45
125	6,680	80–120	300–400	0·37–0·47
115	6,120	100–150	300–400	0·37–0·47
100	5,280	100–150	300–400	0·4 –0·5

Amplifier unit (signal frequency) alignment

6. The sequence is as follows:—

(1) Remove cover from tuning unit, set meter switch to OSC. and system switch at MAN. GC.

(2) Set the tune signal dial at 150. Insert a crystal 8,070 kc/s in ST1, and tune the oscillator to resonance at calibration of 150, by obtaining maximum dip on tuning meter.

(3) Connect the signal generator to the aerial socket as in para. 2 and apply a signal at 150 Mc/s, modulated 30 per cent, at 1,000 c/s. Adjust the output of the signal generator so that the signal is just audible. As the alignment is improved, the output of the signal generator will need to be reduced.

(4) Adjust trimmers C1, C6, C12, using hexagon end of tuning tool, to give maximum audio output. The signal generator tuning may require slight re-adjustment.

(5) Insert a crystal, 5,280 kc/s, set TUNE SIGNAL dial at 100, and tune the oscillator for maximum resonance at calibration of 100 by obtaining maximum dip on tuning meter.

(6) Set signal generator at 100 Mc/s and increase output until the signal is just audible as in (3). If necessary, adjust inductance of L1, L2, L3 in turn, to give maximum output. This is accomplished by varying slightly the turn spacing of these coils, using the wedge end of the tuning tool. The signal generator will require re-adjustment as in (4).

Note . . .

Once set by the makers, it is unlikely that L1, L2, L3 will need further adjustment when re-aligning the receiver.

(7) Repeat the above adjustments (1) to (6) until neither set of adjustments affects the other. A signal of 5 μV at 150 Mc/s and 100 Mc/s, modulated 30 per cent at 1,000 c/s, should give an output of not less than 1 mW + 15 dB into 600 ohms.

(8) Replace cover of tuning unit and secure by one centre screw only. Cut sealing film at rear of centre trimmer aperture and turn back ends to gain access to trimmers. Apply a signal of 5 μV at 150 Mc/s as in (7), adjust C1, C6, C12 to give maximum output and note final reading on output meter. Remove cover and seal trimmers with a small quantity of wax. If not available, sealing wax may be used, but no other substance. Replace cover and check that the original meter readings are repeated, indicating that trimmers have not altered during sealing.

(9) Check that the sensitivity obtained in (7) is maintained at 140, 125 and 115 Mc/s. If not, and the oscillator unit is known to be correctly aligned as in para. 5, the condenser alignment will have to be corrected by split end vane adjustment (*para.* 15, 16).

(10) The amplifier unit should be checked for instability near the minimum capacitance position of the TUNE SIG. control (150 Mc/s) with the crystal removed. This is indicated by a fall of the reading of the tuning meter (set to OSC.) when the TUNE OSC. and TUNE SIGNAL controls are rotated. If this is found to be the case, check that the cathode condensers are not defective and that their leads are very short. They should also be placed as near the chassis as practicable.

AGC characteristics

7. The AGC threshold is defined as the input required to produce a dip in the tuning meter reading of 0·1 mA, with meter switch at SIGNAL and receiver correctly tuned (*para.* 13).

(1) *Threshold*
Set the system switch at AGC. Connect the signal generator to the aerial socket as in para. 2, and apply an input of 5μV unmodulated at the five test frequencies in para. 2. The difference in reading of the tuning meter, off-tune, with meter switch at SIGNAL should be not less than 0·1 mA.

(2) *AGC noise*
With the equipment set up as in (1) apply an input of 5μV at 99·9 Mc/s unmodulated. Increase the input level by 40 dB (100 times) and check that the output noise level falls not less than 25 dB (18 times). The noise measurements are made by tuning the unmodulated carrier to peak.

(3) *AGC*
With the equipment set up as in (1) apply a signal of 5μV at 99·9 Mc/s, modulated 30 per cent at 1,000 c/s, and adjust

the AF gain control to provide an output of 1 mW. Increase the input from the signal generator by amounts up to 80 dB (10,000 times). The AF output should not increase more than 6 dB (2 times).

Muting adjustment

8. This circuit must be adjusted so that when the noise or signal input to the receiver aerial socket is less than 3µV the audio output from the receiver is attenuated, whereas noise or signals above 3µV produce an unattenuated AF output. The "critical voltage," at which the muting diode commences to conduct and produce AF attenuation, is fixed by the setting of the pre-set IF gain control VR3 mounted on the rear of the chassis.

9. When VR3 is set for maximum output from the receiver only, noise or signals below approximately 1µV will be attenuated, so that the muting circuit is effectively inoperative and there will be a high level of noise output. When VR3 is adjusted to give a lower receiver output, the "critical voltage" will increase and so a higher level of noise and signals received will produce an attenuated output.

10. This test may be performed with the receiver tuned to the normal frequency in use. The procedure for setting up the muting circuit is as follows :—

(1) Disconnect aerial from the receiver and to the aerial socket connect the signal generator Type 31 using the 14-ohm terminal with a 100-ohm non-inductive resistor in series with it (*as in para.* 2).

(2) Connect output meter Type 2, adjusted to 600 ohms impedance, to the LINE socket of the receiver.

(3) Set the receiver RF and AF gain controls to maximum, system switch to MAN. GC. and meter switch to SIGNAL. VR3 should be tuned fully counter-clockwise to give maximum output. It will be of assistance to connect a pair of high-resistance telephones to the MONITOR socket of the receiver.

(4) Set the signal generator to the receiver frequency. It should be set to give a 4µV modulated signal and adjusted so that maximum output is indicated on the output meter.

(5) Using a screwdriver, turn VR3 very slowly in a clockwise direction so that the output is gradually decreased, audibly in the telephones and visually on the output meter. Continue to rotate VR3 until the output of the receiver falls sharply. This will be indicated by the output meter and heard in the decrease of noise in the telephones.

(6) Rotate VR3 very slowly counter-clockwise until the output suddenly rises. The correct setting of VR3 is between these two points and it will be found that the "critical voltage" position of VR3 is easily decided ; the instant when the muting diode V15 has commenced to conduct, producing the rapid attenuation in visual and aural output, is quite obvious.

11. It is possible to adjust VR3 so that the receiver is rendered so insensitive that it does not satisfy the sensitivity requirements. The muting adjustment should not, then, be carried out unless the proper equipment is available to check the sensitivity after the muting adjustment has been made.

AF response checking

12. The method detailed below is arranged to check the overall fidelity of the receiver.

(1) Set the system switch at AGC. Connect the signal generator to the aerial socket as in para. 2, and apply an input of 1,000 µV at 99·9 Mc/s unmodulated. Tune for maximum dip on tuning meter with meter switch at SIGNAL.

(2) Couple the oscillator unit Type 25, by means of transformer Type 309, for external modulation of the signal generator. Set the output switch of the oscillator unit at 600 ohms, and set the frequency at 1,000 c/s. Ascertain, from the A.P. or handbook issued with the signal generator the voltage required for 30 per cent modulation, and adjust the OUTPUT CONTROL of oscillator to provide this voltage.

(3) Adjust the AF gain control of the receiver to provide an output of 10 mW.

(4) Vary the modulation frequency, keeping the modulation depth constant at 30 per cent, and find the peak frequency and output, usually between 700 and 1,000 c/s. The attenuation from this peak at

frequencies of 300 and 3,000 c/s should not be greater than 6 dB.

(5) The extended frequency response should satisfy the limits given below, relative to the level at 1,000 c/s.

(6) If the output control of oscillator does not provide smooth control at low frequencies, connect a loading resistor of 500 to 700 ohms across oscillator output terminals and repeat whole sequence of test.

Modulation frequency c/s	120	5000	7000
Attenuation dB	Not less than 10	Not less than 20	Not less than 30

13. The pre-set control VR4 at the rear of the tuning meter is set by the makers so that the combined resistance of meter and control is approximately 200 ohms to enable meters of different internal resistance to be used with the same shunts (R25, R57). The adjustment should not be disturbed, but if it is suspected, or if it becomes necessary to replace the tuning meter, it may be checked as follows:—

(1) Stand receiver in normal position, with front panel vertical. Set meter switch at OSC., system switch at TONE MAN. GC. and RF gain control at maximum.

(2) With no crystal in circuit, the tuning meter should read 0·65 mA. If a reading is found below 0·6 or above 0·7 mA, adjust VR4 and seal with a small quantity of wax or sealing wax.

Typical performance characteristics

14. In making the measurements below, generator leakage was balanced out at each frequency by placing the signal generator output lead in such a position that no signal was heard in the headphones when the signal generator gave a nominal zero output. The signal generator was made to represent a resistive source of 100 ohms. Tuning meter, with switch at SIGNAL, is in parallel with a shunt in anode circuit of V7. The standing meter current with system switch at AGC and no signal is 0·7 to 0·8 mA.

Note . . .

Some receivers have sensitivities up to 10 μV for signal noise = 20 dB, and AGC threshold up to 5 μV.

Variable condensers and circuit alignment

15. The variable condenser assemblies incorporated in the crystal harmonic amplifier and signal amplifier units consist of individual variable condensers, mechanically ganged by means of self-aligning flexible couplings, designed to eliminate angular rotational errors. The condensers are accurately matched to 0·25 pF at six angular positions, after being ganged together mechanically at the maximum capacity position.

16. The alignment of the circuits of the receiver can be carried out as previously described. It is recommended, however, that the adjustment of the variable condensers and the alignment of the signal amplifier circuits is only attempted by a competent technician. In most cases it will be far preferable to fit a new unit complete.

17. The 1st multiplier, IF transformer and beat oscillator employ iron dust cores controlling inductances L4. These cores will only need resetting if an associated component is replaced, or during general realignment. ~~The cores are unthreaded, and have a single fluting in which is cemented a combined elastic and silk filament. When in use the coil former compresses and forms a thread on the surface of the filament which serves to locate and retain in position the iron dust core. Since the surface area of the thread is small, care must be taken not to exert excessive end pressure when using the screwdriver end of the tuning tool, or the core may be displaced one or more complete~~

System switch at Signal frequency Mc/s	Crystal frequency kc/s	MAN. GC Sensitivity. Input for Signal/Noise = 20 dB. μV	AGC AGC threshold (refer para. 6) μV	Tuning meter dip with switch at SIGNAL, for input of 5 μV mA.
156	8,400	3·0	2·0	0·3
150	8,070	3·0	2·0	0·3
140	7,515	3·0	2·0	0·35
125	6,680	3·5	2·5	0·4
115	6,120	4·0	2·5	0·35
100	5,280	4·5	3·0	0·25

threads or forced right through the former. In the case of L4, should this happen and the core is displaced considerably, it is preferable to screw right through and re-insert at the nearer end of the former rather than attempt to unscrew for a long distance against tool pressure. The space available in the other units will not permit this procedure without dismantling, hence the need for care.

18. An earlier type of iron dust core may be found in use. This is threaded and may be recognized in position by the presence of a white filler preparation around the core. This preparation fills the clearance between the thread on the core and that in the former. Its stability is such that the settings are maintained under all working conditions but after some time it sets fairly firmly making adjustment difficult. If it is necessary to re-set any of these cores, it is advisable to warm each core with a narrow soldering-iron bit, so shaped that it will enter the adjusting slot, since the dust cores are rather brittle. If this is made about 4-in. long, and not more than $\frac{3}{16}$-in. diameter, it will not be too hot when fitted to the usual 40 or 80 watt soldering-iron heater. The cores should then be adjusted with the appropriate tool. All replacement cores should be of the unthreaded type as in para. 17, irrespective of the type found to be in use.

AL 11

Chapter 4

ALIGNMENT OF RECEIVER 62 H

ERRATA

In the circuit, fig. 1, insert "L2" against the inductor immediately to the left of and slightly below R13. (The inductor referred to is tuned by C5 and C6 and is in the grid circuit of V2). Amend the labelling of the capacitor immediately to the right of C43 from "CT" to "C7". (The capacitor referred to is across the inductor L5 in the anode circuit of V5).

Chapter 4

ALIGNMENT OF RECEIVER 62 H

LIST OF CONTENTS

LIST OF TABLES

ILLUSTRATION

Introduction

1. In order to align the receiver 62H the following test apparatus is required:—

(1) Signal generator CT218, 10S/86780 *or* Test oscillator CT212, ZD.00784 *or* Signal generator A.P.54704.

(2) Output meter A.P.54708 *or* Wattmeter, absorption A.F. CT.44, ZD.02417 *or* Decibel meter No. 3, ZD.02970.

(3) Noise generator CT207, A.P.63451 (see remarks at end of para. 5) *or* Signal generator A.P.54705 and 56 ohms resistor *or* Test oscillator CT378.

(4) Crystal, 9·72 Mc/s or 4·86 Mc/s.

(5) Meter, about 1mA F.S.D.

Note . . .
Before carrying out any alignment the receiver must be switched on for four hours.

IF alignment

2. (1) Remove the muting valve V15.

(2) Apply a signal of 20mV at 9·72 Mc/s with 30 per cent modulation at 1,000 c/s to the control grid of V9. (A 9·72 Mc/s crystal inserted in the holder ST1 on the receiver will provide adequate output to beat against the signal generator, zero beat providing a crystal check point at 9·72 Mc/s. "Resonance" in subsequent steps of the paragraph refers to this crystal check-point.)

Note . . .
The setting of the centre frequency (9·72 Mc/s) of the I.F. is of extreme importance in the alignment of this receiver.

(3) Adjust the cores of IFT4 (L14 and L15) for peak output.

(4) Detune the signal generator, observing the frequency deviation required either side of resonance for a fall in output of 1·5dB. If the deviation either side of resonance is not the same, readjust the cores by equal amounts (as observed on the output meter), until symmetrical curves about the resonant frequency are obtained. The frequency deviation should be approximately ±45 kc/s.

(5) Apply a signal of 4mV at 9·72 Mc/s to the control grid of the V8 and adjust the cores of IFT3 (L12 and L13) for maximum output. Observe the frequency deviation either side of resonance to cause a 3dB reduction in output. Readjust the cores until symmetrical curves about the resonant frequency are obtained. The frequency deviation should be approximately ±45 kc/s.

(6) Apply a signal of 400μV at 9·72 Mc/s to the control grid of V7 and adjust the cores of IFT2 (L10 and L11) for maximum output. Observe the frequency deviation required for either side of resonance to cause a 4·5dB reduction in output. Readjust the cores of the transformer until symmetrical curves about the resonant frequency are obtained. The frequency deviation should be about ±45 kc/s.

(7) Disconnect the condenser C68 from the anode of V6 and apply a 40μV signal at 9·72 Mc/s via this condenser to the control grid of V3, and adjust the cores of IFT1 (L8 and L9) for maximum output. Observe the frequency deviation on either side of resonance to cause a reduction in output of 6dB. Readjust if necessary the transformer cores to obtain symmetrical curves about the resonant frequency, and check that the final frequency deviation is not less than ±41 kc/s at 6dB down and not more than ±160 kc/s at 60dB down. See also Chap. 6 for measurement of bandwidth and centre frequency.

Note . . .

On no account should the alignment of the I.F. transformers be continued by "peaking" the circuits.

(8) Replace the muting valve V15 and reconnect condenser C68 to the anode of V6.

Heterodyne oscillator alignment

3. (1) Set the system switch of the receiver to the TONE MAN GC position. Remove V15 and disconnect condenser C68 from V6 anode. Apply an unmodulated input of 100μV at exactly 9·72 Mc/s via C68 to the grid circuit of V3 (use the 9·72 Mc/s crystal provided, inserted in holder ST1, which will provide an adequate output to beat against the signal generator).

(2) Set the TONE FREQUENCY CONTROL to the central position. Check that the zero beat of the signal generator coincides with the mid-point setting of the TONE FREQUENCY CONTROL. If this is not the case, slightly adjust the core of L16.

(3) Set the TONE FREQUENCY CONTROL to approximately 1,000 cycles and adjust the LF GAIN control of the receiver to provide an output of 1mW + 10dB (10mW) in 600 ohms.

(4) Switch the system switch of the receiver to the MAN GC position and modulate the signal at 30 per cent modulation at 1,000 cycles. Check that the output level falls by approximately 8dB.

(5) Switch the receiver METER SWITCH to AUDIO, check that the reading of the tuning meter is between 0·45 and 0·60mA when an output level of 1mW + 20dB into 600 ohms is obtained in the external output meter. Replace V15 and reconnect condenser C68 to the anode of V6.

Crystal oscillator and harmonic amplifier adjustment

4. (1) Disconnect the chassis end of R7 and insert a 0—1 milliammeter with positive terminal to chassis and negative to resistor, and remove the cover from the tuning unit.

(2) Insert a 7810 kc/s crystal into the holder ST1 and set TUNE SIGNAL and TUNE OSC. dials to 150·3 Mc/s. Tune receiver to resonance.

(3) Adjust trimmer C4 for maximum reading on milliammeter.

(4) Set METER SWITCH to OSC. and turn R.F. GAIN control fully clockwise.

(5) Apply a signal of 150·3 Mc/s modulated at 30 per cent at 1,000 cycles and adjust the output level of the signal generator so

that the signal is just audible. As the alignment is improved the output of the signal generator must be reduced.

(6) Adjust the trimmers C7, C10 and C15 to give maximum audio output or for maximum dip in the receiver tuning meter.

(7) Insert a 5070 kc/s crystal into the holder ST1 and set the TUNE SIGNAL and TUNE OSC. dials to 100·98 Mc/s. Adjust L4 to give maximum reading on the milliammeter.

(8) Apply a signal of 100·98 Mc/s and increase the output level of the signal generator until the signal is just audible. Readjust L5, L6 and L7 to give maximum dip on the receiver tuning meter.

(9) Repeat the above adjustments (3) to (8) until neither set of adjustments affects the other.

(10) Maximum dip on the tuning meter should now coincide with the maximum reading on the milliammeter on 150·3 and 100·98 Mc/s. Check that this condition is maintained at 139·5, 122·22 and 116·28 Mc/s (crystal frequencies of 7210, 6250 and 5920 kc/s respectively) and that a dip of at least 0·2mA is obtained.

(11) Check the receiver oscillator units for stability, by removing the crystal from the holder ST1, switching the METER SWITCH to OSC., and rotating the TUNE OSC. dial slowly. Note that no dip is shown on the tuning meter on any setting of the dial.

Note . . .
If, when carrying out step (3) of this paragraph, any dip at all is detectable on the tuning meter as C4 is adjusted, the crystal oscillator and harmonic amplifiers are only slightly misaligned and the tuning meter may be used for realignment throughout, i.e. a signal generator is not required.

Amplifier unit alignment

5. (1) Remove the cover from the tuning unit, set the receiver METER SWITCH to OSC., the system switch to MAN G.C., and R.F. GAIN control to maximum.

(2) Set the TUNE SIGNAL dial to approximately 150·3 Mc/s, insert the 7810 kc/s crystal into the holder ST1 and tune the oscillator to resonance at 150·3 Mc/s by obtaining maximum dip on the tuning meter. Connect the signal generator to the aerial socket and apply a signal of 150·3 Mc/s modulated 30 per cent at 1,000 cycles.

(3) Adjust the output level of the signal generator so that the signal is just audible. Adjust trimmers C1, C6, C12 to give a maximum audio output.

(4) Insert a 5070 kc/s crystal in the holder ST1, set the TUNE SIGNAL dial to 100·98 Mc/s and tune the oscillator for maximum dip on the tuning meter.

(5) Set the signal generator to 100·98 Mc/s and increase the output level until the signal is just audible. Adjust L1, L2 and L3 to give maximum output.

(6) Repeat the above adjustments (1) to (5) until neither set of adjustments affects the other. A signal of 5μV at 150·3 Mc/s and 100·98 Mc/s modulated 30 per cent at 1,000 cycles should give an output of not less than 1mW +15dB in 600 ohms. The signal generator must be 75 ohms impedance or be made up to this value (e.g. by using the 56 ohms series resistor with A.P.54705).

(7) Check that the sensitivity in (6) is maintained at 139·5, and 122·22 and 116·28 Mc/s (crystal frequencies 7210, 6250 and 5920 kc/s respectively). See chap. 6 for R.F. sensitivity measurements.

(8) The amplifier unit should be checked for instability near the minimum capacitance position of the TUNE SIGNAL control, with no crystal in the holder ST1. Instability is indicated by a fall of the reading of the tuning meter (switched to OSC.) when the TUNE OSC. and TUNE SIGNAL controls are rotated. Noise Generator CT207 may be used instead of a signal generator for the amplifier unit alignment provided that, with the noise generator connected to the aerial socket and the diode current set to about 100 mA, some deflection due to noise can be obtained on the output meter when the receiver is switched to TONE MAN. GC. The capacitors and inductors can then

be adjusted for maximum noise output. Adjustment must always be made with some noise from the noise generator, particularly when adjusting the first circuit. After alignment the specification figures quoted in Chap. 5 may be used (instead of the figure given in step (6) of this para.) though a good receiver will normally give better figures after realignment, e.g. the typical figures also quoted in Chap. 5.

AGC characteristics

Threshold

6. The AGC threshold level is defined as the unmodulated input required to produce a dip of 0·2mA in the tuning meter, when the METER SWITCH is switched to SIGNAL. Set the system switch to MAN G.C., the R.F. GAIN and L.F. GAIN controls to maximum and apply a signal of 10μV modulated 30 per cent at a 1,000 cycles at the following frequencies:-

Mc/s				
100·98	116·28	122·22	139·5	153·72
Crystal kc/s				
5070	5920	6250	7210	8000

and ensure that the threshold occurs below 10μV.

AGC noise

7. AGC noise is defined as the variation of the output noise power caused by an increase of RF input level. With the equipment set up as described in para. 6, apply an unmodulated input of 5μV at 100·98 Mc/s. Increase input level by 40dB and check that the output noise level falls by not less than 25dB.

AGC

8. With the equipment set up as described in para. 6, with an input level of 10μV modulated 30 per cent at 1,000 cycles at 100·98 Mc/s, adjust the A.F. GAIN control to produce an output of 1mW. With an increase in the input level of 80dB the AF output should not increase more than 5dB.

Muting adjustment

9. The smallest signal which is useful for communications is one which, when modulated 30%, produces a signal to noise ratio of 6dB at the output of the receiver. The muting circuit must be adjusted so that when the signal input into the aerial socket is less than this value the audio output from the receiver is attenuated, whereas noise from signals above this value produce an unattenuated AF output. The critical voltage at which the muting diode conducts and produces AF attenuation is fixed by the setting of the preset IF gain control VR3 mounted at the rear of a chassis.

10. (1) Disconnect the aerial from the receiver, and with the system switch set to MAN GC and R.F. GAIN control at maximum, apply an input at 100·98 Mc/s modulated 30 per cent at 1,000 cycles. VR3 should be turned fully counter-clockwise to give a maximum output. Adjust the signal input until a signal to noise ratio of 6dB is obtained (i.e. vary the signal input until the audio output is 6dB greater when the carrier is modulated than when it is unmodulated). Set the signal input to this value and switch ON the modulation.

(2) Turn VR3 slowly in a clockwise direction to reduce output, (audibly on the headset and visually on the output meter), continue to rotate VR3 until the output of the receiver falls sharply.

(3) Rotate VR3 counter-clockwise until the output suddenly rises. The correct setting of VR3 is found between these two points and it will be found that the critical voltage position of VR3 is easily decided; the instant when the muting diode V15 commences to conduct and produces rapid attenuation is quite obvious.

(4) With the input as in (1) above and the anode to V15 disconnected, the output noise level should remain unchanged. If the anode of V15 is reconnected and an unmodulated input at 100·98 Mc/s of 1½ times the value set in step (1) is switched off, the output noise level should fall by approximately 20dB.

Note . . .
As it is possible to adjust VR3 so that the receiver is rendered so insensitive that it does not satisfy the sensitivity requirements, the muting adjustments should be carefully carried out and the receiver sensitivity checked after this adjustment has been made.

AF response check

11. The AF response is defined as the variation of the receiver AF output level when the modulation frequency of the RF input signal is varied, the depth of modulation remaining constant. See Chap. 6 for AF sensitivity.

12. (1) Set the system switch to A.G.C. Remove V15 and disconnect C68 from the crystal harmonic amplifier (V6), so that an external signal may be applied via this condenser to the mixer valve grid.

(2) Apply an unmodulated input of 2μV at 9·72 Mc/s.

(3) Modulate the signal externally to a depth of 30 per cent at 1,000 cycles and adjust the A.F. GAIN control to provide an output of 10mW.

(4) Vary the modulation frequency, keeping the modulation depth constant at 30 per cent, and determine the peak frequency and output. Check that the attenuation from this peak at modulation frequencies of 300 and 3,000 cycles is not greater than 6dB.

(5) The extended frequency response, relative to the level at 1,000 cycles should satisfy the limits given below.

Modulation frequency c/s	120	5,000	7,000
Attenuation dB not less than	10	20	30

Tuning meter

13. Preset control VR4 at the rear of the tuning meter is set by the makers so that the combined resistance of meter and control is approximately 200 ohms, to enable meters of different internal resistance to be used with the same shunts (R25, R57). If it becomes necessary to replace tuning meters, check as follows:—

(1) Stand receiver in normal position with front panel vertical. Set the meter switch to OSC., system switch to TONE MAN GC and R.F. GAIN control at maximum.

(2) With no crystal in circuit, the tuning meter should read 0·65mA. If the reading is below 0·6 or above 0·7mA readjust VR4 and reseal.

Overall sensitivity

14. (1) With system switch set to MAN GC, R.F. GAIN and L.F. GAIN controls set to maximum, apply a signal of 10μV modulated 30 per cent at 1,000 cycles at the following frequencies:—

RF Mc/s	100·98	116·28	122·22	139·5	153·72
Crystal kc/s	5070	5920	6250	7210	8000

(2) Check that at each of the above frequencies an output is obtained of not less than 1mW +15dB in 600 ohms.

(3) Increase the input to 15μV at each of the above frequencies and ensure that the signal to noise ratio is not less than 20dB. (The noise measurement is made by tuning the unmodulated carrier peak, and the input signal is that produced by a modulation depth of 30 per cent at 1,000 cycles. The L.F. GAIN control should be adjusted to ensure that the signal output during the tests is not greater than 1mW +15dB in 600 ohms). A check of noise factor and gain using noise generator CT207 is described in Chap. 5. This check should be used for all routine measurements.

TABLE 1
List of capacitors

Circuit Ref.	Description	Value pF	Stores No.	Tolerance ±	Max.	Min.
C1	Var	2—16	Z.160009			
2	Var LH	6—48	A.P.61798			
3	Var RH	7—61	A.P.61796			
4	A.M. Type 962	2—8	10C/2072			

Table I—*cont.*

Circuit Ref.	Description	Value pF	Stores No.	Tolerance ±	Max.	Min.
5	Var RH	6—48	A.P.61797			
6, 7	A.M. Type 962	2—8	10C/2072			
8, 9	Twin Var.	7—61	A.P.71695			
10	A.M. Type 962	2—8	10C/2072			
11	Var RH	6—48	A.P.61797			
12	A.M. Type 962	2—8	10C/2072			
14	Var	7—61	A.P.61796			
15	A.M. Type 962	2—8	10C/2072			
16	Type 3111	4·5—20	10C/5686			
17, 18		10,000	10C/12407		100%	0
19	Fixed ceramic	3·3	Z.132419	5pF		
20	,, ,,	100	Z.132300	10%		
21		10,000	10C/12407		100%	0
22	Fixed ceramic	100	Z.132300	10%		
23	,, ,,	33	Z.132283	10%		
24	,, ,,	100	Z.132300	10%		
25	,, ,,	1,000	Z.132630	20%		
26	,, ,,	100	Z.132300	10%		
27	,, ,,	22	Z.132275	10%		
28—32	,, ,,	100	Z.132300	10%		
33	Fixed mica	10,000	Z.124412	10%		
34, 35	Fixed ceramic	100	Z.132300	10%		
36	,, ,,	47	Z.132289	10%		
37	,, ,,	3·3	Z.132419	0·5pF		
40	,, ,,	1,000	Z.132630	20%		
41, 42	Fixed ceramic	100	Z.132300	20%		
43	,, ,,	8·2	Z.132269	5%		
44	,, ,,	47	Z.132289	10%		
45	,, ,,	12	Z.132244	0·5pF		
46—48	,, ,,	100	Z.132300	10%		
51, 52	,, ,,	100	Z.132300	10%		
53	Fixed mica	1,000	Z.124074		100%	0
55	Fixed ceramic	100	Z.132300	10%		
56	,, ,,	47	Z.132289	10%		
57	,, ,,	3·3	Z.132419	0·5pF		
59	,, ,,	3·3	Z.132419	0·5pF		
60, 61	,, ,,	100	Z.132300	10%		
64	,, ,,	100	Z.132300	10%		
65	,, ,,	1,000	Z.132630	20%		
66	,, ,,	1·5	Z.132264	0·5pF		
67	,, ,,	33	Z.132283	10%		
68	,, ,,	3·3	Z.132419	0·5pF		
69, 71	,, ,,	100	Z.132300	10%		
72	Fixed mica	10,000	Z.124412		100%	0
73	,, ,,	8,200	Z.124368	10%		
74, 75	Fixed ceramic	70	AL 20 Z.~~132258~~ 132528	2%		
76	Fixed mica	8,200	Z.124368	10%		
78, 79	,, ,,	10,000	Z.124412		100%	0
80	Fixed ceramic	70	Z.132258	2%		
81, 82	Fixed mica	8,200	Z.124368	10%		
83	Fixed ceramic	70	Z.132258	2%		
84	Fixed mica	10,000	Z.124412		100%	0
85	Fixed paper	100,000	Z.115286	20%		

Table I—*cont.*

Circuit Ref.	Description	Value pF	Stores No.	Tolerance ±	Tolerance Max.	Tolerance Min.
86	Fixed mica	10,000	Z.124412		100%	0
87	,, ,,	8,200	Z.124368	10%		
88	Fixed ceramic	65	Z.132525	2%		
89	,, ,,	70	Z.132258	2%		
90	Fixed mica	10,000	Z.124412		100%	0
91, 92	,, ,,	10,000	Z.124407	20%		
93, 94	,, ,,	10,000	Z.124412		100%	
95	,, ,,	68	Z.125190	2%		
96	,, ,,	22	Z.132277	10%		
97	,, ,,	10,000	Z.124412		100%	0
98	Fixed ceramic	3·3	Z.132419	0·5pF		
99, 100	Fixed mica	10,000	Z.124412		100%	0
101	,, ,,	68	Z.123582	10%		
102	,, ,,	8,200	Z.124368	10%		
103	Fixed ceramic	60	Z.132247	2%		
104	,, ,,	70	Z.132258	2%		
105	Fixed mica	68	Z.123582	10%		
107	,, ,,	1,000	Z.124074		100%	0
108	Fixed paper	500,000	Z.115285	20%		
109	Fixed mica	10,000	Z.124412		100%	0
110	Fixed paper	100,000	Z.115286	20%		
111	Fixed mica	470	Z.123410	5%		
112	,, ,,	10,000	Z.124412		100%	0
113	,, ,,	1,000	Z.124074		100%	0
114	,, ,,	10,000	Z.124407	20%		
115	Fixed paper	100,000	Z.115286	20%		
116	Fixed mica	10,000	Z.124412		100%	0
117, 118	Fixed paper	10,000	Z.115027	20%		
119, — 121	,, ,,	100,000	Z.115286	20%		
122	Fixed mica	500	Z.123466		100%	0
123	,, ,,	10,000	Z.124412		100%	0
125	Fixed ceramic	100	Z.131206	10%		
126	Fixed mica	500	Z.123457	20%		

