PORTABLE TRANSMITTING AND RECEIVING EQUIPMENT

TYPE 3. MK. II.

DESCRIPTION AND OPERATING INSTRUCTIONS

For Set Serial No. 45837

Contents:

B. KERKHOFF.

EQUIPMENT

PACKING A. Plate 1.

SUITCASE containing:—

(a) Transmitter.

(b) Receiver.

(c) Combination Power Pack for A.C. Mains and 6 v. Battery operation.

(d) Instruction Manual.

(e) Spares Box containing:—

(i) 60 ft. Aerial wire.

(ii) 10 ft. Earth wire.

(iii) Transmitting key.

(iv) Telphone headset (L.R.)

(v) 12 Fuses. 5, 10 amp.; 5, 500 m/a.; 2, 1 amp.

(vi) 4 Spare Valves. 7Q7, 7R7, EL32, 6L6.

(vii) Screwdriver.

(viii) 2 brass pins to convert Mains plug to Continental fitting.

~~(ix) ES/BC Adaptor.~~

(x) BC/2 pin Adaptor.

(xi) 4 Tank Coils—L1, 3-0 - 5.5 Mc/s.
L2, 4.5 - 7.5 „
L3, 6.5 - 10.0 „
L4, 9.0 - 16.0 „

1 mains lead ✓

1 battery lead ✓

1 earth pin ✓

PACKING B. Plates 2 and 3.

The above apparatus (a) to (e) is packed into two water-tight containers and in addition the following items are provided:—

(f) 2, 6 v. batteries, type 3.SAF.15 each in a watertight container.

(g) Hand Generator 6 v. 5 amp., with cables—in watertight container.

(h) Webbing carrying equipment.

Crystals are supplied separately.

SPECIFICATIONS.

I. COMBINATION POWER PACK for A.C. and Battery Operation.
Size: $10\frac{3}{4}''$ x $4\frac{1}{16}''$ x 5″. **Weight:** 12lbs. 8ozs.

A. **Mains Supply:** A.C. only. 97-140 volts, 190-250 volts.
40-60 c/s.
Consumption: (a) Transmit 57 watts.
(b) Receive 25 watts.

B. **Battery Supply.** 6 volt accumulator, automobile type of largest available ampere-hour capacity.
Maximum drain 10 amps. This battery is only provided with Packing B.
Consumption: (a) Transmit $9\frac{1}{2}$ amps. (key down) $3\frac{1}{2}$ amps. (key up).
(b) Receive $4\frac{1}{2}$ amps.

A spare vibrator, 6-volt non-synchronous, is fixed inside.

II. TRANSMITTER.

Size: $9\frac{1}{2}''$ x $6\frac{1}{4}''$ x $4\frac{7}{8}''$. **Weight:** 7lbs. 8ozs.
Supply: From the Power Pack—(a) 500v. at 60 mA.
(b) 230v. at 18 mA.
(c) 6.3v. at 1.1 amps.

Circuit: Oscillator-doubler driving Class C amplifier, crystal controlled. Provision for frequency doubling. Plug-in tank coils to cover 3.0 to 16 Mc/sec. "Tune-Send-Receive" switch. Multi-range meter to read voltages and currents on transmitter and receiver. Plug in Transmitting Key.

Power Output. A. On A.C. Mains.
(a) Average fundamental power is 20 watts.
(b) The second harmonic power is 20 watts.
(c) The third harmonic power is 16-20 watts.
B. On Batteries.
(a) Average fundamental power is 20 watts.
(b) The second harmonic power is 18-20 watts.
(c) The third harmonic power is 15-18 watts.

III. RECEIVER.

Size: $9\frac{1}{2}''$ x $4\frac{7}{16}''$ x $4\frac{7}{8}''$. **Weight:** 6lbs. 12ozs.

Supply: From Power Pack (a) 230v. at 28mA.
(b) 6.3v. at 1.2 amps.
(c) $-12\frac{1}{2}$v. to -14v. bias.

Circuit: 4 valve seven stage superheterodyne receiver essentially designed for CW reception. 3 wave band switch selector 3.1 to 15.5 Mc/sec. total coverage. 50-1 slow motion vernier dial. B.F.O. pitch control incorporating ON/OFF switch. Volume control and 'phone jack.

Valves: Frequency changer.—7Q7 Loctal pentagrid. IF Amplifier.—7R7 Loctal double diode pentode. 2nd IF Amplifier & B.F.O.—7Q7 Loctal pentagrid. 2nd Detector & L.F. amplifier.—7R7 Loctal double diode pentode.

Intermediate Frequency: 470 Kc/sec. B.F.O. 470 Kc±3 Kc.

Sensitivity: 1—3 microvolts for 10 milliwatts output at 1000 c.p.s. (C.W. input and B.F.O. on).

Selectivity: Bandwidth. 1 Kc/sec. 3 DB down from peak.
9 Kc/sec. 20 DB down from peak.

Max. Output: 50 milliwatts into 120 ohm telephones. (Impedance 800 ohm at 800 c.p.s.).

INSTALLATION INSTRUCTIONS.

Before setting up to establish communication, the proposed site should be examined as to its suitability for the installation of an efficient Aerial and Earth system, and the question of a power supply considered. Where possible A.C. Mains should be used and a 6-volt large capacity accumulator obtained for emergency use.

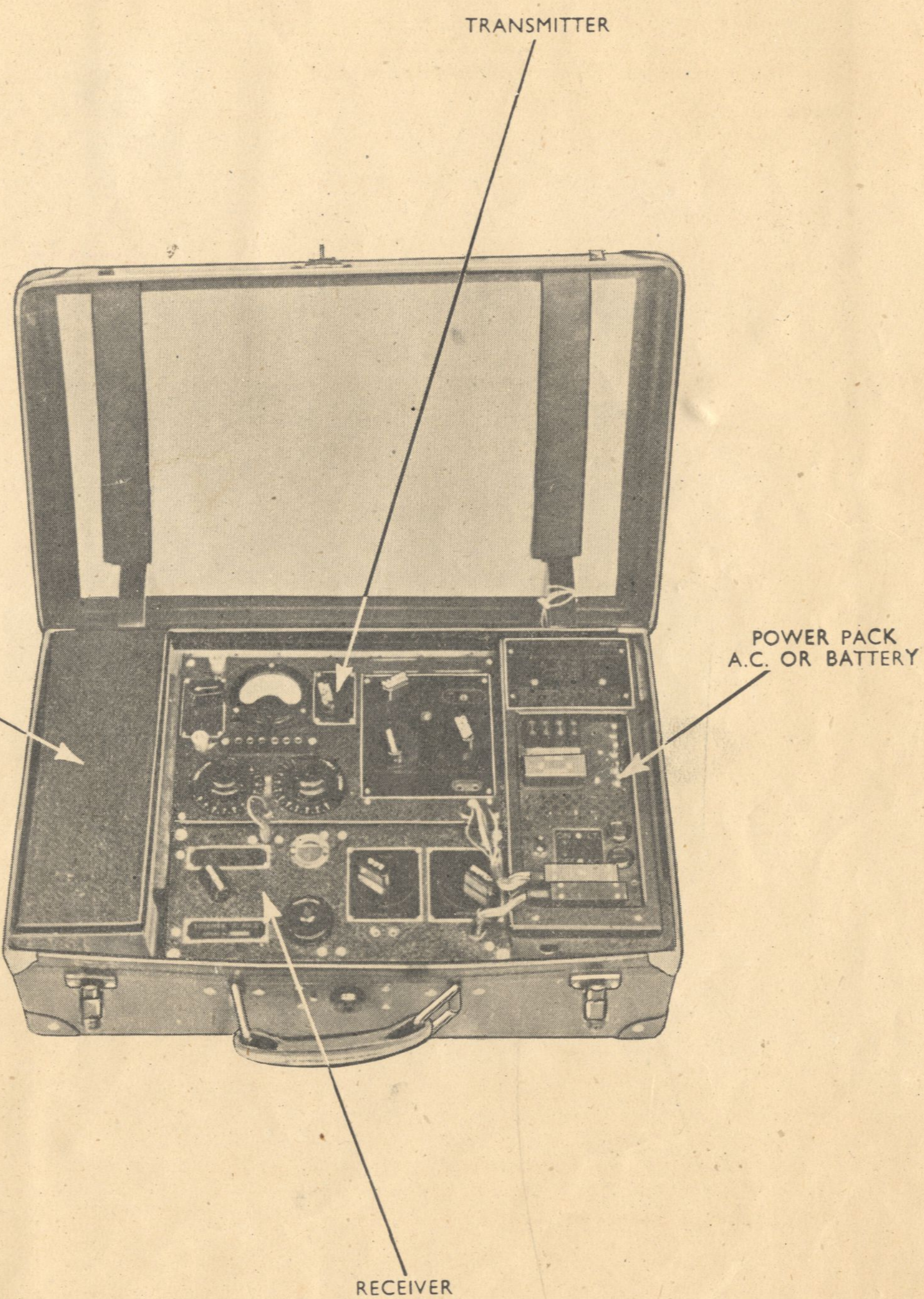
The operator should study Appendix A on Aerials and make himself familiar with the method of adjusting the voltage selector on the Power Pack and Tuning the Receiver and Transmitter.

Aerials: 100 ft. of aerial wire is provided, as much of which as possible should be suspended as high as possible and not too close to earthed objects in order to obtain maximum efficiency. One end will, when operating, be connected to the Aerial terminal on the Transmitter. See Appendix A.

Earth: A good electrical connection must be made to an existing earth tube, a main water pipe or central heating system. If these are not available a wire of the same length as the aerial should be suspended underneath it, preferably two or three feet above the ground. The earth wire or this counterpoise earth will be connected to the Earth terminal on the transmitter.

PLATE I.

PACKING A.



SIZE :— $18\frac{1}{2}'' \times 13\frac{1}{2}'' \times 5\frac{3}{4}''$

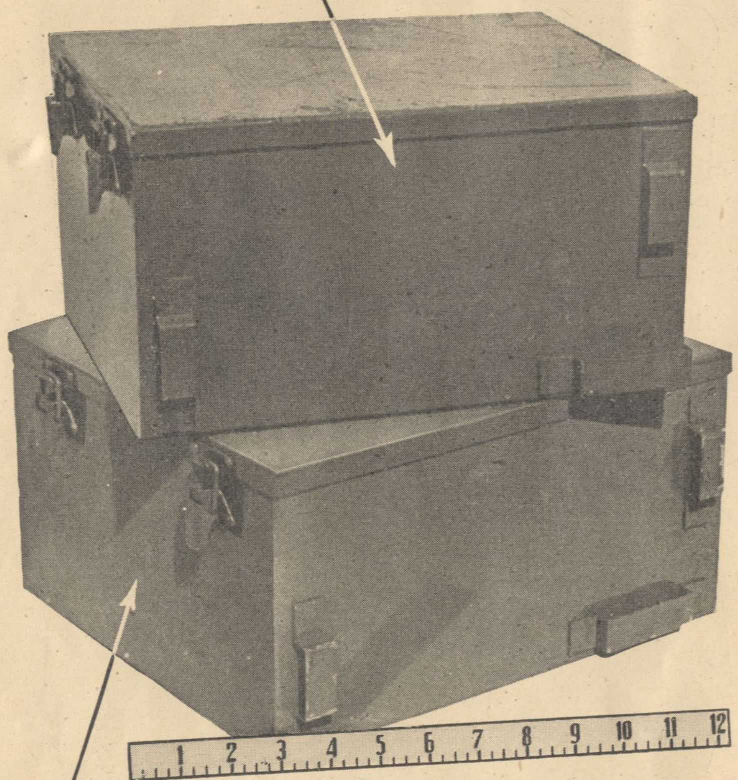
± 46 x 34 x 15

WEIGHT :— $32\frac{3}{4}$ LBS.

± 15 kg.

PLATE 2. PACKING B.

(*a*) POWER PACK AND SPARES BOX



(*b*) TRANSMITTER AND RECEIVER

SIZE (*a*) 13″ x 10″ x 6″
(*b*) $13\frac{1}{4}$″ x $11\frac{1}{2}$″ x 6″

WEIGHT (*a*) 35 LBS.
(*b*) $20\frac{3}{4}$ LBS.

VOLTAGE SELECTOR

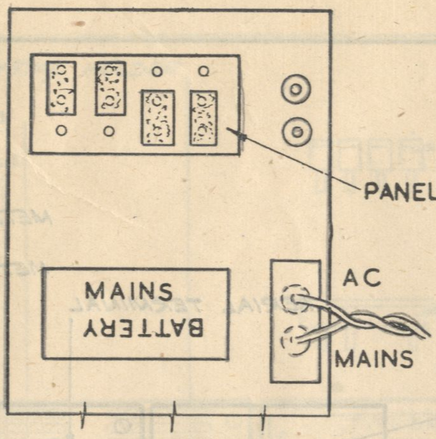


FIG. 1

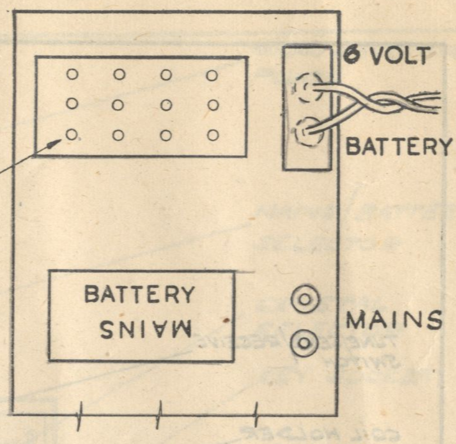


FIG. 10.

PANEL A

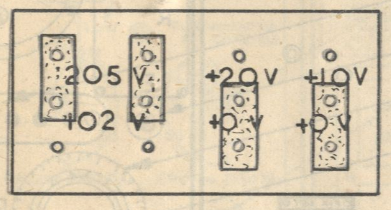


FIG 2 FOR 190-207 V

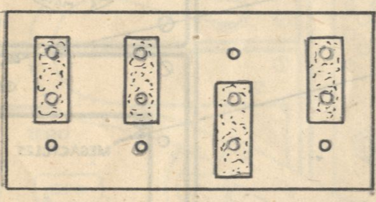


FIG 3 FOR 208-219V

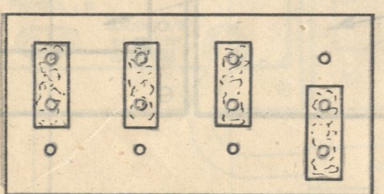


FIG 4 FOR 220-234 V

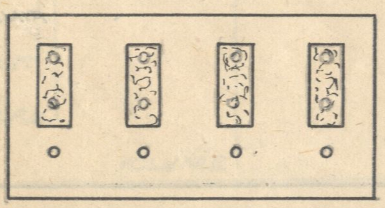


FIG 5 FOR 235-250 V

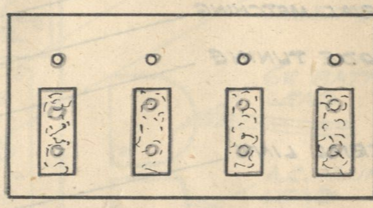


FIG 6 FOR 97-107 V

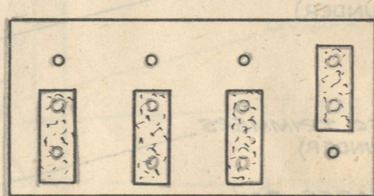


FIG 7 FOR 108-117V

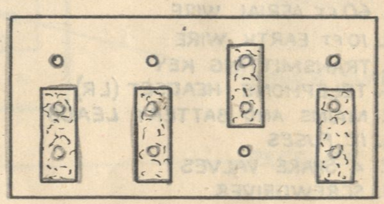


FIG 8 FOR 118-126 V

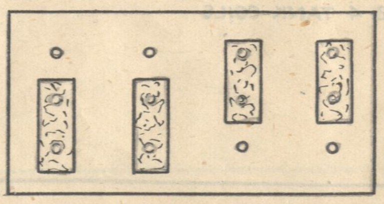
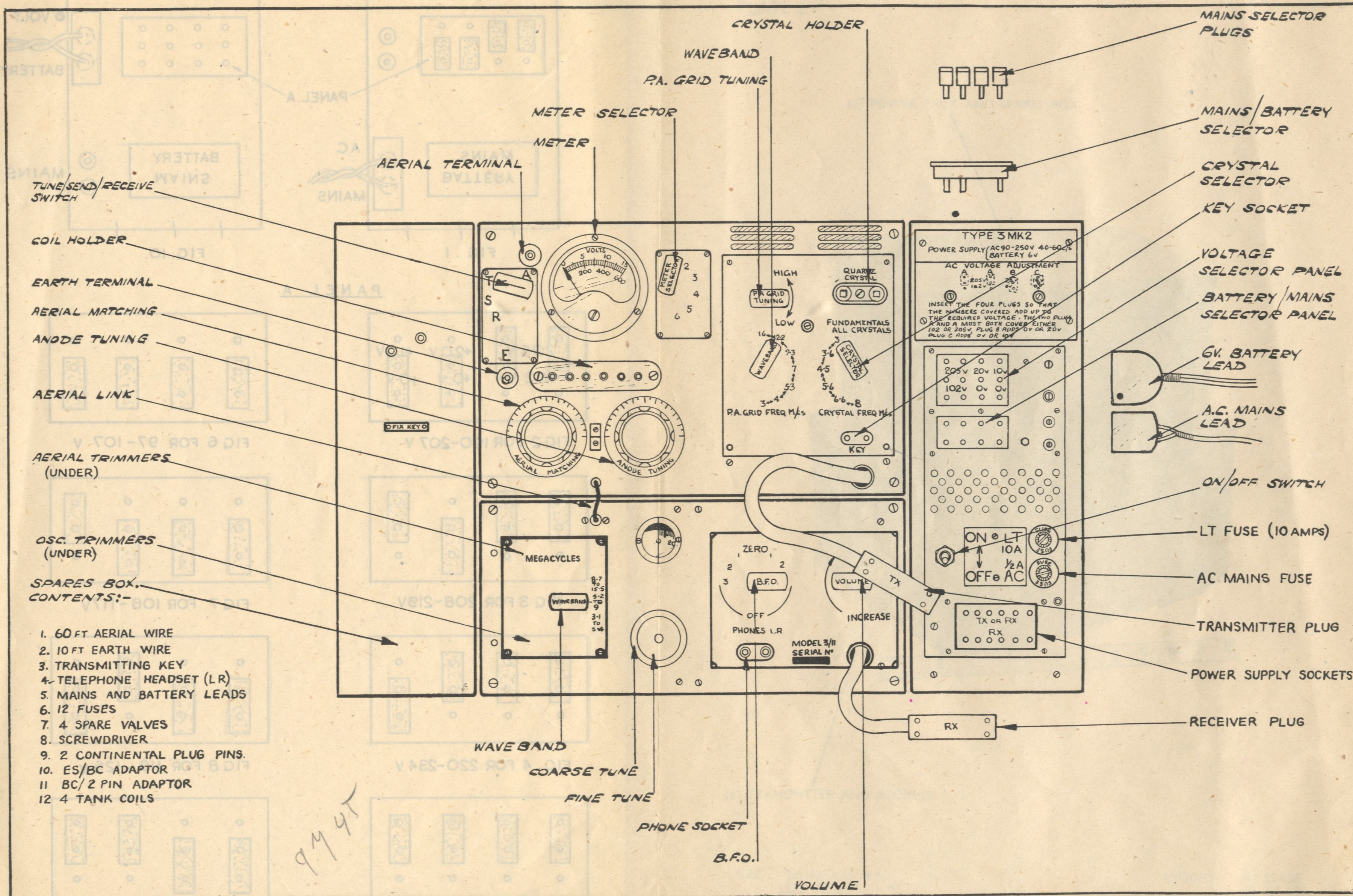


FIG 9 FOR 127-140 V


CRYSTAL HOLDER
WAVEBAND
P.A. GRID TUNING
METER SELECTOR
METER
AERIAL TERMINAL
TUNE/SEND/RECEIVE SWITCH
COIL HOLDER
EARTH TERMINAL
AERIAL MATCHING
ANODE TUNING
AERIAL LINK
AERIAL TRIMMERS (UNDER)
OSC. TRIMMERS (UNDER)
SPARES BOX. CONTENTS:-
1. 60 FT AERIAL WIRE
2. 10 FT EARTH WIRE
3. TRANSMITTING KEY
4. TELEPHONE HEADSET (L.R)
5. MAINS AND BATTERY LEADS
6. 12 FUSES
7. 4 SPARE VALVES
8. SCREWDRIVER
9. 2 CONTINENTAL PLUG PINS.
10. ES/BC ADAPTOR
11 BC/2 PIN ADAPTOR
12 4 TANK COILS
WAVEBAND
COARSE TUNE
FINE TUNE
PHONE SOCKET
B.F.O.
VOLUME
MAINS SELECTOR PLUGS
MAINS/BATTERY SELECTOR
CRYSTAL SELECTOR
KEY SOCKET
VOLTAGE SELECTOR PANEL
BATTERY/MAINS SELECTOR PANEL
6V. BATTERY LEAD
A.C. MAINS LEAD
ON/OFF SWITCH
LT FUSE (10 AMPS)
AC MAINS FUSE
TRANSMITTER PLUG
POWER SUPPLY SOCKETS
RECEIVER PLUG
TYPE 3 MK2
POWER SUPPLY AC 90-250V 40-60 C/S BATTERY 6V
AC VOLTAGE ADJUSTMENT
METER SELECTOR
VOLTS
HIGH
LOW
P.A. GRID TUNING
QUARTZ CRYSTAL
FUNDAMENTALS ALL CRYSTALS
P.A. GRID FREQ M/cs
CRYSTAL FREQ M/cs
KEY
FIX KEY
AERIAL MATCHING
ANODE TUNING
MEGACYCLES
WAVEBAND
ZERO
B.F.O.
OFF
PHONES L.R
VOLUME
INCREASE
MODEL 3/II
SERIAL No
TX
RX
TX or RX
ON
OFF
LT 10A
½A AC
205v 20v 10v
102v 0v 0v

I. POWER PACK.

A. If mains are available ascertain whether they are A.C. or D.C. This apparatus must NOT be used on D.C. Mains. If A.C. is available, ascertain the voltage by reference to the electric light meter, electrical apparatus in use, or the markings on electric light bulbs. Note the type of plug or connection required and prepare your lead for future use.

