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**AP 116E-0724-16**
(Formerly AP 2566F, Vol. I)

# RACK ASSEMBLIES TYPE 243 AND 246 & RECEIVERS TYPE R1968 AND R1475

## GENERAL AND TECHNICAL INFORMATION AND SERVICING

BY COMMAND OF THE DEFENCE COUNCIL

Ministry of Defence

FOR USE IN THE

ROYAL AIR FORCE

Prepared by the Procurement Executive, Ministry of Defence



RESTRICTED

# LAYOUT OF A.P.2566F

## RACK ASSEMBLIES TYPE 243 AND 246

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

| | |
|---|---|
| **VOLUME 1** | **Leading particulars. General and technical information** |
| **VOLUME 2** | **General orders and modifications** |
| **VOLUME 3, Part 1** | **Schedule of spare parts** |
| VOLUME 3, Part 2 | *Inapplicable* |
| VOLUME 3, Part 3 | Scales of unit equipment |
| VOLUME 3, Part 4 | Scales of servicing spares |
| VOLUME 4 | Planned servicing schedules |
| VOLUME 5 | Basic servicing schedules |
| VOLUME 6 | Repair and reconditioning schedule |

## PREFACE

Each leaf, except the original issue of preliminaries, bears the date of issue and the number of the Amendment List with which it was issued. New or amended technical matter will be indicated by black triangles positioned in the text thus:- ◀———▶ to show the extent of amended text, and thus:- ▶ ◀ to show where text has been deleted. When a Part or Chapter is issued in a completely revised form, the triangles will not appear.

The Air Publication number of this manual was altered from AP.2566F, Vol.1 to AP 116E-0724-16 in October 1972 under AL.5. No general revision of page captions has been undertaken, but the code number appears in place of the earlier AP number on new or amended leaves subsequent to October 1972.

In this book there are some references to AP 2883G, Vol.1 (2nd Ed) "Receiving Equipment Type R.1475 and Variants" but it should be noted the AP was made obsolete in D.C.I. Publications Supplement 68/46.

## LIST OF ASSOCIATED PUBLICATIONS

Rack Assemblies Type 242 and 242A & Receiver Type R.1967 ... AP 116E-0706-16 (Formerly AP 2566D, Vol.1)

Receiver Radio 5820-99-943-2775*, 5820-99-999-9292 )... ... AP 116E-0704-1
and Mixer Stage Frequency 5820-99-943-3464 )(Formerly AP 2550M, Vol.1)

* RA17 Mk2

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# CONTENTS OF VOLUME I

## PRELIMINARIES



## PART I

## GENERAL INFORMATION



## PART 2



## PART 3



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

# PART I

# GENERAL INFORMATION

# Notice regarding modification No. 5178

The receiver radio *Ref. No.* 10*D*/5820-99-943-2775 (Racal receiver R.A. 17 Mk.2, to be described in A.P.2550M, Vol. 1) is being introduced into the R.A.F. and will replace the existing receivers in rack assemblies Type 243 (*Ref. No.* 10*D*/18415), Type 246 (*Ref.* No. 10*D*/18419) and Type 9778 (*Ref. No.* 10*D*/20615). To incorporate these new receivers and to allow for their outputs to be fed into new type recorders, which will be introduced shortly, it will be necessary to provide new mains connectors, replace existing output plugs and sockets, and reterminate outputs on a 12-way connector strip on the rack assemblies.

**Note . . .**

*Upon incorporation of the two new receivers and the modification, the three rack assemblies will become identical and be re-referenced rack assembly Type* 14315, *Ref. No.* 10*D*/22177. *Full details of the modification will be found in A.P.2566F, Vol. 2, Part* 1, *Section B. Volume* 1 *will not be amended except by this notice.*

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# Chapter I

## GENERAL DESCRIPTION,

## RACK ASSEMBLIES TYPE 243 AND 246

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### LIST OF ILLUSTRATIONS

# LEADING PARTICULARS

| | |
|---|---|
| **Purpose of equipment** | *Reception of R/T and hand-speed Morse signals* |

| | |
|---|---|
| **RACK ASSEMBLY TYPE 243** | *Stores Ref. Nos. 10D/18415* |
| *Consisting of:—* | |
| ***Rack assembly Type 252*** | *10D/18434* |
| ***Two receivers Type R.1968*** | *10D/18432* |
| ***Panel (control) Type 788*** | *10D/18429* |
| **RACK ASSEMBLY TYPE 246** | *10D/18419* |
| *Consisting of:—* | |
| ***Rack assembly Type 253*** | *10D/18435* |
| ***Panel (control) Type 788*** | *10D/18429* |
| ***Receiving equipments Type R. 1475 (two)*** | *10D/1525* |
| *incorporating:—* | |
| *Receiver unit Type 88* | *10D/1541* |
| *Power units Type 360* | *10K/1260* |

## LEADING PARTICULARS OF RECEIVER TYPE R.1968

*(modified from RCA model AR 88 LF)*

| | |
|---|---|
| ***Purpose of equipment*** | *General purpose ground communications receiver* |
| ***Type of signal*** | *CW, MCW or R/T* |
| ***Frequency range**—total 6 bands* | *73 to 30500 kc/s* |
| *Band 1* | *73 to 205 kc/s* |
| *Band 2* | *195 to 550 kc/s* |
| *Band 3* | *1480 to 4400 kc/s* |
| *Band 4* | *4250 to 12150 kc/s* |
| *Band 5* | *11900 to 19500 kc/s* |
| *Band 6* | *19000 to 30500 kc/s* |
| ***Calibration accuracy*** | *1 division of main scale* |
| ***Dial re-setability** (backlash)* | *1 small division on vernier scale* |
| ***Intermediate frequency*** | *735 kc/s* |
| ***Oscillator stability*** | *re-setting accuracy within 2 kc/s* |
| ***IF selectivity:**—Switch position* | *1. Crystal filter out ... 16000 c/s* |
| | *2. Crystal filter out ... 8000 c/s* |
| | *3. Crystal filter in ... 4000 c/s* |
| | *4. Crystal filter in ... 2000 c/s* |
| | *5. Crystal filter in ... 550 c/s* |

| ***Valves*** | *Circuit ref.* | *Type* |
|---|---|---|
| *RF and IF amplifiers* | *V1, V2, V5, V6, V7* | *CV1978* |
| *Frequency changer* | *V4* | *CV1966* |
| *RF oscillator* | *V3* | *CV1933* |
| *Demodulator* | *V8* | *CV1930* |
| *Noise limiter* | *V9* | *CV1930* |
| *1st AF amplifier* | *V10* | *CV591* |
| *AF output* | *V11* | *CV509* |
| *BFO* | *V12* | *CV1933* |
| *Voltage regulator* | *V13* | *CV216* |
| *Rectifier* | *V14* | *CV1856* |
| *Static discharge neon* | *V16* | *CV651* |

| | |
|---|---|
| ***Power supply requirement*** | *115 or 230V, 25/60 c/s 100W (approx.)* |
| ***Maximum undistorted output*** | *2·5 watts (approx.) when loudspeaker used* |
| | *100mW when low impedance headphones are used* |

***Sensitivity of IF and AF chassis**—such as to produce 0·5W output for less than 120μV input*

| | |
|---|---|
| ***Output impedance*** | *600 ohms, balanced, 1 winding* |
| | *600 ohms, unbalanced, 2 windings* |
| ***Overal dimensions*** | *19¼ in wide × 11 in. high × 19¼ in. deep* |
| ***Weight*** | *100 lb. (unpacked)* |

## LEADING PARTICULARS OF RECEIVER UNIT TYPE 88

*(main component of receiving equipment Type R.1475)*

| | |
|---|---|
| ***Purpose of equipment*** | *General purpose and ground receiver* |
| ***Type of signal*** | *CW, MCW or R/T* |
| ***Frequency range*** | |
| *Main channel* | *2-20·14 Mc/s* |
| *Guard channel* | *2-7·5 Mc/s* |
| ***Main channel*** | |
| *Band 1* | *2 to 3·62 Mc/s* |
| *Band 2* | *3·58 to 6·44 Mc/s* |
| *Band 3* | *6·38 to 11·38 Mc/s* |
| *Band 4* | *11·24 to 20·14 Mc/s* |
| ***Frequency stability*** | *Thermally-controlled local oscillator gives re-setting accuracy better than 4 kc/s, between 11·3 and 20 Mc/s, and within 2 kc/s between 2 and 11·3 Mc/s* |

## LEADING PARTICULARS OF RECEIVER UNIT TYPE 88 (contd.)

**Crystal** ... ... ... BFO crystal controlled, 600 kc/s. Also gives calibration check facility at 600 kc/s intervals

**Maximum sensitivity** ... 1μV input for 50mW output at high-level output, for a signal-to-noise ratio of 20dB. 1μV for 1mW at low-level input for S/N ratio of 20dB

**Intermediate frequency** ... ... ... ... ... ... ... 601·3 kc/s

**Selectivity** ... ... ...
1. On R/T and wide-band CW positions, IF cut-off is 8dB per kc/s; AF output is level to 2dB from 270 to 2750 c/s
2. On other CW positions, IF cut-off is 11dB per kc/s
3. Listening-out bandwidth is 3 kc/s
4. 1·2 kc/s and 300 c/s AF filters can be inserted by switching

**Output impedance** ... ... ... Provision for 20,000, 600, or 150 ohms output load

| **Valves** | Circuit ref. | Type |
|---|---|---|
| RF and IF amplifiers | V1, V5, V7 | CV1053 |
| Local oscillator | V2 | CV1932 |
| Main channel mixer | V3 | CV1347 |
| Guard channel mixer | V4 | CV1347 |
| HT stabilizer for LO | V6 | CV216 |
| Demodulator and BFO | V9 | CV587 |
| AGC | V8 | CV587 |
| Noise limiter | V10 | CV1054 |
| AF amplifier | V11 | CV587 |
| AF output | V12 | CV1932 |
| Tuning indicator | V13 | CV1103 |

**Power input** ... ... ... ... ... ... ... HT feed, approx. 65mA at 250V
LT feed, approx. 1·8A at 12V

**Power output** ... ... ... ... Max. undistorted output at low-level, 3·75mW
Max. undistorted output at high-level, 150mW

**Approximate overall dimension** ... ... ... ... ... ... ... Height $8\frac{3}{4}$ in.
Width $16\frac{1}{2}$ in.
Depth $8\frac{1}{2}$ in.