TABLE 2

List of resistors

Circuit Ref.	Type	Stores	Value Kilohms	Rating Watts	Tolerance per cent
R1		Z.222195	33	¾	10
2		Z.222216	47	¾	10
3		Z.222006	1	¾	10
4		Z.221186	0·39	¾	10
5		Z.222216	47	¾	10
6		Z.222132	10	¾	10
7		Z.223039	100	¾	10
8		Z.222069	3·3	¾	10
9		Z.221153	0·22	¾	10
10, 11		Z.222048	2·2	¾	10
12		Z.221174	0·33	¾	10
13		Z.223081	220	¾	10
14		Z.222132	10	¾	10
15		Z.221216	0·68	¾	10
16		Z.221153	0·22	¾	10
17		Z.222048	2·2	¾	10
18		Z.223101	330	½	10
19		Z.222048	2·2	¾	10
20	A.M.5858	10W/17402	0·2	2	2
21		Z.223123	470	¾	10
22		Z.222132	10	¾	10
23		Z.221153	0·22	¾	10
24		Z.223132	10	¾	10
25	A.M.5853	10W/17397	0·01	0·05	2
26		Z.222048	2·2	¾	10
27		Z.222047	2·2	½	10
28		Z.223038	100	½	10
29		Z.222132	10	¾	10
30		Z.221216	0·68	¾	10
32		Z.222006	1	¾	10
33		Z.222047	2·2	½	10
34		Z.212143	12	1	10
35		Z.212153	15	2½	10
36		Z.222006	1	¾	10
37		Z.223038	100	½	10
38		Z.222132	10	¾	10
39		Z.222047	2·2	½	10
41		Z.221216	0·68	¾	10
42		Z.222131	10	½	10
43		Z.223039	100	¾	10
44		Z.223080	220	½	10
45		Z.223123	470	¾	10
46		Z.223039	100	¾	10
47		Z.223081	220	¾	10
48		Z.223165	1000	¾	10
49		Z.223079	220	¼	10
50		Z.223100	330	¼	10
51		Z.221186	0·39	¾	10
52		Z.222216	47	¾	10
53		Z.222047	2·2	½	10

Table 2—*cont.*

Circuit Ref. Type	Stores	Value Kilohms	Rating Watts	Tolerance per cent
54	Z.223018	68	$\frac{3}{4}$	10
55	Z.222214	47	$\frac{1}{4}$	10
56	Z.222132	10	$\frac{3}{4}$	10
57 A.M. 5854	10W/17398			
58	Z.223072	180	$\frac{3}{4}$	10
59	Z.222069	3·3	$\frac{3}{4}$	10
60	Z.222048	2·2	$\frac{3}{4}$	10
61	Z.223165	1000	$\frac{3}{4}$	10
62	Z.223101	330	$\frac{1}{2}$	10
63	Z.222006	1	$\frac{3}{4}$	10
64	Z.223080	220	$\frac{1}{2}$	10
65	Z.222216	47	$\frac{3}{4}$	10
66	Z.222144	12	$\frac{3}{4}$	10
67 A.M. Type	10W/15173	0·68	7·5	5
68	Z.222048	2·2	$\frac{3}{4}$	10
69	Z.222132	10	$\frac{3}{4}$	10
70	Z.223123	470	$\frac{3}{4}$	10
71	Z.223249	4700	$\frac{3}{4}$	10
100	Z.223037	100	$\frac{1}{4}$	10
101	Z.223058	150	$\frac{3}{4}$	10
102	Z.223037	100	$\frac{1}{4}$	10
103	Z.223058	150	$\frac{3}{4}$	10
104	Z.223037	100	$\frac{1}{4}$	10
105	Z.223058	150	$\frac{1}{4}$	10

TABLE 3

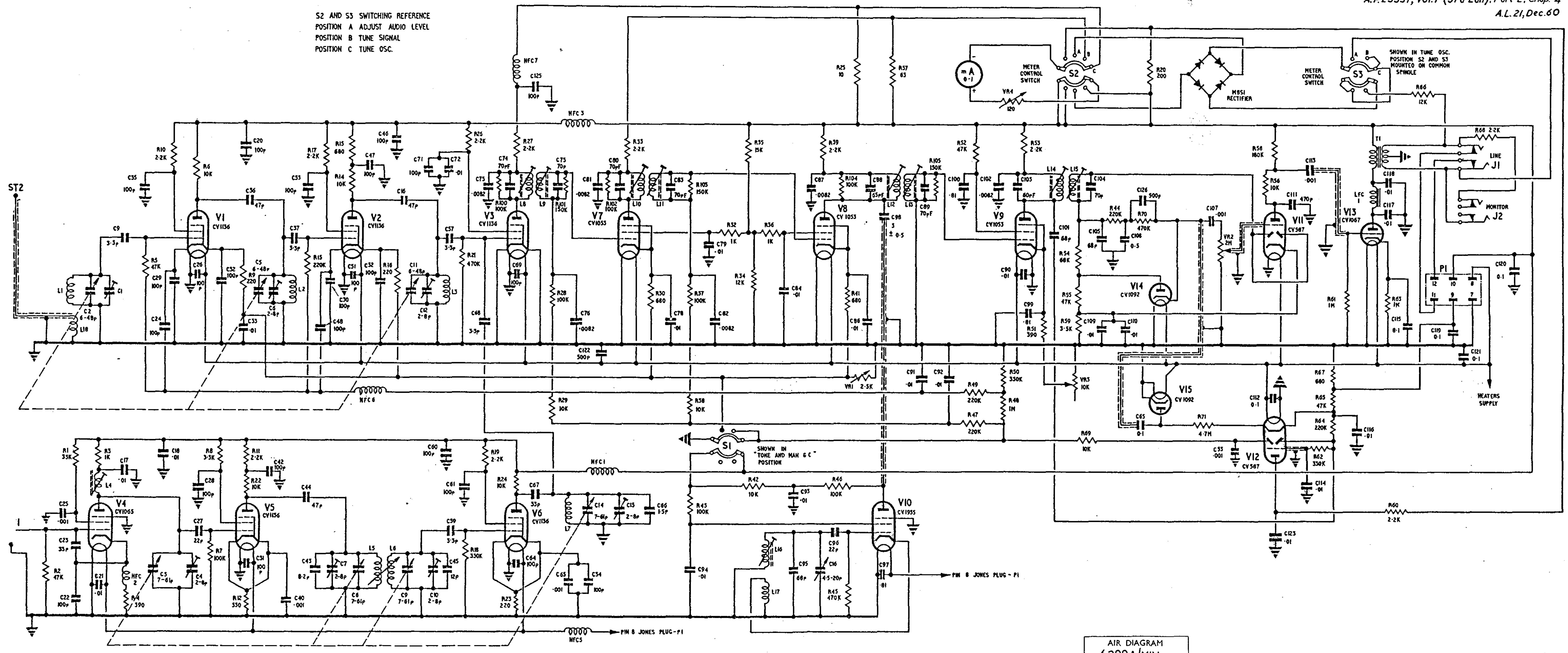
List of valves

Circuit Ref.	Type
V1—3	CV. 1136
4	CV. 1065
5, 6	CV. 1136
7—9	CV. 1053
10	CV. 1935
11, 12	CV. 587
13	CV. 1067
14, 15	CV. 1092

TABLE 4

List of miscellaneous components

Circuit Ref.	Name	Stores	Remarks
VR1	Resistor, style R.A.D.	Z.271756	2·5 megohms
VR2	Resistor, Morgan type H.N.A.R.	10W/15861	2 megohms
VR3	Resistor, Morgan type L.H.N.A.R.	10W/15096	10000 ohms
VR4	Resistor, A.M. Type 4231	10W/15222	200 ohms Painton type CV2
P1	Plug, A.M. Type 206	10H/426	
J1, J2	Jack. A.M. Type 1	10H/1739	
M/A	Milliammeter	5Q/87	0—1 mA
ST1	Socket, A.M. Type 665	10H/19246	
ST2	Socket	10H/185	
IFT 1	Transformer unit	A.P.61439	
2	,, ,,	A.P.61440	
3	,, ,,	A.P.61441	
4	,, ,,	A.P.61442	
IF des 2a	,, ,,	A.P.61438	
HFC 1	ChokeHF	10C/16885	
2	,, ,,	10C/79	
3	,, ,,	10C/16885	
5	,, ,,	10C/13422	
6, 7	,, ,,	10C/2185	
Amplifier unit	R/F43D	A.P.61436	
LFC1	Choke, LF	10C/16887	
Oscillator unit	Des. 7	A.P.61437	
T1	Transformer	10K/16292	
S1	Switch	10F/1247	
2, 3	,,	10F/1248	
HBS1	Rectifier, metal	10D/10972	



Receiver unit 62H - circuit

AIR DIAGRAM
6299A/MIN.

ISSUE 2

Fig.1

Chapter 5

ROUTINE PERFORMANCE CHECKS ON RECEIVER 62H

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

Introduction

1. This chapter contains information on the use of the noise generator CT207 for routine performance checks on the receiver 62H. In all the checks given in this chapter access to the internal circuits of the receiver *is not* required. The use of C.N.R.T.E. (Common Naval Radio Test Equipment) for detailed fault finding, in which access to the internal circuits of the receiver *is* usually required, is described in Chap. 6.

Use of noise generator

General

2. The noise generator CT207 offers a simple and reliable method of checking whether or not the performance of both the VHF receiver and its associated resonators, when fitted, has changed. If it was known that the receiving system was in good operational order when the initial results were taken, subsequent noise generator tests can be performed as a quick routine and results compared to check performance.

3. Although noise generators cannot measure bandwidth or centre frequency of the IF, the trend of the results obtained over a period of time can be used as a reliable indication of performance and to detect deterioration in the vast majority of cases. Full testing details together with a fault diagnosis table are given in this chapter.

Performance checks required

4. There are two distinct sets of results to be obtained, namely:—

(1) The noise factor and noise output of the receiver are measured as in para. 16 to 19. These tests should be carried out monthly on all receivers and the results tabulated and processed as detailed later.

(2) The attenuation (i.e. loss) of the resonators associated with each receiver in C.A.W. (Common Aerial Working) is measured as in para. 30 to 32. It is not, however, necessary for these measurements to be made as frequently as the receiver performance checks. Resonator loss is most conveniently obtained by measuring the receiver factor and noise output at a given frequency and then measuring the overall noise factor with the resonator inserted between the noise generator and the receiver.

5. The recommended routines are as follows:—

(1) Measure the receiver noise factor and noise output as detailed in para. 16 to 19, record the results and determine the noise gain (see step (12) of para. 19 and specimen tables 6A and 6B at the end of the chapter).

(2) Where C.A.W. is employed, measure the overall system noise factor, i.e. with resonator inserted between the CT207 and the receiver (see para. 30 to 32). Complete tables results (see specimen Tables 6A and 6B).

(3) Repeat step (1) at monthly intervals and at each third month include also step (2), i.e. the receiver measurements are to be made monthly and the resonator measurements quarterly.

Purpose of checks

6. The object of the tests given in para. 16 to 19 is to check the noisiness of the receiver and its overall gain by measurement and its bandwidth by implication. By carefully recording the test figures obtained, the trend of the receiver performance can be watched and the receiver taken out of service when it has deteriorated beyond the permissible limit or a marked discontinuity in the trend is observed. This will enable *planned maintenance* to become the established routine. Wrong diagnosis is much less likely to occur if the trend of the results is watched (see para. 28 and 29).

Brief theory of noise factor as applied to a communications receiver

7. A full explanation of the use of noise generators for receiver testing will not be included here. For further information on the noise generator CT207, see B.R.1771(15). Notes on the use of noise generator measurements are given below.

8. The measurement of noise factor will indicate whether or not the receiver is generating more internal noise than is normal. If the noise factor is bad (i.e. high) then the receiver is generating excessive internal noise, and very weak signals which would normally be received are lost below the noise level. The reasons for an increased noise factor are discussed in para. 28 and 29.

9. The measurement of noise output power on the audio output meter of the CT207 will indicate any change of noise gain. This assumes that the noise factor has remained constant.

10. Noise factor can best be understood by considering a practical receiver (and therefore one whose circuits generate some noise themselves) and its effect on signal to noise ratio. To state that such a receiver has a noise factor N means that, owing to the extra noise produced by the receiver, the noise output is increased as if the aerial noise had been multiplied N times (N being a ratio) although the signal is not correspondingly increased. Thus a practical receiver causes a deterioration of signal to noise ratio measured at the output as compared with the signal to noise ratio at the aerial. This deterioration in signal to noise ratio is caused by noise generated throughout the receiver though in practice only the first few stages contribute an important amount. For convenience, this noise, although generated throughout the receiver, is expressed as an *equivalent source* of noise at the input of the receiver and it is this equivalent source which causes the apparent increase of N times the aerial noise. (N, as stated earlier, is the noise factor of the receiver).

11. It is convenient to regard the aerial noise as being ordinary thermal noise (see B.R.1771(12) or (15)) and for this purpose the aerial is assumed to be a resistor at room temperature. This thermal noise is known exactly and it provides a fixed standard of reference which is obviously essential as a basis for measurement. It should nevertheless be appreciated that in practice aerials are not simply resistors at room temperature and thus the significance of an increase in noise factor will depend on the actual noise level in the aerial.

12. The *equivalent source* of noise mentioned in para. 10 can be considered as separate from the receiver—in other words, the "noisy" receiver can be divided into a noise generator developing N times thermal noise feeding into a receiver which generates no noise itself. Thus by measuring the noise factor of a receiver the power generated by the equivalent noise source feeding the receiver is also measured—it is N times the thermal noise. This is the power input to the receiver. The noise power output of the receiver can be measured by an audio power meter and since the ratio of these two powers —the output power divided by the input power—gives the gain of the receiver:—

$$\text{Gain} = \frac{\textit{Noise output power as measured}}{\text{N times thermal noise}}$$

13. Now thermal noise is a constant for any given type of receiver (provided the bandwidth is approximately correct). Hence for any given type of receiver the ratio $\frac{\textit{Noise output power}}{\text{N}}$ is a measure of the gain and changes in the value of this ratio can be used to detect changes in gain. The ratio is called the noise gain and if both the noise output power and the noise factor N are expressed in decibels:—

Noise gain (dB) = Noise output (dB)—Noise factor (dB)

Thus a record of noise factor and noise gain will enable any changes in the receiver performance to be checked. It will be seen for example that if the noise factor is bad and the noise output normal the gain of the receiver must be low.

14. In general noise factor can be read to an accuracy of about $\pm\frac{1}{2}$ dB and noise output to about $\pm\frac{1}{4}$ dB. Variations in conditions under which the measurements are made can cause further experimental errors so that variations in noise factor of less than ± 1 dB and in noise gain of less than ± 2 dB are more probably experimental errors than receiver variations. Variations of this order will probably "smooth out" over several readings. Inspection of readings over a period of time will show any obvious downward trend of results. This idea of watching the trend in readings over a period—so common in other branches of engineering—demonstrates the importance of recording the actual readings obtained rather than just marking the test as satisfactory on test sheets.

15. In para. 13 it was shown that to obtain the noise gain of a receiver the noise factor (dB) was subtracted from the noise output power (dB). To make this clear two examples are given below.

Example A
Noise factor 15 dB

Example A (*contd.*)
Noise output 1 dB
Noise gain =Noise output (dB)
—Noise factor (dB)
=1 dB—15 dB= —14 dB

The negative sign need not cause any confusion since the noise gain is only a relative figure and applies only to the particular type of receiver, i.e. in this case 62H.

Example B
Noise factor 20 dB
Noise output 1 dB
Noise gain=1dB—20dB= —19dB

The gain of this receiver therefore is 5dB (i.e. the difference between —14dB and —19dB) worse than the receiver quoted in Example A.

Measurement of noise factor, noise output, and noise gain

Apparatus required

16. The test rig for the measurements is shown in fig. 1, the following test apparatus being required:—

(1) Noise generator CT207, Admiralty Pattern 63451.

(2) Audio lead, Admiralty Pattern W1034, 5438 or 7149.

(3) R.F. lead, Admiralty Pattern 63909.

(4) R.F. adaptor lead, Admiralty Pattern 63908 or a longer version of this lead which will be supplied later.

(5) Selected test crystals, three in number. (These should be carefully kept for all test purposes).

One in frequency range
7500 to 7800 (7520) kc/s.
6250 to 6750 (6500) kc/s.
5100 to 5800 (5720) kc/s.

The frequency in the bracket is, in each case, the best crystal frequency to use if available.

(6) Avometer (to measure mains voltage).

(7) Receiver to be tested. This must be switched on and set to an operational condition for at least 4 hours before making the test.

Note . . .
Leads Admiralty Pattern 7149 *and the R.F. lead in* (4) *above are for use if the alternative leads specified are too short.*

Preliminary settings of controls

17. The settings of the noise generator controls and the connections to be made to the instrument are as follows:—

(1) Set the VOLTAGE SELECTOR to suit the mains voltage.

(2) Set the AUDIO POWER switch to 5mW.

(3) Turn the SET DIODE CURRENT control fully counterclockwise, i.e. to minimum.

(4) Set the DIODE CURRENT selector switch initially to +4dB. (This will measure noise factors in the range up to 15dB and normally the 62H will lie in this band). If the noise factor lies in the range 15 to 20dB it will be necessary to set the DIODE CURRENT selector switch to the +10dB position.

(5) Connect lead Admiralty Pattern 63909 to the noise generator.

(6) Connect the adaptor lead Admiralty Pattern 63908 (see Note at end of para. 16) to lead Admiralty Pattern 63909.

(7) Connect the other end of the adaptor lead Admiralty Pattern 63908 to the aerial socket of the receiver.

(8) Connect the audio lead Admiralty Pattern W1034 or 5438 (see Note at end of para. 16) to the AUDIO POWER INPUT 600Ω socket of the noise generator and the other end to the LINE (*not* MONITOR) socket of the 62H receiver.

(9) Switch on the noise generator 5 minutes before taking readings.

18. The following settings should be made to the receiver 62H controls:—

(1) Insert the appropriate crystal in the receiver.

(2) Set the R.F. GAIN control to maximum (fully clockwise).

(3) Set the L.F. GAIN control to maximum (fully clockwise).

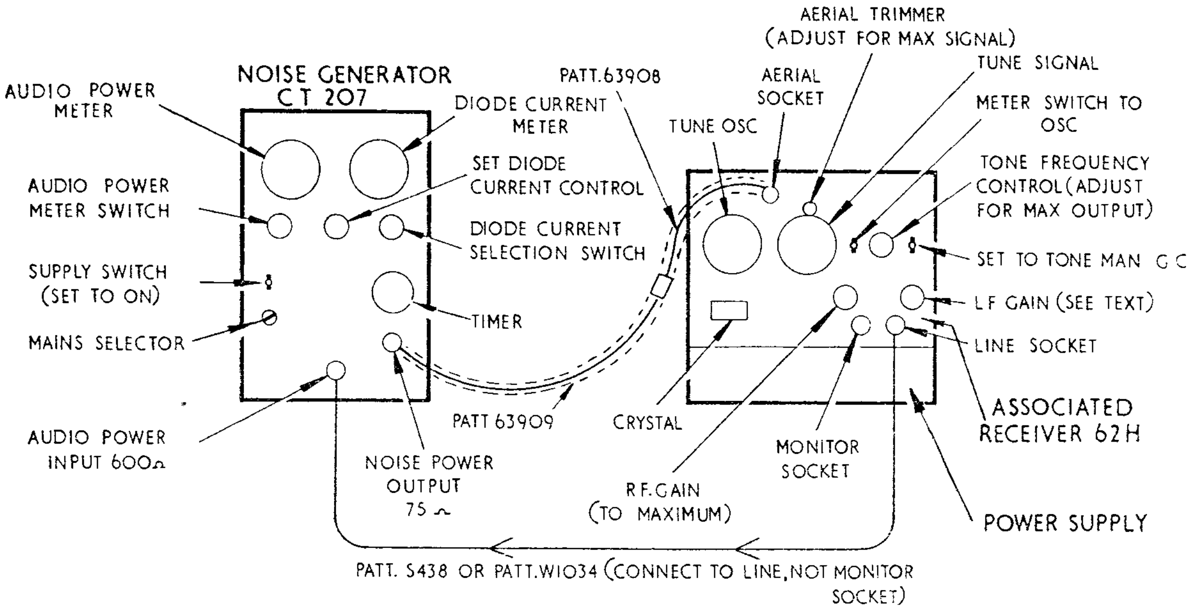


Fig. 1. Test rig for noise factor and noise output

(4) Set the A.G.C. switch to TONE MAN. G.C. (i.e. B.F.O. operating).

(5) Set the TONE FREQUENCY CONTROL so that its pointer is vertical. (This control will be adjusted for maximum noise output later).

(6) Set the METER SWITCH to OSC.

Note . . .
Remember that the receiver must be switched on and set to an operational condition for at least 4 hours *before any measurements are taken. (The reason for this is to enable the receiver to attain a stable temperature).*

Measurement procedure

19. (1) Insert the selected crystal at the low frequency end (e.g. 5720 kc/s) and adjust the TUNE OSC. control for maximum dip on the receiver meter. Record the oscillator dip, i.e. crystal current dip as in the specimen Table 6. Check that the frequency shown on the TUNE OSC. dial is approximately correct (in the example shown 112 Mc/s) to ensure that the oscillator and its multipliers are set to the correct frequencies.

Note . . .
It is important that any considerable difference between the expected TUNE OSC. *frequency and that actually shown on the dial should be investigated since in this particular type of receiver it is possible, by tuning the* TUNE OSC. *control to a very wrong frequency, to select the wrong multiplication ratio. However, provided the frequency shown on the dial and that to be expected with the particular crystal in use agree to within a few Mc/s, incorrect harmonics cannot be obtained.*

(2) Set the noise generator TIMER to 8 minutes and inject noise from the noise generator into the receiver. As a guide, the SET DIODE CURRENT control should be advanced in a clockwise direction until the diode is passing a current of between 10 and 15mA. It will be found that the injection of noise greatly facilitates tuning the receiver.

(3) Adjust the TUNE SIGNAL control to the same frequency as the TUNE OSC. control and then tune it slowly either side for maximum noise output (it may be necessary to reduce temporarily the audio, i.e. L.F. GAIN, control of the receiver). *Very careful* adjustment of the TUNE SIGNAL control is necessary.

(4) Very carefully adjust the aerial trimmer control—this is marked ADJUST FOR MAX. SIGNAL—for maximum noise output power. This adjustment is critical and even a slight misadjustment can cause an apparently serious deterioration in noise factor.

(5) Check that the TUNE OSC. and TUNE SIGNAL controls are at their best adjustment for maximum noise output and re-check the adjustment of the aerial trimmer.

(6) Switch the DIODE CURRENT selector switch on the noise generator to OFF, turn the SET DIODE CURRENT control fully counterclockwise, turn the receiver L.F. GAIN control to maximum, and check that, with the exception of the DIODE CURRENT selector switch, all controls on the receiver and noise generator are set as given in Fig. 1 and para. 17 and 18.

(7) On the receiver adjust the TONE FREQUENCY CONTROL for maximum noise output. If the AUDIO POWER METER on the noise generator reads full scale it may be necessary to advance the AUDIO POWER switch on the noise generator to 50mW (i.e. +10dB); in this instance 10dB must be added to all readings on the dB scale.

(8) Record the reading of the noise generator AUDIO POWER METER in decibels in the column marked Noise Output dB (see specimen Table 6). It is better to use the decibel scale rather than the milliwatt scale since the use of decibels simplifies calculation.

(9) Adjust the receiver L.F. GAIN control to bring the noise generator AUDIO POWER METER reading to a convenient level (say a whole number at about half full scale). The AUDIO POWER switch should, if possible, be set to the 5mW (i.e. +0dB) position.

(10) Switch the DIODE CURRENT selector switch to the +4dB position (see step (4) of paragraph 17) and advance the SET DIODE CURRENT control clockwise until the noise output (i.e. the reading on the AUDIO POWER METER) has increased by 3dB (the original power in mW has been doubled).

(11) On the DIODE CURRENT METER note the reading for noise factor in dB by reading the noise factor scale and adding the appropriate number of dB shown on the DIODE CURRENT selector switch.

(12) Subtract the noise factor in dB (i.e. the reading obtained in the previous step) from the noise output in dB (i.e. the reading obtained in step (8)) to obtain the noise gain of the receiver. This figure should be inserted in the appropriate position in the table provided (see examples in Tables 6A and 6B).

Note . . .
The above completes the noise generator measurements on the receiver at the chosen frequency. If the resonator loss is not *being checked change the crystal in the receiver and repeat the whole of the paragraph for the other frequencies. The check should be carried out at the bottom, middle and top of the frequency range and the table of noise generator readings completed. If the resonator loss* is *being measured it will be found more convenient to make this measurement (see para.* 30 *to* 32) *before changing the crystal. Then change the crystal and repeat the whole procedure for the other frequencies. The time taken for a complete noise generator test of a* 62*H receiver and resonator at one frequency is from* 5 *to* 15 *minutes.*

Example on the measurement procedure

20. Assume that in step (7) of the previous paragraph a reading of —2dB is obtained on the AUDIO POWER METER with the AUDIO POWER switch set to the 50mW (i.e. +10dB) range. Then (since the +10dB range on the noise generator is being used) the noise output of the receiver is given by 10dB+(—2dB) i.e. 8dB and this figure is recorded in the appropriate column (see specimen Table 6). The L.F. GAIN control on the receiver is now reduced (see step (9) of paragraph 19) to bring the AUDIO POWER METER reading to a suitable level. Since it is preferable, if possible, to use the 5mW (i.e. +0dB) position of the AUDIO POWER switch for the subsequent measurements, adjust the L.G. GAIN control on the receiver so that, in this position of the switch, the AUDIO POWER METER reads, say, 0dB (1mW on the upper scale). Switch the DIODE CURRENT selector switch to the +4dB position and advance the SET DIODE CURRENT control clockwise until the reading on the AUDIO POWER METER has increased by 3dB, i.e. in this example until the reading is +3dB (2mW on the upper scale). Observe the reading in dB on the DIODE CURRENT METER. Assume in this example that this is 10dB. Then, since the DIODE CURRENT selector switch is on the +4dB range, the noise factor of the receiver is given by 4dB +10dB, i.e. 14dB. Record this figure in the appropriate column.

Finally, since the noise output is 8dB and the noise factor is 14dB, the noise gain is —6dB (i.e. 8dB —14dB) and this figure should also be recorded in the appropriate column.

Readings obtained from noise generator measurements

Variation of readings

21. Variations of mains supply voltage will not cause any errors in the readings of the CT207 noise generator. However, variations in the supply voltage will affect the receiver noise factor slightly and the noise output (and hence noise gain) appreciably as indicated in the following table:—

Mains voltage variation	Noise factor change	Noise gain change
—10%	+1 dB (i.e. 1 dB worse)	—2.5 dB
+10%	—1 dB (i.e. 1 dB better)	+2·5 dB

It is therefore advisable to note the mains voltage throughout the test and to avoid doing tests when large mains voltage variations exist. (For variations of readings due to faults see para. 28 and 29).

22. In the absence of a fault the noise gain of any given 62H receiver should remain constant or show a slow steady deterioration during the life of the receiver. In paragraphs 25 and 26 some typical and specification figures are given, but it must be remembered that the possible variation between receivers is often greater than the variation in a receiver's performance due to the development of a fault. For this reason it is essential to record all test figures and watch the trend of the results. Any sudden deterioration or discontinuity in the trend of results merits investigation, even though the latest results recorded remain above the reject levels. A significant change, having regard to the possibility of experimental error, is one of more than 2dB.

23. Noise gain figures quoted in this chapter apply only to receivers 62H measured with the noise generator CT207. Comparisons between different types of receivers on the basis of their respective noise gain figures are invalid. Note that the noise gain figure obtained for a receiver 62H is usually of negative sign. This should not lead to confusion; a receiver with, say, a noise gain of —8dB is 2dB down in gain on a similar type of receiver with a noise gain of —6dB. Any change in noise factor is allowed for in noise gain. If for example a receiver normally had a noise factor of 14dB and a noise output of +8·0dB, then the noise gain would be —6·0dB (i.e. +8dB —14dB). Suppose the gain of the first RF valve were to suddenly fall the result would be an increase in noise factor with possibly a slight drop in noise output; the noise factor might become 17dB and the noise output drop by 1dB to +7·0dB. The noise gain would then be +7·0dB —17dB, i.e. —10·0dB. This would indicate that the gain of the receiver had in fact fallen more than was indicated by the change in noise output.

24. Following on from the example at the end of the previous paragraph it is also important to realise that even if two receivers have identical noise output they do not necessarily have the same gain. The two examples below make this clear.

Receiver No. 1

Noise factor 18·5dB   Noise output +0·5dB

Noise gain=(+0·5—18·5) dB= —18dB

Receiver No. 2

Noise factor 13·0dB   Noise output +0·5dB

Noise gain=(+0·5 —13·0) dB= —12.5dB

If two receivers have normal gain but one has a good noise factor and the other a bad noise factor the latter receiver will give greater noise output; hence noise output alone cannot be used as a measure of receiver gain.

Typical readings

25. Typical readings taken on a new 62H Receiver are given in Table 1. It will be noted that a correctly aligned receiver with a good osc. (i.e. crystal) current dip gives consistent results over the whole band. (See para. 28 and 29 for wide variations).

TABLE 1

Col. 1	Col. 2		Col. 3	Col. 4	Col. 5
Crystal frequency kc/s	Osc. Current dip mA From	To	Noise output dB	Noise factor dB	Noise gain (Col. 3—Col. 4) dB
5450	0·65	0·35	+8·0	14·0	—6·0
6300	0·65	0·35	+8·0	14·0	—6·0
7490	0·65	0·35	+8·0	14·0	—6·0

Note . . .
Noise output on new receivers may lie between 0dB and +10dB. Noise factor on new receivers may lie between 12dB and 15dB.

Specification figures

26. Table 2 gives the equivalent noise generator results for a receiver just up to its specification for signal to noise ratio and gain. The noise factor corresponding to the specification signal to noise ratio of 20dB for an input signal of 20μV modulated at 1,000c/s 30% can be given, but since the gain of the receiver is the other specified quantity it will be noticed that the noise output column has been left blank. It should be realised that if the receiver has a gain just equal to its specification, the actual noise output will depend upon the noise factor.

TABLE 2

Col. 1	Col. 2	Col. 3	Col. 4	Col. 5
Crystal frequency	Osc. current dip mA	Noise output dB	Noise factor dB	Noise gain dB
Any crystal to give signal frequency 100 to 150 Mc/s	Not less than 0·2mA change	See note below	17·5	—17·5

Note . . .
This means that if a receiver had a noise factor of 17·5dB the noise output for specification conditions would be 0·0dB (i.e. 1mW).

Reject figures

27. Table 3 gives the figures for noise factor and noise gain below which a receiver should not be allowed to fall. In general when a receiver has deteriorated to its specification condition in Table 2 more detailed tests should be employed to restore the lost performance. If time is not available, however it is permissible to allow the receiver performance to deteriorate to the figures given in Table 3. It must be emphasised, however, that if a more detailed test shows a serious off-setting of the centre frequency of the IF from 9·72 Mc/s further measurements should be made (see Chap. 4). If it is *proved* that realignment is necessary, the instructions in Chap. 4 may be carried out as an emergency measure only, the set being made a Dockyard Defect item as soon as convenient. Provided the CT218 (the recommended instrument) is used, no trouble should be experienced due to leakage from the signal generator.

TABLE 3

Col. 1	Col. 2	Col. 3	Col. 4	Col. 5
Crystal frequency	Osc. current dip mA	Noise output dB	Noise factor dB	Noise gain dB
As in Table 2	Minimum dip 0·2	When less than —5 reject for low gain	19·0	—24·0

Note . . . *Receivers should not normally be allowed to fall to the low level indicated in the above table.*

Fault diagnosis

General indications

28. When a fault occurs its location may often be traced by noise generator tests. Whilst it is not possible to include here every type of fault, an effort has been made to tabulate those which are most likely to occur. The following important points should be noted:—

(1) A worsening, i.e. increase, in noise factor is due to a fault in either of the first two RF valves or their associated circuits. A big increase usually indicates that the first RF valve or its circuit is faulty. Changes in audio and IF gain do not affect the noise factor. Noise factor can be affected by the BFO circuit being off frequency or a failure of the BFO valve since this will alter the point on the second detector curve at which the noise factor is normally measured.

(2) A change in noise gain without a change of noise factor almost certainly indicates an IF or AF loss of gain.

(3) A poor crystal or oscillator, giving a small dip in oscillator current, will normally decrease the noise gain but not affect the noise factor. It is for this reason that the OSC. current dip is recorded (see specimen Tables 6A and 6B).

(4) In most receivers the exact centre of the intermediate frequency is not of vital importance; in the 62H type of receiver, however, the correctness of the centre of the intermediate frequency *is* important since both the receiver local oscillator and the transmitter associated with the receiver are crystal controlled. The noise generator test cannot measure either the IF bandwidth or its centre frequency but practical work has shown that, provided these were correct on installation, any change will be apparent by a change of noise gain. Nevertheless an occasional check of the centre frequency and the bandwidth should be made (see Chap. 6).

