The information given in this document is not to be communicated, either directly or indirectly, to the Press or to any person not authorized to receive it.

CONDITIONS OF RELEASE

(Applicable to copies supplied with Ministry of Defence approval to Commonwealth and Foreign Governments)

1. This document contains classified UK information.

2. This information is disclosed only for official use by the recipient Government and (if so agreed by HM Government) such of its contractors, under seal of secrecy, as may be engaged on a defence project. Disclosure or release to any other Government, national of another country, any unauthorized person, the Press, or in any other way would be a breach of the conditions under which the document is issued.

3. This information is to be safeguarded under rules designed to give the same standard of security as those maintained by HM Government in the UK.

STATION, RADIO, A43R, Mk 2

TECHNICAL HANDBOOK - TECHNICAL DESCRIPTION

Note: These Pages 1 to 4 and 25 to 29, Issue 2, supersede Pages 1 to 4 and 25 to 29, Issue 1, dated 24 Sep 64. Pages 1 to 4 and 26 to 29 have been revised throughout. Page 4a, Issue 2, will be filed immediately after Page 4, Issue 2, dated 6 Jun 67. It contains information previously on Page 4, Issue 1, dated 24 Sep 64.

LIST OF CONTENTS

INTRODUCTION
Warning ... ... ... ... ... ... ... ... ... ... ... ... 1

GENERAL
Role and purpose of equipment ... ... ... ... ... ... ... ... ... ... 2
Main parameters ... ... ... ... ... ... ... ... ... ... ... ... 5
Testing and repair facilities ... ... ... ... ... ... ... ... ... ... ... ... 14

TRANSMITTER-RECEIVER, RADIO, A43R, Mk 2

BRIEF TECHNICAL DESCRIPTION
Transmitter ... ... ... ... ... ... ... ... ... ... ... ... 18
Receiver ... ... ... ... ... ... ... ... ... ... ... ... 19
Power unit ... ... ... ... ... ... ... ... ... ... ... ... 20
Batteries ... ... ... ... ... ... ... ... ... ... ... ... 21
Battery adaptor ... ... ... ... ... ... ... ... ... ... ... ... 22

Issue 2, 6 Jun 67

Distribution - Classes 332 and 336. Code No 2
### TELECOMMUNICATIONS

<table>
<thead>
<tr>
<th>Component</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battery charger</td>
<td>23</td>
</tr>
<tr>
<td>Antenna</td>
<td>24</td>
</tr>
<tr>
<td>Construction</td>
<td>25</td>
</tr>
<tr>
<td>Controls</td>
<td>28</td>
</tr>
</tbody>
</table>

### DETAILED TECHNICAL DESCRIPTION

#### Transmitter
- **General**
- Crystal oscillator doubler stage V301
- Doubler stage V302
- Doubler stage V303
- Doubler stage V304, V305
- Power amplifier V306
- Condition indicator V201 (DM70)
- Sidetone
- Speech clipper VT201 and VT202
- Low pass filter
- **Modulator unit (VT301, VT302 and VT303)**

#### Receive/transmit switching and relay operation
- **Phone receive**
- **Phone transmit**
- Beacon c.w. transmit
- Beacon tone transmit
- **Antenna circuits**

#### Receiver
- **Antenna circuits**
- First r.f. amplifier VT101
- Second r.f. amplifier, VT102
- First mixer stage VT103
- Oscillator and oscillator doubler stages (VT106, 109, 110, 111 and 112)
- First i.f. amplifier stage VT104 and first i.f. filter
- Second mixer stage VT105 (OC170)
- Second oscillator stage VT113 (OC170)
- Second i.f. filter stage (930ko/s)
- Second i.f. amplifier stage VT106 (OC170) (930ko/s)
- Detector stage including third i.f. amplifier VT107 (930ko/s)
- A.G.C. amplifier VT115 and VT114
- Forward a.g.c. to stages VT104 and VT105
- First a.f. amplifier stage VT117
- Second a.f. amplifier VT116
- Handset or headset circuit
- Smoothing circuits
- **Power supply unit VT401, VT402, VT403, and VT404**

#### Test points
- **A43B Mk 2 Later models**

#### Transmitter
- **PA stage**
- **Power supply unit VT403 and VT404**

#### Receiver
- **A.G.C.**
- **Power supply unit VT403 and VT404**

### BATTERY CHARGER
INTRODUCTION

Warning

1. The case of the equipment and the antenna are connected electrically to the positive side of the supply. Care must be taken to isolate the case and the antenna from earth when the battery adaptor is connected to an external supply with its negative side earthed.

GENERAL

Role and purpose of equipment

2. The SRA\textsuperscript{3} is a lightweight manpack v.h.f. radio set which can also be used as a static station. The set is normally used for ground-to-air communications, but it may also be used in a ground-to-ground role.

3. Early models of the A\textsubscript{4}JR Mk 2 suffered long receive to send delay ie, the time taken, after operation of the pressel switch, for the r.f. output to reach 2W. A modification was introduced (Tels F 537 Mod Instr No 2) to reduce this delay to a limit of 4 secs.

4. To reduce this time further, later models of the A\textsubscript{4}JR Mk 2, having the figure 3 on the modification record plate struck through, have design changes incorporated by the manufacturer. Details of these models are given in para 105 onwards.

Main parameters

(Fig 1)

5. The station operates in the frequency band 240 to 300M\textsubscript{c}s and has the following facilities: amplitude modulated telephony, or beacon service modulated c.w. unkeyed.
or beacon service c.w. unkeyed. The station items are listed in Table 1 and illustrated in Fig 1.

6. The transmitter-receiver unit produces a minimum of 2W of r.f. power. Six crystal channels are fitted; the minimum channel spacing is 100Kc/s. Twenty-four alternative channels, each consisting of four tuners, radio frequency, are carried in the cases, stowage. The tuners are aligned for each equipment and no loss of performance should result when a channel frequency is changed.

7. Two types of antenna are supplied for either the manpack role or static role. These operate without adjustment throughout the frequency band of 240-300Mc/s. They consist of:-

(a) Flexible 15 in. stool whip with a loop top for manpack operation.

(b) Discote type antenna that can be mounted on an 8 ft collapsible mast for operation as a static station.

Note: In the static role a 20 ft coaxial connector permits a wider choice of sites for the antenna.

8. The transmitter-receiver is powered by a 12V secondary portable battery externally connected to the bottom of the case by quick release dmus fasteners. Two types of battery, the Magnatex lead acid and the Nife nickel cadmium are in use. They are identical in size and sealed, without vents.

9. The station equipment includes a Charger, battery, transistor type, input 12V or 24V d.c. A preset adjustment sets the regulated charging potential so that it can be used to charge either the Magnatex or the Nife battery. The battery under charge is clipped by dmus fasteners to the rear of the charger.

10. Alternatively the AL3, Mk 2 may be operated from an external 12V supply. The normal battery is replaced by the battery adaptor which is then coupled by the battery connector cable to the external supply. Correct polarity is ensured by the protection relay in the battery adaptor and the polarized connectors of the connector cable.