**Weight** ... ... ... ... ... ... ... ... ... ... ... 31 lb.

**Associated equipment** ... ... ... ... ... ... Power unit Type 360

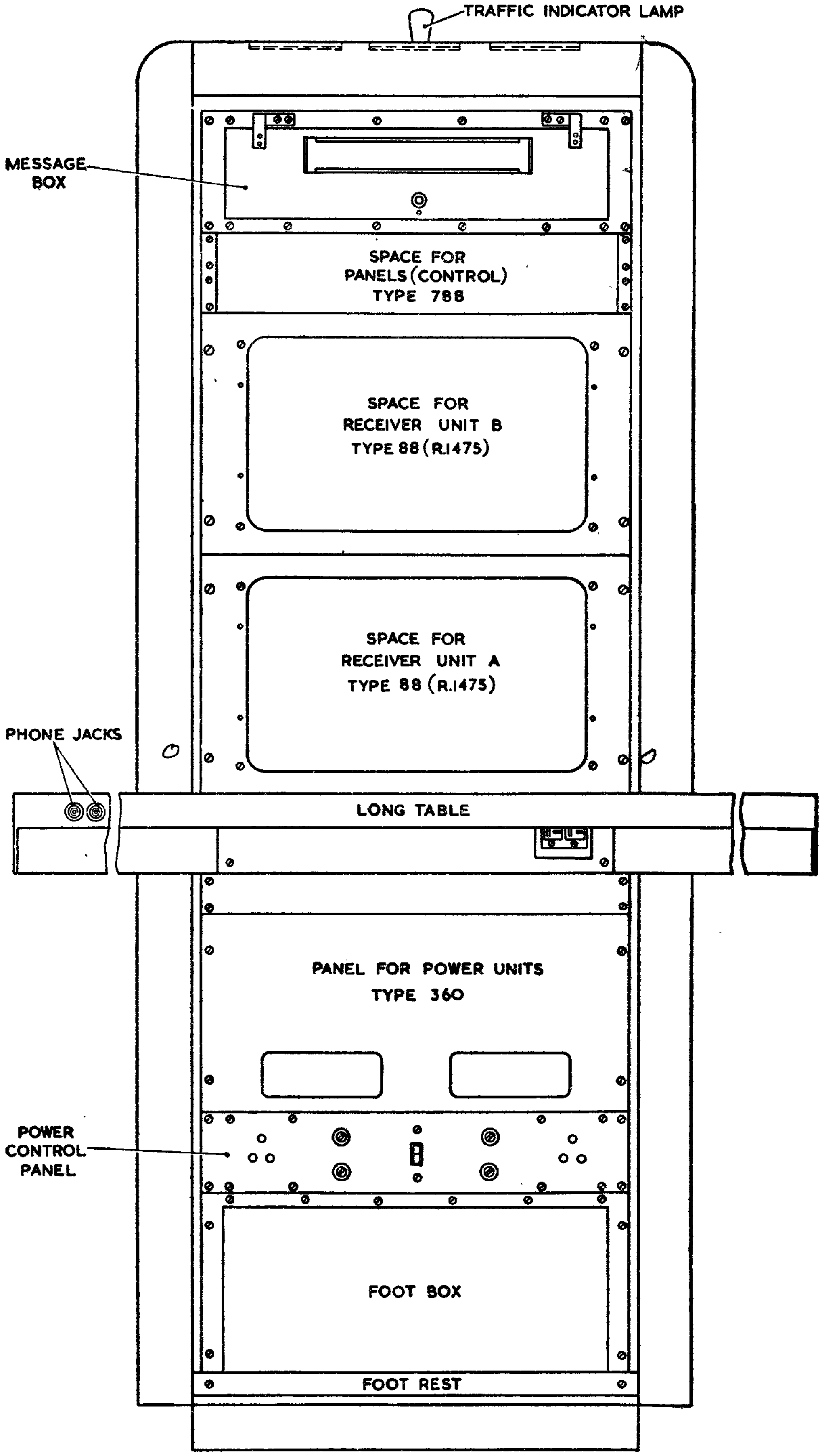



**Fig. 1. Front view of rack assembly Type 253**

**Introduction**

**1.** Rack assemblies Type 243 and 246 are used for the reception of R/T and hand-speed Morse signals. Two receivers are fitted in each type of rack so that a single operator can deal with traffic on two channels, monitoring each in turn. In rack Type 243 the receivers are modified RCA general purpose communication receivers, model AR 88 LF (receivers, Type R.1968), while in rack Type 246 receiving equipments Type R.1475 are used.

**2.** In each type of rack an AC mains power control and fuse panel is fitted to supply the power packs of the two receivers. A signal monitor and control panel allows the audio outputs from the receivers to be monitored. A special pair of headphones, with the ear-pieces wired separately, is used so that the operator can listen to both receivers simultaneously, or to the individual receivers, according to the setting of the functional switch of the rack, on the signal control panel. The AGC lines of the two receivers in a rack may be connected for diversity reception, when both receivers are tuned to a R/T signal which is subject to fading.

**3.** Fitted to the top of the rack is a traffic indicator lamp operated by a switch on the control panel. The control panel also provides for telephone and microphone communications within the operations centre. A long table is fitted to the front of the rack for the convenience of the operator. There is also a foot recess at the bottom of the rack and a message box at the top.

## GENERAL DESCRIPTION

**4.** The basic racks used for the two assemblies are five feet high and 25 in. deep. They are designed to accommodate international standard chassis with front panels 19 in. wide. These basic racks are modified to suit the receivers used in the respective assemblies and therefore have different Stores Ref. Nos. in the two assemblies. In both racks the rear doors and top are louvred to allow ventilation. The side panels are hinged, with a push button fastener at the front. Both the rear doors and the side panels can be lifted clear of the racks for servicing purposes. Fig. 1 gives an indication of the appearance of a basic rack.

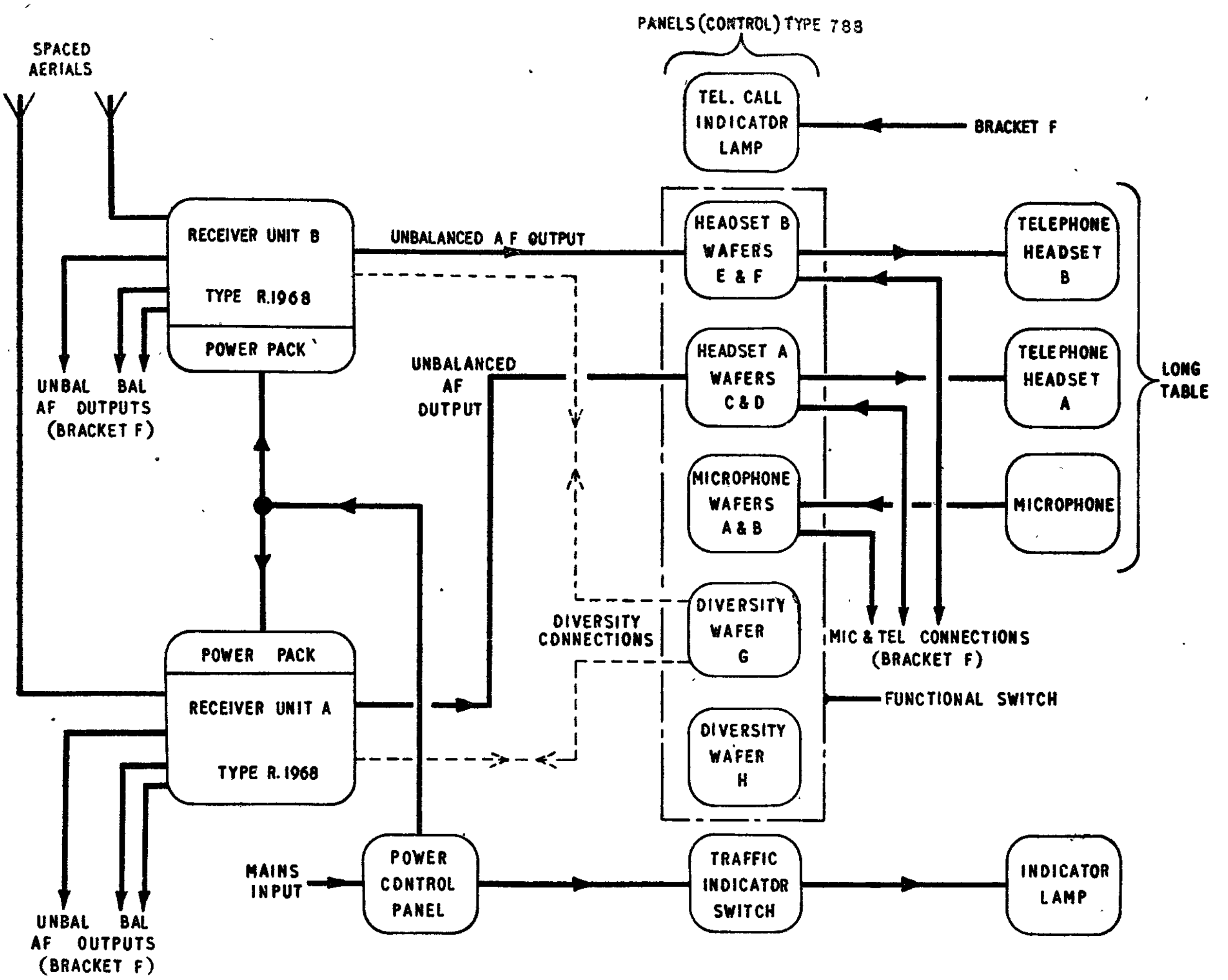



**Fig. 2. Block diagram of rack assembly Type 243**

**Rack assembly Type 243**

**5.** In this assembly the basic rack is Type 252 (*Stores Ref.* 10D/18434). Built into this rack (reading from the bottom at the front) are:—

(1) A foot box and foot rest for the convenience of the operator.

(2) An AC mains power control panel to supply power to the two receivers Type R.1968.

(3) A long table (dimensions 3 ft. long × 17½ in. wide × 3½ in. deep) fitted with headphone sockets and microphone for the use of the operator.

(4) Space for two receivers Type R.1968.

(5) Space for a signal control panel, Type 788.

(6) A message box.

(7) A traffic indicator lamp, mounted on top of the rack and operated by a switch on the signal control panel.

**Rear brackets**

**6.** At the back of rack Type 252 are mounted six bracket assemblies on which are fitted Jones plugs and sockets, interwired for the connection of the various units in the rack, and for connection to external lines and power supplies.

**7.** With the addition of the two receivers (R.1968) and the signal control panel the rack Type 252 becomes Type 243. The receivers and the control panel have rear panel plugs and sockets which are linked to the rear bracket connections by flexible cables wiring with appropriate terminations.

**Rack assembly Type 246**

**8.** In this assembly the basic rack is Type 253 (*Stores Ref.* 10D/18435). The front of this rack (*shown in fig.* 1) differs from the Type 252 in that provision is made for mounting two power units Type 360 in the panel between items (2) and (3), mentioned in para. 5. This is a blank panel in the rack Type 252. In addition the spaces for the two receivers are modified by the addition of two panels with apertures to accommodate the receiver units Type 88, which are only 16½ in. wide. The two power units Type 360 are required because, unlike the R.1968, the R.1475 has no in-built power pack. When the two receivers and two power units are fitted the rack Type 253 becomes Type 246.