(5) Variations in mains voltage will affect both noise factor and noise gain (see para. 21).

Fault diagnosis table

29. The possible faults which may be responsible for variations in noise factor are given in the first part of Table 4 below. The second part of the table lists faults which may be responsible for variations in noise gain.

TABLE 4
Noise factor faults

Symptom		Fault	Remedy or check
Poor noise factor over whole band	A.	Bad contact in RF valves	Check overall gain. Clean valve pins. Check valve holder contacts.
	B.	RF valves failing	Check valves for emission on CT160.
	C.	Low RF gain	Check components in RF circuit.
	D.	Poor crystals used, i.e. low activity	Check that a dip in the current meter when set to OSC. is not less than 0·2mA as the TUNE OSC. dial is rotated through the tuned position.
Poor noise factor over part of band usually at one end.	E.	Poor activity crystal. See D above	
	F.	Misalignment of RF stages	Refer to chapter 4 and check overall sensitivity at each end of band.

TABLE 4—*continued*

Symptom		Fault	Remedy or check
	G.	Aerial trimmer maladjusted	Repeat measurement adjusting the trimmer carefully for maximum noise output with the noise generator on.
Excessively low noise factor is obtained, e.g. 1 to 8 dB	H.	Open circuited 75 ohm terminating resistor in CT207. (Refer to Instrument Handbook B.R.1771(15))	Repair CT207 (As a check on this fault an RF lead of different length may be used to connect the CT207 to the receiver. If this fault is present a different noise factor will be obtained).
Noise factor not obtainable owing to no increase in receiver output noise when noise input is increased	J.	Incorrect tuning	Repeat steps (3), (4) and (5) of para. 19.
	K.	Open circuited RF lead from CT207 to receiver	Check lead for continuity.
	L.	Aerial input lead of receiver disconnected	Visual inspection.
	M.	Very poor noise factor, i.e. greater than 22 dB	See checks under poor noise factor.
		Noise gain faults	
Noise gain low over whole band	A.	Mains voltage or HT supply voltage low	Measure with avometer.
	B.	Loss of gain in receiver	Check AF, IF, and overall sensitivity as described in Chap. 6.
	C.	Change of bandwidth	Dockyard defect.
	D.	BFO not operating properly	Refer to Chap. 4.
	E.	Low oscillator drive	If dip in tuning meter is less than 0·2mA change oscillator valve or crystal.
Noise gain low at one frequency or over part of tuning range. Noise factor normal.	F.	Bad oscillator multiplier tracking	Check osc. current dip. Apply more detailed tests as in Chap. 4.
	G.	Bad crystal giving poor dip in current	Replace crystal.
Noise gain low over whole band. Noise factor bad	H.	First or second RF stage gain low	Check valve pins, components, and valves of 1st and 2nd RF stages.
	J.	Aerial trimmer not peaking properly	Check visually for correct working of trimmer.
Noise gain higher than usual	K.	Mains voltage and HT supply high	Measure voltage using avometer.
Noise gain higher than usual. Noise factor excessively low	L.	Open circuited 75 ohm terminating resistor in in CT207. (Refer to Instrument Handbook B.R.1771(15))	Repair CT207. (As a check on this fault an RF lead of different length may be used to connect the CT207 to the receiver. If this fault is present a different noise factor will be obtained).

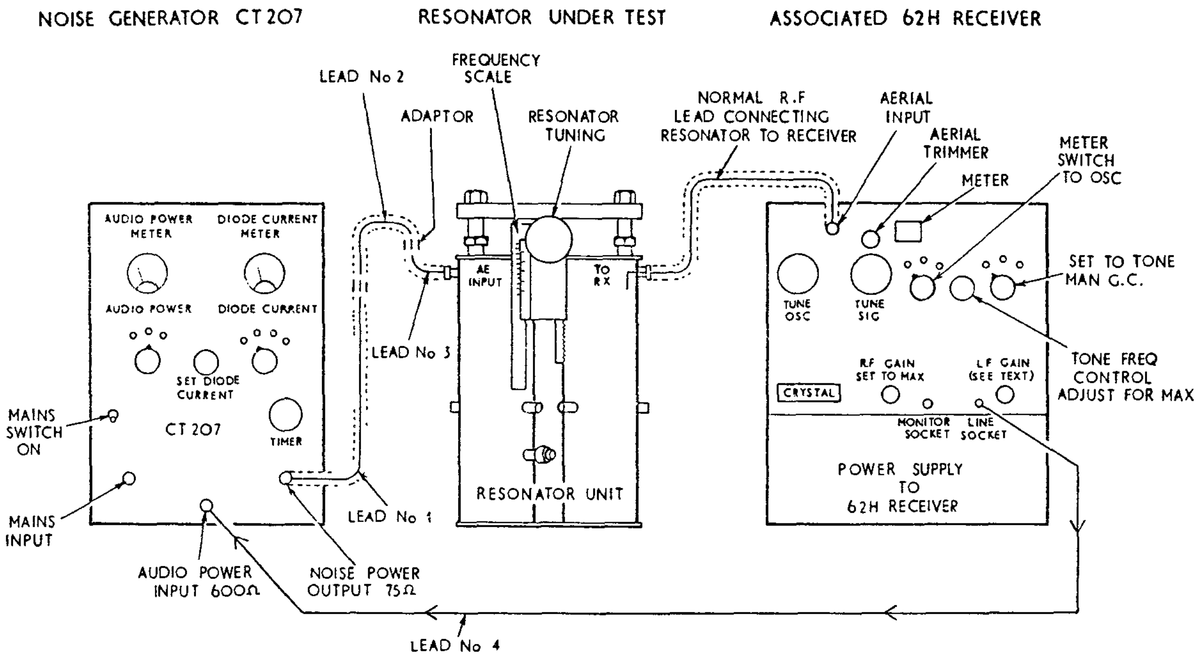
Measurement of resonator attenuation

Preliminary setting-up

30. As recommended in para. 5, the resonator loss should be checked every three months. This is best done at the same time as the measurement of receiver noise factor and noise output. Assuming then that the noise factor and noise output have been measured at a given frequency, the receiver controls and settings should be left as at the end of step (12) of para. 19. The following connections should be made (see fig. 2):—

(1) Disconnect the noise generator RF output lead from the aerial input socket of the receiver and reconnect the RF lead from the resonator to this aerial socket, i.e. as in normal operation.

(2) Disconnect, at the junction box end, the RF lead from the junction box to the resonator input. Connect the now free end of the lead via connector 10H/276 (which will later be supplied with the CT207) to the free end of the noise generator RF lead (A.P.63908 or the longer lead if required).



LEAD No 1 RF LEAD A P63909 SUPPLIED WITH CT207
LEAD No 2 RF LEAD A P63908 " " CT207 (IN SOME CLASSES OF SHIP THIS LEAD IS OF INSUFFICIENT LENGTH AND A LONGER LEAD IS BEING SUPPLIED)
LEAD No 3 RF LEAD FITTED BETWEEN RESONATOR AND JUNCTION BOX IN CAW SYSTEMS
LEAD No 4 AUDIO LEAD A.P W1034 OR A P5438 (IT IS PERMISSIBLE TO LENGTHEN THIS LEAD IF NECESSARY OWING TO OFFICE LAYOUT i.e USE LEAD A.P 7149)
ADAPTOR 10H/276 THIS WILL BE PROVISIONED FOR USE WITH THE CT207

Fig. 2. Test rig for measurement of resonator attenuation

Measurement procedure

31. (1) Set the DIODE CURRENT switch on the CT207 to the +10dB (i.e. 100mA) position and adjust the SET DIODE CURRENT control to give a reading of approximately 50mA (18·5dB).

(2) Set the noise generator TIMER to 8 minutes. Turn the L.F. GAIN control on the 62H receiver to maximum (fully clockwise) and set the AUDIO POWER switch on the CT207 to give a convenient deflection on the AUDIO POWER METER.

(3) Adjust the resonator tuning control so that the frequency shown on the

frequency scale corresponds approximately to the TUNE SIGNAL and TUNE OSC. dials on the 62H receiver.

(4) *Carefully* tune the resonator to obtain a noise power maximum as shown on the AUDIO POWER METER of the CT207. Tune the resonator through the peak in both directions. Owing to possible backlash in the resonator tuning mechanism the value of the peak may differ in the two cases. The final setting should be made in the direction which gives the maximum rise. **Great care is needed in tuning as the whole accuracy of the measurement depends on the exact setting of this maximum.**

Note . . .
If no rise can be obtained the SET DIODE CURRENT *control may be adjusted to give a reading of* 100*mA and step* (4) *repeated.* (*The diode current must not be left at* 100*mA for any period of time as overheating will result*). *If it is still not possible to obtain a rise in noise power either the resonator attenuation is excessive or there is an open circuit in the lead between the connector* 10*H*/276 *and the resonator* (*i.e. the lead which normally connects junction box and resonator*). *To check whether this lead is faulty disconnect it at both ends and connect the lead from the noise generator directly to the resonator. Repeat step* (4). *If a peak can be obtained the fault lies in the lead previously referred to whereas if a peak is still not obtainable the resonator is faulty and should be taken out of service.*

(5) *Very carefully* readjust the TUNE SIGNAL, TUNE OSC., aerial trimmer (marked ADJUST FOR MAX. SIGNAL), and TONE FREQUENCY CONTROL on the 62H receiver to give maximum noise output on the AUDIO POWER METER of the CT207. Turn the DIODE CURRENT switch on the CT207 to the OFF position.

(6) Adjust the L.F. GAIN control on the 62H receiver to bring the reading on the AUDIO POWER METER of the CT207 to 0dB. It may be necessary to set the AUDIO POWER switch to a lower range to do this.

(7) Turn the SET DIODE CURRENT control fully counterclockwise. Set the DIODE CURRENT switch to the +10dB (i.e. 100mA) position and advance the SET DIODE CURRENT control until the noise output has increased by 3dB (i.e. the AUDIO POWER METER reads 3dB).

Note . . .
If it is not possible to obtain a 3dB rise in noise output the alternative measurement procedure described in para. 32 *must be employed.*

(8) On the DIODE CURRENT METER note the reading for noise factor in dB by reading the noise factor scale and adding 10. The result is the overall noise factor of the 62H receiver combined with the resonator. (In other words, the measurement given in this para. 31 is a measurement of the receiver noise factor via the resonator).

(9) Subtract the noise factor of the 62H receiver alone from the overall noise factor obtained in step (8) above in order to obtain the resonator attenuation. For example if the overall noise factor were 20·5dB and the noise factor of the 62H receiver alone (i.e. the figure obtained in step (11) of para. 19) were 14dB then the resonator attenuation would be (20·5—14) dB, that is 6·5dB.

(10) Disconnect the resonator, re-connect the noise generator as in fig. 1, and, at the next frequency required, carry through first the procedure given in para. 19 for the measurement of noise factor and noise gain and then the procedure given above for the measurement of resonator attenuation. Enter the figures obtained in the table (see specimen Table 6A).

Alternative procedure using Abac

32. As mentioned in the note after step (7) of the previous paragraph it may not always be possible to obtain the required 3dB increase in noise output. This breakdown of the method is likely to occur when the receiver noise factor is bad and/or the resonator attenuation high. The following alternative procedure, which involves the use of an abac (fig. 3), must then be used.

(1) If in step (7) of the procedure given in the previous paragraph the 3dB rise cannot be obtained (it is assumed that the procedure has been carried through to this stage) advance, instead, the SET DIODE CURRENT control until the DIODE CURRENT METER reads exactly 100mA.

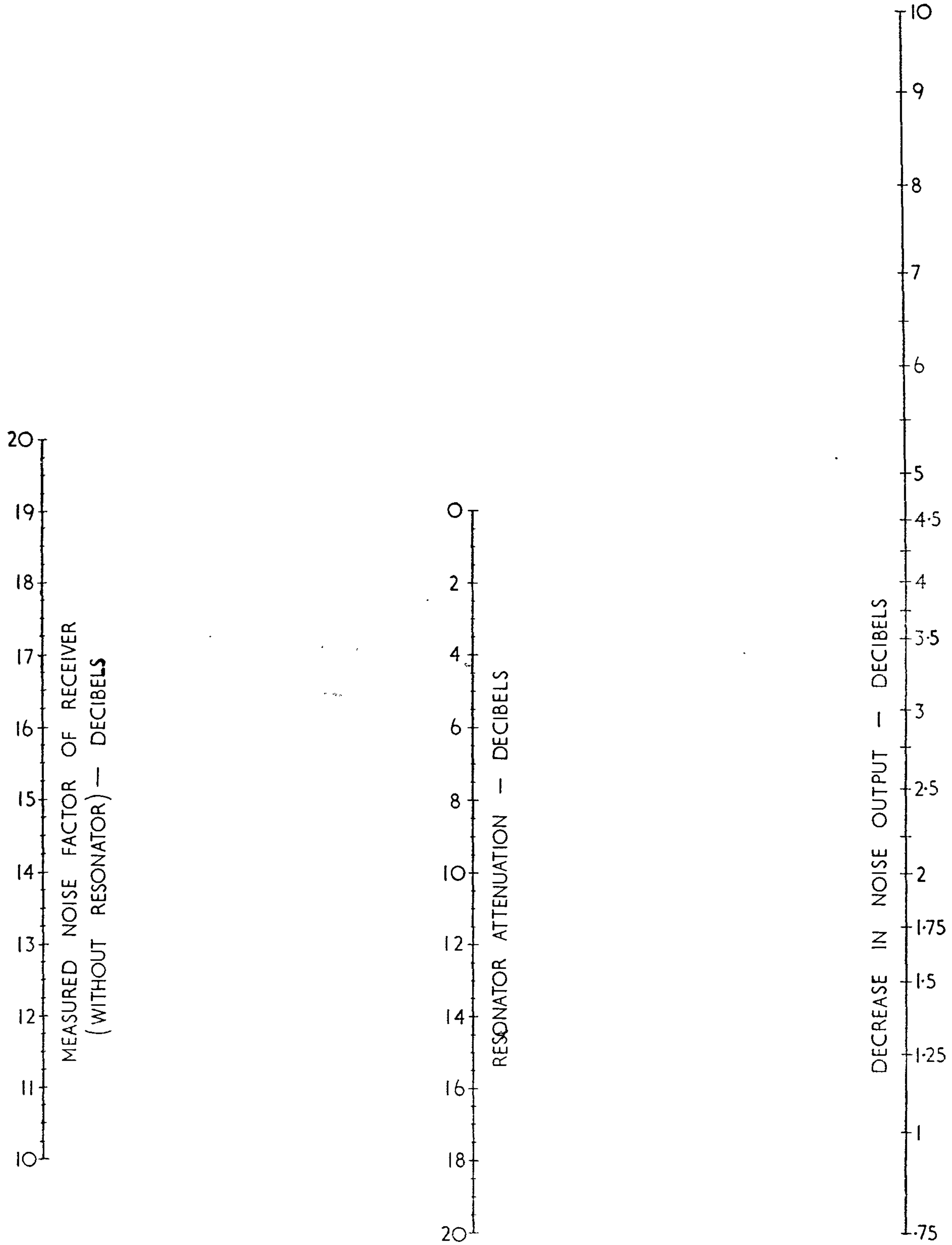


Fig. 3. Abac for estimation of resonator loss

(2) Readjust the L.F. GAIN control on the 62H receiver so that the largest whole figure—if possible the 6dB mark—is indicated on the dB scale of the CT207 AUDIO POWER METER. It may be necessary to set the AUDIO POWER switch to a lower range to achieve this.

(3) Turn the DIODE CURRENT switch on the CT207 to the OFF position and note the decrease in the dB reading on the AUDIO POWER METER dial. Enter this figure (i.e. the difference between the two AUDIO POWER METER readings) in the table (see specimen Table 6B).

(4) Let N be the noise factor of the 62H receiver (that is, the figure obtained in step (11) of paragraph 19) and D the decrease in noise output noted in step (3) above, both quantities being expressed in dB. On the abac (fig. 3) set a ruler or straight edge to pass through a point corresponding to figure N in the first column and a point corresponding to figure D in the third column. The straight edge will then pass through a point in column 2 which gives the insertion loss of the resonator in dB; that is, the resonator attenuation.

Example

Noise factor of 62H receiver=14dB.
Decrease in noise output=2dB.
Hence, by using abac, attenuation of resonator=10dB.

Resonator attenuation readings

33. Table 5 gives the typical figure to be expected from a double resonator and also the specification and rejection figures. Since however the resonators are used in conjunction with a particular 62H receiver, reference should be made to paragraph 34 for the overall rejection figure. This is necessary since a receiver with a good (low) noise factor of say 12 or 14dB can work with a poor resonator having the rejection figure of 8dB as its loss. If, however, the receiver is at its rejection figure of 19·0dB for noise factor the resonator loss should not be allowed to fall to the rejection figure of 8dB.

TABLE 5

Double resonator A.P.65767A or A.P.53293	Attenuation		
	Typical	Specification	Rejection
The junction box of the common aerial working unit should not be included in circuit for these tests.	3 to 5 dB	7 dB	8 dB

Overall performance figure

Rejection figure for receiver and resonator

34. Though the rejection figure for the noise factor of a receiver is 19·0dB and the rejection figure for the resonator attenuation is 8dB, both items being considered separately, it is *not* permissible to operate the combination with both items at their rejection figures. The overall condition beyond which a resonator and receiver combination should not be allowed to fall is as follows:—

Receiver noise factor (in dB)+Resonator attenuation (in dB) must never be more than 24dB.

Results for a typical receiver and resonator combination

35. Table 6A gives a set of results for a typical receiver, resonator combination and would be considered to be satisfactory. The following notes are important in the interpretation of results.

(1) In this receiver and resonator unit it will be seen that when measuring resonator attenuation the method given in para. 31, i.e. the measurement of the noise factor via the resonator, has been used. Column 8 is therefore not used.

(2) The figures in columns 4 and 5 are measured on the receiver as described in para. 19. The figure in column 6 is obtained by subtracting the figure in column 5 from that in column 4. For 62H receivers the result will nearly always be a negative quantity.

(3) The significant figures for the receiver performance are those entered in columns 5 and 6.

(4) The figure for resonator attenuation in column 9 is obtained by subtracting the figure in column 5 from that in column 7.

(5) The overall performance figure in column 10 is obtained by adding the figure in column 5 to that in column 9.

Results for a receiver and resonator combination of just acceptable performance

36. Table 6B gives a set of results for a receiver and resonator unit which, though somewhat worse than normal, is of just acceptable performance. In this case it will be noted that it is column 7 which is left blank because, with these lower values of performance, the alternative method of measuring resonator attenuation given in para. 32 must be used. The remarks in (2) and (3) of the previous paragraph also apply to Table 6B. The figure for column 9 is obtained by using the abac (fig. 3) as detailed in para. 32. As before the overall performance figure in column 10 is obtained by adding the figure in column 5 to that in column 9.

General information

37. The noise generator tests on the receiver only, i.e. columns 1, 2, 3, 4, 5 and 6 in Table 6, will normally be performed more frequently than the whole operation involving the resonator attenuation. For this reason columns 7, 8, 9 and 10 will often be left blank. As stated at the beginning of the chapter it is recommended that the receiver tests be performed monthly and the combined receiver and resonator test be performed quarterly. These noise generator tests will indicate any deterioration in overall performance.

38. If it is found that the noise generator results are satisfactory but that the receiver and resonator do not appear to be operationally up to standard it is recommended that, if possible, the exact centre frequency and bandwidth of the IF amplifier be established as described in the next chapter. This check will only be possible on certain classes of ship which hold the necessary test equipment. Realignment of the receiver should only be undertaken as an emergency measure, the receiver being returned for Dockyard repair at the earliest opportunity.

TABLE 6A

Receiver 62H						Resonator A.P.65767A or 53293			
Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6	Col. 7	Col. 8	Col. 9	Col. 10
Date	Crystal Frequency kc/s	Osc. current dip mA	Receiver tests Paragraph 16, 17, 18 and 19			Resonator tests Paragraphs 30, 31 and 32			Overall performance test receiver noise factor + Resonator attenuation dB
			Noise output dB	Noise factor dB	Noise gain dB	Noise factor via resonator dB	Noise output drop dB	Resonator attenuation dB	
8/2/57	5450	0·6 to 0·3	+6·5	13·0	—6·5	18·0	—	5·0	18·0
8/2/57	6300	0·6 to 0·3	+7·5	12·7	—5·2	17·8	—	5·1	17·8
8/2/57	7490	0·6 to 0·3	+5·2	12·8	—7·6	18·0	—	5·2	18·0

TABLE 6B

Receiver 62H						Resonator A.P.65767A or 53293			
Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6	Col. 7	Col. 8	Col. 9	Col. 10
Date	Crystal Frequency kc/s	Osc. current dip mA	Receiver tests Paragraph 16, 17, 18 and 19			Resonator tests Paragraphs 30, 31 and 32			Overall performance test receiver noise factor + Resonator attenuation dB
			Noise output dB	Noise factor dB	Noise gain dB	Noise factor via resonator dB	Noise output drop dB	Resonator attenuation dB	
8/2/57	5450	0·7 to 0·5	+2·0	16·0	—14·0	—	2·4	7·0	23·0
8/2/57	6300	0·7 to 0·5	+2·5	17·0	—14·5	—	2·0	7·0	24·0
8/2/57	7490	0·6 to 0·4	+1·5	15·5	—14·0	—	2·8	6·6	22·1

Chapter 6

DETAILED FAULT FINDING ON RECEIVER 62H USING C.N.R.T.E.

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

General

1. Detailed tests will normally be required when the noise generator tests described in Chapter 5 indicate either that a fault has developed or that the receiver has deteriorated beyond its "reject level" of performance. In either case access to the receiver circuits will be required, and the following paragraphs detail the procedure for using C.N.R.T.E. and the test figures to be expected.

2. It is recommended that detailed fault tracing should be accomplished in the following order:—

(1) Test of overall IF sensitivity and measurement of IF bandwidth and centre frequency. This will determine whether the fault lies in a pre-IF stage or in the IF and AF stages. If the fault lies in the IF or AF stages proceed to (2), but if the fault lies in a pre-IF stage proceed to (4).

(2) Test of overall AF sensitivity. If this is satisfactory proceed to (3).

(3) Test of individual IF stages by measurement of IF sensitivity and individual IF stage gains.

(4) Test of overall RF gain.

Trend of results

3. Generally, the trend of the results of previous routine noise generator tests will give a clue to the location of the fault, e.g. see fault diagnosis table, Chapter 5, para. 29.

Test rigs and instruments

4. In the following paragraphs, detailed test rigs are included for IF bandwidth and centre frequency, AF sensitivity, IF sensitivity, RF sensitivity, and Tables giving typical input and output voltages or powers are included. Individual receivers vary widely, however, and the figures given are an average set of figures for a normal receiver. The type of test instrument used will depend upon the part of the circuit under test and also on the class of ship. Sufficient information is included for all relevant C.N.R.T.E. instruments but the actual instrument used will depend upon the test outfit allowed to the particular ship.

5. The test rigs given should be closely followed, particularly when RF and IF measurements are being made. Variation of layout can alter the results obtained. During all sensitivity tests other than AF the muting valve V15 should be removed.

OVERALL IF SENSITIVITY—BANDWIDTH—AND CENTRE FREQUENCY

Choice of signal generator

6. The receiver 62H should be switched on for at least four hours before attempting this test. When performing a check of the centre frequency and bandwidth of the receiver IF unit, three signal sources are possible.

(a) Signal generator CT218.

(b) Test oscillator CT212.

(c) Signal generator A.P.54704A.

The order given is that of preference, i.e. if a CT218 is available it should always be used. The other signal sources cannot give such an accurate measurement of either bandwidth or centre frequency.

7. It is important to realise that in this type of receiver, where the transmitter frequency is crystal controlled and the local oscillator of the receiver is crystal controlled, the exact value of the centre frequency of the IF is of vital importance. For this reason it is essential that whichever of the three signal sources quoted above, is used, the position of 9·72 Mc/s must be accurately known. The method of setting the signal source to this frequency is described in Chapter 4, para. 2(2), but for convenience the method is repeated more fully below.

Calibration of signal source

8. Proceed as follows:—

(1) Connect up as for overall IF sensitivity, as detailed in para. 22 and fig. 2 with the signal generator connected to the grid of V3 (pin 6).

(2) Set the receiver 62H controls as follows:—

- (i) R.F. GAIN to maximum (fully clockwise).
- (ii) No crystal inserted.
- (iii) Position of TUNE OSC. and TUNE SIGNAL dials not important.
- (iv) Meter switch to SIGNAL.
- (v) Selector switch to MAN G.C.
- (vi) I.F. GAIN control to maximum (i.e. fully clockwise).

(vii) Audio output connected from LINE socket.

(viii) Switch on receiver and check that mains voltage and receiver voltages are normal.

(3) Disconnect AF wattmeter and replace it by a pair of headphones, plugged into the LINE socket.

(4) Set signal generator or test oscillator to give a CW output signal at 9·72 Mc/s, and 40 dB (100 μV) level.

(5) Insert a 9·72 (or 4·86) Mc/s crystal into the crystal socket of the receiver.

(6) Tune the signal generator or test oscillator slowly about 9·72 Mc/s, for a zero beat. The dial reading of the signal generator or test oscillator at which this zero beat occurs represents 9·72 Mc/s output.

(7) *In the case of CT*218, the "pointer" on the frequency dial should be adjusted so that the frequency scale reads correctly at 9·72 Mc/s. The scale accuracy of the CT218 is then sufficient to use direct reading from the scale when performing a bandwidth measurement.

*In the case of CT*212 *an A.P.*54704*A*. it is necessary to note both the main frequency scale and the logging scale. Measurement of bandwidth necessitates interpolation using the logging scale. This is detailed more fully for the CT212 below (para. 12).

Measurement of IF bandwidth and centre frequency, using CT218

9. Having established the position for a 9·72 Mc/s signal, the bandwidth and centre frequency are measured as below. It is essential when measuring centre frequency that the receiver should have had a warming up period of 4 hours.

(1) Disconnect headphones and reconnect audio output meter, setting it to 600 ohm impedance and on such a range as to measure +15 dB (32 mW).

(2) Set signal generator to give a 9·72 Mc/s signal modulated 30% at 1,000 c/s and of such an amplitude as to give +15 dB (32 mW) audio output into the audio output meter

(3) Increase the signal generator output by 6 dB using the attenuators, and detune the signal source to a lower frequency until the audio output meter again reads +15 dB (32 mW). Note the signal source frequency $f1$ in Mc/s.

(4) Now tune signal source to the frequency above 9·72 Mc/s at which the audio output meter again reads +15 dB (32 mW) and note this frequency $f2$ in Mc/s.

(5) The bandwidth is then obtained by subtracting $f1$ from $f2$ and the centre frequency by taking the mean of $f1$ and $f2$, i.e.,

$$\frac{f1+f2}{2} \text{ Mc/s}$$

For example, let $f1$ be 9·68 Mc/s and $f2$ be 9·77 Mc/s.

The bandwidth at 6 dB $= f2 - f1 = 9{\cdot}77$ Mc/s $- 9{\cdot}68$ Mc/s.

$= 0{\cdot}09$ Mc/s

$= 90$ kc/s

Centre frequency of IF $= \dfrac{f1+f2}{2}$

$$= \frac{19{\cdot}45 \text{ Mc/s}}{2} = 9{\cdot}725 \text{ Mc/s} = F.$$

Thus centre frequency $F = 9{\cdot}725$ Mc/s.

From this it will be seen that though the bandwidth is approximately correct at ±45 kc/s (90 kc/s), the centre frequency is, however, 5 kc/s high.

(6) The bandwidth at 60 dB down is measured in a similar manner to that at 6 dB, except that the signal source output is increased 60 dB instead of 6 dB. It is advisable to detune the signal source by 200 kc/s, before increasing the output by 60 dB, or damage to the audio output meter may result.

Results to be expected (specification)

10. The Specification provides as follows:—

(a) Bandwidth at 6 dB level must be not less than ± 40 kc/s (80 kc/s).

(b) Bandwidth at 60 dB level must not be more than ± 160 kc/s (320 kc/s).

(c) Centre frequency must be within ±6 kc/s of 9·72 Mc/s.

Results when using CT212

11. When using the CT212 for measuring bandwidth, the same procedure is adopted as given above except that it is not possible to read the frequencies directly from the dial. It is necessary to note the dial reading and the logging scale reading, and to estimate the bandwidth by interpolation. Since there is some backlash in the drive and the scale is non-linear in this region, the results obtained will be of a lower order of accuracy than those obtained with the CT218. This fact should be allowed for when assessing whether or not realignment is necessary.

12. As an example on the measurement of bandwidth and centre frequency the following results were obtained. It also demonstrates the method of using the logging scale.

Reading of CT212 logging scale when the test oscillator is set by the crystal to 9·72 Mc/s was +10 division.

Reading of CT212 logging scale for 6 dB in high frequency end=45.

Reading of CT212 logging scale for 6 dB in low frequency end=64.

Number of divisions on logging scale to tune main dial from 9·5 to 10·0 Mc/s=380 divisions.

Thus, each division represents approximately

$\frac{500}{380}$ kc/s=1·315 kc/s.

Now the lower frequency 6 dB position ($f1$) occurred at a logging scale reading of 64, and turning the tuning control in a counter-clockwise direction (through 46 divisions) the logging scale completes one revolution (add 100) and moves on to the graduation on the logging scale marked 10 to give the 9·72 Mc/s position, at a scale reading of 110 (100+10). This means that the 6 dB point was 46 divisions (110—64) from the 9·72 Mc/s point. When tuning is continued in a counter-clockwise direction to obtain the higher frequency 6 dB point, it occurs at a scale reading of 145 (100+45 divisions). Thus the logging scale has been turned through 35 (145—110) divisions above the 9·72 Mc/s point to reach the higher frequency 6 dB point.

Thus:—

$f1$ is 46 divisions below 9·72 Mc/s, i.e. 60·6 kc/s,

$f2$ is 35 divisions above 9·72 Mc/s, i.e. 46·2 kc/s

and

Hence:—$f1$=9·6594 Mc/s

$f2$=9·7662 Mc/s

Hence bandwidth at 6 dB

$=f2-f1$

=106·8 kc/s

and centre frequency$=\frac{f1+f2}{2}$

=9·7128 Mc/s.

=9·71 Mc/s approximately.

From this it will be seen that the centre frequency is nearly 10 kc/s low and the bandwidth is 106·8 kc/s wide. The bandwidth at 60 dB can be found in a similar manner.

13. If two crystals, spaced about 50 kc/s to 100 kc/s either side of 9·72 Mc/s are also available, it is possible to calibrate the logging scale of the CT212 more accurately by using the zero beat principle used to set the signal generator to 9·72 Mc/s. In this case the test oscillator is tuned for zero beat for each crystal, and the logging scale then calibrated. Thus, by using three crystals of, for example, 9·77 Mc/s, 9·72 Mc/s and 9·67 Mc/s, the logging scale can be calibrated in kc/s per division.

RF alignment

14. Details of this test are given in Part 2, Chapter 4, para. 5, steps (2) to (8). However, the noise generator CT207 may be used instead of a signal generator for this alignment, as detailed at the end of para. 5(8) in Chap. 4.

15. When IF realignment is performed as an emergency operation, the receiver should be made a Dockyard Defect item as soon as practicable.

AUDIO FREQUENCY—SENSITIVITY MEASUREMENT

Instruments required

16. Test rigs are shown in fig. 1(a) and 1(b.) Where several suitable types of instruments are available the following is the order of preference:—

(1) Audio oscillator G205, A.P.W7252 *or* Audio frequency oscillator A.P.104290 (Advance J1).

(2) Audio attenuator A.P.100321.

(3) Valve voltmeter CT54 A.P.67921
Avometer model 7X A.P.32144 *or*
Avometer model A.P.48A

(4) Audio output meter (wattmeter AF) CT44, ZD00661 *or*
Wattmeter AF A.P.54708 *or*
Decibel meter No. 3 ZD02970

Connecting leads are as shown in the test rig and as detailed later (para. 28).

Preliminary settings

17. Connect test apparatus and receiver as shown in fig. 1(a) and 1(b). As indicated, the connecting leads used will depend upon the apparatus available. The results to be expected are, however, the same.

