RESTRICTED

B.R.1616(1)

HANDBOOK FOR TYPE 612 SERIES

VOLUME I

TECHNICAL & MECHANICAL DESCRIPTION

1948

To ensure receipt of this handbook with the apparatus to which it refers, it is plan packed with it. In ships and establishments where multiple fitting of the apparatus takes place, this will lead to the supply of copies in excess of requirements. Such excess copies should be surrendered to the local Distributing Authority.

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VOLUME I

TECHNICAL & MECHANICAL DESCRIPTION

RADIO EQUIPMENT DEPARTMENT,
ADMIRALTY.
MAY 1948. (R. E. 39/46)

ADMIRALTY, S.W.1.

6th May, 1948.

R.E. 39/46

B.R. 1616(1) (Restricted) "Handbook for Type 612 Series, Volume I, Technical and Mechanical Description, 1948", having been approved by My Lords Commissioners of the Admiralty, is promulgated for information and guidance.

By Command of Their Lordships,

J. S. Long

To Flag Officers and
Commanding Officers
of H.M. Ships and
Vessels concerned.

B.R.1616(1)

HANDBOOK FOR TYPE 612 SERIES VOL.I

ERRATA

Chapter 9 paragraph 1. Add new sentence :-

"When Plessey plugs and sockets have been exposed to salt water or spray they should be washed out with warm pure water at the earliest opportunity".

Chapter 10 paragraph 5. Add new sentence :-

"When it is necessary to remove a valve, push it out by the centre pin in the base; NEVER pull on the glass envelope".

Chapter 10. Add new paragraph 16 sub-paragraph (3).

"(3) Should the change over relay in the A.T.U. be damaged and no replacement available, the relay can be by-passed by connecting the lead from the "loading coil" direct to the "Aerial Output Socket". If this is done it is necessary to use a separate aerial for the Receiver B46".

HANDBOOK FOR TYPE 512 SERIES

VOLUME I

TECHNICAL AND MECHANICAL DESCRIPTION

LIST OF CONTENTS

LIST OF FIGURES

(CONTAINED IN VOLUME II)

INTRODUCTION

Type 612 has as its main items a H.F. Transmitter, a H.F. Receiver and a M.F. Receiver. These can be obtained in forms suitable for operation from A.C. or D.C. power supplies and thus it is possible to make up a number of combinations of the pieces of apparatus according to the following variations.

Coding	Description of Apparatus
Type 612 ET (replacing Type 52 ERT)	A transportable set operated from 24V D.C. comprising :- H.F. Transmitter 5AH Modulator Unit Aerial Tuning Unit H.F. Receiver B46 M.F. Receiver B47 Remote Control Unit Whip Aerials, Batteries, etc.
Type 612 E (replacing TCS and Types 607/8)	H.F. Transmitter Units, operated from 24V D.C. comprising :- H.F. Transmitter 5AH Modulator Unit Aerial Tuning Unit
Types 612 EF/F (replacing Type 60 EQR)	H.F. Transmitter Units, operated from either 24V D.C., 230V 50 c/s or 180V 500 c/s A.C. comprising :- H.F. Transmitter 5AH Modulator Unit Aerial Tuning Unit A.C. Power Unit
Receiver Outfit CAJ	Receiver B46 with A.C. and D.C. Power Packs (230V 50 c/s or 180V 500 c/s or 24V D.C.)
Receiver Outfit CAK	Receiver B47 with A.C. and D.C. Power Packs
Receiver Outfit CAL	Receiver B46 with A.C. Power Pack
Receiver Outfit CAM	Receiver B47 with A.C. Power Pack
Receiver Outfit CAN	Receiver B46 with D.C. Power Pack
Receiver Outfit CAP	Receiver B47 with D.C. Power Pack
Aerial Outfit AWG	Whip Aerial Outfit, primarily for use with the transmitter but also suitable for use with the receivers. A transmitter and an H.F. receiver only require a single whip aerial

Coding	Description of Apparatus
Battery Outfit BCe.	24V battery outfit of NI-FE cells for use with forms of the equipment requiring D.C. power supplies where normal ship's supply (BBn or 24V mains) is not available.

CHAPTER 1.

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GENERAL DESCRIPTION

FOR THE BENEFIT OF NON-TECHNICAL OFFICERS AND JUNIOR RATINGS. CHAPTER I SHOULD BE READ BEFORE OPERATING THE SET AS IN CHAPTER 2.

CHAPTER 1

GENERAL DESCRIPTION

1. Type 612 consists of a transmitter covering the high frequency band, a receiver covering a slightly wider band and a receiver covering the medium, low and very low frequency bands.

The purpose of the equipment is to provide versatile radio units for general-purpose naval use. Typical examples of use are, B.W.O. emergency equipment; emergency equipment aft (in small ships); small craft equipment; temporary shore stations; equipment for use by landing parties etc.

For these purposes the equipment has been designed as a number of small units which are waterproof, can be easily carried and will fit into tubular steel crates for transport purposes. The units may be bolted together in various ways, for ship installations, or the crates can be assembled to form a convenient equipment for use ashore.

FREQUENCY RANGES AND SERVICES

2. H.F. Receiver B46. 1·4 - 15·0 Mc/s in three bands giving reception of R/T., C.W. or M.C.W.

M.F. Receiver B47. 40·0 - 500 kc/s and 15·0 - 27·0 kc/s in four bands giving reception of R/T., C.W. and M.C.W.

Transmitter 5AH. 1·5 - 13·0 Mc/s in three bands for C.W., M.C.W. or R/T. transmission using amplitude modulation.

POWER OUTPUT AND POWER SUPPLIES

3. The output power of the transmitter (into 100 ohm unbalanced line or Aerial Tuning Unit) is 12 - 20 watts on R/T. and M.C.W., or 24 - 40 watts on C.W.

The output of each receiver is 250 mW. into a loudspeaker or an external 600 ohm line and 4 mW into one pair of telephones.

By using appropriate power units the transmitter and both receivers can be operated from 24V D.C., 230V 50 C/s or 180V 500 c/s A.C. with the following power consumptions:-

H.F. Receiver	.....	42 watts
M.F. Receiver	.....	26 watts
Transmitter	.....	250 watts (Key Pressed)
Transmitter	.....	52 watts (Standby)

CHIEF FEATURES

Receivers

4. Both receivers have good frequency stability and crystal control may be applied to the local oscillator of the H.F. receiver, if desired. Scales are calibrated directly in terms of frequency which can be checked by "Crystal Calibrator", to ensure accurary. No special aerial is required for either set. Both receivers have built-in loudspeakers. A sealed and waterproof construction is used for the units which have specially strong tubular metal travelling crates, designed so that the equipment may be operated in them.

Transmitter

5. The transmitter also has good frequency stability, with or without crystal control, and its main tuning scale is calibrated directly in terms of frequency. An aerial tuning unit enables the transmitter output to be matched to a variety of aerials though a specially designed whip aerial is available. The equipment may be switched on and off from a remote control point, to which may be extended the output of a receiver. There are also intercommunication facilities between the transmitter and the remote unit. Mechanically, the construction of the transmitter is the same as that of the receivers - sealed and waterproof construction, tubular crates, etc.

Composition of the equipment

6. The equipment consists of five main units;

H.F. Receiver B46	Modulator Unit
M.F. Receiver B47	Aerial Tuning Unit
Transmitter Unit 5AH	(Fig.1)

and subsidiary items :-

Remote Control Unit and Cabinet.	Whip Aerial.
A.C. Power Unit (for 5AH).	Batteries.
(Local Operating Desk and	Remote Control Cable.
("Spares" Cabinet.	

The main units and the first two subsidiary units are of similar construction. They consist of cast aluminium-alloy boxes housing the components, which are in each case fixed to the front panel so that the equipment can be removed from its box.

Rubber seals are used in connection with everything passing through the front panel and around the edge of the box. These seals give the units a very high degree of watertightness and the units may be immersed in water to a depth of 2 feet without suffering damage and be ready for use IMMEDIATELY ON WITHDRAWAL FROM THE WATER.

For transport purposes, the units are mounted in tubular steel crates, and operation can take place without removal from the crates. Both features are very useful for landing parties.

BRIEF CIRCUIT DESCRIPTION

H.F. Receiver (Figs. 13, 14)

7. The receiver is of the superheterodyne type and is specially designed to have good frequency stability over long periods, without the use of crystals, although these may be used if desired. The receiver and its power unit are mounted in the one case and change from D.C. to A.C. operation is made by substituting a sub-unit, the change occupying a few minutes.

The circuit consists of a signal limiter, R.F. amplifier, frequency changer, manually controlled local oscillator, two-stage I.F. amplifier, detector (with A.G.C.) and A.F. amplifier, pulse limiter and output stage. For crystal control the triode portion of the frequency changer is used as a local oscillator.

There is also a crystal calibrator giving 100 kc/s beat notes over the entire frequency range of the receiver.

There are two main tuning controls; R.F. signal circuits and the local oscillator circuits. The R.F. amplifier circuits are ganged together but are not ganged to the local oscillator. This does not cause any considerable decrease to the ease of operation. Band-pass filters are used in the input and I.F. circuits and the very high degree of selectivity offered by the receiver is further aided by a crystal band-pass filter and an audio filter. Selectivity may be varied by means of a three position switch.

M.F. Receiver (Figs. 25, 26)

8. This receiver is also of the superheterodyne type and has good frequency stability over long periods without crystals being used. The receiver and its power unit are mounted in one case and change from D.C. to A.C. operation is similar to that in the H.F. receiver.

The circuit consists of, a signal limiter; an R.F. amplifier, a local oscillator combined with a frequency changing valve; two I.F. stages; detector, A.G.C. and A.F. amplifier stage; an output stage. There is also a pulse limiter.

A single tuning control is fitted, all tuned circuits being ganged, and band-pass filters are used in the input and I.F. circuits, the selectivity being further increased by an audio filter, which may be switched in if required.

Transmitter (Figs. 32, 33)

9. The transmitter is housed in three units, the R.F. unit, the Modulator and D.C. Power Unit, and the Aerial Tuning Unit. When operated on A.C. there is also an A.C. Power Unit.

The transmitter circuit is composed of an oscillator and an output stage. The oscillator may be crystal controlled or self-excited and the output stage always acts as an amplifier.

There is a built-in crystal calibrator (and audio amplifier) and beat notes may be obtained at 100 kc/s intervals over the entire frequency range of the transmitter.

A diode rectifier provides sidetone for monitoring the transmission.

9. (Contd.)

Keying is by means of relays, and where a Remote Control Unit is used the control lines do not have to carry large currents or withstand high voltages. The keying system also reduces the H.F. receivers' gain, and where this receiver shares an aerial with the transmitter, arranges the necessary changeover.

All the tuned circuits in the transmitter are ganged.

The modulator circuits comprise a combined M.C.W. tone oscillator and grid-bias rectifier (double diode triode), an A.F. amplifier and a pair of modulator valves. This unit also houses the apparatus for operation from a 24 volt supply. Where it is required to operate the transmitter from A.C. mains the fuse panel on the front of the unit is removed and a plug from a separate A.C. Power Unit is substituted. The A.C. Power Unit uses two full-wave rectifiers of the vacuum type. If A.C. Supply fails, Automatic change to Battery Supply takes place.

The Aerial Tuning Unit comprises a matching circuit, a loading circuit and a dummy load.

Remote Control Unit

10. This is a small watertight unit for operation of the transmitter at distances up to 800 yards, connection between the two being via 100 yard lengths of 10-core cable.

From this unit the transmitter may be switched on and off and keyed and output from a receiver can be extended to its built-in loud-speaker. Intercommunication facilities are also available.

DIMENSIONS

11.

Unit	Width	Height	Depth	Weight
Receiver B46 Carrying Crate	18¼ in. 20¼ in.	11½ in. 17⅜ in.	10½ in. 13¾ in.	43 lb. 68 lb.(loaded)
Receiver B47 Carrying Crate	18¼ in. 20¼ in.	11½ in. 17⅝ in.	10½ in. 13¾ in.	39 lb. 64 lb.(loaded)
Transmitter 5AH Carrying Crate	18¼ in. 22¼ in.	11⅜ in. 17⅝ in.	11½ in. 15 in.	45 lb. 75 lb.(loaded)
Modulator and D.C. Power Unit Carrying Crate	18¼ in. 22¼ in.	8⅞ in. 13¼ in.	11½ in. 15 in.	48 lb. 77 lb.(loaded)
Aerial Tuning Unit Carrying Crate	18¼ in. 22¼ in.	8⅞ in. 15¼ in.	11½ in. 15 in.	33 lb. 59 lb.(loaded)
Remote Control Unit Packed for Transit in Control Cabinet	8 in. 23 in.	11¼ in. 25¾ in.	7 in. 14¾ in.	14½ lb. 79 lb.

11.(Contd.)

Unit	Width	Height	Depth	Weight
"Spares" Cabinet Packed for Transit	23 in.	25¾ in.	13½ in.	98 lb.
Aerial Accessories Box	11¼ in.	16¾ in.	8¼ in.	39 lb. (loaded)
"Golf" Bag	(52 in. long, 3 in. Diameter)			9¼lb. (packed)
Battery (8·4 volt unit in crate)	19½ in. + 3½ in.(Handles)	10⅛ in.	5⅝ in.	52 lb.
A.C. Power Unit for transmitter.	18½ in.	10½ in.	15 in.	104 lb.
A.C. Power Unit for receivers.	4⅛ in.	8 in.	7¼ in.	11½lb.
D.C. Power Unit for receivers.	4⅛ in.	6½ in.	7¼ in.	5½lb.

CHAPTER 2.

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OPERATING INSTRUCTIONS

TUNING INSTRUCTIONS AND TYPICAL READINGS.

CHAPTER 2

OPERATING INSTRUCTIONS

RECEIVER B46

General Procedure

1. This section describes the general procedure for operating the B.46.

(1) Switch on the main supply and allow one minute for the valves to warm up. While this is taking place plug in the headphones (if used) and aerial.

(2) Check that the H.T. and L.T. voltages are approximately normal, 133 and 24 volts respectively. (Pointer Central).

(3) Verify that the appropriate crystals are vertically in the holders if crystal control of the local oscillator is to be used. Chapter 3, para.8.

(4) Set the Band Switch to the appropriate frequency band and the R.F. TUNE and OSCILLATOR TUNE COARSE controls to the required frequency.

(5) Adjust the AE TRIM control for best signal-noise ratio when receiving weak signals or those with a heavy background of interference. By the critical use of this control an improvement of 10 - 15 db in the signal-noise ratio may be obtained.

(6) If interfering signals are received when tuned to the desired station adjust the ANTI CROSS-MOD control for minimum interference.

(7) Use the limiter if static interference is bad.

(8) With C.W. signals the C.W. beat-note control should be carefully adjusted, since by arranging that the note frequency is exactly equal to the resonant frequency of the note filter, a considerable increase in selectivity may be obtained.

Using the Crystal Calibrator

2. (1) If it is desired to set the receiver with the maximum accuracy the crystal calibrator should be used. It is very important that it should be used exactly as detailed, otherwise spurious results may be obtained.

Important Note Crystal Calibrator should always be used when time permits.

(2) Remove the aerial plug from its socket.

(3) Adjust the R.F. TUNE and BANDSWITCH to the desired frequency.

(4) Turn the OSCILLATOR TUNE COARSE control to the frequency which is a multiple of 100 kc/s nearest to the desired one. It may happen that the desired frequency is a multiple of 100 kc/s. An example of the other case would be if it was intended to receive on a frequency of say 3·48, the coarse control at this stage would be set to 3·5 Mc/s.

2. (Contd.)

(5) Turn the ANTI CROSS-MOD control fully anti-clockwise (minimum R.F. gain).

(6) Move the "Service" switch to CAL and the C.W.- R/T switch to C.W.

(7) Adjust the OSCILLATOR TUNE FINE control to select the nearest strong beat note.

(8) Move OSCILLATOR TUNE COARSE to desired frequency. Move the Service switch to TUNE and adjust the R.F. TUNE control to give the loudest signal.

(9) If OSCILLATOR TUNE FINE control is used after setting up as above the dial readings WILL BE INACCURATE.

RECEIVER B47

General Procedure

3. This section describes the general procedure for operating the B47.

(1) Switch on the main supply and allow one minute for the valves to warm up. While this is taking place plug in the headphones (if used) and aerial.

(2) Check that the H.T. and L.T. voltages are approximately normal, 133 and 24 volts respectively. (Pointer Central).

(3) Set the Band Switch to the required frequency. Also the R.F. TUNE control but err slightly to one side if experience has shown slight calibration errors at this part of the frequency band; i.e. if working on 120 kc/s has shown that the true tuning point was a little to the left of the engraved figure, it would be correct to set slightly to the left when adjusting for 125 kc/s. With C.W. signals the C.W. beat-note control should be carefully adjusted, since by arranging that the note frequency is exactly equal to the resonant frequency of the note filter, a considerable increase in selectivity may be obtained.

(4) Adjust the AE TRIM control for best signal-noise ratio when receiving weak signals or those with a heavy back-ground of interference. By the critical use of this control an improvement of 10 - 15 db in signal-noise ratio may be obtained.

(5) If interfering signals are received when tuned to the desired station adjust the ANTI CROSS-MOD control for minimum interference.

(6) Use the Limiter if static interference is bad.

TRANSMITTER

Preliminary Procedure

4. The operations are detailed below:-

(1) Plug in the local handset, telephones, R.F. output lead etc.

4. (Contd)

(2) Move the "OFF-STANDBY-READY" switch on the Modulator Unit to STANDBY. Check that the STANDBY indicator lamp lights.

(3) Set RANGE SWITCH and TUNING CONTROL to the frequency to be used.

(4) Move R/T-M.C.W.-C.W. switch to the service wanted and the REMOTE-LOCAL switch to LOCAL.

Master Control

5. (1) For rough use the scale engravings will be sufficiently accurate to be relied upon when setting the transmitter for a new frequency, but should it be desired to obtain the highest degree of accuracy, the Crystal Calibrator must be used as follows.

(2) Set the TUNING CONTROL to the nearest multiple of 100 kc/s to the new working frequency. If the new working frequency is a multiple of 100 kc/s, set the TUNING CONTROL to it.

(3) Move the R/T-M.C.W.-C.W. switch on the Modulator Unit to C.W. and the CRYSTAL CALIBRATOR switch on the 5AH to CAL. Also plug a pair of telephones into the socket below the R.F. Meter.

(4) Switch on the transmitter and adjust the OSCILLATOR TRIMMER control until a very loud beat note is heard in the telephones.

(5) Adjust the OSCILLATOR TRIMMER control until the beat note reaches its silent point. The oscillator is then set exactly to the 100 kc/s multiple indicated by the scale, and the scale now reads accurately, for that region of the dial.

(6) Set the tuning control to the desired frequency (if different from the 100 kc/s multiple).

(7) If the OSCILLATOR TRIMMER is used after setting up as above, the dial readings will be inaccurate.

Crystal Control

6. (1) Obtain the correct type of Two pin crystal for the frequency it is desired to radiate, according to the following table:-

	Radiated frequency Mc/s	Crystal frequency Mc/s
Band 1	1·5 - 3·25	1·5 - 3·25
Band 2	3·0 - 6·5	1·5 - 3·25
Band 3	6·0 - 13·0	3·0 - 6·5

(2) Insert this crystal in holder 1 or 2 on the R.F. Unit and move the M.O.-Crystal switch to the CRYSTAL position (1 or 2). Also move the OFF-STANDB.-READY switch to STANDBY.

(3) Set the TUNING CONTROL and BAND SWITCH on the 5AH to the declared frequency of the crystal, and the METER SWITCH to position 2.

6. (Contd.)

(4) Move the OFF-STANDBY-READY switch to ready and vary the 5AH tuning control whilst watching the meter (position 1 oscillator anode current). Start with the control on the high frequency side of the working frequency, move it slowly, and note that the meter indication has a minimum value (proving the crystal to be oscillating). Also note that the change in current on one side of the dip is much faster than on the other.

Note the difference between the maximum and minimum anode currents and set the tuning control on the high frequency side of the dip, and at a point corresponding to an anode current equal to the minimum current plus about one third of the difference.

Amplifier Trimmer

7. (1) Disconnect Aerial Tuning Unit from transmitter.

(2) Move meter switch to position 3 (Anode Current).

(3) Move OFF-STANDBY-READY switch to READY.

(4) Press morse key.

(5) Rotate AMPLIFIER TRIMMER until meter gives a dip.

(6) Return OFF-STANDBY-READY switch to STANDBY.

(7) Reconnect Aerial Tuning Unit.

AERIAL TUNING UNIT

Use of Charted Settings

8. (1) Set controls on the Aerial Tuning Unit to charted settings.

(2) Move OFF-STANDBY-READY switch to READY.

(3) Press morse key.

(4) Adjust TUNING and LOADING controls for maximum aerial current (press button below meter to increase reading).

Setting to Frequency not Previously Used

9. (1) Set coupling control to minimum.

(2) Move OFF-STANDBY-READY switch to READY.

(3) Press morse key.

(4) Move tuning control on the Aerial Tuning Unit until the meter in the MATCHING CIRCUIT indicates a maximum. The meter switch should be operated when using the meter if it is required to increase the indication.

9. (Contd.)

(5) Increase the COUPLING control a little and readjust the TUNING control in conjunction with it until optimum position is found of maximum current through the DUMMY AERIAL, but check that the cathode current of the R.F. Amplifier does not exceed 130 mA. (5AH meter switch position 3).

(6) Reduce the coupling control to zero, switch out the DUMMY LOAD and connect the Aerial.

(7) If the Aerial Reactance is capacitive, as it usually will be on Band 1, tune it out by varying the LOADING control until the AERIAL CURRENT meter indicates a maximum. Normally loading should only be used on Band 1. On other bands, set the control to zero turns.

(8) Finally retune and increase the coupling until the maximum aerial current is obtained, or until the cathode current of the R.F. Amplifier reaches its limiting figure - see (6). There must of necessity be a certain amount of inter-dependency between the various aerial circuits, and this in turn will require a search for an optimum setting of the tuning and coupling controls to obtain maximum aerial power. In addition, the loading coil will be required on Band 1, mainly at the low frequency end, with short aerials. The adjustment of the aerial tuning unit is not difficult, and the table at the end of Chapter 9, gives the approximate settings to be expected for various frequencies, using the 36 ft. whip aerial. This table should not be used for initial reference, but only as a rough guide. The essential factor is that a new operator should spend time in becoming familiar with setting the various circuits by trial, in conjunction with the above instructions.

Operation

10. (1) Operate the R/T-C.W.-I.C. switchand tell the operator at the Remote control position, that control is being passed to him for test purposes. Instruct him to check all controls. Irrespective of whether it is used regularly, if a remote control position exists, it should be tested whenever the transmitter is used.

(2) Retake control (if necessary), and report that the transmitter is ready for for service.

(3) To close down the transmitter, move the OFF-STANDBY-READY switch to OFF. If there are periods of more than a few minutes without transmission, this switch should be moved to STANDBY to reduce power drain if batteries are being used. The switch on the D.C. distributing box must always be broken when the set is not in use. (See note following 8.41).

CHAPTER 3.

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RECEIVER B46

FOR TECHNICAL OFFICERS AND RATINGS.

A DESCRIPTION OF CIRCUIT FUNCTIONS.

CHAPTER 3

RECEIVER B46

STATEMENT OF PERFORMANCE

1. Frequency Range. 1·4 - 15·0 Mc/s

Band No. 1.	1·4 - 3·3 Mc/s	(214·3 - 90·9m)	Green
" " 2.	3·3 - 7·3 Mc/s	(90·9 - 41·1m)	Red
" " 3.	7·3 - 15·0 Mc/s	(41·1 - 20·0m)	Blue

System. Superheterodyne of 465 kc/s intermediate frequency.

Frequency Stability. Self-excited local oscillator. Better than 15 parts in a million per degree Centigrade.

Crystal-controlled local oscillator 4 parts in a million per degree Centigrade.

Setting Accuracy. ± 5 kc/s at the worst part of the scale.

Sensitivity. (R/T and M.C.W.)

An input of 10 µV, modulated to a depth of 30% at 400 c/s and fed into the receiver via an artificial aerial of 70 ohms impedance will give an output into 600 ohms of 10 mW and with a signal-noise ratio of 20 db.

Sensitivity. (C.W.)

An input of 5 µV, fed into the receiver via an artificial aerial of 70 ohms impedance will give an output into 600 ohms of 10 mW and with a signal-noise ratio of 20 db.

Selectivity. (I.F.)

Narrow Band: Bandwidth greater than ± 1·0 kc/s for 6 db. loss and less than ± 8 kc/s for 40 db. loss.

Broad Band: Bandwidth greater than ± 2·5 kc/s for 6 db. loss and less than ± 10 kc/s for 40 db. loss.

A note filter of 800 c/s and causing an insertion loss of not more than 3 db can be switched into the audio frequency circuits.

Maximum Output Power.

(1) Loudspeaker Output: 250 mW

(2) 600 ohm Output: 250 mW

(3) Telephone Output: 4 mW in one pair of 600 ohms telephones.

1. (Contd.)

Second Channel Suppression. Greater than 38 db.

Automatic Gain Control and Input Limiter. For a change of input from 50 to 100,000 /uV the change of output level will not exceed 10 db.

Aerial System. A wire aerial of 10 - 40 pF capacitance and 10 ohms resistance may be used. Provision is made for cases where an unbalanced 70 ohm feeder is interposed between the aerial and the receiver or for the simultaneous use of several receivers by series connection.