B. **To adjust the Power Plug to a known Voltage:** Insert the "**Mains—Battery**" plug to read "Mains" as in Fig. 1. The selection is made by inserting 4 small 2-pin plugs into the holes provided on PANEL A. (See Fig. 1.) The plugs must be pushed well in and cover the numbers which add together to the votage required. Two plugs must always cover either the "205v" or "102v." The other two plugs are used to cover "+Ov," "+10v" or "+20v." (See Figs. 1 to 9). Thus in Fig. 4, plugs (A) and (A) cover "205v," plug (C) covers "+20v" and plug (D) covers "+ Ov." The Power Pack is now adjusted for a mains voltage of 205+20+0=225 volts. In practice this setting is used for any voltage between 220 and 234 volts. Similarly in Fig. 9, the voltage is 102+20+10=132 volts. This setting is used for any voltage between 127v and 140 volts.

C. **To adjust the Power Pack when the Mains voltage is not known.** If the mains are known to be A.C. but the voltage is not known, proceed as follows:—

(a) See that the "**RX**" 6-pin plug is not connected to the Power Pack.
(b) Plug the "**TX**" 6-pin plug into the Power Pack and set the "**T.S.R.**" (Tune-Send-Receive) switch to "R" and the "**Meter Selector**" to Position 2.
(c) Set the "**Battery-Mains**" plug to "**Mains**" and adjust the voltage selector to the highest setting (235-250) Fig. 5.
(d) Switch on and the meter will give a reading.
(e) If this reading is less than ½ scale (300) switch off and reset the voltage selector to the next lower setting,—Fig. 4 and recheck the meter reading.
(f) Proceed thus until a voltage setting is found in which the meter reads as nearly ½ scale (300) as possible.
(g) Always use this voltage setting when working on these mains.

NOTE: If the first meter reading (c) is only about 150 the mains are in the 100 volt range, in this case, replace the 500 m/amp fuse by a 1 amp fuse, then, adjust the selector to 127-140 volts, Fig. 9, and make checks progressively as above.

D. **To adjust Power Pack for Battery Operation.** If mains are not available or are unsuitable, a 6-volt accumulator must be procured. It is essential for satisfactory working that, in view of the heavy drain on the battery—up to 10 amps. when transmitting and 4 amps. when receiving—this should be of the automobile type, fully charged and in good condition. Two such batteries may, with advantage, be used in parallel.

(a) With the "ON-OFF" switch on the Power Pack in the "OFF" position connect the lead provided to the battery terminals—polarity will not affect performance—and plug on to the large pins marked "B" Fig. 10.
(b) Set the "**Battery-Mains**" plug to "**Battery**" Fig. 10.
(c) Switch to "ON." A voltage will be shown on the transmitter meter, in Position 2, and a faint hum heard in the Pack.

NOTE: The position of the voltage selector plugs on Panel A is quite immaterial and has no effect when "**Battery Mains**" plug is set to "**Battery.**"

When the Power Pack is set for Battery operation, do not leave the switch in the "ON" position when not operating or the battery will be discharged unnecessarily.

E. **To Change from Battery to Mains operation and vice-versa.** If a rapid change-over from Mains to Battery operation is likely to be required, it is advisable to connect up as specified in sections D and B—both battery and mains leads being connected to the Power Pack. Assuming A.C. mains are in use—should they fail, then

(a) Move Power Pack switch to "OFF."
(b) Reverse "**Battery-Mains**" plug to read "**Battery.**"
(c) Switch to "ON."

NOTE: (i) If the apparatus is to be used with the battery still connected up to the electrical system of a car, the BLACK battery clip should be connected to the terminal which is earthed to the car chassis—irrespective of whether it is Positive or Negative.

(ii) It is absolutely essential that the voltage of the accumulator used should not exceed 6.3 volts, since otherwise the set may be damaged. The accumulator must not be charged whilst connected to the set.

(iii) If, when on battery operation, no hum is heard from the Power Pack and the battery and fuse are in order, the vibrator may be faulty. Disconnect and withdraw the Power Pack from the suitcase. Take out the 2 screws in each side of the metal case and remove the lid. Insert the spare vibrator into the red clip in place of the faulty vibrator.

F. **Transmitter and Receiver Connections:** Normally the 6-pin "TX" cable plug is fitted in the upper row of sockets on the Power Pack, marked "TX" or "**RX.**" The 6-pin "RX" cable plug is fitted in the lower sockets marked "**RX** only." In this position the receiver is automatically switched off when the Transmitter "**T.S.R.**" switch is at "S" (send). If it is required to operate the Receiver alone, its cable plug must be fitted in the upper sockets, "**TX** or **RX.**"

The Aerial and Earth terminals are on the Transmitter panel. The plug on the short yellow lead on the Transmitter should be inserted in the Aerial socket on the Receiver. If the Receiver alone is to be used, the Aerial wire may be removed from the transmitter aerial terminal and used in the receiver aerial socket.

G. **Fuses.** Two fuse holders are provided on the power pack panel. One marked L.T. is fitted with a 10-amp. fuse of the cartridge type, the other, marked A.C., is sent out with a 500 mA fuse as is normally used on 200-250 volt mains. For use on 100-120 volt mains 1-amp fuses are provided for use in this position. A fuse may be replaced readily by unscrewing the plug of the appropriate fuse holder (see diagram), withdrawing the plug and fitting another cartridge fuse of the correct rating.

II. TRANSMITTER.

The operator should make himself familiar with the function of the following controls.

A. "**Crystal Selector.**" This switch adjusts the transmitter to suit different crystal frequencies and not the operating frequency. One position of the switch is for use on fundamental operation irrespective of crystal frequency.

B. "**Wave Band.**" This switch sets the frequency of the oscillator valve to the band required. This will usually be the transmitting frequency, e.g. Using a 6.0 mc/s crystal on fundamental set the "**Wave Band**" to "5-7" and the transmission is on 6·0 mc/s. With the "**Crystal Selector**" set to "**Harmonic 5.2-6,**" and the same crystal, the "**Wave Band**" would be set to 9-12 mc/s and the transmitted frequency would be 12.0 mc/s.

C. "**T.S.R.**" This "Tune-send-receive" switch performs the following functions.

(i) **Position "T."** In this position the transmitter is ready for tuning. The key is short circuited. The power to P.A. (Power Amplifier) is reduced to protect the valve. The aerial is disconnected so that no signal is transmitted until required. The receiver H.T. is switched off. Receiver heaters are still on.

(ii) **Position "S."** The Receiver H.T. is still switched OFF. The aerial is in circuit. When the key is depressed, the P.A. valve will transmit at full power. This is the operating position.

(iii) **Position "R."** The Transmitter HT is now off and Receiver H.T. on. The Aerial is now connected to the receiver. No other transmitter controls should be altered in going from "Send to Receive."

NOTE : So long as the "**TX**" and "**RX**" plugs are in the Power Pack sockets and the Power Pack switch on, the heaters of both transmitter and receiver are on.

D. "**Meter Selector.**" This switches the moving coil meter into different circuits of the transmitter or receiver to measure either voltage or current. The positions of the switch are as tabulated on page 5.

E. "P.A. **Grid Tuning.**" This knob controls a variable condenser which is a fine adjustment to the setting of the "Wave Band" switch. With the "**Meter Selector**" in Position 3 tuning is accomplished by observing the deflection given by the P.A. Grid Current.

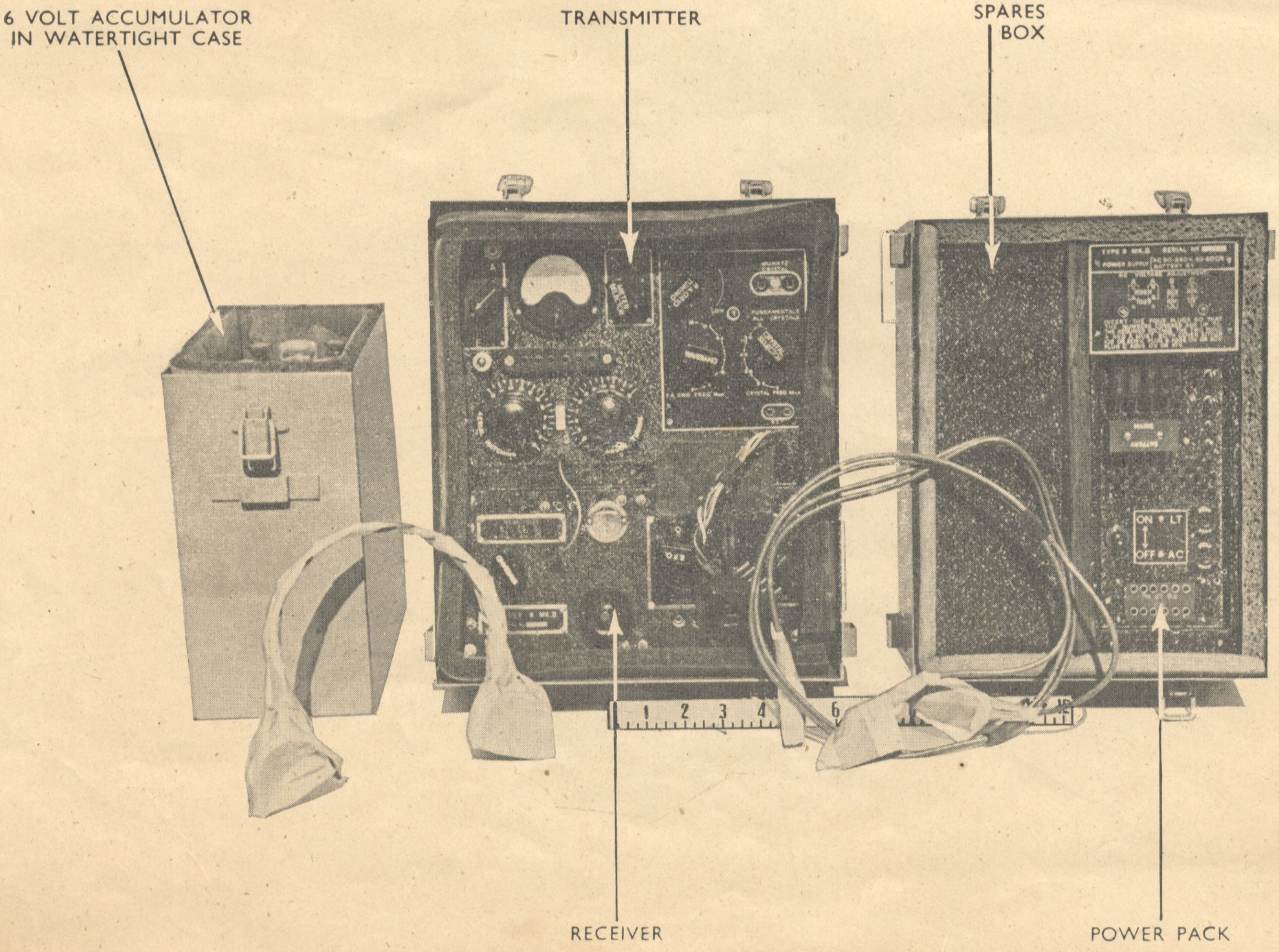
F. "**Anode Tuning.**" This controls the tuning condenser for the P.A. valve. It is always adjusted for minimum P.A. total current.

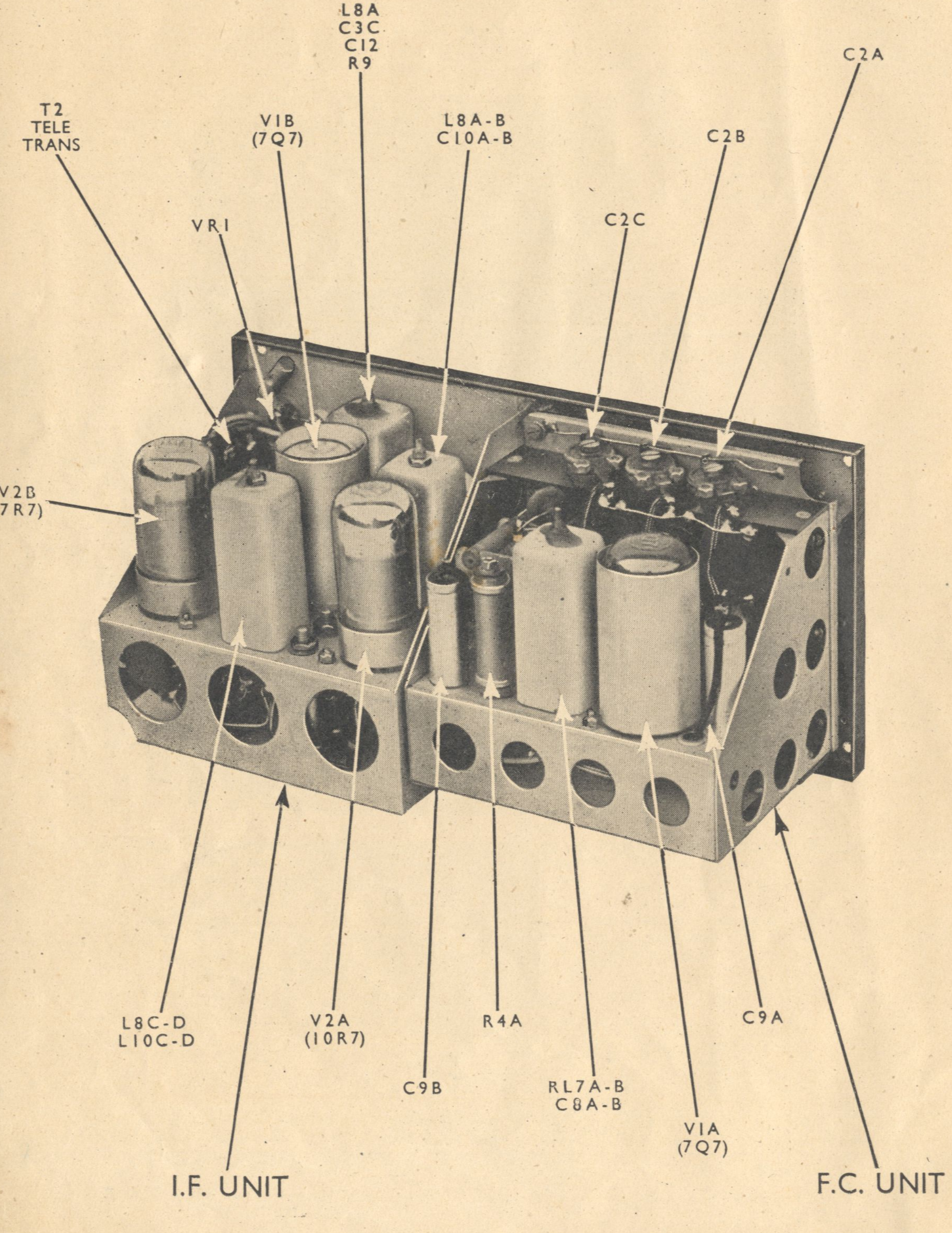
G. "**Aerial Matching.**" This knob controls a variable condenser and is used to adjust or match the transmitter to suit any particular aerial. It may be considered as a "load-increasing" control.

The two sockets above the "**Crystal Selector**" are for 2-pin quartz crystals (3.000-8.000 mc/s) and those below, for the 2-pin plug on the key lead. The Aerial terminal is above the "**T.S.R.**" switch and the Earth below it. See illustration.

PLATE 3.

WATER TIGHT PACKING




L8A
C3C
C12
R9
C2A
T2
TELE
TRANS
V1B
(7Q7)
L8A-B
C10A-B
C2B
VR1
C2C
V2B
(7R7)
L8C-D
L10C-D
V2A
(10R7)
R4A
C9A
C9B
RL7A-B
C8A-B
V1A
(7Q7)
I.F. UNIT
F.C. UNIT

Meter Selector. "T.S.R." switch in "T" or "S."

Position.	Circuit Measured.	Full Scale Meter Reading.	Normal Reading.
1.	Oscillator voltage.	600 volts.	230 volts.
2.	P.A. Voltage.	600(x2) volts.	230(x2) volts.
3.	P.A. Grid current.	6 m/a.	1 to 3 m/a.
4.	Osc. Grid current.	1.5 m/a.	.25 to .75 m/a.
5.	None.	—	—
6.	P.A. Total current.	120 m/a.	65-70 m/a.
		600 on scale.	325-350 on scale.

"T.S.R." switch on "R."

Position.	Circuit Measured.	Full Scale Meter Reading.	Normal Reading.
1.	Receiver voltage.	600 volts.	230 volts.
2.	P.A. voltage.	600(x2) volts.	260(x2) volts.
3.	None.	—	—
4.	Receiver current.	15 m/a (x2)	12.5 m/a(x2).
5.	None.	—	—
6.	None.	—	—

NOTE: (i) Normal readings are for the transmitter tuned up and working and for the receiver working at almost full volume.

(ii) At Position 2. Full scale indicates 1200 volts, i.e. 600(x2).

H. **The Meter.** Unless other readings are required, as when testing the apparatus, or tuning the Transmitter, it is advisable to make a habit of leaving the "**Meter Selector Switch**" in Position 2 reading Anode volts. In this Position, the Meter is an indication that the set is "ON" and that the Power Supply is in order. Should the mains fail, the meter will register this. An immediate change-over to battery operation should then be effected, when the meter will again read approximately half scale if all is in order.

Tank Coils. To obtain the highest efficiency over the wide wave band covered, each of the 4 coils can be plugged in in two ways, A and B. The particular coil and its position will depend upon the installation—Aerial-Earth, etc., but the following table will serve as a guide under average conditions with 40-50 ft. (13-17 metres) of aerial wire. The "A" position is that in which the letter A on the coil base faces the operator in the usual position.

		FREQUENCY (Mc/s)	
Coil.	Position.	Minimum.	Maximum.
L1	A	3.0	4.0
L1	B	3.75	5.25
L2	A	4.5	6.25
L2	B	5.5	7.5
L3	A	6.5	9.0
L3	B	7.0	10.0
L4	A	9.0	13.0
L4	B	12.0	16.0

If the setting of either knob reaches "O" whilst tuning the transmitter a smaller coil is required, e.g. L2B instead of L2A or L4A instead of L3B. Similarly if either knob reaches "10" then a larger coil is required.

OPERATING INSTRUCTIONS.

With an A.C. power supply, aerial and earth system installed, and, if possible, a 6v. accumulator for emergency use available, proceed as follows:—

I. PRELIMINARIES.

(a) Open the suitcase, and examine the apparatus.

(b) Plug the 6-pin plugs marked "**TX**" and "**RX,**" which will be found lying on the panel into the sockets on the Power Pack marked "**TX and RX**" and "**RX only**" respectively (Page 4 Sect. F).

(c) Open the spares box, remove the mains and battery leads, plug them on to their appropriate pins (See Figs I and II). See that the "ON-OFF" switch on the Power Pack is to "OFF," then connect the Battery clips to the Battery terminals and plug in and switch on the mains.

(d) Plug the key into the transmitter and the telephones into the receiver.

(e) Attach the Aerial and Earth wires to the appropriate terminals (see illustration).

(f) Adjust the Power Pack voltage selector to the voltage of the mains (previously determined) and set the "**Battery-Mains**" plug to "**Mains.**"

(g) Insert the **Aerial plug** on the Transmitter into the socket on the Receiver (see illustration).