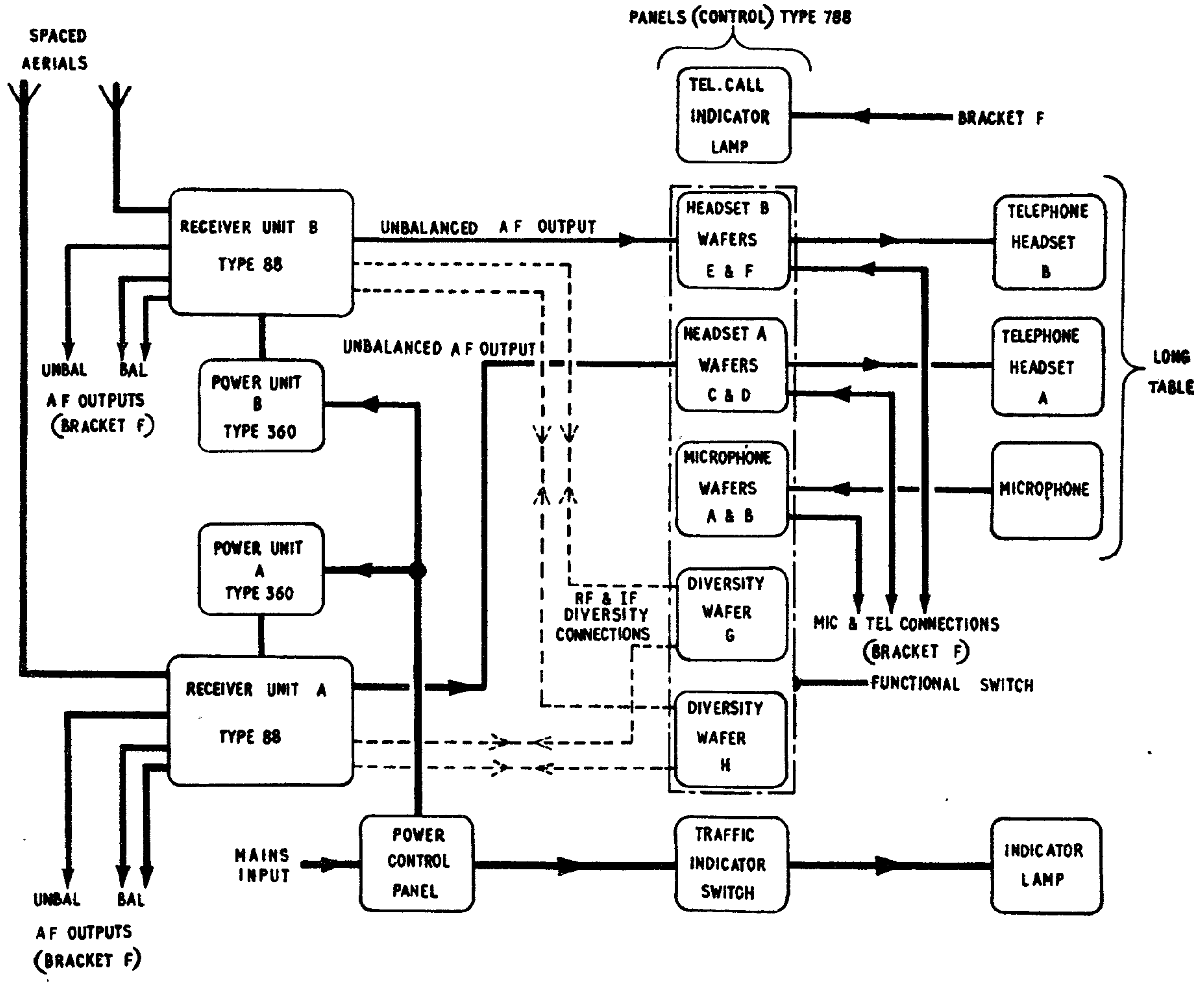



**Fig. 3. Block diagram of rack assembly Type 246**

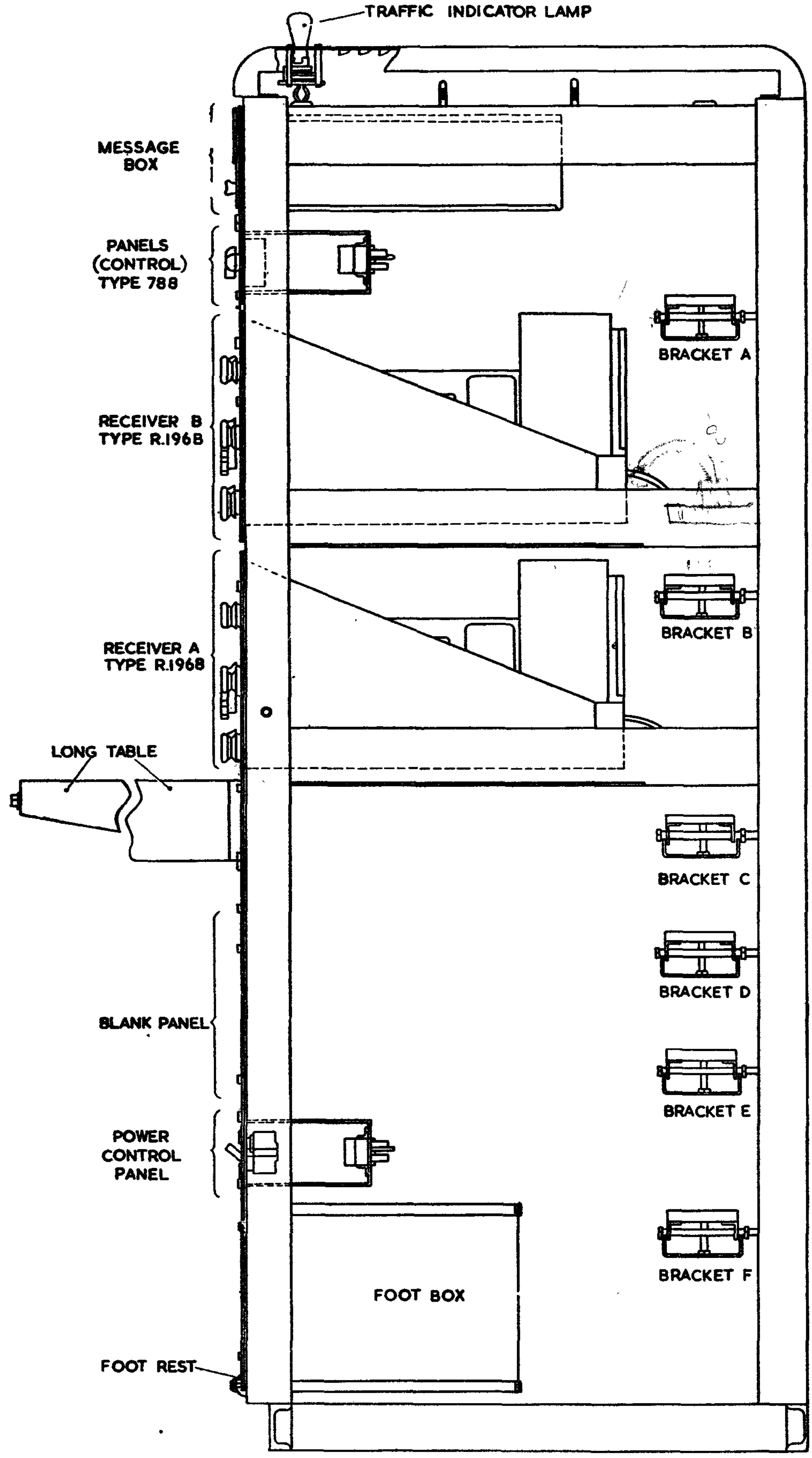


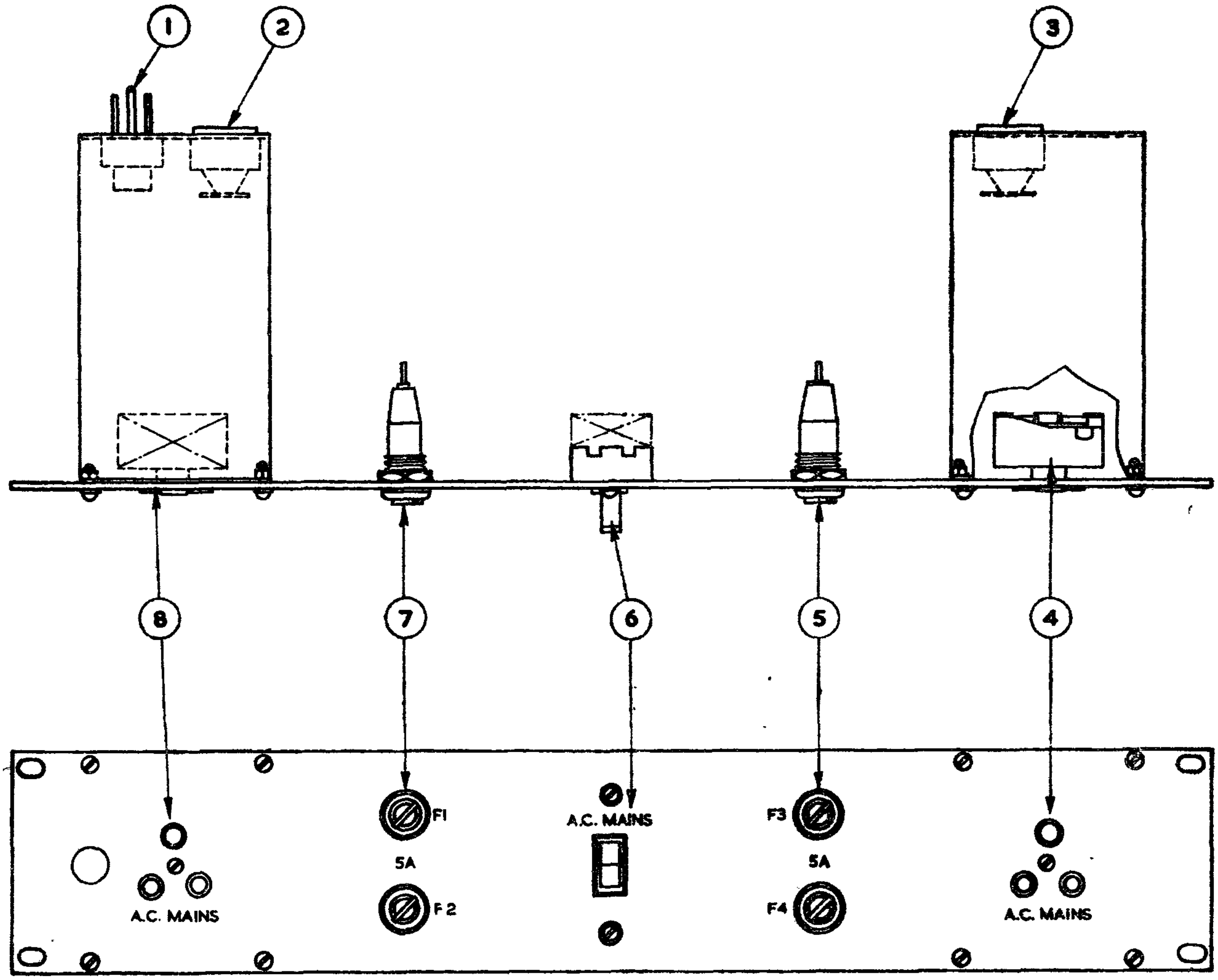

**Fig. 4. Side view of rack assembly Type 243, with side panel removed**

#### Interconnection of units

**9.** The rear bracket connections on the rack Type 253 are the same as on the Type 252. Both racks are wired for the accommodation of either the R.1968 or the R.1475. In both assemblies the inputs from the aerials may be made via 75-ohm coaxial feeders, or via 600-ohm transmission lines matched into 75-ohm coaxial feeders, terminated by plugs which mate with sockets mounted on the rear panels of the receivers. The audio outputs from the receivers are monitored by the operator, using the signal control panel, and are applied to the bottom bracket (F) at the rear of the rack for external use. Figs. 2 and 3 give block diagrams showing the interconnection of the units in the two assemblies, while fig. 4 shows the positions of the rear brackets. The wiring diagram for the racks (*Part* 2, *Chap*. 1, *fig*. 1) shows the relative positions of the plugs and sockets mounted on the rear brackets, as viewed from the rear. In fig. 2 and 3 the diversity connection between the two receivers is shown dotted. This connection is used only when a single R/T channel is being received.