Power Supply. 24 volts D.C. or A.C. 230 volts 50 c/s, 180 volts 500 c/s.

Maximum Power Consumption. 42 watts.

GENERAL (ELECTRICAL)

2. The B46 receiver is of the superheterodyne type and has been especially designed to have a high degree of frequency stability over long periods of operation without the use of crystals, although these may be used if desired.

Although the receiver and its power unit (A.C. mains or battery operated) are mounted in a single case, four sub-sections will be used in this chapter to describe the electrical features, viz:

(1) Aerial Input and R.F. Amplifier Circuits.

(2) Frequency Changing and Local Oscillator Circuits.

(3) I.F. Amplifier and Output Circuits.

(4) Power Supply Circuits.

INPUT AND R.F. AMPLIFIER (Fig. 15)

3. Aerial and earth connections are provided by a plug and socket on the receiver. Connection B (Marked on the moulding) is for direct linkage to an open aerial or the Aerial Tuning Unit on all bands; the capacitance of the aerial should not exceed 100 pF. For aerials of greater capacitance a 100 pF capacitor must be joined in series. Connections A and C provide for a 70 ohm transmission line where one is interposed between the aerial and the receiver. They are also used when operating several receivers from the same aerial.

An aerial trimming capacitor, C401, is fitted and critical adjustment of this can give 10 - 15 db improvement in signal-noise ratio on weak signals.

The tuned input circuits consist of bottom inductance coupled band-pass filters L1, L4, L7 and L2, L5, L8, for the three bands. The filters have capacitance and inductance trimmers at the high and low frequency ends of the bands. This arrangement enables the correct L:C ratio to be obtained exactly at two points on each band and, by aiding the ganging of the oscillator and signal circuits, secures good calibration accuracy.

4. Connected across the input circuit of V2 is a diode (CV1092) to protect the R.F. amplifier valve against overloading. At normal signal levels V1 is inoperative and contributes only a small capacitance to the tuned circuits. At high levels the control grid of V2 becomes increasingly negative due to A.G.C. action, the anode current decreases and hence the voltage across the cathode resistor R2 decreases. Since this bias is common also to V1 a condition is reached in which V1 conducts for peak input levels at the diode which are greater than the instantaneous value of the bias. With the valve conducting, its impedance is low and the tuned circuit is effectively short circuited. In this latter state the A.G.C. voltage starts to fall, since there is now no signal, or only a small signal input, to maintain it. Consequently the voltage across R2 rises and the impedance of V1 increases and the cycle of operation begins again. The net result is that the mean signal level at the control grid of V2 is kept at a value which prevents blocking and severe overloading. This limiter gives a measure of protection against radar interference but the efficiency depends on the pulse recurrence frequency of the interfering signal and the time-constant of the receiver A.G.C. system.

A portion of the cathode bias resistance of V2 is taken out to a variable resistor on the front panel and marked ANTI-CROSS MOD. Critical adjustment of this control will remove certain types of interference produced by strong signals cross-modulating the wanted signal.

5. All tuning coils in the R.F. Amplifier circuits are of the adjustable dust-cored type and the cores are fitted with locking plugs.

The output of the amplifier is in the form of a tuned anode circuit with the anode connection tapped down the coil on bands 1 and 2. The anode circuits are tuned by C19 which is ganged with C1 and C2 in the input filter circuits.

None of these circuits is temperature compensated because the selectivity is much less than that of the intermediate frequency amplifiers and a certain amount of drift is permissible in the R.F. circuits. The setting of the signal circuits is not very critical during searching since the local oscillator has a separate tuning control. For signals below the "knee" of the automatic gain control curve, i.e. for very weak signals, the signal circuits and aerial trimming capacitor must be carefully adjusted to obtain the optimum signal-noise ratio.

LOCAL OSCILLATOR AND FREQUENCY CHANGER
(Fig. 16)

6. The frequency changer V3 is a triode-hexode (CV1347). For operating the receiver with a crystal controlled local oscillator the triode portion is used, the crystal XL1 or XL2 being brought into circuit by the "service" switch S102, to provide alternative frequency channels.

When working without crystal control a separate triode V101 (CV1055) is used. It operates as a Colpitts oscillator with variable inductance L.113. Table I gives the method of operation and frequency coverage of the local oscillator in its self-excited form:-

6. (Contd.)

TABLE I

Signal Frequency Mc/s	Local Oscillator Frequency Mc/s.	Frequency Changing on
15·0 - 7·3	7·73 - 3·88	Second Harmonic
7·3 - 3·3	7·76 - 3·76	Fundamental
3·3 - 1·4	3·76 - 1·86	Fundamental

7. The use of the oscillator second harmonic reduces the "conversion gain" at the highest frequencies, but is more than compensated by the avoidance of complex switching in a high stability oscillator.

This is achieved by specially compensating individual oscillators during manufacture. In the frequency range 3·3 - 15 Mc/s the compensating capacitors are C115 - C124. Only four of these will be used at a time but the actual ones will not be the same for each oscillator. On the 1·4 - 3·3 Mc/s range compensation is secured by choice of C134 or C135. Over the range 3·3 - 15 Mc/s the oscillator frequency can be varied by ± ·15% and on the 1·4 - 3·3 Mc/s range by ± ·5% by means of the "Fine" control. This allows the operator some latitude in searching over a limited range with the "coarse" tuning control of the oscillator locked. The "Fine" tuning control is C113 which is the total "Fine" tuning capacitance on the 1·4 - 3·3 Mc/s range. On the other ranges C113 (and C112 to restrict the frequency deviation) forms the total tuning capacitance.

The Heater Mats, R104 and R105, are not normally connected, but when the receiver is to be exposed to arctic conditions, the heater mats can be connected for operation, by soldering the loose (WHITE) lead, from one heater mat to the vacant terminal on the other mat. The heaters dissipate about 2 watts. There is no thermostatic control. L116 and C108, C107, C114 and C129 are for trimming the calibrated oscillator scale to the oscillator frequency.

8. Crystal control of the local oscillator may be used for all frequencies of 2 Mc/s and above and Table II shows the correct crystal frequency for any desired signal frequency. It is possible to insert the crystals across the sockets, i.e. with one pin in the right socket and one pin in the socket of the alternative channel crystal. The correct alignment of the pins is indicated by an arrow on the socket and it must be ascertained that the pins are vertical when plugging in crystals.

TABLE II

Signal Frequency Mc/s	Corresponding Crystal Frequency
2 - 10	Signal frequency +465 kc/s
10 - 15	$\frac{\text{Signal frequency +465 kc/s}}{2}$

8. (Contd.)
The anode of the frequency changer is tuned to the I.F. (465 kc/s) by means of L17 and C28 - C30 and a coil coupled to L17 forms a low impedance link to the input stage of the first I.F. amplifier.

CRYSTAL CALIBRATOR
(Fig. 16)

9. Associated with the separate R.F. oscillator unit is a calibrator consisting of V100 (CV1053) acting as a crystal controlled oscillator, the crystal XL103 being connected in series with the control grid and the tuned circuit composed of L114 and C100 and C101. The circuit is tuned to give about 80% of the maximum grid current and is stable with respect to voltage changes, etc.

The output is taken to the suppressor grid of the R.F. amplifier via a coupling coil and a low impedance transmission line. By means of the calibrator the receiver can be accurately adjusted to any 100 kc/s point in the range.

I.F. AMPLIFIER AND OUTPUT
(Fig. 17)

10. The input voltage from the frequency changer is developed across coupling coils in L231 and L232 and since the input circuits of the first I.F. stage are linked with selectivity arrangements, the latter will be reviewed first.

Three degrees of selectivity are available and are controlled by S201. In position 3, BROAD selectivity, the input is inductively coupled to the tuned temperature compensated grid circuit of the first I.F. stage. (Interposed between the detector and triode parts of V203 is a noise limiting circuit formed from V204 and V205 (CV1092). A detailed description of the limiter circuit is given in paragraphs 14 to 16 of this chapter).

The combination of L17 in the R.F. Unit and L232 in the I.F. Unit gives in effect a link-coupled band-pass filter. In the next position, NORMAL selectivity, the tuned grid circuit, is replaced by a double crystal band-pass filter having a peak separation of 2 kc/s, i.e. each crystal is ground to oscillate at a frequency of 1 kc/s above and below 465 kc/s. The circuit behaves as two crystal "gate" circuits in parallel and will consequently have a response curve with two sharp peaks. Between the peaks the attenuation will depend on the value of the load impedance into which the crystal works. The grid-cathode capacitance of V201 is tuned out by L232. L232 also determines the effective bandwidth, i.e. the shape of the response curve.

In position 1 of the switch, NARROW selectivity, the crystal band-pass circuit is retained and a note filter composed of L237, C252, C253, C255 and C261 is interposed between the output valve and its driver. The filter is tuned to a frequency of 800 c/s and when not in use R226 is connected in its place so that the output level remains constant.

11. The inter-stage coupling between the first and second I.F. amplifier valves consists of a two-stage inductively coupled band-pass filter formed from L233 and L234 and their associated capacitors. A similar filter, composed of L235 and L236 and the associated capacitors, is also used between the second I.F. stage valve V202 (CV1053) and the double-diode triode V203 (CV1055), which functions as detector and driver for the output stage as well as providing automatic gain control. With BROAD selectivity there are six tuned circuits at intermediate

11. (Contd.)
frequency and seven when switched to NORMAL or NARROW selectivity.

The load for the A.G.C. diode is R211 and the stages controlled are the first I.F., the R.F. amplifier and the frequency changer. The A.G.C. does not come into operation until the positive peak input at the A.G.C. diode anode exceeds the steady D.C. voltage developed across R213. Bias for the triode portion of V203 is obtained with the cathode resistor R214.

12. The manual volume control R402 on the front panel, controls the input to the amplifier portion of V203 and the valves output is passed to V206 via a resistance-capacitance coupling. The output V206 (CV511) uses transformer coupling in its output circuit. T202 has two secondary windings, one of 3 ohms impedance for connection to the speech coil of the built-in loudspeaker and another of 600 ohms impedance for connection to an extension line via the output jack JK401. A second output jack JK402 has R405 and R406 in series to reduce the output level to comfortable telephone strength even though the volume control may be turned up to loudspeaker strength.

C.W. OSCILLATOR

13. For the reception of C.W. signals the C.W. oscillator V207 (CV1091) is brought into use. It is essentially a grid-cathode temperature-compensated oscillator and the coil in the anode circuit only consists of a few turns so that its impedance at intermediate frequency is small. This gives good electronic isolation between the oscillator and the I.F. circuits and prevents the frequency of the oscillator from being affected by very strong signals. Endeavour has been made to ensure that the oscillator frequency does not vary much despite wide variations of temperature, humidity and supply voltages.

A proportion of the oscillator tuning capacitance (C239) is variable and is brought out to a front-panel control so that the C.W. beat note may be varied. The range of variation is $\pm$ 1,000 c/s and enables the different frequency between the C.W. signal and the oscillator to be exactly the centre frequency of the note filter.

The cathode of the C.W. oscillator valve is heated all the time that the receiver is working and the oscillator is started by switching on the screen and anode supply with S401.

Under conditions where the receiver is working in close proximity to a transmitter operating on the same frequency it is necessary for the former to be muted when transmission takes place. This is accomplished by RL1 in the R.F. unit and controlled by the transmitter. When this relay operates, a short circuit is placed on the input band-pass filter and a negative bias is applied to the F.C. and I.F. amplifier valves, thus effectively reducing the receiver gain to provide a monitoring output. The relay is of the high-speed type and has an operating time of about 1 millisecond.

NOISE LIMITER
(Fig. 17)

14. This limiter operates by a comparison of the audio or modulation voltage with the carrier voltage or by comparison of the short duration noise-voltage with the carrier voltage. Its operation is somewhat complex and can best

14. (Contd.)
be understood by considering the circuit under two conditions.

1. When an unmodulated carrier is being received.
2. When modulation is applied to this carrier.

Unmodulated Carrier

15. With an unmodulated carrier fed from L236 into the diode circuit current will flow through R218, R219 and R220 in the direction shown by the arrow, setting up a voltage between points A and E such that A is always positive with respect to E. This voltage will of course be quite steady and since the point B will be positive with respect to point F, V205 will conduct.

V204 will not conduct because the diode current of V205 flowing through R224 will render point D positive with respect to point C.

C248 will charge slowly because of the long time-constant of R223 and this capacitor.

Modulated Carrier

16. Consider that the slider F is moved up the point G, i.e. the only part of the signal diode load which is effective with regard to the limiter circuit is R218 and R219.

If the carrier is now modulated to a depth of 100% the voltage across R218 and R219 will vary between zero and twice the steady-state (unmodulated) value. There the momentary peak voltage across AB will equal the previous steady-state voltage across AG since R218 and R219 are equal, (still assuming that F is moved up to G, i.e. to give the maximum limiting condition). But owing to the long time-constant of the combination C248 - R223 the point C cannot change in potential very quickly with respect to A, and therefore point B will momentarily become negative to point D and V205 will stop conducting.

However, although V205 is extinguished, its electrodes still form a small capacitor and since B is momentarily negative with respect to point G, there will be a voltage tending to drive a current through R224 in an opposite direction to that shown by the arrow, i.e. C will become positive with respect to D, and V204 will conduct and bring point D practically to earth potential so far as audio output is concerned, and will so provide a double limiting effect. When a pulse of "noise" is received it is equivalent to a signal exceeding 100% modulation and limiting action takes place.

POWER SUPPLY CIRCUITS

Battery Operated Power Unit (Fig. 29)

17. The valve heaters are supplied directly from the 24 volt battery and are connected in four series - parallel groups, interconnected at various points to equalise voltage drops.

The anode supplies are obtained from a small dynamotor operating from the battery.

17. (Contd.)
Input to the dynamotor is via two low-pass filters composed of L401, L402, C401 to C405.

The input and output positive leads to the power unit are fitted with single-pole fuses and safety switches which break both circuits when the receiver unit is withdrawn from its waterproof case.

An important point to note is that the casing of the dynamotor is not earthed. This is to prevent "noise" voltage generated in the carcass of the machine from being supplied with multiple paths to the receiver chassis. The machine has a metal screen between its chassis and the receiver, forming an electrostatic screen.

A.C. Mains Operated Power Unit (Fig. 31)

18. This unit consists of a main transformer T501 with a primary winding tapped for 230 volts, 50 c/s and 180 volts, 500 c/s. There are two secondary windings; one is tapped for 126, 136 and 146 volts for the anode supply and the other winding supplies 25 volts for the valve heater circuits.

Rectification of the H.T. supply is by means of a full-wave selenium rectifier W501 and there is an 8 /uF bank of smoothing capacitors.

Each secondary circuit is fused on one pole, likewise the primary circuit which also contains a safety switch closed only when the receiver is in its waterproof case.

STAGES AND VALVES

19.

Function	Code	A.P.
Input Limiter	V1	CV1092
R.F. Amplifier	V2	CV1053
Frequency Changer and Local Oscillator	V3	CV1347
Crystal Calibrator	V100	CV1053
Separate Local Oscillator	V101	CV1055
1st I.F. Amplifier	V201	CV1053
2nd I.F. Amplifier	V202	CV1053
Detector, A.G.C. and 1st A.F. Stage	V203	CV1055
Audio Limiter 1	V204	CV1092
Audio Limiter 2	V205	CV1092
Output Stage	V206	CV511
C.W. Oscillator	V207	CV1091

GENERAL (MECHANICAL) (Fig. 9)

20. The receiver consists of a single unit housing the radio circuits, power supply equipment and loudspeaker.

A cast light-alloy box with a cast front panel is used for the unit and a rubber insert is provided around the front edge to make a watertight seal between the box and the panel. All contacts and controls pass through the front panel with waterproof seals and the whole unit may be immersed in water to a depth of 2 feet for short periods without suffering damage.

Four sub-units make up the receiver chassis:-

1. R.F. Unit.
2. Local Oscillator and Crystal Calibrator Unit.
3. I.F. Amplifier.
4. Power Unit.

The local oscillator and calibrator unit is mounted on the left hand side, looking from the front, and the Power Unit, with loudspeaker, is on the opposite side. The I.F. Unit hinges about its lower front edges, giving access to its valve and to the underside of the R.F. Unit. All trimming controls are accessible from the rear of the receiver when it is removed from its case.

To maintain the air in the receiver in a perfectly dry state a renewable silica-gel capsule is fitted. The colour of the contents can be seen by the operator and changes from blue to pink as moisture is absorbed.

Transportable Mounting (Fig. 4)

21. For transportable use the sealed receiver unit is mounted in a tubular steel crate fitted with stout rubber shock absorbing mountings. This crate forms a convenient means for carrying the unit and the design is such that rough handling will not impair the effectiveness of the waterproof joints.

During transit, the front panel is protected from damage by a light metal cover and doors. When the equipment is required for use the doors are opened, and the panel cover removed and stowed at the back of the crate, or the space provided in the spares cabinet.

The crates may be mounted together into any convenient form of station assembly.

Rack Mounting

22. For use where space is important or for indoor installations likely to remain fixed for long periods, a rack mounting is more compact and can be arranged by removing the receiver from its crate and mounting it with other units of the Type 612 equipment.

FRONT PANEL CONTROLS AND FITTINGS

Controls

23. (Fig. 4)

Marking	Function
OSCILLATOR TUNE COARSE	Oscillator Tuning Control. Coarse (with locking device)
OSCILLATOR TUNE FINE	Oscillator Tuning Control. Fine
R.F. TUNE	R.F. Tuning Control
XTAL 1-XTAL 2-TUNE-CAL	"Service" Selector Switch Blank position is result of modification and should not be used
BAND SWITCH	Band Switch
DIAL LIGHTS	Dial Light Control
METER H.T.-L.T.	Meter Switch
AE. TRIM	Aerial Trimming Control
ANTI CROSS-MOD	R.F. Gain Control
A.F. GAIN	A.F. Gain Control
BAND WIDTH	Selectivity Switch
LIMITER ON-OFF	Limiter Switch
C.W.-R/T	Heterodyne Oscillator Switch
C.W. NOTE	Heterodyne Note Control
SPEAKER VOLUME	Loudspeaker Volume Control
POWER ON-OFF	Mains Switch

Other Fittings

24.

Marking	Function
MUTING	Socket for Muting Circuit Connection
POWER INPUT	Socket for Power Supply Connection
AERIAL	Socket for Aerial Connections
EARTH	Earth Terminal
PHONES	Telephone Jack
LINE 600 OHMS	A.F. Output Jack
METER	Voltmeter
XTAL 1 XTAL 2	Crystal Sockets (2) with waterproof cover.
DRYER	Silica-Gel Capsule
BATT or A.C. (According to the type fitted)	Window Indicating Type of Power Unit

AERIAL SYSTEM

25. The 36 ft. whip aerial specially designed for use with Transmitter 5AH is quite suitable, or a wire aerial about 40 ft. long and erected so that at least half the length is vertical may be used.

DIMENSIONS AND WEIGHTS

26.

	Width	Height	Depth	Weight
Receiver	$18\frac{1}{4}$ in.	$11\frac{1}{2}$ in.	$10\frac{1}{2}$ in.	43 lb.
Carrying Crate	$20\frac{1}{4}$ in.	$17\frac{3}{8}$ in.	$13\frac{3}{4}$ in.	68 lb. (loaded)

CHAPTER 4.

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RECEIVER B47

FOR TECHNICAL OFFICERS AND RATINGS.

A DESCRIPTION OF CIRCUIT FUNCTIONS.

CHAPTER 4

RECEIVER B47

STATEMENT OF PERFORMANCE

1. Frequency Range. 15 - 27 kc/s and 40 - 500 kc/s.

Band No. 1	15 - 27 kc/s	(20,000 - 11,100 m.)
Band No. 2	40 - 90 kc/s	(7,500 - 3,330 m.)
Band No. 3	90 - 220 kc/s	(3,330 - 1,360 m.)
Band No. 4	220 - 500 kc/s	(1,360 - 600 m.)

System. Superheterodyne.

Intermediate Frequency. 35 kc/s.

Frequency Stability. 100 parts in a million per degree centigrade.

Setting Accuracy. ± 5 kc/s at the worst part of the scale.

Sensitivity (C.W.)

Band 1. An input of 100 μV fed into the receiver via an artificial aerial of 70 ohms impedance will give an output into telephones of 10 mW into 600 ohms and with a signal-noise ratio of 16 db.

Bands 2, 3, 4. An input of 4 μV fed into the receiver via an artifical aerial of 70 ohms impedance will give an output of 10 mW into 600 ohms and with a signal-noise ratio of 20 db.

Sensitivity (R/T and M.C.W.)

Bands 1 - 3. An input of 10 μV modulated to a depth of 30 per cent at 400 c/s and fed into the receiver via an artificial aerial of 70 ohms impedance will give an output into telephones of 10 mW into 600 ohms and with a signal-noise ratio of 20 db.

Selectivity (I.F.)

Bandwidth greater than ± 0·75 kc/s for 6 db loss.
Bandwidth less than ± 3·8 kc/s for 40 db loss.

A note filter of 1 kc/s bandwidth and causing an insertion loss of not more than 3 db can be switched into the audio frequency circuits.

Maximum Output Power

(1) Loudspeaker Output - 250 mW

(2) 600 ohm Output - 250 mW

(3) Telephone Output - 4 mW in one pair of 600 ohm telephones.

1. (Contd.)
Second Channel Suppression

Bands 1 - 3. Greater than 50 db.
Band 4. " " 20 db.

Automatic Gain Control and Limiter

For a change of input from 50 to 10^5 uV the change of output level will not exceed 10 db.

Aerial System. Any wire aerial of about 100 pF capacitance and 10 ohms resistance may be used. Provision is made for cases where a balanced feeder is interposed between the aerial and the receiver or for the simultaneous use of several receivers.

Power Supply. 24 volts D.C., 230 volts 50 c/s.
180 volts 500 c/s.

Maximum Power Consumption. 26 watts.

GENERAL (ELECTRICAL)

2. The B47 receiver is a superheterodyne type and is specially designed to have a high degree of frequency stability over long periods of operation.

It differs from the B46 in that it has no crystal calibrator, no muting arrangement for use in conjunction with a transmitter and it is not fitted with a separate local oscillator.

Although the receiver and its power unit (A.C. mains or battery operated) are mounted in a single case, four sub-sectionswill be used in this chapter to describe the electrical features viz:-

(1) Aerial Input and R.F. Amplifier Circuits.
(2) Frequency Changing and Local Oscillator Circuits.
(3) I.F. Amplifier and Output Circuits.
(4) Power Supply Circuits.

INPUT AND R.F. AMPLIFIER
(Fig. 27)

3. Aerial and earth connections are provided by a plug and socket on the receiver. Connection B (marked on the moulding) is for direct linkage to an open aerial on bands 2, 3 and 4; the capacitance of the aerial should not exceed 100 pF. For aerials of greater capacitance a 100 pF capacitor must be connected in series. This connection is used for all types of input on Band 1.

The two other connections provide for a 70 ohm transmission line where one is interposed between the aerial and the receiver, or for the operation of several receivers from the same aerial, and can only be used on Bands 2, 3 and 4.

An aerial trimming capacitor C301 is fitted and critical adjustment of this can give 10 - 15 db improvement in signal-noise ratio on weak signals.

3. (Contd.)
The tuned input circuits consist of two band-pass filters, composed of L1, L5, L9 and L2, L6, L10 for the filters of the three frequency bands. On Band 1, the aerial circuit is untuned and the input voltages are developed across R19. The filters have capacitance and inductance trimmers for adjustment at the high and low frequency ends of the bands. This arrangement enables the correct L.C. ratio to be obtained exactly at two points on each band and by aiding the ganging of the oscillator and signal circuits, secures good calibration accuracy.

4. Gas filled valve V4 is connected across C2 to protect the input circuit against high voltages due to static discharge. It "strikes" at 80 - 100 volts.

C17 is an additional trimmer necessitated by the high self-capacitance of L10. C26 and C61 serve similar purposes for L11 and L14 respectively.

From the second band-pass filter the signals are passed to the control grid to the R.F. amplifier V2 (CV1053) via C11.

R5 is connected between the grid circuit and earth in order to limit the maximum impedance of the tuned circuits.

Connected across the input circuit of V2 is a diode V1 (CV1092) to protect the R.F. amplifier valve against overloading.

5. All tuning coils in the R.F. amplifier circuits are of the adjustable dust-cored type and the cores are fitted with locking plugs which make accidental change of setting improbable.

The output of the R.F. amplifier is a tapped tuned anode circuit, L3, L7, L11, and L13 being switched in according to the frequency band in use. Tuning is by the variable capacitor C30 which is ganged with the other main tuning capacitors. Finally the signals are fed to the control grid of the frequency changing valve via C29. R18 is fitted in the A.V.C. line for extra decoupling.

LOCAL OSCILLATOR AND FREQUENCY CHANGER
(Fig. 27)

6. The frequency changer V3 is a triode-hexode (CV1347), the triode section being the local oscillator. The oscillator has a temperature compensated tuned grid circuit.

It will be seen that the cathode bias resistor R9 of V3 is not by-passed by a capacitor. This is so that the resultant negative feedback will raise the input impedance and increase the selectivity.

The anode circuit of the hexode portion of V3 is tuned to the I.F. of 35 kc/s by a dust-cored coil L18 and the temperature compensating capacitors C63 - C65. The coil forms the primary circuit of a band-pass filter and the secondary circuit is a low impedance link-coupling to the first I.F. amplifier.