(h) The "**Meter-Selector**" switch should be in Position 2.

(i) Select your crystal and the appropriate coil. Plug them in.

(j) Set the "**Crystal Selector**" and "**Wave Band**" switches to the correct frequency.

II. TO TUNE THE RECEIVER.

(a) Turn the "**T.S.R.**" switch to "**R**" and switch on the Power Pack. There should be a deflection of about half scale on the meter (indicating anode volts) and in a few moments a faint hum heard in the telephones.

(b) Set the "**Wave Band**" switch to the desired band.

(c) If CW is to be received, set the B.F.O. knob to the "ON" position at "O."

(d) Consult the chart or graph relating to frequency and dial settings and move the tuning control over the setting indicated for the frequency desired and advance the volume control towards maximum until a comfortable volume is reached.

(e) Should the station not be received at once, check the "**T.S.R.,**" "**Wave Band**" switch and Graph reading and then again search around the setting indicated by moving the tuning control slowly to and fro on either side of the number given on the chart.

(f) **Beat Frequency Control.** Attention to the following points will ensure best reception. The beat oscillator is provided with a control for varying the pitch of the note received. This control is normally set to "**O.**" When a station is received, the main tuning knob should be adjusted to give the lowest pitch possible and then the "**B.F.O.**" control set to give the desired note for morse reception. Setting the "**B.F.O.**" control on either side of zero will provide the required note. If interference from another station is experienced, setting the control to the same number on the other side of the zero should be tried. This will give the same pitched note for the wanted station but a different note for the interfering station, thus permitting the operator to recognise easily his own station. When searching for a station, the B.F.O. control should always be at "O." The receiver is designed to give maximum volume for a note of 1000 cycles per second and the B.F.O. control should always be adjusted for this frequency.

III. TO TUNE THE TRANSMITTER.

(a) **Transmitting on Fundamental.**

For the purpose of this example, it is assumed that a crystal of a frequency of 3.755 mc/s is to be used.

(i) Connect up the Aerial, Earth, Key, Telephones and Power Pack as already described.
(ii) Take Coil L1 and plug it into its socket with the figures L1A to the front.
(iii) Plug the crystal into its socket and set the "**Crystal Selector**" knob to "**Fundamental all Crystals.**"
(iv) Set "**Wave Band**" knob to Position "3-4."
(v) Set "**Meter Selector**" to Position 2—P.A. Voltage.
(vi) Set the "**T.S.R.**" switch to "T" (Tune).
(vii) Set "**Anode Tuning**" and "**Aerial Matching**" knobs to "10."
(viii) Switch on the power pack. The meter should read about 300.
(ix) Switch "**Meter Selector**" to 3. Adjust "**PA Grid Tuning**" for maximum meter reading.
(x) Switch **Meter Selector** to 6. (PA total current, meter reads about half scale).
(xi) Turn the **Anode Tuning Knob** until the meter reading dips to a minimum value, this is usually about 100 with the **Anode Tuning** knob at about 2. The Transmitter is now in tune and ready to be matched to the aerial.
(xii) Turn the "**T.S.R.**" switch to "S." The meter will now cease to read until the key is pressed.
(xiii) Press the Key. The meter reading is now greater (about 200) as the aerial is beginning to take power from the transmitter.

Matching the Aerial. The Key must be held down whilst matching.

(xiv) Readjust the "**Anode Tuning**" for **DIP** (minimum reading on meter).
(xv) Turn "**Aerial Tuning**" knob from "10" towards "0" until the meter reads 320 (one division more than half-scale).
(xvi) Readjust "**Anode Tuning**" for dip.
(xvii) Repeat xv and xvi until when "**Anode Tuning**" is to "dip," the meter reading is exactly half-scale (300).

NOTES :—(1) The meter **MUST DIP** to the final reading. This is proof that the transmitter is tuning. The valve will take more current when off tune, but give out much less power.

(2) With a bad earth or a too short aerial, it may not be possible to load up fully, the transmitter. In this case the "dip" will be below 320 on the scale (65 m/a).

(b) **Transmitting on Harmonic.**

It is assumed that the same crystal (3·755 mc/s) is to be used (in daylight) and that the signal is to be sent out on 7·510 mc/s, which is the second harmonic or double the crystal frequency. The transmitter is set up as above (1) to(XVII) except for the following details :—

(i) The tank coil will now be L3A as given in the coil table (Page 5).
(ii) The "**Crystal Selector**" knob is now set to "**Harmonic 3·6-4·6,**" since the crystal frequency falls between these numbers.
(iii) The "**Wave Band**" knob is now set to "7-9" since the harmonic (7·570) is between 7 and 9 mc/s.
(iv) Everything else is done in the same order, and the meter readings will be the same. The aerial is matched in the same way and the "**Anode Tuning**" control adjusted to give the dip between 300 and 320. The power radiated is the same on harmonic as on fundamental frequency.

With the "**Meter Selector**" switch at Position 4, the meter measures the oscillator grid current, and proves whether or not the crystal is working. It need only be used if there is any doubt that the transmitter is working properly. It normally reads 2½—7½ on the 15 scale—that is ·25 to ·75 m/a.

(c) **Transmitting on Third and Fourth Harmonics.**

The transmitter may be used to send on third and fourth harmonics if necessary. The tuning up is again as above, except that :—

(i) The tank coil must be chosen for 3 or 4 times the crystal frequency (3rd or 4th harmonic) as required.
(ii) The "**Crystal Selector**" is set for second harmonic.
(iii) The "**Wave Band**" knob should be set to correspond with the tank coil. This would be "9·3-12·2" for the 3rd harmonic of the crystal frequency used in the above example (3·755 mc/s) sending out on 11·215 mc/s.
On the 4th harmonic of the same crystal the output frequency would be 15·020 mc/s, and the "**Wave Band**" setting would be "12·2-16·0."

NOTE : (1) The power of the transmitter will be less as higher harmonics are used. This is usually more than compensated for, by the increased aerial efficiency at higher frequencies.

(2) It may not be possible to "load" the transmitter to as high a meter reading as on fundamental, and it is recommended that the reading 280 and 260 be substituted for 320 and 300 in (XV) and(XVII) above on fourth harmonic, and on third also if the transmitter will not "tune up."

AERIALS.

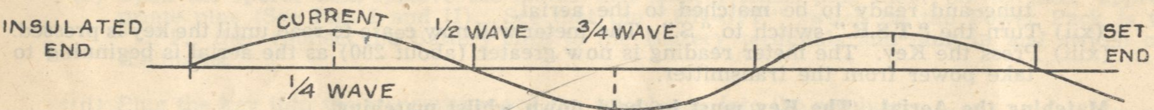
APPENDIX A.

The most usual type of aerial is the so called Marconi aerial which consists of a length of wire, one end insulated and the other end attached to the aerial terminal of the transmitter. A second length of wire joins the earth terminal of the transmitter to a conductor entering the ground. In this type of aerial the main losses are due to the resistance of the earth connection and every effort must be made to obtain as good an earth connection as possible.

The rated power of a transmitter is the power it will deliver to a suitable aerial but the power delivered to the aerial is **NOT** the power **RADIATED** by the aerial, which is always less and unless the aerial-earth system is efficient may be very considerably less. The remainder of the power is dissipated as heat in neighbouring objects such as walls, etc., and in the ground.

CURRENT DISTRIBUTION IN AERIALS.

If a long wire, insulated at one end, has the other end attached to the aerial terminal of the transmitter, an alternating current is produced in the wire, the amplitude of which varies along the wire. For a long wire the current reaches a maximum at a distance of a ¼ wavelength along the wire and then decreases.



Since the power radiated is proportional to the square of the current, it is clearly desirable to have at least one current maximum occur somewhere along the aerial. The shortest aerial which can be considered reasonably efficient is a quarter-wave aerial.

FREQUENCY	3 Mc/S	6 Mc/S	12 Mc/S	16 Mc/S
WAVE LENGTH	100 metres	50 metres	25 metres	20 metres
¼ WAVE LENGTH	25 „	12½ „	6¼ „	5 „

EARTH RESISTANCE.

The resistance of the earth connection usually varies from about 10 ohms. obtained when the earth wire is soldered to a main water pipe near to the ground to about 100 ohms. obtained from a moderate earth connection.

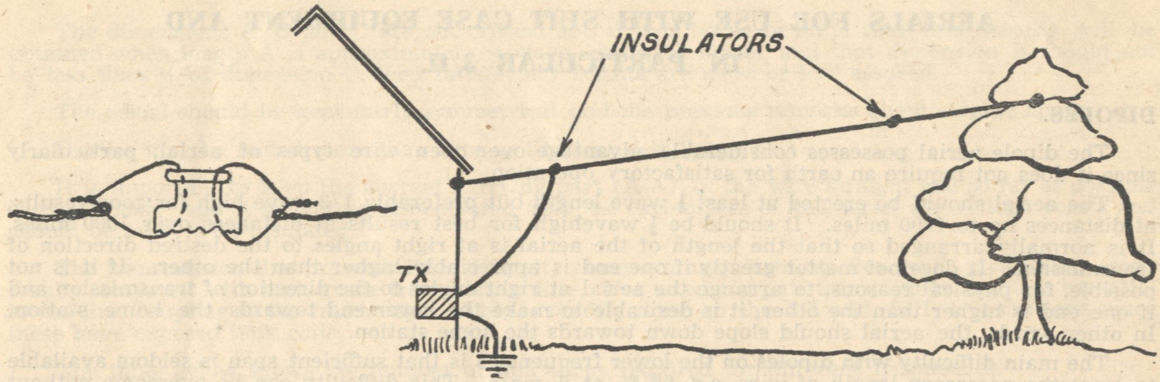
Earth Resistance in ohms.		10	50	100
Radiated power as a percentage	¼ wave	80%	44%	29%
of the power in the aerial	⅛ wave	50%	16%	9%
	1/16 wave	20%	5%	2½%

The amount of power that can be afforded to be wasted when using suitcase sets is small, it is therefore never any use trying to use a shorter aerial than ⅛ wave and this only in conjunction with a very good earth.

ERECTING AN AERIAL.

It is not usually practicable to erect a vertical ¼ wave aerial although this would be very efficient, but at least this length of wire and more if possible should be erected with a long vertical or rising portion and the top bent in some way towards the horizontal as in an inverted L. The exact length of wire is not critical as the transmitter is matched to the aerial in use during the tuning operations. The whole should be left well away from earthed objects such as buildings, cliff sides, surrounding trees, etc., and the end not attached to the transmitter should be insulated. In dry weather the rubber covering of the wire will be sufficient insulation but in wet weather it would be better to use an insulator. An old bottle neck may be used for this purpose.

If it is impossible to use an outdoor aerial great care must be used to erect the most efficient indoor aerial possible. At least a ¼ wave length of wire should be used and this arranged high in the house —possibly in zig-zag fashion in the space amongst the rafters under the roof. Should circumstances restrict activities to one room the aerial wire should be arranged in zig-zag fashion across the room about a foot below the ceiling, spacing the wires as widely as possible, paying special attention to the fact that no part of the wire should run parallel to metal girders—electric wires, water pipes or spouting, nor should the wire be doubled back on itself at any point.

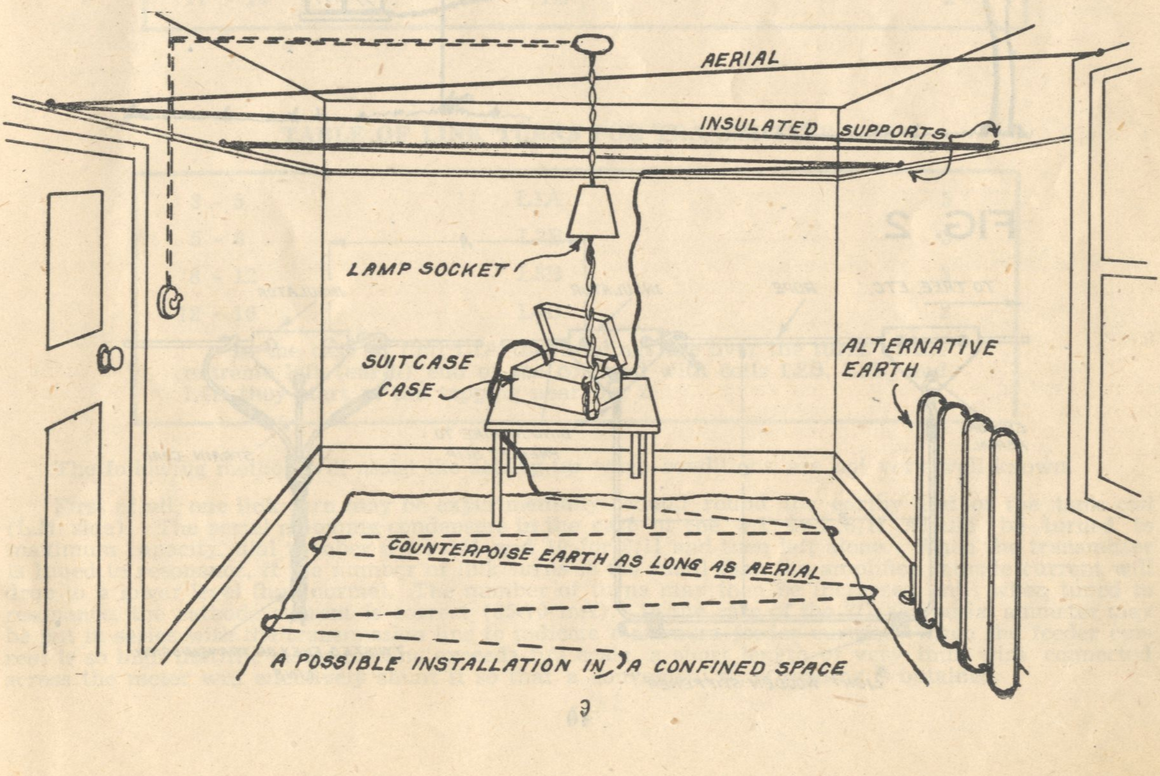


THE EARTH.

An efficient earth is most important. The ideal would be to solder a short length of wire to a large sheet of copper buried in moist earth near to the transmitter and to attach the free end of the wire to the earth terminal of the transmitter. Failing this, a copper earth tube, a large coil of barbed wire, an old oil drum well scraped, or some such metal receptical could be buried instead, but it is most important that where it is attached to the earthwire should be clean metal, a good electrical contact, preferably soldered should be made and that the ground should be moist.

If indoors, a water pipe may be convenient. Choose a cold water pipe near to the ground if possible, rather than a hot pipe which may be loosely attached to dry walls in several places before finally making a good earth connection. Scrape the pipe clean before attaching the earth wire.

If no pipes are available a length of wire arrayed in zig-zag fashion or a piece of wire netting may be placed underneath the floor covering and attached to the transmitter by a short earth wire. An efficient counterpoise earth may be made by arranging a wire of about the same length as the aerial wire, and insulated from earthed objects underneath the aerial wire and 2 or 3 feet above the ground. If indoors the counterpoise earth should be on the floor—perhaps under the carpet and well separated from the indoor aerial wire.



AERIALS FOR USE WITH SUIT CASE EQUIPMENT AND IN PARTICULAR 3/II.

DIPOLES.

The dipole aerial possesses considerable advantage over open wire types of aerial, particularly since it does not require an earth for satisfactory operation.

The aerial should be erected at least ¼ wave length but preferably 1/3 wave high for good results, at distances up to 1000 miles. It should be ½ wavehigh for best results at distances over 1000 miles. It is normally arranged so that the length of the aerial is at right angles to the desired direction of transmission. It does not matter greatly if one end is appreciably higher than the other. If it is not possible, for physical reasons, to arrange the aerial at right angles to the direction of transmission and if one end is higher than the other, it is desirable to make the lower end towards the home station. In other words, the aerial should slope down towards the home station.

The main difficulty with dipoles on the lower frequencies is that sufficient span is seldom available to erect the necessary length of wire, e.g. 66 ft. at 7 mc/s. This difficulty can be overcome without appreciably reducing the performance of the aerial by folding the wire in the manner illustrated in figure (1).

FIG. 1

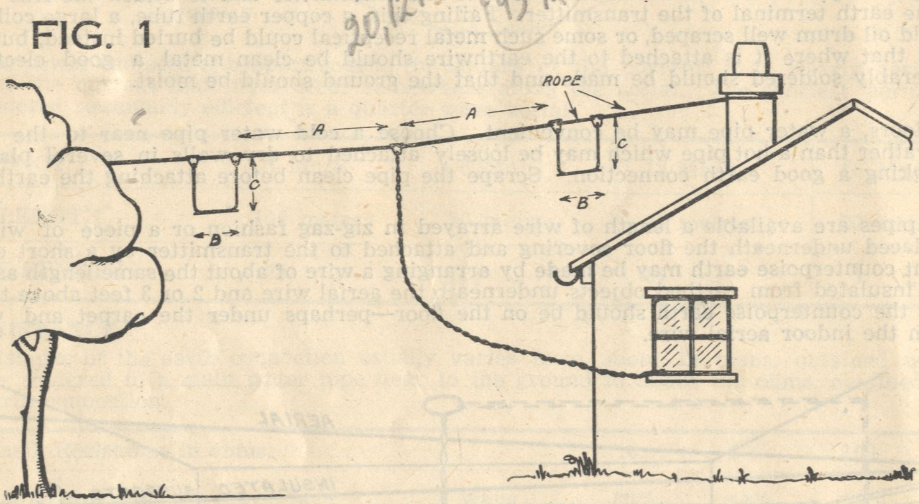
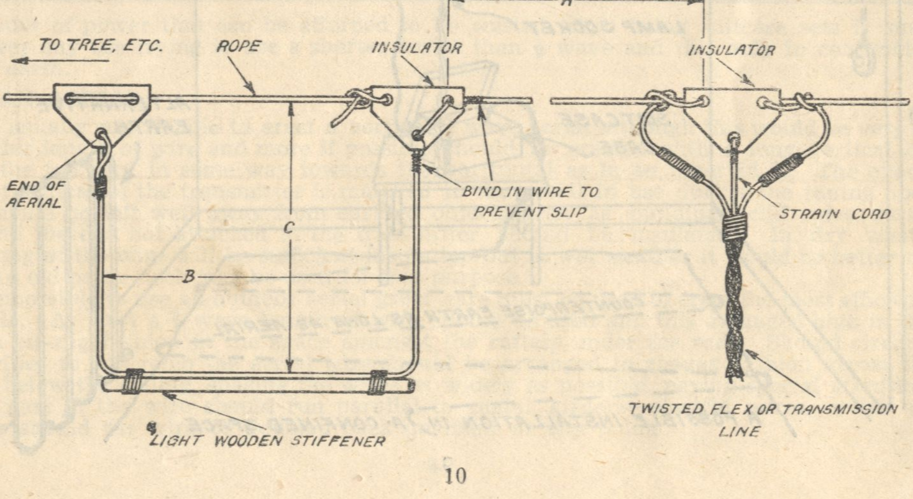


FIG. 2



The dimensions A, B and C are not critical and if it is borne in mind that best results will be obtained when length A is approximately ⅛ wave length or longer and that dimension B should not be less than ½ of dimension C, then satisfactory results are more or less assured.

The aerial should be kept fairly symmetrical and the previous remarks about sloping apply.

Dipoles may be folded more than once as illustrated in figure 5.

It is important to keep the current carrying part (A-A), of the wire straight and so far as possible in the "clear," and it should be remembered that the extremities of the aerial are voltage points and should be fairly well insulated.

The transmission line presents little difficulty since ordinary lighting flex will give fairly good results compared with high grade transmission line. For a twisted pair transmission line it is essential to use link coupling to the transmitter. This is readily done on the 3/I and 3/II transmitters, since these have exposed tank coils.

The table below shows the number of link turns required for different frequencies.

TABLE OF LINK TURNS FOR TRANSMITTER 3/I

Frequency (mc/s).	Coil.	Number of turns.
3 - 4.5	L1	4
4.5 - 5.8	L2	4
5.8 - 8	L3 or L4	4
7 - 9	L4	4
9 - 11	L5	2
11 - 16	L6	2

TABLE OF LINK TURNS FOR TRANSMITTER 3/II.

3 - 5	L1A	5
5 - 8	L2B	3
8 - 12	L3B	3
12 - 16	L4B	2

In the case of Coil L1A the windings are over the turns at the extreme left (earth) end of the coil and with coils L2B, L3B, and L4B they start at the tapping near pin 2.

The following method will assist the setting up when conditions are not very well known.

First of all, one link turn may be experimentally wound round the earthy end of the tank coil (L.H. side). The aerial matching condensers in the case of the 3/I and 3/II should be turned to maximum capacity, dial number 0 for 3/1 and 10 for 3/II and then left alone. When the transmitter is tuned to resonance, if the number of link turns is too small then the amplifier cathode current will drop to a lower level than normal. The number of turns may then be increased until when tuned to resonance, the cathode current is correct (65-70 mA). In the case of the 3/I, the aerial ammeter may be put in series with the transmission line to indicate maximum feeder current When the feeder current is so high that the meter reading exceeds full scale, a short length of very thin wire connected across the meter will effectively shunt it so that a convenient scale reading is obtained.