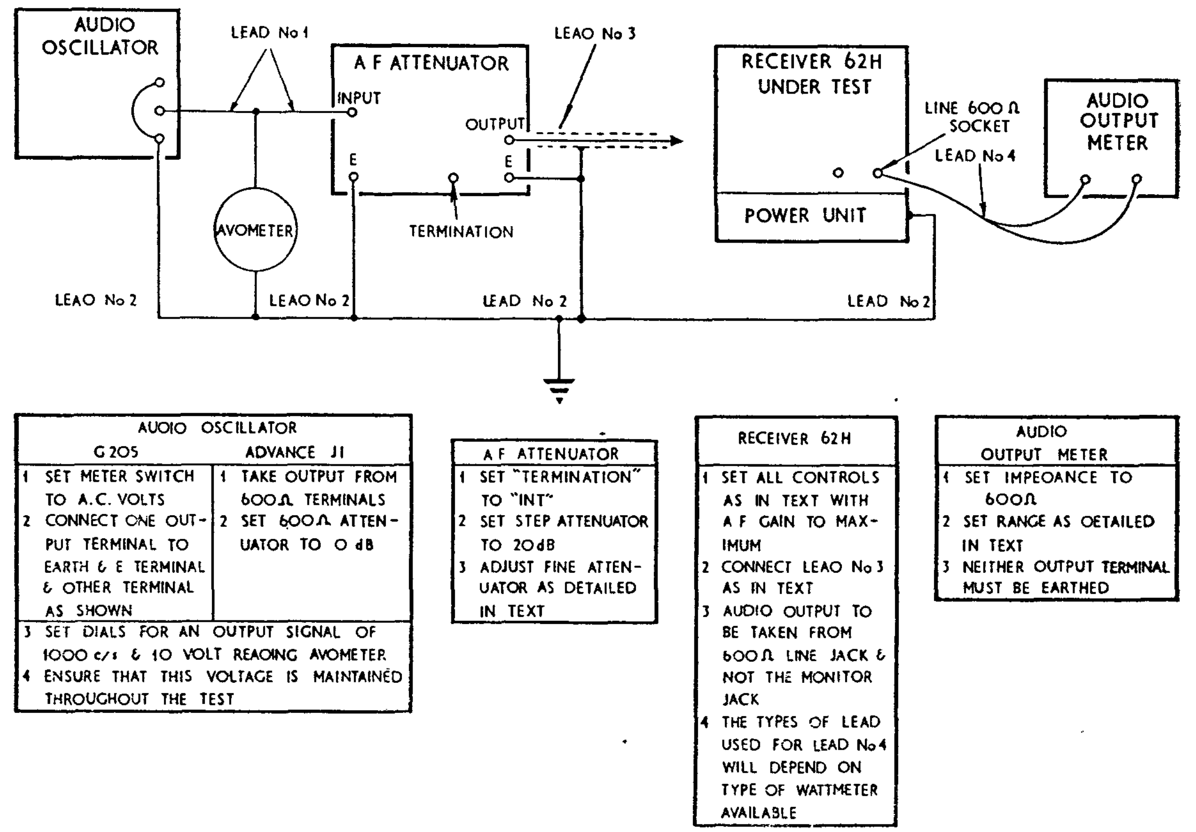


Fig. 1(a). Test rig for AF sensitivity (big ships)

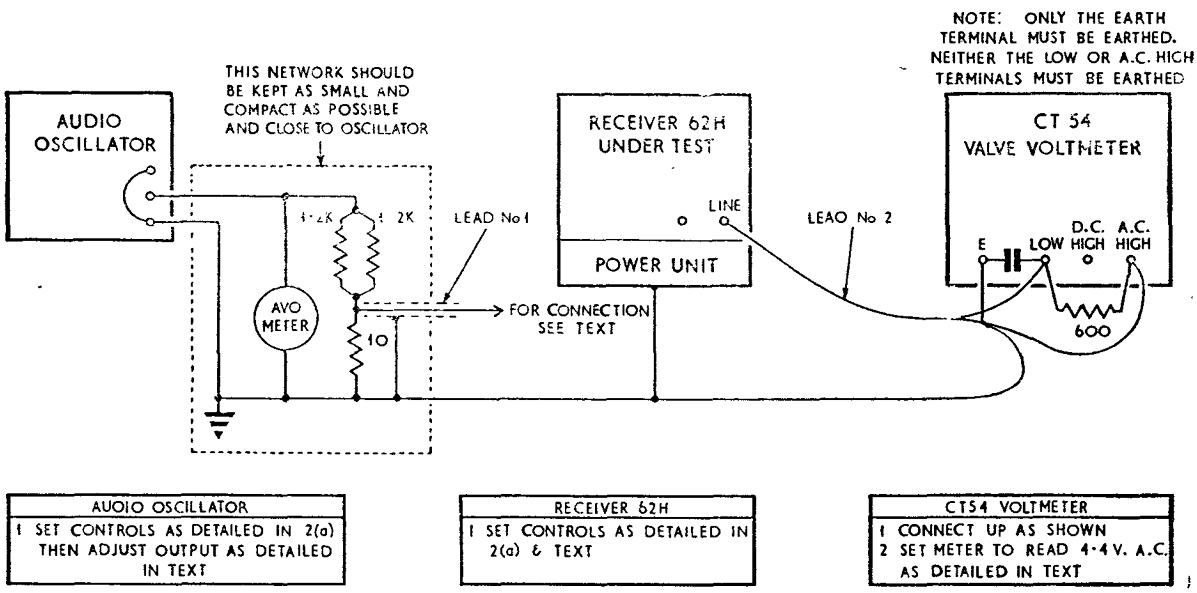


Fig. 1(b). Test rig for audio frequency sensitivity (small ship rig)

(1) *Receiver settings*

(i) RF GAIN to minimum.

(ii) No crystal inserted.

(iii) Position of TUNE OSC. and TUNE SIGNAL dials not important.

(iv) Meter switch to AUDIO.

(v) Selector switch to MAN GC.

(vi) LF GAIN to maximum i.e. fully clockwise.

(vii) Output from LINE socket.

(2) *Audio oscillator settings using G*205

(i) Meter switch to A.C. VOLTS and mains switch to ON.

(ii) Connect one output terminal to the E terminal and to earth and the other terminal to the AF attenuator input terminal.

(iii) Set frequency for 1000 c/s output.

(iv) Adjust output control knob, until avometer reads 10 volts AC.

(3) ***Aud.o oscillator settings using Advanc J*.1 (*A.P*.104290)** (alternative instrument to G205).

(i) Take output from 600 ohms terminals, and earth left-hand terminal of the 600 ohms pair; the right-hand terminal should be connected to the input terminal of the AF attenuator.

(ii) Connect the E terminal to earth.

(iii) Set 600 ohms attenuator (on right hand edge of panel) to 0 dB.

(iv) Adjust output frequency to 1000 c/s.

(v) Adjust output voltage control for 10 volts A.C. on Avometer.

(4) *AF attenuator settings* (*A.P*.100321)

(i) Set termination to INT.

(ii) Set coarse attenuator to 20 dB.

(iii) Set fine attenuator to 25 dB.

(iv) Connect output terminal of attenuator via a short screened lead to the live (top) contact of the LF volume control VR2 of the 62H Receiver (junction of C107 and VR2) (see circuit fig. 1, B.R.1511 A.P.2555F, Vol. 1, Part 2, Chapter 4, A.L.11).

(v) Earth the screening of this cable and also connect it to the E terminals of the AF attenuator.

(5) *Wattmeter absorption settings*; *A.F. No.* 1 *ZD*00661, *CT*44

(i) Set impedance to 600 ohms (right hand control).

(ii) Set power range to +15 dB (60 mV) (read red calibration for dB).

(6) *Settings using A.P.*54708 *wattmeter AF*

(i) Set OHMS to 60.

(ii) Set IMPEDANCE MULTIPLIER to 10.

(iii) Set METER MULTIPLIER to 0 dB (×1·0).

(iv) Connect lower terminal to earth conductor of lead No. 4.

(v) Connect upper terminal to the "live" conductor of lead No. 4.

(7) *Settings using decibel meter portable No.* 3, *ZD*02970

(i) Set left hand control to TRANSM, 600 (red scale).

(ii) Set right hand control to DECIBELS +20.

Procedure for AF sensitivity measurement

18. Proceed as follows:—

(1) Switch on receiver and check that mains voltage and HT are correct.

(2) Check that Avometer across audio oscillator is reading 10 volts AC.

(3) Adjust fine attenuator of the AF attenuator A.P.100321 until the output meter reads +15 dBm (above 1 mV, i.e. 32 mW).

(4) Note the reading of the fine attenuator in dB.

(5) In a typical receiver, this fine attenuator should read between 13 dB and 19 dB (i.e. total attenuation should lie between 33 and 39 dB). (This means, in effect, that 0·15 volts r.m.s. at 1000 c/s is required at the input to give +15 dBm output.)

Testing in small ships

19. In small ships where test equipment is limited, the test rig given in fig. 1(b) may be used. The value of resistors should be checked and those closest to the value indicated chosen. The valve voltmeter CT54 can be used as an output meter. The voltage indicated by the valve voltmeter CT54 can be converted to the equivalent power by reference to fig. 3.

Small ship test rig

20. Proceed as follows:—

(1) Connect the apparatus as shown in fig. 1(b). The output of the resistor network should be connected via a short screened lead to the live (centre) contact of LF volume control, VR2 (Junction of C107 and VR2); see fig. 1 B.R.1511, A.P.2555F Vol. 1, Part 2, Chapter 4, A.L.11.

(2) Set 62H Receiver controls as in para. 17, (1), and the audio oscillator as in para. 17(2), or 17(3) depending upon the oscillator used.

(3) The OUTPUT LEVEL control of the audio oscillator should be adjusted until the valve voltmeter reads 4·4 volts, corresponding to 15 dBm audio output power (fig. 3). With this output, the Avometer reading will normally lie between 7 volts and 14 volts for a typical receiver.

MEASUREMENT OF IF SENSITIVITY AND INDIVIDUAL IF STAGE GAINS

General conditions for test

21. It is important that attention be directed to the following points:—

(1) Before measuring the IF sensitivity and stage gain it must be known that the centre frequency of the IF amplifier is correct. A test to establish this centre frequency has already been given (para. 9).

(2) If available, a screened room should be used for all IF and RF measurements and the special leads or adaptors used when called for in the text.

(3) When measuring the individual stage gains, the signal source frequency must be adjusted each time for peak audio output.

(4) The signal generator (or test oscillator) is always used in its terminated condition, and modulated to a depth of 30% at 1000 c/s.

(5) The receiver muting valve V15 should be removed during the tests.

Measurement of IF sensitivity and individual IF stage gains—preliminary settings

22. The warming up period must not be less than 15 mins. (for a quick test), and should preferably be longer (4 hours for consistent results). Connect the test instruments as shown in fig. 2. Where several instruments are suitable, they are detailed in order of preference.

(1) *Receiver 62H settings*

(i) RF gain to maximum (fully clockwise).

(ii) No crystal inserted.

(iii) Position of TUNE OSC. and TUNE SIGNAL dials not important.

(iv) Meter switch to SIGNAL.

(v) Selector switch to MAN G.C.

(vi) L.F. gain control to maximum (i.e. fully clockwise).

(vii) Audio output connected from LINE socket.

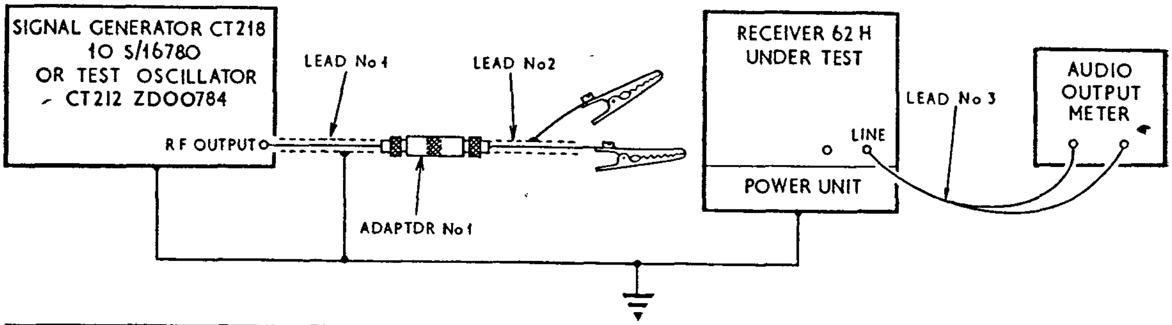
(viii) Switch on receiver and check that mains voltage and receiver voltages are normal.

(2) *AF wattmeter settings*

The audio output meters and methods of connection already detailed should be used (para. 17(5), (6) and (7)).

(3) *Settings with signal generator CT*218

(i) Set crystal check to OFF.



SIGNAL GENERATOR CT218	TEST OSCILLATOR CT 212
1 CRYSTAL, CHECK "OFF" 2 FREQUENCY RANGE "G" 3 MODULATION TO A.M. 4 MAINS "ON" 5 MODULATION FREQUENCY 1000 c/s 6 OUTPUT VOLTAGE & MULTIPLIER, SEE TEXT 7 SET CARRIER LEVEL TO x1 8 SET MODULATION TO 30% 9 SET TO FREQUENCY AS DETAILED IN TEXT	1 FREQUENCY RANGE — 6 2 MODULATION TO - A.M. 3 DEVIATION TO 3D 4 SET TUNING AS DETAILED IN TEXT 5 SET CARRIER LEVEL TO "CAL" 6 SET MODULATION TO "CAL" 7 SET FINE & COARSE ATTENUATORS AS DETAILED IN TEXT

AUDIO OUTPUT METER
1 SET IMPEDANCE TO 600 Ω
2 SET RANGE TO READ +15 dBm(32mW)
3 NEITHER OUTPUT TERMINAL MUST BE EARTHED

LEADS & ADAPTORS

LEAD No	DESCRIPTION	PATT No
1	3FT 75Ω UNIRADIO 32 OR 70	ZD00378
2	SHORT ADAPTOR LEAD WITH CROCODILE CLIPS	A.P. 6D865
3	DEPENDS ON WATTMETER USED	
ADAPTOR No 1	TERMINATING L-PAD 75 OHMS	A.P 71232

Fig. 2. Test rig for IF sensitivity of 62H type receiver

(ii) Set frequency range to G.

(iii) Set modulation selector to A.M.

(iv) Set mains to ON and carrier to ON.

(v) *Set modulation frequency to 1000 c/s.

(vi) Set output voltage multiplier as detailed in text (see Table below).

(vii) Set carrier level to 'X1'.

(viii) Set modulation depth to 30%.

(ix) Set frequency to 9·72 Mc/s and then adjust it for peak audio output as described in text.

(x) Connect output from RF output plug by leads detailed later (para. 28) and to test points in the receiver as shown below in Table (para. 23).

(4) *Settings with test oscillator CT212, ZD00784*

(i) Set frequency range to 6.

(ii) Set modulation to A.M.

(iii) Deviation control setting immaterial.

(iv) Set tuning to 9·72 Mc/s and adjust for peak audio output as in text.

(v) *Set carrier level to CAL.

(vi) Set modulation level to CAL.

*With selector switch set to appropriate position.

(vii) Set fine and coarse attenuators as detailed in Table (see below).

(viii) Connect RF output from RF plug by leads as detailed later (para. 28(3)).

Signal injection points typical results

23. Stage gains and overall gains are given in terms of decibels, since the signal generator readings are more easily interpreted using decibels. The corresponding input voltages are given in brackets, e.g. Input 20 Bd (10μV) means that the input is 20 dB above 1μV (i.e. 10μV).

The figures quoted in the Table that follows are those for a typical receiver. Variations of up to ±6dB may be expected in the stage gain (third column) figures obtained from good receivers. It will be observed that, since the stage gain may differ by ±6 dB from the figures quoted, there may be quite wide variations from the figures quoted in the second column (for signal generator input level), particularly at the early IF stages.

VOLTS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
mW	1·67	6·67	15·0	26·7	41·7	60·0	81·7	107	135	167	201	240	282	327	375	427	481	540	602	667
dB	2·22	8·24	11·8	14·3	16·2	17·8	19·1	20·3	21·3	22·2	23·0	23·8	24·5	25·1	25·7	26·3	26·8	27·3	27·8	28·2

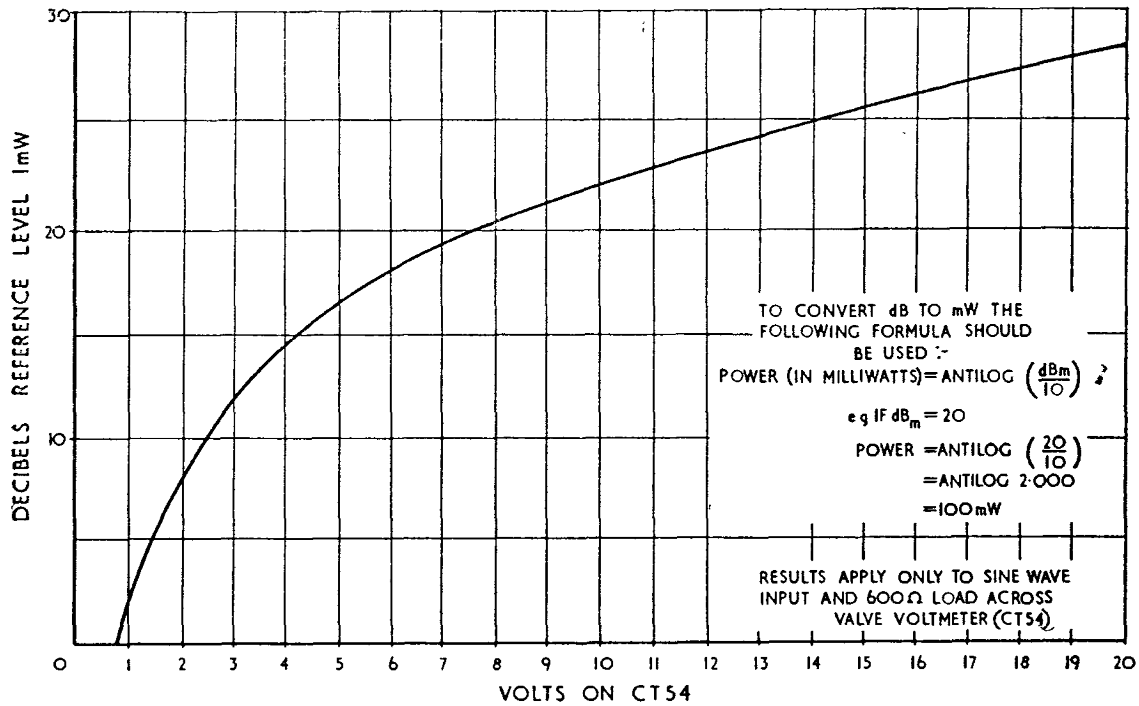


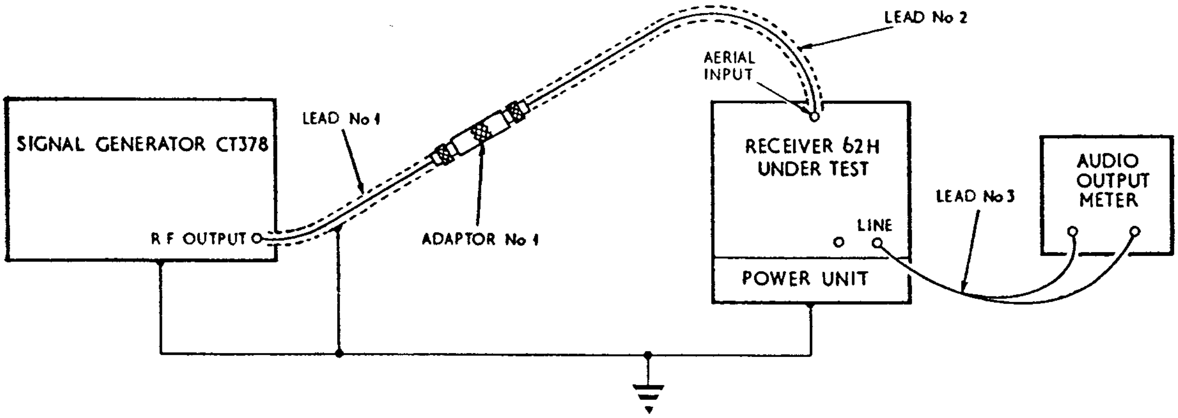
Fig. 3. Conversion graph for using CT54 as a wattmeter

TABLE 1

Results from a typical receiver

Test point in circuit	*Approx. signal generator input in dB above 1μV*	*Typical stage gain in dB*	*Audio output in dB above 1 mW*
V3 grid via C68*	48 dB (250μV)	Via C68=18 dB	+ 15 dB (32 mW)
V3 grid direct (pin 6)	30 dB (32μV)	Of V_3=35 dB	+15 dB (32 mW)
V7 grid (top cap)	65 dB (1·8 mV)	Of V_7=21 dB	+15 dB (32 mW)
V8 grid (top cap)	86 dB (20 mV)	Of V_8=23 dB	+15 dB (32 mW)
V9 grid (top cap)	97 dB (70·8 mV)	—	+3 dB (2 mW)

*During this measurement C68 should be disconnected from the junction of C67 and L7, the signal generator being fed to the free end of C68.



SIGNAL GENERATOR CT378
1 FREQUENCY RANGE – G
2 MODULATION TO "INT. A.M."
3 MAINS "ON"
4 ADJUST COARSE & FINE ATTENUATORS AS DETAILED IN TEXT
5 SET CARRIER LEVEL TO x 1

RECEIVER 62H
1 SWITCH ON
2 SET R F GAIN TO MAXIMUM (CLOCKWISE)
3 INSERT APPROPRIATE CRYSTAL
4 SET METER SWITCH TO "OSC"
5 SET SELECTOR SWITCH TO "MAN G C"
6 SET L F GAIN TO MAXIMUM (CLOCKWISE)
7 CONNECT AUDIO OUTPUT LEAD TO LINE SOCKET
8 ADJUST "TUNE OSC", "TUNE SIG" & AERIAL TRIMMER FOR MAXIMUM AS TUNING PROCEDURE

AUDIO OUTPUT METER
1 SET IMPEDANCE TO 600Ω
2 SET RANGE TO READ + 15 dBm (32 mW)
3 NEITHER OUTPUT TERMINAL MUST BE EARTHED

Fig. 4. Test rig for overall RF sensitivity

OVERALL RF GAIN MEASUREMENTS

General conditions for test

24. It is recommended that only an overall gain from aerial socket to AF output be performed, since noise generator test figure will usually indicate any loss of RF gain (see fault diagnosis table, Chapter 5). The test rig is shown in fig. 4. Attention is drawn to the following points:—

(1) When performing an overall RF measurement, it is very important to use the correct leads and adaptors to prevent stray radiation and instability.

(2) The recommended signal source is Marconi signal generator, type TF801B/3 J.S. Catalogue No. 6625–99–943–1911, in Dockyards; and the signal generator CT378 (A.P. 71115) on board ship.

(3) The noise generator CT207 may also be used as detailed in Chapter 5.

Overall RF gain measurement—preliminary settings

25. The warming up period must not be less than 15 minutes and should preferably be longer (4 hours).

(1) *Receiver 62H settings*

(i) Set R.F. GAIN to maximum (fully clockwise) and switch on receiver.

(ii) Insert crystal at appropriate frequency.

(iii) Set meter switch to TUNE OSCILLATOR.

(iv) Set selector switch to MAN G.C.

(v) Set L.F. gain control to maximum (fully clockwise).

(vi) Connect audio output to meter from the LINE socket, *not* the MONITOR socket.

(vii) Adjust TUNE OSC., TUNE SIG., and AERIAL TRIMMER controls as in normal operation (see Chapter 4). Note also that the crystal current dip on the tuning meter is not less than 0·2 mA.

(2) *AF wattmeter setting*

The setting of the instrument is the same as that already detailed (para. 17(5), (6) or (7)).

(3) *Signal generator CT378 (A.P.71115)*

(i) Set mains to ON.

(ii) Set frequency range to frequency in use (Range G).

(iii) Set modulator selector to INT. A.M.

(iv) Adjust coarse and fine attenuators to give 1μV initially, and then adjust as in text.

(v) Set carrier level to X1.

Procedure for overall RF gain measurement

26. Proceed as follows:—

(1) If available a screened room should be used.

(2) Note that the centre frequency of the IF amplifier must be known to be correct.

(3) The muting valve V15 should still be removed.

(4) The connections are as shown in fig. 4, and it is important to use the coaxial terminating unit shown. This prevents standing waves being set up in the coaxial lead No. 1. The use of clip terminations or similar temporary connections is not acceptable as it gives rise to wide variations in results.

(5) Ensure that all connections are correct and all instruments and the receiver are switched on and thoroughly warmed up. Increase the input from the signal source until an audio output power of 15 dB above 1 mW (i.e. 32 mW) is obtained.

A typical receiver will require 14 to 20 dB (5 to 10μV) input to obtain this audio output.

General rules and conclusions

27. The information given in this Chapter is sufficient to enable all normal servicing using C.N.R.T.E. test instruments to be performed. The actual test rig used will depend upon the allocation of instruments and class of ship. The following general rules should be observed:—

(1) IF realignment should never be attempted unless it has definitely been proved beyond all doubt that the IF centre frequency and bandwidth are at fault, and in the case of 62H, the exact frequency of the centre of the IF is important and the signal generator must be calibrated by a 9·72 Mc/s crystal in the oscillator circuit (see para. 8). The receiver and signal source used must have at least 4 hours running to stabilise.

(2) The most suitable signal generator to use is the CT218, which should be used as detailed in its handbook, and the exact frequency of the IF 9·72 Mc/s set against a crystal (see para. 8).

(3) If the CT218 is not available, a less accurate result can be obtained using the CT212 test oscillator. It is necessary in this case to use the logging scale and interpolate the results. Due to the possibility of backlash in the drive mechanism, all bandwidth measurements should be made by tuning the signal generator in to the desired frequency in one direction only (i.e. either always clockwise or always counter-clockwise).

(4) After an emergency realignment, the receiver should be entered as soon as possible as a Dockyard Defect item, giving full details of the fault which necessitated the realignment.

Details of connecting cables for the different test rigs

28. (1) *Test rig fig.* 1(*a*)

Lead No.	*Details*	*Pattern No.*
1	Short piece of insulated p.v.c. covered wire, as short as possible.	—
	(**Note:** *All leads between oscillator and attenuator should be short.*)	
2	Earth lead of similar type to No. 1.	—
3	Should be as short as possible and screened. Connect screening to earth.	—
4	Depends upon wattmeter used. A 'phone jack connected to a short length of twin cable is satisfactory.	—

(2) *Test rig fig.* 1(*b*)

Lead No.	*Detail*	*Pattern No.*
Note	Circuit in dotted lines should be kept as small and compact as possible and all leads as short as possible.	—
1	Should be a screened audio cable as lead 3 above.	—
2	A 'phone jack connected to a short length of twin cable is satisfactory.	—

(3) *Test rig fig.* 2

Lead No.	*Detail*	*Pattern No.*
1	75 ohm 5 ft. long (supplied with CT202)	A.P.61670 5 ft. long
	or	
	75 ohm 3 ft. long (supplied with CT218)	ZD00378 3 ft. long
2	Supplied with CT82 box of connectors	A.P.60865
3	As leads para. (b) 2 and para. (a) 4 above	—
Adaptor No. 1	Terminating "L" pad 75 ohms.	A.P.71232

(4) *Test rig, fig.* 4

Lead No.	*Detail*	*Pattern No.*
1	75 ohm 5 ft. long supplied with CT202 75 ohm 3 ft. long supplied with CT218	A.P.61670 ZD00378
2	75 ohm lead supplied with CT82	A.P.60866
3	Depends upon wattmeter used, see para. (b) 2 and para. (a) 4 above.	—
Adaptor No. 1	Terminating "L" pad 75 ohm	A.P.71232

Dmd 6270 267152 3250 8/58 AB539/3 1770

RECEIVER, TYPE 1392A

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

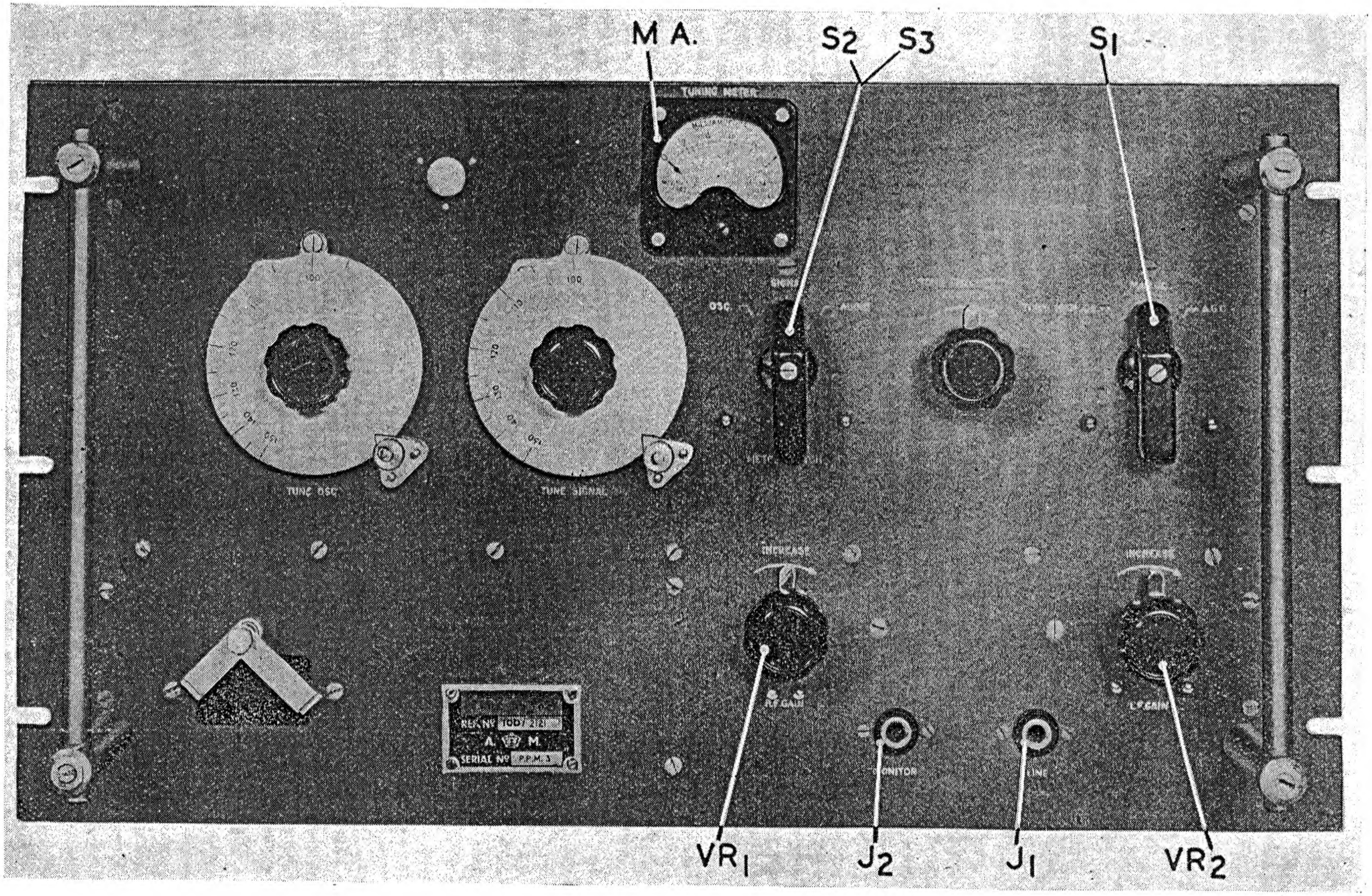


Fig. 1.—Receiver, type R.1392A—front view

RECEIVER TYPE, 1392A

INTRODUCTION

Purpose

1. The R.1392A shown in fig. 1 and 7 is a modified version of receiver, type R.1392, designed for use for communication and D.F., and is primarily intended for employment with transmitter, type T.1131A. It comprises a 15-valve superheterodyne receiver designed for the reception of R/T or C.W. signals, with or without automatic gain control.