To tie the valve heaters to earth so far as R.F. potential are concerned C35 and C36 are connected between the heater circuits and the chassis and the H.T. line is similarly earthed by means of C28.

I.F. AMPLIFIER AND OUTPUT (Fig. 28)

7. The input voltage to the first I.F. stage is developed across the coupling coil of the band-pass filter L132. This coupling is fixed and C101 and C102 control the bandwidth. The signals are passed from the secondary winding of the filter direct to the control grid of the first I.F. amplifier V101 (CV1053). The second I.F. valve is of the same type and the two are coupled by means of the band-pass circuits formed around L133 and L134. The capacitors used for tuning the various I.F. circuits are all combinations of silvered mica and ceramic types to give give good temperature compensation.

The circuits are all trimmed by adjusting the dust cores of the inductors. Neither of the cathode bias resistors in the I.F. stages are by-passed. This minimises the damping of the grid circuit.

V103, a double-diode-triode (CV1055) functions as detector and driver valve for the output stage as well as providing automatic gain control.

8. The signal-diode load circuit comprises L136, R116, R117 and R118. Across R118 is connected a tuned circuit consisting of L139 and C139, C140 and C141. This circuit is tuned to resonance at 35 kc/s and at this frequency is resistive and of a low value and hence forms an effective short circuit to 35 kc/s components of the diode load current.

The automatic gain control diode is connected to L135 and its load resistor R112.

The grid of V103 is returned to the junction of R114 and R110, via the audio frequency volume control on the front panel. The voltage drop across R114 is approximately 2 and is positive at the cathode, hence the grid of V103 is negatively biassed to 2 volts.

V104 (CV1055) is used as a double-diode noise limiter, the grid and anode of the triode portion being connected together and to earth. A detailed description of the limiter circuit is given in paragraphs 11 to 13 of this chapter.

A note filter composed of L137 and C146, C147, C154, and C155 is connected across the output of V103. The filter is tuned to resonate at 800 c/s and causes only a small insertion loss which is maintained within 3 db.(i.e. there is no audible change) by resistor R123 being switched into circuit when the filter is switched out.

The manual volume control on the front panel controls the input to the amplifier portion of V103 and the valve's output is passed to V105 via a resistance capacitance coupling.

9. The output stage V105 (CV511) uses transformer coupling and the primary winding of the output transformer T102 is shunted by C153 to filter off any second harmonic of the I.F. and to restrict the output at the higher A.F. Without this capacitor the A.F. input to T102 would result in self-oscillation at frequencies around 10 - 15 kc/s. This effect is assisted by the omission of a by-pass capacitor across R126 but its omission increases the input impedance of V105 and hence reduces the damping effect of the note filter circuit.

9. (Contd)
T102 has two secondary windings, one of 3 ohms impedance for connection to the speech coil of the built-in loudspeaker and another of 600 ohms impedance for connection to an extension line via the output jack JK301. A second output jack JK302 has R305 and R306 in series to reduce the output level to comfortable telephone strength although the manual volume control may be turned up to loudspeaker strength.

C.W. OSCILLATOR

10. For the reception of C.W. signals the C.W. oscillator V106 (CV1091) is brought into use. It is essentially a grid-cathode oscillator and the coil in the anode circuit consists of few turns so that its impedance at I.F. is small. This gives good electronic isolation between the oscillator and the I.F. circuits, and prevents the frequency of the oscillator from being affected by very strong signals.

A proportion of the oscillator tuning capacitance (C131) is variable and is brought out to a front panel control so that the C.W. beat note may be varied. The range of variation is $\pm$ 1500 c/s and enables the difference frequency between the C.W. signal and the oscillator to be exactly the centre frequency of the note filter.

The cathode of V6 is heated all the time the receiver is working but the screen and anode supplies are switched on by S301.

NOISE LIMITER

11. This limiter operates by a comparison of the audio or modulation voltage with the carrier voltage or by comparison of the short duration noise-voltage with the carrier voltage. Its operation is somewhat complex and can best be understood by considering the circuit under two conditions:-

(1) When an unmodulated carrier is being received.

(2) When modulation is applied to this carrier.

Unmodulated Carrier (Fig. 28)

12. With an unmodulated carrier fed from L136 into the diode circuit current will flow through R116, R117 and R118 in the direction shown by the arrow, setting up a voltage between points A and E such that A is always positive with respect to E. This voltage will of course be quite steady and since the point B will be positive with respect to point F, the diode 1 will conduct.

Diode 2 will not conduct because the current of diode 1 flowing through R121 will render point D positive with respect to point C. C143 will charge slowly because of the long time-constant of R120 and this capacitor.

Modulated Carrier

13. Consider that the slider F is moved up to the point G, i.e. the only part of the signal diode load which is effective with regard to the limiter circuit is R117 and R118.

13. (Contd)
If the carrier is now modulated to a depth of 100 per cent the voltage across R118 and R117 will vary between zero and twice the steady-state (unmodulated) value. There the momentary peak voltage across AB will equal the previous steady-state voltage across AG, since R117 and R118 are equal, (still assuming that F is moved up to G, i.e. to give the maximum limiting condition). But owing to the long time-constant of the combination C143 - R120 the point C cannot change in potential very quickly with respect to A, and therefore point B will momentarily become negative to point D and diode 1 will stop conducting.

However, although diode 1 is extinguished, its electrodes still form a small capacitor, and since B is momentarily negative with respect to point G, there will be a voltage tending to drive a current through R121 in an opposite direction to that shown by the arrow, i.e. C will become positive with respect to D, and diode 2 will conduct and will bring point D practically to earth potential so far as audio output is concerned, and will so provide a double limiting effect.

POWER SUPPLY CIRCUITS

Battery Operated Power Unit (Fig. 29)

14. The valve heaters are supplied directly from the 24 volt battery and are connected in four series - parallel groups, interconnected at various points to equalise voltage drops.

The anode supplies are obtained from a small dynamotor, operating from the battery.

Input to the dynamotor is via two low-pass filters composed of L401, L402, and C401 and C405.

Both the input and output positive leads to the power unit are fitted with single-pole fuses and safety switches which break both circuits when the receiver unit is withdrawn from its waterproof case.

An important point to note is that the casing of the dynamotor is not earthed. This is to prevent "noise" voltages generated in the carcase of the machine from being supplied with multiple paths to the receiver chassis. The machine has a metal screen between its chassis and the receiver forming an electrostatic shield.

A.C. Mains Operated Power Unit (Fig. 31)

15. This unit consists of a mains transformer T501 with a primary winding tapped for 230 volts 50 c/s and 180 volts 500 c/s. There are two secondary windings; one is tapped for 126, 136 and 146 volts for the anode supply and the other winding supplies 25 volts for the valve heater circuits.

Rectification of the H.T. supply is by means of a full-wave selenium rectifier W501 and there is an 8 μF bank of reservoir capacitors, with a smoothing choke, and another 8 μF bank of smoothing capacitors.

Each secondary circuit is fused on one pole, likewise the primary circuit which also contains a safety switch closed only when the receiver is in its waterproof case.

STAGES AND VALVES

16.

Function	Code	A.P.
Input Limiter	V1	CV1092
R.F. Amplifier	V2	CV1053
Frequency Changer and Local Oscillator	V3	CV1347
1st R.F. Amplifier	V101	CV1053
2nd I.F. Amplifier	V102	CV1053
Detector, A.G.C. and 1st A.F. Stage	V103	CV1055
Audio Limiter	V104	CV1055
Output Stage	V105	CV511
C.W. Oscillator	V106	CV1091

GENERAL (MECHANICAL) (Fig.23)

17. The receiver consists of a single unit which houses the radio circuits, power supply equipment and loudspeaker.

A cast light-alloy box with a cast front panel is used for the unit and a rubber insert is provided around the front edge to make a watertight seal between the box and the panel. All contacts and controls pass through the front panel with waterproof seals and the whole unit may be immersed in water to a depth of 2 ft. for short periods without suffering damage.

Three sub-units make up the receiver chassis:-

(1) Radio Frequency Unit

(2) Intermediate Frequency Unit

(3) Power Unit

On the lower half of the set is the I.F. Unit and to provide maximum accessibility it hinges about its lower front edge, giving access to valves and the underside of the R.F. Unit. The upper half of the chassis is occupied by the R.F. Unit and the right hand side is taken by the Power Unit. All trimming controls are accessible from the rear of the receiver when it is removed from the case.

17. (Contd.)
To maintain the air in the receiver in a perfectly dry state a renewable silica-gel capsule is fitted. The colour of the contents can be seen by the operator and changes from blue to pink as moisture is absorbed.

Transportable Mounting (Fig. (18)

18. For transportable use the sealed receiver unit is mounted in a tubular steel crate fitted with stout rubber shock absorbing mountings. This crate forms a convenient means for carrying the unit and the design is such that rough handling will not impair the effectiveness of the waterproof joints.

During transit the front panel is protected from damage by a light metal cover and doors. When the equipment is required for use the doors are opened and the panel cover removed and stowed at the back of the crate or in the space provided in the spares cabinet.

The crates may be fitted together into any convenient form of station assembly.

Rack Mounting

19. For use where space is important or for indoor installations likely to remain fixed for long periods, a rack mounting is more compact and can be arranged by removing the receiver from its crate and mounting it with other units of the Type 612 equipment.

FRONT PANEL CONTROLS AND FITTINGS

Controls (Fig. 18)

20.

Marking	Function
R.F. TUNE	R.F. Tuning Control (with locking device)
AE. TRIM	Aerial Trimming Control
DIAL LIGHTS	Dial Light Control
METER H.T. - L.T.	Meter Switch
ANTI CROSS-MOD	R.F. Gain Control
A.F. GAIN	A.F. Gain Control
LIMITER ON-OFF	Limiter Switch
C.W. - R/T	Heterodyne Oscillator Switch
C.W. NOTE	Heterodyne Note Control
SPEAKER VOLUME	Loudspeaker Volume Control
NOTE FILTER ON-OFF	Note Filter Switch
BAND SWITCH	Band Switch

Other Fittings

21.

Marking	Function
POWER INPUT	Socket for Power Supply Connection
AERIAL	Socket for Aerial Connections
EARTH	Earth Terminal
PHONES	Telephone Jack
LINE 600 OHMS	A.F. Output Jack
METER	Voltmeter
DRYER	Silica-Gel Capsule
BATT or A.C. (according to the type fitted).	Window indicating type of Power Unit

AERIAL SYSTEM

22. Any wire aerial 30 - 50 ft. in length and erected so that at least half the length is vertical will be found to be satisfactory.

Alternatively, a whip aerial of the type specially designed for use with Transmitter 5AH may be used.

DIMENSIONS AND WEIGHTS

23.

	Width	Height	Depth	Weight
Receiver	$18\frac{1}{4}$ in.	$11\frac{1}{2}$ in.	$10\frac{1}{2}$ in.	39 lb
Carrying Crate	$20\frac{1}{4}$ in.	$17\frac{5}{8}$ in.	$13\frac{3}{4}$ in.	64 lb (loaded)

CHAPTER 5.

★

TRANSMITTING UNITS

FOR TECHNICAL OFFICERS AND RATINGS.

A DESCRIPTION OF CIRCUIT FUNCTIONS.

CHAPTER 5

TRANSMITTING UNITS

STATEMENT OF PERFORMANCE

1. Frequency Range. 1·5 - 13·0 Mc/s.

Band No. 1	(green)	1·5 - 3·25 Mc/s.	(200 - 92·2 m.)
Band No. 2	(red)	3·0 - 6·5 Mc/s.	(100 - 46·2 m.)
Band No. 3	(blue)	6·0 - 13·0 Mc/s.	(50 - 23·1 m.)

Output Power (Into 100 ohm unbalanced line).

12 - 20 watts, R/T and M.C.W.
24 - 40 watts, C.W.

Frequency Stability

Master oscillator self-excited: 15 parts in a million per degree centigrade.

Master oscillator crystal controlled: 50 parts in a million for ambient temperature -10°C to 40°C.

After using the crystal calibrator the frequency can be set to within 5 kc/s at the worst (H.F.) end of the scale.

Audio Frequency Response

Flat within 3 db over the frequency range 400 - 3,000 c/s.

Harmonic Distortion

Not greater than 10 per cent R.M.S. at 80 per cent modulation for a modulation frequency of 1,000 c/s.

Harmonic Suppression

Better than 50 db (with the Aerial Tuning Unit in use).

Speech Input Level

1·0 volt R.M.S. via 100 ohms for 90 per cent depth of modulation with 1,000 c/s tone.

Modulation

The transmitter carrier is amplitude modulated and the modulation is applied to the anodes and screens of the R.F. amplifier.

Output Impedance

The transmitter is designed to work into a 100 ohm unbalanced line. By connecting it to the Aerial Tuning Unit it will work into aerials 15 - 120 feet long, though it is better to use the specially designed whip aerial.

1. (Contd.)
Keying. Up to 20 words per minute, with "break-in" facilities.

Power Supply. 24 volts D.C. or A.C. 230 volts, 50 c/s, 180 volts 500 c/s. Consumption is 250 watts with key pressed.

GENERAL (ELECTRICAL)

2. In order to secure maximum flexibility in application and to reduce the weight of the individual units the transmitting equipment has been designed to occupy three separate units.

(1) Transmitter 5AH.

(2) Aerial Tuning Unit.

(3) Modulator, Control and Power Unit.

The three units are identical in A.C. and D.C. forms except that for A.C. operation the Modulator Unit receives its input power supply from a separate A.C. power unit and not direct from a battery. Details of the A.C. unit are given in paragraphs 16 to 20.

Transmitter 5AH (Fig. 40)

3. This unit contains the exciter and output stages, monitoring diode and crystal calibrator.

The master oscillator V.1 (CV.124) is a beam tetrode and may be self-excited or operated with crystal control. The frequency determining circuit consists basically of L.1, C.1 and C.2, the coil and capacitors being connected in parallel between the grid and earth. In practice, extra capacitors, C.3 and C.4 are provided for temperature compensation and tuning, and a further set C.5 - C.8 is brought in to change the frequency band. C.55 is brought out to a front panel control for fine tuning purposes. C.38 acts as a grid blocking capacitor and L.5 permits cathode current to flow to earth (the cathode is at high R.F. potential to earth).

R32 limits the anode current when the valve is not in oscillation, by providing automatic bias whilst R.29 - R.31 suppress parasitic oscillations.

4. For crystal control S.7 connects either XL1 or XL2 between the grid and the tuning coil. In series with the crystals are C.53 and C.54. These reduce the effective capacitance of the coupling capacitor C.38 and prevent self-excited oscillation when the switch is set for crystal control and the tuned circuits are not in the correct position for the crystal in use.

To improve further the temperature-frequency compensation given by the combination of silvered mica and ceramic capacitors in the tuned circuit, the inductance and capacitance elements are housed in a chamber fitted with a heater R.13 and a thermostat X1 to maintain the temperature above 30°C.

The anode circuit of the oscillator is tuned by means of the variable inductor L.2 and C.23 - C.31. C.24 and C.25 with L.2 form a wavetrap system for the suppression of sub-harmonics. On Bands 2 and 3 the combination forms a resonant

4. (Contd.)
path to earth at half the frequency at which the whole of the oscillator anode circuit is tuned.

On band 1 C.23 acts as a blocking capacitor so that the grids of V.2 and V.3 are not short circuited to earth. The value of C.23 is chosen to provide the correct voltage on C.51 for neutralising purposes. C.23 however, does not act as a wavetrap on this band since operation is at the fundamental frequency.

5. Coupling between the master oscillator and this tuned circuit is via C.10 and the voltage developed is applied to the grids of V.2 and V.3 (CV.124) connected in parallel.

Coupling between the output of this parallel pair and the output circuit is via C.11. The output circuit is in the form of a "pi" network, the input and output capacitors and inductors being changed by means of S.1c and S.1d so as to maintain constant impedance ratios to the outgoing 100 ohm line. Mistuning at this stage is unlikely to cause damage owing to the characteristics of the valves and the use of ganging.

All four frequency-band switches S.1a, S.1b, S.1c and S.1d are ganged; also the tuning coils L.1, L.2, L.3 and L.4. The variable inductance coil assemblies are coupled to a large spiral dial with a separate scale for each frequency band, markings being at 10 kc/s and 100 kc/s points. The 100 kc/s points, which are crystal calibration points, are marked in black, whereas the others are marked in red, blue or green, according to the frequency band. Variable capacitors are used for trimming purposes and variable inductors for padding.

Precise information regarding the tuning of the circuits is best illustrated in tabular form as shown below:-

Frequency Band	Frequency Determining Circuit Mc/s	Oscillator Anode Circuit Mc/s	Output Circuit	Remarks
1. (Green)	1·5 - 3·25	1·5 - 3·25	1·5 - 3·25	
2. (Red)	1.5 - 3·25	3·0 - 6·5	3·0 - 6·5	Doubling in interstage circuit
3. (Blue)	3·0 - 6·5	6·0 - 13·0	6·0 - 13·0	Frequency determining circuit operates at double frequency for this band.

Sidetone

6. Sidetone for monitoring the transmission is obtained as follows. The voltage developed across R20 (between the output transmission line and earth) is applied to the diode V6.

On M.C.W. and R/T a contact of the R/T-M.C.W.-C.W. switch on the Modulator Unit connects one end of the primary of the sidetone transformer to earth, thus completing the diode output circuit. Audio signals are passed via the secondary of the transformer to the sidetone jack on the Modulator Unit and to the telephones.

6. (Contd.)
In the C.W. position the contact of the R/T-M.C.W.-C.W. switch disconnects the transformer primary from earth and connects it to the anode of the Tone Oscillator (V3). When the key is pressed the sidetone diode will supply a D.C. voltage at the anode of the Tone Oscillator and cause it to oscillate. Since the primary of the sidetone transformer is in the anode circuit of this valve, the A.F. oscillation will be induced into the secondary winding of the sidetone transformer and passed to the sidetone jack and telephones.

Crystal Calibrator Unit

7. This is contained in the Transmitter 5AH and consists of two stages:-

(1) Crystal Controlled Oscillator-Mixer.

(2) Audio Amplifier.

The oscillator V.4 (CV.1091) is controlled by XL3 on a fundamental frequency of 100 kc/s and is coupled to the output of the master oscillator by C.41, so that the beat frequency is injected on all bands. The zero beat points will be 100 kc/s apart and the audio amplifier V.5 (CV.1091) raises the beat note to headphone level. C.42 provides feedback for V.4.

The calibrator may be used for accurately adjusting the transmitter to any frequency within its range which is a multiple of 100 kc/s. Precise settings to intermediate frequencies are obtained by setting the scale to the nearest 100 kc/s point and then adjusting the scale-setting trimmer C.55 for zero beat, afterwards setting the scale to the exact frequency required.

A non-locking switch S.8 enables H.T. to be applied to the master oscillator alone whilst the transmitter output valves V.2 and V.3 have their screens earthed and the aerial is disconnected. This enables the transmitter to be adjusted against the crystal calibrator without the former radiating.

Keying Circuit (Fig. 34)

8. In order to avoid large currents in the control lines when the transmitter is keyed from the Remote Control Unit the following relay circuit has been designed so that only the current required to operate RL.2 in the Modulator Unit is carried by the control lines.

When relay 2 operates, voltage is applied to the coils of relays 1, 3 and 4. Relay 1 performs the following functions:-

(1) Contact 1.1 applies anode and screen voltages to the master oscillator V.1.

(2) Contact 1.2 disconnects the screens of V.2 and V.3 from earth and connects them to the H.T. supply.

(3) Contact 1.3 disconnects the inner conductor of the outgoing R.F. cable from earth and connects it to the output circuit.

Relay 3 is a high speed relay and relay 4 is one which releases slowly. These two relays each have a "make" contact which supplies energising voltage to the B.46 muting relay. Accordingly this relay is made quickly and released slowly. In this way the receiver is muted before the transmitted is switched on and stays muted until after the transmitter has gone off.

8. (Contd.)
The relay in the Aerial Tuning Unit is operated in parallel with the receiver muting relay and also has a slow releasing characteristic which is useful inasmuch as it saves the aerial relay from many operations during fast keying. The delay is such that the receiver muting and aerial relays release between words so that break-in between words is possible.

AERIAL TUNING UNIT
(Fig. 43)

9. The output of the R.F. Unit is passed to this unit via a 100 ohm transmission line and various combinations of inductance and capacitance are introduced into the tuned circuits by means of a five-position switch.

L.1 is fitted with a continuously variable wiper for tuning adjustment and has a separate control for tapping into the coil at each turn for matching. L.2 is a simple rotating coil for loading the aerial, RL.1 is a vacuum relay used to connect the aerial to this tuning unit or the H.F. Receiver, changeover being controlled from the keying circuit of the transmitter.

M.1 indicates the circulating current in the closed circuit and M.2 the aerial current. Both meters are used in conjunction with push switches which increase the deflections when required. A dummy load may be used to absorb the transmitter output without energy being radiated from the aerial.

MODULATOR, CONTROL AND D.C. POWER INPUT
(Fig. 47)

10. This unit houses three separate groups of components connected with the transmitter; those associated with the modulator circuits, the control circuits and D.C. power supply equipment. Therefore, although the three groups are interconnected in many ways they will be described separately as far as possible.

Modulation Equipment

11. The transmitter is anode and screen modulated by the conventional method, input to the modulator stages being fed into a single triode amplifier V.4 (CV1032) via T.4 which has a variable resistor R.27 and a fixed resistor R.36 connected across its secondary winding. This enables the depth of modulation to be varied between about 50 per cent and 90 per cent. The level is pre-set at 70 per cent but the control is accessible from the front panel.

Output from V.4 is fed into the pair of tetrodes V.5 and V.6 (CV124) which operate in class AB.1 push-pull.

Bias for the push-pull pair is obtained partly from their cathode resistors R.32 and R.33 and partly from the diode rectifier in V.3, as will be explained later.

The output of the modulation transformer T.6 is fed direct into the anode and screen supply circuits of the R.F. amplifier. C.26 is used to prevent sparking at the contacts of K.4.

The heaters of the three modulator valves are switched off when the transmitter is working on C.W.

Microphones

15. Microphone with either double and single pressel switches can be used in conjunction with this transmitter and the change from one type to the other only necessitates the interchanging of two plugs in the Modulator Unit. The single pressel microphone will only be used in special cases for which the necessary instructions will be issued.

A.C. POWER UNIT FOR THE TRANSMITTER

General (Fig. (51)

16. This unit enables the transmitter to be operated when only an A.C. mains supply is available as a source of power. It is a rectifier unit which can be coupled to the Modulator Unit to permit the Modulator and 5AH to receive their normal supplies, the only exception being the valve heaters, which are fed with A.C. instead of D.C.

If batteries are also connected to the Modulator Unit automatic changeover from mains to battery operation is available should the former fail and there will be automatic change back when the A.C. supply is restored, since if both supplies are connected the A.C. will "take charge". In each case the change involves a delay of less than 3 seconds. The D.C. supply should be switched off at the D.C. Junction Box unless emergency changeover facility is required.

Circuit Description

17. The mains input is fed, via an interference-suppression filter and fuses to the primary windings of T.1 and T.2. Tappings are provided for supplies of 230 volts, 50 c/s and 180 volts, 500 c/s. There is one variable tap in the primary of T.1 and two on the primary of T.2 for this purpose, the latter enabling two alternative output voltages to be obtained with each kind of input.

The output side of T.1 has three windings giving supplies:-

(1) 24 volts A.C. for the heaters of valves in the 5AH and Modulator Unit.

(2) 30 volts, which is rectified by the selenium rectifier W.1 to give a nominal 24 volts D.C. for the control circuits.

(3) 2·5-0-2·5 volts A.C. for the filaments of V.1 and V.2 (CV717) in the A.C. Power Unit.

18. Linkage between the A.C. Power Unit and the Modulator Unit is very simple. The fuse panel is removed from the Modulator Unit and is replaced by a connecting unit carrying a 25-way socket. This connecting unit is normally stowed in a socket on the A.C. Power Unit into which the fuse panel from the Modulator Unit is now plugged. A link between the connector on the Modulator Unit and the A.C. Power Unit is made by a 25-way cable.

Operation of the A.C. Power Unit

NOTE The following description assumes that the transmitter is operating in the "Ready" condition.

19. Fig. 51 shows the relays unoperated and it can be assumed that the transmitter is operating off batteries. The battery supply will appear at terminals 15 and 16 of SK1 and will be distributed to one "heater" line and one "heater"

19. (Contd.)
line plus one "control" feed, via relay contacts 9.1 and 8.1 to terminals 5 and 4 respectively. The battery line at terminals 12 and 13 will similarly reach terminals 1 and 2 via RL9.2 and RL8.2.

The H.T. supply will come from the dynamotor at terminals 14 and reach the transmitter circuits via RL6.2 and terminal 3.

The feed to the "motor" side of the dynamotor comes in and out again via terminals 8 and 9 and RL8.3.

20. Assume now that the A.C. mains are switched on: RL8 and RL9 operate causing:-

(1) The transmitter valve heaters to be fed from the 24 volts A.C. source. (RL9.1, RL9.2).

(2) The "motor" circuit of the dynamotor to be broken (RL8.3).

(3) The "A.C. ON" indicator lamp to light. (RL8.4).