END-FED AERIALS.

Performance similar to that of a dipole may be obtained from an end-fed aerial arranged as shown in figure 3. The length A should be ½ wave length long or slightly shorter (.95 of ½ wave length) if straight. It may be folded as previously described, in which case the folding should be done at the high voltage ends. It may only be necessary to fold back the distant end of the aerial, but if the span available is restricted it may also be folded near the feeder.

FIG. 3

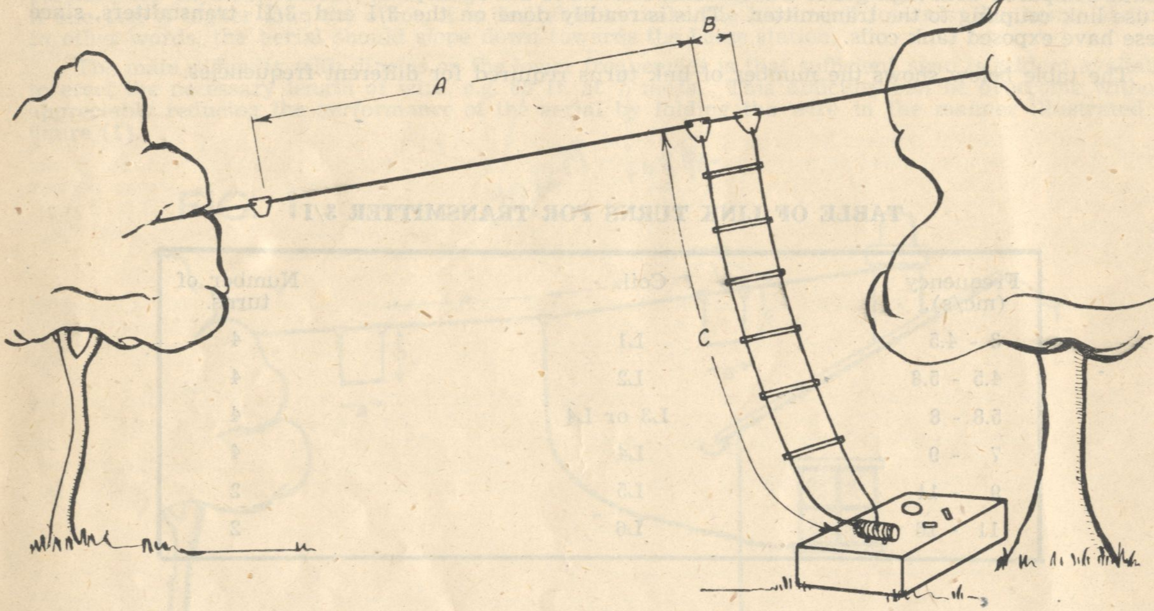
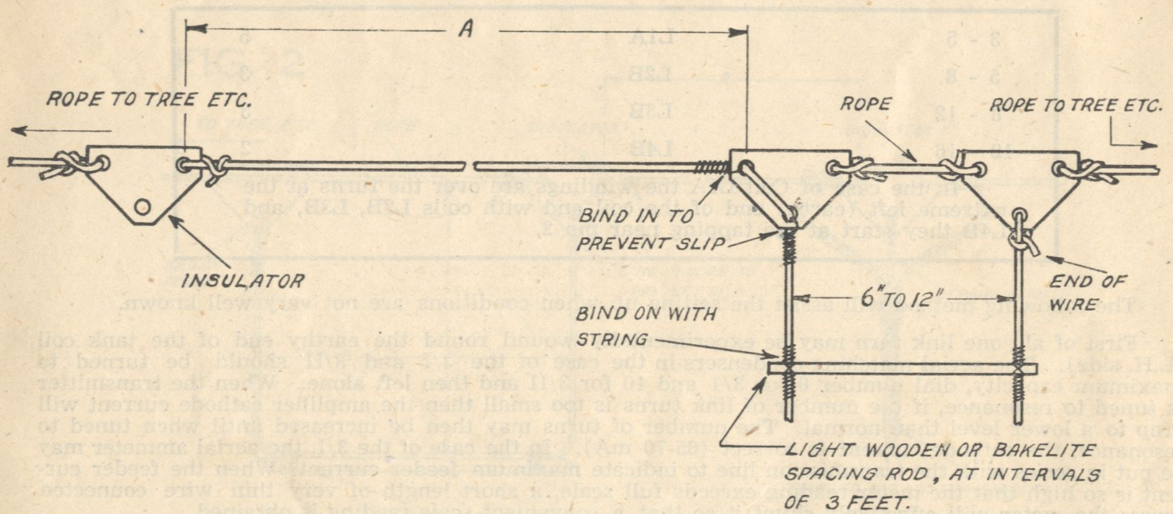


FIG. 4



The current carrying portion, which is approximately $\frac{1}{4}$ wave length long and in the middle of length A, should be kept straight. The feeder shown consists of a $\frac{1}{4}$ wave length of wire which goes to a link wrapped round the tank coil, the other end of which goes to second $\frac{1}{4}$ wave length of wire held parallel to the feeder, and insulated at the top end. This effectively eliminates the use of an earth.

The dimension C should be .98 of $\frac{1}{4}$ wave length as nearly as possible. The dimension B is not critical. It should be noted that the open ends of the wires as well as the knee of the aerial at the junction of A and C are voltage points and should be well insulated.

The remarks about direction and sloping concerning the dipole apply equally well to this aerial. Matching is done in the same way.

FIG. 5

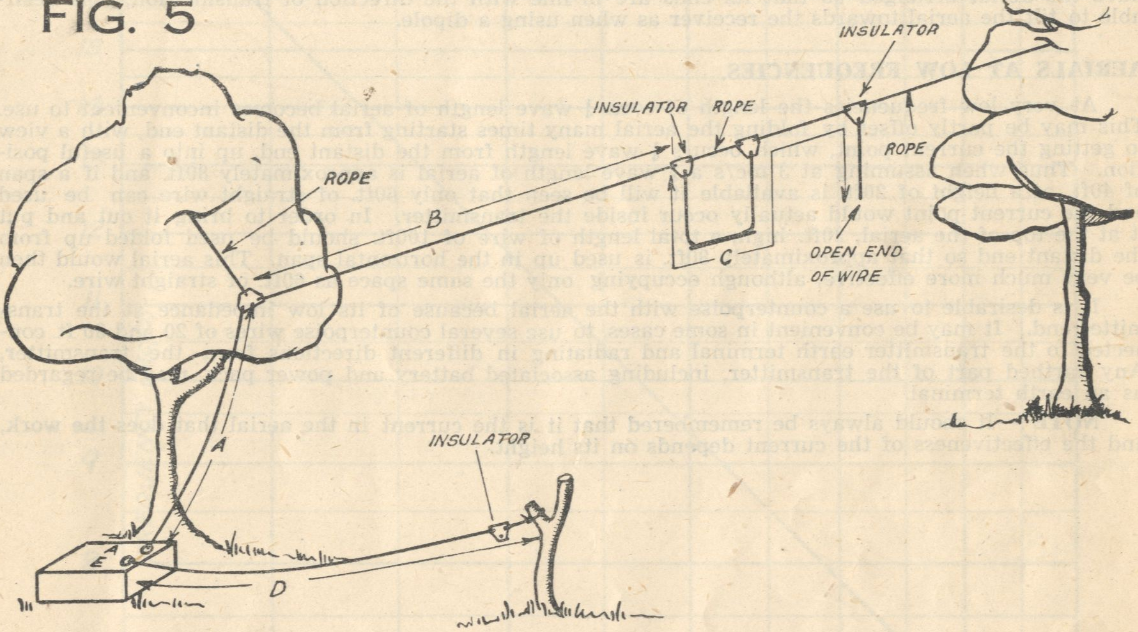
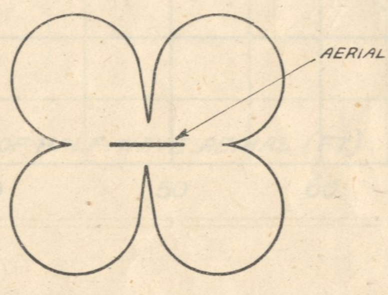


FIG. 6



PLAN OF POLAR DIAGRAM OF
FULL WAVE HORIZONTAL AERIAL

The aerial shown in figure 5 consists of an open wire of total length approximately $\frac{3}{4}$ wave length (A, B and C), using a counter-poise D. A counterpoise is preferable to an earth in this case since the low impedance of the aerial at the transmitter end would involve considerable loss when used with an average earth.

The length D should be $\frac{1}{4}$ wave length of wire suspended a foot or so above earth and since the far end of the wire is a voltage point, it should be well insulated. The maximum current point in the aerial will occur approximately $\frac{1}{4}$ wave length from the far end and this should be arranged to be as high as possible and well clear of trees, etc.

The method of folding shown in figure 5 is not essential and the aerial may be folded more or less as convenient. The remarks regarding direction, sloping, etc., concerning dipoles apply equally well in this case.

It frequently happens when using high frequencies that a full wave length aerial can be conveniently erected. It should be noted that a full wave length aerial is markedly more directional than shorter aerials and has four main lobes. It should not, if at all possible, be erected so that its length is at right angles to the direction of transmission but should preferably be arranged so that it lies in a plane approximately 45° to the desired direction of transmission. Although the propagation from the ends is low, that is the transmission is weaker in the directions along the length of the aerial, the drop in power is not so great as in the direction at right angles to the aerial, especially at distances under 500 miles. (See figure 6.)

If it is not possible to arrange the aerial so that the best angle is obtained and it is necessary to have the aerial arranged so that its ends are in line with the direction of transmission, it is desirable to tilt the aerial towards the receiver as when using a dipole.

AERIALS AT LOW FREQUENCIES.

At very low frequencies the length of even ¼ wave length of aerial becomes inconvenient to use. This may be partly offset by folding the aerial many times starting from the distant end, with a view to getting the current point, which occurs ¼ wave length from the distant end, up into a useful position. Thus when assuming at 3 mc/s a ¼ wave length of aerial is approximately 80ft. and if a span of 40ft. at a height of 20ft. is available it will be seen that only 60ft. of straight wire can be used and the current point would actually occur inside the transmitter. In order to bring it out and put it at the top of the aerial, 20ft. high, a total length of wire of 100ft. should be used folded up from the distant end so that approximately 80ft. is used up in the horizontal span. This aerial would then be very much more effective, although occupying only the same space as 60ft. of straight wire.

It is desirable to use a counterpoise with the aerial because of its low impedance at the transmitter end. It may be convenient in some cases, to use several counterpoise wires of 20 and 30 ft. connected to the transmitter earth terminal and radiating in different directions from the transmitter, Any earthed part of the transmitter, including associated battery and power pack, may be regarded as an earth terminal.

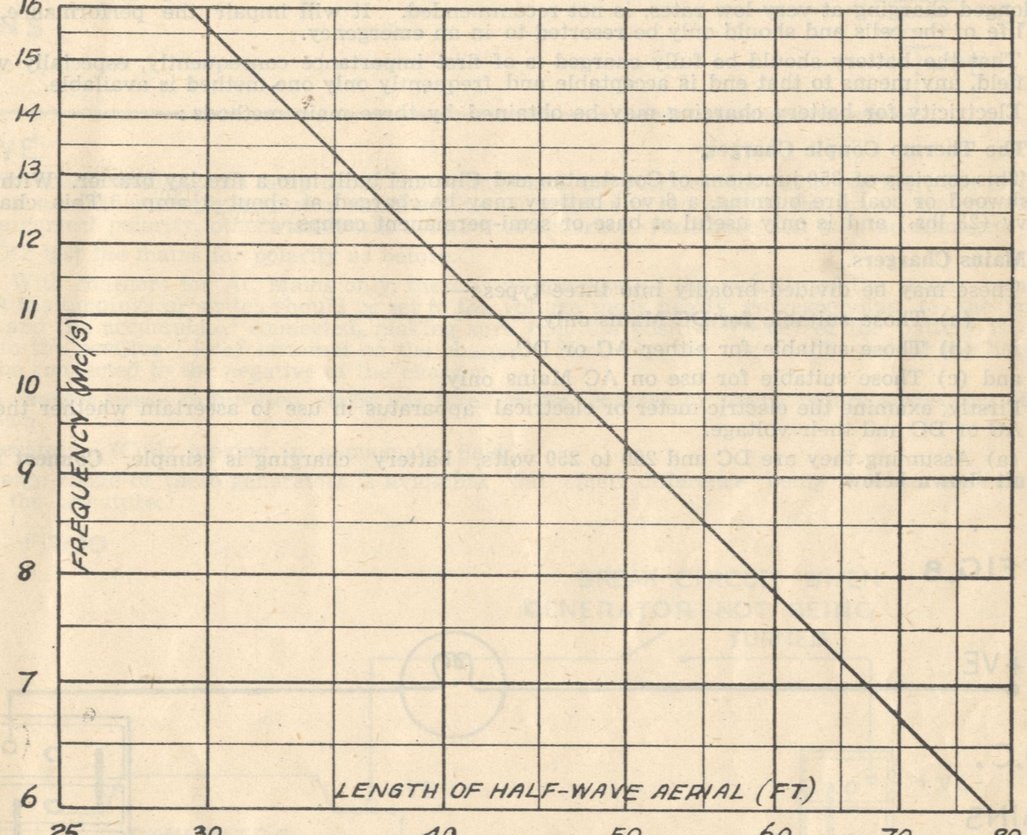
NOTE :—It should always be remembered that it is the current in the aerial that does the work, and the effectiveness of the current depends on its height.

FIG. 7

LENGTH OF AERIAL $= \frac{0.95\lambda}{2}$

WHEN λ = LENGTH

LENGTH IN FEET $= \frac{466}{\text{FREQUENCY (Mc/s)}}$



NOTE:

1. FOR FREQUENCIES BELOW 6 Mc/S (3-8 Mc/S) THE LENGTH OF A HALF-WAVE AERIAL IS TWICE THE CORRESPONDING LENGTH AT DOUBLE THE FREQUENCY.

2. THE LENGTH OF A QUARTER-WAVE AERIAL IS HALF THE LENGTH OF A HALF-WAVE AERIAL AT THE SAME FREQUENCY.

3. THE LENGTH OF A FULL-WAVE AERIAL IS TWICE THE LENGTH OF A HALF-WAVE AERIAL AT THE SAME FREQUENCY.

APPENDIX B—BATTERY CHARGING AND MAINTENANCE OF LEAD-ACID BATTERIES.

When suitable electric mains and power packs are available, they should be used as the source of power, but when these are not available then very satisfactory results can be otained by using a 6 volt accumulator and a vibrator pack, but only if the battery is **fully charged** and **in good condition.** It is therefore essential that the operator who has to rely on batteries should pay special attention to Battery charging and Maintenance.

A run down battery should be recharged by means of proper charging plant at the rate specified by the makers of the battery until the cells are gassing freely and the voltage and specific gravity of the acid in each cell have remained constant for three hours. Trickle charging, or any form of prolonged charging at very low rates, is not recommended. It will impair the performance, reduce the life of the cells and should only be resorted to in an emergency.

That the battery should be fully charged is of first importance consequently, especially when in the field, any means to that end is acceptable and frequently only one method is available.

Electricity for battery charging may be obtained by three main methods :—

1. **The Thermo Couple Charger.**

This consists of 350 junctions of Constantan and Chromel built into a fireclay brazier. With a good brushwood or coal fire burning, a 6 volt battery may be charged at about 1 amp. This charger is heavy (23 lbs.) and is only useful at base or semi-permanent camps.

2. **Mains Chargers.**

These may be divided broadly into three types :—

(a) Those suitable for DC Mains only,

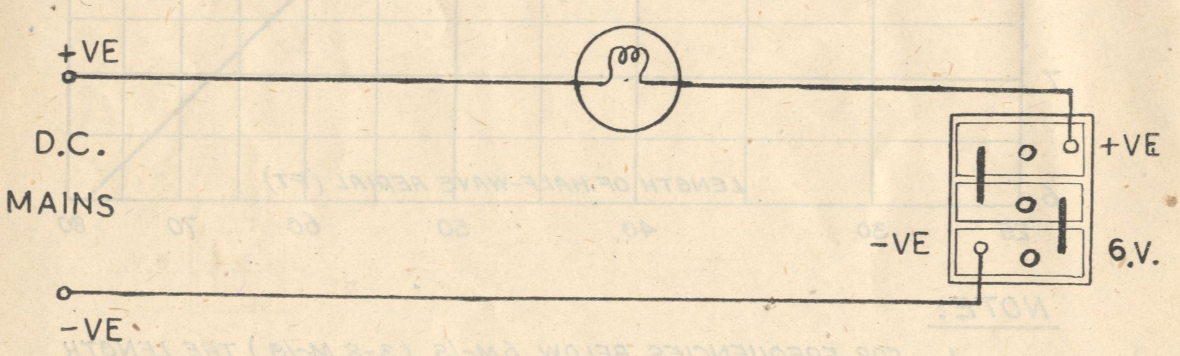
(b) Those suitable for either AC or DC,

and (c) Those suitable for use on AC Mains only.

Firstly, examine the electric meter or electrical apparatus in use to ascertain whether the mains are AC or DC and their voltage.

(a) Assuming they are DC and 200 to 250 volts, battery charging is simple. **Connect up the circuit shown below.**

FIG. 8



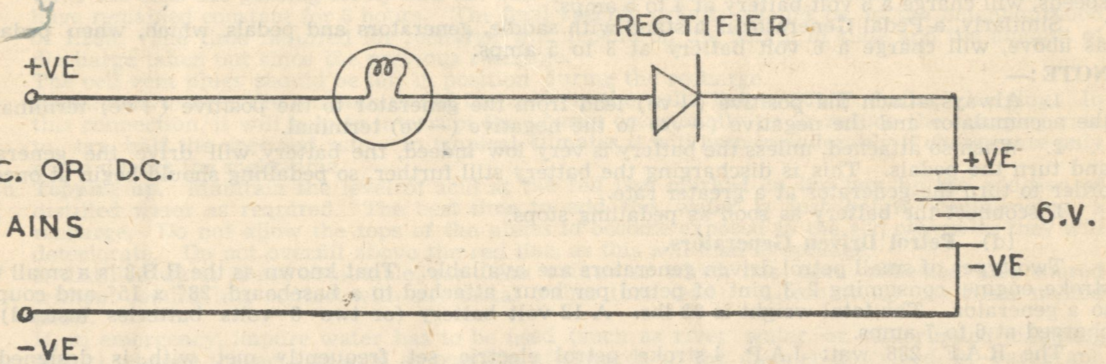
If the mains are 200 volts and the lamp is 100 watts, the charging current will be 100/200=½ amp.

If a 1000 watt electric fire is substituted for the 100 watt lamp, then the charging current will be 1000/200=5 amps.

It is important that the polarity of the mains should be known and connected correctly. If there is any doubt about this, connect up the circuit shown above using a lamp, but instead of attaching the wires to the battery, hold them an inch or two apart in a glass of water. Bubbles will appear at the negative lead. This wire should be connected to the negative terminal of the battery and the corresponding mains plug marked for future reference.

(b) Some chargers may be used on either AC or DC mains and in the absence of switches or moveable plugs, it is probable that the circuit will be as shown below.

FIG.9



If the mains are AC, the lamp drops the voltage and the rectifier acts as a rectifier, but if they are DC, the rectifier simply acts as a small additional resistance **but only** if the mains are connected with the correct polarity, otherwise it will act as a considerable resistance and may be damaged.

If DC, test the mains for polarity as before.

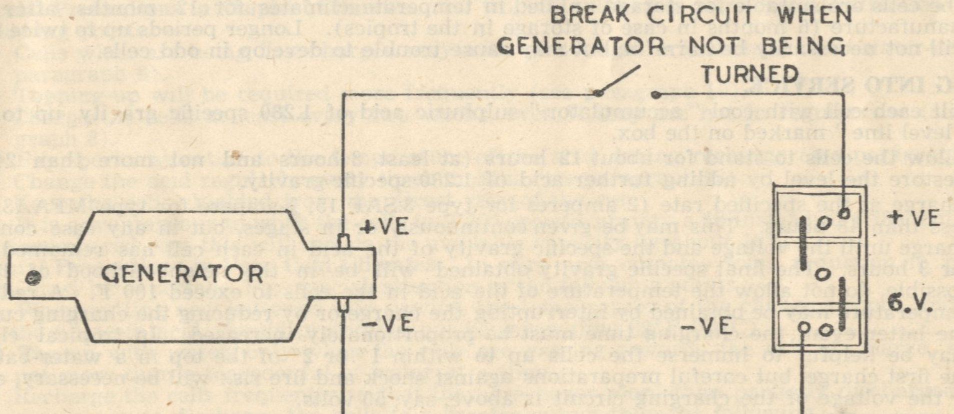
(c) With chargers for AC Mains only, there is no question of the polarity of the mains connection, but the tappings or switch should be set to the voltage most nearly corresponding to the main voltage and the accumulator connected, making sure that the positive (+ve) of the battery is connected to the positive (+ve) terminal on the charger. Similarly, the negative (−ve) of the battery should be connected to the negative of the charger.