2. The frequency range of the receiver is from 100 to 150 Mc/s, and is suitable for the reception of transmissions spaced by 90 kc/s.

3. The receiver is built on a 10 × 17 chassis fitted with a 19 in. panel for mounting on standard telephone racks or cabinets. It is provided with a suitably-ventilated dust cover.

Power supplies

4. The R.1392A is designed to operate from a filament supply of 6·3 volts at 4·0 amperes and a high tension supply of 240–250 volts at 80 milliamperes. Neither side of the latter supply is earthed.

5. Supplies are normally derived from a 200–250 volt single-phase A.C. mains via a power unit, type 234A. For 6-v. d.c. supplies P.U.138 is employed. These power units are built on a separate chassis fitted with a 19 in. panel as shown in fig. 9.

GENERAL DESCRIPTION

6. The receiver, type 1392A, consists of an input circuit designed for connection to coaxial feeder cable having a surge impedance of 100 ohms. This circuit is followed by two stages of signal frequency amplification embodying three tuned circuits and employing valves, type VR136.

7. Frequency changing is effected by control grid modulation of the mixer valve, type VR136.

8. The heterodyne oscillator is crystal controlled, the crystal frequency being $\frac{1}{18}$th of the desired output frequency. The frequency multiplication is obtained by use of a crystal oscillator and trebling circuit using a VR53 valve, followed by a frequency multiplying stage employing a VR136 which selects the 18th harmonic of the crystal frequency. This is fed to a tuned amplifier stage employing a second VR136 valve, the output of which is applied to the control grid of the mixer valve. The frequency multiplying chain employs 4-ganged tuning capacitors.

9. The intermediate frequency amplifier consists of three amplifying stages in which valves of the VR53 type are employed. These intermediate circuits have band pass characteristics.

10. Rectification at the output of the I.F. amplifying chain is afforded by the use of a double diode triode valve, type 6Q7G. The audio frequency component of the rectified current being amplified first by the triode portion of the above valve and then by the output valve, type VR67. Resistance capacity inter-valve coupling is employed which together with cathode degeneration below 400 c.p.s. provides low note attenuation.

11. The output of the amplifier is designed for connection to a balanced line having a surge impedance of 600 ohms. In the 600 ohm impedance circuit a low pass filter is introduced, the function of which is to attenuate all frequencies above 3,000 c.p.s.

12. The output of the filter is jack terminated, provision being made for line and monitoring facilities.

13. Delayed amplified AGC is provided using a second valve, type 6Q7G double diode triode capacity coupled to the output of the final I.F. amplifying stage. The control is designed to be fully operative with an input signal voltage of the order of 10 μV at 100 Mc/s and 5 μV at 150 Mc/s. Gain control is applied in the form of additional negative bias to the control grid of the two signal frequency amplifying valves and the first and second stages of the I.F. amplifier.

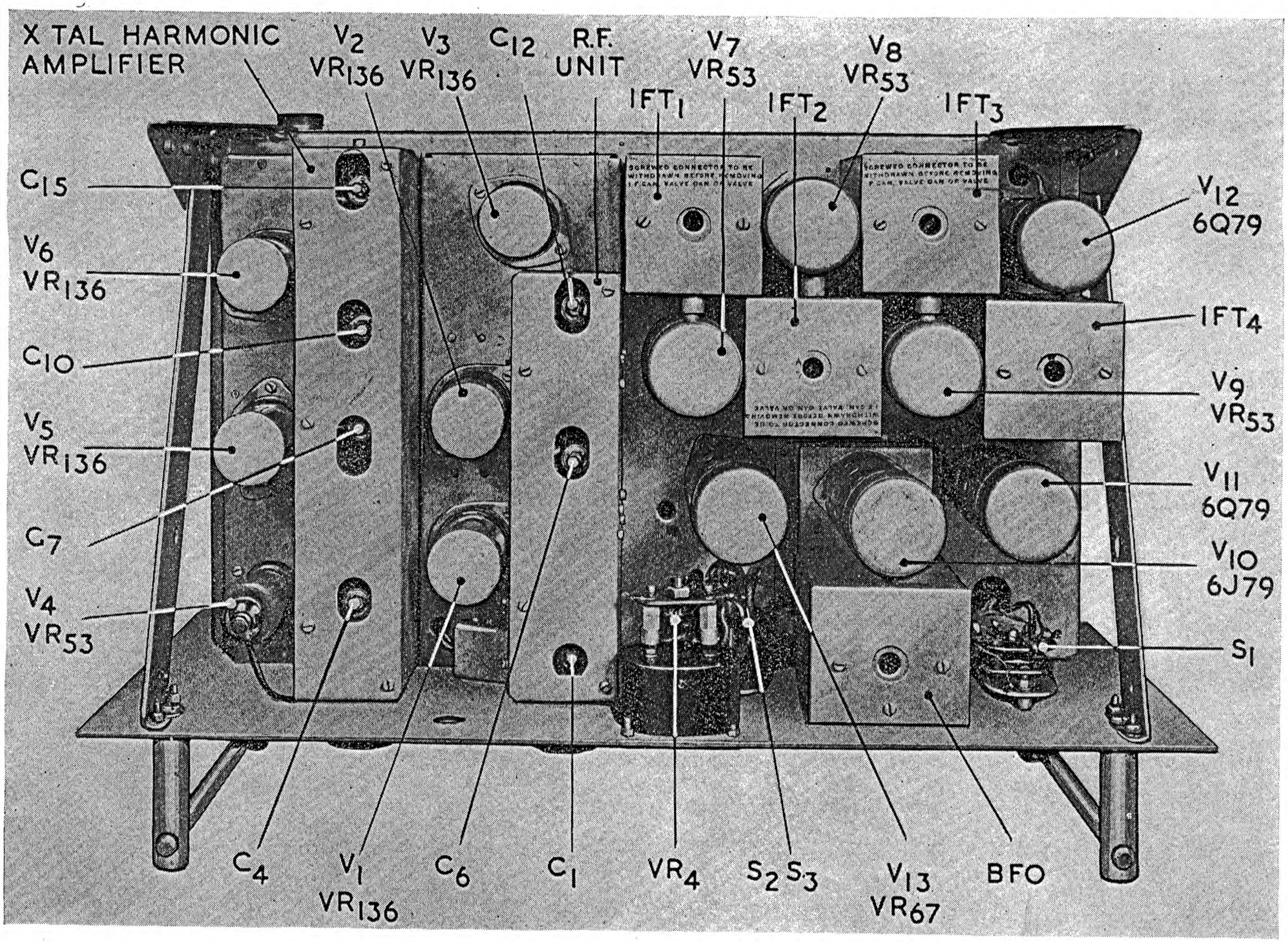


Fig. 2.—Top view of chassis, R.1392A, valves—screens in position

14. A beat oscillator at I.F. is provided for the reception of unmodulated incoming signals. Provision is made for beat tone adjustment.

15. Protection is afforded against interference from pulse transmissions by means of a series diode limiter circuit and a muting circuit is provided to reduce site noise in the absence of a transmission.

The following tuning and control facilities are provided:—

(*a*) Signal frequency amplifier tuning condenser, consisting of three-ganged capacitors, driven by a slow motion dial having a drive ratio of 5·5:1 respectively.

(*b*) Oscillator tuning condenser, consisting of four-ganged capacitors with similar drive.

(*c*) Manual S.F. and I.F. gain control.

(*d*) Manual A.F. gain control.

(*e*) Meter switch with one 0–1 milliammeter providing the following facilities:—

- (i) Visual tuning indication of crystal chain.
- (ii) Visual tuning indication of amplifier stages.
- (iii) Visual tuning indication of A.F. output level.

A second switch is provided, which performs the following functions:—

(*a*) Automatic gain control.

(*b*) Manual gain control.

(*c*) Manual gain control and B.F.O.

CONSTRUCTIONAL DETAILS

16. Reference should be made to fig. 1 to 6, which show various views of the receiver. It will be seen that the receiver consists of a rack mounted front panel supported by two angle brackets and screwed to a 17 in. × 10 in. silver-plated chassis, on the top of which are mounted the following sub-assemblies:—

(1) Signal amplifier unit (V_1, V_2 and V_3).

(2) Crystal harmonic amplifier unit (V_4, V_5 and V_6).

(3) I.F.T_1, I.F.T_2, I.F.T_3, I.F.T_4 (V_7, V_8, V_9).

(4) Intermediate frequency oscillator (V_{10}).

17. Below the chassis are mounted sub-assemblies for valves 7, 8, 9, 10, and 11, on which the associated components are mounted. This method has been adopted for ease of assembly and all component leads have been restricted to the shortest possible length. In the case where one lead on a component is longer than the other, the lead at the high R.F. potential has been made the shorter whenever possible. Although this method of mounting provides the most convenient assembly, it also renders the replacement of individual components reasonably simple. Two large holes are provided in the end of the chassis to give additional accessibility to components.

18. Effective screening is necessary for the various high potential grid and anode leads and terminals in the I.F. amplifier. In the case of the anode leads this is achieved by the use of small screening covers screwed to the chassis. To avoid the use of unsatisfactory screened grid leads, a screwed grid connector has been developed and applied to all I.F. grid connections. This method provides the necessary screening required.

19. The variable tuned circuits in the crystal and tuned amplifier circuits consists of small straight line variable capacitors (one twin section is employed in the crystal harmonic amplifier) coupled by means of flexible self-aligning couplings which are free of both backlash and angular rotational errors. The capacitance alignment of these capacitors is carried out after they are assembled and coupled together.

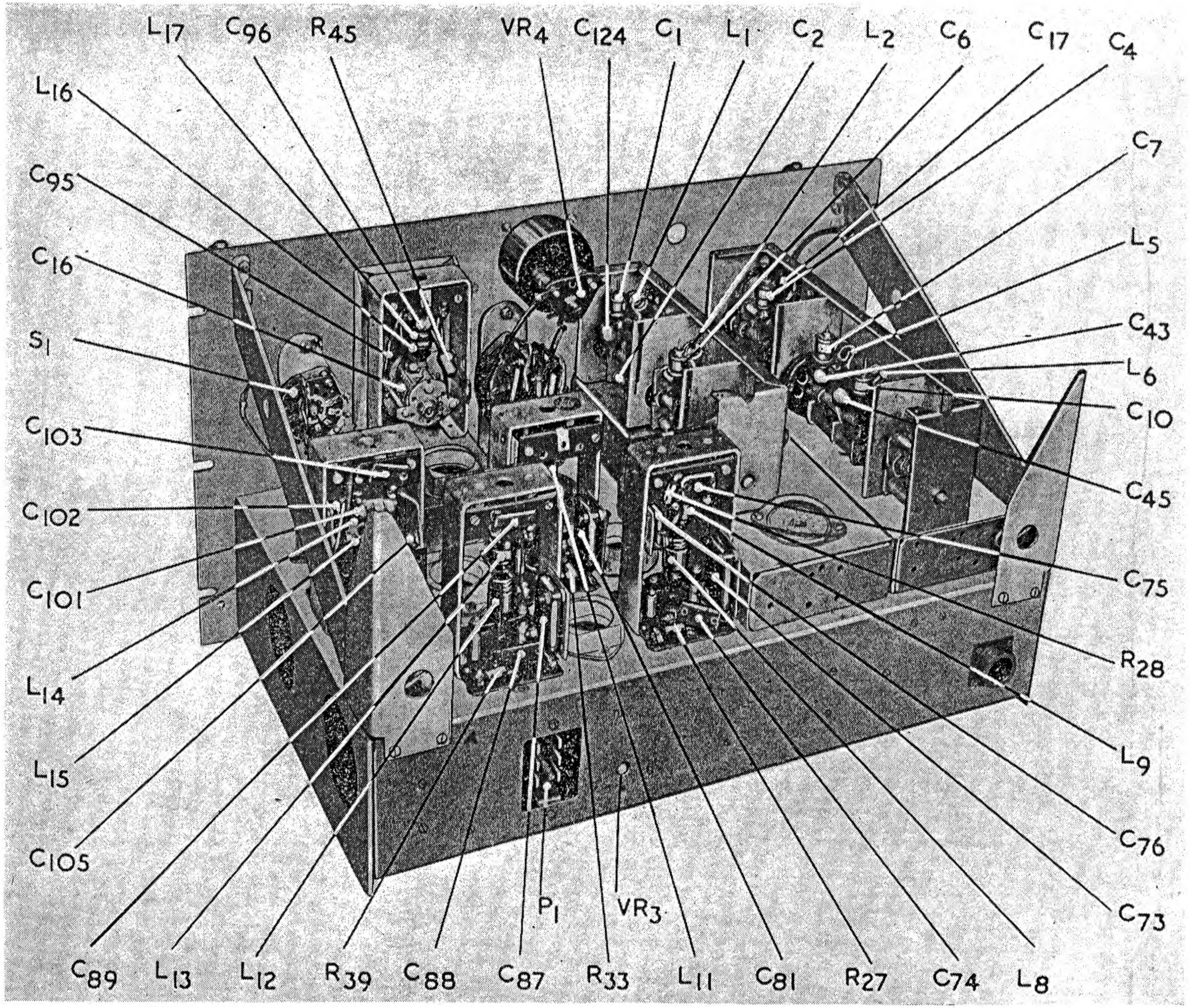


Fig. 3.—Top rear view, R.1392A, valves-screens removed

20. Care has been exercised in the wiring and assembly of the two amplifier units to ensure that all components associated with grid and anodes are wired as short as possible and disposed to give the greatest possible clearance to surrounding terminals, components and metal work consistent with short leads to ensure minimum stray capacitance with maximum stability of capacitance.

21. The I.F. transformers consist of a primary and secondary winding mounted coaxially, each tuned by a screw dust iron core. These are held in a "U" shape frame which carry the necessary resistors, capacitors, terminal plates and screening covers. The tuning capacitance is in the form of silver mica fixed capacitors. Two rotating switches are mounted on the chassis by means of brackets. One controls the circuit position of the meter mounted on the front panel immediately above it and the other gives different gain control operations and switches in the I.F. oscillator.

22. Particular attention has been paid to tropical requirements at all H.T. and high-resistance-to-earth points, high quality Bakelite being employed with adequate leakage path lengths. In addition care has been taken to ensure that the insulation of all A.G.C. feed leads is maintained under all conditions of humidity by the employment of plastic insulating materials.

23. To facilitate servicing and tracing of leads, the following colour code has been mainly adopted:—

Black	Earth.
Red	H.T. positive.
Orange	Screens.
Yellow	Anodes.
Green	Heater (live side).
Blue	L.F. circuits (live side).
Grey	Cathodes and H.T. negatives (when below earth).
White	A.G.C. feeders.

In the cable form it has, however, been necessary to deviate from the above colour code in order to make a distinction between the various wires which go to make up the cable form. Where this has occurred, the colour of the next part of the circuit to that in question has been adopted whenever possible.

Power supplies

24. Power unit, type 234A, shown in fig. 8, 9, 10, or 11 is designed to be used in conjunction with receivers, type P.38 and 1392A. It supplies both L.T. and H.T. voltages required by these receivers.

25. The unit is built on a 17 in. × 10 in. chassis, and has a ·125 in. thick steel, zinc-plated panel measuring 19 in. × 7 in. arranged for relay rack mounting. A meter is incorporated to read the input voltage to the transformer primary and also the H.T. output voltage. The output voltage can be slected to suit the needs of the receiver in use by means of a switch which alters the voltage tapping on the secondary of the mains transformer.

26. It must be noted that the negative return lead is insulated from the chassis.

27. A dust cover is provided which has four louvres on top and four at the rear to ensure good ventilation. The cover, as a whole, is attached to the chassis by means of two "DZUS" fasteners.

28. A 0–300 v. moving iron meter situated on the front panel of the power unit is normally connected across the primary of the mains transformer and measures the input voltage, but by means of a lever switch marked "Press to read H.T.", the meter can be switched over to read the smoothed D.C. secondary voltage of the transformer.

29. With the exception of the filter circuit and rectifier valve holder, the wiring is carried out by cable form, using "UNICEL 4" for all leads except the L.T. suppl y, which is wired in "UNICEL 19".

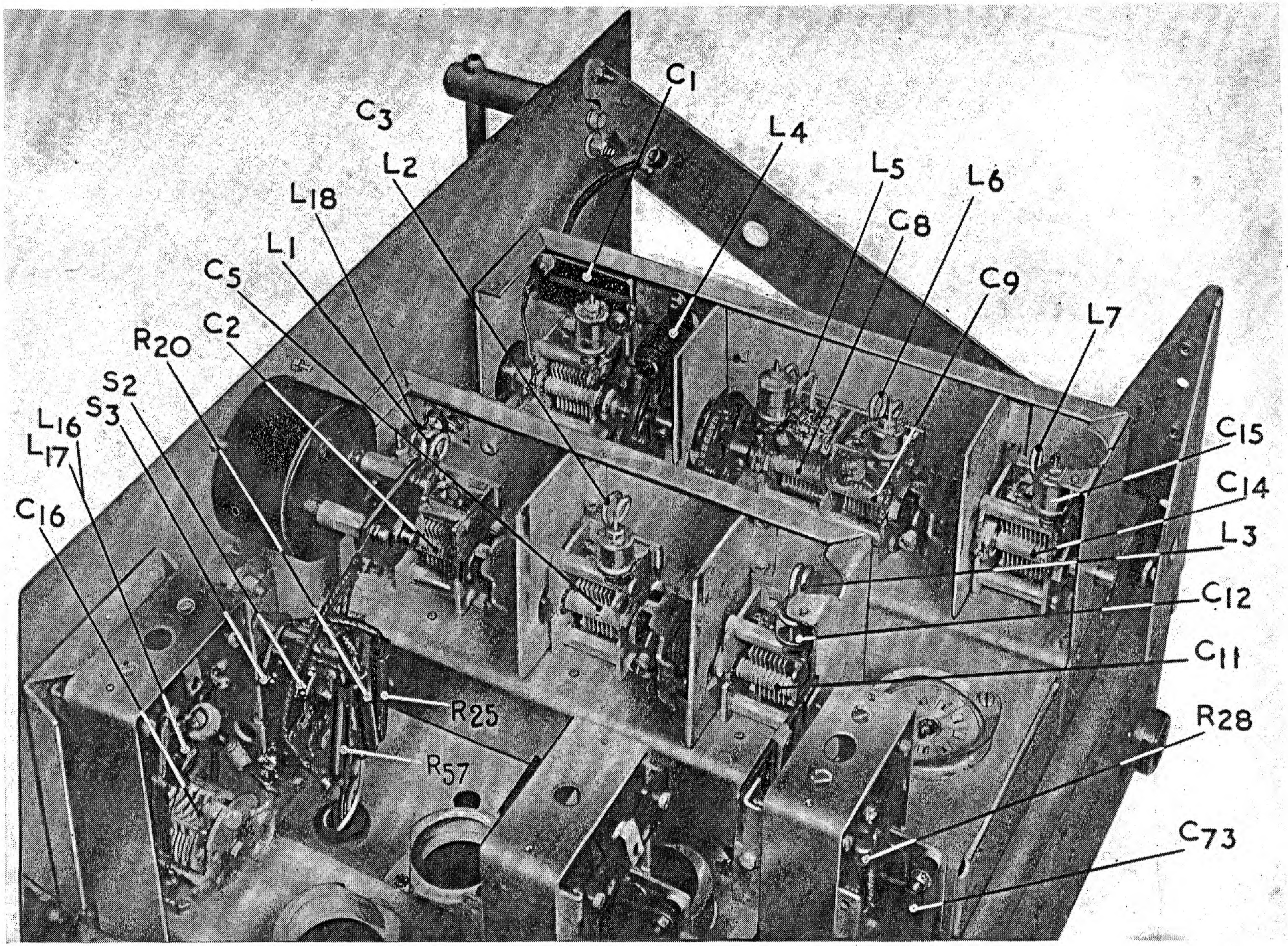


Fig. 4.—R.1392A, top side view showing variable condensers

Receiver controls and fittings

30. The following controls are fitted to the front panel of the receiver, type R.1392A, unless otherwise stated.

Key	*Controls*	*Remarks*
C_2, C_5, C_{11}	"TUNE SIGNAL" control	3-gang variable capacitor tuning the radio frequency stages. Direct scale calibration is in Mc/s.
C_3, C_8, C_9	"TUNE OSC" control	4-gang variable capacitor tuning the first heterodyne osc. stages. The direct frequency scale calibration is in Mc/s.
VR_1	"INCREASE" control	R/F gain control (situated nearest centre of panel).
VR_2	"INCREASE" control	A/F gain control (situated near edge of panel).
SW_1, SW_2	"METER SWITCH"	4-position switch labelled "Osc", "Signal", "Audio".
	"TUNING METER"	0–1 milliammeter.
SW_3	Gain control switch	3-position switch labelled "Tone Man. G.C.", "Man. G.C.", "A.G.C.", switches gain control as designed. In the first position of this switch the beat oscillator is operative.
C_{16}	"TONE FREQUENCY" control	Variable capacitor tuning the beat oscillator stage.
J_1, J_2	Jack sockets	Labelled "Monitor" and "Line" respectively.
ST_1	"CRYSTAL" socket	Designed to fit standard A.M. crystal holders 10X and 10XJ.
ST_2	Aerial socket	Designed to fit standard plug connected to end of concentric line.
P_1	Power plug	6-way Jones plug situated at back of receiver. Designed to fit socket at end of cable for power unit.

Power unit controls and fittings

31. The following, unless otherwise stated, are fitted on the front panel of the power unit.

Key	*Controls*	*Remarks*
S_2	"ON/OFF" switch	Makes and breaks primary circuit to transformers.
PL	Pilot lamp	Connected in parallel with receiver filament supply.
S_3	Meter switch	Lever labelled "Press to read H.T. output volts". When button released meter reads input voltage across transformer primary, when pressed reads H.T. voltage supplied to receiver.
VM	Voltmeter	Moving iron 0–300 volt meter.
F_1, F_2, F_3, F_4	"Fuses" compartment	Contains fuses and links for selecting input voltage (S_1). Access is by unbolting the protecting cover which must *never* be done with mains switch "ON"
P_1	Power unit plug	Situated at back of power unit. Designed to fit two-way socket at end of mains lead.
P_2	Power output socket	Six-way socket situated at back of power unit. Designed to fit Jones plug at end of cable.
S_4		Switches the tapping point on mains transformer secondary to provide alternative voltages for operation of R1392A or P38 receivers.

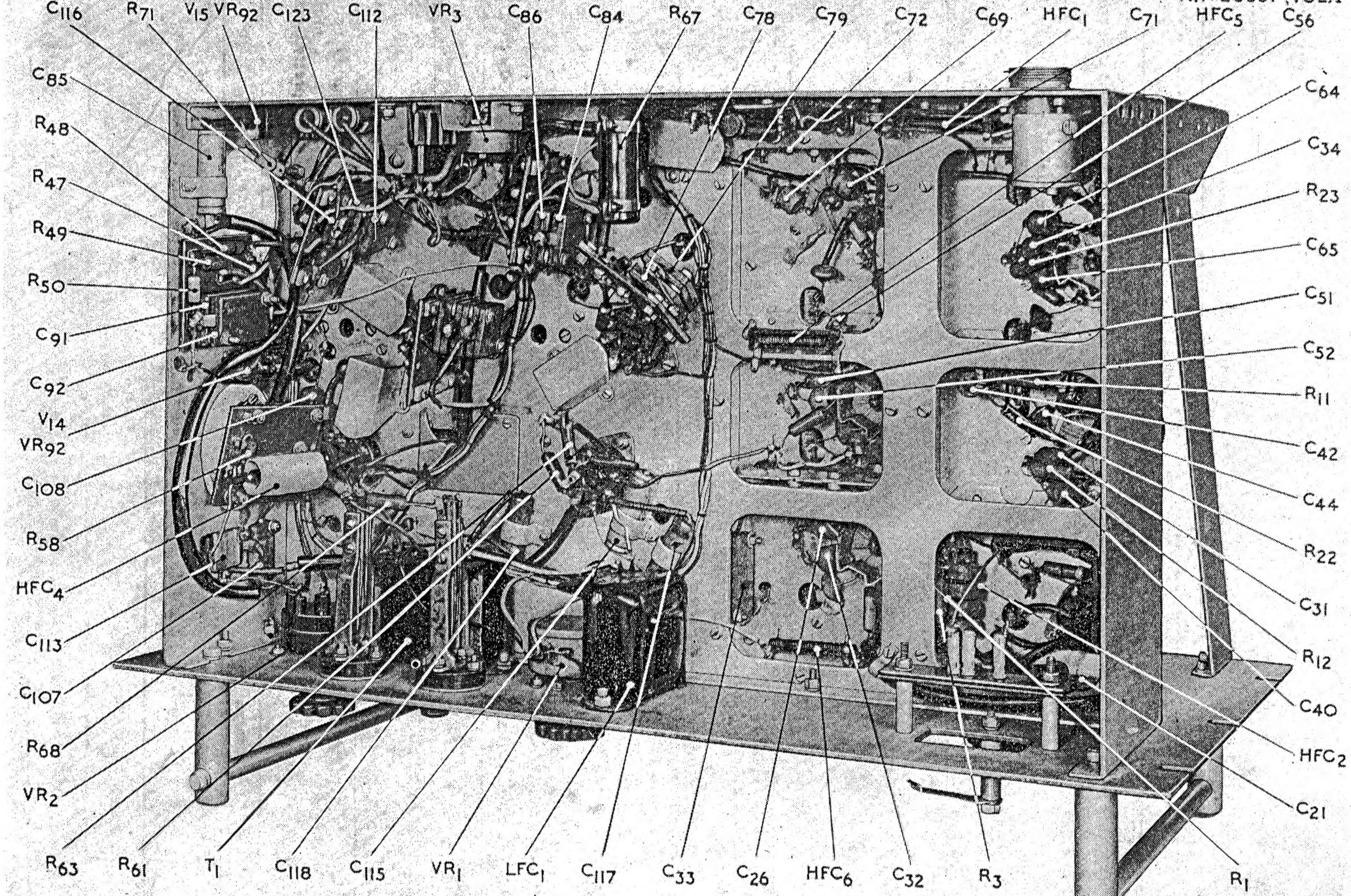


Fig. 5.—R.1392A, underside view showing components

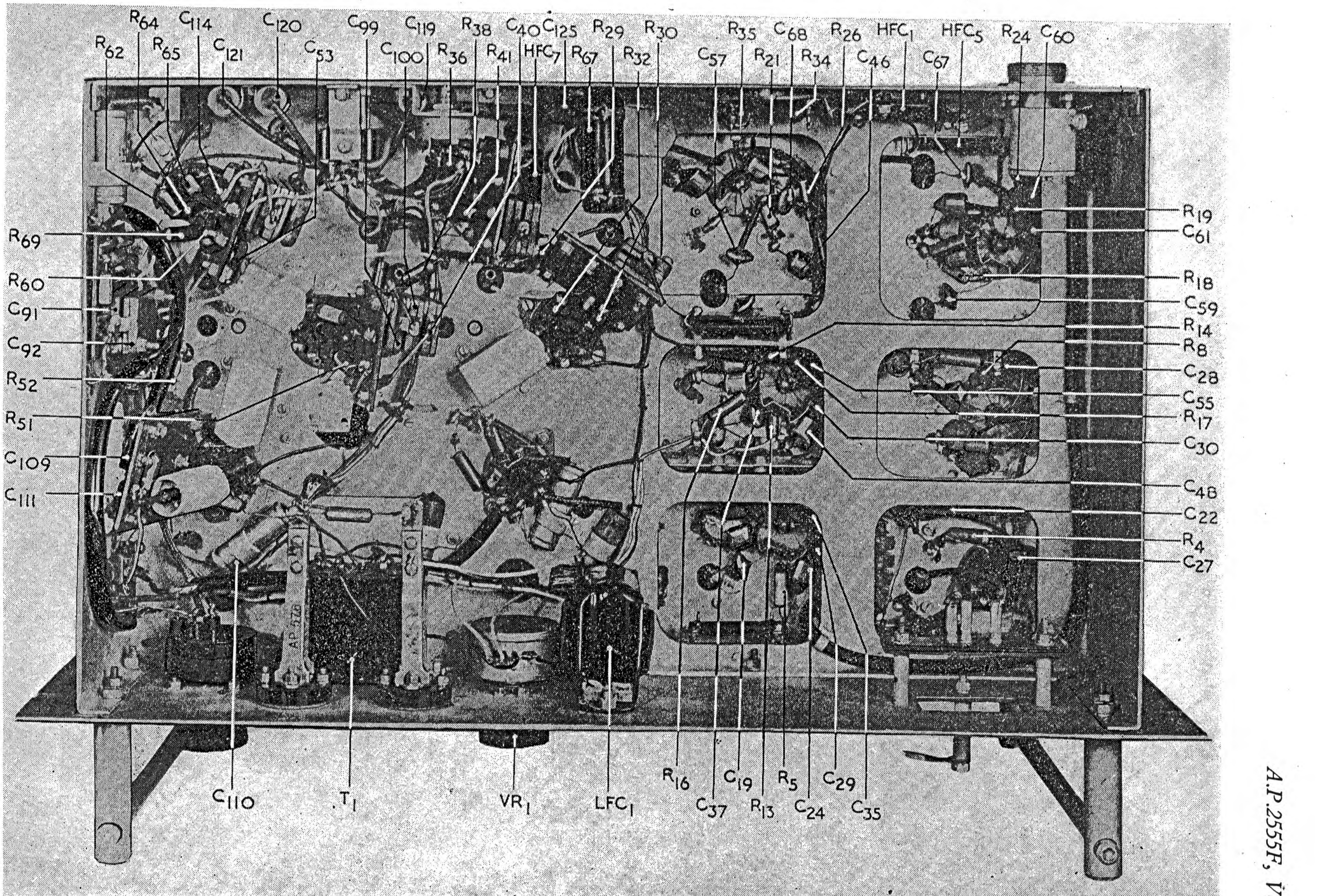
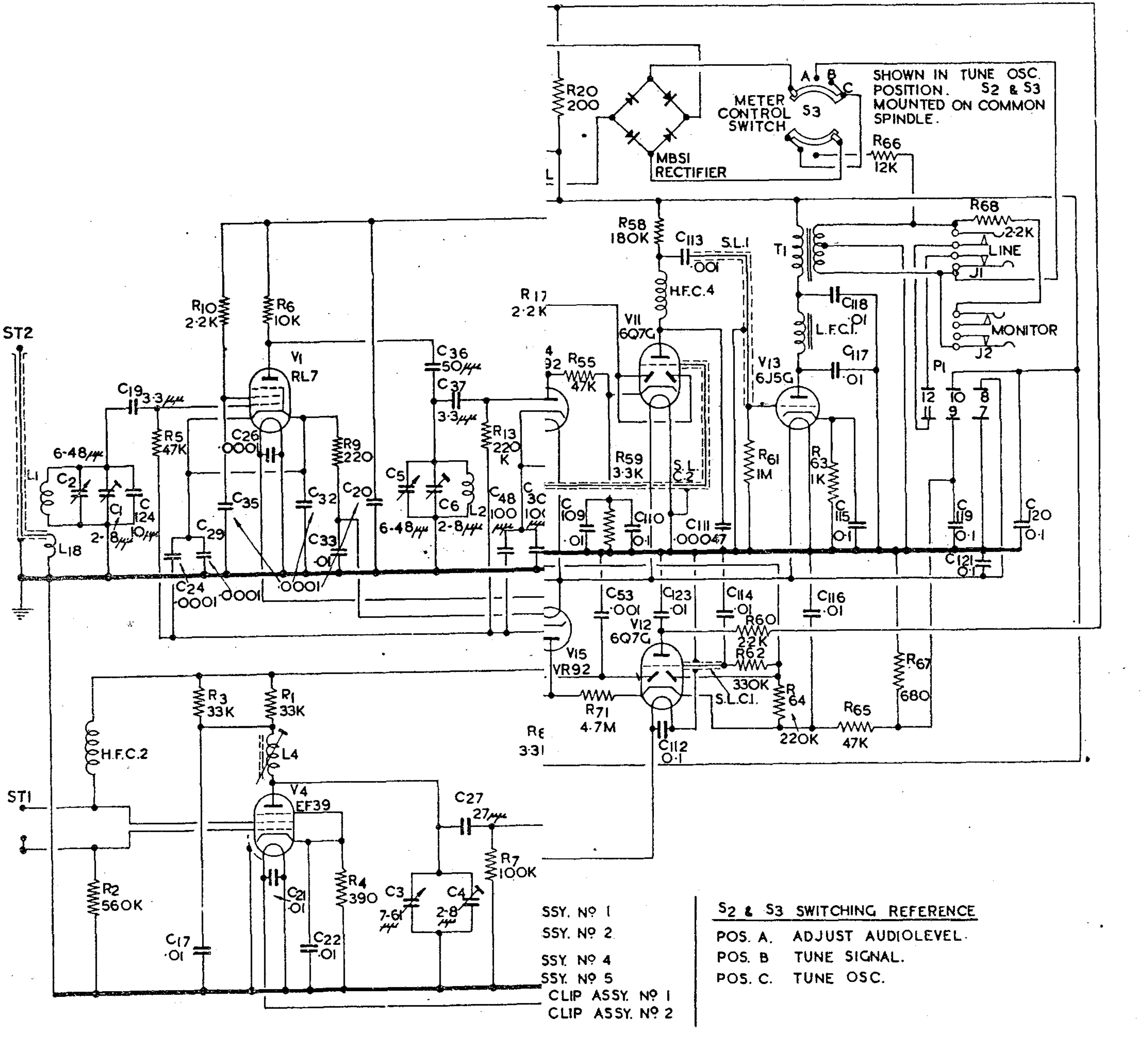


Fig. 6.—R.1392A, underside view showing components



PP3840 M /G1319 6/45 5925 C & P Gp. 959 (4)

OPERATING INSTRUCTIONS

Receiver tuning

32. To operate the R.1392A with aerial connected and the set switched on, the following procedure should be adopted:—

(*a*) Insert a crystal of suitable frequency for the channel required

$$\text{f crystal} = \frac{(\text{f signal} - 4{\cdot}86)\ \text{Mc/s}}{18}$$

i.e., the R crystal will be 0·27 Mc/s lower in frequency than the transmitter crysta..