#### Power control panel

**10.** The position in the rack of this panel is shown in fig. 4. Line drawings of the front and top views of it are given in fig. 5. The annotations in this figure are referred to below. The mains input to the rack is applied to the Jones plug (1), marked AC MAINS, on the right of the control panel as viewed from the rear. This input is taken to the two front panel standard 5A 3-pin sockets (4 and 8), via the right-hand pair of cartridge fuses F3 and F4 (5). The rear Jones sockets (2) and (3), marked AC RXA RXB and INDIC, are supplied via the switch (6),




| | | | Stores Ref. |
|---|---|---|---|
| 1 | AC MAINS input | Plug Type 195 (4-pole Jones type) | 10H/324 |
| 2 | AC to RXA and RXB | Socket Type 530 (4-pole Jones type) | 10H/4052 |
| 3 | AC to INDICATOR | Socket Type 530 (4-pole Jones type) | 10H/4052 |
| 4, 8 | AC MAINS | Sockets, 3-pin, 5A | 5A/3954 |
| 5, 7 | Fuse holders and fuse links | | |
| 6 | AC MAINS | Switches Type 267, D/P, S/T | 10F/10685 |

**Fig. 5. Front and top views of power control panel**

marked AC MAINS and the two left-hand fuses F1 and F2 (7). The Jones sockets are connected to corresponding plugs on bracket F at the rear of the rack. These plugs feed their respective items of equipment via the rack wiring.

**Panel (control) Type 788**

**11.** This is the signal control panel. Its position in the rack is indicated in fig. 4, and line drawings of the front and top views of it are given in fig. 6. Mounted at the rear of the panel are three plug plug and socket assemblies (*fig.* 7) associated with the neighbouring front panel components. Viewed from the front, the controls are as follows (*the annotations refer to fig.* 6):—

(1) On the left is a double-pole switch (6), which completes the circuit for the TRAFFIC INDICATOR.

(2) In the centre is an indicator light (5) for the telephone call line (TEL. CALL LINE).

(3) On the right is the main functional switch (4) of the rack. This is 4-wafer, 8-section, 5-position switch, providing the following facilities on the five positions:—

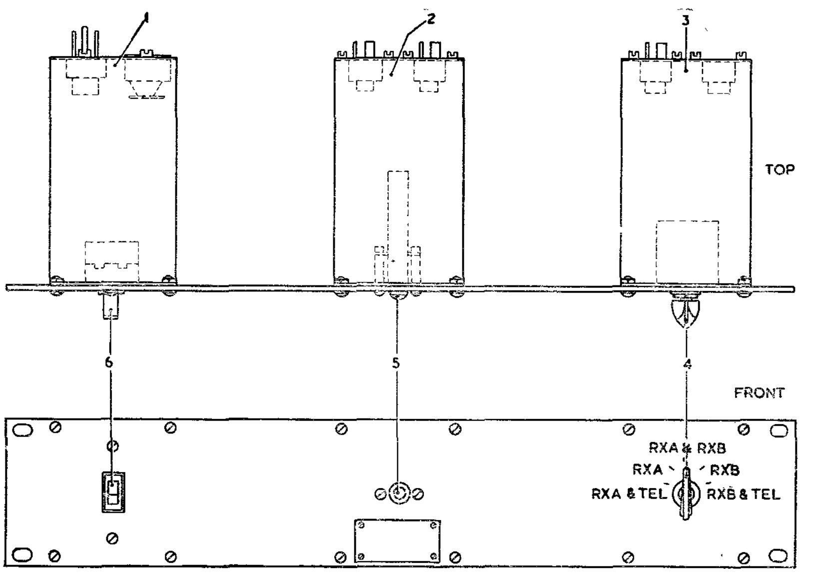
(a) RXA & TEL. The operator's microphone is connected to the external line. One headphone is connected to the external line and one to the unbalanced AF output of receiver A (the lower receiver).

(b) RXA. The microphone circuit is broken and both headphones are connected in parallel to the AF output of receiver A.

(c) RXA & RXB. The microphone circuit is broken. One headphone is connected to receiver A and one to receiver B. The AGC lines of the two receivers are connected for diversity operation only when the RXA and RXB plugs are in the RXA and RXB DIVERSITY sockets on bracket A.

(d) RXB. The microphone circuit is broken and both headphones are connected in parallel to receiver B.

(e) RXB & TEL. The microphone is connected to the external line. One headphone is connected to the external line and the other to receiver B.




| | | | Stores Ref. |
|---|---|---|---|
| 1 | Plug and socket bracket assembly (RH) | | |
| | TRAFFIC INDICATOR | 1 Plug Type 195 (4-pole Jones type) | 10H/324 |
| | | 1 Socket Type 530 (4-pole Jones type) | 10H/4052 |
| 2 | Plug and socket bracket assembly (centre) | | |
| | TEL. CALL LINE | 2 Plugs Type 694 (4-pole miniature Jones type) | 10H/19201 |
| | TEL. LINE., MIC. LINE | | |
| 3 | Plug and socket bracket assembly (LH) | | |
| | RXA, RXB | 2 Plugs Type 694 (4-pole miniature Jones type) | 10H/19201 |
| | TEL. JACKS, MIC. | 2 Sockets Type S/304/AB (4-pole miniature Jones type) | 10H/18801 |
| 4 | Functional switch, ceramic wafer type | | 10F/[illegible] |
| | | 1 Knob Type 105, black bakelite, pointer type | 10A/13162 |
| 5 | TEL. CALL indicator lamp | | |
| | | Cap, lamp, red | 10A/10494 |
| | | Jack, lamp, Type 3 | 10H/9102 |
| | | Lamps, filament, 6V, 0·24W | |
| 6 | TRAFFIC INDICATOR tumbler switch, D/P, S/T, Type 267 | | 10F/10685 |

**Fig. 6. Front and top views of panels (control) Type 788**

*Rear connections*

**12.** These are illustrated in fig. 7. They are Jones plugs and sockets which provide for the connections to other units in the rack assembly as outlined in para. 11. Reading from the right, as viewed from the rear of the signal control panel the connectors are as follows:—

(1) TRAFFIC INDICATOR plug and socket. The power supply from the power control panel is fed into the rack on the bottom rear bracket F, applied to the signal control panel on bracket A, and, subject to the operation of the control switch, fed to the indicator lamp mounted on top of the rack.

(2) TEL. CALL LINE. The external input is applied to the plug on bracket F and conveyed by the rack wiring to the socket on bracket A which feeds the indicator light via the plug on the rear bracket of the control panel. Item (3) is on the same rear bracket.

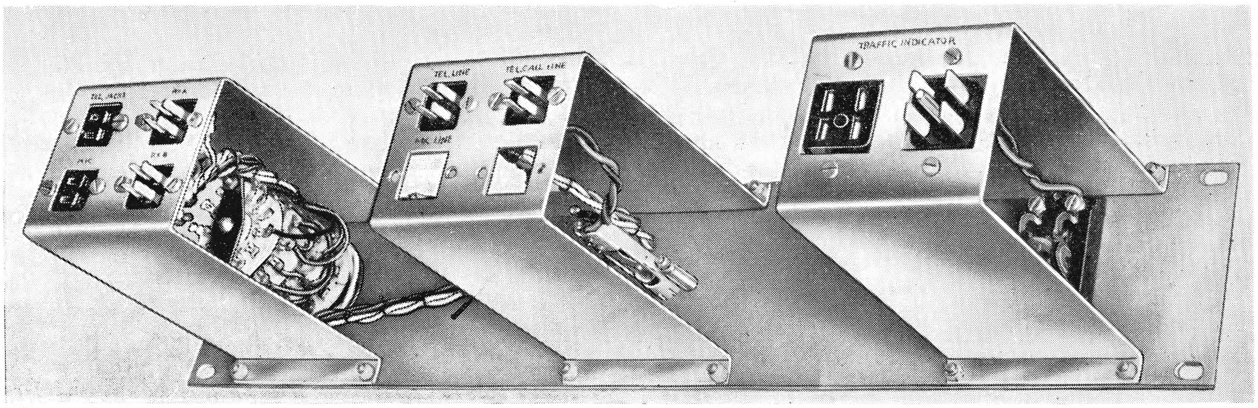
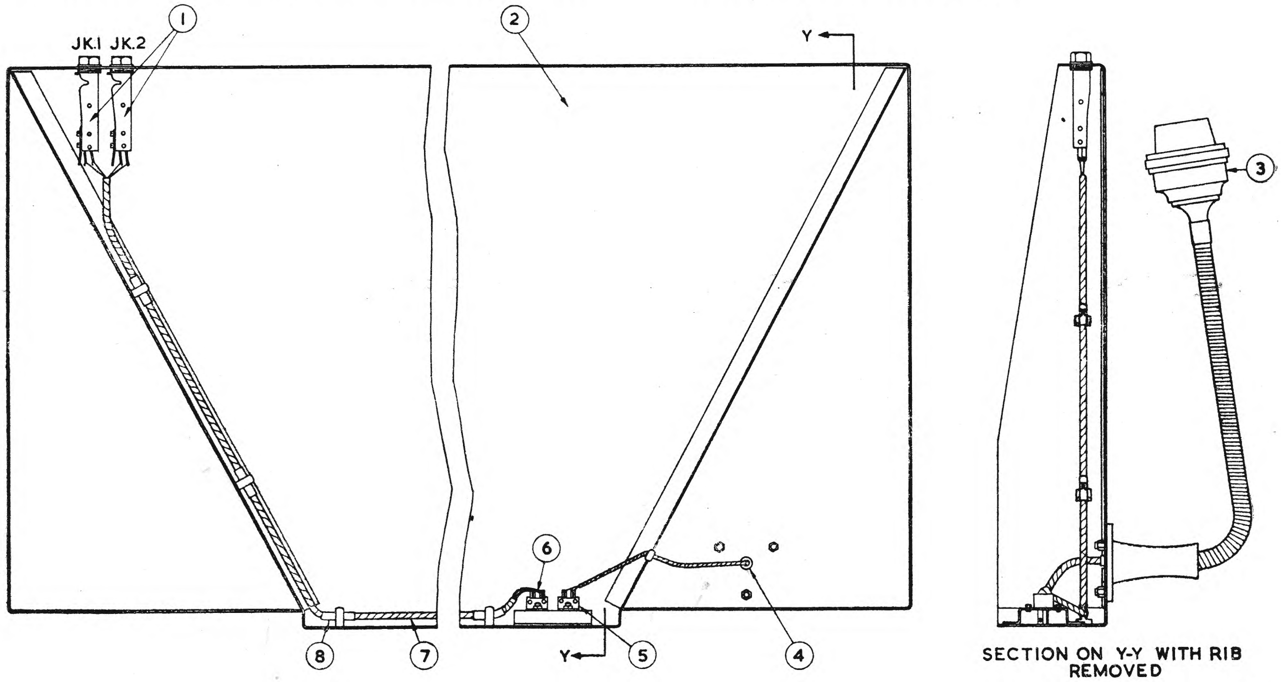



**Fig. 7. Panels (control) Type 788, rear view**

(3) TEL. LINE, MIC. LINE. External connections to the rack are made on bracket F and thence by rack wiring to bracket A which provides for connection to the plug at the rear of the control panel.

(4) RXB. RXA. These plugs, mounted with RxB above RxA are on the left-hand assembly, at the rear of the panel Type 788. They provide for unbalanced AF output and AGC line connections to the two receivers in the rack, via connectors on brackets A, B and C. Alternative sockets on bracket A permit the unbalanced AF outputs from the two receivers to be applied to the signal control panel either with or without the AGC connection.