If a charger ceases to function, check any fuses on the charger or mains before suspecting other breakdown.

3. **Generators.** (Coils moving in a magnetic field.)

A large range of these generators is available, the chief difference being in the method of driving the armature.

FIG.10



(a) **Wind generator.**

In this case drive is by means of a geared prop ellor attached to the generator and the whole supported on a 10ft. steel lattice mast—total weight 100lbs.

Charging rate—6 volt battery at about 2 amps according to wind velocity.

(b) **Hand Generators.**

There are several varieties of hand driven generators—some fitted to a tripod and others provided with clamps for attaching to a table or shelf. The ir weights vary from about 5 lbs. to 11 lbs. and when turned at 80 r.p.m., charge a 6 volt battery 2.5 to 3 amps.

(c) **Pedal Generators and Cycle Adaptors.**

Again there are variations in the method of drive. In the case of the Cycle Adaptor, the generator, together with a stand, is fitted to a standard cycle which, when pedalled at normal cycling speeds, will charge a 6 volt battery at 4 to 5 amps.

Similarly, a Pedal Generator is a stand with saddle, generators and pedals which, when pedalled as above, will charge a 6 volt battery at 3 to 5 amps.

NOTE :—

1. Always attach the positive (+ve) lead from the generator to the positive (+ve) terminal of the accumulator and the negative (—ve) to the negative (—ve) terminal.

2. When so attached, unless the battery is very low indeed, the battery will drive the generator and turn the pedals. This is discharging the battery still further, so pedalling should begin at once in order to turn the generator at a greater rate.

Disconnect the battery as soon as pedalling stops.

(d) **Petrol Driven Generators.**

Two types of small petrol driven generators are available. That known as the R.B.8 is a small two stroke engine, consuming 2/3 pint of petrol per hour, attached to a baseboard, 28″ x 15″ and coupled to a generator. The total weight is 82 lbs. A 12 volt battery (or two 6 volts batteries instead) is charged at 6 to 7 amps.

The R.A.F. 288 watt J.A.P. 4-stroke petrol electric set frequently met with, is designed to operate over a range of 14/32 volts for charging 12 V. 18 V. and 24 V. batteries. The normal charging rate is 9 amps and the maximum (for ½ hour) is 15 amps.

Size : 2′ 2½″ x 10″ x 1′ 7″.

Weight : 90 lbs. approx.

(e) **Steam Powered Generator.**

This consists of a boiler suspended in a brazier (weight 48 lbs.) and connected by flexible tubing to a small twin cylinder steam engine directly coupled to a generator (weight 22 lbs.). With a steam pressure of 30 to 35 lbs. per sq. inch and a consumption of half a gallon of water and 15 to 20 lbs. of wood per hour, a 6 volt accumulator may be charged at 4 amps.

THE CARE OF BATTERIES.

STORAGE PRIOR TO USE.

1. The batteries are supplied in an unfilled uncharged condition. Any liquid observed in the cells prior to filling in and first charge is water condensate from the wet separators. This will have no adverse effect on the operation of the cells.
2. The store room must be dry and should be kept as cool as possible. The cells should preferably be stored in the dark, but, in any case, they must be protected from the direct rays of the sun.
3. The cells are suitable for storage unfilled in temperate climates for 12 months after date of manufacture (6 months in case of storage in the tropics). Longer periods up to twice the above will not necessarily be harmful, but may cause trouble to develop in odd cells.

PUTTING INTO SERVICE.

4. Fill each cell with cool "accumulator" sulphuric acid of 1.280 specific gravity, up to the red "level line" marked on the box.
5. Allow the cells to stand for about 12 hours (at least 8 hours and not more than 24 hours). Restore the level by adding further acid of 1.280 specific gravity.
6. Charge at the specified rate (2 amperes for type 3.SAF 15, ¾-ampere for type MFA.13), for not less than 48 hours. This may be given continuously or in stages, but in any case continue the charge until the voltage and the specific gravity of the acid in each cell has remained constant for 3 hours. The final specific gravity obtained will be in the neighbourhood of 1.250. If possible, do not allow the temperature of the acid in the cells to exceed 100°F. A reduction in temperature may be obtained by interrupting the charge or by reducing the charging current. In the latter event, the charging time must be proportionately increased. In tropical climates it may be helpful to immerse the cells up to within 1″ or 2″ of the top in a water-bath during the first charge, but careful preparations against shock and fire risk will be necessary, especially if the voltage of the charging circuit is above, say, 50 volts.
7. **IMPORTANT.** At the end of the first charge pour out the electrolyte and refill immediately with fresh acid of 1.280 specific gravity. The cells are then ready for service.

OPERATION IN SERVICE.

8. **When to Recharge.** The cells should be recharged :—
   (a) Immediately prior to each operational discharge.
   (b) Whenever the specific gravity has fallen to 1.150 or the voltage has fallen, on load, to 1.80 volts. If the cells have been discharged to a specific gravity below 1.150, it is essential to give them a recharge IMMEDIATELY.
   (c) In any case, even if the cells have been standing idle, they must be recharged at least every month in temperate climates or every two weeks in tropical climates.

9. **How to Recharge.** Whilst on charge, the cells should stand on a dry bench or floor of some insulating material. A wooden bench covered by glass sheets makes a very suitable arrangement. Charge at the specified rate (2 amperes for type 3 SAF.15, ¾-ampere for type MFA.13) until the cells are gassing freely and the voltage and specific gravity of the acid in each cell have remained constant for 3 hours. The final specific gravity should be in the neighbourhood of 1.280. The time required for recharge will depend on the length of time and the amount of discharge taken out since the previous recharge.
The cell vent plugs should be left in position during the recharge.
Endeavour to keep the temperature of the acid in the cells below 100°F during charging. In this connection, it will help to interrupt the charge occasionally or to reduce the charging rate to, say, half the specified rate. In tropical climates it will help considerably if charges are only given during the night-time.

10. **Topping-up.** Maintain the level of acid at the red line marked on the box by the addition of distilled water as required. The best time to add the water is just before commencing a recharge. Do not allow the tops of the plates to become exposed to the air, otherwise they will deteriorate. Do not overfill above the red line, as this will lead to spillage.
If distilled water is not obtainable, use clean rainwater which has been collected and stored without coming into contact with any metal (other than lead). Alternatively use clean melted snow.
If, in emergency, impure water has to be used (such as river water or chlorinated drinking water), change the acid as soon as possible afterwards in the manner described in paragraph 13. Never add acid to the cells except to compensate for spillage.

11. **Cleanliness, etc.** Keep the cells clean and the filling plugs and connections tight. Keep the terminals lightly smeared with pure vaseline or petroleum jelly, so as to prevent corrosion.

12. **Safety.** Never bring a flame or spark near the cells at any time, but particularly during or shortly after a recharge.

13. **Changing Acid.** Once every 6 months in temperate climates, or once every 3 months in tropical climates, give the cells a full recharge as described in paragraph 9, and then pour out the existing acid. Refill the cells immediately with fresh acid of 1.280 specfic gravity.
Never change the acid without first giving the cells a full recharge.

14. **Idle Batteries.** If the batteries are standing idle, then once per month in temperate climates, or once in every two weeks in tropical climates, they must be topped-up as described in paragraph 10, and then recharged as described in paragraph 9. Batteries which are standing idle should be disconnected from all external apparatus.

15. **Trickle Charging.** Continuous trickle charging, or any form of prolonged charging at very low rates, is not recommended. It will impair the performance and reduce the life of the cells.

16. **Frothing.** If cells are found to froth on charge, this may be stopped temporarily by dropping a small pinch of dry soap into the cells. A rather more lasting care may be effected by changing the acid as described in paragraph 13.

17. **Special Precautions in Tropical Climates.** In tropical climates pay special attention to the following points :—
(a) Cells whch are being first-charged may with advantage be immersed in a water-bath (see paragraph 6).
(b) Topping-up will be required more frequently (see paragraph 10).
(c) Charge the cells at least every two weeks, even if they are not in regular use (see paragraph 8).
(d) Pay special attention to the temperature of the acid during recharge (see paragraph 9).
(e) Change the acid regularly every three months (see paragraph 13).
(f) Keep the cells shielded from the direct rays of the sun.
(g) It is advantageous to work the cells in 1.250 specific gravity acid instead of 1.280, but it must be remembered that this will reduce the available capacity by about 10%.

18. **Special Precautions in Very Cold Climates.** In very cold climates some reduction in performance must be expected. Pay special attention to the following points :—
(a) When putting new batteries into service, the temperature of the charging room, and also of the filling-in acid, should preferably not be lower than 32°F (O°C).
(b) Top-up with water, only when the cells are gassing towards the end of charge, and add not more than a teaspoonful of water at a time.
(c) Recharge the cells frequently so that they are never more than partially discharged. Take care never to discharge the cells to a greater output than the following :—

Prevailing Temperature.	**Ampere-hours output.** Type 3 SAF. 15.	Type MFA. 13.
plus 20°F (−7°C.)	27 ampere-hours	10 ampere-hours.
plus 10°F (−12°C.)	19 ampere-hours	8 ampere-hours.
0°F (−18°C.)	15 ampere-hours	6.5 ampere-hours.
—10°F (−23°C.)	13.5 ampere-hours	5.5 ampere hours.
—21°F (−29°C.)	10 ampere-hours	4 ampere-hours.

If the above outputs are accidentally exceeded, it is essential to recharge the cells immediately. If these precautions are not taken, the acid in the cells may freeze, in which case they will be ruined

3/II.—MAINTENANCE, FAULT-TRACING AND RECEIVER ALIGNMENT.

Routine Inspection and Maintenance
(Page 20)

Simple Fault-Finding
(Page 20)

Continuity Testing
(Page 21)

Receiver Testing
(Page 24)

Transmitter and Power Pack Testing
(Pages 22 and 23)

Re-alignment
(Pages 26 and 27)

Testing Crystals
(Page 25)

1. ROUTINE INSPECTION AND MAINTENANCE.

It is important to carry out regularly inspection of the equipment. Small faults should be rectified before they become serious.

a. Check aerial and earth wires and connections.
b. Keep plugs and sockets clean, slightly greased with vaseline, if outdoors.
c. Check control knobs ; tighten grub screws if necessary.
d. Check spares kit and know how to pack it properly and quickly.
e. See that all valves are firmly in their sockets.
f. Keep inside of set clean with aid of a small brush.
g. Keep accumulators charged, terminals clean and slightly greased. Top up with distilled water to keep acid level above the plates.

II. SIMPLE FAULT FINDING.

Faults divide into classes :—

1. **Breakdown** or short circuit of some part resulting in stoppage of the unit (receiver, transmitter or power pack) accompanied by noise of sparking or smoke from the defective part). In most cases the fuses in the power pack will blow immediately.
   Action : Switch off quickly, disconnect power supply and inspect for fault. This will usually be found quickly. Typical example—condenser broken down.
2. **Disconnection** or open circuit, of some part or wire resulting in the stoppage of the unit in which it occurs. This usually causes no risk of damage to equipment, which may be left switched on whilst simple tests are carried out.
   Typical faults :—plug not making contact, wire broken, or resistor or coil open circuit
3. **Intermittent faults**, which cause erratic behaviour of unit in which they are located. Usually due to poor connections in plugs, fractured wires or weak switch contacts and frequently defective valves.
4. **Deceptive faults** frequently cause the fault finder to investigate some part of the circuit which is apparently defective when in fact the trouble may lie elsewhere. For example, a soft valve VIB causes the volume control to became inoperative, implying that it is faulty.
   Again, a bad contact or broken wire in the power pack may stop the receiver operating whilst not affecting the transmitter, thus implying that the power pack is in order and the receiver faulty, when the reverse is the case.
   To aid in finding such faults the following tables should be consulted.
   (The moral is to "Look before you Leap.")

Some of the fault finding operations, especially those requiring immediate action on the part of the operator, should be committed to memory.

In carrying out tests it must be remembered that although the voltages in the receiver are not high enough to cause more than an unpleasant shock, the voltages in the transmitter and power pack in certain places can be dangerous to life.

NEVER BE CARELESS—DEATH IS PERMANENT.

Do not carry out tests inside units with power switched on, or the set might be damaged irreparably, which has the same effect as a dead operator—the message cannot be sent.

The meter on the panel of the transmitter is provided with a switch (Meter Selector) which enables the operator to measure the current or voltage in different circuits. The normal readings quoted in the tables are average for a number of wireless sets but will vary slightly from one set to another. The reading of a new set should be compared with the table and any difference noted for future reference. If even a small part of the circuit is faulty, the meter will probably read more or less than normal and if the amount by which each part affects the meter is known, then the fault may be found very easily.

Rule of Thumb Tests. Use of Ears and Eyes.

Noise : The power pack normally has a faint low pitched mechanical hum when working on mains. The operator should accustom himself to this so that he may at once "hear" if something unusual is taking place.

On vibrator operation from batteries the hum from the vibrator is distinctive and louder and again provides assurance of working or danger signal according to note.

The receiver provides plenty of evidence of life. The normal hiss of the receiver in the telephones at maximum volume indicates that all is well. Reducing the gain control should reduce the noise. Switching on the B.F.O. should produce a click and an increase of hiss if the B.F.O. is working properly.

Switching from one wave band to another causes clicks in the telephones. Touching the metal aerial socket with any metal object should produce clicks if the Frequency changer unit is working.

The transmitter produces no characteristic noise and use must be made of the meter provided.

Observation that all plugs are pushed well into their sockets should be instinctive to the operator. The glow of valves may be observed through venilating holes in the cases of the units.

Continuity Tests. Use of Headphones and Meter.

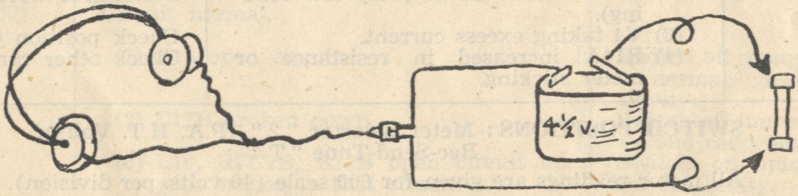
The simplest method of determining whether, or not, a connection between two points, or a coil or resistor is broken, is to use the telephones and any battery or accumulator of 1½, 2, 3, 4, 4½ or 6 volts. When a pair of telephones is connected across a battery a click will he heard when contact is made. Now if the connection is made to the battery through a lead which is suspected of being broken, if a click is heard the lead is in order or if no click is heard the lead must be broken in some place. This method is useful and may be employed to test coils, transformers, resistors, leads from sets to cable plugs, mains lead, etc. It is not a satisfactory method of testing condensers, however, since the charging up current of a good condenser will cause a click and give the impression that it is broken down.

The meter in the transmitter can be employed in continuity testing, especially of condensers. The TX cable plug is removed from the power pack (which should be disconnected from the mains,) and a wire connected to the "HT—" pin of the cable plug. This is the one nearest the point where the cable enters the plug. This wire should be connected to the negative (—) Terminal of a battery or accumulator having any voltage up to 12 volts. Set the transmitter switches to "R" and Meter Selector to "4." Now connect a second wire to the positive (+) terminal of the battery and a third wire to the Earth terminal of the transmitter.

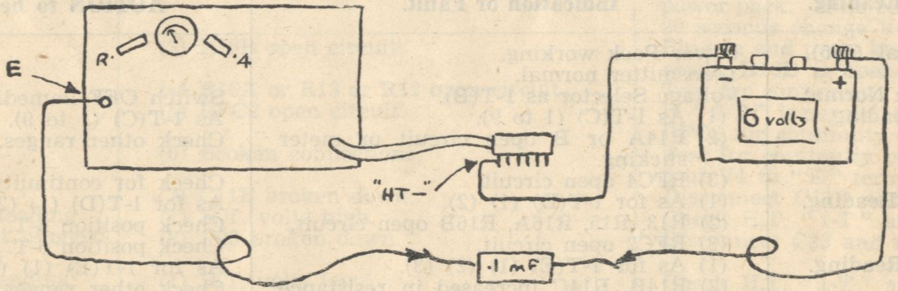
Touching the ends of the second and third wires together will make the meter read the voltage of the battery on the 15 scale. (6 volt battery will read 6,)

If the second and third wires are connected across a condenser the meter will give a reading if the condenser is faulty. The condenser should have at least one end disconnected from the rest of the circuit so as not to get false readings. When continuity testing on the receiver, it must not be plugged into the power pack, and when the power pack is tested for continuity it should not be connected to any mains or accumulator.,

The meter may be used to check the continuity of the telephones and vice-versa, thus ensuring that both methods of test are working.



TESTING A FUSE FOR CONTINUITY WITH TELEPHONES AND BATTERY



METER BEING USED TO CHECK CONDENSER

USE OF METER AND TABLES.

SWITCH POSITIONS: Meter Selector "1" (Oscillator H.T. Volts)
Rec-Send-Tune "T"

All meter readings are given for 600 scale (20 volts per division).

Meter Reading.	Indication or Fault.	ACTION to be taken.
(A) Normal (210).	Power Pack working. Transmitter normal.	
(B) Twice Normal.	Voltage Selector Set for 97-140 V. MAINS VOLTAGE 190-250 V.	Switch OFF immediately. Reset voltage selector.
(C) No Reading.	(1) Mains not connected or switched on.	Check plugs, switch, leads.
	(2) D.C. mains supply.	Recheck mains, fuses.
	(3) Fuses blown.	Examine and test continuity.
	(4) Voltage selector and Mains/Battery plugs.	Push down.
	(5) Tx. cable plug.	Push down or sideways.
	(6) Mains lead broken.	Test continuity.
	(7) On/Off switch faulty, or Primary of T1 open circuit or RFC3A open circuit.	Test for continuity between mains pins (S1A) with switch ON.
	(8) Broken wire or connection inside Power pack or Transmitter.	Inspect and test for continuity.
	(9) Secondary of T1 open circuit.	Test for continuity across C27A and C27B.
	(10) R14A or meter or R20 open circuit.	Check other positions 2-T for R14A, 1-R for R20.
(D) High Reading (up to 300)	(1) Voltage selector incorrectly set.	Recheck mains.
	(2) V3 or V4 not taking current.	Check position 6-T for V4. See if valves glowing.
	(3) C11B or C11C broken down.	Disconnect C11B—retest. Disconnect C11C—retest.
	(4) L7, L8, L9 or RFC1A open circuit.	Check with crystal in socket on 4-T.
	(5) L5, L6 open circuit.	Set Crystal Selector switch to "Fundamental" see Note I-T/D/5.
	(6) R14A reduced in resistance.	Check other ranges.
(E) Low Reading.	(1) Voltage selector incorrectly set.	Recheck mains.
	(2) C11D broken down (very low reading).	Disconnect C11D—retest.
	(3) V4 taking excess current.	Check position 6T.
	(4) R14A increased in resistance or meter sticking.	Check other ranges.

SWITCH POSITIONS: Meter Selector "2" (P.A. H.T. Volts).
Rec-Send-Tune "T"

All meter readings are given for 600 scale (40 volts per division).

Meter Reading.	Indication or Fault.	ACTION to be taken.
(A) Normal (265).	Power Pack working. Transmitter normal.	
(B) Twice Normal.	Voltage Selector as 1-T(B).	Switch OFF immediately.
(C) No Reading.	(1) As 1-T(C) (1 to 9).	As 1-T(C) (1 to 9).
	(2) R14A or B open circuit or meter sticking.	Check other ranges.
	(3) RFC4 open circuit.	Check for continuity.
(D) High Reading.	(1) As for 1-T(D) (1) (2).	As for 1-T(D) (1) (2).
	(2) R13, R15, R16A, R16B open circuit.	Check position 6-T.
	(3) RFC2 open circuit.	Check position 6-T.
(E) Low Reading.	(1) As for 1-T(E) (1) (2) (3).	As for 1-T(E) (1) (2) (3).
	(2) R14B, R14C increased in resistance or meter sticking.	Check other ranges.

SWITCH POSITION : Meter Selector "3" (P.A. Grid current).
Rec-Send-Tune "T"

All meter readings are given for 600 scale (.2 milliamp per div.).