(*b*) Set the meter switch to "Osc".

(*c*) Set the gain control switch to A.G.C.

(*d*) Set the "Tune Osc" and "Tune Signal" dials to the required signal frequency as indicated by the calibration.

(*e*) Find the dip in the reading of the tuning meter which occurs when the "Tune Osc" dial is moved about ± 3 Mc/s on either side of the dial reading concerned. Set the "Tune Osc" dial to give the trough of this dip. The crystal oscillator harmonic selector is then correctly tuned for the required channel.

(*f*) Set the meter switch to "Signal".

(*g*) In the presence of a test signal find the dip in the reading of the tuning meter which occurs when the "Tune Signal" dial is moved about ± 3 Mc/s on either side of the dial reading concerned. Set the "Tune Osc" dial to give the trough of this dip. The signal amplifier is then correctly tuned for the required channel.

33. With very weak signals indeed (less than 5–10 μV) or no signals it will not always be possible to tune the signal amplifier in this manner as insufficient signal may be received to operate the A.G.C. If this is the case, proceed as follows:—

(*h*) Set the meter switch to audio.

(*i*) Set the L.F. gain control to maximum (and the R.F. gain control to maximum if the gain control switch is on manual) and adjust R.F. tuning to provide the maximum signal output level.

34. When working on "Manual G.C.", always set the L.F. gain control to about ¾ of max. for high audio levels, and adjust the overall gain by means of the R.F. control. For lower audio levels, the L.F. control should be reduced accordingly. For C.W. operation, proceed as described, then:—

(*k*) Set the gain control switch to tone and manual G.C. and

(*l*) Adjust the beat frequency given by the intermediate frequency oscillator to the desired value by means of the tone frequency control.

Operation of power unit

35. Before putting the unit into service it should first be inspected for superficial damage, possibly received in transit.

36. The tappings on the mains transformer primary should be adjusted to suit the voltage to be used with the power unit. To do this, take off the cover located on the front panel marked "FUSES". This is done by undoing the two wing nuts and pulling on the handle provided. The transformer primary tappings and the link connection are now exposed so that the link switch can be set by pulling out the link and inserting it in its correct position.

37. Before replacing the cover, examine the fuses located on the underside of the fuse cover in order to see that they are of the correct value, e.g. 1 amp. fuses in each mains input lead, 150 m.a. fuses in H.T. + and − leads.

CIRCUIT DESCRIPTION

General

38. The 1392A receiver comprises an R.F. amplifier, frequency changer, heterodyne oscillator, I.F. amplifier, beat oscillator, second detector, output stage and A.G.C. circuit, pulse limiter and noise suppressor.

39. Refer to the circuit diagram, fig. 7. The aerial input is coupled to the receiver by means of the circuit comprising L_{18}, L_1 tuned by C_2, C_1 and C_{124}, so that it matches a coaxial feeder cable having a surge impedance of 100 ohms. •

Aerial input circuit

40. The signal is fed from this aerial input coupling circuit, via C_{19}, to the grid of V_1 (VR136) the first signal frequency amplifying valve. In this valve, the signal is amplified and passed from the anode, via C_{36}, to a tuned radio frequency circuit comprising L_2 tuned by C_5 and the trimmer C_6.

R.F. amplifier circuits

41. C_{37} couples the amplified signal from the aforementioned tuned circuit to the grid of V_2 (VR136) the second signal frequency amplifying valve. In this valve the signal receives further amplification and is fed from the anode of V_2, via C_{56}, to a tuned circuit comprising L_3 and C_{11}. C_{12} is the associated trimmer capacitor. The output from the tuned circuit is fed to the grid of V_3 via C_{57}.

42. The R.F. tuned circuits and the input circuit are tuned by three ganged variable condensers, controlled by the TUNE SIGNAL KNOB on the front panel of the receiver. Trimming capacitor C_1, C_6, or C_{12} are connected in parallel with the variable capacitors C_2, C_5, and C_{11} respectively. When "MAN G.C." is used, automatic grid bias is applied by the cathode series resistances R_9, R_{16}, and the variable control VR_1. When A.G.C. is used, VR1 is short-circuited and bias, additional to that due to R_9 and R_{16} is applied by the A.G.C. voltage across R_{50}.

I.F. amplifier circuits

43. V_3 is a frequency changer valve. In this valve, the radio frequency signal is mixed with the heterodyne voltage produced by the heterodyne oscillator to produce an intermediate frequency of 4·86 Mc/s. Capacitance coupling through C_{57} and C_{68} is used and no grid bias is applied. The anode circuit tuned to the I.F. of 4·86 Mc/s is inductively coupled by L_8 and L_9 to the similarly tuned grid circuit of the 1st I.F. amplifier valve. The I.F. signals so produced are then passed through the I.F. chain comprising V_7, V_8, and V_9 (VR53's) whose intermediate circuits consist of I.F.T_1, I.F.T_2, I.F.T_3, and I.F.T_4. These I.F. transformers have band pass characteristics, are all tuned to a mid-frequency of 4·86 Mc/s and have a band width of ± 25 kc/s at 6db down. Each of the dust cores of the coil L_8 to L_{15} is provided with a trimmer.

44. When Man. G.C. is used, the first two stages have automatic grid bias applied by the cathode series resistance R_{30}, R_{31}, R_{40}, R_{41} and the variable control VR1. When A.G.C. is used VR1 is short-circuited and bias, additional to that due to R_{30}, R_{31}, R_{40}, R_{41}, is applied by the A.G.C. voltage across R_{50} and R_{48}. The third stage has fixed automatic grid bias applied by the cathode series resistance R_{51}.

Pulse limiter

45. In order to limit pulse interference a VR92 diode valve V_{14} is connected in the audio feed from V_{11}, the second detector valve. When pulse signals of greater level than 100 per cent. modulation are received the lower end of L_{15} connected to R_{54} momentarily goes negative many more times than the steady carrier and the diode V_{14} becomes non-conducting and pulse interference is thus momentarily cut off.

46. This action is as follows. The time constant of R_{44} and C_{108} is slower than the required modulation, hence the lower end of R_{70} is always at the same potential as the steady carrier potential at the lower end of L_{15}. However, the time constant of R_{70} and C_{126} is much faster and can be ignored, and since R_{70} is many times greater than the diode conductance the cathode and anode of V_{14} are virtually tied together during normal operation.

Interchannel noise limiter

47. The VR92 diode V_{15} and C_{85} is connected in shunt across the audio gain control VR2. In the absence of a carrier a positive priming voltage is derived from the A.G.C. circuit, causing V_{15} to become conducting which ensures that a large attenuation is provided. The presence of a carrier produces a negative priming voltage, causing V_{15} to become non-conducting, this removes the shunt and the A.F. signals are no longer attenuated.

Second detector and L.F. amplifier

48. The L.F. signals are coupled into the grid of V_{11} (6Q7G) a double diode triode valve via C_{107} and the variable resistance VR.2, which is the audio gain control. Here the L.F. signals are amplified. The diodes of this double triode is used as the second detector. The I.F. output is developed in the tuned circuit (L_{15}, C_{104}) inductively coupled to the anode of the 3rd I.F. valve V_9. The diode anode is connected to the top of the tuned circuit, the bottom of which is connected to the cathode through resistance R_{54}, R_{55} across which the A.F. voltage is developed.

Output circuits

49. The output from the anode of V_{11} is resistance capacitance coupled (R_{58} and C_{113}) to the grid of V_{13} (6J5G) the audio output valve which further amplifies the audio frequency signals.

50. The output is fed via an audio transformer T_1 into a low pass filter comprising C_{117}, LFC_1 and C_{118} which attenuates all frequencies above 3,000 c/s. The output which is designed for connection to a balanced line having a surge impedance of 600 ohms, is jack terminated. Provision is made for line monitoring facilities by means of J_1 and J_2 which are connected in parallel.

Hèterodyne oscillator circuit

51. The heterodyne oscillator which is crystal controlled comprises V_4, V_5, and V_6. The crystal frequency is $\frac{1}{18}$th of the desired output frequency.

52. V_4 (VR.53) operates as a Pierce crystal oscillator and trebler valve, with the crystal connected between the grid and screen. The screen is at H.T. positive potential, but is isolated from the H.T. line for R.F. by the choke H.F.C_2. The anode circuit comprises L_4, C_{17}, C_3, C_4, and is tuned by C_3 to three times the crystal frequency. The trebled crystal frequency output from the anode of V_4 is coupled, via C_{27}, to the grid of the harmonic generator valve (V_5).

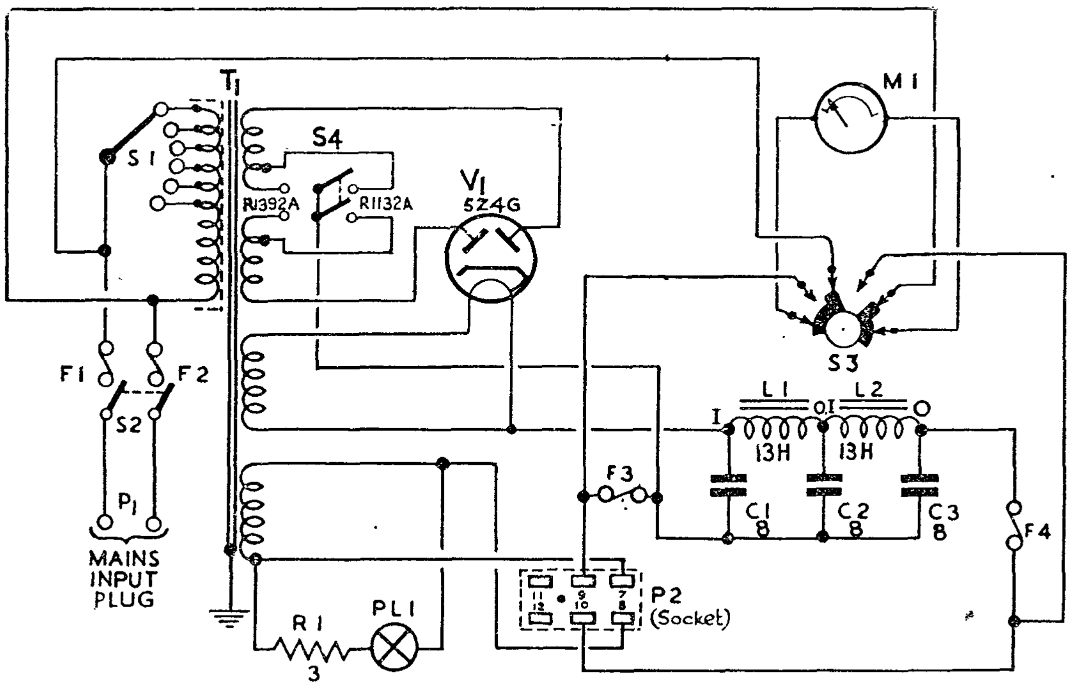


Fig. 8.—Power unit, type 234A, circuit diagram

53. V_5 (VR.136) is a frequency multiplier whose tuned circuit consists of L_5 tuned by C_8, C_7, and C_{43}. This circuit is tuned to the 18th harmonic of the crystal frequency and is inductively coupled to a similar circuit comprising the coil L_6 tuned by C_9, C_{10}, and C_{45}. The output is fed via the blocking condenser C_{59} into the grid of V_6 (VR.136) which functions as a tuned amplifier.

54. The tuned output stage of V_6 comprises L_7 tuned by C_{14} and C_{15} to 18 times the crystal frequency and from which signals are fed, via C_{68}, to the control grid of V_3 the mixer valve.

55. The four tuning condensers used in the heterodyne oscillator C_3, C_8, C_9, C_{14} are ganged and controlled by the TUNE OSC knob on the front panel of the receiver. Trimming capacitors C_4, C_7, C_{10}, and C_{15} respectively are connected in parallel with the variable capacitors. Fixed automatic bias is applied to each of the three valves by the series cathode resistances R_4, R_{12}, R_{23} respectively.

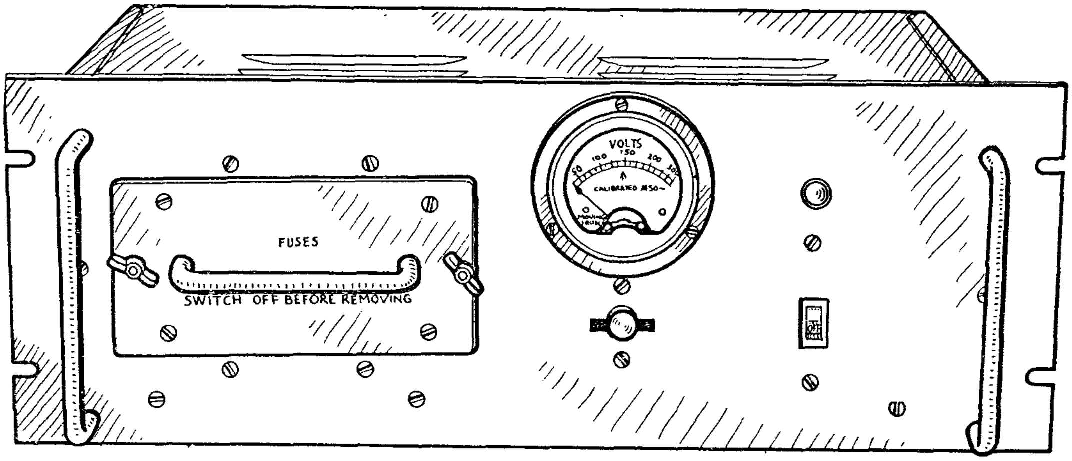


Fig. 9.—Power unit, type 234A, front view

A.G.C. circuit

56. Delayed amplified automatic gain control is provided by V_{12} (6Q7G) a double diode triode. One diode portion of this valve is capacitance coupled through C_{101} to the output from the anode of V_9 the final I.F. amplifying valve. The d.c. output from V_{12} is fed to the control grid of the signal frequency amplifying valves V_1, V_2 and the first and second stages of the I.F. amplifier (V_7 and V_8) in the form of additional negative bias.

57. Delayed operation is obtained as follows:—

When the set is on, with no incoming signal, the standard current of all valves which passes through R_{67}, causes a constant voltage of about 50 volts to appear between the earth and H.T. negative. The grid of V_{12} is at approximately cathode potential, whilst the triode anode is near H.T. positive, so that a considerable current is flowing through the triode, and so through R_{65}, producing a voltage drop across the latter of approximately 60 volts. Thus the cathode potential is about 10 volts positive to earth and since the diode anode connected to R_{69} is at earth potential this diode is inoperative.

58. When a signal enters the receiver an I.F. voltage appears at the anode of V_9 which is applied through C_{101} to the diode anode V_{12} connected to it. The positive swings make this diode conducting, giving rise to a current in R_{64}, so that the diode anode assumes a negative potential. This causes a negative bias to be applied to the grid of V_{12}, the magnitude of which is dependent on the carrier strength. This gives rise to a reduction in the current through the valve, and hence through R_{65}, so that the cathode assumes a potential between +10 volts and −50 volts relative to earth, dependent upon the signal strength. For small signals the cathode is still above earth potential, so that the diode with its anode connected to R_{69} is inoperative. For larger signals the delay voltage is overcome, and this diode passes current, the path being completed through R_{69}, R_{48}, R_{50}, R_{67}, and R_{65} so that the diode anode assumes a negative potential with respect to earth dependent on the carrier strength. The negative voltage appearing across R_{50} is applied to V_1 and V_2 whilst that across R_{50} and R_{48} is applied to V_7 and V_8.

Beat oscillator

59. V_{10} comprises a beat oscillator operating at I.F. with control grid, priming grid and cathode as the oscillator electrodes connected to L_{16} and L_{17} respectively. L_{16} is tuned to I.F. by C_{16} and C_{95}. The anode is electron coupled, being separated electrostatically by G_2 and G_3, both of which are held at earth potential as far as oscillator frequencies are concerned.

60. H.T. is only supplied to V_{10} with the control switch SW_3 as in the TONE MAN G.C. position.

61. The anode of the second I.F. amplifier valve (V_8) is coupled by C_{98} to the anode of the beat oscillator valve (V_{10}). Thus the output from V_{10} (when used) is combined with the output from V_8, and both are amplified by V_9.

62. The output from V_{10} is at a frequency usually adjusted to beat at approximately 1,000 c/s with the output from V_8, and is consequently sufficiently close to 4·86 Mc/s to be well within the band passed by the tuned circuits, which have a nominal band width of 50 kc/s.

63. Since the maximum variation in the capacity of C_{16}, which is controlled by the TONE FREQUENCY control on the front panel, is of the order of $\frac{1}{100}$th of the total capacity of C_{16} and C_{95}, in parallel, the frequency of the output is variable over a small range about the mean I.F. of 4·86 Mc/s. L_{16} can be adjusted by a trimmer. The resistance R_{44} shunts the coil L_{17}.

Bias circuits

64. The remainder of the biased circuits and decoupling circuits throughout the receiver function in the normal manner. Twin capacitors are, however, provided for each UHF cathode to provide a low inductive path to earth.

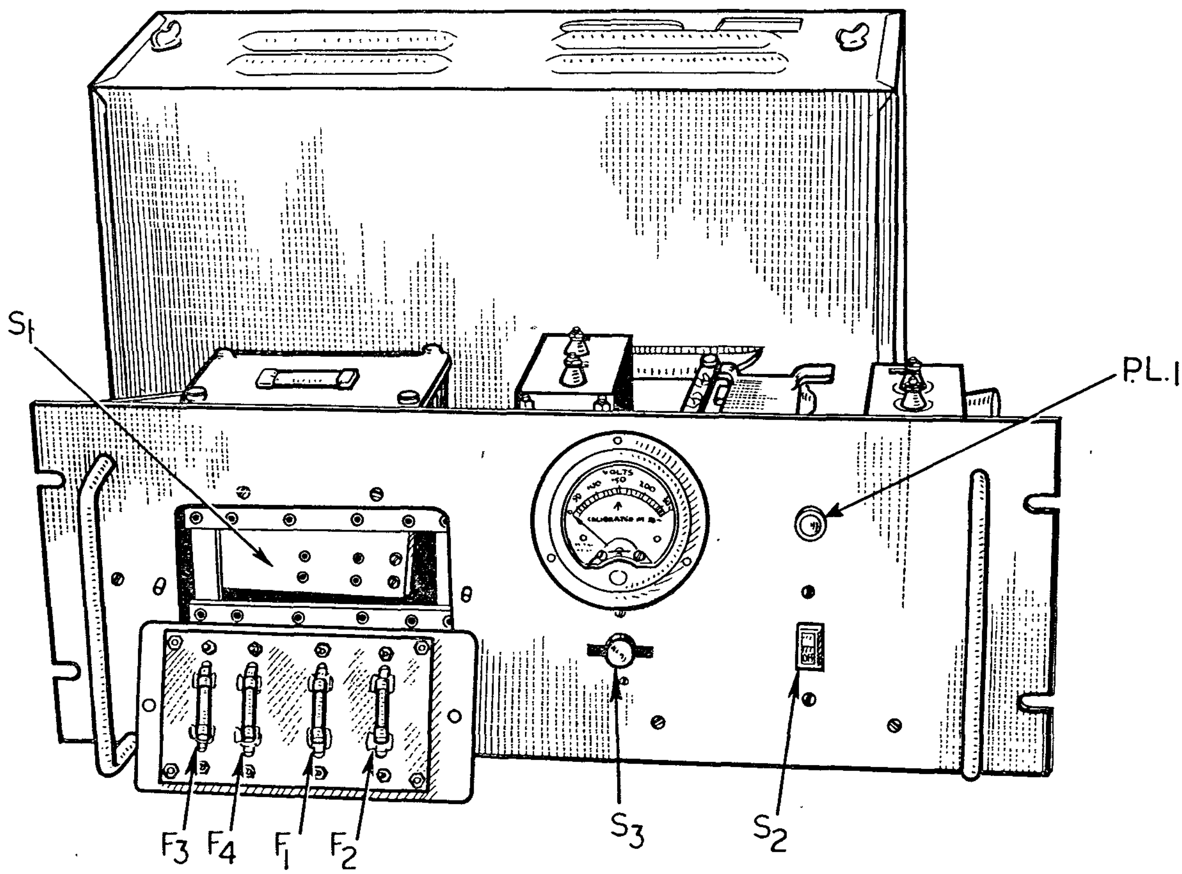


Fig. 10.—Power unit, type 234A, front view—fuses exposed

Switch S_1

65. The switch S_1 gives:—

(1) Automatic R.F. gain control operation.

(2) Manual R.F. gain control operation.

(3) Manual R.F. gain operation together with beat oscillator.

Switch S_2

66. Switch S_2 performs the following functions:—

(1) Switches the d.c. 0–1 milliammeter into the anode circuit of the frequency changer valve whereby the magnitude of the heterodyne voltage is indicated by a fall in anode current.

(2) The anode current of the first I.F. amplifier is used as an indication of A.G.C. control and therefore of signal level. It should be used for tuning the signal frequency of the amplifier whenever possible.

(3) Switches the meter into a bridge rectifier connected across the 600 ohm output for indication of receiver output levels.

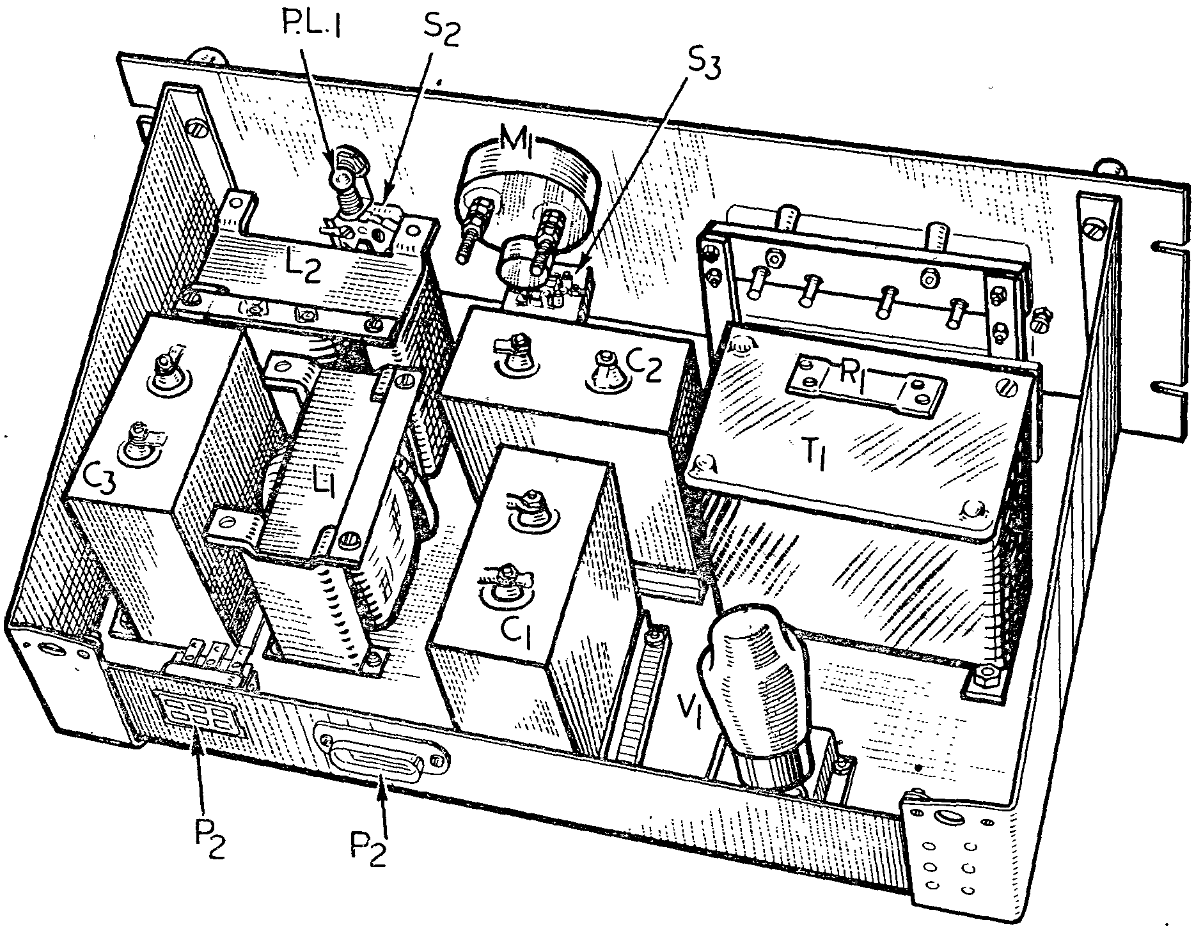


Fig. 11.—Power unit, type 234A, top view of chassis showing components

Power unit circuit particulars

67. The receiver power supply is fed in from the power unit, type 234A, through a 6-core cable terminating in a socket which fits into the Jones plug (P_2) at the back of the receiver. H.T. at 260 v. or 210 v. d.c. and L.T. at 6·3 v. 50 c/s is supplied.

68. The 50 c/s input to the power unit is applied to the primary of the mains transformer T_2 which is tapped to provide any voltage combination in 10 v. steps between 200 v. and 250 v. This is done by means of a link plug (S_1) mounted between the sockets carrying the fuse carrier.

69. The high voltage secondary of T_1 is provided with two tappings selected by switch S_4 which supplies voltages of 260 v. and 210 v. d.c. for use with receiver, type L392A and P.38 respectively.

70. The L.T. secondary windings of T_1 provides a voltage of 5 v. at 2 amps. to the power unit rectifier valve heater and a voltage of 6·3 v. at 4·3 amps. to the receiver valve heaters. The ends of this latter windings are taken to terminals 7 and 8 of the output socket P_2. The pilot lamp and series resistance R_1 are connected across the winding.

71. The ends of the 280 v. secondary winding, which has its centre point connected through a fuse F_3 to the H.T. negative terminal (9) of P_2, are each connected to the anode of the power unit rectifier valve. The cathode is connected through the two-stage filters L_1 L_2, C_1, C_2, C_3 and fuse F_4 to the H.T. positive terminal (10) of P_2.

72. Ripple is below ·01 per cent and regulation is such that the variation in H.T. due to a change from zero to full L.T. load is less than 5 volts.

SERVICING

Valves

73. A table of the valves and their functions, which are employed in the receiver R.1392A are given below:—

Identity No.	*Function*	*General classification*	*Type*
V_1	1st R.F. amplifier	Pentode	VR.136
V_2	2nd R.F. amplifier	Pentode	VR.136
V_3	Frequency changer	Pentode	VR.136
V_4	Crystal oscillator and treble	Pentode	VR.53
V_5	Harmonic generator (18X crystal frequency)	Pentode	VR.136
V_6	Oscillator amplifier	Pentode	VR.136
V_7	1st I.F. amplifier	Pentode	VR.53
V_8	2nd I.F. amplifier	Pentode	VR.53
V_9	3rd I.F. amplifier	Pentode	VR.53
V_{10}	Beat oscillator	Pentode	6J7G
V_{11}	De-modulated and L.F. amplifier	Double diode triode	6Q7G
V_{12}	A.G.C. rectifier and d.c. amplifier	Double diode triode	6Q7G
V_{13}	Output amplifier	Triode	VR.67
V_{14}	Pulse interference suppressor		VR.92
V_{15}	Noise interference suppressor		VR.92

Valve replacements

74. As all valves in the receiver are not readily accessible the following procedure should be followed where it is required to renew valves in the following units.

75. Signal amplifier unit (V_1, V_2 and V_3). The first signal frequency amplifier V_1 (VR.136), the second signal frequency amplifier V_2 (VR.136), and frequency changer V_3 (VR.136), are all mounted on the signal amplifier unit. These three valves are easily removed after taking off the dust cover of the receiver, by means of the simple valve removal tool available.

76. Harmonic amplifier unit (V_4, V_5, and V_6). The crystal oscillator and first multiplier V_4 (VR.53), the second multiplier V_5 (VR.136), and the harmonic amplifier (VR.136), are all mounted on the crystal harmonic amplifier unit. The type VR.136 valves are also easily removed with the tool available. The VR.53 should be withdrawn in the normal manner.

77. I.F. amplifier section (V_7, V_1, V_9 and V_{10}). The first, second and third I.F. amplifiers, V_7, V_8 and V_9 (all type VR.53), should be removed in the normal manner after removing firstly the valve can cap, secondly unscrewing the removable insulated grid connector fitted to each I.F. transformer, and finally, the valve can.

78. The I.F. oscillator V_{10} (6J7G) is removed in a similar manner, the screwed grid connector mounted in the coil chamber being fitted in the same manner as those in the I.F. transformers. It should be noted that this connector is insulated with plastic sleeving and *not* Frequentite R. The two types should not be confused.

79. Audio and A.G.C. section (V_{11}, V_{12}, and V_{13}). The de-modulator, A.G.C. amplifier and output valves V_{11}, V_{12}, and V_{13} (6Q7G, 6Q7G, and VR67 respectively) should be removed in the normal manner.

80. Noise and pulse suppressors (V_{14} and V_{15}). The pulse interference suppressor valve (V_{14}) is situated below the chassis near 1FT4. The noise interference suppressor valve (V_{15}) is located near the A.G.C. valve.

Unit replacements

81. When for the purpose of servicing it is required to detach the various units and sub-assemblies of the R.1392A, the following method should be adopted after all valves have been removed:—

(i) The crystal harmonic amplifier unit should be removed by withdrawing the six screws fixing it to the chassis. The dial must first be removed and the two leads taking supplies from the chassis, the two connecting the crystal, and the lead providing the output feed must all be disconnected.

(ii) The signal amplifier unit should be removed in a similar manner to the crystal harmonic amplifier unit.

82. Each unit has a detachable cover for the variable condenser chamber, which will make it possible to renew some of the small components incorporated, without removing the complete unit.

83. I.F. transformer units. These should be removed by disconnecting the leads to the terminals projecting through the ½ in. diameter holes in the chassis, then removing the small screens over certain associated leads, and finally withdrawing the four cheese-head screws which hold the transformer to the chassis. The transformers will then come away as units with the shield cans fixed to the frames. These shield cans may be removed from the transformer units, either when mounted or unmounted, by undoing the two 6BA cheese-head screws on the top of each can.

84. A number of components in the I.F. transformers are accessible without removing the units from the chassis after removing the shield cans.

85. I.F. oscillator unit. This should be removed complete by disconnecting the three leads under the chassis taken into the unit, after first removing the flat screening cover and removing the six bolts which fix the base of the unit to the chassis. Some of the components in the coil chamber of this unit may be renewed, after removing the cover, with the units in position.