The changeover of RL8.3 will cause RL6 to operate, resulting in:-

(1) The H.T. output being transferred from the dynamotor to V.1 and V.2 (centre tap of the filament transformer). (RL6.2).

(2) The energising of T.2 (for 350 volts output) (RL6.1).

When the "Service" key on the Modulator Unit is moved to "C.W." RL7 is operated via terminal 10 which changes the primary tapping of T.2 so that the H.T. output is now 475 volts.

CONTROL CIRCUITS

Local Control (Fig. 34)

21. Control of the transmitter and its associated apparatus is by means of direct and indirect switching, using relays. Modulation is controlled by a switch on the Modulator Unit. When in C.W. this switch disconnects the filament and anode supplies of valves V4, V5 and V6 in the Modulator Unit, short circuits the modulation transformer secondary, and connects the H.T. voltage supply to V3 as required for monitoring. It also arranges the correct H.T. value for the type of transmission. (5.14).

In the M.C.W. position the modulation valves filament and H.T. supply is restored, the short removed from the modulation transformer and tone fed to the transmitter. Also the main H.T. voltage is reduced and the transmitter monitoring circuit connected to earth. Similar conditions apply to R/T except that the modulation input transformer is connected to the microphone line.

22. In the "Local" position the Remote-Local switch disconnects the remote microphone, keying and on-off lines and also the standby-ready indication leads. The other local switches are brought into circuit.

With the local modulation switch to "W.T.", and H.T. on, RL4 operates connecting a supply to the local key jack via a contact of the Ready switch. For R/T an additional supply is extended to RL2 (microphone relay) to provide a circuit for speech currents from the local microphone to the modulation input transformer.

22. (Contd.)
The Off-Standby-Ready switch on the Modulator Unit controls RL3 and RL4. The functions of the switches and relays are summarised in the tables in paragraphs 25 and 26.

23. The local keying jack on the Modulator Unit is connected to the keying relay via the Remote-Local switch and, provided RL4 is operated and the Ready switch made, can be used to key the transmitter. The Aerial C.O.S. should be to "Transmit".

The local microphone socket can be used provided the local modulation switch is to "R/T". This connects a supply to RL2 when the pressel switch is made. RL2 operates the keying relay and brings on the carrier. Speech currents pass via the local R/T switch to the modulation input transformer.

24. For local reception during remote control (onboard ship) a phone jack and potentiometer volume control are available on the relay unit. The phone jack and handset socket on the Modulator Unit are short circuited by the "Off-Standby-Ready" switch.

Keys (Fig. '67)

25. S3. (3 Positions).

Position	Contacts	Function
I.C.	a - b	Connect the microphone to the intercommunication circuits.
	d	Prepare the microphone energising circuit.
	e	Signals the Remote Control Unit via the "Intercommunication Call" circuit.
W.T.	a - b	Connect the microphone to the intercommunication circuits.
	e	Prepare the "Intercommunication Call" circuits for operation from the Remote Control Unit.
R/T	a - b	Prepare for connection of the microphone to the modulator.
	d	Prepare the microphone keying circuit.
	e	Prepare the "Intercommunication Call" circuit for operation from the Remote Control Unit.
	c	Prepare the microphone energising circuit.

25. (Contd.)
S4. (2 Positions).

Position	Contacts	Function
LOCAL	a - b	Prepare for connection of the "Local" microphone to the modulator.
	c	Local "Ready" feed circuit.
	d	Local "Standby" control circuit.
	e	Local "Ready" control circuit.
	f	Prepare "Local" keying circuit.
REMOTE	a - b	Prepare for connection of the "Remote" microphone to the modulator.
	c	Remote "Ready" feed circuit.
	d	Remote "Standby" control circuit.
	e	Remote "Ready" control circuit.
	f	Prepare "Remote" keying circuit.

S5. (3 Positions).

Position	Contacts	Function
OFF	Supply available but all units switched off.	
STANDBY	a	Switch on valve heaters via RL3.
READY	b	Switch on dynamotor via RL4 and RL5.
	j	Prepare local "Ready" feed circuit.
	a	Switch on valve heaters via RL3.

S6. (3 Positions).

Position	Contacts	Function
R/T	a - b	Prepare for connection of the microphone to the modulator.
	e	Connect 350 volt winding of dynamotor to the valve anode circuits.
	f	Switch on the heaters of the modulator valves.

25. S6. (3 Positions) (Contd.)

Position	Contacts	Function
R/T	g	Prepare R/T and M.C.W. sidetone circuits.
	h	Apply H.T. to modulator valves.
M.C.W.	a - b	Connect the tone oscillator to the modulator circuits.
	e	Connect the 350 volt winding of the Dynamotor to the valve anode circuits.
	f	Switch on the heaters of the modulator valves.
	g	Prepare R/T and M.C.W. sidetone circuits.
	h	Apply H.T. to modulator valves.
C.W.	a - b	Connect the tone oscillator to the modulator circuits.
	e	Connect the 475 volt winding of the Dynamotor to the valve anode circuits.
	f	Disconnect heaters of the modulator valves.
	g	Prepare the C.W. sidetone circuit.
	h	Short circuit the modulator output and disconnect the modulator H.T. supply.

Relays

26.

Relay	Function
RL.1	Acts in conjunction with RL.2 in the Remote Control Unit for calling purposes. When the "Intercomm." key is operated at either end both "Intercomm. Call" signal lamps light and go out when the "Called" operator answers by moving his "Intercomm." key.
RL.2	Is in the microphone energising circuit and operates when the pressel switch is pressed on R/T; the contacts complete the transmitter keying circuit.
RL.3	"Standby" relay. Switches on the heaters of the R.F. valves and modulator unit valve V.3 when working C.W. and switches on these together with the modulator valves V.4, V.5 and V.6 when working M.C.W. and R/T causes the "Standby" lamp to light.

26. (Contd.)

Relay	Function
RL.4	"Ready" relay. Starts the dynamotor by causing RL.5 to operate. Switches off the "Standby" lamp and causes the "Ready" lamp to light. Prepares the operating circuits of the keying relays in the various units.
RL.5	"Dynamotor" relay. Switches on the "motor" side of the dynamotor. Carries a heavy three-turn winding which holds-in the relay while starting.

Remote Control Unit Circuits

27. The Remote Control Unit forms part of Type 612ET (Transportable Equipment) only. Remote Control in ships is achieved by relay units (6.8).

When S4 in the Modulator Unit is switched to REMOTE, parts of the control circuits are transferred to the Remote Control Unit as indicated in the previous sections. S.2 in the Remote Control Unit operates in a similar manner to S.3 on the Modulator Unit.

28. The functions of S.1 are as follows :-

Position	Contacts	Function
OFF	Supply available but all transmitting units switched off.	
STANDBY	a	Switch on valve heaters via R.3 in the Modulator Unit.
	h - j	Complete the circuit for the Remote Control, "Standby" lamp via contacts on RL.4 in the Modulator Unit.
READY	a	Keep valve heaters switched on via RL.3 in the Modulator Unit.
	b	Switch on the Dynamotor via RL.4 and RL.5 in the Modulator Unit.
	h - j	Complete the circuit for the Remote Control Unit "Ready" lamp.

29. The functions of the relays in the Remote Control Unit are as follows :-

Relay	Function
RL.1	The windings are used as chokes and the contacts are not used.
RL.2	Acts in conjunction with RL.1 in the Modulator Unit for calling purposes. When the "Intercom." key is operated at either end both "Intercom. Call" signal lamps light and go out when the "Called" operator answers by moving his "Intercom." key.
RL.3	In microphone energising circuit and operates when pressel switch is pressed.

29. (Contd.)

It will be noted that when the LOCAL-REMOTE key is thrown for REMOTE OPERATION the "standby" lamps will light on both the Remote Control and Modulator Unit if S.1 in the former unit is at "Standby" and the "Ready" lamps will light in both units when it is moved to "Ready".

STAGES AND VALVES

Transmitter 5AH

30.

Function	Code	A.P.
Master Oscillator	V.1	CV.124
R.F. Amplifier	V.2	CV.124
R.F. Amplifier	V.3	CV.124
Crystal Calibrator Oscillator Mixer	V.4	CV.1091
Crystal Calibrator A.F. Amplifier	V.5	CV.1091
Sidetone Rectifier	V.6	CV.1092

Modulator Unit

31.

Function	Code	A.P.
M.C.W. Tone Oscillator and Grid Bias Rectifier	V.3	CV.1055
A.F. Amplifier	V.4	CV.1032
Modulator	V.5 V.6	CV.124 CV.124

32.

A.C. Power Unit	Code	A.P.
Full Wave Rectifier	V.1 V.2	CV.717 CV.717

GENERAL (MECHANICAL)

33. The transmitter consists of three units (Transmitter 5AH, Aerial Tuning Unit and Modulator Unit) and an auxiliary power unit if operation is required from A.C. mains.

Cast light-alloy boxes are used for the units, with cast front panels and a rubber insert is provided around the front edge to make a watertight seal between the box and the panel. All contacts and controls pass through the front panels with water-proof seals and the units may be immersed in water to a depth of two feet for short periods without suffering damage.

33. (Contd.)
To maintain the air in the units in a perfectly dry state, renewable silica gel capsules are fitted. The colour of the contents can be seen by the operator and changes from blue to pink as moisture is absorbed.

Transportable Mountings

34. For transportable use the units are mounted in tubular steel crates fitted with shock absorbing mountings. These crates form a convenient means for carrying the units and the design is such that rough handling will not impair the effectiveness of any waterproof seals.

During transit the front panels are protected from damage by light metal covers and doors.

When the equipment is required for use the doors of the crates are opened, and the panel covers removed and stowed at the back of the crate or in the "Spares" cabinet. Nothing more is required except connecting up and the units are not removed from their crates.

If desired, crates may be bolted together into any convenient form of station assembly.

Rack Mounting

35. For use where space is important or for indoor installations likely to remain fixed for long periods, a rack mounting is more compact and can be arranged by removing the units from their crates, bolting them together and then mounting the complete assembly for shock absorbtion purposes.

FRONT PANEL CONTROLS AND FITTINGS

Transmitter 5AH Controls

36.

Marking	Function
TUNING CONTROL	Tuning Control for Master Oscillator, Amplifier and Output stages (with locking device).
M. OSC. CRYSTAL 1 CRYSTAL 2	Master Oscillator Switch.
BAND SWITCH 1, 2, 3	Band Switch.
AMP. TRIMMER	Output Circuit Trimmer.
METER SWITCH 1, 2, 3, 4	Meter Switch.
CAL-OP.	Crystal Calibrator On-Off Switch.
DIAL LIGHT	Dial Light Control.
NET	Push Button Operating Master Oscillator.
OSC. TRIMMER	Trimmer for Oscillating Frequency.

Transmitter 5AH. Other Fittings

37.

Marking	Function
TO MODULATOR	Plug for Modulating Unit Connection.
R.F. OUTPUT	Socket for Aerial Tuning Unit Connection.
TO A.T.U.	Plug for Aerial Relay Connection.
TO REC.	Plug for Receiver Muting Connection.
PHONES FOR OSC.CALIBRATION	Phone Jack. Crystal Calibrator.
DRYER	Silica-Gel Capsule.
METER	Measurement of Transmitter Supplies.

Aerial Tuning Unit Controls

38.

Marking	Function
TUNING	Closed Circuit Tuning Control.
COUPLING	Closed Circuit Coupling Control.
LOADING	Aerial Loading Control.
BAND SWITCHES 1, 2A, 2B, 3A, 3B	Band Switch.
AERIAL-DUMMY	Dummy-External Aerial Switch.
PRESS TO INCREASE	Meter Range-Change Push Buttons (2).

Aerial Tuning Unit. Other Fittings

39.

Marking	Function
REC.	Aerial Connection to B46.
AERIAL	Aerial Socket. Release by turning collar clockwise.
R.F. INPUT	Sockets. Aerial Tuning Unit to 5AH.
TO TRANS.	Plug. Aerial Relay Connections.
DRYER	Silica-Gel Capsule.
MATCHING CIRCUIT CURRENT	Closed Circuit Ammeter.
AERIAL CURRENT	Aerial Ammeter.

Modulator Unit. Controls

40.

Marking	Function
R/T-M.C.W.-C.W.	"Service" Key.
R/T-W.T.-I.C.	"Service"-"Intercommunication Key".
OFF-S.B.-READY	Main ON-OFF Key (with "Standby" position).
REMOTE-LOCAL	Remote-Local Control Key.
MOD. CONTROL	Modulator Depth Control (preset).
TEST METER SWITCH 1, 2, 3, 4	Meter Switch.

Modulator Unit. Other Fittings

41.

Marking	Function
TO TRANS.	Socket. 5AH to Modulator Unit. Connection.
TO BATTERY	Plug. Main D.C. Input Connection.
DRYER	Silica-Gel Capsule.
STANDBY, I.C. CALL, READY	Indicator Lamps (3).
FUSES	Fuse Panel.
LINE 600 OHMS	Jack. Receiver Output to Modulator. Connection.
PHONES	Phone Jack.
LOCAL KEY	"Local" Morse Key Jack.
LOCAL HANDSET	Handset Jack.
TO CONTROL UNIT REMOTE	Socket. Modulator Unit to Remote Control Unit.
TEST METER.	Meter.
-	Watch Holder.

A.C. Power Unit. Controls

42. None. (The A.C. supply is controlled from a A.C. Distribution Box).

A.C. Power Unit. Other Fittings

43. A.C. ON indicator lamp (green).

DIMENSIONS AND WEIGHTS

44.

	Width	Height	Depth	Weight
Transmitter 5AH	18¼ in.	11⅜ in.	11½ in.	42 lb
Carrying crate	22¼ in.	17⅝ in.	15 in.	54 lb(loaded)
Modulator Unit	18¼ in.	8⅞ in.	11½ in.	47 lb
Carrying crate	22¼ in.	13¼ in.	15 in.	69 lb(loaded)
Aerial Tuning Unit	18¼ in.	8⅞ in.	11½ in.	33 lb
Carrying crate	22¼ in.	15¼ in.	15 in.	53 lb(loaded)
A.C. Power Unit	18½ in.	10½ in.	15 in.	104 lb

CHAPTER 6.

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ANCILLARY EQUIPMENT.

EQUIPMENT FOR PARTICULAR REQUIREMENTS.

CHAPTER 6

ANCILLARY EQUIPMENT

GENERAL

1. Apart from the radio units proper there are a number of pieces of ancillary equipment which may be used in conjunction with the Type 612. Not all of it will be required at any one time, in fact most of it will only be wanted in connection with the transportable form of the apparatus, Type 612ET. However, it is all detailed in this chapter for reference purposes.

WHIP AERIAL

2. This aerial has been specially designed for use with the transmitter but it is quite suitable for use with either of the receivers.

It consists of nine 4-foot lengths of hardened molybdenum-steel tubing, tapered and designed so that the ends push into each other. It stands on a single base insulator and is supported by four guy ropes fitted with bakelite insulators.

For transport purposes the aerial rods are carried in a "golf" bag and the guy ropes, base insulator, anchors, etc. are carried in a small wooden box. The golf bag and box can be carried by one man who can also erect the aerial, though the services of a second man are useful. Details regarding the erection procedure are given in Chapter 7.

LOCAL OPERATOR'S DESK AND "SPARES" BOX

3. For transportable use the Type 612 equipment is used in conjunction with a specially designed desk or cabinet. This cabinet houses auxiliary items and "Spares". It can also be used to stand units on and the top can be arranged to form an operating desk.

The two drawers and one cupboard contain the following items:-

Interconnecting Cables

2 Receiver Power Cables
1 Modulator Power Cable
1 Receiver Muting Cable
1 Transmitter to Modulator Interconnecting Cable
1 Transmitter to Aerial Tuning Unit Keying Cable
1 Transmitter to Aerial Tuning Unit R.F. Cable
1 B46 to Aerial Tuning Unit Cable
1 B46 to Aerial Cable
1 Transmitter to Aerial Cable
1 Earth Cable
1 Power Cable. Battery to Generator
1 Power Cable. Battery to Power Distribution Box for 3 Batts
1 Spare D.C. Power Unit for Receivers

3. (Contd.)
Spare Valves

5 CV124	2 CV1091
1 CV511	2 CV1092
4 CV1053	1 CV1347
2 CV1055	1 CV1932

Miscellaneous

1 "Avo Minor" Universal Test Set
1 Morse Key (with lead and plug)
1 Microtelephone (with lead and plug)
1 Pair Headphones (with lead and plug)
1 Telephone Cord (with 2 plugs Gauge A)
2 Message Pads
1 Handbook B.R.1616(1)(2)
1 Folding Stool
6 Silica Gel Capsules
1 Inspection Lamp (with lead and plug)
1 Roll Adhesive Tape
Spare Fuses and Valves
2 Pencils
2 Sets spare Brushes for Dynamotor
1 Power Distribution Box (A.P.65142)
2 16V 3W M.E.S. Lamps
6 G.P.O. type 4004G Lamps
3 12V 2W Festoon Lamps
1 Tool Roll (Page 126)
2 24V 4W Lamps

WATCH

4. Watch holders are fitted to certain units but watches are not provided as part of the equipment. They must be obtained through the usual channels as required.

BATTERIES

5. The batteries supplied for use with Type 612 are the nickel cadmium units of 8·4 volts (7 cells), 45 ampere-hours. One set, consisting of three such units connected in series to give 25·2 volts (nominally 24), is required for the transmitter and receivers, or any one alone. Therefore, if the equipment is in continuous use, at least one spare set must be provided so that one can be on charge whilst the other is in use.

If one receiver is situated at the remote control position a further additional set of 24 volt batteries will be required for it.

PETROL-ELECTRIC SET

6. A petrol-electric set will be required if the equipment is used in situations where the batteries cannot be charged by any other means.

REMOTE CONTROL EQUIPMENT

Ashore

7. Where remote control of the transmitter is required the specially designed Remote Control Unit must be used. Only the transmitter can be distantly controlled but the output of either receiver can be extended to the distant station. The Remote Control Unit is housed in a wooden carrying box which also serves as an operating table. The box contains the following items:-

1 Remote Control Unit
1 Microtelephone (with lead and plug)
1 Morse Key (with lead and plug)
1 Silica Gel Capsule
1 Battery Connector Cable (for receiver sited at the remote position)
2 Message Pads
1 pair Headphones (with lead and plug)
1 Folding Stool
1 Inspection Lamp (with lead and plug)
1 Power Distribution Box (A.P.65230)

In addition to the box containing the actual remote control equipment, cables will be required to connect the remote control station with the main station. Special drums of cable have been prepared for this purpose, each drum containing 100 yards of cable.

The total length of cable used will depend on requirements but must not exceed 800 yards. Both ends of the cable are available so it is not necessary to remove cable from drum.

Onboard Ship

8. Type 612 can be adapted for use with the Control Outfits KCH/W, KDA and KHA series, by means of relay units which obtain their bobbin supplies from the Modulator Unit. A microphone socket and On switch are fitted at all remote positions. For further information refer to the appropriate control system handbook.

AERIAL C.O.S.
(Fig. 55)

9. An aerial C.O.S. is fitted with every ship installation. Adaptor plates permit the connection of an 8" or a 4" trunk, or the flexible lead from a whip aerial.

The R.F. portion of the switch connects the aerial:-

(1) Receive: connects the aerial through an exchange or direct to a receiver. Note however that the Transmit position should be used when the B46 is operated in conjunction with Type 612; the muting relay and A.T.U. aerial relay then transfer the aerial to the appropriate unit.

9. (Contd.)

(2) Transmit: aerial connected to the A.T.U.

(3) Earth through Resistor: This arrangement is required in ships fitted with H.F. D.F. In other ships a link short circuits the resistor and the aerial is directly earthed. The same link is used to complete the lamp indication circuit to the H.F. D.F. Office through the cam operated auxiliary contacts of the C.O.S.

(4) Isolate: aerial not connected.

10. Other contacts of the cam operated switch arrange the circuits of the relay unit and ship's control system. A Yale locking device prevents movement of the switch to the "Transmit" position when there is a man aloft, ammunitioning is in progress etc.

CHAPTER 7.

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INSTALLATION

INSTRUCTIONS FOR ERECTING THE SET ASHORE.

ASSOCIATION WITH OTHER EQUIPMENT IN SHIPS

CHAPTER 7

INSTALLATION

GENERAL

1. This chapter mainly describes the installation of the Type 612ET, i.e., the transportable form, battery operated and using the transmitter and both receivers.

The installation of less complex forms will be quite easy in the light of these instructions, but additional information on ship installations is given in paragraphs 9 to 12. Ashore, before installation proper commences, erect the tent if one is to be used.

ERECTING THE WHIP AERIAL

2. The whip aerial should be erected by two men. Proceed as follows:-

(1) Open the wooden box and lay all the contents some 5 feet from where the aerial will finally stand. The box should contain:-

4 Guy ropes, complete with bakelite insulators and wooden shackles; all four guys meeting at a small cross-piece with a hole in the middle.
4 "T"-iron anchors.
1 Square steel plate with a hole in the middle.
1 Steel spike fitting the hole in the above plate.
1 Earth Spike.
1 Base Insulator.
1 2 lb. Hammer.
2 Sets Chain-type Insulators.
1 Tin Grease, GS.
100 feet Insulated Aerial Wire.

(2) Lay out the contents of the canvas "golf" bag. This consists of nine metal tubes of varying size.

(3) Lay the square plate where the aerial is to stand and drive the steel spike into the ground through the hole in the plate. Also drive the earthing spike into the ground near the plate.

(4) Examine the aerial tubes and it will be seen the coloured matching bands have been painted on them.

(5) Select the thickest aerial section, lightly grease the end without a coloured band on it and insert it into the base insulator, which should be laying on its side.

(6) Select the next thickest tube section, grease the end with the band matching the upper end of the bottom section and fit the two together with a twisting motion. Then fit the third section after greasing the end.

2. (Contd.)

(7) Keeping the bottom of the base insulator close to the middle of the square steel plate, use the three sections which have been fitted together as a measure and mark off the positions of the four anchors which should be equally spaced, one at each side or corner of the base plate.

(8) Drive in the anchors to slope at about 30-45 degrees away from the vertical line of the aerial.

(9) Fit a fourth section, greasing all joints and when this has been done, slip over the top of this section the square fitting which acts as the meeting point for the four guy ropes. Lay out the ropes in their approximate positions near the anchors and then fit sections five, six, seven, eight and nine, greasing the end in each case before assembly.

(10) Lay the aerial so that the base is near the centre peg and pointing along the line to one of the guy anchors.

(11) Attach the guy rope to anchor nearest to the aerial. Also attach the hooks of the two side guys to their respective anchors.

(12) Holding the fourth guy, lift the aerial into a vertical position so that the bottom of the base insulator fits over the head of the spike holding the base plate.

(13) Steady the aerial and tighten the guy ropes until there is reasonable tension in each and the aerial is vertical when viewed from two positions 90 degrees apart.

(14) Roll up the canvas bag and place it in the wooden box, together with the hammer and tin of grease.

This aerial will serve for the transmitter and the H.F. receiver. The M.F. receiver will require a separate aerial. This may be a second whip aerial or it may be a simple aerial suspended between trees, etc., using the aerial wire and insulators provided in the aerial box.

ERECTING THE EQUIPMENT

3. (1) Stand the "spares" cabinet on level ground, open the front by turning the catches in a clockwise direction and attach it to the top of the cabinet, to form a desk.

(2) Stand the H.F. (B46) receiver in its crate, on top of the cabinet.

(3) Mount the Modulator Unit of the transmitter on top of the B46 receiver.

(4) Lay the wooden box which held the whip aerial, on its side and stand the M.F. (B47) receiver on it. The transmitter should then be stood on top of the B47 receiver and the Aerial Tuning Unit mounted at the base of the aerial.

(5) Open all crate doors fully and remove the dust covers protecting the panels. The dust covers should be placed in the lower compartment of the "spares" cabinet.

3. (Contd.)

(6) Hang the Power Distribution Box on the left-hand door of the Modulator Unit crate.

(7) Stand the batteries on the left-hand side of the equipment but do not attach the battery connectors to the Power Distribution Box.

(8) Set up the Remote Control Unit. The transit case contains the Unit, Morse Key, Handset, Stool and Inspection lamp. Reel off the remote control cable, drum-by-drum, until the distant point is reached. Great care must be exercised to see that dirt does not enter the cable connectors. These are fitted with dust caps which should not be removed until the joints are made. The cable on the drum should be connected to the Modulator via the 6' connector provided. Unwind the cable from the Remote Control position toward the Modulator position, so that Plug Coupler finishes near to Modulator Unit.

(9) Connect all units by their various cables, taking care that all plug-socket connections are clean and dry. The cables are marked at their ends to show where they are connected and the lengths are sufficient to permit the cables to pass round the backs of the units. The various connections to be made are:-

Aerial Tuning Unit to Whip Aerial
" " " " B46
" " " " Transmitter 5AH (2 links, coaxial and 2 pin)
Transmitter Unit to Modulator Unit
" " " B46
B46 to Power Distribution Box
B47 " " " "
B47 to its own separate aerial
Modulator Unit to Remote Control
" " " Power Distribution Box

Connect the earth terminal on the Aerial Tuning Unit, or B47 to the earth spike driven in the ground.

(10) Fix the morse key in the mounting provided on the operating desk and insert its plug into the appropriate socket on the Modulator Unit. Also plug in handsets and headphones.

(11) Check that the main ON-OFF switches on the two receivers and the Modulator Unit are all in the OFF position and then attach the battery connectors to the Power Distribution Box.