(5) MIC. TEL. JACKS. These two sockets are also mounted on the left-hand assembly behind the functional switch, with the MIC. socket at the bottom. They are connected by the rack wiring to bracket D and thence to the microphone and headphone sockets mounted on the long table. The plug and socket connections between the rack and the long table are made so that the table may be removed for transit purposes.




| | | Stores Ref. |
|---|---|---|
| 1 | Telephone jack sockets, Type 31 | 10H/2116 |
| 2 | Long table for rack assemblies Type 243 and 246 | |
| 3 | Microphone complete { microphone Type 55 | 10A/15982 |
| | { flexible arm | 10G/16926 |
| 4 | Grommet, PVC, $\frac{1}{4}$ in. dia. chassis hole | |
| 5 { | Plug Type 694 (4-pole Jones type, panel mounting) | 10H/19201 |
| 6 { | for MIC. and TEL. JACKS | |
| 7 | Durawire, GD, S11, 14/·0076 in., colours green and brown twisted together | |
| 8 | Sleeve, PVC, No. P2A × 1 in. long, black | |

**Fig. 8. Wiring of long table**

**Long table**

**13.** An underside view of the long table is given in fig. 8 to show the wiring from the miniature Jones plugs to the microphone and the headphone sockets. The miniature Jones plugs on the long table are connected to the sockets on rear bracket D by " flexible " connectors.

## RECEIVER TYPE R.1968

**Modifications**

**14.** As stated in para. 1 this is the RCA receiver AR 88 LF modified for rack working. The main modifications that have been carried out are listed below. The same modifications are incorporated in receiver Type R.1967 on conversion from the AR 88.

(1) Aerial coaxial socket SK201 is fitted to the rear panel.

(2) Plug PL201 is fitted to the mains input lead.

(3) The terminal boards TB2 and TB4 on the rear panel are modified and wired to socket SK202 to facilitate common AGC of the two receivers and to provide interconnection within the rack assembly.

(4) A 0-300 micro-amp. tuning meter (M201) is connected in the demodulator diode (V8) load circuit, and fixed to the front panel.

(5) The AGC circuitry of V1 is modified (R203 and R217 to R219) so that one fifth of full AGC is applied. This prevents overloading of succeeding stages without greatly impairing the sensitivity of the receiver.

(6) An IF GAIN control (R206) is fitted in the cathode circuit common to V5 and V6.

(7) The tone control is removed from the circuit and from the front panel, so that the IF GAIN control can be fitted to the panel in its place.

(8) The BFO feed is increased by soldering 3 in. lengths of enamelled wire to pin 4 on V7 and pin 3 on V12, and cutting the wires to give the correct electrostatic coupling. This is indicated by a reading of 50 micro-amps. on the tuning meter when the BFO is switched on, but no signal is being received, and when the RF GAIN control is fully counter-clockwise, the selectivity switch in position 3 and the BFO control adjusted for maximum reading.

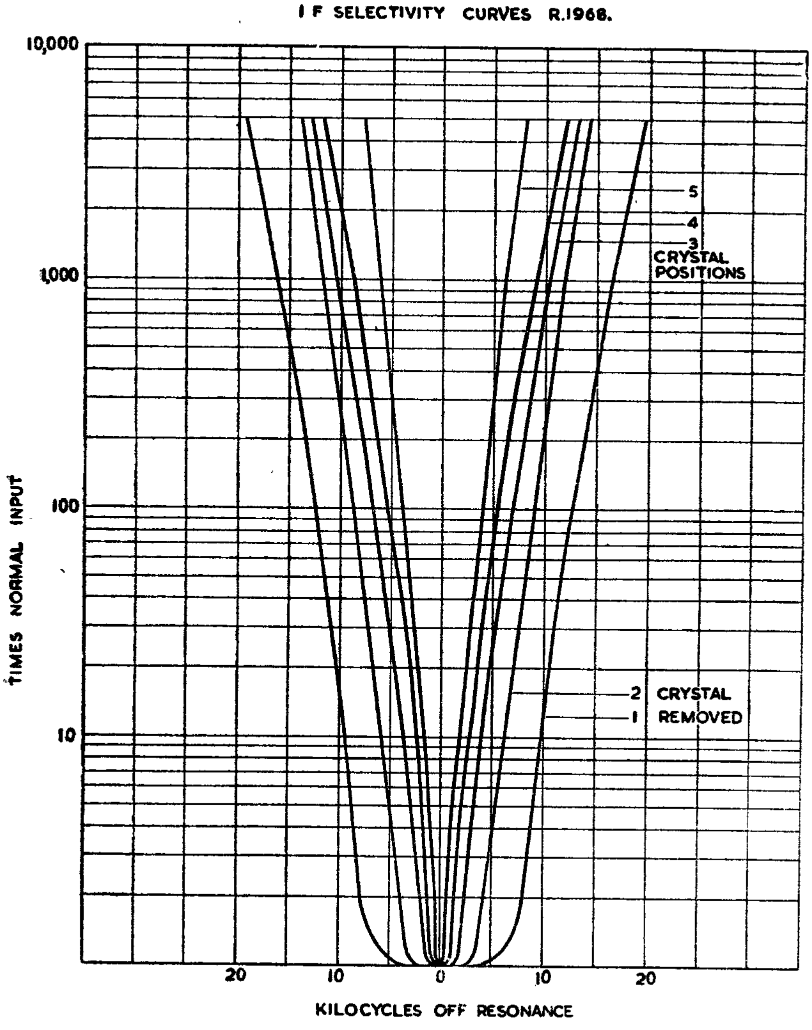



**Fig. 9. IF selectivity curves R.1968**

(9) The previously fitted output transformer is replaced by T201.

(10) In those chassis in which it is fitted the high impedance 'phone jack is rewired in the secondary circuit of the output transformer, in parallel with the low impedance jack.

(11) Minor modifications are shown on the circuit diagram by referencing the components from 200 e.g. R201 to R218 are modified items.

**General characteristics**

**15.** The receiver Type R.1968 may be compared with the Type R.1967 (modified AR 88) which is described and illustrated in A.P.2566D, Vol. 1. Although the two types have different RF ranges and different IFs, and although the major components are not interchangeable, reference may be made to the illustrations in A.P.2566D, Vol. 1, Part 1, Chap. 4 and Part 2, Chap. 2 for the component layout and general appearance of the R.1968. Like the R.1967 the R.1968 is a general purpose communications receiver employing 14 valves and designed to operate from AC mains of both U.S.A. and U.K. voltages and frequencies, or, with a separate vibrator power unit from a 6V, 12A supply. This facility is not required in rack assembly Type 243. The receiver employs a superheterodyne circuit with two stages of RF amplification to give selectivity and three IF amplifiers to increase the sensitivity. The receiver has six ranges, five degrees of variable IF selectivity, including three degrees of crystal IF filtering, a BFO for CW operation and a noise limiter. Adequate AF amplification is provided by an AF amplifier and an output stage, and there is an in-built power pack.

*Sensitivity*

**16.** The sensitivity is such that the main limiting factor is the noise generated in the first RF circuit. For this reason accurate alignment of the RF unit and a careful check on the signal-to-noise ratio are essential, particularly as the receiver will normally be working with very weak signal inputs. Table 1 gives the specified inputs for 20dB signal-to-noise ratio on the six tuning ranges of the receiver.

**TABLE 1**
**Signal-to-noise ratio, R.1968**
(tolerance +50 per cent on any *one* range)

| Range | Frequency | Input (μV)* |
|---|---|---|
| 1 | 80 kc/s | 17·3 |
| | 200 ,, | 15·1 |
| 2 | 200 ,, | 8·6 |
| | 500 ,, | 14·2 |
| 3 | 1·6 Mc/s | 11·5 |
| | 4·3 ,, | 8·6 |
| 4 | 4·3 ,, | 13·7 |
| | 12·0 ,, | 10·1 |
| 5 | 12·0 ,, | 10·1 |
| | 19·3 ,, | 10·1 |
| 6 | 19·3 ,, | 10·8 |
| | 30·0 ,, | 11·0 |

* Input modulated 30 per cent for 20dB signal-to-noise ratio.

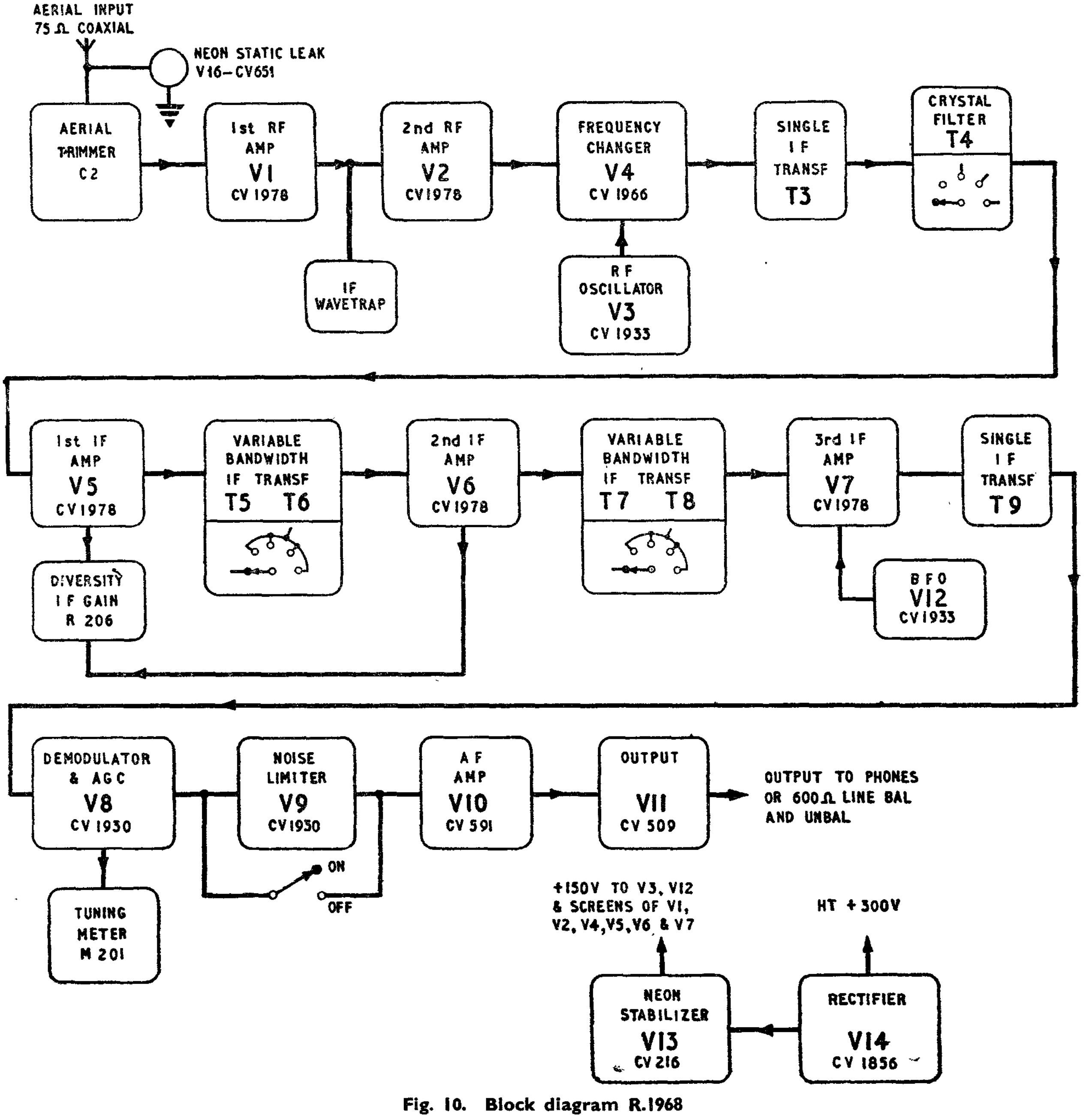



**Fig. 10. Block diagram R.1968**

*Signal-to-noise ratio*

**17.** A large part of the noise is due to shot effect in the first RF valve and to thermal agitation in the tuned circuit, but it is made as small as possible by the use of a low noise valve (CV1978) and by careful layout of the tuned circuits. It may be noted that the signal-to-noise ratio of the R.1968 tends to be inferior to that of the R.1556B (the unmodified AR 88 LF). This is due chiefly to the wider audio-frequency response of the new type output transformer (T201) and to the removal of the tone control, which again increases the response at higher audio-frequencies. The increase in overall sensitivity, resulting from the modified AGC circuit, also has an effect, which, however, is not so apparent as the effect of the increased audio bandwidth.