11. The AL3, Mk 2 may also be operated from the Charger, battery, transistor type in the 'float' charge condition. Instead of using the external 12V supply, as in para 10, the cable is connected to the front panel 2-pole socket of the charger which is charging a battery. It must be noted that if the equipment is operated continually on transmit ie, beacon service, the battery will gradually discharge and the output power will fall off.

12. Two types of audio equipment are provided, these being:-

(a) A nylon handset, SI type.

(b) A microphone and twin receiver headgear assembly, SI type.

13. The tuners, radio frequency providing alternative frequency channels are carried in a case which also provides storage facilities for small ancillaries. The tuners, radio frequency are stowed as shown in Fig 25/8.
Testing and repair facilities

14. Removal of the front panel desiccator gives access to a B7G test socket. Using the adaptor, test provided, the following voltages may be measured:

<table>
<thead>
<tr>
<th>Pin</th>
<th>Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sidetone (-V)</td>
</tr>
<tr>
<td>3</td>
<td>+3.2V</td>
</tr>
<tr>
<td>4</td>
<td>-12V</td>
</tr>
<tr>
<td>5</td>
<td>+150V</td>
</tr>
<tr>
<td>6</td>
<td>+75V</td>
</tr>
<tr>
<td>7</td>
<td>A.G.C. (-V) (Pin 2 is a receiver earth point)</td>
</tr>
</tbody>
</table>

15. The receiver and the transmitter chassis are mounted on hinges and can be swung out for servicing purposes. To allow either assembly to be tested clips are fitted to hold a set of tuners, radio frequency as a substitute for the tuners fitted to the turret drum.

16. With the exception of the power amplifier valve in the transmitter, all transistors and valves are wired in. The semi-conductors in the receiver i.f. stages are mounted within the actual i.f. transformers. As these stages are dipped in transparent rosin, a faulty stage will normally be completely replaced. I.F. cores are sealed and cannot be adjusted.

17. To aid identification of components and test points, the circuit diagrams, layouts and component tables in Tels F 532 Part 2 use the following code which is added to the component number marked on the assembly:

- Receiver - 100
- Front panel - 200
- Transmitter - 300
- Power supply unit - 400
- Battery charger - 500

Unit codes are marked on a flange of each assembly.
Fig 1 - Complete station
<table>
<thead>
<tr>
<th>Item No</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Transmitter-receiver, radio, A43R, including: -</td>
</tr>
<tr>
<td></td>
<td>* Desiccator</td>
</tr>
<tr>
<td></td>
<td>* Indicator, humidity</td>
</tr>
<tr>
<td></td>
<td>* Tuner, r.f., channel frequency, transmitter A43R (qty 6)</td>
</tr>
<tr>
<td></td>
<td>* Tuner, r.f., channel frequency, crystallized, transmitter A43R (qty 6)</td>
</tr>
<tr>
<td></td>
<td>* Tuner, r.f., channel frequency, receiver A43R (qty 6)</td>
</tr>
<tr>
<td></td>
<td>* Tuner, r.f., channel frequency, crystallized, receiver A43R (qty 6)</td>
</tr>
<tr>
<td>2</td>
<td>Microphone and receiver headgear assembly, Redifon A 6258/s.Ed.A</td>
</tr>
<tr>
<td>3</td>
<td>Handset, Redifon A 6257/s.Ed.A</td>
</tr>
<tr>
<td>4</td>
<td>** Tuner, r.f., channel frequency, transmitter A43R (qty Army 18, RAF 10)</td>
</tr>
<tr>
<td>5</td>
<td>** Tuner, r.f., channel frequency, crystallized, transmitter A43R</td>
</tr>
<tr>
<td></td>
<td>(qty Army 18, RAF 10)</td>
</tr>
<tr>
<td>6</td>
<td>** Tuner, r.f., channel frequency, receiver A43R (qty Army 18, RAF 10)</td>
</tr>
<tr>
<td>7</td>
<td>** Tuner, r.f., channel frequency, crystallized, receiver A43R (qty Army 18, RAF 10)</td>
</tr>
<tr>
<td>8</td>
<td>Antenna, Redifon, A 6256/s.Ed.A</td>
</tr>
<tr>
<td>9</td>
<td>Antenna, remote and mast assembly, comprising: -</td>
</tr>
<tr>
<td></td>
<td>Antenna, Redifon A 6267/s.Ed.A</td>
</tr>
<tr>
<td></td>
<td>Cable assembly, r.f., Redifon A 6274/s.Ed.A</td>
</tr>
<tr>
<td></td>
<td>Mast, Redifon A 6255 Ed.A (including stay and peg assembly)</td>
</tr>
<tr>
<td>10</td>
<td>Adaptor and cable assembly, Redifon A 6245/s.Ed.A</td>
</tr>
<tr>
<td>11</td>
<td>Case, antenna, Redifon OP.5120/S</td>
</tr>
<tr>
<td>12</td>
<td>Case, transmitter-receiver, OP.5121/S</td>
</tr>
<tr>
<td>13</td>
<td>Plate, instruction, operating, Transmitter-receiver, radio, A43R</td>
</tr>
<tr>
<td>14</td>
<td>Plate, extension platform, Harness, electrical equipment</td>
</tr>
<tr>
<td>15</td>
<td>Cable assembly, special purpose, electrical, Redifon A 6272/s.Ed.A</td>
</tr>
<tr>
<td>16</td>
<td>Case, carrying, battery</td>
</tr>
<tr>
<td>17</td>
<td>** Case, stowage, tuning units, r.f.</td>
</tr>
<tr>
<td>18</td>
<td>Adaptor, test, Redifon A 6259/s.Ed.A</td>
</tr>
<tr>
<td>19</td>
<td>Charger, battery, input 12V/24V, Mk 2, Redifon A 6249/Ed.B</td>
</tr>
<tr>
<td>21</td>
<td>Carrier, radio station, manpack kit, No 1 comprising: -</td>
</tr>
<tr>
<td></td>
<td>Case, radio station ancillaries, web, 5 in. x 8 in. deep x 14.1/2 in.</td>
</tr>
<tr>
<td></td>
<td>Harness, electrical equipment</td>
</tr>
<tr>
<td>22</td>
<td>Battery, secondary, Redifon A 6227/M Edn B (Magnetex) or</td>
</tr>
<tr>
<td></td>
<td>Battery, secondary, 12V, Redifon A 6227 Edn C (Nickel cadmium) } (qty 3)</td>
</tr>
</tbody>
</table>

*This item is fitted in transmitter-receiver, radio

**RN and RM equipment is limited to 6 channels
TRANSMITTER-RECEIVER, RADIO, A43R, MK 2

BRIEF TECHNICAL DESCRIPTION

Transmitter (Fig 2001)

18. The transmitter frequency is crystal controlled on each of the six channels in the frequency range 200-300Mc/s and uses valves in the v.f. stages. A crystal oscillator doubler V301, fundamental crystal frequency of fs/16, is followed by three class C frequency doublers, V302, V303, V304 and V305. The final doubler uses two valves in parallel to provide the necessary drive for the push pull power amplifier V306, which is a high efficiency indirectly heated double tetrode. To contribute to battery economy and operating efficiency heater voltage is reduced to a low level on receive and given an initial heater boost when switched to phone transmit. This action reduces the transmit warm-up time to a minimum. The modulator uses transistors throughout and includes a speech clipper to prevent over modulation and a low pass filter to limit the bandwidth. The speech clipper functions as a tone generator when the set is switched to BEACON TONE. A condition indicator on the front panel provides a visual display of r.f. output and modulation level.