(12) Set up the petrol-electric battery charging plant, if one is to be used and put the spare batteries on charge if necessary.

Note The petrol-electric set must not be less than 50 yards from the receivers.

4. The above procedure will cover an average transportable installation but it is permissible to modify it if circumstances seem to justify it. For example, the units may be rearranged in any other order except that the Aerial Tuning Unit must always be at the base of the aerial. If space is not available, as might be so in the case of installation in a building, it is possible to remove the units from their crates but this should not be done unless it is absolutely unavoidable because they are then not protected from vibration and are very likely to be damaged in transit unless properly repacked in the crates when the station is moved. If the units are removed from their crates they may be bolted together by

4. (Contd.)
means of the lugs on the cast-alloy boxes.

A.C. Operated Transmitter

5. Setting up the transmitter for A.C. operation follows that for D.C. operation so far as all the main units are concerned. In addition, the A.C. Power Unit is needed and should be mounted reasonably near the Modulator Unit but it need not be on the table or operating desk since it has no external controls. Underneath the operating desk is a suitable place. Connections are made as follows:-

(1) Remove the fuse panel from the Modulator Unit.

(2) Remove the Connector from the socket on the A.C. Power Unit where it is normally stowed. The connector is something like the Modulator fuse panel but has a 25-way socket attached to it.

(3) Plug the connector into the socket on the Modulator Unit which held the Modulator fuse panel and plug the latter into the socket on the A.C. Power Unit where the connector was stowed.

(4) Link the 25-way socket on the connector to the 25-way plug on the A.C. Power Unit with the cable provided.

Note This cable cannot accidentally be interchanged with the cable linking the Modulator and Transmitter 5AH as the 25-way plugs are not interchangeable.

(4a) When used with Remote Control Outfits on board ship, A.P.65137 or 66104 (12 cores) should be used on the Modulator. A.P.65136 (10 cores) is used only for transportable equipment.

(5) Connect the A.C. Power Unit with the A.C. Distribution Box and connect the A.C. mains to the latter. The A.C. Power Unit is switched on and off by means of the switch on the Distribution Box. Do not switch on A.C. power until items (1) to (4) have been carried out.

(6) If a 24 volt battery is available connect it to the Modulator Unit in the usual way and this transmitter will then be ready for automatic change-over to battery operation, if the A.C. Supply fails. Do NOT leave the D.C. switched on unless emergency change-over facility is required.

A.C. Operated Equipments. Adjusting the Transformers

6. Both receivers have windows in the front panel which will show whether the apparatus is for BATT or A.C. use. If the set is correctly marked "A.C." and has been drawn straight from store in a new condition it is intended for use on 230 volts, 50 c/s mains and should NOT be opened. If it has been used before and there is any doubt regarding the mains transformer tappings it must be opened by unscrewing the bolts around the edge of the panel with the tool provided in the tool kit and withdrawing the unit from its case. Examine the mains transformer T1 and check its connections are according to Table 1. If the set is altered to 180V 500 c/s working, this fact should be written on the A.C. label visible through the window.

6. (Contd.)

TABLE 1

Mains Supply	"Mains" Terminals on Transformer Panel
230 volts, 50 c/s	1 and 3
180 " 500 c/s	1 and 2

Leave the receiver out of its case for as short a time as possible and read Chapter 10 paragraph 3, for guidance on resealing the equipment in a perfectly dry condition.

A.C. Power Unit for Transmitter

7. As in the case of the receivers, if the unit is drawn straight from store in a new condition it will be set for use on 230 volts, 50 c/s and should not be opened. If there is any doubt verify the tappings.

In the case of this unit three connections have to be checked one on T1 and two on T2. The connections should be according to Table 2.

TABLE 2

Mains Supply	"Mains" Terminals on Transformer Panel
230 volts, 50 c/s	Green/Blue to terminal 3. Blue/Red " " 5.
180 " 500 c/s	Green/Blue to terminal 2 Blue/Red " " 4

Conversion of Receivers from A.C. to D.C. Operation

8. This change-over only requires a few minutes work. Proceed as follows:-

(1) Open the receiver by unscrewing the bolts around the edge of the panel with the box spanner provided in the tool kit.

(2) Disconnect the connections to the A.C. power unit at the multi-way plug.

(3) Remove the four front-panel screws (Fig. 4) and the two rear-panel screws (Fig. 5) and take away the A.C. power unit.

(4) Substitute the other unit and replace the screws. Check that the hinged flap near the safety switches (Fig. 6) is not holding them closed.

(5) Read Chapter 10 paragraph 3 regarding resealing the unit.

SHIP INSTALLATION

9. Ship installations may be either Type 612E, fitted as the emergency transmitter aft in destroyers or as a normal set in coastal force craft, or Type 612EF, fitted in B.R.R.'s, the second office of flotilla leaders and in certain craft used for combined operations. The Installation Specification is No. B.685.

Control Circuits (Fig. 34)

10. By the use of Relay Units the equipment can be operated with control outfits KCH/W, the KDA and KHA series. Adaptation is as follows.

The Remote-Local switch on the Modulator Unit connects the microphone, keying and on-off leads through the Relay Unit to the remote control lines, disconnects the Off-Standby-Ready switch and Local R/T -W.T.-I.C. switch and breaks the supply to the local microphone relay in the Modulator Unit. The Off-Standby-Ready switch on the Relay Unit takes control. A delay time must be allowed for warming the filaments when moving the Remote-Local switch. The filaments are supplied for the Standby and Ready position whichever switch is controlling (i.e. remote or local).

The switch on the Relay Unit should normally be to "Standby" when the Remote-Local switch is to "Remote". This operates RL3 in the Modulator Unit which supplies the transmitter and modulator filaments (with the Standby lamp in parallel). Switching to "Ready" operates RL4 in the Modulator Unit and this extinguishes the Standby lamps and lights the Ready lamps. In A.C. working it also supplies the H.T. relay in the power unit thus completing the mains supply to the H.T. transformer primary. In D.C. working the filament supply operates the motor start relay RL5 which completes the motor supply via a hold-on winding of the relay. The latter ensures that the motor attains correct speed before the contacts can open again. At full speed the voltage across the winding is reduced sufficiently to permit release when the operating winding is de-energised.

In addition to switching on H.T. RL4 connects a supply to relay RL in the Relay Unit, provided that the Aerial C.O.S. is to "Transmit". This relay lights the remote Ready lamp and extends the keying line from the Modulator Unit to the remote line. On R/T relay RR in the Relay Unit is also supplied. This operates and in turn supplies the microphone relay MR. Opening a gate switch releases RL4 and H.T. is switched off.

With the gates closed, H.T. on and the Aerial C.O.S. to "Transmit" the remote key operates relay RL and thus the keying relay in the transmitter which (a) brings on the carrier, (b) operates the send-receive relay in the Aerial Tuning Unit and (c) operates the muting relay in the B46.

N.B. (b) and (c) occur before (a) on operation; (a) occurs before (b) and (c) on release.

For R/T. with H.T. on, a 24V supply is fed by RL4 to relay RR which connects relay MR to the microphone line. MR is controlled by the pressel switch, operating the keying relay to bring on the carrier, lighting the remote In Use lamps and connecting a side-tone resistor across the phone line.

Aerial C.O.S. (Fig. 55)

11. An aerial C.O.S. permits the transmitter output to be fed into:-

(1) A trunk running directly from the C.O.S. to the aerial,

11. (Contd.)
(2) a flexible cable connected to a trunk aerial,

(3) a coaxial cable to a whip aerial, or

(4) a flexible cable connected to a receiver aerial (emergency only).

The aerial C.O.S. contains a resistor to enable the aerial to be correctly earthed in ships fitted with H.F. D.F. Normally the resistor will not be required and is short circuited by a link. Provision is also made for H.F. D.F. warning circuits. A receiver socket fitted on the switch allows a receiver to be connected to the transmitter aerial in emergency.

Power Supplies

12. The transmitter normally operates from 230V A.C. mains fed via a distributing box to an A.C. power unit which supplies the control circuits, filaments and H.T. When the mains supply is switched on a 24V supply from the D.C. control circuit rectifier (in the A.C. Power Unit) operates two relays. These relays change the filament and control circuit supplies from the battery to the power unit and the H.T. load from the D.C. motor to the A.C. power unit.

In the event of A.C. mains failure the switching relays are released and the circuit reverts to battery operation. (As this might happen when the set is unattended the main switch for the battery should normally be kept in the "Off" position, otherwise the battery will be discharged to no purpose). Battery outfits vary according to the type of ship:-

(1) Equipment installed in B.R.R.'s or in a flotilla leader's second office uses the normal ship's Battery Outfit BBn.

(2) Where fitted aft as the emergency transceiver NIFE cells are used. This is termed Battery Outfit BCe.

(3) In coastal craft the ship's 24V mains supply is used.

13. In a ship where the associated receivers B46 and B47 are required only for emergency they are operated from the 24V battery. To provide reception to remote positions a patching cord is connected between the receiver jack marked "Line 600 ohms" and the "Emergency Receiver" jack on the Relay Unit. When the emergency receiver switch is operated the receiver output is connected to the phone line. The receiver should be monitored on the phone jack of the Relay Unit with its volume control set to a predetermined position and the volume adjusted by the receiver controls to give a reasonable signal strength in the phones and thus ensure the correct level throughout the ship.

CHAPTER 8.

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PRE-OPERATING TESTS.

A FUNCTIONAL CHECK AFTER INSTALLATION

CHAPTER 8

PRE-OPERATING TESTS

GENERAL

1. After installing the equipment it is desirable to give it a systematic functional check. This is not a performance check but proves that all controls are in order and also serves to familiarise the operator with their position and function.

NOTE: Care should be taken to exclude moisture when returning units to their cases, as the Silica-gel capsules will only absorb moisture from the air. This is VERY IMPORTANT since it will be found that if the set is closed up in a damp condition, the Silica-gel capsule will have to be renewed many times before all the moisture is removed and the drying out operation will therefore take a long time, during which, corrosion may take place, or mould start to form. In most cases, this can be achieved by running the unit, slightly withdrawn from its case, for about thirty minutes.

A signal generator may be used, if desired, to test the receivers but it must not be used to check their calibrations since it is unlikely that it will be sufficiently accurate for this purpose.

RECEIVER B46

2. (1) Switch on and while the valves are warming up, set the receiver controls as follows:-

Control	Set to
Service Switch	Tune
AE. Trim	Any position
Oscillator Tune Fine	Align the white dot on the knob with the mark on the panel.
Band Switch	Band 1.
Selectivity Switch	Broad
Limiter Switch	Off
Anti-Cross-Mod. Control	Fully clockwise
A.F. Gain Control	" "
Speaker Volume Control	" "
C.W.-R/T Switch	R/T
C.W. Note Control	Align the white dot on the knob with the mark on the panel

(2) Check that the H.T. voltage is approximately 133 volts and that the L.T. voltage is approximately 24 volts. (Pointer Central).

2. (Contd.)

(3) Adjust the OSCILLATOR TUNE: COARSE and R.F. TUNE controls to the high frequency end of the bands and then adjust the AE. TRIM control until the noise in the telephones is at a maximum. During general reception conditions adjustment of the AE.TRIM control will often improve the signal-noise ratio, especially when weak signals are being received.

(4) Adjust the R.F. TUNE control to the frequency of an R/T. or M.C.W. station believed to be working and then adjust the OSCILLATOR TUNE: COARSE control until the station is heard. Vary the OSCILLATOR TUNE:FINE control for best reception and also readjust the R.F. TUNE control if necessary.

(5) Test the SPEAKER VOLUME control and then switch off the loudspeaker with this control.

(6) Plug a pair of telephones into the jack marked PHONES and check that the the A.F. GAIN control is working correctly.

(7) Remove the telephones from their proper jack and plug them into the one marked LINE 600 OHM. Turn the SPEAKER VOLUME control very slightly and verify that output is obtained.

(8) Turn either of the main tuning controls until the signal entirely disappears even with the volume control turned well up. Note the noise present. Then turn the BANDWIDTH switch from "Broad" to "Narrow" and then "Sharp". As selectivity increases the noise level should decrease. Return the switch to "Broad" after testing.

(9) Retune the receiver and endeavour to find a weak signal or attenuate the input if a signal generator is being used. Then turn the ANTI-CROSS-MOD. control anti-clockwise and the signal strength should decrease. Return the control to the normal position.

(10) Move the C.W.- R/T switch to C.W. and tune to a transmitter operating on this service. Then vary the C.W. NOTE control and verify that it causes the pitch of the note to vary.

(11) If "atmospherics" are present or if noises are induced in the aerial by adjacent electrical machinery it may be possible to check the limiter.

(12) Turn the BAND SWITCH to Band 2 and endeavour to tune at least one station operating any service. Two stations, one towards each end of the band are preferable but a single transmission will prove that the band switch is undamaged.

(13) Repeat (12) on Band 3.

(14) If a suitable crystal can be obtained (see Chapter 3, Table II), insert it in the crystal holder, position 1 and move the "Service" switch to XTAL.1.

(15) Set the tuning controls to the nominal frequency and check that the receiver operates correctly. It may be necessary to invite the co-operation of a transmitter or to use a signal generator for this test.

(16) Repeat (14) with a crystal in position 2 and "Service" switch to XTAL.2.

(17) Start the local transmitter and tune it in with the "Service" switch set to "TUNE". Note whether the signal is now at a reasonable level. If it is not, remove the receiver from its case by undoing the screws around

2.(17) (Contd.)

the edge of the front panel and adjust R9 (Fig. 5) until a comfortable signal level is reached. Adjustment of R9 should only be carried out on permanent installations.

(18) Operation of the crystal calibrator should now be checked. The tests described here only prove that the calibrator circuits are in correct working order and the exact use of the facility is described in detail in Chapter 2, paragraph 2.

(19) With the BAND SWITCH set to any band adjust the R.F. TUNE control to a frequency that is an exact multiple of 100 kc/s.

(20) Move the "Service" switch to CAL. and the C.W.- R/T switch to C.W.

(21) Turn the OSCILLATOR TUNE: COARSE control to the same frequency as chosen in (19) and then adjust the OSCILLATOR TUNE: FINE control to select the nearest strong beat note and tune it to silence. The receiver is then tuned to the frequency chosen nominally in (19).

(22) If a remote control unit is being used, check that the output of the receiver can be extended to the remote unit by plugging up the jack marked LINE 600 OHMS on the receiver to the RECEIVER OUTPUT on the Modulator Unit. The receiver cannot be controlled remotely, only its output can be extended. Communication with the distant unit is via the intercommunication circuit of the transmitter with which it is designed to operate.

RECEIVER B47

3. (1) Switch on and while the valves are warming up, set the receiver controls as follows :-

Control	Set to
Band Selector Switch	Band 1.
AE. Trim	Any position.
Anti-Cross-Mod.	Fully clockwise.
A.F. Gain Control	" "
Limiter Switch	Off.
Note Filter Switch	Out.
C.W.-R/T Switch	R/T
C.W. Beat Note Control	Align the white dot on the knob with the mark on the panel.
Loudspeaker Volume Control	Mid position.

3. (Contd.)

(2) Check that the H.T. voltage is approximately 133 volts and that the L.T. voltage is approximately 24 volts. (Pointer Central).

(3) Adjust the R.F. TUNE control to the high frequency end of the band and then adjust the AE. TRIM control for maximum noise in the telephones. During general reception the signal-noise ratio may be improved 10-15 db by the critical adjustment of this control.

(4) Adjust the R.F. TUNE control until a station is heard, or use a signal generator to provide a signal.

(5) Test the louspeaker volume control and afterwards switch off the loudspeaker with the switch incorporated in this control.

(6) Test the A.F. GAIN control whilst checking the telephone circuit.

(7) Remove the headphones from their proper jack and plug them into the one marked LINE 600 OHMS. Turn the SPEAKER VOLUME control slightly clockwise and check that output is obtained.

(8) Turn the R.F. TUNE control until the signal disappears. Note the amount of noise present. Then switch in the Note Filter and the noise level should decrease. Switch out the filter.

(9) Retune the receiver and find a station weak in signal strength or attenuate the input to the receiver if a signal generator is being used. Then turn the ANTI-CROSS-MOD control anti-clockwise and the signal should decrease in strength. Return the control to the mid position.

(10) Throw the C.W.- R/T. switch to the C.W. position and tune in a C.W. transmission. Then vary the C.W. NOTE control and check that it causes the pitch of the note to change.

(11) Turn the band switch to Band 2 and endeavour to tune in at least one station operating any service. Two stations, one at each end of the band are preferable but a single transmission will prove that the band switch is undamaged.

(12) Repeat (11) on Bands 3 and 4.

(13) If "atmospherics" are present or if noises are induced in the aerial by electrical machinery, it may be possible to test the Limiter.

(14) If a remote control unit is being used, check that the output of the receiver can be extended to the remote unit by plugging up the jack marked LINE 600 OHMS on the receiver to the jack on the Modulator Unit marked RECEIVER OUTPUT.

TRANSMITTER UNITS

4. (1) Switch on the main power supply if a switch is provided at some external point.

(2) Move the OFF-STANDBY-READY key to STANDBY and leave it in this position for at least one minute to allow the valve heaters to reach their final temperatures. The 'Standby' indicator lamp on the Modulator Unit should be alight. Set the R/T.-M.C.W.-C.W. key to M.C.W.

4.(2) (Contd.)

IMPORTANT: Whenever the "Service" of the transmitter is changed from C.W. to R/T or M.C.W. the above key must be switched from READY to STANDBY for one minute to allow the modulator valves to heat fully.

(3) Check that the battery voltage is not below 23 in the case of the D.C. model or that the heater voltage is not below 23 in the case of the A.C. model. Also check the control circuit supply in the latter model; it should be between 20 and 24 volts.

(4) Set the main tuning control to a frequency in Band 1. Also adjust the band switch in the Aerial Tuning Unit.

Note: It is dangerous to operate the Aerial Tuning Unit with the band switch in the wrong position. High currents may be obtained which will damage the meters.

(5) After one minute move the OFF-STANDBY-READY key to READY and in the D.C. model the rotary transformer should start. In both models the READY lamp should light.

(6) For the next tests,(7) to (15) inclusive, the telegraph key should be held down.

(7) Move the meter switch on the Modulator Unit for the meter to indicate H.T. voltage, which should be about 350.

(8) Remove the load from the transmitter by breaking the link between the 5AH and Aerial Tuning Unit.

(9) Adjust the output circuit trimmer in the 5AH and verify that the final stage anode current reaches the charted minimum for the frequency stated. Leave the set trimmed for minimum anode current and reconnect the link between the 5AH and Aerial Tuning Unit.

(10) Move the R.F. meter switch to positions 3 and 4 and check that the corresponding indications are approximately as charted.

(11) Switch in the dummy aerial with the switch on the Aerial Tuning Unit and set the COUPLING and LOADING controls on this unit to zero.

(12) Move the TUNING control on the Aerial Tuning Unit until the meter in the MATCHING CIRCUIT indicates a maximum. The meter switch should be operated when using the meter if it is required to increase the indication.

(13) Increase the COUPLING control a little and readjust the TUNING control in conjunction with it until an optimum position is found of maximum current through the dummy aerial but check that the cathode current of the R.F. amplifier does not exceed 130 mA. (R.F. meter switch position 3).

(14) These tests have been carried out to prove that the transmitter is functioning correctly and this should be further checked by comparing the meter indications with those charted for the same frequency.

(15) Reduce the COUPLING control to zero, switch out the dummy load and connect the aerial.

4. (Contd.)

(16) If the aerial reactance is capacitive, as it usually will be, tune it by varying the LOADING control until the AERIAL CURRENT meter indicates a maximum. Normally loading should only be used on Band 1. On other bands set the control to zero turns.

(17) Finally retune and increase the coupling until the maximum aerial current is obtained or until the cathode current of the R F. amplifier reaches its limiting figure. See (12).

There must, of necessity, be a certain amount of inter-dependency between the various aerial circuits and this in turn will require a search for an optimum setting of the tuning and coupling controls to obtain maximum aerial power. In addition, the loading coil will be required on Band 1, mainly at low frequency end, with short aerials.

The adjustment of the Aerial Tuning Unit is not difficult and the table at the end of the chapter gives the approximate settings to be expected for various frequencies, using the 36 ft. whip aerial. This table should be used only as a rough guide. The essential factor is that a new operator should spend time in becoming familiar with setting the various circuits by trial in conjunction with the above instruction.

(18) Next move the OFF-STANDBY-READY key to STANDBY and move the R/T -M.C.W.-C.W. to C.W.

Note: This last key should not be moved to the C.W. position unless the set has been previously tuned correctly in the M.C.W. position.

(19) Move the OFF-STANDBY-READY key to READY and the transmitter will not be operating on full power.

(20) Repeat (7) to (17) inclusive, with the telegraph key down but noting :-

(i) In (7) the H.T. voltage will now be about 475.

(ii) In (13) the maximum permissible cathode current will now be 170 mA.

(21) Repeat (7) to (19) inclusive, using other charted frequencies and verify that the meter indications are approximately as charted. The signal radiated by the transmitter may be monitored on a nearby receiver that is not muted.

(22) On one of the frequencies which is an exact multiple of 100 kc/s check the operation of the crystal calibrator by moving the CRYSTAL CAL. switch on the 5AH to CAL and plugging the telephones into the socket below the R.F. meter. Set the tuning dial as closely as possible to the desired frequency (100 kc/s multiple) and adjust the OSC. TRIMMER control on the 5AH until a very loud beat note is heard, then adjust the trimmer for the silent (or minimum frequency) point of this beating frequency. A number of fainter beats may be heard but these should be ignored and the greatly increased volume of the wanted note will make identification easy.

(23) Having completed the above tests, switch off the crystal calibrator and replace the telephone plug in its normal jack.

(24) Move the OFF-STANDBY-READY key to STANDBY; the R/T -M.C.W.-C.W. key to M.C.W. and wait one minute for the modulator valve heaters to reach their operating temperature.

4. (Contd.)

(25) Move the OFF-STANDBY-READY key to READY and the transmitter will be operating on M.C.W., modulated to a depth of about 70% with an 800 c/s note when the telegraph key is down. The depth of modulation is preset and is not intended to be altered.

(26) Operate the telegraph key and check that side-tone is heard in the hand microphone.

(27) With the telegraph key down, check the meter indications against charted figures for positions 1, 3 and 4 of the meter switch on the 5AH and for positions 2, 3 and 4 of the meter switch on the Modulator Unit

(28) Move the OFF-STANDBY-READY key to STANDBY, the R/T -M.C.W.-C.W. key to R/T and the R/T -W.T.-I.C. key to R/T Wait one minute for the modulator valves to heat.

(29) Move the OFF-STANDBY-READY key to READY and the transmitter will be operating on R/T and side-tone should be heard in the hand microtelephone when transmission takes place.

Note: When the R/T -W.T.-I.C. key on the 5AH is at R/T it is possible to transmit on C.W. (at reduced power) by using the telegraph key in the usual way, the microphone being ignored. This facility is not usually required.

(30) On completion of the above tests leave the transmitter in full operation and move the LOCAL-REMOTE- key to REMOTE. This extends the following facilities to the Remote Control position :-

(i) OFF-STANDBY-READY controls

(ii) R/T -W.T.-I.C. control.

(31) Move the R/T -W.T.-I.C. key on the Remote Control Unit to R/T. and if the OFF-STANDBY-READY key was at OFF when the changeover from local to remote control was made allow it to remain at STANDBY, for the usual minute to allow for modulator valves to heat.

(32) Move the remote OFF-STANDBY-READY key to READY and verify that the equipment transmits R/T and that side-tone can be heard in the hand microtelephone.

(33) Move the R/T -W.T.-I.C. key to W.T. and verify that M.C.W. is transmitted when the telegraph key is operated and that side-tone is heard in the telephones.

(34) Move the OFF-STANDBY-READY key to STANDBY and set the R/T.-M.C.W.-C.W. key on the Modulator Unit to C.W.

(35) Change the OFF-STANDBY-READY key back to READY and the transmitter is now operating on C.W. Check that transmission takes place when the "Remote" telegraph key is operated.

(36) Lastly check the intercommunication circuits between the transmitter and the Remote Control Unit, in both directions, using the I.C. CALL positions of the R/T -W.T.-I.C. keys for signalling purposes.

4. (Contd.)

(37) If the transmitter is to be used with crystal control of the master oscillator a test should now be made. For this purpose it is not essential to have a crystal of the correct working frequency. Any crystal suitable for the transmitter can be used, i.e. any one ground for a frequency between 1·5 and 6·5 Mc/s, inclusive.

(38) Insert this crystal in holder 1 or 2 on the 5AH and move the CRYSTAL-M.OSC. switch to the CRYSTAL position (1 or 2). Also move the OFF-STANDBY-READY key to STANDBY.

(39) Set the tuning control and band switch on the 5AH to the declared frequency of the crystal and the R.F. meter switch to position 2. On bands 2 and 3 the frequency should be twice the declared frequency of the crystal. The crystal frequencies for the three bands are as follows :-

Band	1	1·5 - 3·25	Mc/s
"	2	1·5 - 3·25	"
"	3	3·0 - 6·5	"

(40) Move the OFF-STANDBY-READY key to READY and vary the 5AH tuning control whilst watching the R.F. meter (Position 1. Oscillator plate current). Start with the control on the high frequency side of the working frequency, move it slowly, and note that the meter indication has a minimum value (proving the crystal to be oscillating). Also note that the change in current on one side of the dip is much faster than on the other. Set the tuning control so that the current is about 30% away from the dip of the side which has the gradual change in current, i.e. towards higher frequency. It is important that approach to the dip must be only made from the high frequency side, therefore if there is any "overshoot" the control must be moved right back in the high frequency direction and a new approach made. The move backwards should be sufficient to cause the crystal to stop oscillating and the grid current to fall to zero.