86. I.F. amplifier, de-modulator and A.G.C. amplifier valve circuit assemblies. These should be removed complete by detaching the few leads which take supplies, etc., to these assemblies, and removing the 6BA half-nuts which fix each assembly with the associated valve can base to the chassis. It will be found that the 6BA screws which fix the sockets to the brackets of each assembly are tapped into the feet of each bracket and locked. This makes it possible to remove the valve can base and then the complete assembly as a unit. It will, of course, be necessary to remove the valve concerned, as described above, before attempting to remove any of the valve circuit assemblies.

87. Meter switch and rectifier unit. These two components are mounted on a single bracket fixed by 4BA bolts to the chassis. To renew either the switch or rectifier, it will be necessary to remove the output valve. The R.F. gain control should be unfastened from the front panel and withdrawn into the chassis, without unsoldering the leads, sufficiently to allow access to the 4BA nuts with a box spanner. The switch and rectifier unit should then be removed complete, after disconnecting the associated leads.

88. Gain control switch. This is most easily removed by unscrewing the hexagonal nut fixing the switch to its bracket with a thin flat spanner.

89. When fitting a new switch it is important not to omit the locking washer behind the nut, otherwise the switch may work loose in operation. This will be evident before the spindle actually becomes loose, since there is appreciable clearance between the locating peg and its corresponding hole. This rule also applies to the fitting of the meter switch on its bracket.

90. Single components, such as gain controls, output transformers, L.F. filter choke, etc., may be removed singly in the usual way.

Voltage measurements

91. The following table shows the approximate voltages (using a Model 7 avometer) which should exist between the points listed and earth.

Valve	*Cathode*	*Screen*	*Anode*
V_1	1·6	195	135
V_2	1·6	195	135
V_3	0 (No crystal) (With crystal)	175 195	160 185
V_4	3·3 (No crystal) 5·5 (With crystal)	195 200	75 120
V_5	1·7 (No crystal) 1·3 (With crystal)	— —	130 150
V_6	1·6	200	130
V_7	2·2	74	195
V_8	2·2	74	195
V_9	3·8	115	188
V_{10}	—	88	38
V_{11}	1·5	—	80
V_{12}	—	—	130
V_{13}	6	—	200
V_{14}			
V_{15}			

A.G.G. negative supply voltage—50 volts (Pins 2 and 9 on Plug P_1) H.T. supply voltage 250 volts (Pins 10 and 9 on Plug P_1).

ALIGNMENT

General

92. In order to align the receiver, type R.1392A the following test apparatus is required:—

(*a*) Signal generator, type T.F.390G

(*b*) Output meter, type T.F.340

The R.F. GAIN control should always be set at maximum, and the L.F. GAIN control set to a suitable level.

I.F. alignment

93. To align the I.F. circuits proceed as follows:—

(*a*) Connect the 14 ohm terminal of the signal generator to the control grid of V_9 direct.

(*b*) Inject a signal (about 20 mV) at 4·86 Mc/s, refer to crystal standards, with 30 per cent modulation at 1000 c/s. The frequency difference between transmitter and receiver crystals on any channel may be used to calibrate the signal generator accurately at 4·86 Mc/s.

(*c*) Adjust the I.F. transformer T.4 for peak output.

(*d*) Detune the signal generator and observe the frequency deviation required on either side of resonance to produce a reduction in output of 1·5 db's. If the frequency deviation on each side of resonance is not the same, readjust L.14 and L.15 by approximately equal amounts—as observed on the output meter—until symmetry of resonance is obtained. The frequency deviation should be about ± 25 kc/s.

(*e*) Inject the signal (about 1 mV) into the control grid of V_8, and adjust I.F.T 3 for peak output. Observe the frequency deviation required on each side of resonance to produce a reduction in output of 3 db's. Readjust L.12 and L.13 by approximately equal amounts until symmetry of resonance is obtained. The frequency deviation should be about ± 25 kc/s.

(*f*) Repeat by injection of the signal (about 70 μV) into the grid of V_7 and adjustment of L.10 and L.11, and also by injection of the signal (about 100 μV) into the grid of V_3 through IPF and adjustment of L.8 and L.9. The frequency deviation should be about ± 25 kc/s for $4\frac{1}{2}$ db down.

Check that approximate symmetry of resonance is maintained for a 45 db increase in input and that the frequency deviation is within ± 90 kc/s.

(*g*) Inject about 3 μV through C_{68} (disconnected by removing the lead from C_{14}) into the grid of V_3 and adjust L.8 or L.9. The frequency deviation should be not less than ± 25 kc/s at 6 db and not greater than ± 90 kc/s. at 60 db.

Beat oscillator alignment

94. The heterodyne oscillator should be aligned as follows:—

(*a*) Bring the oscillator into operation by switching the gain control switch to TONE MAN. G.C. position.

(*b*) Set the TONE FREQUENCY CONTROL to the central position, when the condenser C_{16} should be at half its maximum value.

(*c*) Connect the 14 ohm terminal of the signal generator through a 4 pf condenser (C_{68}) to the grid of V_3, and inject a signal of 10μV at 4·8 mc/s with no modulation. Then trim the core of L.16 to give zero beat.

(*d*) Set the TONE FREQUENCY CONTROL to approximately 1000 c/s and note the output level. This should be at least three times (+10 db) the output obtained by applying 30 per cent modulation at 1000 c/s to the injected signal, with the switch turned to MAN G.C.

A.F. response checking

95. Check the A.F. response as follows:—

(*a*) Connect the 14 ohm terminal of the signal generator through a 1 pf condenser (C_{68}) to the grid of V_3, and inject a signal of 50 μV at 4·86 mc/s with external modulation.

(*b*) Set the output to 1 m.w. at peak A.F. response, and measure the decibel loss, relative to the peak level at the following frequencies:—

These should be as indicated below:—

A.F.	*Loss in db*
180 c/s	8 (min.)
400 c/s	6 (max.)
3000 c/s	6 (max.)
5000 c/s	8 (min.)

Crystal harmonic amplifier alignment

96. When aligning the beat oscillator, insert a 0–1 milliammeter between the end of R_7 and earth, and then proceed as follows:—

(*a*) Set the TUNE OSC. dial to 150 mc/s and insert a 8070 kc/s crystal in ST.1.

(*b*) Adjust the trimmer (C_4) to give maximum reading of the inserted milliammeter.

(*c*) Set the meter switch to OSC.

(*d*) Connect the 14 ohm terminal of the signal generator through a condenser of a capacity between 30–100 pf to C_4, and inject a signal at 150 Mc/s with 30 per cent modulation at 1000 c/s, adjusting the output so that the signal is just audible. (As the alignment is improved, the signal generator output will need to be reduced.)

(*e*) Adjust the trimmers, C_7, C_{10}, and C_{15} for maximum audio output, or maximum dip in the tuning meter. (The signal generator tuning may require slight adjustment for maximum output.)

(*f*) Follow the same procedure to adjust L.4, L.5, L.6, and L.7, using a crystal frequency of 6120 kc/s, and an injected signal frequency to which TUNE OSC. is set, of 115 Mc/s. Once set by the makers, it is unlikely that L.5, L.6, and L.7 should need further adjustment when realigning the receiver except in very exceptional circumstances.

(*g*) Repeat the above adjustments (*a*) to (*e*), then (*f*) until neither set of adjustments affects the other.

(*h*) Check the C.H.A. for stability by rotating the dial slowly after alignment, and noting that the tuning meter (set to OSC.) shows no dip at any dial setting with the crystal absent.

Note.—The meter dip should be at least 0·1 m.a. in (*a*) to (*f*). Check that for frequencies of 100 and 130 Mc/s (crystal frequencies of 5,280 and 6,950 kc/s respectively) the tuning meter dip is at least 0·1 m.a. If this is not the case, the condenser alignment will have to be corrected by split end vane adjustment (see para. 101 and 102).

R.F. alignment

97. The radio frequency alignment should be done as follows:—

(*a*) Insert a 8070 kc/s crystal in S.T.1, and tune the oscillator to 150 mc/s by obtaining maximum dip in the meter, switched to OSC.

(*b*) Set the TUNE SIG. dial to 150 Mc/s.

(*c*) Connect the 1400 ohm terminal of the signal generator through a 100 ohm resistance to the aerial socket and inject a signal at exactly 150 Mc/s with 30 per cent modulation at 1000 c/s, and adjust the output of the signal generator so that the signal is just audible.

(*d*) Adjust the trimmers C_1, C_6, C_{12} for maximum output. The signal generator tuning may require slight adjustment to obtain maximum output.

(*e*) Follow the same procedure to adjust L.1, L.2, and L.3, using a crystal frequency of 6,120 kc/s, and an injected signal frequency, to which the TUNE R.F. dial is set, of 115 mc/s. Once set at the makers, it is unlikely that L.1, L.2, and L.3 should need adjustment when realigning the receiver, except in very exceptional circumstances.

(*f*) Repeat the above adjustments (*a*) to (*d*), then (*e*), until neither set of adjustments affects the other.

(*g*) The R.F. amplifier should be checked for instability near the minimum capacitance position of the TUNE SIG. control (150 mc/s) with crystal removed. This is indicated by a fall of the reading of the tuning meter (set to TUNE OSC.), when TUNE OSC. and TUNE R.F. controls are rotated. If this is found to be the case, check that all cathode condensers are O.K., and that their leads are very short. They should also be placed as near the chassis as practicable.

A.G.C. characteristics

98. Proceed as follows:—

(*a*) With the gain control switch at A.G.C., inject into the aerial socket a C.W. signal (to which the receiver is tuned), and adjust its strength to produce a dip in the tuning meter reading of 0·02 m.a. This is the A.G.C. threshold level and should not require a signal input of more than $10\mu V$ at 100 Mc/s or $5\mu V$ at 150 Mc/s when the signal generator is made to represent a resistive source of 100 ohms.

(*b*) Without disturbing the settings in (*a*) in any way modulate the signal 30 per cent at 100 c/s and adjust the A.F. output to 1 m.w. Increase the input (from the signal generator) by amounts up to 10,000 times (80 db). The A.F. output should not increase more than 2 times (6 db).

For an unmodulated signal, the A.F. noise output should decrease at least 18 times (25 db) when the signal is increased 100 times (40 db) from the threshold level.

Muting adjustment

99. The variable resistance control (VR_3) is adjusted in production to provide a 20 db reduction in receiver noise with no input signal and have no attenuation with an input signal of 3μV at any point within the tuning range of 100–150 Mc/s. The muting effect may be varied by adjustment of VR_3 to suit individual requirements.

Typical overall performance characteristics

100. In making the measurements below, generator leakage was balanced out at each frequency, by placing the signal generator output lead in such a position that no signal was heard in the telephone, when the signal generator gave a nominal zero output. The signal generator was made to represent a resistive source of 600 ohms.

Crystal frequency	*Signal frequency*	*Sensitivity input for 20 db signal/noise*	*A.G.C. Threshold*	*V_3 anode current dip (with crystal) (on meter scale)*
5120 kc/s	99·62 Mc/s	4·4μV + 6·0	1μV	
5300	105·12	4·2	2·7	
5825	114·42	4·0	3·2	
5844	114·92	4·0	2·6	
6111	119·47	3·6	2·3	
6187·5	121·07	3·6	2·2	·3 to ·4 m.a.
6575	127·97	2·8	2·1	
6777	131·72	2·6	1·9	
7057	131·72	2·6	1·9	
7444	143·62	2·5	2·0	
7460	143·82	2·4	1·9	
8070	147·32	3·5 4·0	3·0	

V_3 anode current with no crystal was 9·2 m.a. on all frequencies.

Note.—Some receivers have sensitivities up to 10μV for 20 db signal/noise.

Notes on variable condenser and circuit alignment

101. The variable condenser assemblies incorporated in the crystal harmonic amplifier and signal amplifier units consist of individual variable capacitors, mechanically ganged by means of self-aligning flexible couplings, designed to eliminate angular rotational errors. The capacitors are accurately matched to ·25 pf at six angular positions, after being ganged together mechanically at the maximum capacitance position.

102. The alignment of the circuits of the receiver can be carried out as previously described. It is recommended, however, that the adjustment of the variable capacitors and the alignment of the signal amplifier circuits is only attempted by a competent technician. In most cases it will be far preferable to fit a new unit complete.

103. In the case of the 1st multiplier, I.F. transformer and I.F. oscillator, it will probably be found that the settings of the iron dust cores controlling inductances L4, L8, L9, L10, L11, L.12, L.13, L.14, L.15, and L.16 are difficult to alter. This is because they are coated with a preparation designed to fill up the clearance between the thread on the core and that in the former, which, after some time, sets fairly firmly. The stability of the filler preparation is such that the settings are maintained under all working conditions. It will only be necessary to reset these cores if an associated component is replaced.

104. If it is necessary to reset any of these cores, it is advisable to warm each core with a narrow soldering-iron bit, so shaped that it will enter the adjusting slot, since the dust cores are rather brittle. If this is made about 4 in. long, and not more than $\frac{3}{16}$ in. diameter, it will not be too hot when fitted to the usual 40 or 80 watt soldering-iron heater. The cores should then be adjusted with the appropriate tool.

LIST OF APPENDICES

APPENDIX A

TUNING AND SETTING UP INSTRUCTIONS

Initial checks and precautions

1. Ensure that the power unit mains switch is set to OFF.

2. Select the correct mains voltage as follows:—

(a) Unscrew the two wing nuts which retain the fuse panel in the power unit.

(b) Withdraw the fuse panel.

(c) Ensure that the mains voltage selector is set to the voltage of the available mains supply.

3. Ensure that the selector switch on the fuse panel is set to "R1392".

4. (a) Ensure that fuses of the correct value are fitted.

(i) HT fuses—150mA (red) 10H/95.

(ii) MAINS fuses—1 amp (blue) 10H/9613.

(b) Replace the fuse panel and tighten the wing nuts.

5. Check or make the following external connections:—

(a) Aerial plug to receiver SK2 socket.

(b) LT. HT cable between P1 of the receiver and P2 of the power unit.

(c) Mains input cable to P1 of the power unit.

(d) Line output from pins 11 and 12 of receiver P1.

(e) Telephone headset to receiver monitor jack.

Note . . .

If no meter is fitted, perform the checks detailed in para. 6(c) and 7, by connecting an external meter to the sockets on the blanking plate.

6. (a) Switch on mains supply to the power unit.

(b) Set the power unit mains switch to ON.

(c) Ensure that the voltmeter on the power unit indicates the correct voltage for the available mains supply.

(d) Check that the indicator lamp on the power unit has lit.

7. Ensure that the voltmeter on the power unit indicates between 250 and 260 volts, when the meter switch is pressed to the right.

8. Allow at least 15 minutes to elapse after switching on in order that the receiver may reach its normal operating temperature.

Crystal

9. (a) Insert a crystal of the correct frequency into the receiver ST1 socket.

(b) The frequency of the crystal may be obtained from the following formula:

Crystal freq (Mc/s) =
(Signal Freq — 4·86) Mc/s

Controls

10. Unlock both tuning dials, then set the receiver controls as follows:—

(a) Meter switch to OSC.

(b) System switch to AGC.

(c) RF GAIN and LF GAIN controls to maximum.

(d) Set TUNE OSC and TUNE SIGNAL dials to the required frequency.

11. Tune the oscillator as follows:-

(a) Rock the TUNE OSC control gently either side of the dial calibration point to find the dip in the tuning meter reading.
(b) Set the control at the point which gives minimum reading in the tuning meter. This point must not be more than ± 3 Mc/s from the dial calibration point, and produce a dip of at least 0·2mA in the meter reading.

(c) Lock the TUNE OSC control at this setting, checking that the meter reading does not vary.

12. Tune the signal circuits to a local transmission as follows:—

(a) Reset the meter switch to SIGNAL.

(b) Rock the TUNE SIGNAL control gently either side of the dial calibration point to find the dip in the tuning meter reading.

(c) Set the control at the point which gives minimum reading in the tuning meter. The dial setting must be similar to that of the TUNE OSC dial.

(d) Lock the TUNE SIGNAL control at this setting, checking that the meter reading does not vary.

(e) Switch off the local transmission.

13. When no local transmission or other incoming signal is available for tuning as in para. 12. tune the signal circuits as follows:—

(a) Rock the TUNE SIGNAL control gently either side of the dial calibration point to obtain maximum background noises in the telephone headset. The TUNE SIGNAL dial setting must be similar to that of the TUNE OSC dial.

(b) Lock the TUNE SIGNAL control at this setting, checking that the background noise does not vary.

14. Setting up the muting control. Tools and test equipment.

The following are required for setting up of the muting control RV3:—

Tools tuning trimmer	10A/13565
Signal Generator CT520	10S/9447666
Wattmeter Absorption AF	10S 9149811
Multi- meter Set CT498A	10S 1057049
Plug Type 1	10H 488
Telephone headset Type 8	10AH/13
Crystal Unit (as required) R1392B, D and E	10XAJ/———
Crystal Unit (as required) R1392J	10XZDMA/———

Note . . .

1. *Adjustment of the muting control may be performed with the receiver tuned to any convenient frequency.*

2. *When Mod. No. RMC* 0192 *has not been fitted ignore paras. (c) to (f) inclusive.*

15. (a) Set the receiver system switch to MAN GC.

(b) Disconnect the aerial from the receiver.

(c) Short circuit the aerial input socket and resistor RV3.

(d) Connect the multimeter, set to read 100V DC, between V12 cathode (positive) and chassis.

(e) Check that the multimeter reads 35V ± 3V. If not adjust the variable resistor RV5.

(f) Remove the short circuits from the aerial input socket and resistor RV3.

(g) Connect the signal generator output to the receiver aerial socket using connector detailed in Appendix G1.

(h) Set the signal generator to give a 7μV modulated output at the receiver frequency.

(i) Set the wattmeter to 600 ohms and

connect it to the receiver line socket using the plug Type 1.

(k) Adjust the signal generator frequency slightly for maximum receiver output as indicated by the wattmeter or telephone headset.

16. (a) Insert the trimming tool into the slot in the spindle of RV3 and turn it fully counter-clockwise (maximum sensitivity).

(b) Turning RV3 slowly clockwise, note the gradual decrease in receiver output indicated on the wattmeter or the telephone headset. Continue to rotate RV3 until a sudden decrease in receiver output is observed. Note the position of the slot.

(c) Rotate RV3 slightly in a counter-clockwise direction until the receiver output rises rapidly. Note the position of the slot.

(d) Set the control RV3 midway between the positions noted in para. 16(b) and 16(c).

17. Verify the setting of RV3 by checking the sensitivity of the receiver as follows:—

(a) Increase the output level of the signal generator to 10μV.

(b) Ensure that the receiver output as indicated by the wattmeter is not less than 1mW +15db.

APPENDIX B1

TESTING AND ALIGNMENT OF I.F. CIRCUITS (R1392B, D and E)

Note . . .

> 1. *When the receiver is shown by tests in paras. 6 and 7 to be misaligned then realignment must be carried out by 3rd line personnel only.*
> 2. *Allow the signal generator CT520* 4 *hours to warm up before using for IF alignment.*

Tools and test equipment

1. The following are required for aligning the IF circuits:—

Tools tuning trimmer	10A/13505
Signal Generator CT520	10S/9447666
Wattmeter Absorption AF	10S/9149811
Telephone headset Type 8	10AH/13
Plug Type 1	10H/488
Crystal Unit	10XAJ/4860
Silicon compound (IF cores retaining)	33H/9423548
Adaptor Crystal Type 91	10XAE/4

Preparation

2. Prepare the receiver as follows:—

(a) Ensure that the mains supply to the power unit is switched off. Set the power unit mains switch to off.

(b) Disconnect all external connections, and remove the receiver from the rack. Remove the dust cover.

(c) Stand the receiver on end, in a convenient position on the test bench, so that easy access is gained to top and bottom IF trimmers.

(d) Connect the receiver to a power unit as a bench installation. Ensure that the power unit mains switch is set to OFF.

(e) Plug the telephone headset into the receiver MONITOR jack.

(f) Set the controls as follows:—

(i) Meter switch to SIGNAL.

(ii) System switch to AGC.

(iii) RF GAIN control to maximum (fully clockwise).

(iv) LF GAIN control to maximum (fully clockwise).

(v) MUTING control (RV3) to maximum (fully counter-clockwise).

(g) Insert a 4860 Kc/s crystal into socket ST1.

3. Prepare the signal generator as follows:—

(a) Connect the signal generator output between the control grid (Pin 6) of the mixer valve (V3) and receiver chassis using adaptor No. 2 (App. G1).

(b) Connect the signal generator to the mains supply.

(c) Set the signal generator controls as follows:—

(i) Range switch to cover 4·860 Mc/s.

(ii) FREQUENCY CONTROL to 4·860 Mc/s.

(iii) INCREMENTAL FREQUENCY CONTROL to 0.

(iv) Output controls to give 10μV output.

(v) MAINS switch to ON.

(vi) CARRIER switch to ON.

(vii) SET CARRIER for correct level.

4. Prepare the wattmeter as follows:

(a) Set the impedance selector switch to 600 ohms.

(b) Set the power range selector switch to 1mW +15db.

(c) Insert the wattmeter input plug into the receiver LINE jack.

5. Set the signal generator frequency to the receiver crystal as follows:—

(a) Switch on receiver power unit, allow at least 15 minutes for the equipment to reach a stable operating temperature.

(b) Carefully adjust the signal generator FREQUENCY control until a beat note is heard in the receiver telephones.

(c) Set the FREQUENCY control to the zero beat position.

(d) Note the dial setting.

Sensitivity and frequency check

6. (a) Remove the crystal from the receiver.

(b) Set the signal generator MOD switch to ON.

(c) Adjust the signal generator FREQUENCY control for maximum receiver output as indicated by the wattmeter. Reset wattmeter power range switch as necessary to give a convenient reading.

(d) Note the output obtained and the setting of the FREQUENCY control.

(e) If the receiver output is 1mW +15db or more, and maximum response occurs within 3 Kc/s either side of 4860 Kc/s perform the bandwidth checks detailed in para. 7.

(f) If maximum response occurs outside the 3 Kc/s limit, or the receiver output is less than 1mW +15db and cannot be improved by substitution of IF and/or AF valves, perform the realignment operations detailed in para. 10 to 14.

Caution . . .

Avoid damage to the wattmeter by setting the power range switch temporarily to a suitable higher range whenever the signal generator output is increased.

6db bandwidth check

7. (a) Adjust the receiver LF GAIN control until the output indicated by the wattmeter is exactly 1mW.

(b) Increase the signal generator output to 20μV.

(c) Adjust the signal generator INC FREQUENCY control either side of resonance, and note the frequencies at which the receiver output is exactly 1mW (these are the 6db down points).

(d) Ensure that these frequencies are not less than 50 Kc/s apart, and are equally disposed on each side of resonance.

(e) Reset the INC FREQUENCY control to zero.

(f) If the bandwidth on either side of resonance is less than 25 Kc/s at the 6db points, perform the realignment operations detailed in para. 10 to 14.

60db bandwidth check

8. (a) Increase the signal generator output to 10mV.
(b) Carefully adjust the signal generator INC FREQUENCY control either side of 4860 Kc/s.

(c) Note the frequencies at which the receiver output is exactly 1mW (these are the 60db down points). Ensure that they are not more than 180 Kc/s apart and are equally disposed on each side of 4860 Kc/s.

Muting adjustment

9. When all checks are satisfactorily concluded, reset the muting control RV3 as follows:—

(a) Switch off the signal generator and disconnect it from the receiver.

(b) Switch off the receiver power unit and disconnect all external connections.

(c) Refit the dust cover to the receiver.

(d) Perform the operations detailed in App. A., para. 5 to 17.

IF Alignment

Note . . .

If on completion of the tests detailed in paras. 6, 7 and 8, the IF circuits appear to be badly misaligned, carry out the instructions in para. 10 *and then proceed as in para.* 16. *If the IF circuits appear to require only slight alignment, carry out the instructions in para.* 10 *and then proceed as in para* 11.

10. To align the IF circuits if the receiver does not pass the tests detailed in paras. 6, 7 and 8, prepare the equipment as follows:—

(a) Insert a 4860 Kc/s crystal in receiver socket ST1.

(b) Set receiver RF GAIN and LF GAIN to maximum.

(c) Set the signal generator controls as follows:—

(i) MOD switch to OFF.

(ii) Adjust FREQUENCY control to obtain zero beat in receiver telephone headset.

(iii) MOD switch to ON.

(d) Remove the receiver crystal.

(e) Adjust the signal generator output voltage to obtain a reading not exceeding 1mW + 15dB in the wattmeter.

Note . . .

Reduce the signal generator output voltage as necessary during the alignment operations, so that the receiver output does not exceed 1mW + 15dB.

11. Adjustment of the fourth IF transformer.

(a) Adjust the core of L15 (through the hole below IFT4) for maximum reading on the wattmeter.

(b) Adjust the core of L14 (through the hole on the top of IFT4) for maximum reading on the wattmeter.

12. Adjustment of the third IF transformer.

(a) Repeat the operations detailed in para. 10.

(b) Adjust first the top and then the bottom core of IFT3 for maximum reading on the wattmeter.

13. Adjustment of the second IF transformer.

(a) Repeat the operations detailed in para. 10.

(b) Adjust first the top, and then the bottom core of IFT2 for maximum reading on the wattmeter.

14. Adjustment of the first IF transformer.

(a) Repeat the operations detailed in para. 10.

(b) Adjust first the top and then the bottom core of IFT1 for maximum reading on the wattmeter.

15. IF Sensitivity, frequency and bandwidth checks.

Repeat the checks detailed in paras. 6, 7 and 8, starting at para. 6(c). When IF alignment is satisfactorily completed, continue with the B.F.O. alignment at para. 17.

16. When checks carried out in paras. 6, 7 and 8 show the IF circuits to be badly misaligned, proceed as follows:—

(a) Remove the muting valve V15 from its holder.

(b) Using adaptor No. 2 (see Appendix
AL5 C), apply a signal of [illegible] mV, modulated 30% at 1000 c/s to the control grid of V9.

(c) Insert a crystal of 4860 Kc/s into receiver socket ST1 and adjust the signal generator FREQUENCY control for zero beat in the headset. Remove the crystal from the socket.

(d) Adjust the cores of IFT4 for peak output as indicated by the wattmeter.

Adjust LF GAIN for a convenient receiver output on the wattmeter, not exceeding 1mW + 15dB.

(e) Tune the INC. FREQUENCY control both sides of resonance, and observe the frequency deviation required to cause a reduction in output power of 1·5dB on each side. The frequency deviation should be 25 Kc/s each side of resonance. Re-adjust the cores of IFT4 if this reading is not obtained until readings of 25 Kc/s each side of resonance are achieved. Leave INC. FREQUENCY control at zero.

(f) Disconnect signal generator output from control grid V9, and apply a signal of [redacted]mV to control grid of V8.

(g) Repeat operation detailed in para. 16(c).

(h) Adjust the cores of IFT3 for maximum receiver output. Keep receiver LF GAIN adjusted to the reading selected in para. 16(d).

(j) Tune the INC. FREQUENCY control both sides of resonance and observe the frequency deviation required to cause a reduction in output power of 3dB on each side. These frequencies should be ± 25 Kc/s either side of resonance. If necessary, L12 and L13 should be re-adjusted until the specification is achieved. Leave INC. FREQUENCY control at zero.

(k) Disconnect signal generator from control grid of V8, and apply a signal of [redacted] micro volts to the control grid of V7.

(l) Repeat operation detailed in para. 16(c).

(m) Adjust the cores of IFT2 for maximum receiver output. Keep receiver LF GAIN adjusted to the reading selected in para. 16(d).

(n) Tune the INC FREQUENCY control both sides of resonance and observe the frequency deviation required to cause a reduction in output power of 4·5dB either side of resonance. These frequencies should be ± 25 Kc/s either side of resonance. If necessary, L10 and L11 should be re-adjusted until the specification is achieved. Leave INC. FREQUENCY at zero.

(p) Disconnect signal generator from control grid of V7, and apply a signal of [redacted] micro volts to the control grid (Pin 6) of the mixer valve (V3).

(q) Repeat operation detailed in para. 16(c).

(r) Adjust the cores of IFT1 for maximum receiver output. Keep receiver LF GAIN adjusted to the reading selected in para. 16(d).

(s) Tune the INC. FREQUENCY control both sides of resonance and observe the frequency deviation required to cause a reduction in output power of 6dB either side of resonance. These frequencies should be ± 25 Kc/s either side of resonance. If necessary, L8 and L9 should be re-adjusted until the specification is achieved.

(t) Increase the signal generator output by 60dB, and tune the INC. FREQUENCY control both sides of resonance until the output power reads the same as that selected in para. 16(d). These frequencies should be ± 90 Kc/s either side of resonance.

(u) Replace the muting valve V15 into its holder.

17. Beat oscillator alignment.

Align the heterodyne oscillator as follows:—

(a) Set the system switch to TONE MAN GC.

(b) Set the TONE FREQUENCY control to its central position. Check the capacitor C16 to ensure that its plates are set to give half maximum value.

(c) Switch on the signal generator CARRIER switch and adjust output controls to give 10µV.

(d) Adjust the core of L16 to obtain zero beat in the headset.

(e) Switch off signal generator and disconnect it from the receiver.

18. RF alignment.

Whenever the IF circuits have been adjusted, it is necessary to re-align the RF circuits, as detailed in App. B2.

APPENDIX B2

ALIGNMENT OF CRYSTAL OSCILLATOR, HARMONIC AMPLIFIER AND RF AMPLIFIER CIRCUITS (R1392B, D, E AND J)

Tools, test equipment and materials

1. The following are required for aligning the crystal oscillator, harmonic amplifier and RF amplifier circuits:—

Tools tuning trimmer		10A 13505
Tools tuning coils		~~10/13506~~ 10A/13506
Signal Generator CT520		10S/9447666
Wattmeter Absorption AF		10S 9149811
Telephone Headset Type 8		10AH 13
Plug Type 1		10H 488
Millammeter (0-1 FSD)		5Q 87
Capacitor tubular ceramic 100pf		10C 0132380
Sealing wax		Code No. 55-11
Crystal Unit	R1392B, D and E	10XAJ/5280
Crystal Unit	R1392B, D and E	10XAJ 6120
Crystal Unit	R1392B, D and E	10XAJ 6680
Crystal Unit	R1392B, D and E	10XAJ 7515
Crystal Unit	R1392B, D and E	10XAJ/8392
Crystal Unit	R1392J	10XZDMA/5285·55
Crystal Unit	R1392J	10XZDMA/6118·88
Crystal Unit	R1392J	10XZDMA/6674·44
Crystal Unit	R1392J	10XZDMA/7785·55
Crystal Unit	R1392J	10XZDMA/8396·66
Adaptor Crystal Type 91		10XAE/4

Note . . .
Crystal frequencies quoted in brackets in the remainder of the text are applicable to R1392J.

Preparation

2. Prepare the receiver as follows:—

(a) Ensure that the mains supply to the power unit is switched OFF. Set the power unit mains switch S2 to OFF.

(b) Disconnect all external connections and remove the receiver from the rack. Remove the Receiver dust cover and the covers on the RF amplifier and oscillator units.

(c) Stand the receiver in a convenient position on the bench and connect to the power unit as a bench installation. Ensure that the power unit mains switch is set to OFF.

(d) Plug the telephone headset into the receiver MONITOR jack.

(e) Set the receiver controls as follows:—

(i) Meter switch to OSC.

(ii) System switch to MAN GC.

(iii) RF GAIN and LF GAIN controls fully clockwise.

(iv) Muting control RV3 fully counter-clockwise.

(f) Identify R7 on the underside of the harmonic amplifier, disconnect it at the chassis end and insert the milliammeter in series, with positive to chassis.

(g) Insert the 5280 Kc/s (5285·55 Kc/s) crystal into socket ST1 and set the TUNE OSC and TUNE SIGNAL dials to 100 Mc/s.

Note . . .

During subsequent operations the TUNE SIGNAL dial must be kept at the same setting as the TUNE OSC dial.

3. Switch on the receiver power unit and allow at least 15 minutes for the equipment to reach a stable operating temperature.

Oscillator unit alignment

4. Using the hexagon end of the trimming tool, adjust the core of L4 for peak reading on the external milliammeters.

5. Replace the crystal with one of 8392 Kc/s (8396·66 Kc/s) and set the TUNE OSC control to 156 Mc/s. Adjust C4 for peak reading on the external milliammeter.