Receiver (Fig 2001)

19. The receiver is a six channel crystal controlled double superheterodyne in the frequency range 200-300Mc/s and uses transistors throughout. Crystal oscillator doubler VT108, fundamental crystal frequency of fs-19.05/16, is followed by three frequency doubler stages VT109, VT110, VT111 and VT112. The 1st mixer VT103 is fed by the signal fs, from amplifiers VT101 and VT102 and the crystal controlled frequency, fs-19.05. The resultant 1st i.f., 19.05Mc/s, is amplified by VT104 and fed to 2nd mixer VT105 together with the 19.98Mc/s output from 2nd oscillator VT113. The 2nd i.f. of 930kc/s is amplified by VT106 and VT107 before rectification by the detector UR102. The a.f. output is fed to the audio amplifiers VT116 and VT117 and also to the a.g.c. amplifiers VT114 and VT115. A.G.C. is applied to the first mixer and also to the 1st i.f. and 2nd mixer stages.

Power unit

20. The power unit is a double transistor convertor. It provides transmitter h.t. supplies of +150V and +75V d.c., and a +3.2V d.c. supply for transistor emitter bias and transmitter valve filaments. The transistor collectors and carbon microphone energizing supplies are taken direct from the -12V input. The transistor convertor circuits operate at high efficiency on a short time constant to provide power for immediate reception, and the minimum delay when transmitting.

Batteries

21. Two types of battery have been developed for A43R, Mk 2:—

(a) The Magntax battery contains 42 miniature Magntax sealed lead acid cells connected in series banks of seven cells in parallel to give a nominal
12V supply. These cells are set in epoxy resin within a metal case to form a fully enclosed battery unit which is secured by dms type
fasteners to the back of the transmitter-receiver case. The battery
should not be discharged below 10V on load.

(b) The Mife battery is of nickel cadmium type and consists of 10 cells
of sintered plate construction. The cell assembly is set in epoxy
resin within a metal case to form a fully enclosed battery unit of
identical shape and fixing as the lead acid battery. In manufacture
(after the final conditioning charge) the cells are each permanently
plugged to prevent the loss of electrolyte.
Fig 3 - Battery adaptor and cable assembly
Fig 4 - Charger, battery, transistor type, input 12V or 24V d.c.
(A 6249/L Ed B)
Battery adaptor

22. The battery adaptor is used when the A43R, Mk 2 is connected to an external supply. To prevent damage to the equipment, the adaptor contains a relay whose operation is dependent on the polarity of the applied voltage. The relay's operating coil is connected in series with a diode across the external supply.

Battery charger

23. The battery charger is designed to operate from a d.c. supply of either 12 or 24V nominal, eg a vehicle or aircraft battery or electrical system. The input voltage selection is affected automatically by means of a voltage sensitive relay. The charger provides a constant voltage output at 13.2V for a Magnatex lead acid battery or 14.6V for a Nife nickel cadmium battery. It can deliver sufficient current to float charge one normal battery unit at the correct rate whilst simultaneously operating one equipment in the receive condition via the battery adaptor. The mean charging current for the lead acid battery is 350mA, and the nickel cadmium battery 1A. The input circuits are protected by a diode MR501 to prevent damage to the transistors VT501 and VT502 by reversed supply polarity. The unit is fitted with a meter which indicates the charge condition of the battery to which the charger has been adjusted. The charging supply must not fall below 11V or 22V or the indication of meter M501 may be inaccurate and show the battery to be fully charged, even though this is not so.

Antenna

24. For manpack use a whip antenna of 15 in. length and 50Ω impedance is used, this is made of steel tape and has a loop at the top. This increases the capacitance slightly which helps to nullify the stray capacitance due to the fixing plug by reflecting a small inductance at the feed point. The standing wave ratio of the whip antenna when working against the set case is approximately 1.8:1 over the frequency range of the set. For static operation of the A43R, Mk 2 a wideband discone antenna and short mast is provided. The discone type of antenna for A43R, Mk 2 is of skeleton construction and uses elements made of steel tape. It is completely collapsible and the centre section is moulded in epoxy resin. The A43R, Mk 2 is connected to the antenna by a 20 ft coaxial cable assembly of 50Ω impedance, and is terminated at either end by v.h.f. plugs. The discone antenna functions as an elementary form of horn radiator and operates by matching the characteristic impedance of the feeder to that of free space. As such the antenna is non-resonant and the band of operation is governed at the lower end by the length of the sloping elements. These have to be somewhat greater than λ/4 long at the lowest frequency of operation. The impedance presented by the antenna depends on the disc to cone spacing, the length of the upper or disc elements and the angle of the lower elements, and the combination which gives the best results over the required band is best found empirically. The upper operating frequency of the antenna is dependent on the number of radial elements, the bandwidth increasing with a greater number of radials. The A43R, Mk 2 discone covers the frequency range of 240-300Mc/s with a standing wave ratio of approximately 2:1, and over the frequencies of 240-255 and 272-273Mc/s better than 1.5:1. The height of the mast is 8 ft, when erected, and is made up of seven sections of 16.1/2 in.
Construction

25. The transmitter-receiver is housed in a corrosion-resistant case which is ribbed and stressed for strength and sealed against the ingress of moisture. The controls are positioned on the top panel and protected by a deep surrounding flange. A silica-gel desiccator capsule is fitted and a humidity indicator is attached to the top of the desiccator. The complete equipment may be withdrawn from the case after removing four Allen-headed screws.

26. The equipment can be dismantled into five main assemblies.

(a) The front panel assembly secured by seven Allen screws and two countersunk Allen screws under the channel selector knob.

(b) The main chassis containing the speech clipper, low pass filter and turret switch. This chassis is mounted behind the front panel.

(c) The power unit attached to the lower end of the turret switch.

(d) The transmitter assembly.

(e) The receiver assembly.

27. The receiver and the transmitter chassis are mounted on hinges and can be swung out for servicing. These chassis can be tested in the servicing position by fitting tuners, radio frequency in the clips provided.

Fig 5 - Transmitter deck viewed from the top, also side view of receiver turret contacts
Fig 6 - Front panel layout

Controls

28. The front panel controls are shown in Fig 6 and details are given below:–

Switch SA
OFF
PHONE – The set is switched for use on telephony amplitude modulation
BEACON CW – The set is switched to transmit, output is unmodulated c.w.
BEACON TONE – The set is switched to transmit, output is modulated c.w. at approximately 1000c/s

Turret switch
1 to 6 – Selects one of six channel frequencies

RV203
VOLUME – Sets receiver volume

Plug G
50Ω CABLE OR AERIAL – Connection to antenna

Socket SKTH
HANDSET – Connections to Microphone and receiver headgear assembly or handset

Condition indicator (V201)
– Visual indication of battery charge, transmitter output and modulation
Detailed Technical Description

Transmitter

General

29. The transmitter operates in the frequency band 240 to 300Mc/s. Frequency selection is by means of a six position turret switch and two tuners, radio frequency are used in each position. Crystals and capacitors mounted on these tuners are underlined in the text.