(41) After the transmitter frequency has been set the Aerial Tuning Unit should be adjusted exactly as described in (11) to (17) inclusive.

Note: On completion of these tests, or at any time when the set will be unattended, the main battery supply switch should be broken. This is particularly necessary in installations where the equipment is normally A.C. fed since breaking the A.C. supply switch alone (or a failure of the mains) will release the relays in the A.C. power unit and transfer the load to the D.C. supply and discharge the emergency batteries.

TYPICAL READINGS FOR TRANSMITTER UNITS

NOTE: Where two readings are given for one frequency the second reading is for M.C.W. transmission.

TRANSMITTER 5AH							
Freq.	M.O.	Band	Tuning	Osc.H.T.	CAL. H.T.	Ampl.H.T.	Ampl. Grid
1500 Kc/s	Yes	1	1·5	40	-	150	4·4
" "	"	"	"	27	-	90	4·0
5000 kc/s	"	2	5·0	42	-	142	3·0
13160 kc/s	"	3	13·16	48	7·5	125	1·8
" "	"	"	"	30	-	80	1·0

AERIAL TUNING UNIT						
Freq.	Band	Tuning	Coupling	Load	C.C.	Aerial
1500 kc/s	1	145	015	350	3·5	0·4
"	"	"	"	"	2·4	0·28
5000 kc/s	2	055	002	000	1·5	0·52
13160 kc/s	3	037	001	"	1·2	0·3
"	"	"	"	"	0·9	0·2

MODULATOR UNIT				
Modn.	Batty.	H.T.	T.O.H.T.	V2-V4
C.W.	22·5	450	-	-
M.C.W.	20	320	2	70

CHAPTER 9.

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ROUTINE MAINTENANCE DIRECTIONS

A LIST OF PREVENTIVE ACTIONS REQUIRED

TO KEEP THE APPARATUS EFFICIENT

CHAPTER 9.

ROUTINE MAINTENANCE DIRECTIONS

GENERAL

1. Certain parts of the equipment require periodical attention to ensure dependable and efficient operation, and the term "maintenance" is used to cover this upkeep. It does not cover the diagnosis and clearance of faults: these are dealt with in Chapter 10.

"Maintenance" is therefore considered to comprise the following:-

(1) Checking the general functioning of the equipment.

(2) Reducing the chances of failure by regular inspection and attention.

(3) Locating and clearing simple faults, including valve replacement.

NEVER OPEN A SEALED UNIT UNLESS FORCED TO. If it has been properly sealed, the silica-gel capsule will maintain the interior air in a perfectly dry condition and it is preferable to maintain this dryness rather than to open the equipment and seek for potential faults. The maintenance details to be covered when an equipment is opened for repair purposes are given in Chapter 10, paragraph 4. Do NOT leave Loudspeaker cover unsealed unless in actual use.

The glass seals used on transformers and chokes are vulnerable and special care must be exercised to avoid damage when units are opened.

WEEKLY ROUTINE

2. W1. Switch on the transmitter and receivers and verify operation on all frequency bands. Note the results and enter the information on the Performance Record Sheet.

W2. Tighten all terminals, plugs, etc. and check that the telephone cords, cables etc. are not damaged.

W3. Exchange any silica-gel capsules whose contents are not blue. Any capsules which are on the border line of pink and blue should be replaced by blue ones. It is far better to change the capsules more frequently than is necessary rather than the reverse, since a perfectly dry interior atmosphere is the best safeguard against the formation of corrosion on metal work and mould on organic materials. Both of these increase the liability of the equipment to breakdown and although the changing of a capsule may only take a minute, the tracing of a fault at a later date may take hours. The capsules should not be thrown away, but should be heated until the contents again turn blue. The maximum temperature to which the silica-gel should be subjected is 300°F (= 150°C). Above this temperature its "indicating" properties will be lost though the material will still absorb moisture. If capsules in a sealed unit will not remain blue for several weeks, examination should be made to ensure correct placing of rubber seals and tightness of Panel components.

2. (Contd.)

W4. Lower the whip aerial, separate the tube sections, regrease them where they fit together and re-assemble. If this is not done at weekly intervals,
Ashore: the tubes will probably "seize" together and separation without damage will be impossible. Check that the insulators are clean, and when the aerial is erected, that it is vertical and the guys are reasonably tight.

Onboard ship: With single wire and/or whip aerials test aerial insulation. This can be done conveniently at the Aerial C.O.S. with a Megger. Next earth the deck insulator and test for continuity of trunk/connector wiring between the C.O.S. and earth. Unearth the deck insulator.

W5. Check the depth of liquid above the battery plates. If it is less than $\frac{1}{2}$ inch increase it to this figure, by using distilled water. Do not leave the cell vents open for long periods. Also verify that the spare battery is fully charged. The condition of nickel-cadmium batteries is indicated only by the terminal voltage on load, not by the specific gravity of the electrolyte.

W6. If only one battery is used it is important that it is NOT charged whilst the equipment is in use as the necessarily increased terminal voltage will tend to decrease the life of the valves.

W7. Thoroughly clean all front panel fittings and if corrosion is present remove it carefully and apply a thin coat of varnish or paint to the spot.

W8. Check over all the external leads to the units and examine with particular care all the battery connections. If the latter are corroded they should be cleaned and coated with a mere trace of mineral oil or grease.

W9. Check the operation of the remote control lines for switching on, keying, Microphone, and inter-communication.

MONTHLY ROUTINE

3. M1. Switch on transmitter and receivers, verifying operation on 1,500, 5,000 10,000 and 13,160 kc/s. Note the results and enter the information on the Performance Record Sheet.

M2. Check the contents of the spares box. (In order to maintain the correct stock always demand a replacement as soon as possible after using a spare component, thus keeping the box complete).

Note If a unit is functioning satisfactorily, it should NOT be opened; but when it is necessary to open a unit, gearing and relays should receive attention.

BATTERY MAINTENANCE

4. The nickel-cadmium cells used in some of the batteries for operating the equipment should be maintained in the regulation manner for alkaline batteries as laid down in B.R.268(a), Electrical Manual, Vol. II, Primary and Secondary Batteries, Chapters IX, X and XI, but the following is a summary of the essential data for the type recommended, NIFE type F4.

4. (Contd.)

Capacity of cells: 45 ampere-hours.
Normal discharge current: 4·5 amperes.
Normal charging current: 11·25 amperes for 6 hours.
Depth of electrolyte above plates: $\frac{1}{2}$ inch.
Cell voltage when fully discharged at normal rate: 1·10V.
Renewal electrolyte: NIFE type "A".
Quantity per cell: 0·76 pint.

The following points should also be observed:-

(1) Keep the tops of the plates covered with $\frac{1}{2}$ inch of electrolyte. Use distilled water for topping up.

(2) Keep the cells and crates clean and dry.

(3) Give the battery a regular overcharge and avoid overdischarging the cells. Overcharging will NOT damage the cells, but overdischarging will.

(4) Do not allow the temperature to rise above 115°F. Whenever possible remove the lid of the battery box while charging is taking place.

(5) See that the specific gravity of the electrolyte is between 1·16 and 1·19.

If the specific gravity is high, distilled water may be added to the cells, but if it is low the electrolyte must be replaced, as laid down in 264.7 of the above manual. On no account "top up" with electrolyte.

(6) Remember that SULPHURIC ACID WILL DESTROY AN ALKALI BATTERY. Do not use utensils which have been used for acid. If possible, do not use hydrometers which are also used for lead-acid batteries. If this is unavoidable, they should be thoroughly rinsed with fresh water before being used with the opposite type of cell.

(7) Electrolyte should be changed after 1 year, (following the instructions given in B.1, 264-267 of the Manual) unless the battery has not had frequent use. "Frequent" is here taken to mean use that necessitates 3 or more charging periods per week.

Safety Precautions

5. The following safety precautions should be observed in connection with nickel-iron batteries.

(1) The electrolyte is Caustic, a corrosive, which must not be allowed to touch the person, clothes, woodwork etc. In the event of accident, it is IMPERATIVE that the Caustic be neutralised AS SOON AS POSSIBLE. For this purpose, a bottle of Boric Lotion should be kept near the batteries.

Neutralising agents for Caustic, in descending order of efficacy are:-

(i) Boric Lotion.

(ii) Milk.

(iii) Vinegar, diluted one part in four parts of water.

(iv) Wash freely with RUNNING water (Dilutes the Caustic).

5.(1) (Contd.)

These neutralising agents may also be used if Caustic is splashed in the eye, care being taken to ensure that the eyball is reached.

(2) The containers of this type of cell are "alive" and must be insulated before connections are made to the terminals. Normally the wooden containers provide this insulation.

CHAPTER 10.

SERVICING

A DESCRIPTION OF RE-ALIGNMENT AND

CORRECTIVE ACTIONS WITH TYPICAL DATA.

CHAPTER 10

SERVICING

GENERAL

1. During service, faults of various types are likely to occur in any part of the equipment and it is obviously impossible to give a complete fault location routine that will enable every conceivable fault to be diagnosed. In general, therefore, it is assumed that those responsible for fault location are fully conversant with systematic methods of analysis. There is, however, one fault location axiom which should always be remembered and constantly followed: When looking for trouble in a radio set always examine all the simple possible causes of failure first.

Spare R.F. and I.F. Units are allowed in the establishment of stores held by ships and maintenance bases. These permit the immediate return to operation of receivers whilst the defective unit is being serviced.

OPENING THE UNITS

2. Do not break the seals of units unless it is absolutely essential but if it cannot be avoided all units in the equipment are opened by unscrewing the bolts around the edge of the panel with the special box spanner provided in the tool kit. The panel and all the apparatus can then be withdrawn from the box.

The receivers, Transmitter 5AH and Modulator have safety switches which normally prevent the equipment from being operated out of the boxes. For test purposes, however, hinged flaps are provided on the receivers whereby the safety switches can be held in the "closed" position. In the case of the Transmitter and Modulator out-of-case operation may take place by laying the chassis on their backs.

RESEALING UNITS

3. After any sealed unit has been opened it is most important that it should be resealed in a proper manner since a perfectly dry interior stmosphere is the best safeguard against the formation of corrosion on metalwork and mould on organic materials. Both of these increase the liability of the equipment to breakdown and although the changing of a capsule may only take a minute, the tracing of a fault at a later date may take hours.

A silica-gel capsule will maintain the interior air in a dry condition but it will only absorb minute amounts of moisture and cannot cope with moisture present on components or on the sides of the box. It is important therefore that these should be thoroughly dry before the box is reclosed. The method of achieving this must depend on circumstances and be left to the mechanic but one method is to run the unit for a time, slightly withdrawn from its case, and with the valve heaters on. In the case of the Remote Control and Aerial Tuning Units this is of course impossible and other means must be used.

3. (Contd.)
When it is reasonably certain that the set is dry it may be returned to its box and the bolts tightened, working gradually round the edge of the box.

After a unit has been resealed watch the silica-gel capsule for a few days and change as may be necessary. If many changes are required it is proof that drying-out was not thoroughly done.

ROUTINE MAINTENANCE WHEN SEALS ARE BROKEN

4. When a fault or valve replacement necessitates the opening of a unit the opportunity should be taken to carry out various maintenance operations which alone would not justify breaking the seals. These are detailed below:-

(1) Examine the interior for signs of corrosion, also examine components such as resistors for signs of overheating. If corrosion is found it should be carefully removed, whilst components showing signs of serious overheating should be replaced and the cause found.

(2) Remove all valves from their holders. Clean the pins and sockets with carbon tetrachloride or cleaning solution (A.P.55945) and replace the valves.

(3) Clean the dynamotor commutator with a piece of fluffless rag. Blow all carbon dust, which may arise from the brushes, from the interior of the set.

VALVES

5. A complete set of tested valves of the same types as are used in the equipment should always be readily available. If faulty operation of a receiver or the transmitter is observed and a valve defect is suspected, each valve may be checked by replacing it with a valve known to be in good condition.

Do not remove valves while the set is switched on, or switch on whilst any valve is out of position. Owing to the series-parallel connection of the filaments, this causes excessive voltages across the filaments of some of the valves in circuit, which will burn them out, or at least shorten their lives.

FUSES

6. A "blown" fuse is generally an indication of an overload, which may be due to a defective component, including a valve, and therefore an attempt should always be made to find the cause of the overload before replacing the fuse.

F401-2 and F501-3 are fitted in the D.C. and A.C. power units of the receivers: F6-10 in the A.C. power unit for the transmitter units.

6. (Contd.)
F1-5 and F11-12 (adaptor) can be transposed as shown in the table:-

Equipment wired for:	F1-5 Location	F11-F12
Normal A.C. Supply	A.C. Supply Unit	Modulator Unit
Normal D.C. Supply	Modulator Unit	A.C. Supply Unit

COMPONENT REPLACEMENT

7. Although the replacement of components would at first consideration appear to consist merely in referring to Appendix 1 and obtaining a component of the appropriate value there are several places in the Type 612 equipment where the new component must be an exact duplicate of the old one. The circumstances requiring this careful choice are generally connected with temperature compensation and detailed guidance is given in the following sub-sections.

B46. Separate Local Oscillator

8. In this receiver the components in the separate beat frequency oscillator are chosen with extreme care. The long term stability is better than 10 parts in a million per degree Centigrade and this high degree of stability is only achieved by specially compensating each oscillator during manufacture. In the frequency range 3·3 - 15 Mc/s the compensating capacitors are C115 - C124. Only four of these capacitors will be in circuit in a particular oscillator, though the complete set may be present. On the 1·4 - 3.3 Mc/s frequency range compensation is secured by the choice of either C134 or C135. Thus any interference with the capacitors or change in type even though the value is the same, will result in the good temperature-frequency characteristic of the oscillator being lost.

Because of the individual compensation of the oscillators it would be wrong to assume an error if the wiring of two units did not agree.

L116, C108, C107, C114 and C129 are for trimming the calibrated oscillator scale to a frequency standard during manufacture. If the adjustments are disturbed there may be considerable difficulty in regaining the correct positions.

B46. Crystal Calibrator

9. The tuned circuit of the crystal calibrator contains the variable capacitor C101 and the adjustment of this should not be changed. It is set to tune the circuit to 80% of the maximum grid current and this figure is the highest which can be permitted for the circuit to remain stable under conditions of varying electrode voltages on the valve.

B46. Input Circuits

10. These circuits have all been carefully trimmed during manufacture and the settings should not be disturbed. The band-pass filters have capacitance and inductance trimmers to enable the correct L:C ratio to be obtained exactly at two points in each frequency band and by aiding the ganging of the oscillator and signal circuits, secure good calibration accuracy. It will be seen that

10. (Contd.)
disturbance of the trimmers will not only spoil the calibration of the scales but may be very difficult to correct without the proper technique.

In connection with the couplings it should be pointed out that L10 is actually a piece of 16 gauge tinned copper wire, $\frac{3}{4}$ inch long.

B46. C.W. Oscillator

11. This circuit is temperature compensated by the correct choice of silvered mica and ceramic capacitors which should of course not be changed in value or type.

B46. D.C. Power Unit

12. If replacements are necessary in this unit, care should be taken to retain the same wiring runs.

B47. Local Oscillator

13. The oscillator is compensated at both ends of each frequency band for temperature variations. For example, on band 4, at 550 kc/s, C52, which has a negative capacitance-temperature coefficient which just compensates for the positive inductance-temperature coefficient of L4. At 220 kc/s a combination of C39 - C42 secures compensation, while at intermediate points in the band the error is quite small. Therefore any change in the type of capacitor used will produce a frequency drift with temperature at only one part of a band.

B47. Output Circuit

14. The capacitor shunting the primary winding of transformer should be kept at approximately its specified value since its function is to by-pass any second harmonic of the intermediate frequency and to prevent self-oscillation in the transformer winding at the higher audio frequencies.

B47. D.C. Power Unit

15. If replacements are necessary in this unit care should be taken to retain the same wiring runs.

Transmitter Unit

16. In general, all transmitter components should be replaced with the proper types but two circuits need special care.

(1) The capacitors in the master oscillator tuned circuit e.g. C2, C6 should only be replaced with exact duplicate of any which may be removed.

(2) C43 in the crystal calibrator must also be replaced with an exact duplicate.

REALIGNMENT DATA

IMPORTANT NOTE - NO ATTEMPT TO REALIGN ANY PART OF THE TYPE 612 EQUIPMENT SHOULD BE MADE UNLESS THE PROPER TEST APPARATUS IS AVAILABLE.

Apparatus Required

17. (Suitable types are given in brackets).

1 R.F. Signal Generator capable of delivering signals of 465 kc/s ± 20 c/s and 35 kc/s ± 20 c/s, with internal modulation at 400 c/s and with a peak output of at least 1½ volts. (Marconi Type T.F. 144G or F).

1 Output Power Meter with an impedance of 600 ohms. (Marconi Type 340).

1 Valve voltmeter with ranges down to 100 /uV. (Marconi Type T.F. 428B).

1 Microammeter: range 0-500. 1 Microammeter: range 0-25.

1 Multi-Range Test Set ("Avometer" Model 40 or 7 or "Weston" Model 722).

1 A.F. Oscillator. Range: 0-10,000 c/s.
Output Volts: 25 into 600 ohms. (Marconi T.F. 195L).

2 24 watt 12 volt metal filament lamps.

4 Special tools for adjusting and locking inductor and capacitor trimmers. These will be found inside the receivers. (Figs. 7 and 20).

B46. Pin Voltages

18.

Valve	Anode Voltage	Suppressor Grid Voltage	Screen Grid Voltage	Cathode-to-earth Voltage	Heater Voltage
V1	-	-	-	1.6 - 1.8	6
V2	115	-	65	1.6 - 1.8	6
V3	Hex. 130 Osc. 55	50	50	0.8	6
V100	55	0	55	0	6
V201	120	0.8	60	0.8	6
V202	125	1	60	1	6
V203	83	-	-	20	6
V204	-	-	-	2.2	6
V205	-	-	-	2.2	6
V206	125	-	125	9	6
V207	100	0	100	5	6

NOTE - The A.G.C. and cross-modulation control lines should be short circuited to the chassis before measuring pin voltages.

B46. Realignment of I.F. Stages (Fig. 8)

19. (1) Connect the output meter (600 ohms impedance) to the jack on the receiver marked LINE 600 ohms.

(2) Short circuit the A.G.C. and cross-modulation control lines to the chassis. Switch off the loudspeaker.

(3) Set the R.F. oscillator and signal frequency circuits for 1·4 Mc/s.

(4) Set the selectivity switch to BROAD.

(5) Connect the R.F. signal generator between the control grid of V202 and the chassis.

(6) Set the generator to 465 kc/s ± 20 c/s.

(7) Inject a signal sufficient to give about 25 mW output. This will require an input of about 40 mV.

(8) Adjust C227 and C234 to give maximum deflection on the output meter. Do not retrim C234 after adjusting C227.

(9) Disconnect the signal generator from V202 and connect it between the control grid of V201 and chassis.

(10) Retain the same frequency (465 kc/s) and inject a signal sufficient to give an output of 25 mW. This will require an input of about 700 /uV.

(11) Adjust C218 and C223 for maximum deflection on the output meter. Do not retrim C223 after adjusting C218.

(12) Next connect the signal generator to the control grid of the hexode portion of the frequency changer V2.

(13) Set the selectivity switch to NARROW.

(14) Retain the same frequency (465 kc/s) and inject a signal sufficient to give about 25 mW output. This will now require an input of only about 60 /uV.

(15) Adjust C210 and C204 for maximum deflection on the output meter. Also adjust C29 in the R.F. Unit for the same condition.

(16) Reset the signal generator to the frequency of 461 kc/s i.e., 4 kc/s below the intermediate frequency.

(17) Adjust C203 to give <u>minimum</u> deflection on the output meter.

(18) Reset the signal generator to the frequency of 465 kc/s and the selectivity switch to BROAD.

(19) Readjust C210 to give maximum deflection on the output meter.

(20) Adjust C212 to give maximum deflection on the output meter.

(21) Disconnect the A.G.C. and cross-modulation control lines from the chassis.

B46. Realigning the R.F. Oscillator

20. (1) The R.F. Oscillator can only be aligned if the I.F. and C.W. Oscillator stages are correctly aligned.

(2) Short circuit the A.G.C. line to the chassis.

(3) Turn the ANTI CROSS-MOD. control fully clockwise.

(4) Set the "Service" switch to TUNE and the selectivity switch to the BROAD position.

(5) Set the OSCILLATOR TUNE (FINE) control to its mid position, i.e. with the white dot on the knob uppermost.

(6) Plug a pair of telephones into the appropriate output jack.

(7) Connect the R.F. signal generator between the control grid of the hexode portion of the frequency changer V3 and the chassis. Adjust the generator to 3·3 Mc/s, with modulation at 400 c/s to a depth of 30%.

(8) Adjust the OSCILLATOR TUNE (COARSE) control for 3·3 Mc/s.

(9) Switch on the receiver and adjust C108 to zero beat position. If zero beat cannot be obtained, re-adjust C108 to about MID position and adjust for Zero beat position with C107 and C114, which are in parallel with C108.

It will be necessary to remove the can to obtain access to C107 and C114. Unscrew V101 top cap lead plug from side of can, before removing can. (See Vol. 2, Figs. 5 and 6).

After replacing can, re-trim with C108.

(10) Reset the signal generator and OSCILLATOR TUNE (COARSE) controls for 15 Mc/s.

(11) Adjust the dust core of L116, after carefully loosening the bakelite nut, until zero beat in the telephones is again reached.

(12) Repeat the adjustment of C108 on 3·3 Mc/s and return to the adjustment of L116 on 15 Mc/s until C108 and L116 are both correctly adjusted.

(13) Tune the R.F. oscillator and signal generator to 1·4 Mc/s.

(14) Adjust C129 until zero beat is reached in the telephones.

(15) The "tracking" of the R.F. oscillator should now be correct at all points of the scale on all frequency bands. Relock the dust core of L116 with the bakelite nut.

(16) Disconnect the A.G.C. line from the chassis.

B46. Realigning the C.W. Oscillator (Fig. 12)

21. (1) Set the C.W. NOTE control so that the white dot on the control knob is uppermost. This corresponds to the capacitor being in its mid mechanical position.

21. (Contd.)
(2) Move the R/T -C.W. switch to C.W. and set the selectivity switch to its mid position.

(3) Connect the R.F. signal generator between the control grid of the frequency changer V3 and the chassis.

(4) Adjust the generator to give an unmodulated signal of 465 kc/s frequency.

(5) Switch on the receiver and adjust C240 in the C.W. oscillator until zero beat is produced in the loudspeaker or telephones.

B46. Realigning the Signal Frequency Circuits (Fig. 7)

22. (1) The signal frequency circuits can only be aligned if the R.F. oscillator, C.W. oscillator and I.F. stages are all correctly aligned.

(2) Connect the A.G.C. line and the aerial terminal AE.3 to the chassis.

(3) Link the "earthy" side of an R.F. signal generator to the chassis of the receiver and connect the other terminal of the generator to aerial terminal AE.1 via a 60 ohm carbon or ceramic resistor.

(4) Strap together the chassis of the receiver and generator using thick copper strip.

(5) Turn the ANTI CROSS-MOD. control fully clockwise.

(6) Set the selectivity switch to NARROW and switch on the C.W. oscillator.

(7) Set the signal generator, the OSCILLATOR TUNE (COARSE) and R.F. TUNE controls each for 15 Mc/s the OSCILLATOR TUNE (FINE) control being in the mid position, i.e. with the white dot on the knob uppermost.

(8) Adjust C3, C14 and the aerial trimming capacitor for maximum output in the loudspeaker. For this purpose it may be necessary to vary the C.W. note to obtain the optimum frequency for the audio output but if care is taken in the aligning process, no difficulty will be experienced in obtaining a definite peak in the output as the capacitors are varied. If the conditions are correct there will be two positions; 180 degrees apart, where each capacitor will give maximum response.

(9) Having adjusted C3, C14 and the aerial trimmer for maximum output in the loudspeaker, reset the signal generator and the receiver tuning controls for 7·2 Mc/s.

(10) Loosen the bakelite nuts locking the dust cores of L1, L2 and L3 and adjust the cores for maximum output in the loudspeaker.

(11) Reset the receiver and generator for 15 Mc/s and readjust C3, C14 and the aerial trimmer for maximum output in the loudspeaker and then re-check the inductor core positions for maximum output at 7·2 Mc/s. It will be found advisable to rock slightly the ganged capacitor on either side of the alignment frequency to obtain optimum results.

(12) Lock the dust cores of the inductors with the bakelite nuts and note that this does not cause the output to decrease, thereby indicating that the circuits are being put out of tune. Do not varnish the bakelite nuts.

22. (Contd.)
(13) Connect the signal generator to the aerial terminal AE.2 and chassis, interposing a 100 pF capacitor instead of the 60 ohm resistor between the generator and the aerial terminal.

(14) Set the generator and receiver controls for 15 Mc/s and verify that maximum output can still be obtained within the range of the aerial trimming capacitor. If it cannot, the above aligning process has not been correctly carried out.