**Design features**

**18.** The receiver is designed for general purpose communications and will withstand severe climatic changes and line voltage variations without appreciable impairment of performance. The main features of design are listed below.

(1) Mechanical band spread, with a single control, provides for easy tuning of a previously logged station.

(2) A vernier tuning dial makes for accurate logging.

(3) A tuning meter is fitted to assist in accurate tuning.

(4) A tuning lock for service under extreme conditions of vibration is fitted below the main tuning knob.

(5) There is a front panel aerial trimmer for circuit alignment.

(6) A four-gang tuning condenser and associated circuits give high image ratio, and very low oscillator radiation on all bands.

(7) Screens have been built around the gang condenser, the local oscillator section and the RF amplifier section in order to minimize oscillator radiation on all bands. Complete external shielding prevents coupling to any portion of the circuit except through the aerial circuit.

(8) An IF wave trap is provided in the RF amplifier circuit.

(9) Temperature compensated oscillator circuits are used on all bands.

(10) Regulation of the anode voltage of the local oscillator gives good oscillator stability through normal variations in line voltage.

(11) Variable selectivity is provided, with expansion of the normal selectivity characteristic for standby, and there is a crystal filter for ultra sharp selectivity when required. The crystal filter circuit is adjusted to give the selectivity characteristics shown in fig. 9.

(12) An automatic noise limiter limits interference to a percentage of modulation.

(13) A noise limiter switch switches the noise limiter ON or OFF as required.

(14) The modifications already listed in para. 14 confer the following additional facilities:—

(a) The AGC lines of the two receivers in a rack may be connected for reception in dual diversity, so that the stronger signal reduces the noise contributed by the receiver carrying the weaker signal.

(b) The tuning meter facilitates accurate tuning by giving a maximum reading when the receiver is in tune, and also provides a means of balancing the IF gains of the two receivers in a rack, using the DIVERSITY IF GAIN control.

**Performance**

**19.** Performance data are given in the leading particulars at the beginning of this chapter and in Table 1 (*Signal-to-noise ratio R.*1968) Table 2 (*IF bandwidths*) and Table 3 (*AF response*).

**TABLE 2**

**IF bandwidths, R.1968**

(tolerance ± 10%)

| Selectivity switch position | IF bandwidth at minus 6dB |
|---|---|
| 1 | 16 k/cs |
| 2 | 8 ,, |
| 3 | 4 ,, |
| 4 | 2 ,, |
| 5 | 550 c/s |

**20.** The AF response figures are for an input to the AF amplifier valve V10.

**TABLE 3**

**AF response, R.1968**

(Input—constant at 0·225 to 0·25V. Tolerance ± 10%)

| *Frequency of input* | 50 c/s | 110 c/s | 500 c/s | 1 kc/s | 2 kc/s | 4 kc/s | 8 kc/s |
|---|---|---|---|---|---|---|---|
| *Output across dummy load* | 0·26V | 0·7V | 1·5V | 1·6V | 1·6V | 1·6V | 1·5V |

The power output is tested at 500 c/s by increasing the input until an output of 2·5 watts is dissipated across the dummy load. At this level there should be no appreciable distortion.

**TABLE 4**
**Valve base connections, R.1968**

| Valve No. Type | V1, V2, V5 V6, V7 CV1978 | V4 CV1966 | V3, V12 CV1933 | V8, V9 CV1930 | V10 CV591 | V11 CV509 | V14 CV1856 | V13 CV216 | Static discharge neon CV651 |
|---|---|---|---|---|---|---|---|---|---|
| Pin | | | | | | | | | |
| 1 | M | M. G5 | M | M | M | — | — | — | miniature |
| 2 | H | H | H | H | H | H | F | C (cold) | bayonet |
| 3 | C, G3 | A | A | D2 | G3 | A | X | X | cap |
| 4 | G1 | G2, G4 | X | C2 | G1 | G2 | A2 | X | |
| 5 | C | G1 (IG) | G | D1 | C | G1 | X | A | |
| 6 | G2 | C | X | X | G2 | X | A1 | X | |
| 7 | H | H | H | H | H | H | X | X | |
| 8 | A | G3 (control) | C | C1 | A | C | F | X | |

International octal base reading clockwise from the locating tongue.
— denotes a blank pin and X that no pin is fitted.

M = metal shield
H = heater (indirectly heated)
F = filament (directly heated)
C = cathode. Double cathode C1, C2
G = grid, numbered from cathode
IG—injector grid
A = anode
D1, D2 = diode anodes.

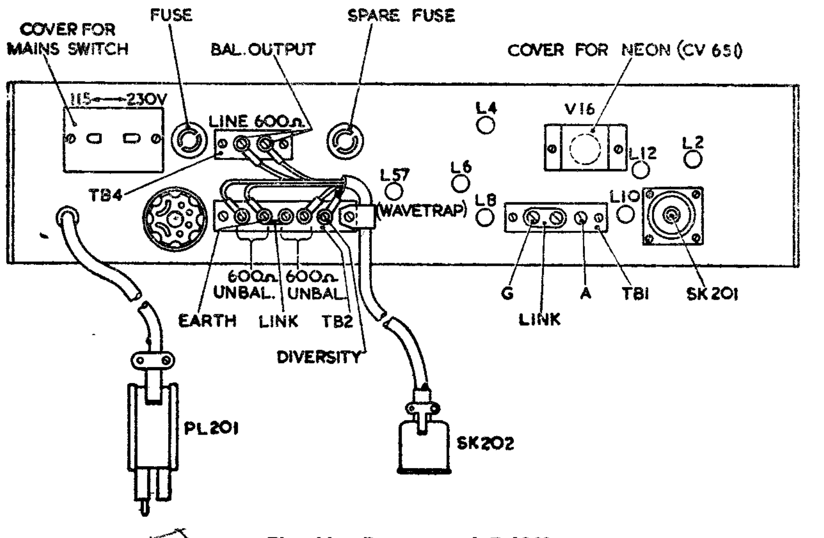



**Fig. 11. Rear panel R.1968**

**Circuit layout**

**21.** A block diagram of the receiver Type R.1968 is given in fig. 10. It will be observed that the layout is conventional. The refinements that have been incorporated have already been discussed in para. 18. A circuit description is given in Part 2, Chapter 1. All the valves are international octal based except the CV651 which has a miniature bayonet base. Table 4 gives the valve base connections.

**External connections**

**22.** These are shown in the illustration of the rear panel of the receiver (*fig.* 11). As described in para. 14 the modifications incorporated in the receiver include the fitting of a coaxial socket SK201 for the 75-ohm impedance aerial input. The mains input lead is terminated with a Jones plug (PL201) which mates with a socket on bracket B (receiver B), or bracket C (receiver A), at the rear of the rack assembly. These sockets are fed from the AC MAINS RXA & RXB plug on bracket F, which in turn is supplied from the power control panel.

**23.** The two unbalanced 600-ohm impedance AF outputs, the single 600-ohm balanced AF output and the AGC line of the receiver are connected to the output socket SK202 which mates with a corresponding plug on rear bracket B or C. The balanced output and one unbalanced output from each receiver are taken to bracket F for external use. The other 600-ohm unbalanced AF output is taken to panels (control) Type 788 (via connections on bracket A) where its application is determined by the main functional switch of the rack. The AGC lines are similarly taken to bracket A, where connection may be made to the signal control panel (Type 788). The AGC lines are joined in position 3 of the functional switch only when the receivers are connected to the DIVERSITY sockets on bracket A.

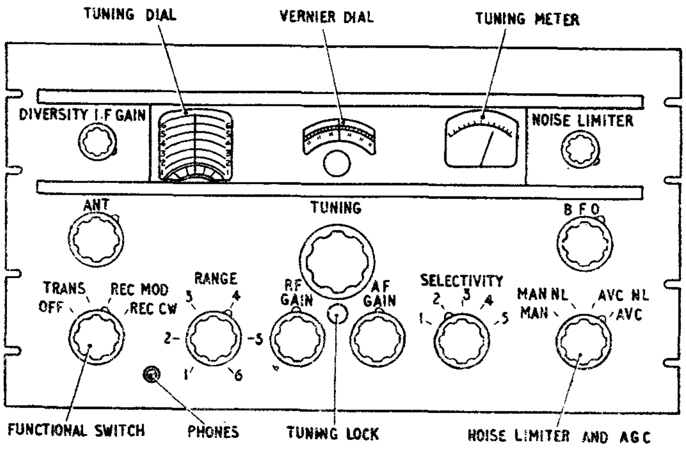



Fig. 12. Front panel R.1968

**Dials and controls**

**24.** The front panel dials and controls of the receiver are shown in fig. 12. The purpose of the controls is explained fully in Chapter 2, which deals with the installation and operation of the rack assembly. A brief outline of the function of the controls is given below.

(1) TUNING. The main tuning control is in the centre of the front panel. It provides mechanical bandspread with minimum backlash (one small division of the vernier scale).

(2) *Main tuning dial.* This is on the left and consists of a disc with seven scales, one for each of the six bands, and a log scale. The calibration accuracy is to one division of the main scale.

(3) *Vernier tuning dial.* This is in the centre and has a scale with arbitrary calibrations for exact tuning and log records of particular communication stations. It is used in conjunction with the log scale on the main tuning dial to give additional figures for logging.

(4) *Functional switch.* This is the bottom left-hand control. Starting from counter-clockwise the four positions are:—

(a) OFF—the AC mains supply is switched off.

(b) TRANS—the transmit position which switches the valve heaters on, but not the HT. This position is not required in rack assemblies Type 243 and 246.

(c) REC. MOD—for normal R/T and MCW reception.

(d) REC. CW—for CW reception with BFO switched on.

(5) ANT. This is the aerial trimmer, situated above the functional switch and provided for circuit alignment.

(6) RANGE. This is a six-position switch, to the right of the functional switch, for selecting the RF range.

(7) TUNING LOCK. This is situated below the main tuning dial and serves to lock the main tuning control under conditions of vibration.

(8) RF GAIN—to the left below the TUNING LOCK. This continuously variable sensitivity control is used in conjunction with the AUDIO GAIN (volume) control for manual gain operations. With AGC in use it should be set full clockwise, but may be turned counter-clockwise to eliminate interference.