Crystal oscillator doubler stage V301 (CV2105)

30. A directly heated pentode operates in a crystal doubler circuit. Crystal XL301 in the grid circuit is trimmed by C302, (C301 may also be connected), fundamental crystal frequency is fs/16. The anode circuit, L301 and C307 is tuned to twice the crystal frequency fs/8. A semi-conductor diode QR302 is connected between V301 grid and the filament dropper resistor R327. Its function is to limit the grid voltage to a safe operating level and so protect crystal XL301. The diode, which is back biased from the potential divider across the +3.2V supply, conducts and limits the grid voltage swing if it rises above 1.1V. The screen grid is fed from the 75V line via R304 and is decoupled by C310. Test point TP301 is connected to the junction of grid resistors R301 and R302. The output is fed via C312 to the doubler (V302) grid.

Doubler stage V302 (CV2105)

31. This stage is operated in Class C and is biased directly from the -12V supply via contacts 9 and 10 of relay RL43. The anode circuit, L302 and C313 is tuned to fs/4. The screen grid is fed from the 75V line via R308 and decoupled by C315. Test point TP302 is connected to the junction of grid resistors R305 and R306. The output is fed via C317 to the doubler (V303) grid.

Doubler stage V303 (CV2299)

32. This stage is also operated in Class C and is biased from the -12V supply. The anode load, untuned r.f. choke L303, is coupled via C321 to the tuned push-pull grid circuit of the next doubler stage V304 and V305. This circuit is tuned to fs/2.

Doubler stage V304, V305 (CV2299)

33. This stage is operated as a push-pull doubler with the anodes connected in parallel. V304 and V305 grids are fed from opposite ends of tuned circuit L304 and C322 and the centre tap of L304 is connected to earth via R313 and C323. Preset capacitor C324 is connected between V305 grid and chassis and is adjusted to equalize the drive to V304 and V305.

34. The anodes are connected to the +150V line via r.f. choke L305 and R316 decoupled by C327. The output circuit is T301 primary tuned by C328 and C329. Note that C329 is omitted for frequencies above 250Mc/s. Test points TP305, TP306 and TP308 are connected to the screen resistors R316 and R317. These test points are used when the valve currents are equalized by adjustment of C324.
Power amplifier V306 (CV2466)

35. The input to the grids of V306, an indirectly heated double tetrode, is from T301 secondary which is tuned by C332 to the final frequency (fs). Grid bias is fed to the centre tap of T301 secondary from the -12V line via R319, R321 and R320. Test points TP309 and TP310 are connected to each side of R321.

36. The anode and screen supplies are fed from the +150V line via the operating coil of relay RL2/2 and the secondary of the modulating transformer T303 to the junction of R323 and R324. R323 decoupled by C334 is connected to the screens and R324 decoupled by C340 is connected via the r.f. choke L306 to the centre tap of the tank coil L307.

37. Tank coil L307 is tuned by C333 and C335. These capacitors are connected in parallel for frequencies below 265Mc/s and in series for frequencies above 265Mc/s. During manufacture the wiring is arranged so that the output stage is neutralized and it should not normally require readjustment when V306 is replaced.

38. The series tuned circuit, L308 and C341, is inductively coupled to the tank coil L307 and is designed to give an output impedance of 500. The adjustment of L308 and C341 is made at the band edge frequencies, 240 and 300Mc/s, and is set for optimum performance during manufacture.

39. V306 heater is centre tapped and each half requires 6V for normal operation. When the equipment is switched to PHONE and is in the receive condition, +2.9V derived from the +3.2V supply is applied to the two halves of the heater connected in parallel. On switching to transmit relay RL4/4 operates and 12V is applied to each half of the heater. The valve quickly warms up and the combined anode and screen current operates relay RL2/2 connecting the 12V to the two halves of the heater in series ie, normal operation. These circuits are described in more detail in para 49-52.

Condition indicator V201 (DM70)

40. V201 is an electronic indicator valve and consists of a triode assembly with a fluorescent coated target anode which shows a column of light when the indicator is conducting. The height of the column is controlled by the grid potential, as the grid voltage becomes more positive the column increases in height.

41. The r.f. voltage developed across L309, which is inductively coupled to the tank coil L307, is rectified by the crystal diode MR301. The positive voltage across the diode load R337 is applied to V201 grid. This voltage is normally greater than the negative bias from the fixed potentiometer R326 and R325 between the -12V line and earth and the valve conducts. The anode is connected directly to the 75V line. The height of the light column is dependent on the carrier output, the modulation and the battery charge.

Sidetone

42. The demodulated signal which is fed to V201, is also applied to the base of WE116, the receiver a.f. amplifier via C208 and R213 and true sidetone is heard in the earphones.
Fig 7 - Top view of the receiver assembly

Fig 8 - Top view of the power unit assembly
Speech clipper VT201 and VT202 (CV5439 type)

43. The speech clipper is a two stage directly coupled amplifier which prevents over-modulation with changes of voice level. VT202 operates as an emitter follower and VT201 operates in the common base mode. The emitters of both transistors are thermally stabilized.

44. A.F. signals from the microphone are applied to the base of VT202 via RV202 and C206. Positive going signals above amplitude governed by the base bias conditions, set by R209 and R210, cause VT202 to cut off. The signal, with positive peaks clipped is developed across common emitter resistor R206. VT201 is now cut off by negative peaks exceeding the base bias conditions set by R203 and R204. Symmetry of clipping action is governed by RV202 and the amplitude of the output by RV201. Correct adjustment of these controls gives an output which will produce 90% modulation before the clipping threshold level is reached. When clipping takes place it will handle an increase in amplitude of four times above threshold level for an increase in output of less than 26%.

45. When the service switch is set to BEACON TONE the clipper circuit operates as an audio oscillator, thus providing tone modulation for radio beacon (A2) transmission. The frequency of the tone is governed by the value of C205 switched into circuit by contacts 22 and 23 of 5ABc. The tone frequency is preset within the range 300-3000c/s. A sample set was found to be generating a tone at approximately 800c/s. This was produced by a nominal capacitance value for C205 of 0.1µF (made up of 2 x 0.05µF ±20% capacitors in parallel).

Low pass filter

46. The output from the speech clipper is fed to the double π section low pass filter via the blocking capacitor C204. The filter is designed to pass frequencies between 300c/s and 3kc/s with an attenuation factor of less than 3.5dB. Above 3.5kc/s the rate of attenuation is at least 20dB per octave. The filter components are inductors L201 and L202, shunt capacitors C201, C202 and C203, and series resistor R202.