Meter Reading.	Indication or Fault.	ACTION to be taken.
(A) Normal "O" (untuned)	Circuit normal.	
(B) Meter reads backwards.	(1) Meter zero setting wrong.	Switch off; see if meter returns to "O."
	(2) C17B short circuit.	Switch off, remove V4, retest.
	(3) V4 defective.	As for (2); replace V4 if meter now reads "O."

SWITCH POSITION : Meter Selector "4" (Osc. Grid current)
Rec-Send-Tune "T"

All meter readings are given for 15 scale (.05 milliamp per div).

Meter Reading.	Indication or Fault.	ACTION to be taken.
(A) Normal "O" (no crystal).	Circuit normal.	
(B) Meter reads backwards.	(1) Meter zero setting wrong.	Switch off, if meter does not return to zero, adjust screw on meter.
	(2) Defective V3.	Change V3, retest.

SWITCH POSITION : Meter Selector "6" (P.A. cathode current)
Rec-Send-Tune "T"

All readings are given for 600 scale (4 milliamps per division).

Meter Reading.	Indication or Fault.	ACTION to be taken.
(A) Normal (150). (=30m.A.)	Circuit normal.	
(B) Full Scale.	(1) R15 open circuit.	Switch off immediately. If Z-T is normal check R15 for continuity.
	(2) C17B broken down.	Switch off immediately. Remove V4 and carry out 3-T (B) (2).
	(3) L10, RFC1B, R11B open circuit or wire broken in that circuit.	Switch off immediately. Test for continuity.
(C) No Reading.	(1) No. H.T. volts.	Test "2-T."
	(2) No L.T. volts at valve.	Press down Tx cables plug in power pack. If no reading after 20 seconds change V4.
	(3) R16B open circuit.	Plug in and press key. If meter reads, R16B is open circuit.
	(4) R16A or R13 or R12 open circuit.	Test for continuity.
	(5) RFC2 open circuit.	If "2-T" is normal or high, test RFC2 for continuity.
	(6) Broken connections.	Test for continuity between pin 8 of V4 to "E" terminal.
	(7) C11E broken down.	Disconnect C11E and retest.
(D) High Reading. (Key not plugged in).	(1) H.T. volts high.	Check H.T. "1-T" and "2-T."
	(2) C23 broken down.	Disconnect C23 and retest.
(E) Low Reading.	(1) H.T. volts low.	Check H.T. "1-T" and "2-T."
	(2) Valve emission low.	Try spare valve.
	(3) Meter sticking.	Try other ranges.

RECEIVER TESTS.

SWITCH POSITION : Meter Selector "1" (Receiver H.T. volts)
Rec-Send-Tune "R"

All meter readings given for 600 scale (20 volts per division).

Meter Reading.	Indication or Fault.	ACTION to be taken.
(A) Normal (230).	Receiver, Transmitter, switching, and power pack normal.	
(B) Twice Normal.	As for "1-T."	SWITCH OFF IMMEDIATELY.
(C) No Reading.	(1) As for "1-T" (C) (1 to 10).	As for "1-T" (C) (1 to 9).
	(2) Rx cable plug.	Push down and sideways.
	(3) Short circuit in receiver.	Remove Rx cable plug, if meter reads, fault is in RX.
	(4) R21 open circuit.	Check position "1-T"; if normal, check position "4-R." If full scale, switch off, remove Rx and Tx plugs from P.P. and test for continuity between "HT—" and "E" sockets.
(D) High Reading.	(1) Voltage Selector incorrectly set.	Recheck mains.
	(2) R14A reduced in resistance.	Check other ranges.
	(3) Receiver not taking current due to valves having no L.T. volts.	Check "1-T." If normal check "4-R." If no reading push Rx plug down and sideways. Look through vent holes to see if valves glow.
(E) Low Reading.	(1) As for "1-T" (E) (1 and 4).	As for "1-T" (E) (1 and 4).
	(2) Receiver taking excess current.	Check "1-T." If normal check "4-R."

SWITCH POSITION : Meter Selector "2" / Rec-Send-Tune "R" } as for "2-T"

SWITCH POSITION : Meter Selector "3" / Rec-Send-Tune "R" } NO readings.

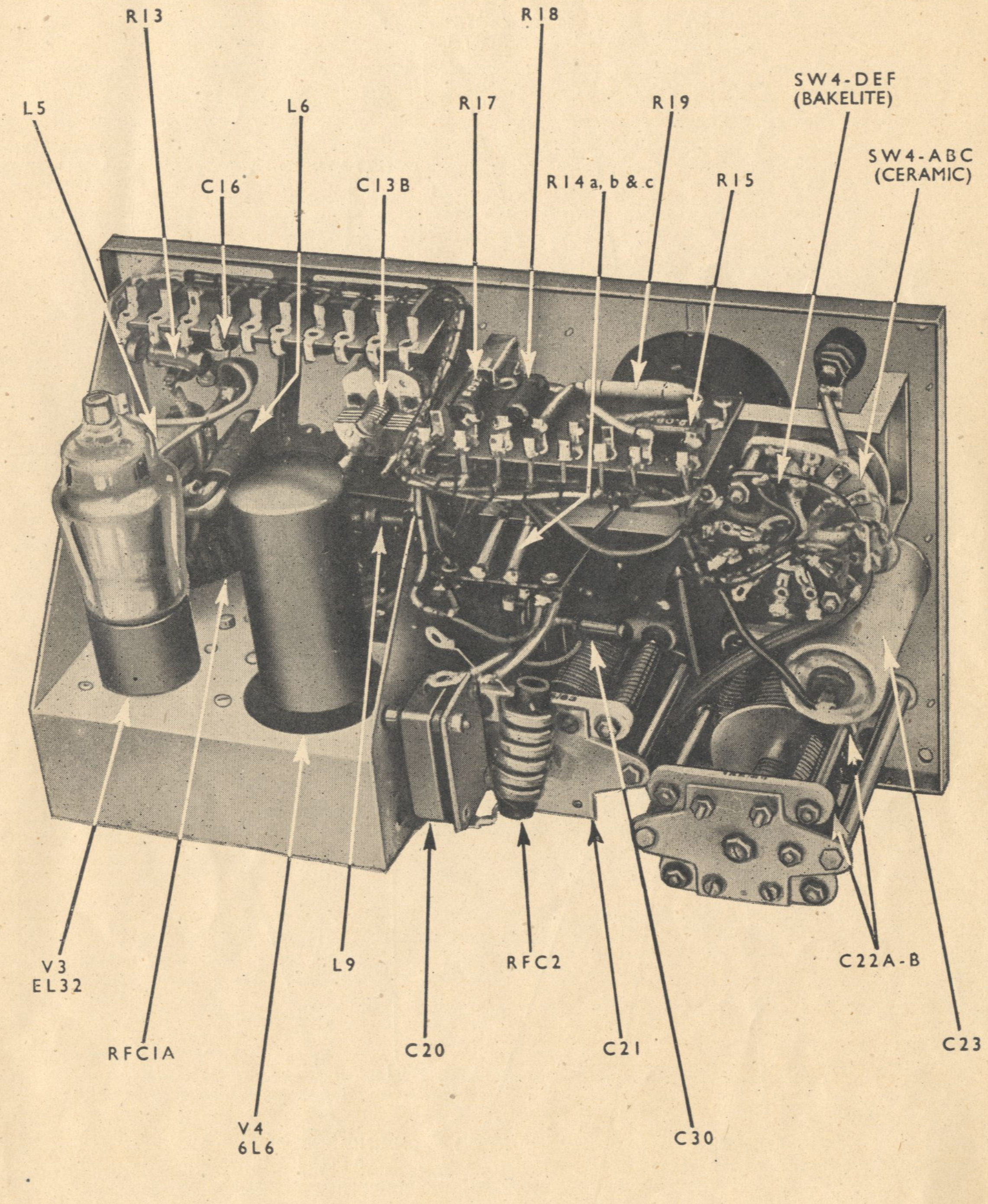
SWITCH POSITION : Meter Selector "4" (Receiver current)
Rec-Send-Tune "R"

All readings given for 15 scale (1 milliamp per division).

Meter Reading.	Indication or Fault.	ACTION to be taken.
(A) Normal (12½). (=25m.A.)	Receiver, Transmitter, switching, and power pack normal.	
(B) Full Scale.	(1) Short circuit in receiver.	Check "1-R" (C) (1 to 3). Do not keep set switched on except to short times on tests.
	(2) R21 open circuit.	Switch off. See "1-R" (C) (4).
	(3) C9B or C9C defective. (If C9B is defective R5 will probably be discoloured.)	Disconnect C9B and retest. Disconnect C9C and retest.
(C) No Reading.	(1) As for "1-T" (C) (1 to 10).	As for "1-T" (C) (1 to 10).
	(2) Receiver not taking current.	Check "1-R." If normal read on.
	(3) As for "1-R" (D) (2).	As for "1-R" (D) (2).
	(4) Rx or Tx plugs.	Push down and sideways.
	(5) Broken leads in cables.	Examine and test for continuity.
	(6) R19 open circuit or meter defective.	Check other ranges, see note "4-R"/C/5.
(D) High Reading.	(1) Voltage selector incorrectly set.	Check "1-T."
	(2) If volume control inoperative defective valve V1B or shorted condenser C9F or broken connection between VR1 and Rx cable plug or between VR1 and R6A.	Change V1B and retest; disconnect C9F and retest. Inspect and test connections for continuity.

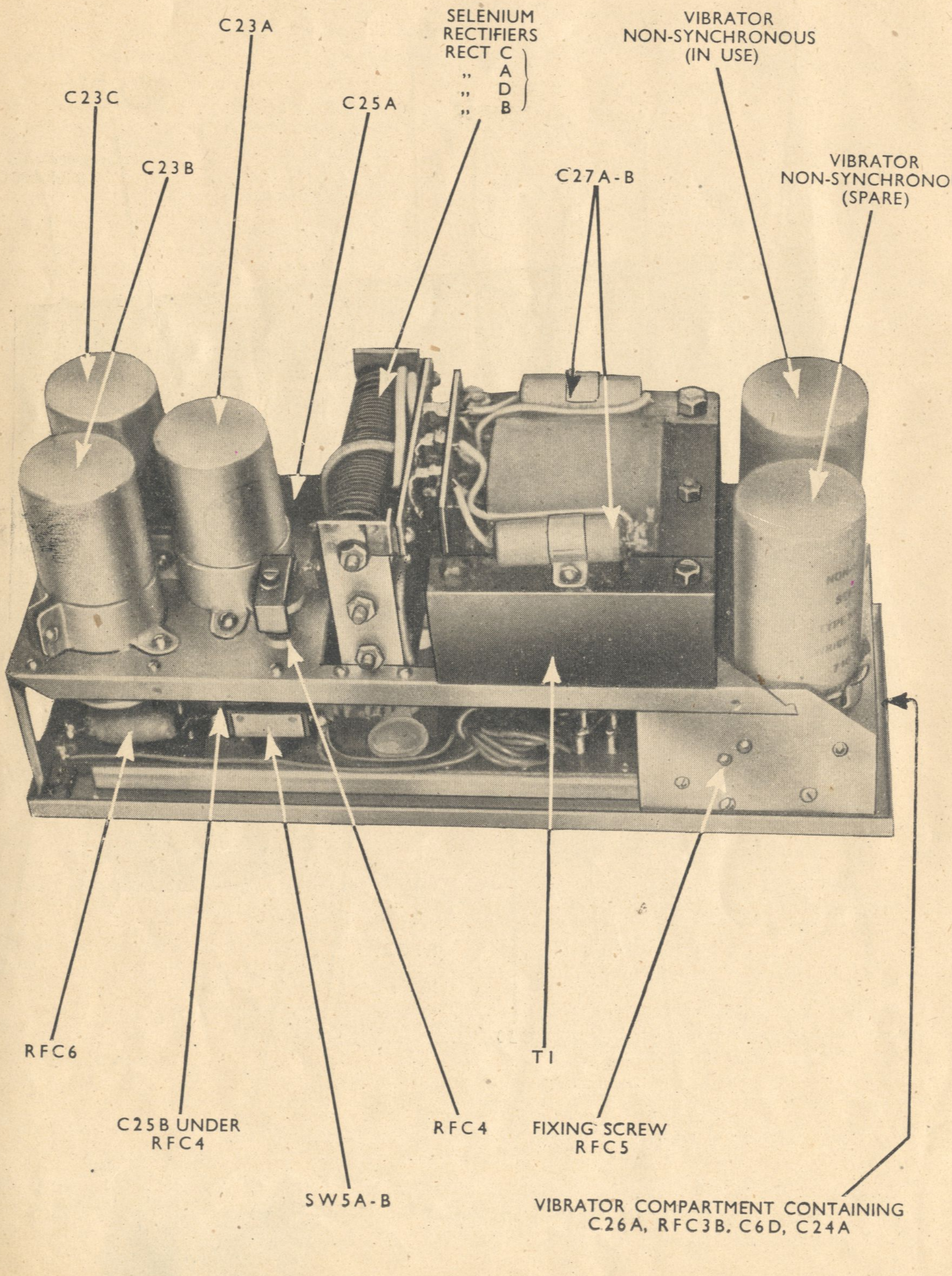
PLATE 5.

TRANSMITTER CHASSIS
(OSCILLATOR UNIT, SWITCH BRIDGE, TUNING ASSEMBLY)



WHEN 6L6G (GLASS) VALVE IS USED AS V4, A METAL SHIELD IS PROVIDED FOR V3.

POWER PACK CHASSIS



Meter Reading.	Indication or Fault.	ACTION to be taken.
	(3) If BFO does not work:—Defective V1B or C7D or C12. Short between spindle or BFO condenser and panel.	Change V1B—retest. Inspect for short between BFO condenser spindle and panel. Test for continuity. Disconnect C7D, test for continuity, if faulty, disconnect C7F and use to replace C7D.
	(4) If no checks from aerial or waveband switch:—Defective V1A, C9A, C6B. Defective I.F. transformer.	Change V1A—retest. Disconnect C9A—retest. Disconnect C6B—retest. Check all I.F. windings for continuity.
(E) Low Reading.	(1) Voltage selector incorrectly set.	Check "1-T."
	(2) (6 divisions low) V1A or V1B defective.	Change V1A—retest. Change V1B—retest.
	(3) (3 divisions low) V2A or V2B defective.	Change V2A—retest. Change V2B—retest.
	(4) R7B, R4B, R8, R7A, R5, R4A or T2 defective.	Test for continuity, according to note 4/R/E4.
	(5) No sound in telephones when junction of R6C C6C is touched:—Defective V2B, C7E or R7B, T2.	Change V2B—retest. Disconnect C7E—retest. Test R7B and T2 for continuity as note 4-R/E4.

Notes on Use of Tables.

1-T. D/5. If the Crystal selector switch is set to "Fundamental" when the transmitter is switched to tune, plugging a crystal into the socket will give a reading on "4-T." If RFCIA is defective set the Crystal selector to the frequency of the crystal when a reading should be obtained. Conversely if no reading can be obtained when set to crystal frequency but obtained when switch is set to Fundamental, then coils L5 or L6 or the switch are defective and should be checked for continuity.

If V3 or L7, L8 or L9 are defective no reading will be obtained on "4-T" for any position of the crystal switch.

More than one crystal should be tried to make sure that it is not the crystal which is defective.

1-R. C/3. If a short circuit occurs in the receiver between an H.T.+ point and earth (chassis) it may be found by

(a) Visual examination of all points connected to the H.T.+ line which runs round the set. Inspection should include the following points: T2 tags 3 and 4, R7B, L8C, R8, R7A, C9E, tags and wire between I.F. unit and Frequency changer unit, R5, R4A, C9B.

(b) Measuring continuity with meter between H.T.+ on Rx cable plug (2 pins joined together) and chassis. A reading indicates a short circuit. If a reading is obtained, disconnect each of the following components in turn, rechecking after each is disconnected. When the faulty component is disconnected the meter will no longer read. That component should be removed or completely disconnected from the circuit and tested for shorting.

Disconnect:—C9C, R8 (tests C9E and L8A), R5 (tests C9B and RL7A), R4A (tests C9A), L8C, tag 3 of T2, R4B (tests C7D, C13A, C12, C3C and L8E).

4-R. C/5. To test meter on range "4-R" if it is suspected of being faulty connect up as for continuity test as described on page 21 and measure continuity of telephones. If reading and click in telephones is obtained then meter is O.K. If not, check continuity from HT,—pin of Tx cable plug to R19, R19 to meter —, meter — to meter +, and meter + to earth terminal, using telephones.

4-R. E/4. To test continuity of resistors R7B, R4B, R8, R7A, R5, R4A and transformer T2, connect up as for continuity test as page 21, and connect wire between "E" terminal of transmitter and H.T.+ pins of Rx cable plug. Wire from battery is then connected in turn to each of the following points when a reading should be obtained. The number of the resistor tested is given in the brackets:—

Pin No. 5 of V2B valveholder (R7B). Pin No. 3 of V1B (R4B), C9E (R8). C9D (R7A). C9B (R5). C9A (R4A). Tag 4 of T2.

VIBRATOR OPERATION.

Normally the readings obtained on the meter when operating from 6 volt accumulators will be the same or slightly less than when working on mains.

The meter readings will fall below normal as the battery runs down. When looking for power pack faults, the "LT" fuse and vibrator should be first checked, together with battery leads and connections.

The vibrator itself may be tested by removing it from the power pack and connecting wires from each of its thick pins to a 6 volt battery when it should buzz if it is in order.

RECEIVER ALIGNMENT.

The alignment of the tuned circuits of the receiver should not be attempted except by an EXPERIENCED man equipped with the instruments mentioned below. If replacement of a defective coil or trimmer is made, the adjustments of other circuits should not be touched, when approximate adjustment of the replaced component may be carried out by tuning a steady station on the appropriate band and adjusting for maximum response. The alignment instructions should be read through carefully before proceeding.

The equipment necessary for the re-alignment of the complete receiver :—

(1) Signal generator covering frequency range at least 400 Kc/s to 15 Mc/s, with attenuator. Provision for internal modulation at 400 cycles/sec, with switch for modulation "on-off."

(2) An output meter with ranges up to at least 100 mW, and input which may be adjusted to match 800 ohms. Alternatively a rectifier type meter of approx. 1000 ohms per volt reading 10 volts full scale, having a resistor as nearly as possible of 875 ohms connected across its terminals, may be used.

This will match the 800 ohms output of the receiver and will read power approximately as follows :—

1 mW = .9 V. 5 mW = 2 V. 10 mW = 2.8 V.
50 mW = 6.3 V. 100 mW = 9 V.

Small box spanners and trimming wrenches should be obtained or made to fit the lock-nuts and adjusting screws of the I.F. transformers and R.F. coils, while a screwdriver, preferably of insulating material, should be made up to fit the slotted heads of the ceramic trimmers in the Frequency-changer Unit.

The tester should ensure that he knows the position and circuit reference number of all the trimmers. It is assumed that the receiver is in normal good working order and requires only alignment. It is WASTE OF TIME to try to align a receiver having some fault present.

The normal dummy aerial (if fitted to the signal generator) must be replaced by a carbon resistor of approx. 40 ohms in series with a condenser of 100 pF (.0001mF). This will henceforth be termed the "D.A."

To start, connect up the receiver and, with case removed, put it into operation. Connect the output meter to the Telephone sockets. A pair of telephones, with a high resistance (10-20,000 ohms) connected in series, may also be connected across the telephone sockets so that the tester may hear what is happening. High impedance phones are preferable if available.

I.F. Alignment.

(1) Set the Signal Generator (S.G.) to 470 Kc/s with modulation on.

(2) Connect the earthy side of the S.G. to receiver chassis and the D.A. to the grid of the first I.F. valve (V2A pin 6).

(3) With receiver gain at max. and B.F.O. off, dial 0 degrees on 3.1-5.4 Mc/band, and adjust the S.G. attenuator until a signal is heard.

(4) Adjust L8D, L8C, L8B, L8A for maximum response in that order and recheck. The S.G. attenuator setting may be reduced as necessary so that the output does not exceed 50 mW. Re-lock the trimmers with the lock nuts.

(5) Transfer the D.A. to grid of Frequency-Changer valve (V1A pin 6) and adjust RL7A, RL7B until maximum response is obtained, then re-check. Reduce input and re-lock trimmers as in (4).

(6) If the set appears to be instable reduce the setting of the gain control until it is quite stable. Detune the S.G. to each side of 470 Kc/s. The response should be approximately symmetrical. Reset the S.G. to 470 Kc/s.

(7) Switch off S.G. modulation and set B.F.O. control to "O." A beat note should be heard. Adjust L8E for zero-beat. Adjusting the B.F.O. control from −3 to +3 should give approximately equal notes on each side with maximum volume at approx. −1 and +1. Re-lock the B.F.O. trimmer.