(9) DIVERSITY IF GAIN. This control in the top left-hand corner of the front panel is used for balancing the gains of two receivers used in diversity. Its normal setting is one-third to one-quarter back from maximum because there is a likelihood of " ringing " in the IF tuned circuits at maximum gain.

(10) AUDIO GAIN—to the right of RF GAIN. This control adjusts the volume to the desired strength in the headphones.

(11) SELECTIVITY switch. This is a five-position switch for determining the IF bandwidth. The five bandwidth curves are shown in fig. 9 and the widths at minus 6dB are listed in Table 2.

The five positions are:—

(a) 16 kc/s—IF bandwidth for high fidelity, modulated reception, for standby use.

(b) 8 kc/s—IF bandwidth for normal modulated reception.

(c) 4 kc/s—Crystal filter in, for CW telegraph or sharp modulated signal reception.

(d) 2 kc/s—Crystal filter in, for sharper CW telegraph reception.

(e) 550 c/s—Crystal filter in, for sharpest CW telegraph reception.

(12) NOISE LIMITER—AVC switch (the term AGC is used in the text in preference to the panel marking of AVC). This is a four-position switch in the bottom right-hand corner of the front panel. Starting from fully counter-clockwise the positions are:—

(a) AGC and NL out—manual gain only, for CW with no interference.

(b) NL on, AGC out—manual gain, for CW with interference.

(c) NL and AGC on—for modulated reception with interference.

(d) AGC on, NL out—for modulated reception with no interference.

(13) NOISE LIMITER control. This is in the top right-hand corner of the front panel. It sets the receiver for operation at the required level of noise limitation. The fully clockwise position limits the noise interference to 100 per cent modulation. As the knob is turned counter-clockwise the noise interference is limited to continuously lower percentages of modulation, so that in the fully counter-clockwise position the noise limiter is operative on any modulation whatsoever.

(14) BFO control. This is below the NOISE LIMITER control. It is used for CW code signals and should be adjusted to give the desired audio pitch after the signal has been accurately tuned.

(15) TUNING METER. This is connected in the diode demodulator load circuit and measures the rectified signal current. The receiver is in tune when the meter reading is at a maximum for that particular signal.

## RECEIVING EQUIPMENT TYPE R.1475

**25.** Receiver unit Type 88 and power unit Type 360, which make up this receiving equipment, are described in detail in A.P.2883G, Vol. 1, (2nd. Edition), to which reference should be made for full descriptions and a complete set of illustrations. A brief description is given in this chapter to explain the purpose of the equipment in the rack assembly Type 246. Similarly, in Part 2, Chapter 1 of this A.P. sufficient information is given to link up the circuitry of the equipment with that of the other units in the rack, but more detailed information is available in A.P.2883G. The servicing information from A.P.2883G, which is comparatively brief, is repeated in Part 3, Chapter 1 of this A.P., so that the rack assembly Type 246 may be serviced even if A.P.2883G, is not available.

**26.** Receiving equipment Type R.1475 is tropicalized and should be capable of operating satisfactorily under humid conditions in the tropics, or under arctic conditions. It is also designed for operation under severe conditions of vibration. The positions of the two receivers and two power units in the rack Type 246 are shown in the front view of the rack assembly Type 253 (*fig.* 1). As already stated the rack Type 253 becomes Type 246 with the addition of the receivers and power units.

### General characteristics, receiver unit Type 88

**27.** The receiver unit Type 88 is a general purpose communications receiver employing 13 valves and covering a frequency range from 2 to 20 Mc/s (in round figures), in four bands as given in the leading particulars. For descriptive purposes these bands may be taken as 2 to 3·6, 3·6 to 6·4, 6·4 to 11·3 and 11·3 to 20 Mc/s. The receiver employs a superheterodyne circuit, with a radio frequency amplifier stage to give additional selectivity, and power output stage. Provision is made for CW, MCW or R/T reception.

*Tuning*

**28.** The calibration accuracy of the tuning scale is such that the receiver can be tuned to any frequency within the band 2 to 11·3 Mc/s with an accuracy of 2 kc/s, i.e., within the side-bands of an R/T transmission or within beat-note range of a

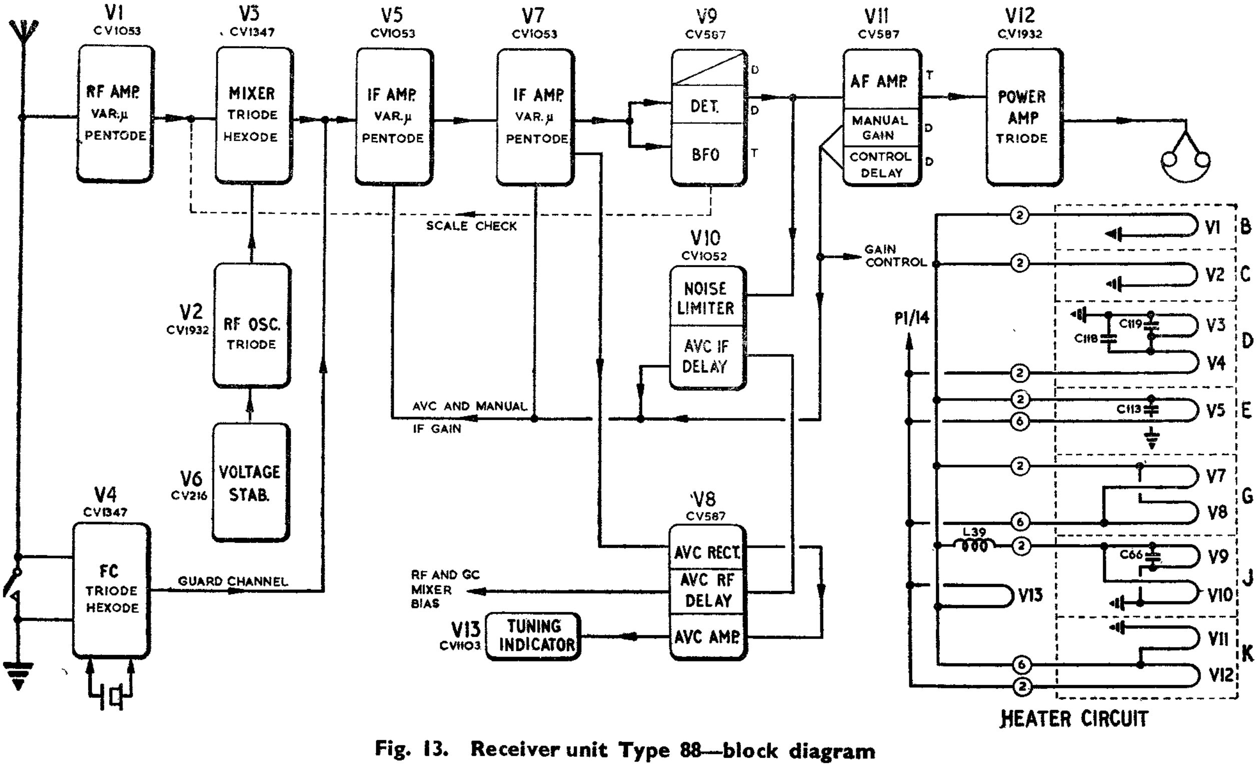


**Fig. 13. Receiver unit Type 88—block diagram**

CW transmission. On the 11·3 to 20 Mc/s band the scale can be set to within 4 kc/s of a specified frequency.

*Monitoring*

**29.** The receiver incorporates a self-monitoring system by which the calibration can be checked at 600kc/s intervals over the whole frequency range, using an internal crystal standard. Means are provided for adjusting the calibration to compensate for temperature drift, though compensation for normal temperature changes is provided automatically by thermally-controlled capacitors and inductors in the local oscillator circuit.

*Guard channel*

**30.** In addition to the main signal frequency channel, an additional receiving channel is provided on a single pre-selected frequency in the 2 to 7·5 Mc/s band. When it is in use, signals on this *guard* channel break through, irrespective of the frequency setting of the main channel. Interference between the two mixer valves may, however, be experienced if the main and guard channel frequencies are in harmonic relationship, so provision is made for switching off the guard channel when it is not required.

*Gain controls*

**31.** Independent RF and AF GAIN controls are provided, any condition from full AGC to full manual control being obtainable. A system of amplified AGC is employed, combined with the manual RF GAIN control in such a manner that the sensitivity can be set manually, but the AGC overrides the manual setting when the incoming signal strength is sufficient to overload the receiver. The AGC characteristics are such that an 80 dB change in input causes less than 6 dB change in output. The AGC time constant is adjustable in two steps. One position is suitable for hand-speed CW reception and the other gives optimum conditions for R/T, high-speed CW, or listening through during CW traffic.

*Noise limiter*

**32.** A noise limiting circuit is incorporated to reduce in amplitude sharp impulsive noises, such as those caused by the ignition circuits of internal combustion engines. The duration of individual noise pulses of this type is generally quite short, so the limiting circuit provides for rapid recovery of the receiver after a noise pulse, and as a result the noise suppression only slightly reduces the intelligibility of R/T traffic. A higher degree of suppression is available where appreciable distortion can be accepted, i.e., for CW reception.

**Receiver layout**

**33.** A block diagram of the receiver is given in fig. 13. All the valves have international octal bases, the connections for which are given in Table 5. Except for V6, the neon voltage stabilizer, which has no heater, all the valves have 6·3V heaters. Since the R.1475 has provision (not required in rack assembly Type 246) for operation from a 12V DC supply the heaters are connected in a series parallel circuit (shown in the block diagram) which is still used when the equipment is operated from an AC supply, as in the present application.