Modulator unit VT301 (CV7363) VT302 and VT303 (CV7084)

47. The modulator is a three stage amplifier with a 5W push-pull output stage providing anode and screen modulation of the transmitter power amplifier. The frequency response has been cut below 300c/s to reduce the size of the driver and output transformers.

48. The modulator input from the low pass filter is fed to VT301 base, fixed bias being provided by R332, R330 and R331 across the -12V supply. The emitter is thermally stabilized by R333. The collector output is fed to the bases of VT302 and VT303 by T302 secondary; fixed bias is applied to the secondary circuit tap from the junction of R325 and R336 connected across the -12V supply. Negative feedback from VT302 collector is fed via C354 and R329 to VT301 base to ensure crossover distortion is kept at a low level. The modulating signal is developed across T303 secondary which is the anode and screen supply to the power amplifier.
Receive/transmit switching and relay operation

Phone receive

49. The -12V supply is connected via PLB6 to:
   (a) Power supply unit section supplying +3.2V.
   (b) Receiver via RLA3, smoothing choke L203 and SKTF-C.
   (c) 2nd a.f. amplifier via RLA2-13, R212, T201 primary and SKTF-J.
   (d) Operating coil RLA4, this will of course not operate until the earth return is completed by the microphone pressel switch.
   (e) Test socket pin 4.

50. The +3.2V from the power supply unit is connected to:
   (a) Receiver via RLA4 and SKTF-E (emitter supply).
   (b) Receiver via SKTF-A, protective antenna circuit which operates when switched to transmit.
   (c) Test socket pin 3.
   (d) Power amplifier V306, pre-heat filament supply via RLA4, R216, RLA2, SKT-F, RL82 and L312. This voltage, approximately +2.9V to the centre tap of V306 filament allows the power amplifier to warm up rapidly when the set is switched to transmit. The two halves of the filament winding are connected in parallel as pin 4 is strapped to chassis and pin 5 is connected to chassis via L311 and RL81. Each half of V306 filament has a nominal rated voltage rating of 6V. All the other transmitting valves are disconnected on receive as they are the directly heated type and have a quick warm up time.

Phone transmit

51. Closing the pressel switch completes the earth return to the operating coil of RLA4 and the relay contacts changeover. The -12V supply is connected via S1A6a and PLB6 to:
   (a) Power supply unit section supplying +3.2V as 49(a).
   (b) Test socket pin 4 as 49(e).
   (c) RLA2-13, R212, SKTF-J to 2nd a.f. amplifier.
   (d) Power supply unit +150V and +75V via RLA3 thus disconnecting the receiver supply.
   (e) Transmitter bias and operating coil RLD4 via SKTF-H.
   (f) Microphone polarizing voltage via RLA3, PIK-J, SABb, R211, R215 and RV202, PIK-H and SKTF-A.
   (g) Modulator via RLA3, PIK-J, SABb, PIK-H, SKTF-D.
   (h) Speech clipper via RLA3, PIK-J, SABb, PIK-H, SKTF-D, R332 and SKTF-J.
   (i) Power amplifier filament pre-heat via RLA2, SKTF-F, RL82 and L312.
   Therefore the 2,9V applied to the two halves of the filament during
the receive condition has been replaced by a 12V, boost voltage. This results in a rapid heating and the combined anode and screen current rises quickly and operates RLE/2 in the 150V feed line. The two halves of the filament are not put in series across the -12V supply by RLB2 disconnecting the boost voltage to the centre tap and RLB1 connecting the 12V via the line detailed in (d) and L311.

52. The +3.2V is connected to:

(a) Receiver SKTF-A, protective antenna circuit operating as described in para 56.

(b) Transmitter filament supply via RLA4 and SKTD-C.

(c) Test socket pin 3.

Beacon c.w. transmit

53. The earth return for RLA/4 is completed by SAFc and the set is at permanent transmit. The -12V supplies are as detailed in para 51 except that SABb and SAFb are open and therefore the microphone modulation and speech clipper are inoperative.

Beacon tone transmit

54. The earth return for RLA/4 is completed by SAFc as for Beacon c.w. transmit. The -12V supplies are as detailed in para 51 with the exception of the microphone energizing supply as SABb is not made. The speech clipper operates as tone generator as C205 is connected from VT201 base via PIK-D, SABc, and PIK-E to VT202 collector.

Antenna circuits

55. When the operating coil of RLA/4 is energized as described in para 51, change over contact RLA1 transfers the receiver input circuit from the antenna to muting capacitor C211 during transmission. As previously described in para 51(e) RLC/1 will be energized and its contacts will open to remove the damping capacitor C356 from across the transmitter r.f. circuit during transmission.

Receiver

Antenna circuits

56. The incoming signal from the 500Ω antenna is fed to a tap on L101 tuned by C101. To prevent damage to the input transistor by r.f. energy from the transmitter, germanium diodes HR106 and HR107 (of the 0A70 type) are connected across L101. On transmit the diodes are forward biased by the +3.2V fed through R160 and they heavily damp the tuned circuit. When the set is switched to receive the -12V supply is connected to the diodes which are then reversed biased and so have a negligible effect on the antenna circuits. The input to the receiver is also disconnected from the antenna by RLA1 (as shown in para 55 describing relay operation) and short circuited by C211 when the set is switched to transmit.
First r.f. amplifier VT101 (T1832)

57. This stage operates in the grounded base mode. Signals from L101 are coupled to the emitter by C102, fixed emitter bias derived from the +3.2V line is applied via R103, R101 and r.f. choke L102 decoupled by C105. The collector tuned circuit L103 and C104 is coupled to the next stage by C107.

Second r.f. amplifier VT102 (T1832)

58. This stage also operates in the grounded base mode and emitter bias is applied from the +3.2V line via R104 and r.f. choke L104, shunted by R161 and decoupled by C109. The collector tuned circuit L105 and C108 is coupled to the first emitter by C111.

First mixer stage VT103 (T1832)

59. The mixer stage is operated in a hybrid configuration r.f. input to emitter, oscillator to base, and the output is taken from the collector coupled into a tapped i.f. coil L107. It performs the function of accepting signals at channel frequencies of 240–300Mc/s, from the r.f. stages, and the local oscillator, combining these and amplifying the resultant frequency to be passed on to the first 19.05Mc/s i.f. amplifier. The emitter of VT103 is fed with input signal by C111 and is provided with a.g.c. control by the a.g.c. 1 line derived from the a.g.c. amplifiers VT114 and VT115. The standing current present through R106 is determined by R108 and R109 which provide the base potential of transistor VT103. The current is prevented from passing into the a.g.c. amplifier through R131 by MR101 (0470) a germanium diode. However when the signal exceeds the designed level, the negative a.g.c.1 output from the a.g.c. amplifier is fed to the cathode of MR101. Providing the potential derived from the a.g.c. amplifier exceeds the standing potential across R106, MR101 will conduct and further increments of a.g.c. output current will be subtracted from the available emitter current of VT103. Hence the forward gain and attenuation of VT103 can be controlled.

60. The mixer a.g.c. system provides a wide range of control due to the high degree of loop gain available via the intermediate frequency stages, and the setting of the a.g.c. amplifier output.