(15) Repeat (7) - (12) inclusive except that the high and low frequencies should be 7·3 and 3·3 Mc/s respectively. In this case the three relevant capacitors will be C5, C15 and the aerial trimmer, whilst the three inductors will be L4, L5 and L6.

(16) Repeat (7) - (12) inclusive except that the high and low frequencies should be 3·4 and 1·4 Mc/s respectively. In this case the three relevant capacitors will be C7, C16 and the aerial trimmer, whilst the three inductors will be L7, L8 and L9.

(17) Disconnect the A.G.C. line from the chassis.

B46. Checking the Diode Limiter (V1)

23. (1) This check cannot be made unless the signal circuits are correctly aligned.

(2) Remove the short circuiting wire across the test point X1 in the cathode circuit of V1 and connect in its place a microammeter, range 0 - 250.

(3) Turn the ANTI CROSS-MOD. control fully clockwise.

(4) Connect the R.F. signal generator between aerial terminals AE.1 and AE.3 via a 600 ohm carbon or ceramic resistor.

(5) Adjust the generator to 15 Mc/s and to deliver an unmodulated output of 1 volt. The receiver should also be tuned to the same frequency.

(6) The microammeter should indicate a minimum current of 100 microamps.

(7) If the current specified in (6) cannot be obtained the diode is defective, assuming its heater voltage to be correct.

(8) Replace the short-circuiting link across the test point when the meter is removed at the conclusion of the test.

B46. Adjusting the Crystal Calibrator (Fig. 6)

14. (1) Set the "Service" switch to CAL.

(2) Connect a microammeter across R101 in the control grid circuit of V100 and adjust C101 until 100 microamps is indicated on the meter.

(3) Tune the signal-frequency and R.F. oscillator circuits of the receiver to 15 Mc/s; connect an output meter having an impedance of 600 ohms across the output jack marked LINE 600 ohms.

24. (Contd.)

(4) Switch on the C.W. oscillator and verify that the calibrator is delivering an output of at least 2 mW. This figure will increase rapidly as the receiver is tuned to frequencies lower than 15 Mc/s.

(5) If the minimum conditions specified in (2) and (3) cannot be fulfilled, V100 the crystal or some other component in the calibrator circuit is defective or possibly the H.T. supply is incorrect.

(6) Switch the receiver to C.W. and verify that beat notes, spaced 100 kc/s apart, are produced over all three frequency bands. For this check the ANTI CROSS-MOD. control may be used where the sensitivity of the receiver is high.

B47. Pin Voltages

25.

Valve	Anode Voltage	Suppressor Grid Voltage	Screen Grid Voltage	Cathode-to-earth Voltage	Heater Voltage
V1	-	-	-	6	6
V2	125	1	42	1·2 - 5·5	6
V3	Hex. 127 Osc. 110	-	55.	1·5	6
V101	122	1	45	1	6
V102	122	1	40	1	6
V103	75	-	-	20	6
V104	0	-	-	0.5	6
V105	120	-	130	9	6
V106	30	0	30	0	6

B47. Realignment of I.F. Stages (Fig. 21)

26. (1) Connect an output meter having an impedance of 600 ohms to the jack on the receiver marked LINE 600 ohms.

(2) Short circuit the A.G.C. and cross modulation control lines to the chassis. Switch off the loudspeaker.

(3) Connect an R.F. signal generator between the control grid of V102 and the chassis. Tune the receiver to 500 kc/s.

(4) Set the signal generator to 35 kc/s ± 20.c/s.

(5) Inject a signal sufficient to give about 25 mW output. This will require an input of about 0·6 volt.

26. (Contd.)

(6) Adjust the dust core of L136 after first loosening the bakelite nut, for maximum output on the meter. Retighten the locking nut.

(7) Next adjust the core of L135 in a similar manner and lock when adjusted.

(8) Reconnect the signal generator between the control grid of V101 and the chassis. Retain the same frequency (35 kc/s) and inject a signal sufficient to give about 25 mW output. This will now require an input of only about 2,000 /uV.

(9) Readjust the core of L134 for maximum output, afterwards tightening the locking nut.

(10) Repeat (9) for the core of L133.

(11) Reconnect the signal generator between the control grid of the frequency changer V3 and the chassis.

(12) Inject a signal of 35 kc/s to give again an output of 25 mW. This will now only require an input of about 700 /uV.

(13) Readjust the core of L132 for maximum output, afterwards tightening the locking nut.

(14) Repeat (13) for the core of L18 on the R.F. Unit.

(15) Recheck that all the bakelite locking nuts are tight.

(16) Disconnect the A.G.C. and cross-modulation control lines from the chassis.

B47. Realigning the R.F. Oscillator (Fig. 20)

27. (1) The R.F. Oscillator can only be aligned if the I.F. and C.W. oscillator stages are correctly aligned.

(2) Short circuit the A.G.C. line to the chassis and switch the note filter into circuit.

(3) Turn the ANTI CROSS-MOD. control fully clockwise.

(4) Plug a pair of telephones into the appropriate output jack.

(5) Connect the R.F. signal generator between the control grid of the hexode portion of the frequency changer V3 and the chassis. Adjust the generator to 500 kc/s, with modulation at 400 c/s to a depth of 30%.

(6) Set the receiver tuning dial to 500 kc/s and adjust C53 for zero beat in the telephones.

(7) Change the testing frequency of both the receiver and the signal generator to 220 kc/s in Band 4 and adjust the dust core of L4 for zero beat.

(8) Retune the generator and receiver to the same frequency in Band 3 and adjust C55 for zero beat.

(9) Next tune the generator and receiver to 90 kc/s in Band 3 and adjust the core of L8 for zero beat.

27. (Contd.)
(10) Tune the receiver and generator to the same frequency in Band 2 and adjust C57 and C61 for zero beat.

(11) Change to 40 kc/s in Band 2 and adjust the core of L12 for zero beat in the telephones.

(12) Switch to Band 1 and set the receiver and signal generator for 27 kc/s and adjust C59 and C60 for zero beat.

(13) Retune next to 15 kc/s and adjust the core of L14 for zero beat.

(14) Carefully lock all the dust cores with the bakelite nuts.

(15) Disconnect the A.G.C. line from the chassis.

B47. Realigning the Signal Frequency Circuits (Figs. 20, 24)

28. (1) The signal frequency circuits can only be aligned if the receiver R.F. oscillator, C.W. oscillator and I.F. stages are all correctly aligned.

(2) Connect the A.G.C. line and the aerial terminal AE.3 to the chassis.

(3) Link the "earthy" side of the R.F. signal generator to the chassis of the receiver and connect the other terminal of the generator to aerial terminal AE.1 via a 60 ohm carbon or ceramic resistor.

(4) Turn the ANTI CROSS-MOD control fully clockwise.

(5) Switch on the C.W. Oscillator.

(6) Set the signal generator and the receiver tuning control to 500 kc/s.

(7) Adjust C3, C18 and the aerial trimmer for maximum output in the loudspeaker.

(8) Retune the signal generator and the receiver for the 220 kc/s in Band 4 and adjust the dust cores of L2 and L3 for maximum output in the loudspeaker.

(9) Reset the receiver and generator for the same frequency in Band 3 and adjust C2 and C4 for maximum loudspeaker output.

(10) Change the frequency to 90 kc/s in the same band and adjust the cores of L5, L6 and L7 for maximum loudspeaker output.

(11) Next retune the receiver and signal generator for 90 kc/s in Band 2 and adjust C17, C22, C26 and the aerial trimmer for maximum loudspeaker output.

(12) Retune to the frequency of 40 kc/s and adjust the cores of L9, L10 and L11 for the same condition.

(13) Lastly change the test frequency to 27 kc/s and adjust C24 and C25 for the best output. If the loudspeaker output rises too much during alignment, reduce it by means of the A.F. volume control. The ANTI CROSS-MOD. control must be left in the fully clockwise position during the whole of the alignment procedure.

28. (Contd.)
(14) Connect the signal generator to the aerial terminal AE.2 and chassis interposing a 100 pF capacitor between the generator and the aerial terminal.

(15) Set the generator and receiver controls for 500 kc/s and verify that maximum output can still be obtained within the range of the aerial trimming capacitor. If it cannot, the above aligning process has not been correctly carried out.

(16) Disconnect the A.G.C. line from the chassis.

B47. Checking the Diode Limiter (V1)

29. (1) This check cannot be made unless the signal circuits are correctly aligned.

(2) Insert a microammeter, range 0 - 50, between the cathode of V1 and the junction of R16 and R17.

(3) Turn the ANTI CROSS-MOD. control fully clockwise.

(4) Connect the R.F. signal generator between aerial terminal AE.1 and the chassis via a 100 pF capacitor.

(5) Adjust the generator to 500 kc/s and to deliver an unmodulated output of 1 volt. The receiver should also be tuned to the same frequency.

(6) The microammeter should indicate at least 10 microamps.

(7) If the current specified in (6) cannot be obtained the diode is defective, assuming its heater voltage to be correct.

(8) Short circuit the test point where the microammeter was connected.

5AH. Pin Voltages

30.

Valve	Anode Voltage	Screen Grid Voltage	Suppressor Grid Voltage	Cathode-to-earth Voltage	Heater Voltage
V1					
V2					
V3					
V4					
V5					
V6					

Modulator Unit. Pin Voltages

31.

Valve	Anode Voltage	Screen Grid Voltage	Cathode-to-earth Voltage	Heater Voltage
V3	116	-	1·95	6
V4	210 70% mod. 226 zero mod.		5·9 70% mod. 6.3 zero mod.	6
V5	347 70% mod. 353 zero mod.	287 70% mod. 310 zero mod.	10 70% mod. 5 zero mod.	6
V6	347 70% mod. 353 zero mod.	287 70% mod. 310 zero mod.	10 70% mod. 5 zero mod.	6

A.C. Power Unit. Pin Voltages

32.

Valve	Anode Voltage	Heater Voltage
V1	High 580 - 0 - 580 Low 450 - 0 - 450	5
V2	High 580 - 0 - 580 Low 450 - 0 - 450	5

5AH. Realigning the Amplifier Stage (Fig. 39)

33. (1) The Amplifier stage of the transmitter can only be realigned if the 5AH is operated when it is withdrawn from its case. This will necessitate special operation of the safety switch and extreme care to guard against accidental contact with high voltage parts.

(2) Set up the 5AH and Modulator Unit for M.C.W. operation and with the "Service" switch at the M. Osc. position.

(3) Set the meter switch to position (grid current) and the frequency band switch to Band 1.

(4) Disconnect the 5AH from the Aerial Tuning Unit (if it is connected to the latter).

(5) Switch on and allow the set 15 minutes to warm up.

(6) Turn the TUNING CONTROL to the extreme low frequency end of Band 3 (about 6·0 Mc/s.) When the mechanical stop is reached adjust C27 for maximum grid current.

33. (Contd.)

(7) Tune to the extreme high frequency end of the band (about 3·2 Mc/s) and again adjust for maximum grid current by varying the dust core of L13.

(8) Repeat (6) on Band 2, but adjusting C29 at the low frequency end of the band.

(9) Repeat (7) on Band 2, but adjusting the core of L14 at the high frequency end of the band.

(10) Repeat (6) on Band 3, but adjusting C31A and C31B at the low frequency end of the band. On Band 3 the capacitor tuning is very flat.

(11) Repeat (7) on Band 3, but adjusting the core of L15 at the high frequency end of the band.

(12) Switch off and connect between the output terminal and the chassis, two, 24-volt, 12 watt lamps in series.

(13) Switch on and tune through each band, retrimming the output stage occasionally by means of the front panel control marked AMP. TRIMMER. The lamps should light fairly brightly at a frequency of 1·5 Mc/s and should become dimmer as 13 Mc/s is approached. The grid current should also decline in the same way.

(14) If there are any sudden decreases or irregularities in the lamp brilliance or grid current the probable causes are:-

(i) Incorrect alignment as detailed in (6) - (11) inclusive, or

(ii) bad electrical contact between moving and fixed parts.

(15) The minimum value of grid current in each band should be:-

Band 1	2 mA
" 2	2 mA
" 3	1 mA

If the minimum figure cannot be obtained on any band it is likely that a valve in the master oscillator stages is defective but if the grid current is low on only one band, defective alignment is probably the cause.

5AH. Realigning the Master Oscillator (Fig. 39)

34. (1) The master oscillator stage of the transmitter can only be realigned if the unit is withdrawn from its own case.

(2) Set up the 5AH and Modulator Unit for M.C.W. operation and with the "Service" switch at the M. OSC. position.

(3) Switch on the crystal calibrator and plug a pair of telephones into the jack under the meter on the 5AH.

(4) Set the master oscillator trimmer on the front panel to its mid position, i.e. with the white spot on the knob uppermost.

34. (Contd.)

(5) Set the transmitter TUNING CONTROL to 6 Mc/s on Band 3 and adjust C4 for zero beat in the telephones.

(6) Retune the transmitter to 13 Mc/s and adjust L11 to give zero beat.

(7) Retune to 3·0 Mc/s on Band 2 and adjust C5 to give zero beat.

(8) Reset the transmitter to 6·5 Mc/s on Band 2 and verify that zero beat can be obtained in the telephones by varying the trimmer capacitor on the front panel.

(9) Retune to Band 1, at 1·5 and 3·0 Mc/s and check that zero beat can be obtained by varying C55.

FAULT LOCATION TABLE. TRANSMITTING UNITS

35. It is obviously impossible to list every possible fault in the transmitting units but the following table is intended to suggest some of the more likely ones:-

Symptom	Possible Cause	Remarks
"Standby" lamp does not light when the equipment is switched to "Standby".	(i) Lamp defective. (ii) Fuses blown in the Modulator Unit or A.C. Power Unit, or possibly the mains supply has failed. (iii) Battery is so far discharged that the control relays will not operate. The border line is about 16 volts. (iv) RL3 is defective. Dirty contact in the lamp circuit.	
All valves fail to heat.	(i) RL3 is defective. (ii) Filament open circuited. (iii) Dirty contacts on S6.	
Valves in 5AH fail.	(i) Inter-unit connections defective.	

35. (Contd.)

Symptom	Possible Cause	Remarks
Dynamotor will not start when the "Ready" key is operated.	(i) RL5 defective. (ii) RL4 defective. (iii) Dirty contacts on S5.	
"Ready" lamp fails to light.	RL4 has dirty contact.	
Aerial ammeter not indicating.	(i) Aerial grounded. (ii) Aerial ammeter burnt out. (iii) A.T.U. not properly tuned. (iv) Inter-unit connections defective.	If the aerial is correct disconnect the A.T.U. and clip two 12V 24 watt lamps (wired in series) between the 5AH Output socket and the case. This will prove whether the fault is external to the 5AH. If the lamps light brightly the fault is in the A.T.U. or the aerial. Check over both carefully.
No transmission though all meter indications are normal.	(i) A.T.U. switched to "Dummy Load". (ii) RL1 in the A.T.U. not operating. (iii) Aerial "Changeover" cable disconnected.	
Low output from the A.T.U. on all services. 5AH normal.	(i) Incorrectly tuned A.T.U. (ii) Aerial damaged i.e. partially grounded or shortened. (iii) Component in the A.T.U. has broken down. (iv) Meter defective.	Have sliders jumped from coils?

35. (Contd.)

Symptom	Possible Cause	Remarks
	(v) Bandswitch in the A.T.U. not set correctly relative to the bandswitch in the 5AH.	A dangerous condition since excessive currents may damage the meters in the A.T.U.
No output from 5AH on any service (as shown by lamps connected between R.F. output socket and case failing to light.)	(i) Moving contacts on L3 or L4 have "jumped". (ii) Defective valve(s). (iii) Relay(s) defective. (iv) Component broken down. (v) Master oscillator has stopped oscillating.	Check: S7, all voltages, contacts of L2, waveband switch.
No output from Modulator Unit on M.C.W.	(i) Modulator V3 has failed (absence of "tone"). (ii) V4, V5 or V6 defective.	If only one of the V5, V6 pair is working the transmitter will not be fully modulated.
	S3 and S6 on the Modulator Unit are not BOTH in the correct positions.	
No output from Modulator Unit on R/T	(i) Modulator V4, V5, or V6 are defective. (ii) Modulation transformer (T6) has failed. (iii) S3 and S6 on the Modulator Unit are not BOTH in the correct positions.	If V5 or V6 alone is working in the modulator output stage speech will be distorted.

35. (Contd.)

Symptom	Possible Cause	Remarks
No sidetone on M.C.W. and R/T. No sidetone on C.W.	V6 (or its associated components) in the 5AH is defective. V6 in the 5AH or V3 in the Modulator Unit is defective.	
Low output from the 5AH on all services.	(i) Battery is partially discharged. The point where the output will begin to fall off badly is about 21 volts.	
	(ii) Output circuit trimmer not properly adjusted.	
	(iii) V2 or V3 in the 5AH is defective.	
	(iv) One member of the pair L8 - L9 or C10A - C10B is open circuited.	Not a very likely fault.
	(v) Ganging of the tuned circuits has drifted.	Not a very likely fault.
Output frequency is variable or slowly drifts.	(i) One member of a combination such as C2 - C4 or C5 - C7 has a defective soldered joint.	
	(ii) X1 is not operating.	This will produce a gradual change of frequency with temperature.

APPENDICES

★

DETAILS OF COMPONENTS USED AND SPARES

APPENDIX 1

RECEIVER B46

A.P. 58674 - D.C.Supply
A.P. 65873 - A.C.Supply

CAPACITORS

Code	Value	Tol. ± %	D.C.	A.P.
C1/2	266 pF	-	-	52920
C3	2·5 - 24 pF	-	-	60467
C4	15 pF	10	500	Z132073
C5	2·5 - 24 pF			60467
C6	15 pF	10	500	Z132073
C7	2·5 - 24 pF			60467
C10	0·01 µF	25	350	W4185
C11	100 pF	10	350	51059
C12/13	0·01 µF	25	350	W4185
C14	2·5 - 24 pF			60467
C15/16	2·5 - 24 pF			60467
C18	0·01 µF	25	350	W4185
C19	266 pF			52920
C20	100 pF	10	350	51059
C21/27	0·01 µF	25	350	W4185
C28	5·6 pF	0·5	500	Z132267
C29	2·5 - 24 pF			60467
C30	68 pF	2	350	51055
C100	33 pF	5	750	50145
C101	2·5 - 24 pF			60467
C102	0·01 µF	25	350	W4185
C103/4	680 pF	10	350	51088
C105/6	82 pF	5	350	51057
C107	2·5 - 24 pF	-	-	60467
C108	3·5 - 25 pF	-	-	W4864
C110	180 pF	2	350	51070
C111	100 pF	2	350	51061
C112	22 pF	5	500	51039
C113	50 pF			W6868
C114	2·5 - 24 pF			60467
C115	82 pF	1	500	52858
C116	39 pF	2	350	51037
C117	100 pF	2	350	51061
C118	82 pF	2	350	51058
C119	39 pF	5	350	51037
C120	22 pF	5	350	51039
C121	100 pF	1	500	52860
C122	82 pF	1	500	52858
C123	39 pF	5	750	52855
C124	22 pF	5	750	Z132276
C125	470 pF	2	350	51082
C126	390 pF	2	350	51046
C127	100 pF	2	350	51061

APPENDIX 1

CAPACITORS (Contd.)

Code	Value	Tol. ± %	D.C.	A.P.
C128	150 pF	1	500	52861
C129	6-100 pF			W4866
C131	470 pF	2	350	51082
C132	390 pF	2	350	51046
C133	100 pF	2	350	51061
C134	150 pF	1	500	52861
C135	150 pF	2	350	51067
C201/2	0·005 µF	25	500	Z115524
C203	0·5-8 pF			60497
C204	2·5-24 pF			60467
C206	68 pF	2	350	51055
C207	22 pF	10	500	52918
C208	68 pF	2	350	51055
C209	22 pF	10	500	52918
C210	2.5 - 24 pF			60467
C212	2·5-24 pF			60467
C213/6	0·1 µF	25	150	52253
C218	2·5-24 pF			60467
C219	68 pF	2	350	51055
C220	22 pF	10	500	52918
C221	68 pF	2	350	51055
C222	22 pF	10	500	52918
C223	2·5-24 pF			60467
C225	0·1 µF	25	150	52253
C226	0·1 µF	25	250	Z116287
C227	2·5-24 pF			60467
C228	68 pF	2	350	51055
C229	22 pF	10	500	52918
C230	82 pF	2	350	51058
C231	0·1 µF	25	250	Z116287
C232	68 pF	2	350	51055
C233	22 pF	10	500	52918
C234	2·5-24 pF			60467
C235	0·1 µF	25	150	52253
C236	1·0 µF	25	150	Z116295
C239	2·7-29 pF			52846
C240	2·5-24 pF			60467
C241	82 pF	2	350	51058
C242	10 pF	0·5	500	Z132252
C243	0·001 µF	10	350	51200
C245	0·01 µF	25	250	Z115552
C246	220 pF	10	350	51071
C247	0·1 µF	25	250	Z116287
C248	0·1 µF	25	150	52253
C251	0·1 µF	25	250	Z116287
C252/3	0·01 µF	10	350	W4185
C254	0·1 µF	25	250	Z116287
C255	0·01 µF	10	350	W4185
C256	0·002 µF	25	500	Z115551
C257	0·01 µF	25	350	Z115552
C258/9	1·0 µF	25	150	Z116295
C260	0·01 µF	25	350	Z115552

CAPACITORS (Contd.)

Code	Value	Tol.± %	.D.C.	A.P.
C261	0·01 /uF	10	350	W4185
C401	3·8-50 pF			60350
C402	0·1 /uF	25	150	52253

RESISTORS

Code	Value	Tol.± %	Wattage	A.P.
R1	470,000	10	0·25	W9013
R2	220	10	0·5	W1551A
R3/4	47,000	10	0·5	W5165
R5	1 Meg.	10	0·25	W9019
R6	4,700	10	0·5	W2639A
R7	470,000	10	0·25	W9013
R8	47,000	10	0·5	W5165
R9	50,000	30	0·1	32908
R10	150	5		60547
R11	100	10	0·25	W8947
R12	47,000	10	0·25	W6995
R13	220	10	0·25	W1551A
R15	150,000	10	0·5	W6820
R16	4,700	10	0·5	W2639A
R100	270,000	10	0·25	W9009
R101	2,700	10	0·25	W8973
R102	47,000	10	0·5	W5165
R103	22,000	10	0·5	W1584A
R104	200	10		-
R105	40	10		-
R107	22,000	10	0·5	W1584A
R109	120	5	3	60233
R201	150,000	10	0·5	W6820
R202	220	10	0·5	W1551A
R203	150,000	10	0·5	W6820
R204	4,700	10	0·5	W2639A
R205	100,000	10	0·5	W6225
R206	470	10	0·5	W4205A
R207	150,000	10	0·5	W6820
R208	4,700	10	0·5	W2639A
R209	680,000	10	0·5	W8266
R211	1 Meg.	10	0·5	W2644
R212	100,000	10	0·5	W6225
R213	10,000	10	0·5	W2641
R214	2,200	10	0·5	W5399
R215	47,000	10	0·5	W5165
R217	3,300	10	0·5	W8636A
R218/9	100,000	10	0·5	W6225
R220	100,000	30	0·1	60439
R221	15,000	10	0·5	W4816
R223	680,000	10	0·5	W8266
R224	470,000	10	0·5	W5904

APPENDIX 1

RESISTORS (Contd.)

Code	Value	Tol. ± %	Wattage	A.P.
R225	4,700	10	0·5	W2639A
R226	47,000	10	0·5	W5165
R228	470,000	10	0·5	W5904
R229	1,000	10	0·5	W2634
R230/1	4,700	10	0·5	W2639A
R232	120	5	3	60233
R401/2	5,000	30	0·1	60346
R403	220,000	5	0·5	Z223077
R404	47,000	5	0·5	W5165
R405	4,700	10	0·5	W2639A
R406	4,700	10	0·5	W2639A
R407	50	10	1·0	60459
R408	50	10	3·0	60409
R409	50	10	1·0	60459

CRYSTALS

Code	Maker's Code	Remarks	A.P.
XL1	2 Pin Crystal Unit	As required	-
XL2	" " " "	" "	-
XL103	S.T. & C. 4002	100 kc/s	60175
XL201	" 4015 Group 2	464 kc/s	-
XL202	" " " "	466 kc/s	-

SWITCHES

Code	Maker's Code	Remarks	A.P.
S1	S.T. & C. RL7016/110	3 pole 3 position	60415
S101	" RL7016/106		60398
S102	"		60397
S201	" RL SPEC 7016/112		-
S401			10F/10338
S402			"
S403			10F/1211
S404			10F/747

VALVES

Code	Maker's Code	Remarks	A.P.
V1	EA50	VR92	CV1092
V2	EF39	VR53	CV1053
V3	ECH35		CV1347
V100	EF39	VR53	CV1053
V101	EBC33	VR55	CV1055

VALVES (Contd.)