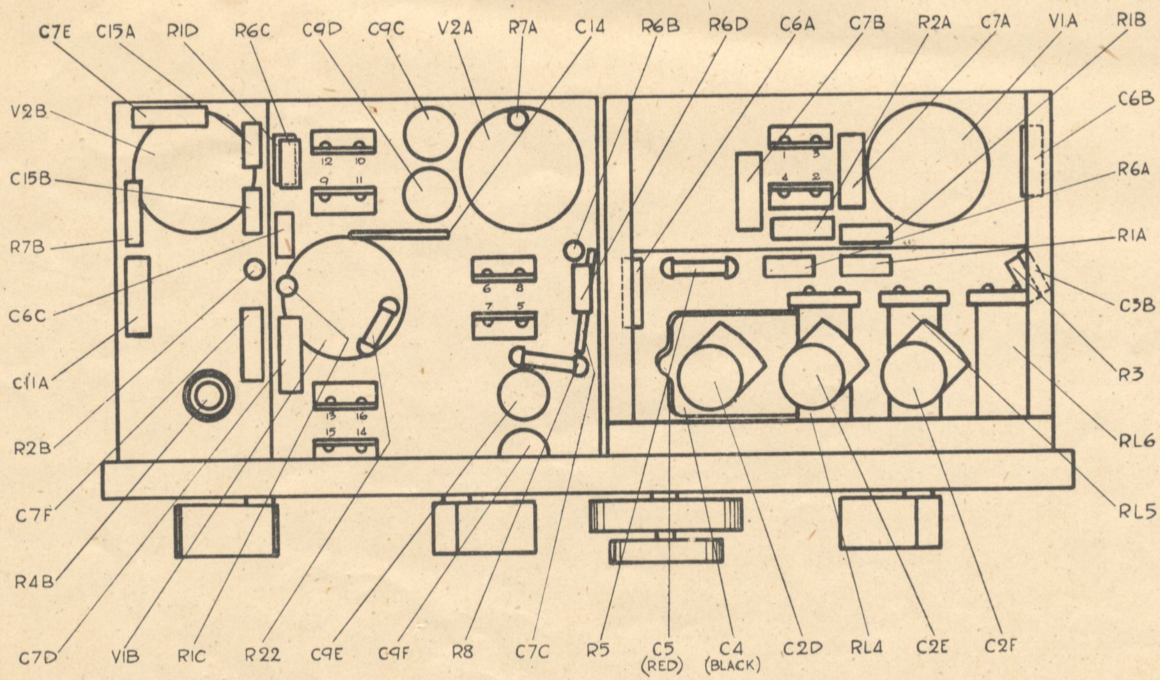
Alignment of Oscillator circuits :—

Assuming that the circuits are well out of adjustment proceed as below, following alignment or checking of the I.F. amplifier.

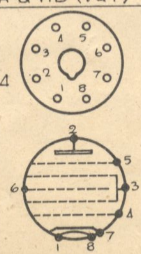
Set the wave band switch to the band to be aligned, and set the receiver tuning dial to 0 degrees. See that the blades of the tuning condenser are fully meshed.

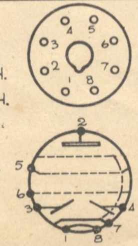
For the purpose of this example it will be considered that the 3.1 to 5.4 Mc/s band is being realigned.

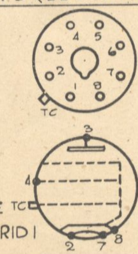
DIAGRAM SHOWING LOCATION OF RECEIVER COMPONENTS.

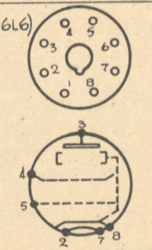


I.F. TRANSFORMER CONNECTIONS			VALVES V1A & V1B (7Q7)	VALVES V2A & V2B (7R7)	VALVE V3 (EL 32) TX	VALVE V4 (6L6G) TX
1.	IP	RL7A	1. HEATER	1. HEATER	1. BLANK	1. SHELL (FOR 6L6)
2.	OP	RL7A	2. ANODE	2. ANODE	2. HEATER	2. HEATER
3.	OS	RL7B	3. GRIDS 2 & 4	3. DIODE L.H.	3. ANODE	3. ANODE
4.	IS	RL7B	4. GRID 1	4. DIODE R.H.	4. GRID 2	4. GRID 2
5.	IP	L8A	5. GRID 5	5. GRID 2	5. BLANK	5. GRID 1
6.	OP	L8A	6. GRID 3	6. GRID 1	6. BLANK	6. BLANK
7.	IS	L9A	7. CATHODE	7. CATHODE	7. HEATER	7. HEATER
8.	OS	L9A	8. HEATER	8. HEATER	8. CATHODE	8. CATHODE
9.	IP	L8C			TOP CAP GRID 1	
10	OP	L8C				
11	IS	L8D				
12	OS	L8D				





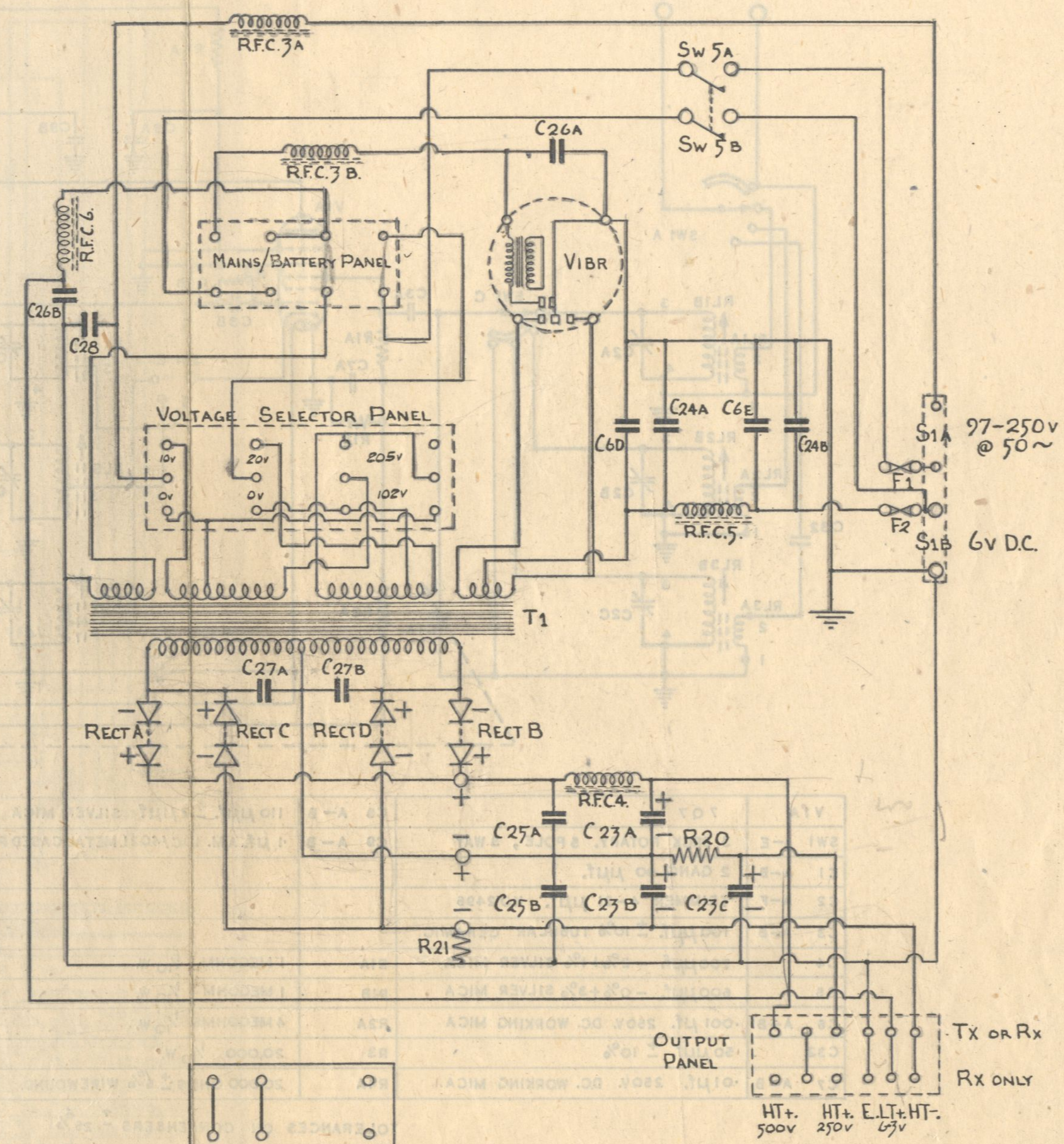




NOTE: VALVE CONNECTIONS VIEWED FROM UNDERSIDE OF CHASSIS

Ref No R5080.

Code	Description
T1	Combined Transformer.
Vibr	6 Volt Non Synchronous Vibrator.
Rect A-D	Westalite Selenium 30 Disc Rectifier.
C23 A-C	16 MFD 350 V, Working, Electrolytic.
C24 A&B	·5 MFD 50 V, DC Working. (Paper)
C25 A&B	·1 MFD 450 V, DC Working. (Paper)
C26 A&B	·1 MFD 350 V, DC Working. (Paper)
C27 A&B	·04 MFD 300 V, AC Working, 115 c/s (Paper)
C28	·006 MFD 300 V, AC Working, 115 c/s (Paper)
C6 D&E	·001 MFD 250 V, DC Working (Mica)
R.F.C. 3 A&B	Iron Dust Cored Choke (34 S.W.G. D.S.C.)
R.F.C. 4.	Iron Dust Cored Choke (38 S.W.G. D.S.C.)
R.F.C. 5.	Iron Dust Cored Choke (14 SWG Enam)
R.F.C. 6.	Iron Dust Cored Choke (22 S.W.G. D.S.C.)
R.20.	1300 Ω ±5% 3 W Wirewound Resistor.
R.21.	500 Ω ±5% 1½ W Wirewound Resistor.
SW5 A&B	Double Pole ON-OFF Toggle Switch.
S1A	2 Amp Mains Plug Panel
S1B	5 Amp Battery Plug Panel.
F1	500 mA Fuse. Belling Lee. L338.
F2	10. Amp Fuse. Bulgin F36.



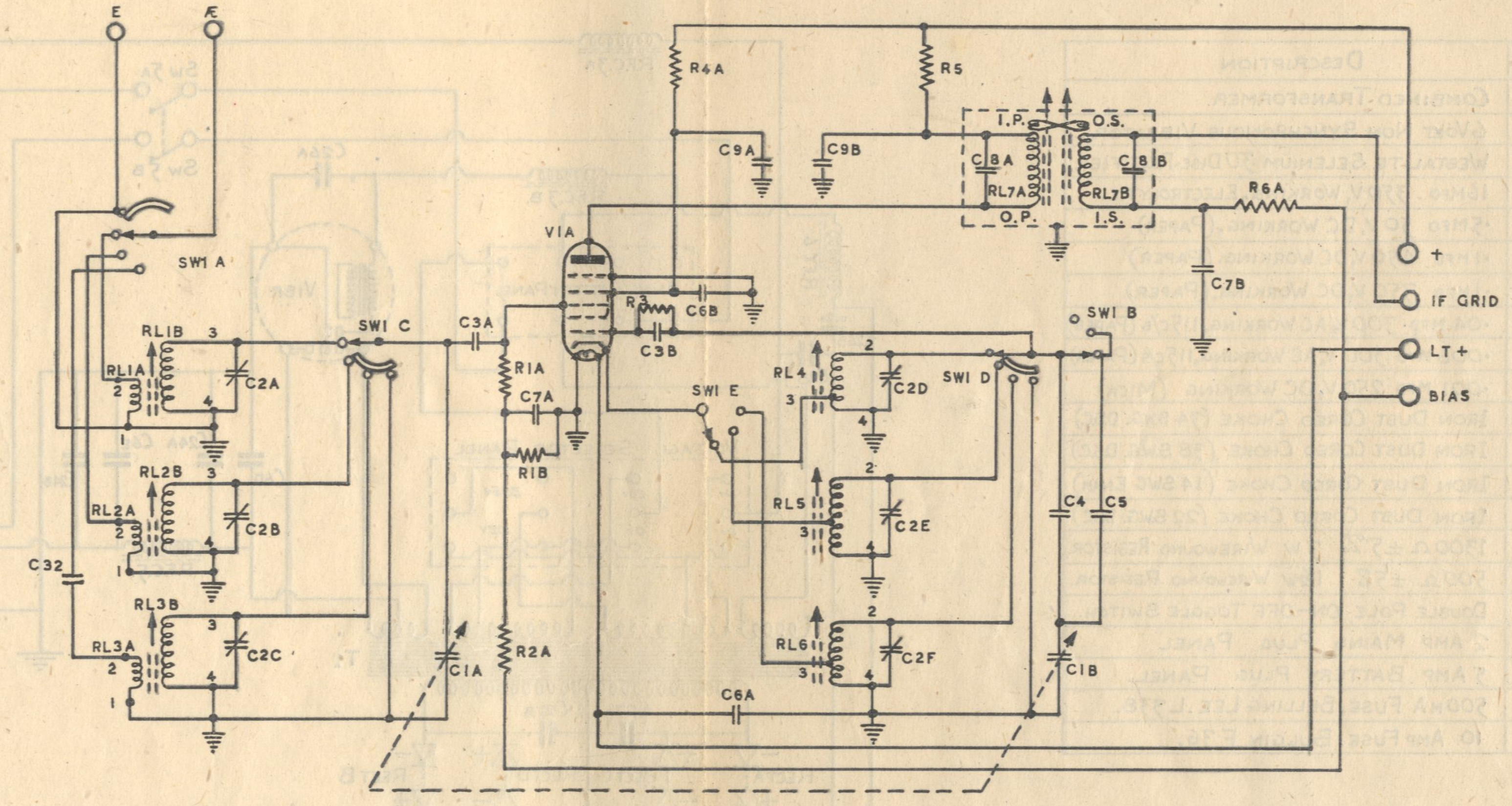
Mains/Battery Change over Plug Showing Connections.

Unless otherwise stated tolerances on:- Condensers ±25%
Resistors ±20%

Note: In this Circuit Diagram all the Socket Panels are as seen from the underside.

Rev. B. F2 was 7½ Amp. Fuse. Bulgin F35. 9·5·44
Rev. A. Lead to SW5B was taken from power pack side of fuse. 11.6.43.

	Description	Drawn	Scale	Date	Drawing No
Model 3/II	Circuit Diagram for Model 3/II Power Pack	G.H.R.	–	27/1/42	CD 2037.



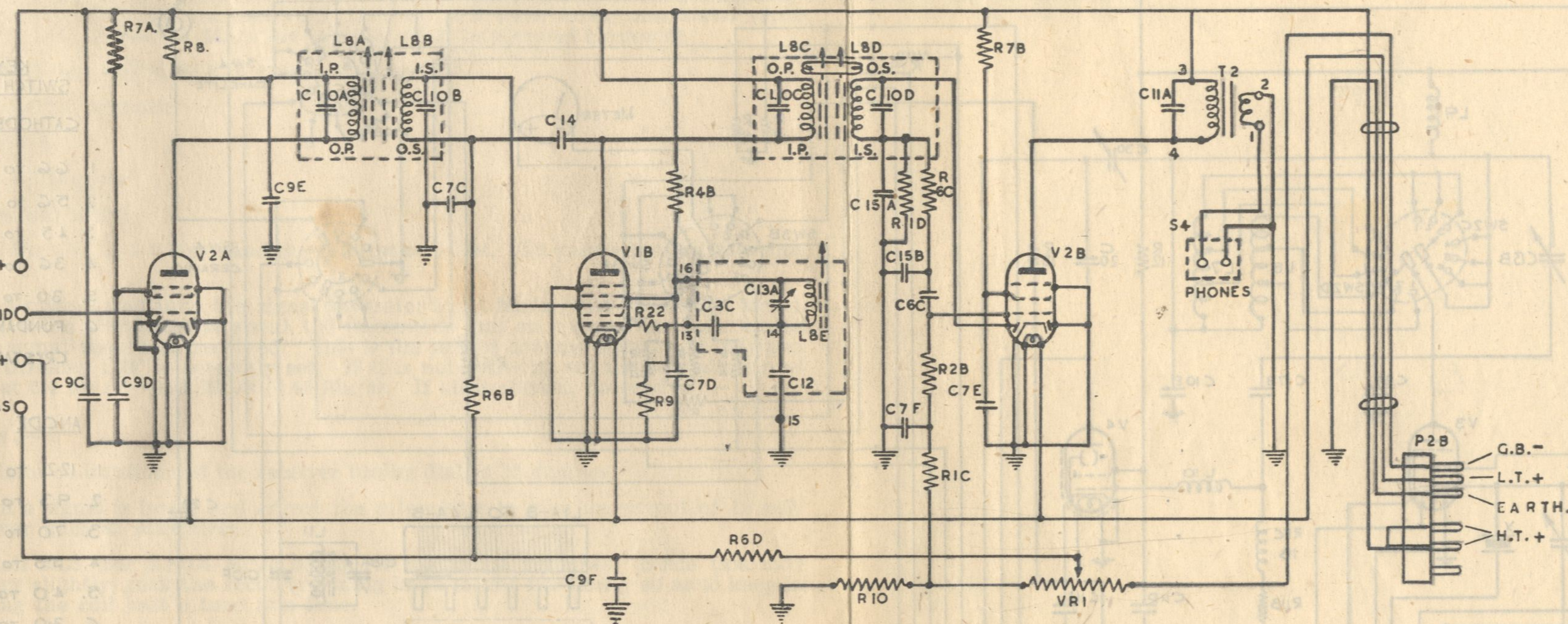
V1A	7Q7	C8 A–B	110 μμf. ± 2 μμf SILVER MICA	R5	5,000 OHMS ½W. WIREWOUND
SW1 A–E	3 DECK ROTARY. 5 POLE, 3 WAY	C9 A–B	·1 μf. A.M. 10C/4021. METAL CASED PAPER	R6A	150,000 OHMS 1/10 W.
C1 A–B	2 GANG 90 μμf.			RL1 A–B	AERIAL COIL 8·7 – 15·2 MC/S.
C2 A–F	TRIMMER 4–21 μμf. KO 2496			RL2 A–B	,, ,, 5·2 – 9·04 ,,
C3 A–B	100 μμf. ± 10% TUBULAR CERAMIC			RL3 A–B	,, ,, 3·1 – 5·4 ,,
C4	700 μμf. – 2% + 1% SILVER MICA	R1A	1 MEGOHM 1/10 W.	RL4	OSCILLATOR COIL 8·7 – 15·2 ,,
C5	600 μμf. – 0% + 3% SILVER MICA	R1B	1 MEGOHM 1/10 W.	RL5	,, ,, 5·2 – 9·04 ,,
C6 A–B	·001 μf. 250V. D.C. WORKING MICA	R2A	4 MEGOHMS 1/10 W.	RL6	,, ,, 3·1 – 5·4 ,,
C32	50 μμf. ± 10%	R3	20,000 1/10 W.	RL7 A–B	I.F. COIL 470 KC/S. 7/45 LITZ.
C7 A–B	·01 μf. 250V. D.C. WORKING MICA	R4A	20,000 OHMS ± 5% WIREWOUND. 6 W.		

TOLERANCES ON CONDENSERS ± 25%

,, ,, RESISTANCES ± 20%

REVISION A. SW1 A–E WAS 6 POLE; C2 A–F WAS 2–9 μμf. KO 2509; C31 A–B REMOVED.
9·5·44

DESCRIPTION	DRAWN	SCALE	DATE	DRAWING NO.
RECEIVER – FREQUENCY CHANGER UNIT. 3 MK II	R.W.R.		4–11–43	CD 2039.