61. The local oscillator output is injected into the base of VT103 via the secondary of T106. Emitter r.f. filtering is provided by the network L106, R162 and C112. C113 and C114 are used to decouple the –12V line, and the base potential divider respectively.

Oscillator and oscillator doubler stages
(VT108, 109, 110 (00170), 111 and 112 (T1832))

62. To allow channel setting crystals to be used in a receiver operating in the v.h.f. band, it is necessary to use relatively low frequency crystals and employ multiplier amplifiers to step up the required mixer injection frequency, which is 19.05Mc/s below the signal frequency. In the A43 Mk 2 the crystals are situated in the tuners, radio frequency and are of the style J type with a temperature coefficient of -40°C +70°C ±0.003, and are marked with the final channel frequency and symbol R.
63. The first oscillator transistor VT108 (Q0170) is operated in the common emitter mode. The circuit is a modified Colpitts, which depends upon the relative low impedance of the collector load to allow it to function as a frequency multiplier. The base is operated with a back biased diode MR104 (Q0470) which limits the amplitude of the oscillator as a safety circuit, if the crystal selected is of higher than average activity.

64. The oscillator VT108 is tuned by C147 and C148 together with XL101. C147 may be linked to C148 to suit the crystal fitted, and is not required for all channels. As the stage operates as a doubler oscillator the crystals are ground to operate between 13.8 and 17.6Mc/s. The collector circuit is tuned to twice this frequency at 27.6 to 35.2Mc/s by T103 and C150. Bias for the stage is derived from the +3.2V line decoupled by R159 and choke L118. C149, C151 form the feedback circuit between the emitter and the base, and R128 provides d.c. bias to the base.

65. T103 is an h.f. transformer and the matched secondary coupling winding supplies drive to the base of the frequency multiplier stage VT109. The primary of T103 is tapped down to optimum coupling from the collector of VT108. A diode MR103 (Q070) is connected as a forward limiter to prevent over-drive of this stage. The emitter is directly biased from the +3.2V line via R132 decoupled by C154. The collector tuned circuit is formed by T104 and C153, is tuned to operate over the range of 55.2 to 70.4Mc/s and the matched secondary feeds into the base circuit of VT110 which operates as a further frequency multiplier stage.

66. VT110 stage is electrically similar to VT109 and it is transformer coupled to VT111 and VT112 by T105. It is operated as a frequency multiplier over the range 110.4 to 140.8Mc/s. The tuning capacitor of the collector circuit is C156. MR105 (Q070) is connected as a forward limiter to prevent over-drive to the stage.

67. The final frequency multiplier consists of a push-pull input transistor stage, VT111 and VT112. These transistors are of the germanium micro-alloy diffused base type, designed to provide adequate v.h.f. oscillator power, and are interchangeable with the r.f. transistors used elsewhere in the receiver. The mode of operation is grounded base and they are operated in Class B. The drive is applied to the emitters of VT111 and VT112 from the parallel connected secondary of T105, which is a close coupled bifilar winding.

68. The bases of this stage are grounded. Bias is applied to the emitters by connecting the bifilar coupling windings to R138 from the +3.2V line. Emitter stabilization is provided by R137 which in conjunction with R138 constitutes a potential divider across the +3.2V supply, decoupled by C159.

69. The collectors are connected in parallel to provide single ended output, the primary of T106, tuned by capacitor C161 forming part of the common collector load. The frequency coverage is 220.8 to 281.6Mc/s. The collectors are supplied from the -12V supply by R139 and decoupled by r.f. choke L117 and C162. The secondary winding of T106 provides drive to the base circuit of the first mixer stage VT103 and is matched for best overall performance over the frequency coverage of the receiver.
First i.f. amplifier stage VT104 (OC170) and first i.f. filter

70. The 19.05Mc/s signal produced in the collector circuit of VT103 is fed to the i.f. coil L107 which is coupled by C116, C117 and C118 to capacitance coupling, to the transformer T101 producing a bandpass i.f. response. R110 is the VT105 collector supply resistor from the -12V line and decoupled by C115. The output of the i.f. filter is shunted by R111 to ground and coupled to the emitter of the first i.f. amplifier VT104 by C119. VT104 is operated in the common base configuration although in fact the base is fed with a.g.c. 2 supply. Emitter stabilizing is provided by R111 which is grounded. The collector is connected to a tap on coil L308, the tap being arranged for optimum coupling and i.f. gain. The collector coil and T102 and associated coupling components C123, C124 and C125 constitute a bandpass filter of similar design to the first i.f. filter.

71. The first i.f. filter and the first i.f. amplifier stages have been constructed as separate assemblies each with its own screening can. In the case of the first i.f. amplifier the transistor VT104 is incorporated on the sub-assembly within the screening can.

Second mixer stage VT105 (OC170)

72. Second mixer stage VT105 is constructed as a screened unit and in conjunction with second oscillator VT113 functions to convert the first i.f. frequency of 19.05Mc/s down to the second i.f. frequency of 930kc/s.

73. The second mixer stage consists of VT105 which is operated as a hybrid mixer, r.f. input to base, oscillator to emitter, and the 930kc/s second i.f. output is taken from the collector. The input from the second oscillator VT113 is at a frequency of 19.98Mc/s which when mixed with the first i.f. of 19.05Mc/s produces a second i.f. of 930kc/s.

74. The 19.05Mc/s i.f. output from T102 secondary is fed to the base of VT105, the secondary being matched into the base impedance of VT105 and is connected to the a.g.c. 2 line. The output from the second oscillator VT113 is fed to the emitter of VT105 via C126, from the transformer T107, the emitter being stabilized by R113. The secondary of T107 has been designed to match the emitter impedance of VT105. The collector circuit consists of a tuned winding L109, damped by R115 and tuned to 930kc/s by the iron dust core and C127. This circuit including L110 tuned by its core and C129, forms with L109 a bandpass circuit with capacitance coupling across C128.

Second oscillator stage VT113 (OC170)

75. The second oscillator stage is crystal controlled and has been designed for high stability operation. The specification calling for a tolerance of ±10a/s over the operating frequency of 19.98Mc/s. The transistor is operated as a modified Colpitts oscillator and the output being taken from the emitter via T107 which is adjusted for maximum amplitude of signal. The collector is fed from the -12V line by R143, and from this point R140 is fed to the base for bias and a.c. stabilization with R141 forming the end component of a potential divider. The 19.98Mc/s crystal is parallel tuned by the air spaced preset capacitor C163 and the tuned circuit is between base and chassis earth. The emitter is stabilized by the resistor R142.
which is in series with the primary of the output transformer T107. C164, C165 and coupling capacitor C166 together form the feedback circuit from emitter to base. Output is taken from the high impedance point at the junction of C164 and C165 to the primary of T107 which is critically coupled by the secondary winding to the emitter coupling capacitor C126 in the second mixer VT105.