6. Repeat paras. 2(g), 4 and 5 until further adjustments produce no improvement in meter readings.

7. Prepare the signal generator as follows:—

(a) Connect the signal generator output lead via adaptor No. 2 (App. G1) and a 100pF capacitor to the tag of the variable capacitor C11 to which the 3·3pF capacitor C57 is connected.

(b) Connect the earth braiding of adaptor No. 2 to the receiver chassis.

(c) Connect the signal generator to the mains supply.

(d) Set the signal generator controls as follows:—

(i) Range switch to cover 100 Mc/s.

(ii) FREQUENCY control to 100 Mc/s.

(iii) INC FREQUENCY control to 0.

(iv) Output controls to 5μV.

(v) MAINS switch to ON.

(vi) CARRIER switch to OFF.

8. Prepare the wattmeter as follows:—

(a) Set the IMPEDANCE selector switch to 600 ohms.

(b) Set the POWER RANGE selector switch to read 1mW +6db.

(c) Connect the terminals to the plug Type 1 and insert the plug into the receiver LINE jack.

Note . . .

Once set by the manufacturers, coils L5, L6 and L7 will normally remain at the correct setting. Therefore, when performing the following operation, the amount of movement required to check the alignment is very small.

9. With the 5280 Kc/s (5285-55 Kc/s) crystal inserted and the OSC TUNE control set to 100 Mc/s adjust L5, L6 and L7 by slightly extending or compressing the coil turns, using the wedge tuning tool, for minimum reading on the receiver tuning meter, maximum deflection on the wattmeter.

10. Replace crystal with 8392 Kc/s (8396·66 Kc/s), set OSC TUNE to 156 Mc/s and signal generator FREQUENCY CONTROL to 156 Mc/s. Adjust C7, C10 and C15 for minimum reading on the receiver tuning meter, maximum deflection on the wattmeter.

11. Repeat paras. 9 and 10 until further adjustment produces no improvement in the meter readings.

12. Using crystals of 5280 Kc/s, 6120 Kc/s, 6680 Kc/s, 7515 Kc/s and 8392 Kc/s (5285·55 Kc/s, 6118·88 Kc/s, 6674·44 Kc/s, 7785·55 Kc/s and 8396·66 Kc/s), set the TUNE OSC to 100 Mc/s, 115 Mc/s, 125 Mc/s, 140 Mc/s and 156 Mc/s (100 Mc/s, 115 Mc/s, 125 Mc/s, 145 Mc/s and 156 Mc/s) respectively and adjust for a minimum reading on the receiver tuning meter, maximum deflection on the wattmeter, at each frequency. Check that the difference between the meter readings with the oscillator tuned and untuned is greater than 0·2mA on all test frequencies.

13. (a) Replace oscillator unit dust cover and secure by the centre screw only.

(b) Repeat the operations detailed in paras. 2(g), 4, 5 and 10 and note the final meter readings.

(c) Remove the cover and carefully seal the trimmers C4, C7, C10 and C15 with a small quantity of sealing wax.

(d) Replace the cover and ensure that the meter readings are the same as those obtained in para. 13(b).

(e) Secure the dust cover by tightening the five screws.

14. Carry out the oscillator stability check as follows:—

(a) Remove the crystal from the receiver socket ST1.

(b) Rotate the TUNE OSC dial slowly throughout its full range, ensure that there is no dip in the tuning meter reading at any setting of the dial.

15. Set the receiver power unit mains switch to off, disconnect the external ammeter and resolder the free end of R7 to the chassis.

Amplifier Unit RF alignment

16. (a) Set the receiver power unit mains switch to ON.

(b) Ensure that the receiver controls are as follows:—

(i) Meter switch to OSC.

(ii) System switch to MAN GC.

(iii) RF GAIN and LF GAIN fully clockwise.

(iv) Muting control fully counter-clockwise.

17. Insert a 5280 Kc/s (5285·55 Kc/s) crystal into the receiver socket ST1 and connect the wattmeter to the LINE jack.

18. Set the signal generator to produce an output of 50μV modulated to a depth of 30 per cent, connect the signal generator output to the receiver aerial socket, using Adaptor No. 1 (App. G1).

19. Set the signal generator FREQUENCY control to 100 Mc/s and the receiver TUNE SIGNAL control to 100 Mc/s. Adjust the TUNE OSC control for minimum reading on the receiver meters.

20. Adjust the signal generator FREQUENCY control for a peak reading on the wattmeter.

Note . . .
Once set by the makers, coils L1, L2 and L3 will normally remain at the correct settings. Therefore, when performing the following operation, the mount of movement required to check alignment is very small.

21. Adjust L1, L2 and L3 by extending or compressing the coil turns for peak reading on the output meter.

22. Reset the signal generator FREQUENCY control to 156 Mc/s and the receiver TUNE SIGNAL control to 156 Mc/s.

23. Replace the crystal with one of 8392 Kc/s (8396·66 Kc/s) and adjust the TUNE OSC control for minimum reading on the receiver meter.

24. Adjust the signal generator FREQUENCY control for peak reading on the wattmeter.

25. Adjust C1, C6 and C12 for a peak reading on the wattmeter.

26. Repeat paras. 17 and 19 to 25 above until no further improvement can be obtained on the wattmeter readings.

27. Replace the crystal by one of frequency 6680 Kc/s (6674·44 Kc/s) and adjust the TUNE OSC control for minimum reading on the receiver meter.

28. Set the signal generator FREQUENCY to 125 Mc/s and the TUNE SIGNAL control to 125 Mc/s.

29. Adjust signal generator FREQUENCY control and TUNE SIGNAL control for peak reading on the wattmeter.

30. Adjust L18 for peak reading on the wattmeter.

31. If the setting of L18 required alteration, repeat paras. 17 and 19 to 25 above, adjusting only L1 and C1.

32. Reduce the signal generator output to 10μV and set the frequency to 100 Mc/s.

33. Replace the crystal by one of 5280 Kc/s (5285·55 Kc/s) and adjust the TUNE OSC control for minimum reading on the Receiver tuning meter.

34. Set the system switch to AGC and the meter switch to SIGNAL and note the reading on the receiver meter.

35. Adjust the TUNE SIGNAL control and the signal generator FREQUENCY control for minimum reading on the receiver meter. This reading should show a dip greater than 0·1mA compared with the reading noted in para. 34.

36. Repeat paras. 32 to 35 using crystals of 6120 Kc/s, 6680 Kc/s, 7515 Kc/s and 8392 Kc/s (6118·88 Kc/s, 6674·44 Kc/s, 7785·55 Kc/s and 8396·66 Kc/s), and signal generator frequencies set to 115 Mc/s, 125 Mc/s, 140 Mc/s and 156 Mc/s respectively (115 Mc/s, 125 Mc/s, 145 Mc/s and 156 Mc/s respectively), ensuring that the TUNE/UNTUNED condition of the TUNE SIGNAL control produces a dip in the receiver tuning meter in excess of 0·1mA at all test frequencies.

37. (a) Replace the RF amplifier unit dust cover and secure by one screw.

(b) Adjust the signal generator output to give 10μV at 156 Mc/s.

(c) Tune the receiver for maximum reading on the wattmeter.

(d) Adjust C1, C6 and C12 for maximum output: note this reading.

(e) Remove the dust cover and carefully seal the trimmer with a small quantity of sealing wax.

(f) Replace the dust cover, check that the wattmeter readings are the same as those obtained in para. 37(d) and tighten the securing screws.

Muting adjustment

38. Reset the muting control RV3 as follows:—

(a) Carry out the operations detailed in Appendix A, paras. 14 to 17 inclusive.

39. (a) Using appropriate crystals carry out overall sensitivity checks at 156, 140, 125, 115 and 100 Mc/s (156, 145, 125, 115 and 100 Mc/s). At least 1mW +15db must be obtained at all test frequencies.

(b) Providing the overall sensitivity is satisfactory, refit receiver into the rack.

APPENDIX B3

TESTING AND ALIGNMENT OF 25 Kc/s IF CIRCUITS FOR 50 Kc/s CHANNEL SPACING

Note . . .

This alignment is for R1392J only.

Caution . . .

1. *The IF alignment should only be performed by suitably experienced personnel and should not be attempted unless appropriate test equipment is available.*

2. *Allow the Signal Generator CT520 4 hours to warm up before starting alignment.*

Tools and test equipment

1. The following are required for aligning the IF circuits:—

Tools tuning trimmer	10A/13505
Signal Generator CT520	10S 9447666
Wattmeter absorption AF	10S 9149811
Telephone headset Type 8	10AH 13
Crystal unit	10XZDMA/4860
Plug Type 1	10H 488
Silicon Compound (IF core retaining)	33H/9423548

Preparation

2. Prepare the receiver as follows:

(a) Switch off mains supply and remove all external connections from the rear of the receiver.

(b) Remove the dust cover and stand the receiver on its end, so that easy access may be gained to the top and bottom IF trimmers.

(c) Connect the receiver to a power unit.

(d) Set the controls as follows:—

(i) Meter switch to SIGNAL.

(ii) System switch to MAN GC.

(iii) RF and LF GAIN controls to Maximum (fully clockwise).

(iv) MUTING control (RV3) to Maximum (fully counter-clockwise).

(e) Plug the telephone headset into the receiver MONITOR jack and insert the 4860 Kc/s crystal.

3. Prepare the signal generator as follows:—

(a) Connect the signal generator output between the control grid (Pin 6) of the Mixer valve (V3) and the receiver chassis using connector No. 2. (Appendix G1).

(b) Set the signal generator frequency to 4·860 Mc/s and output controls to give 10 microvolt output.

(c) Switch power ON and allow a 4 hours warm up period.

(i) Adjust SET CARRIER to correct level.

(ii) Adjust SET MOD to correct level.

(iii) Set modulation to 30%.

(iv) Set to CW.

(v) Set INC FREQ. control to 0.

4. Prepare the wattmeter as follows:—

(a) Set the impedance selector to 600 ohms.

(b) Set the power range selector switch to cover 32mW.

(c) Connect the wattmeter to the receiver LINE jack.

5. Set the signal generator frequency to the receiver crystal as follows:—

(a) Switch on receiver power unit, allow at least 15 minutes for the equipment to reach a stable operating temperature.

(b) Adjust the signal generator FREQUENCY control until a beat note is heard in the telephone headset. Further adjust until this beat note falls to zero.

(c) Remove the crystal from the receiver.

Sensitivity test

6. Set the signal generator to AM and check that the reading on the wattmeter is not less than 32mW.

Caution . . .

To prevent possible damage to the wattmeter whilst carrying out 6db and 60db checks, set the power range switch to a suitable higher range when the signal generator output is increased.

6db bandwidth check

7. (a) Adjust the signal generator INC FREQ control either side of 0 Kc/s to find the two peak response points. Select the setting which gives the highest output on the wattmeter.

(b) Adjust the receiver LF GAIN control until the output indicated by the wattmeter is exactly 1mW. This is now a reference level so the LF GAIN control must not be readjusted during this test.

(c) Increase the signal generator output to 20μV. (+6db).

(d) Adjust the INC FREQUENCY control either side of zero, and note the frequencies at which the output is exactly 1mW (these are the 6db down points).

(e) Ensure that these frequencies are not less than ±12 Kc/s from 4860 Kc/s.

(f) If the receiver bandwidth is outside this limit, carry out alignment procedure detailed in paras. 9 and 10.

60db bandwidth check

8. (a) Increase the signal generator output to 10 mV (+60db). See "CAUTION".

(b) Carefully adjust the signal generator INC FREQ control either side of 0 Kc/s.

(c) Note the frequencies at which the wattmeter reads exactly 1mW (these are the 60db down points).

(d) Ensure that these frequencies are not greater than ± 40 Kc/s from 4860 Kc/s.

(e) If the receiver bandwidth is outside this limit, carry out alignment procedure detailed in paras. 9 and 10.

IF alignment

9. To align the IF circuits if the receiver does not pass the tests detailed in paras. 7 and 8, prepare the equipment as follows:—

(a) Insert a 4860 Kc/s crystal in receiver socket ST1.

(b) Set RF GAIN and LF GAIN to maximum.

(c) Set the signal generator for 4·860 Mc/s CW at 16 Millivolts.

(d) Set the wattmeter to a suitable range.

(e) Connect the signal generator to the control grid (TC) of V9, using adaptor No. 2 (see Appendix G).

(f) Adjust signal generator FREQUENCY tuning control for zero beat in the headset.

(g) Remove the crystal from the receiver.

(h) Set the signal generator to 30% MOD at 1 Kc/s.

10. Adjustment of IF transformers.

(a) Adjust the cores of L14 and L15 for peak reading on the wattmeter.

(b) Reduce the signal generator output to 1·6 Millivolts and transfer the lead to the grid of V8. Adjust the cores of L12 and L13 for peak reading on the wattmeter.

(c) Reduce the signal generator output to 160 microvolt and transfer the lead to the grid of V7. Adjust the cores of L10 and L11 for peak reading on the wattmeter.

(d) Reduce the signal generator output to 16 microvolt and transfer the lead to the grid of V3. Adjust the cores of L8, L8A and L9 for peak reading on the wattmeter.

(e) Offset the incremental tuning control by not less than 40 divisions from 0 and increase the output to 16 millivolts.

(f) Readjust the incremental tuning for full scale deflection on the wattmeter.

(g) Using great care, adjust the neutralising capacitor C58 in IFT1 for minimum reading on the wattmeter, resetting the incremental tuning as necessary towards 0 until further adjustment of the neutralising capacitors fails to reduce the wattmeter reading.

Note . . .

Capacitor C58 is factory set and should not normally need adjustment; should this become necessary, it must only be carried out by experienced fitters or failing this, at Third Line.

(h) Repeat operation detailed in para. 10(d).

(j) Check the 6db bandwidth as detailed in para. 7, slightly adjusting the cores of L8, L8A and/or L9 as necessary.

11. Carry out operations detailed in Appendix B1, paras. 17 and 18.

APPENDIX C1

TOOLS, TEST EQUIPMENT AND MATERIALS

Item No.	Nomenclature	Section Ref. No.		Daily	Weekly	3 Monthly	3rd Line Non Calendar
1	Telephone headset Type 8	10AH/13		x	x	x	x
2	Multimeter Set CT498A	5QP/1057049	AL.7	x	x	x	x
3	Signal Generator Type CT520	10S/9447666				x	x
4	Wattmeter absorption AF	10S/9149811				x	x
5	Tester Insulation resistance Type D	5G/203				x	
6	Plug Type 1	10H/488				x	x
7	Plug Type 150	10H/133				x	x
8	Crystal Unit	10XAJ/5280	R1392B, D and E				x
9	Crystal Unit	10XAJ/6120	R1392B, D and E				x
10	Crystal Unit	10XAJ/6680	R1392B, D and E				x
11	Crystal Unit	10XAJ/7515	R1392B, D and E				x
12	Crystal Unit	10XAJ/8392	R1392B, D and E				x
13	Crystal Unit	10XZDMA/5285·55	R1392J				x
14	Crystal Unit	10XZDMA/6118·88	R1392J				x
15	Crystal Unit	10XZDMA/6674·44	R1392J				x
16	Crystal Unit	10XZDMA/7785·55	R1392J				x
17	Crystal Unit	10XZDMA/8396·66	R1392J				x
18	Adaptor Crystal Type 91	10XAE/4					x
19	Cloth mutton	32B/~~1062~~ 1250407	AL.7	x	x	x	x
20	Tools tuning trimmer	10A/13505				x	x

Additional items required for unscheduled 3rd Line Servicing

Item No.	Nomenclature	Section Ref. No.
21	Crystal Unit	10XAJ/4860 (R1392B, D & E)
22	Crystal Unit	10XZDMA/4860 (R1392J)
23	Tools tuning coils	10A/13506
24	Milliammeter moving coil (0-1mA F.S.D.)	5Q/87
25	Capacitor tubular ceramic 100 pf	10C/0132380
26	Sealing Wax	Code No. 50-11
27	Silicon Compound core restaining	33H/9423548

APPENDIX C2

LIST OF VALVES AND FUSES

Abbreviations used in pin connection tables:

A = Anode G = Grid (numbered from the cathode)
C = Cathode H = Heater
D = Diode Anode M = Metallizing or Metal Shield

TABLE 1

RECEIVER VALVES

Valve	Ref. No.	Function	Type	Base	T.C.	Pin Connections 1	2	3	4	5	6	7	8	9
V1	CV 1136	1st RF Amplifier	HF Pentode	B9G		H	A	G2	MC G3	MC G3	G1	MC G3	MC G3	H
V2	CV 1136	2nd RF Amplifier	HF Pentode	B9G		..	..	..	..	..	..	..	..	..
V3	CV 1136	Mixer	HF Pentode	B9G		..	..	..	..	..	..	..	..	..
V4	CV 1065	Oscillator/Trebler	HF Pentode	Mazda Octal	G1	H	C	A	G2	G3	M		H	
V5	CV 1136	Freq. Multiplier	HF Pentode	B9G		H	A	G2	MC G3	MC G3	G1	MC G3	MC G3	H
V6	CV 1136	Buffer Amplifier	HF Pentode	B9G		..	..	..	..	..	..	..	..	..
V7	CV 1053	1st RF Amplifier	Vari-Mu HF Pen.	Octal	G1	M	H	A	G2	G3		H	C	
V8	CV 1053	2nd RF Amplifier	.. .. ..	Octal	G1	..	..	..	..	..	..	..	..	
V9	CV 1053	3rd RF Amplifier	.. .. ..	Octal	G1	..	..	..	..	..	..	..	..	
V10	CV 1935	BFO	HF Pentode	Octal	G1	M	H	A	G2	G3		H	C	
V11	CV 587	AF Amplifier	D.D. Triode	Octal	G1		H	A	D1	D2		H	C	
V12	CV 587	AGC Rectifier and DC amp.	.. ..	Octal	G1	..	..	..	..	..	..	..	..	
V13	CV 1932	Output	Triode	Octal			H	A		G1		H	C	
V14	CV 1092	Pulse Interference Limiter	Diode											
V15	CV 1092	Muting	Diode											
MOD. 2654	CV 1092	Detector	Diode											

Fuse	Sect. Ref. No.	Function	Rating	Nomenclature	Colour Code
F1 and F2	10H/9613	Mains Fuses	1 Amp	Fuses Type 5	Blue
F3 and F4	10H/95	HT Fuses	150 mA	Fuses Type 19	Red

APPENDIX C3

USE OF ~~TEST SET MULTIRANGE No. 1~~ MULTIMETER SET CT498A AS AN OUTPUT POWER METER

Note . . .

Receiver power output in db relative to 1mW	Actual power in mW	~~Test set multirange No. 1~~ CT498A reading (10V AC range)
−6	0·25	0·40
−5	0·32	0·45
−4	0·40	0·50
−3	0·50	0·60
−2	0·63	0·70
−1	0·79	0·80
0	1·00	0·90
+1	1·26	1·00
+2	1·59	1·10
+3	2·00	1·20
+4	2·51	1·40
+5	3·16	1·60
+6	3·98	1·80
+7	5·01	2·00
+8	6·31	2·30
+9	7·94	2·50
+10	10·00	2·90
+11	12·59	3·20
+12	15·85	3·60
+13	19·95	4·10
+14	25·12	4·50
+15	31·62	5·10
+16	39·81	5·70
+17	50·12	6·30
+18	63·10	7·10
+19	79·43	8·00
+20	100·00	8·80

APPENDIX D1

FAULT LOCATION CHART

Symptom	Probable Fault	Remedy
Power Supply and Fuses		
1. Meter readings normal. Receiver functions normally. Power unit indicator lamp not lit.	(a) Faulty indicator lamp.	(a) Renew lamp.
	(b) Open circuit supply to indicator lamp.	(b) Trace open circuit and reconnect.
2. No meter readings. Indicator lamp not lit. Receiver does not function.	(a) Main supply failure.	(a) Check external supply.
	(b) F1 and/or F2 open circuited.	(b) Renew fuses as necessary with fuses 1 amp. (blue) 10H/9613.
3. Receiver does not function. Indicator lamp lit. P.U. reads normal AC input but no reading on HT.	(a) Fuses F3 and/or F4 open circuited.	(a) Renew fuses as necessary with fuses 150mA (red) 10H/95.
	(b) Rectifier valve V1 524G faulty.	(b) Renew valve V1. 10CV/1863.
Crystal		
4. Meter switch at OSC. System switch to AGC Valve noise only in 'phones. No dip in tuning meter reading when TUNE OSC dial is rocked about the calibration point.	(a) Crystal faulty.	(a) Renew crystal.
	(b) High resistance contact to ST1.	(b) Clean contacts and replace crystal
	(c) Oscillator trebler V4 faulty.	(c) Renew valve V4 10CV/1065.
	(d) Multiplier valve V5 faulty.	(d) Renew valve V5 10CV/1136.
Valves		
5. Symptom as at 4 above but with a slight dip in tuning meter reading.	V6 faulty.	Renew valve V6 10CV/1136.
6. Meter switch at OSC. System switch at AGC. Valve noise only in 'phones. Tuning meter reading zero.	Mixer valve V3 faulty.	Renew valve V3 10CV/1136

Symptom	Probable Fault	Remedy
7. Meter switch at SIGNAL. System switch at AGC. With strong signal input, no dip in tuning meter when TUNE SIGNAL dial is rocked about the calibration point.		
(a) Valve noise only in 'phones.	(a) R.F. amplifier V1 and/or V2 faulty.	(a) Ensure that valve pins make good contact in valve holder, or renew as necessary valve 10CV/1136.
(b) Faint valve noise only.	(b) IF amplifier V8 and/or V9 faulty.	(b) Check grid lead and valve holder connections, or renew as necessary valve 10CV/1053.
(c) Low output.	(c) AGC valve V12 faulty.	(c) Check grid lead and valve holder connections. If in order, renew valve, 10CV/587.
8. Meter switch at SIGNAL. System switch at AGC. With strong signal input, no dip in tuning meter when TUNE SIGNAL is rocked about the calibration point. Faint valve noise only. Tuning meter reading:—		
(a) High.	(a) First IF valve V7 signal grid open circuited.	(a) Check grid lead, valve pins and valve holder connections. If in order renew valve 10CV/1053.
(b) Zero.	(b) V7 faulty open circuit heater or no emission.	(b) Renew valve V7 10CV/1053.
9. Tuning meter readings normal on OSC and SIGNAL. Little or no audio output.	(a) AF amplifier valve V11 signal grid open circuited.	(a) Check grid lead, valve pins and valve holder connections. If in order renew valve 10CV/587.
	(b) V11 or V13 faulty.	(b) Renew valve V11 10CV/587, or V13, 10CV/1932.
	(c) Detector valve faulty.	Renew detector valve 10CV/1092.

Symptom	Probable Fault	Remedy
10. Tuning meter readings normal. No heterodyne note on TONE MAN GC.	B.F.O. valve V10 faulty.	Replace valve V10, 10CV/1935.
11. OSC meter reading normal. SIGNAL meter reading slightly higher on MAN GC than on AGC. Little or no audio output.	Pulse limiter valve V14 faulty.	Replace valve V14, 10CV/1092
12. Tuning meter readings normal. Noise level high with no signal input.	Noise limiter valve V15 faulty.	Replace valve V15, 10CV/1092

APPENDIX D2

TYPICAL VALVE AND LINE VOLTAGES

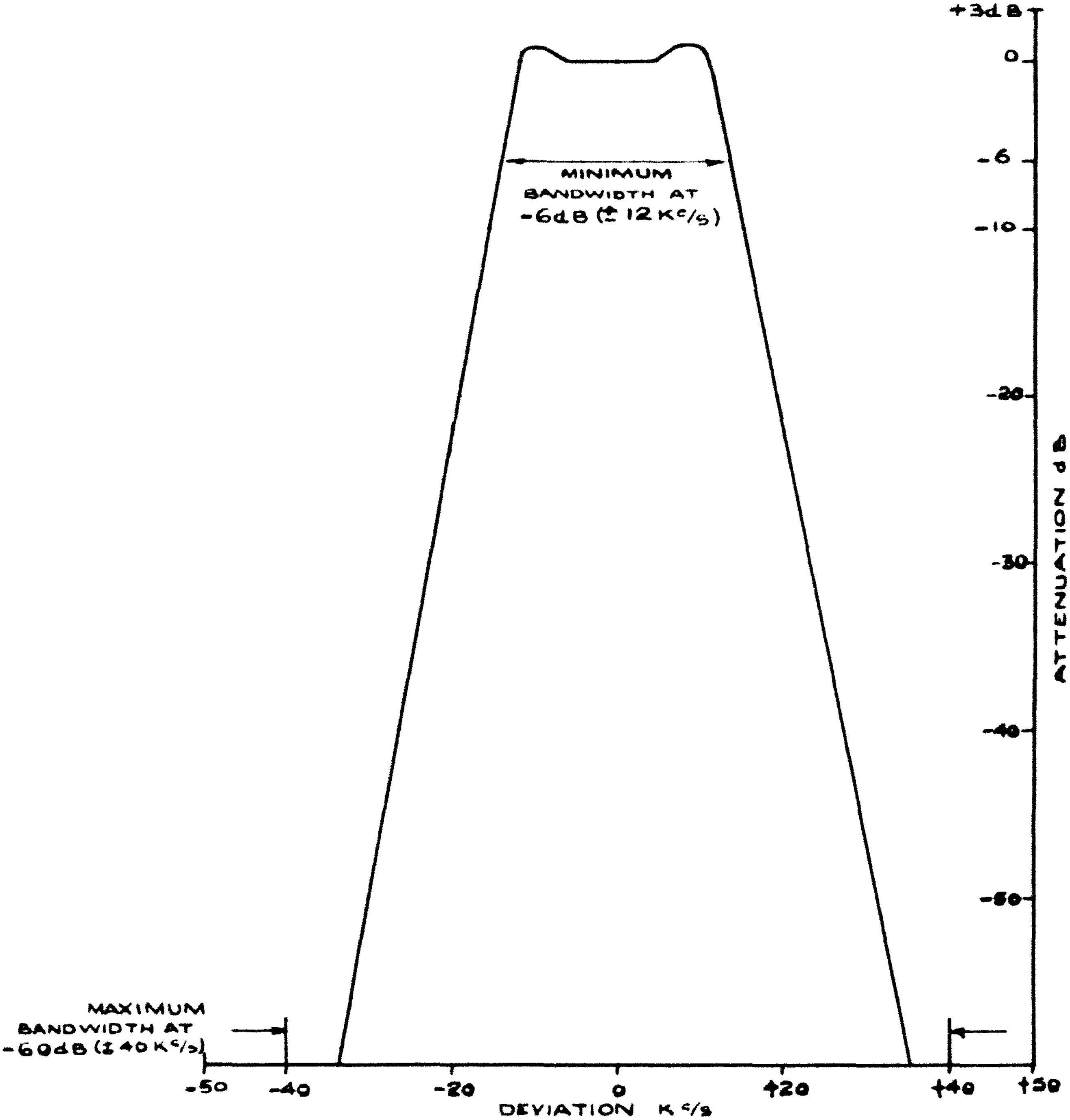
1. The following table gives the approximate voltage readings which should be obtained between the points listed and chassis. voltages are to be measured with the receiver in the following condition: --

(a) Aerial - disconnected.
(b) Output connected as normal.
(c) Gain controls set to maximum (fully clockwise).
(d) System switch to TONE MAN GC.
(e) Meter switch to SIGNAL.
(f) Receiver tuned to normal operational frequency.

Valve	Ref. No.	Function	Anode Pin	Anode Volts	Screen Pin	Screen Volts	Cathode Pin	Cathode Volts
V1	CV 1136	1st RF Amplifier	2	135	3	195	4, 5, 7 or 8	1.6
V2	CV 1136	2nd RF Amplifier	2	135	3	195	4, 5, 7 or 8	1.6
V3	CV 1136	Mixer (No crystal)	2	160	3	150	4, 5, 7 or 8	0
V3	CV 1136	Mixer (With crystal)	2	185	3	195	4, 5, 7 or 8	0
V4	CV 1065	Osc and Trebler (No crystal)	3	200	4	150	Across R4	1.8
V4	CV 1065	Osc and Trebler (With crystal)	3	190/210	4	140/160	Across R4	1.6-2.0
V5	CV 1136	Freq. Multiplier (No crystal)	2	130	3	190	4, 5, 7 or 8	1.7
V5	CV 1136	Freq. Multiplier (With crystal)	2	150	3	195	4, 5, 7 or 8	1.3
V6	CV 1136	Buffer Amp.	2	130	3	200	4, 5, 7 or 8	1.6
V7	CV 1053	1st IF Amp.	3	195	4	74	8	2.2
V8	CV 1053	2nd IF Amp.	3	195	4	74	8	2.2
V9	CV 1053	3rd IF Amp.	3	188	4	115	8	3.8
V10	CV 1935	BFO	3	38	4	88		
V11	CV 587	A.F. Amp.	3	80			8	1.5
V12	CV 587	A.G.C.	3	130	--			
V13	CV 1932	Output	3	200	-	--	8	6

Appendix D3

TYPICAL I.F. AMPLIFIER RESPONSE OF R.1392J



Appendix F

PERFORMANCE CRITERIA

Note . . .

Two types of figure are used in this appendix, "Performance Figures" and "Servicing Figures". The former are starred, are mandatory, and must be met. The latter are for guidance only, but should be recorded to show deterioration, if any, of the equipment.

Test	*Reference*	*Performance Criteria*
	PERFORMANCE FIGURES	
SENSITIVITY (For 10 micro V input)	Div 2, Sect 4, Para 17b	At least 15 dBm*
SIGNAL TO NOISE RATIO	Div 2, Sect 4, Para 17g.	R1392 D, B and E* At least 20 dB down on 15 dBm (5 dBm) R1392 J At least 10 dB down on 15 dBm
AGC	Div 2, Sect 4, Para 18b	A fall in meter reading of at least* 0·1 mA when system switch is set to AGC.
	SERVICING FIGURES	
METER READINGS:--	Div 1, Sect 2, Para 4	
Osc (Mixer Ia)		0·6 to 0·7 mA.
TUNE (1st IF Ia)		0·8 to 0·9 mA. (0·7 to 0·8 mA if mod No. 2654 not incorporated)
HT. (PU234A)	Div 1, Sect 2, Para 3. (Div. 1, Sect 1, Para 4)	250 to 260 volts

APPENDIX E

GENERAL PHYSICAL SERVICEABILITY

The continuous serviceability of a radio installation depends not only on the servicing operations specified in the schedules, but also on the observance by operators, mechanics and fitters, of small defects of a physical nature which should be reported and rectified as they occur. Some of these defects which should become obvious to personnel in the normal course of their work on the installation are listed below, but the experienced radio tradesman will obviously extend this list to meet the requirements of the particular installation.

(a) Mechanical structures should be secure and rigid, nuts and bolts should be tight.

(b) Major components should be securely fixed.

(c) Porcelain insulators should show no signs of damage or arcing at high voltage points.

(d) There should be no signs of overheating, or other deterioration, of resistors, chokes, transformers or other components.

(e) Cables and cable forms should be securely clamped, and should not be subject to undue strain, and should show no signs of damage.

(f) Braiding should be adequately earthed.

(g) All cables (where applicable) should carry identification sleeves.

APPENDIX G1

Local Manufacture of adaptor leads for use with Signal Generator CT520

1. Adaptor lead No. 1

This adaptor lead is to be used when connecting the output of the Signal Generator CT520 to the Receiver aerial socket. It consists of a 12 inch length of 75 ohms coaxial cable (Uniradio 57, 5E/9100285) fitted with a plug Type 150 (10H/133) at one end and a male N-type plug (10H 5803675) at the other end.

An adaptor such as Transradio BNC male to N female (Code BSA 3/7) must be used to connect the lead No. 1 to the CT 520 output lead.

2. Adaptor lead No. 2

This adaptor lead is to be used when connecting the output of the CT520 via the terminating unit TM 5551 to the receiver for IF Amplifier and Oscillator Unit alignment. It consists of a 12 inch length of 75 ohms coaxial cable (Uniradio 70, 5E/9100298) with a BNC plug (10H/20770, 5935-99-5809636) at one end and crocodile clips (5K/9400856) at the other end.

Appendix G2

NEUTRALISING TUNING TOOL (R1392J)

This item to be locally manufactured from unit resources.