V1B	7Q7			R6D	470,000 OHMS 1/10 W. ± 10%
V2A-B	7R7			R22	47 OHMS 1/10 W. PARASITIC STOPPER.
C3C	100μμf ± 10% TUBULAR CERAMIC.				
C6C	·001μf 250V D.C. WORKING MICA.	R1C	1 MEGOHM 1/10 W.	VR1	100,000 OHMS POTENTIOMETER. C.T. LOG LAW.
C7C-D	·01μf ± 10% 250V DC WORKING MICA.	R1D	1 MEGOHM 1/10 W.		
C7E-F	·01μf ± 25%	R2B	4 MEGOHMS 1/10 W.	T2	TRANSFORMER TYPE 210. RATIO 15-1
C9C-F	·1μf A.M. 10C/4021. METAL CASED PAPER.	R4B	20,000 OHMS ± 5% WIREWOUND. 6W.		
C10A-D	220 P.F. SILVER MICA ± 4 P.F.	R6B	150,000 OHMS 1/10 W.	L8A-E	IF COIL. 470 KC/S 7/45 LITZ.
C11A	·002μf 350V. D.C. WORKING MICA.	R6C	150,000 OHMS 1/10 W.		
C12	1000 PF. SILVER MICA ± 20 PF	R7A-B	100,000 OHMS 1/4 W. INSULATED.	S4	TELEPHONE SOCKET.
C13A	25 PF. VARIABLE 3 POINT FIX.	R8	1,000 OHMS 1/4 W. WIREWOUND.		
C14	6 PF. ± 20%. CERAMIC.	R9	20,000 OHMS 1/10 W.	P2B	CABLE PLUG.
C15A-B	100μμf ± 20% SILVER MICA MOULDED	R10	39,000 OHMS 1/10 W. +0%-10%		

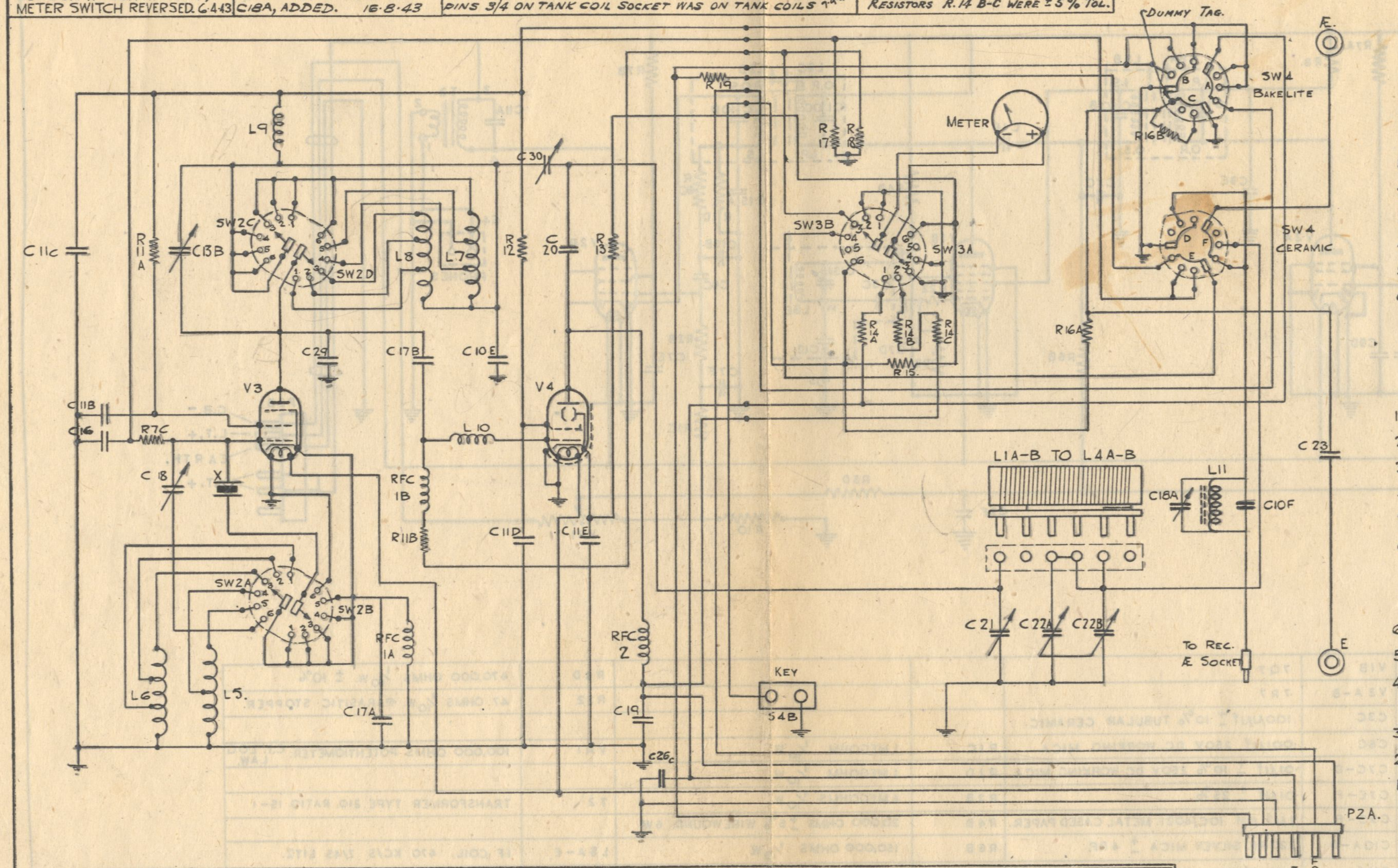
TOLERANCES ON CONDENSERS ± 25%
" " RESISTANCES ± 20%
} UNLESS OTHERWISE STATED

R9 IS NOW FITTED INSIDE THE B.F.O. CAN WITH C3C

REVISION A. R.22 WAS 50 Ω; NOTE RE R9 ADDED; R10 WAS 40,000 Ω 1/10W, TOLERANCE ADDED; R6D TOLERANCE ADDED. 9·5·44

DESCRIPTION.	DRAWN	SCALE	DATE	DRAWING NO.
RECEIVER I.F. UNIT. 3 MK II	R.W.R.		17-11-43	CD 2045

REVISION A: CONTACTS 1, METER SWITCH REVERSED. 6·4·43	REVISION "B." CONDENSER C18A, ADDED. 16·8·43	REVISION "C." CONDENSER C26C ADDED. SHORTING LINK PINS 3/4 ON TANK COIL SOCKET WAS ON TANK COILS 7·9·43	REV. 'D' 15:4:44. RESISTORS R.14 B-C WERE ± 5% TOL.



KEY TO SWITCH POSITIONS

CATHODE SWITCH.

1. 6·6 TO 8·0 Mc/s
2. 5·6 TO 6·6 "
3. 4·5 TO 5·6 "
4. 3·6 TO 4·5 "
5. 3·0 TO 3·6 "
6. FUNDAMENTALS (ALL CRYSTALS.

ANODE SWITCH

1. 12·2 TO 16·0 Mc/s
2. 9·3 TO 12·2 "
3. 7·0 TO 9·3 "
4. 5·3 TO 7·0 "
5. 4·0 TO 5·3 "
6. 3·0 TO 4·0 "

METER SWITCH

6 PA 0–120 m/A.
5 OFF
4 OSCILLATOR GRID m/A } RECEIVER m/A
3 P.A. GRID m/A
2 P.A. VOLTS 0–1200 V
1 OSCILLATOR VOLTS } RECEIVER VOLTS } 0–600 V.

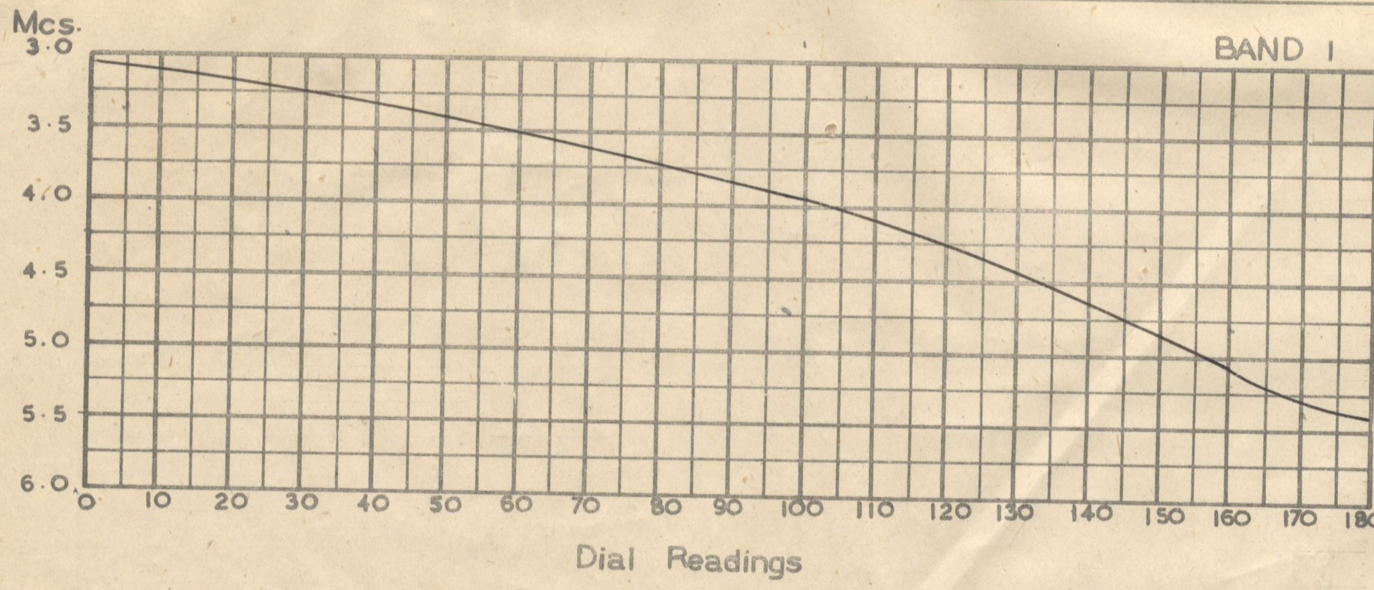
HT– LT+ E 250 V IN 250 V OUT 500 V

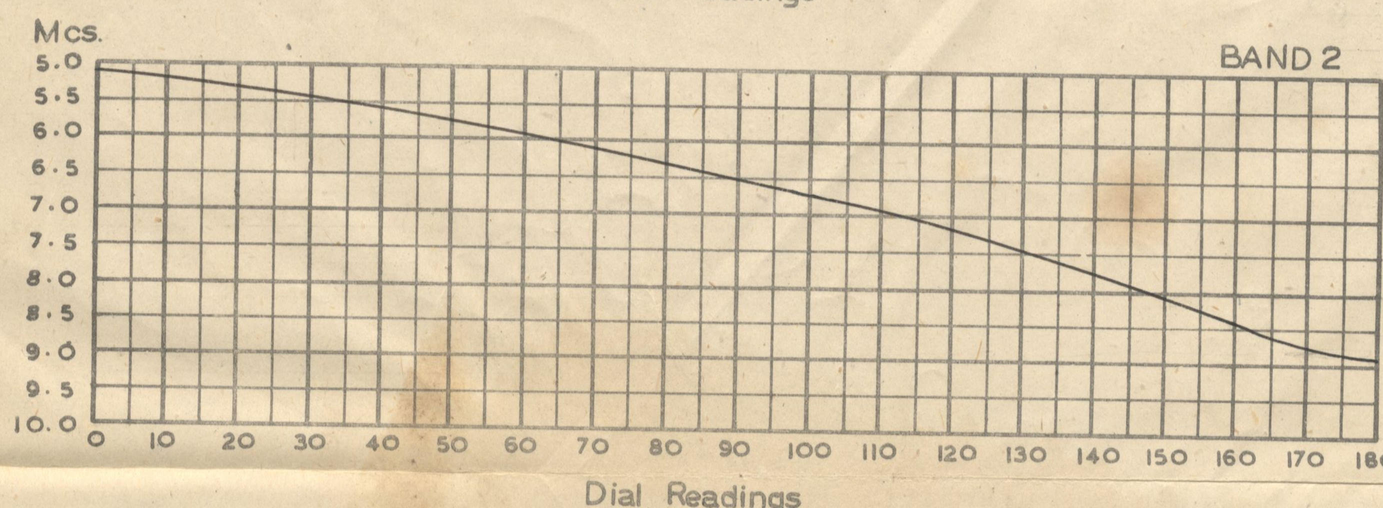
V3	EL 32	C30	2·5~9pF, VARIABLE.	L5	OSC. CATHODE COIL, LF
V4	6L6G	R7C	100,000Ω, ¼ W.	L6	" " " , HF
SW2(A-B, C-D)	SINGLE DECK, 2 POLE, 6 WAY, 5/16" SPINDLE.	R11A-B	20,000Ω ½ W.	L7	" ANODE " , LF
SW3(A-B)	" " " " 1⅛" "	R12.	500Ω ½ W. WIREWOUND	L8	" " " , HF
SW4(A-F)	TWO DECK, 1 CERAMIC, 1 BAKELITE, EA. 3 POLE 3 WAY	R13	200Ω ± 5%, 3 W. WIREWOUND.	L9	NEUTRALISING COIL
C10 E-F	220pF, SILVERED MICA, ± 4pF	R14 A-C.	1·2 MΩ. 1 W. R.14A ~ ± 5% R.14B-C ~ ± 2%	L10	ANTI-PARASITIC COIL
C11B-E	·002mF, 350v. D.C. WKG. MICA.	R15	2·08Ω ± 2% 1½ W. WIREWOUND.	L11	WAVE-TRAP COIL
C13B	50pF, POLAR VARIABLE (3 POINT FIXING.)	R16A-B	200Ω ± 10% 1½ W. WIREWOUND.	P2A	CABLE PLUG
C16	250pF, MICA.	R17	250Ω ± 5% 1½ W. WIREWOUND.	METER	500Ω 0·5 mA.
C17A-B	100pF ± 5%, 350v. D.C. WKG. SILVERED MICA	R18	45·5Ω ± 2% 1½ W. WIREWOUND.	X	CRYSTAL SOCKET.
C18, C18A	TRIMMER 15–45pF.	R19	29,500Ω ± 2% ½ W.	S4B	KEY SOCKET
C19	·002mF, ± 20% 750 v. DC. WKG.	RFC1A-B	4 SECTION CHOKE, ¼" FORMER.		
C20	·002mF ± 20% 2200 v. DC. TEST.	RFC2	6 " " ⅜" "	C26.C	·1mF PAPER TUBULAR.
C21	300pF, SINGLE SECTION.	L1A-B.	TANK COIL 3-4 MCS 3¾ - 5¼ MCS		
C22A-B	300pF, 2 GANG.	L2A-B	" " 4½-6¼ MCS 5½ -7½ MCS		
C23.	1 mF, METAL CASED PAPER	L3A-B.	" " 6½-9 MCS 7 - 10 MCS		
C29	25pF, ± 1·25pF. SILVERED MICA.	L4A-B.	" " - 9-13 MCS 12-16 MCS		

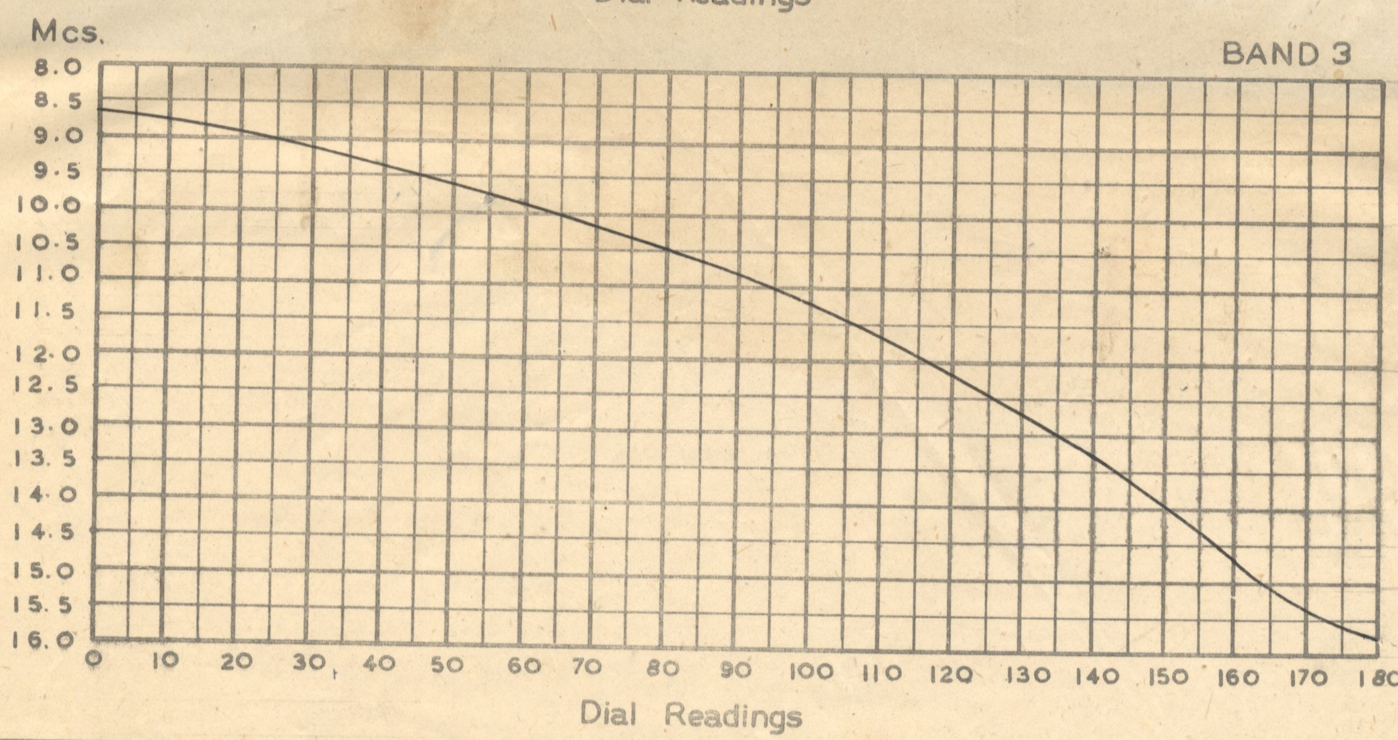
NOTE: ALL SWITCHES VIEWED FROM REAR OF TRANSMITTER

TOLERANCES ON CONDENSERS ± 25% } UNLESS OTHERWISE STATED
" " RESISTANCES ± 20%

DESCRIPTION	DRAWN	SCALE	DATE	DRAWING No.
MODEL 3/II CIRCUIT DIAGRAM FOR MODEL 3/II TRANSMITTER.	A.C.G.	—	8·3·43	C.D 2038.







CALIBRATION CURVES

SERIAL No. 45837

Apply the D.A. to the Aerial socket and the metal case of the receiver (earth). Set the S.G. to approx. 3.1 Mc/s and adjust frequency and attenuator until a signal is received and note the frequency. If the frequency is less than 3.1 Mc/s the oscillator coil trimmer will have to be unscrewed (anti-clockwise). If the frequency is more than 3.1 Mc/s the trimmer must be screwed clockwise.

(1) Set the S.G. to 3.1 Mc/s and adjust RL6 to receive the signal.

(2) Set the receiver dial to 180 degrees.

(3) Set the S.G. to 5.4 Mc/s.

(4) Adjust C2F to receive the signal.

(5) Recheck (1) to (4) in that order.

The receiver now tunes from 3.1 to 5.4 Mc/s and the calibration is set. To ensure that adjustments are correct:—

(6) Set the receiver to 5.4 Mc/s and tune the signal generator to 5.4 Mc/s+0.94 Mc/s (6.34 Mc/s). Increase the setting of the attenuator to about 100 microvolts and on rocking the S.G. tuning about its setting a signal should be received. This is the second channel signal and indicates that the oscillator trimmer C2F is correctly set. If it is not correctly set the second channel signal will appear at 5.4 Mc/s −0.94 Mc/s (4.46 Mc/s). If all is correct, proceed to:—

Alignment of Aerial circuits :—

(7) Having set the oscillator calibration, set the receiver tuning dial to 30 degrees.

(8) Adjust the S.G. until a signal is heard and adjust the attenuator to give an output of 10 mW approx. with receiver gain at maximum.

(9) Adjust the aerial coil RL3 (for 3.1-5.4 Mc/s band) for maximum response. Since this may alter the tuning very slightly, rock the receiver tuning knob to and fro slowly so as to keep in tune whilst adjusting the coil half a turn at a time.

(10) Set the receiver dial to 160 degrees and tune S.G. to receive signal as in (8).

(11) Adjust aerial trimmer C2C (for 3.1-5.4 Mc/s band) for maximum response. Rock the tuning as before to maintain tuning as necessary.

(12) Recheck (7) to (11) in that order. The aerial circuits are now exactly in alignment with the oscillator circuits.

To align Bands 2 and 3, read as for Band 1, substituting in

(1)	5.2 Mc/s and RL5	(Band 2)	8.7 Mc/s and RL4	(Band 3)
(3)	9.04 Mc/s	(„ 2)	15.2 Mc/s	(„ 3)
(4)	C2E	(„ 2)	C2D	(„ 3)
(6)	9.04 Mc/s+0.94 Mc/s (9.98)	(„ 2)	15.2 Mc/s+0.94 Mc/s (16.14)	(„ 3)
(9)	RL2	(„ 2)	RL1	(„ 3)
(11)	C2B	(„ 2)	C2A	(„ 3)

After adjustment, re-seal all trimmers with wax.

Alignment of Wave trap in Transmitter :—

With the transmitter and receiver connected up in the normal way and set to "Receive," apply the D.A. to the Ae and E terminals of the Transmitter. Set S.G. to 470 Kc/s and increase attenuator setting until a signal is heard. Adjust the trimmer (C2G) on the switch assembly until the signal is at a minimum. Seal the trimmer with wax.