Second i.f. filter stage (930kc/s)

76. This stage is a screened assembly consisting of two tuned circuits, L111, C131 and L112, C133, coupled by the bottom capacitor C132 thus forming a bandpass network operating at 930kc/s. The input signal is fed by series capacitor C130 and damped by R117. The output from L112 is taken at low impedance and shunted to chassis earth by R118. External to the screening can and fitted between the filter and the next stage is an attenuator matching network consisting of R155 and R156.

Second i.f. amplifier stage VT106 (OC170) (930kc/s)

77. This stage contains VT106, operated in the common emitter configuration with the input from the previous stage taken directly to the base. Bias is applied to the emitter via R210 which is connected to the +3.2V line. The collector circuit consists of L113, C137, and L114, C139, which together constitute a bandpass filter. Top capacitance coupling by C138; L113 is tuned by C137 and damped by R119 to provide optimum matching for VT106 collector and output to VT107. The collector supply is taken from the -12V line via R121. Resistor R157 is in series with the collector to limit the gain of VT106 at 930kc/s and to maintain the output impedance. The stage is neutralized by a series circuit consisting of the overwind on L113 and C135.

Detector stage including third i.f. amplifier VT107 (OC170) (930kc/s)

78. This stage is a screened assembly containing the third i.f. amplifier stage VT107 and the crystal diode detector L3102. The signal from the previous stage is fed directly to the base of VT107 which is operated in the common emitter mode. The stage is similar to that of VT106 in that it uses two tuned circuits L115, C143 and L116, C145 top coupled by C144 to form a bandpass filter.

79. A portion of L115 and C141 form a series neutralizing circuit connected between the base of VT107 and the collector circuit. L115 tuned circuit is damped by R124. R123 is connected between the tuned circuit L115, C143 and the collector of VT107 to limit the gain at 930kc/s, and maintain output impedance to the detector. The signal is coupled directly to the cathode (equivalent) element of the detector i.e. R127 and the filter capacitor C146. The output of the detector is fed in parallel to the first a.g.c. amplifier VT115 and to the first audio frequency amplifier VT117.

A.G.C. amplifier VT115 and VT114 (CV7363)

80. The impedances in transistor a.g.c. circuits are much lower than in those of conventional valve receivers. This introduces a new problem with transistors because the a.g.c. system has to supply significant power and not just voltage as with valves. To prevent excessive loading of the detector stage, some form of d.c. amplifier stage is required to be inserted between the detector stage and the
controlled stages. Direct coupling is most suitable in the a.g.c. line because it ensures that blocking cannot occur when the receiver experiences sudden strong input signals.

81. The transistors are in the common emitter mode with the collectors connected in parallel directly to the -12V line. The negative going input from the detector stage is fed to the base of VT115 via R148. The base is connected to chassis earth by C168, a large capacitor to provide a long time constant to the input circuit. The base of VT114 is directly coupled to the emitter of VT115 which is operated as an emitter follower. The emitter is stabilized by R147 which has been given a high ohmic value to increase the gain and also by reducing the emitter current assists the stability of the stage. VT114 also operates as an emitter follower stage with the emitter potential being set by the network R144, R145 and R146. The collector and upper end of R144 are fed from the -12V line. The a.g.c. 1 and a.g.c. 2 voltages are in the order of -1V and -2.6V respectively, these being tapped off the junctions of R146, R145 and R144, R145.

Forward a.g.c. to stages VT104 and VT105

82. The initial a.g.c. action in the A43R Mk 2 takes place at the mixer VT103, and for this purpose reverse a.g.c. is used (para 59 refers), if however the range of the mixer a.g.c. is exceeded by a large reduction in signal, the second a.g.c. comes into action thus giving the set a wider range of control. The second a.g.c. system controls VT103 and VT105, and operates on the forward control. Transistor a.g.c. systems depend on the fact that the output level of a transistor varies with both collector voltage and collector current. In forward a.g.c., gain is reduced by reducing the collector voltage, usually by increasing the collector current and thus the voltage drop across the decoupled resistor in the collector circuit. This is a simplified account of the action of a.g.c. circuits because gain is also affected by the variations in transistor input and output impedance with the bias voltage and current.

83. Negative going supply a.g.c. 2 is fed to the base of VT104 via R154 to increase the forward current of VT104, and a variation of collector current produced, this causes the voltage across R112 to drop and a reduction in collector to emitter voltage, and hence the gain of the stage. A similar method is used in the case of VT105 except the input is fed through the secondary of T102 to the base of VT105 and the current variation of R114 alters the applied voltage to the collector and thus the gain.

First a.f. amplifier stage VT117 (CV7363)

84. The signal from the detector is fed by C171 to the base, which is connected to the potential divider R151, R152 is connected from the -12V line to chassis earth. The stage operates in an emitter follower configuration, the output being coupled to RV203 by C170. The collector is fed directly from the -12V line.

Second a.f. amplifier VT116 (CV7363)

85. The stage is operated in the common emitter mode with the amplified audio signal from VT117 being fed from the slider of RV203, the emitter stabilizing resistor for VT117. The input point is also used to introduce the sidetone audio voltage derived from H4304 via C208 and R213. The negative 12V supply line is fed through R212 and primary of T201 to the collector of VT116. The emitter is
connected to chassis earth. The collector is connected to the base by R149 which is shunted by C169 for response purposes. The secondary of T201 is matched to the impedance of the 300Ω electro-magnetic earphone.

Handset or headset circuit

86. The pressel switch fitted to either the handset (or headset) assemblies operates the coil of RLA/4 by earthing the -12V supply from RLA2-13. This facility is confined to the PHONE setting of the system switch SA.

87. The microphone is connected via pin A SKTH of the Bendix-Thorn connector to the input of the low pass filter via PIK-N. The earphone is connected to PIK-N, and on to the output transformer T201.

Smoothing circuit

88. An iron cored inductance is connected from the -12V supply line RLA3-8 and functions as a filter circuit to ensure the receiver power is free from ripple. The receiver side of the inductance is also connected to C210 to provide capacitive smoothing.

Power supply unit VT401, VT402 (CV7084), VT403 and VT404 (CV5416)

89. The power supply consists of two transistor d.c./d.c. convertors. One part of the convertor uses a pair of CV5416 (VT403 and VT404) to provide the +3.2V supply and operates continuously. On receive it supplies the emitter bias chain and the 'pre-heat' voltage for the p.a. valve heater. On transmit the oscillator and multiplier valves also obtain their filament voltage from this source.

90. The second part of the transistor convertor which operates only on transmit uses a pair of CV7084 transistors (VT401 and VT402) to provide +150V and +75V for the transmitter.

91. Both power supplies perform the same basic function as a vibrator type convertor in that d.c. from the supply battery is applied to a high speed switch (in this case the transistors). The interrupted primary voltage is then stepped up by the transformer secondary windings, rectified and smoothed.