Code	Maker's Code	Remarks	A.P.
V102	EF39	VR53	CV1053
V202	EF39	VR53	CV1053
V203	EBC33	VR55	CV1055
V204/5	EA50	VR92	CV1092
V206	6V6GT		CV511
V207	EF50	VR91	CV1091

MISCELLANEOUS

Code	Maker's Code	Remarks	A.P.
T202	S.T. & C. BS 43138.1		65732
RL1	Siemen's H860		60221
JK401/2	Igranic P72		10H/694
LP401/2	G.E.C. OS1233	12V 3 watts	SL/278
LS401	Celestion P2.VA		57160
M401	RCL.230.11.M	0/1 mA	60347
W401	S.T. & C. 16A		W6355
8 in No.	Celestion valveholders	SP8/UA Interoctal	W2999
3 " "	Belling-Lee "		10H/1923
1 " "	Benjamin "	75/652	52382
1 " "	Crate carrying for B46/47		65847
All coils	S.T. & C.		-
-	B46 load complete	-	65956
-	Amplifier unit, R.F.		65674
-	Amplifier unit, I.F.		65675
-	Oscillator unit		65676
-	Front panel		65677

RECEIVER B47

A.P. 58675 - D.C. Supply
A.P. 65955 - A.C. Supply

CAPACITORS

Code	Value	Tol. ± %	D.C.	A.P.
C2	532 pF			60348
C3/4	2•5 - 24 pF			60467
C5	22 pF	5	500	Z132275
C6	2•5 - 24 pF			60467
C7	30 pF	5	500	Z132282
C8	10 pF	5	500	Z132252
C10	0•1 µF	25	150	52253
C11	82 pF	10	500	Z132298
C12	532 pF			60348
C13	0•01 µF	10	350	W4185
C14/15	0•5 µF	25	250	Z116293
C16	0•1 µF	25	150	52253
C17/18	2•5 - 24 pF			60467
C19	22 pF	5	500	Z132282
C20	2•5 - 24 pF			60467
C21	33 pF	5	500	51039
C22	2•5 - 24 pF			60467
C23	47 pF	5		Z132287
C24/26	2•5 - 24 pF			60467
C27	100 pF	2	350	51061
C28	0•5 µF	25	250	Z116293
C29	47 pF	5	500	Z132287
C30	532 pF			60348
C31	0•01 µF	25	350	W4185
C32	0•5 µF	25	250	Z116293
C33	33 pF	10	500	52854
C34	0•1 µF	25	150	52253
C35/36	0•01 µF	25	350	Z115552
C39/41	680 pF	2	350	51088
C42	470 pF	5	500	Z132322
C43	560 pF	2	350	51085
C44	330 pF	2	350	51079
C46	150 pF	5	500	Z132305
C47	560 pF	2	350	51085
C48	220 pF	5	500	Z132311
C49	220 pF	2	350	51073
C50	18 pF	5	500	Z132273
C51	56 pF	5	500	Z132291
C52	22 pF	5	500	51039
C53	2•5 - 24 pF			60467
C54	33 pF	5	500	Z132282
C55	2•5 - 24 pF			60467
C56	82 pF	1	500	52858
C57	2•5 - 24 pF			60467
C58	150 pF	2	350	51067
C59/61	2•5 - 24 pF			60467
C62	532 pF			60348

APPENDIX 1

CAPACITORS (Contd.)

Code	Value	Tol. ± %	D.C.	A.P.
C63	470 pF	2	350	51082
C64	330 pF	2	350	51079
C65	47 pF	5	500	Z132287
C66	0·5 µF	25	250	Z116293
C68	8·2 pF	10	500	Z132269
C101	0·005 µF	25	500	Z115524
C102	0·01 µF	25	350	W4185
C103	470 pF	2	350	51082
C104	330 pF	2	350	51079
C105	47 pF	5	500	52856
C107	0·1 µF	25	150	52253
C108	0·5 µF	25	250	Z116293
C109	470 pF	2	350	51082
C110	330 pF	2	350	51079
C111	47 pF	5	750	52856
C113	0·5 µF	25	250	Z116293
C114	470 pF	2	350	51082
C115	330 pF	2	350	51079
C116	47 pF	5	750	52856
C118	0·5 µF	25	250	Z116293
C119	470 pF	2	350	51082
C120	330 pF	2	350	51079
C121	47 pF	5	750	52856
C122	0·5 µF	25	250	Z116293
C123	1·0 µF	20	250	51395
C125	470 pF	2	350	51082
C126	330 pF	2	350	51079
C127	47 pF	5	750	52856
C128	560 pF	10	350	51083
C130	0·1 µF	25	150	52253
C131	5 -100 pF			60344
C132	470 pF	2	350	51082
C133	33 pF	± 0·5 pF	750	Z132282
C134	0·01 µF	10	350	41082
C136	1 µF	25	150	Z116295
C137	0·5 µF	25	250	Z116293
C138	560 pF	10	350	51083
C139	470 pF	2	350	51082
C140	330 pF	2	350	51079
C141	47 pF	5	750	52856
C143	0·1 µF	25	150	52253
C144	1·0 µF	20	250	51395
C146/7	0·01 µF	10	350	W8185
C148	0·1 µF	25	250	52253
C150	0·5 µF	25	250	Z116293
C151/2	0·01 µF	25	350	Z115552
C153	0·005 µF	25	500	Z115524
C154/5	0·01 µF	10	350	W4185
C301	5·5 - 100 pF			60465
C302	0·1 µF	25	150	52253

RESISTORS

Code	Value	Tol. ± %	Wattage	A.P.
R1	370,000	10	0·25	W9013
R2	470	10	0·5	W4205A
R3	100,000	10	0·5	W6225
R5	1 Meg	10	0·25	W9019
R6	4,700	10	0·5	W2639A
R7	470,000	10	0·25	W9013
R8	47,000	10	0·5	W5165
R9	220	10	0·5	W1551A
R11	100	10	0·25	W8947
R12	47,000	10	0·25	W8995
R13/14	4,700	10	0·5	W2639A
R16	10,000	10	0·5	W2641
R17	100,000	10	0·5	W6225
R18	100,000	10	0·25	W9001
R19	10,000	10	0·25	W8983
R101	100,000	10	0·5	W6225
R102	470	10	0·5	W4205A
R103	150,000	10	0·5	W6820
R104	4,700	10	0·5	W2639A
R106	470	10	0·5	W4205A
R107	150,000	10	0·5	W6820
R112	1 Meg	10	0·5	W2644
R113	680,000	10	0·5	W8266
R114	2,200	10	0·5	W5399
R115	47,000	10	0·5	W5165
R116	100,000	10	0·1	60439
R117/9	100,000	10	0·5	W6225
R120	680,000	10	0·25	W9016
R121	470,000	10	0·25	W9013
R123	47,000	10	0·5	W5165
R125	4,700	10	0·5	W2639A
R126	1,000	10	0·5	W2634
R127	470,000	10	0·5	W5904
R128	30	5	5	60445
R301	5,000	30	0·1	60346
R302	500,000	30	0·1	60438
R303	220,000	5	0·5	Z223077
R304	47,000	5	0·5	Z222212
R305/6	4,700	10	0·5	W2639A
R307	100	10	1	52913
R308	100	5	3	60409
R309	50	10	1	60459

SWITCHES

Code	Maker's Code	Remarks	A.P.
S1 S301/5	S.T. & C.		- 10F/10338

APPENDIX 1

VALVES

Code	Maker's Code	Remarks	A.P.
V1	EA50	VR92	CV1092
V2	EF39	VR53	CV1053
V3	ECH35		CV1347
V4		Neon Lamp	10E/285
V101/2	EF39	VR53	CV1053
V103/4	EBC33	VR55	CV1055
V105	6V6GT		CV511
V106	EF50	VR91	CV1091

MISCELLANEOUS

Code	Maker's Code	Remarks	A.P.
T102	S.T. & C. BS 43138.1		65732
JK301/2	Igranic P72		10H/694
LP301	G.E.C. OS1233	12V 3 watts	SL/278
LS301	Celestion P.2.VA		57160
M301		0/1 mA	C0347
W301	S.T. & C. B6A	1 mA	W6355
7 in No.	Celestion valveholders	SP8/US Inter-octal	W2999
1 in No.	Belling Lee valveholders		10H/1923
1 in No.	Benjamin "	75/775	52382
1 in No.	Crate carrying for B46/B47		65847
All coils	S.T. & C.		-
-	B47 load complete		65957
-	Amplifier Unit, R.F.		65678
-	Amplifier Unit, I.F.		65679
-	Front Panel		65680

D. C. POWER UNIT

FOR RECEIVERS B46-B47

A.P. 58426

CAPACITORS

Code	Value	Tol. ± %	D.C.W.	A.P.
C401/4	0·5 µF	25	150	Z116293
C405	2 µF	20	150	Z116298
C406/7	0·1 µF	20	250	Z116287
C408	0·5 µF	20	250	Z116293
C409	2 µF	20	250	Z116299
C410	4 µF	20	250	50828

MISCELLANEOUS

Code	Maker's Code	Remarks	A.P.
X1	S.T. & C.	Dynamotor	65747
F401	Belling-Lee 1055/3	3 A	55949
F402	" " 1055/250	250 mA	646
PL501	Painton P308 CCT		60412
S103/4	Walters		10F/1786
All coils	S.T. & C		

A. C. POWER UNIT

FOR RECEIVERS B46 - B47

A.P.65167

MISCELLANEOUS

Code	Maker's Code	Remarks	A.P.
C501/8	Hunt WN.101	2/uF ± 20% 250V D.C.	Z116299
F501	Belling-Lee 1055/1	1A	648
F502	" " 1055/150	150 mA	W180
F503	" "	5A	55949
PL501	Painton P309/CCT		60412
W501	S.T. & C.		60402
S501	Walters		10F/1786
T501	S.T. & C.	40VA Single Phase	65761
L501	"		65756

TRANSMITTER 5AH

A.P. 59517

RESISTORS

Code	Value	Tol. ±%	Wattage	A.P.
R1	20,000	5	3	52338
R2/3	100	10	¾	Z221111
R4/6	15,000	5	3	52203
R8	130	5	5	60431
R9	4,700	10	¾	W2639A
R10/11	50,000	5	5	50063
R13	60	-	-	-
R14	39	5	3	60425
R15	91	2	3	60509
R16	500	2	3	60511
R17	5000	5	3	60022
R20	47,000	10	¾	W5165
R22	1,000	2	3	60426
R23	20	2	3	60423
R24	1M	10	¾	W2644
R25	18,000	10	¾	W8801
R26	10,000	10	¾	W2641
R27	20,000	5	3	52338
R28	1,000	10	¾	W1558
R29/31	100	10	¾	Z221111
R32	200	5	3	52406
R33	1,000	2	3	60426
R34	100	10	¾	Z221111
R35	10	10	½	W3292
R36	68	10	2½	60555
R37	20	2	3	60423
R38/39	150	10	1	60433
R40/41	47	10	¾	Z221069

CAPACITORS

Code	Value	Tol. ±%	D.C.	A.P.
C1	400 pF	1	350	60601
C2A	111 pF	1	500	60583
C2B	5 pF	20	500	60579
C2C	10 pF	10	500	60580
C3A	80 pF	12·5	350	60603
C3B	10 pF	10	350	60580
C3C	5 pF	20	350	60579
C4	3-20 pF			66491

APPENDIX 1

CAPACITORS. (Contd.)

Code	Value	Tol. ± %	D.C.	A.P.
C5A/B	3-20 pF			66491
C6A	140 pF	1	350	60595
C6B	50 pF	2	500	60581
C6C/D	25 pF	4	500	60582
C7A	725 pF	1	350	60598
C7B	50 pF	2	350	60581
C7C	25 pF	4	350	60582
C8A/B	900 pF	1	350	
C10A/B	100 pF	+100-0	750	Z123203
C11A/B	·003/uF	+100-0	750	Z124248
C12/16	·01/uF	20	1000	Z115503
C17A/B	·01/uF	+100-0	750	Z124415
C18/19	·001/uF	+100-0	750	Z124075
C20/21	·01/uF	20	1000	Z115503
C22	·1/uF	20	1000	Z115508
C23	308 pF	2	500	60585
C24/25D	923 pF	2	500	60586
C27	3-20 pF			66491
C28	287 pF	2	500	60587
C29	3-20 pF			66491
C30A/B	600 pF	1	500	60588
C31A/B	3-20 pF			66491
C32	22 pF	5	2000	60589
C33	100 pF	2	1000	60591
C34A/B	159 pF	2	1000	60592
C35	318 pF	2	2000	60593
C36A/D	228 pF	2	2000	60594
C37	318 pF	2	2000	60593
C38	200 pF	15	350	W1431
C39	15-100 pF			66489
C40	27 pF	5	2000	60590
C41	2·2 pF	16	500	Z132250
C42	10 pF	20	4000	60578
C43	47 pF	5	500	Z132288
C44	·1/uF	20	1000	Z115508
C45	·1/uF	20	350	Z115506
C47	200 pF	20	350	Z123247
C49	·01/uF	20	1000	Z115503
C50	1/uF	25	75 at 85°C.	Z115322
C51A/B	3 pF	16	500	60584
C52	·01/uF	25	350	Z115552
C53/54	27 pF	5	500	Z132438
C55	2·3-5 pF			66490
C56	·1/uF	20	1000	Z115508
C57/59	·5/uF	25	75 at 85°C.	Z115262
C60/61	·01/uF	25	350	Z115552

VALVES AND HOLDERS

Code	Maker's Code	Remarks	A.P.
V1/3	S.T.C. 2B/250A	Similar to 807	CV124
	Celestion	5 pin	10H/3248
V4/5	Mullard EF50		CV1091
	Benjamin holders	9 pin	52382
V6	Mullard EA50		CV1092
	Belling Lee holder		10H/1923

RELAYS

Code	Maker's Code	Remarks	A.P.
RL1	S.T.C. 4665 MAJ/TFS	3 make 3 break	60357
RL2/3	Siemens H96C	H.S. 1 contact	60221
RL4	S.T.C. 4632 ABL/TFS	1 contact	60358

SWITCHES

Code	Maker's Code	Remarks	A.P.
S1/2	S.T.C. 112/4014B		66534
S3/4	S.T.C. 112/4014A		66533
S7	S.T.C.	D.P. 3 way	66488
S8	Walters 1290	D.P.push button	10F/1786
S9	Burgess		W4648
S10		D.P. On-Off	10F/747
S11	S.T.C.	D.P. 4 way	66487

MISCELLANEOUS

Code	Maker's Code	Remarks	A.P.
T1/2	S.T.C. B.S.43138/3		65838
T3	S.T.C. B.S.42138/1		65757
M1	Turner W909	0/5 mA D.C.	66035
SK1/2	Plessey CZ49219	3 pin	10H/19152
SK3	S.T.C. 50/4083/1		
PL1	Plessey CZ49061	25 pin	10H/19121

MISCELLANEOUS. (Contd.)

Code	Maker's Code	Remarks	A.P.
LP1/2		12V 3·6 watts	16204
X1	Sunvic RL7014-2	Thermostat	66492
XL1/2	S.T.C.	As required	-
XL3	S.T.C.	100 Kc/s	60176
Dryer	Silica gel		65599
JK1	Igranic P72		10H/694
2 in No.	Lampholders M.E.S. 27		7391
1 in No.	Crate carrying for 5AH		65845
-	Transmitter 5AH load complete		65959

MODULATOR UNIT

A.P. 65169

CAPACITORS

Code	Value (µF)	Tol. ± %	D.C.	A.P.
C1/8	2	25	75	Z115323
C9/10	0·1	20	750	Z115319
C11	1	25	750	Z112876
C12	0·25	20	250	Z115320
C13/16	0·5	20	350	Z115321
C17	·5	25	75	Z115262
C19	1	25	75	Z115322
C20	0·05	20	450	Z115297
C21	0·1	5	450	Z115318
C23	2	25	75	Z115323
C24	0·25	20	450	Z115302
C25	0·1	20	450	Z115299
C26	0·01	20	750 at 71°C	W2813
C27/28	0·01	20	1000	Z115295

RESISTORS

Code	Value (ohms)	Tol. ± %	Wattage	A.P.
R1	1,500	10	3/4	W1559
R2/3	100	10	3/4	W1572
R4	1,500	10	3/4	W1559
R5/6	100	10	3/4	W1572
R7/8	1,500	10	1/2	W5907
R9/10	470	5	3	52187
R11	1,200	5	1/2	60226
R12/13	390	5	1/2	W5545
R14	1,200	5	1/2	60226
R15/16	4,700	10	1/2	W2639A
R17	100,000	2	5	60537
R18	25	2	3	60538
R19/21	1,000	2	3	60426
R22	2,200	10	3/4	W3793
R23	100,000	10	3/4	W1587
R24	10,000	2	3	60539
R25	,000	10	3/4	W1558
R26	100,000	10	3/4	W1587
R27	20,000			66536
R28	3,900	5	5	60432
R29	10,000	5	3	52524
R30	6·8	5	5	60536
R31	10·5	5	5	60430
R32/33	270	5	5	60227
R34/35	22	10	3/4	W3241A
R36	27,000	10	3/4	W7236
R37/38	470	5	3	52187
R39	100	5	5	52738
R40	220	10	3/4	W3293A

RELAYS

Code	Maker's Code	Remarks	A.P.
RL1/2	G.E.C.		60354
RL3/4	S.T. & C. 4632PH		52660
RL5	" 4172E		60359

KEYS AND SWITCHES

Code	Maker's Code	Remarks	A.P.
S1	S.T. & C.		66487
S2	Burgess		W4648
S3	S.T. & C. 4152 F		60399
S4	" " G		60416
S5	" " D		60415
S6	"		-

PLUGS

Code	Maker's Code	Remarks	A.P.
PL1	Plessey CZ48992-2 way		10H/19068
PL3	S.T. & C. 16 way		-
PL4/5	" 13 way		-
PL6	" 6 way		-
PL7	" 13 way		-

SOCKETS

Code	Maker's Code	Remarks	A.P.
SK1	Plessey CZ49459 - 12 way		10H/19155
SK2	" CZ4922G - 25 "		10H/19157
SK3	S.T. & C. 16 way		-
SK4/5	" 13 way		-
SK6	" 6 way		-
SK7	" 13 way		-

VALVES

Code	Maker's Code	Remarks	A.P.
V3	Mullard EBC33	VR55	CV1055
V4	Brimor 6J5G		CV1932
V5/6	S.T.C. 5B/250A	Similar to 807	CV124

MISCELLANEOUS

Code	Maker's Code	Remarks	A.P.
X1	S.T. & C. Dynamotor	Rotary transformer	65996
JK1/4	Igranic P72		10H/694
JK5		7 pin	W6981
LP1/3	S.T. & C. 4004G	6V 0·24 W	9
Holders	" 4008B	Jack, Lamp, P010	55876A
M1	Turner W909	0/5 mA	66035
1 in No.	Crate carrying for Modr.		66036
All coils	and transformers ....S.T. & C.		-
F1	Belling Lee L1055/5	5A	55949
F2	" " " /3	3A	55948
F3	" " " /1	1A	W648
F4	" " " /3	3A	55948
F5	" " " /5	5A	55949
-	Modulator load, complete		65980

A. C. POWER UNIT

(FOR THE TRANSMITTER)

A.P. 66199

CAPACITORS

Code	Value (uF)	Tol. ± %	D.C.	A.P.
C1	8	-	900	Z112877
C2	12	-	200	Z112878
C3/6	0.02	20	350	W5032
C7	40.0	-	50	60634

FUSES

Code	Maker's Code	Remarks	A.P.
F6/7	Belling-Lee L1055/2	3A	55948
F8	" " L1055/5	5A	55949
F9	" " L1055/2	3A	55948
F10	" " L1055/1	1A	648
F11/12	" " L1055/5	5A	55949

RESISTORS

Code	Value	Tolerance	Wattage	A.P.
R1	470 ohms	5%	3	52187
R2A/D	68 K	"	5	60512

RELAYS

Code	Maker's Code	Remarks	A.P.
RL6/7	Seimens	200 ohms 2 contacts	60508
RL8	"	" " 4 "	60507
RL9	"	" " 2 "	60508

APPENDIX 1

MISCELLANEOUS

Code	Maker's Code	Remarks	A.P.
PL1	Plessey CZ49061	25 way	10H/19121
PL2	" CZ48994	4 way	10H/19084
SK1	" CZ49229	25 way	10H/19157
LP1	S.T. & C. 4004G		8097M
W1	"		50738
W2	"		60531
S1	Burgess C/GRS		4648
T1	S.T. & C.		65762
T2	"		65763
V1/2	5R4GY	Alternative 5U4G (CV575)	CV717
2 in No.	Valveholders Celestion		50055
L1	S.T. & C.	·8H at 300 mA 75 ohms	65764
L2	"	·45H at 1·2A 2·5 ohms	66528
L3/4	"	450/uH	-
LP1		Lampholder	55876

REMOTE CONTROL UNIT

A.P. 58409

RESISTORS

Code	Value (ohms)	Tol. ± %	Wattage	A.P.
R1/2	4,700	10	·25	W8977
R3	50	"	1	60459
R4/5	10,000	"	·25	W8983
R6/7	1,500	"	"	W8968
R8/9	100	"	"	W8947

MISCELLANEOUS

Code	Maker's Code	Remarks	A.P.
C1/6	Hunt 2uF ± 25% 250V		Z116299
JK1/4	Igranic P72		10H/694
LP1/3	S.T. & C. 4004C	6V 0.24 W	9
RL1/3	G.E.C. P.O. type 100+100		60354
T1	S.T. & C. BS 43138·2		65754
S1	" 41 52D	2 pole changeover	60415
S2	" 4152F	3 " " "	60399
LS1	Celestion P2VA		57160
Lamp Holders	S.T. & C. 4008B	Jack Lamp P.O.10	55876A

LIST OF ANCILLARY EQUIPMENT

DESCRIPTION	A.P.
Plugs	W6645
Clamps	W6647
Junction box and gas gap Des. 2	65609
Junction box earthing Des. 3	65610
Aerial rods	65874-82
Bag for aerial rods	66062
Stake steel for guys	66055
Plate base	66056
Pin base	66057
Insulator base	66058
Guys and spreaders	66059
Box carrying	66060
Box of parts	66061
Base insulator) Ship fitting components	66065
Support insulating) Part of Trunk Outfit TK	66236
Aerial wire, insulated, 100 ft.	13082D
Hammer 2 lb	DHT.6131/1203
Chain insulators. Type 9	AM.10B/1275
Socket R.F. panel mounting	66092
Plug R.F. for A.P.66524	66093
Socket R.F. for connecting cable	66094
Plug R.F. for panel mounting	66095
Stake earthing	66244
Switch aerial C.O.	66126
Bag of aerial rods (containing A.P.65874-82)	66445
Trunk termination Des. 2 for flexible cable	66524
Connectors, set of, for A.P.66126	66548
Adaptor plate with A.P.66092 socket	66549
Battery accumulator	14143
Battery charge-discharge unit 24V 12A 110/220V D.C. supply	66151
Generator petrol engine driven 400W 40V D.C.	55595
Handlamp for Type 612ET	66603
Relay unit Des. 49	66464
Connection flexible on drum 300 ft.	65978
Remote control, cable T.R.S.	12750A
Handset double pressel	56960X
Junction box (Receiver aerial)	W3681
" " pyrotenax and polythene junction	W7971
Box power distribution	65142
Junction box D.C.	65143
" " A.C.	65144
" " R.C.	65146
Box distributing with four sockets	66230
Junction box aerial	66516
" " battery	66530
Connector 4' Modulator to B46/B47. G.P.O. Plug	57718
" 6' " " 300 ft. Cable. 10 core. 12 pin	65136
" 3'6" " " J.B. for ship R/C outfits. 12 core. 12 pin	65137
" 2' Transmitter to A.T.U. 3 pin	65138
" 15' " " " " "	65139
"	65140
" 2'+2'+2' J.B. to Nife battery. 2 pin	65141

DESCRIPTION			A.P.
Connector	5'+2'+2'	J.B. to battery. 2 pin	65611
"	15'	B46 to A.T.U. 1 pin.	65666
"	6'	Transmitter to Modulator. 25 pin	65667
"	6'6"	Modulator to J.B. 2 pin	65668
"	6'6"	B46 to J.B. 4 pin	65669
"	15'	Transmitter to A.T.U. coaxial	65670
"	6'6"	Modulator to J.B. for ship R/C Outfits. 12 core 12 pin	66014
"	3'6"	Transmitter to B46. 3 pin	66116
"	8'6"	" " " " "	66117
"	2'	Modulator to transmitter. 25 pin	66118
"	3'	B46-B47 to J.B. 4 pin	66119
"	8'6"	A.C. power unit to J.B. 4 pin	66120
"	6"	Transmitter to A.T.U. coaxial	66121
"	6'	B46 to A.T.U. 3 pin	66122
"	15'	B47 to AWG. 1 pin	66123
"	8'6"	B46 to J.B. 3 pin	66124
"	3'	A.T.U. to AWG. 1 pin	66125
"	12'	Modulator to A.C. power Unit. 25 pin	66467
Cable drum. Mk. 2 No. 5			WB3767 (Army)
" "		Carrying handle	YA7532 (Army)

BIBLIOGRAPHY

Type	"E" List	Handbook
612E/F/EF	E965	B.R.1616(1)(2)
612ET	E981	B.R.1616(1)(2)
CAJ/K/N/P	E966	B.R.1616(1)(2)
AWG	E960	B.R.1625

TOOL ROLL

1 $\frac{5}{8}$" Screw driver
1 $\frac{1}{8}$" " "
1 Pair Side Cutters.
1 " 4" Pliers
1 2BA Box spanner
1 4BA " "
1 6BA " "
1 8BA " "
1 $\frac{1}{4}$" " "
1 $\frac{1}{2}$" " "
1 Set Terry Flat BA Spanners