92. The circuit providing the +150V and +75V supplies operates in the following manner. On switching to transmit the -12V supply is applied to the collectors of VT401 and VT402 via the centre tapped collector winding on T401. Also connected across the supply is the biasing network R401 and R402 and the junction of these two resistors is connected to the centre tap of the base winding on T401. This potential provides a small forward bias to VT401 and VT402 to ensure starting. Due to differences in the characteristics of the two transistors, one will conduct more heavily than the other (Assume this is VT401), the resultant voltages developed across the transformer windings will cause VT401 to 'bottom' (conduct heavily) whilst due to the opposite phasing of the windings VT402 will be cut off. This action will continue until the transformer core reaches saturation; the voltages then collapse, switching off VT401 and the overswing biases VT402 on. Regeneration
causes VT402 to bottom and it remains so until the transformer core once again reaches saturation in the opposite direction. The voltage collapses, VT402 switches off, VT401 switches on and so the cycle repeats itself.

93. On the secondary side of T401 full wave bridge rectification takes place via M401, M402, M403 and M404 (CV7039). The full winding is used to provide the +150V supply which is smoothed by C402, L402 and C403. Half the secondary winding is used for the +75V supply which is additionally smoothed by L401 and C401.

94. The action of the +3.2V supply circuit consisting of VT403, VT404 and T402 is basically similar to the previous one except that forward bias is provided from the junction of R403 and M405 (OA70). R405 and R406 provide current limiting during initial operation as the supply starts on load. Full wave rectification by M406 and M407 (CV7036) is used and the +3.2V output is smoothed by C403, L403, C407 and C409.

Test points

95. Several test points are placed throughout the set to assist in fault tracing. To gain access to these points the set must be unsealed; test point information is given in Tels F 532 Part 2 Table 2504.

A4R Mk 2. Later models.

96. In the following paragraphs and tables details are given of the circuits and component changes between the earlier and later models. Table 2 lists component changes.

97. The principal difference between the two models is in the p.a. section of the transmitter and minor alterations have been incorporated in both the receiver section and the power supply unit.

98. The p.a. valve V306 is now a directly heated high efficiency double tetrode type QQ202/6 and its heater volts are applied through contacts RLA2 operated by the pressel switch. Screen voltage on V304 and V305 is now raised to 150V d.c.

99. The relay RLA/4 has been changed for a type having heavy duty contacts to carry the p.a. valve heater current (RLA-2). Relay RLB/2 has been removed from circuit.

100. The resistors R312, R315 and R322 in the transmitter have been changed either in value or rating, R216 has been removed. Capacitor C321 is changed in value and C343, C352 and C358 together with L312 have been removed.

101. In the power supply unit, R403 is changed in value and the toroid transformer T402 is changed for one having an additional secondary winding giving 2.2V off load for the p.a. valve heater. This connection is made from pin 10 of T402 to pin 1 of SK B and thence to pin P of SK D via RLA-2.

102. In the receiver section (Fig 2526), R153 is changed in value and resistor R163 and diode MR108 added to the a.g.c. amplifier.

103. The technical description given in Tels F 532 Part 1 Issue 1 applies in the main to the later models with the exception of the details resulting from the circuit changes. In the following paragraphs the corresponding paragraphs of the Issue 1 are given in parenthesis to enable cross reference to be made.
Table 2 - Component additions/changes

<table>
<thead>
<tr>
<th>Cct ref</th>
<th>Component location</th>
<th>Value</th>
<th>Rating</th>
<th>Type</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RESISTORS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R313</td>
<td>E2</td>
<td>6.8K</td>
<td>1/8</td>
<td>comp</td>
<td>10</td>
</tr>
<tr>
<td>R315</td>
<td>G1</td>
<td>4.7K</td>
<td>1</td>
<td>comp</td>
<td>5</td>
</tr>
<tr>
<td>R322</td>
<td>H3</td>
<td>3.9K</td>
<td>1/8</td>
<td>comp</td>
<td>10</td>
</tr>
<tr>
<td>R403</td>
<td>G8</td>
<td>680</td>
<td>1/8</td>
<td>comp</td>
<td>10</td>
</tr>
<tr>
<td>R216</td>
<td>N8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R153</td>
<td>AA6</td>
<td>56</td>
<td>1/8</td>
<td>comp</td>
<td>10</td>
</tr>
<tr>
<td>R163</td>
<td>AA4</td>
<td>330K</td>
<td>1/8</td>
<td>comp</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAPACITORS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C321</td>
<td>E2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C343</td>
<td>L1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C352</td>
<td>D5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MISCELLANEOUS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RLA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RLB</td>
<td>M1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L312</td>
<td>D5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V306</td>
<td>J2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MR108</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Transmitter

P.A. stage
(Fig 2025)

104. The p.a. valve (V306) is a directly heated durable tetrode (para 18, 35). Heater volts are applied via RLA-2, operated by the pressel switch, and pre-heat voltages are not necessary (para 39).

Phone transmit

105. The -12V supply (para 51(c)) is re-routed from RLA2-13 to RLA3-9. The p.a. filament pre-heat (para 51(j)) operation does not apply.
106. The addition of R163 and MR108 to the base circuit of VT115 reduces the time constant of R148 and C168 thus reducing the a.g.c. attack time (para 81).

107. The toroid transformer T402 is changed for one having an additional secondary winding giving 2.2V a.c. off load (para 94).

108. The output voltages of the converter T402, VT403 and VT404 are +3.2V and 2.2V a.c. On receive, the +3.2V supplies the emitter bias chain. On transmit this voltage is fed to the oscillator and multiplier valves as filament voltage and the 2.2V is fed to the p.a. valve heater.

**BATTERY CHARGER**

109. The battery charger is designed to operate from a d.c. supply of either 12 or 24V nominal, e.g. a vehicle or aircraft battery or electrical system. The input voltage selection is effected entirely automatically by means of a voltage-sensitive relay. The charger provides a constant voltage output at either 13.2V for lead-acid batteries or 14.6V for use with the nickel cadmium batteries. It can deliver sufficient current to float-charge one normal battery unit at the correct rate whilst simultaneously operating one equipment in the receive condition via the battery adaptor.

110. Rectifier MR501 (CV7122) presents a low resistance to normal current flow when the supply voltage is connected in the correct polarity, but a very high resistance to a reverse current in the event of the supply voltage being inadvertently reversed. This arrangement prevents the possibility of damage to transistors VT501 and VT502 (CV7085) being caused by reversed polarity.

111. The value of R501 is selected so that relay RLA/2 will operate at 19 ±1V, so that for input voltages below this figure RLA/2 will remain de-energized and so in turn will relay RLB/2. The transistor oscillator VT501, VT502, will therefore operate using the inner taps on the main primary winding of T501, to give 17V nominal output from the secondary.

112. To ensure that the oscillator will start, it is necessary for a large forward bias to be applied initially to the bases of VT501 and VT502 to establish base-emitter current. A diode, MR502 (CV7039) is included in the circuit for this purpose. Under starting conditions, MR502 is biased in the reverse direction and so has a very high d.c. resistance. A large bias is therefore applied to the bases of VT501 and VT502. As oscillation builds up, the base potential of the transistors becomes positive with respect to that of the emitters owing to the rectifying action of the base-emitter junctions. Therefore, MR502 then becomes biased in the forward direction, and so its d.c. resistance is reduced; this allows the base current to assume an appropriate value for the continuously operating condition.