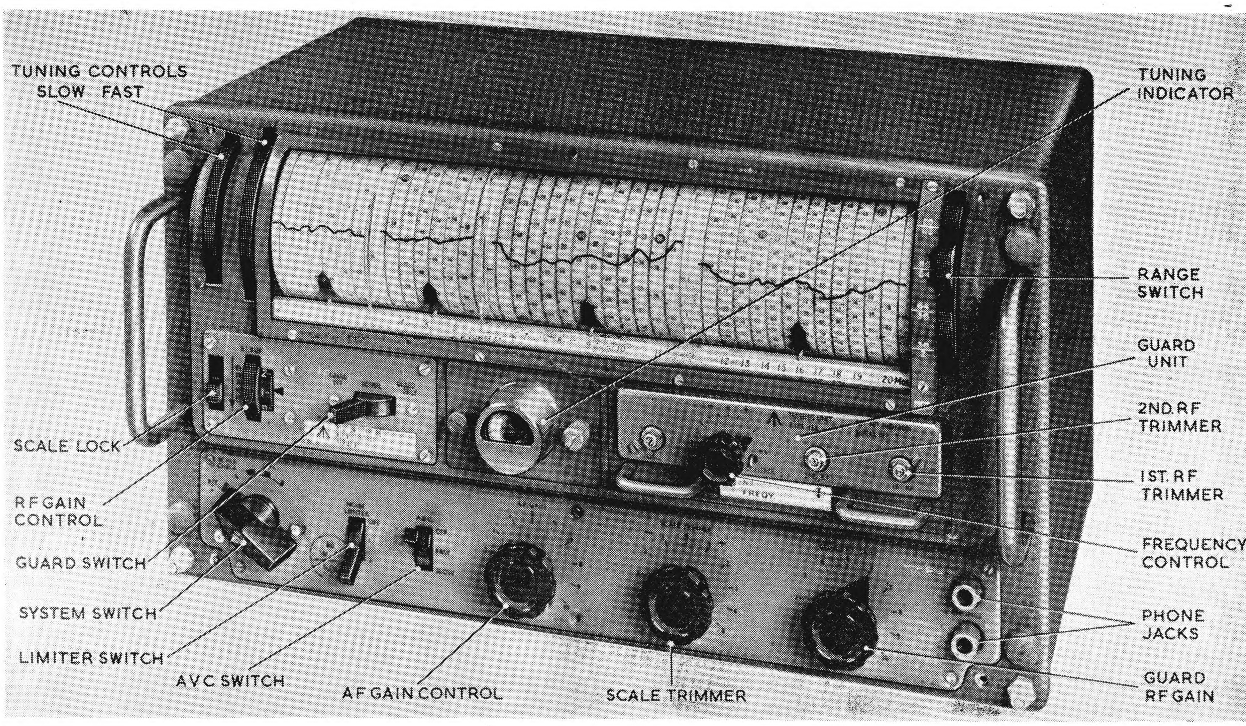



**Fig. 14. Receiver unit Type 88—front panel**

## TABLE 5

**Valve base connections, receiver unit Type 88**

| Valve No. Type | V1, V5, V7 CV1053 | V2, V12 CV1932 | V3, V4 CV1347 | V6 CV216 | V8, V9, V11 CV587 | V10 CV1054 | V13 CV1103 |
|---|---|---|---|---|---|---|---|
| Pin | | | | | | | |
| 1 | M | — | M | — | — | M.S | — |
| 2 | H | H | H | C (cold) | H | H | H |
| 3 | A | A | A | X | A | D2 | A |
| 4 | G2 | X | G4, G2 | X | D2 | C2 | Target |
| 5 | G3 | G | G3, Go | A | D1 | D1 | G |
| 6 | X | X | Ao | X | — | X | X |
| 7 | H | H | H | X | H | H | H |
| 8 | C | C | C | X | C | C1 | C |
| TC | G1 | | G1 | | G | | |

— denotes that a pin is fitted but no internal connection.
X denotes that no pin is fitted.

M = metallizing
H = heater
C = Cathode. Double cathodes C1, C2
S = internal shield

G = grid (numbered from cathode to anode)
A = anode. Ao = oscillator anode
D = diode anode
D1, D2 = double diode anodes

**Outline of circuit**

**34.** With reference to the block diagram, the main receiving channel includes the RF amplifier V1, the local oscillator V2 and the main mixer valve V3, feeding into the IF and AF stages which are common to both main and guard channels. The guard channel includes the valve V4, which acts as a crystal-controlled local oscillator and mixer, and also feeds into the common IF and AF stages. The HT voltage for the main channel local oscillator is stabilized by the valve V6.

**35.** Two stages of IF amplification, V5 and V7, follow the mixer stages. The signal from V7 is applied to V8 and V9. V8 is double-diode triode, which acts as the AGC rectifier and amplified, delayed AGC control valve. V9 is also a double-diode triode. The diode section is used for signal demodulation and the triode section acts as BFO during CW reception.

**36.** The demodulated signal is applied to the triode section of a third double-diode triode (V11) for AF amplification. The diode sections of V11 are used in the delayed AGC circuit. V10 is a double-diode, one section being used in the noise limiting circuit and the other as part of the manual gain control delay system. V12 is the AF power amplifier. It feeds the output transformer, from which either high or low-level outputs are available. The magic-eye tuning indicator V13 is fed from the cathode of the AGC amplifier V8. A detailed description of the circuit is given in A.P.2883G, Vol. 1, (2nd Edition), Part 2, Chapter 1.

**Controls** (*fig. 14*)

**37.** The operating controls may be divided into two groups, namely, the main and guard channel controls.

*Main channel controls*

**38.** The main channel controls are as follows:—

(1) TUNING *control*

(2) *Scale lock*

(3) SYSTEM *switch*

(4) RF GAIN *control*

(5) AF GAIN *control*

(6) *Scale trimmer*

(7) AGC *time constant switch*

(8) RANGE *switch*

(9) NOISE LIMITER *switch*

*Guard channel controls*

**39.** The guard channel controls are:—

(1) *Frequency trimmer*

(2) *Guard RF gain control*

(3) *Guard channel switch*

(4) *Oscillator trimmer* }
(5) *First RF trimmer* } Pre-set
(6) *Second RF trimmer* }

**Beat frequency oscillator**

**40.** No BFO trimmer control is fitted for CW reception because the BFO is crystal-controlled and the tuning scale calibration is within audible beat-note range of the nominal frequency. This calibration accuracy is achieved, in the main channel by the use of a temperature compensated local oscillator circuit, and in the guard channel by the use of a crystal-controlled local oscillator with a trimmer giving a small manually-controlled range of frequency variation. The local oscillators are set up so that an intermediate frequency of 601·3 kc/s is always maintained. The frequency of the BFO is crystal-controlled at 600 kc/s, so that the beat note in CW reception has a frequency of 1,300 c/s.

#### Tuning scale

**41.** The whole frequency range of the four bands is covered by a scale thirty feet long, of which five feet is occupied by each of the two lower ranges and ten feet by each of the two higher ranges. The discrimination is thus reasonably uniform over the whole range, 10 kc/s steps being represented by about one-eight of an inch at the higher frequencies, and somewhat more at the lower end of the scale. The scale is marked in 10 kc/s graduations throughout the frequency range. The scale itself is a spiral line drawn upon a cylindrical surface divided into four ranges, the axis of the cylinder being horizontal (*fig.* 14). The scale lighting is controlled by the range switch so that only the portion of the scale corresponding with the selected range is illuminated.

**42.** A transparent window carrying a cursor line is fitted close to the curved surface of the scale. The frequency setting is indicated by the intersection of the frequency scale and the cursor line. Four metal pointers (one for each range) are fitted near the bottom of the scale. As the scale is rotated, these pointers move horizontally along a fixed horizontal scale showing whole numbers of megacycles.

#### *Reading tuning scale*

**43.** Fig. 15 shows, diagrammatically, one range of the scale. The black pointer indicates 8 megacycles, and the intersection of the cursor line and the tuning scale indicates the fraction of a megacycle to be added to the whole number, in this case 53 (3), the digit in brackets being estimated by eye. The scale is therefore set to 8·533 Mc/s.

#### *Scale check*

**44.** The frequency calibration can readily be checked at 600 kc/s intervals over the whole frequency range by putting the SYSTEM switch to the position marked S/C (abbreviation for SCALE CHECK). In this position the harmonics of the 600 kc/s crystal-controlled BFO are fed into the input circuit of the main mixer valve, the RF amplifier and guard mixer valves being switched off. On rotating the scale throughout its complete range, heterodyne beat-notes are heard at 600 kc/s intervals along the scale, at multiples of 600 kc/s.

**45.** The points at which these beat-notes are heard are known as the checking points. They are clearly marked on the scale by being printed in white figures on a black circle. On the range 6·4 to 11·3 Mc/s, the checking frequencies are 6·6 7·2, 7·8, etc. Mc/s. Two of these, 6·6 and 9·6 Mc/s, are indicated in fig. 15.

#### Tuning

**46.** Tuning is performed by knurled thumb-operated controls at the left-hand end of the scale. Two such controls are provided one giving a one-to-one ratio drive, and the other driving through a five-to-one reduction gearing for fine tuning.

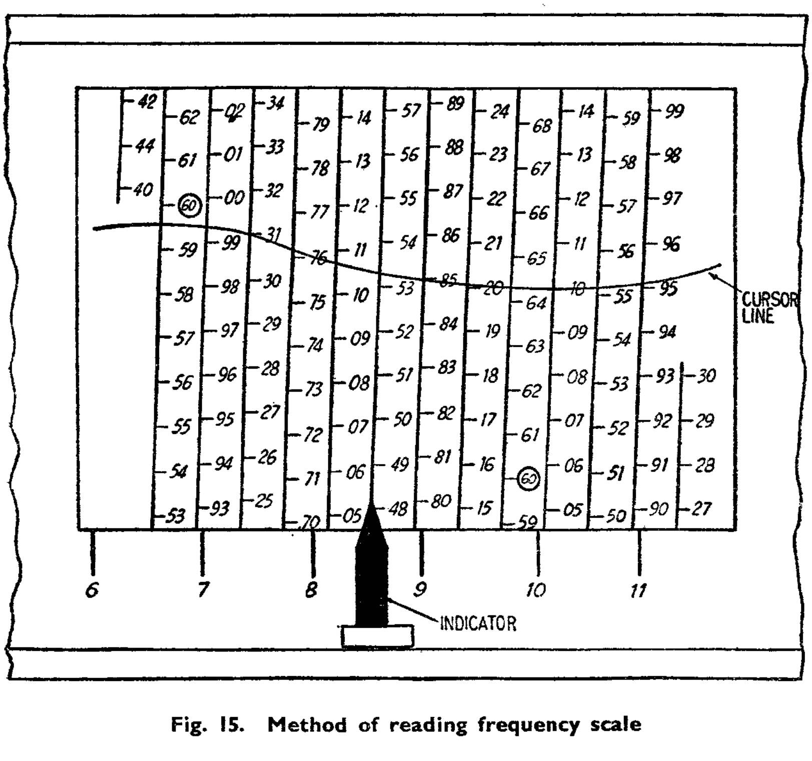



**Fig. 15. Method of reading frequency scale**

#### Scale lock

**47.** The SCALE LOCK control is provided in order to prevent the displacement, through accident or vibration, of the scale, after setting it to the desired frequency. In the design of this lock, care has been taken to ensure that the operation of the lock does not displace the scale from the desired setting.

#### System switch

**48.** The SYSTEM switch controls three distinct operations, namely:

(1) Variation of selectivity.

(2) BFO on-off switching.

(3) Circuit change for scale checking.

The switch has five positions. The first three are marked only by rectangles of varying width, representing CW reception on varying bandwidths. The first is the *narrow* position, the IF bandwidth being 3 kc/s and the AF bandwidth 300 c/s; the second is the *medium* position, having an IF bandwidth of 3 kc/s and an AF bandwidth of 1·2 kc/s, while the third is the *wide* position, with an IF bandwidth of 5kc/s and an AF bandwidth of 3 kc/s. IF and AF response curves are given in A.P. 2883G Vol. 1, (2nd Edition), Part 1, Chap. 1.

**49.** The fourth position marked S/C (SCALE CHECK) is used when checking the calibration as described in Chapter 2, para. 33. In the four positions mentioned the BFO is switched on.

**50.** The fifth position is marked R/T and provides for either R/T or MCW reception, the BFO being switched off. The IF bandwidth is 5 kc/s and the AF bandwidth 3 kc/s. The overall response of the amplifier is practically level between 270 and 2750 c/s.

**51.** The circuit changes made by the SYSTEM switch are dealt with in Part 2, Chapter 1, para. 70-73 of this volume.

#### Sensitivity and volume controls

**52.** The RF GAIN or sensitivity control may be marked HF GAIN on the front panel, while the AF GAIN or volume control may be marked LF GAIN. The RF GAIN control is a potentiometer which supplies variable standing bias to the RF amplifier valve (V1) along the RF AGC line. Full manual control of sensitivity is thus obtained, but the AGC can over-ride the manual control if required. Even if the controls are badly adjusted, grid blocking cannot be produced by strong signals. The AF GAIN control is conventional, operating in the control-grid circuit of the AF amplifying valve preceeding the output stage.

#### Scale trimmer

**53.** The scale trimmer is fitted to compensate for any change in the calibration due to temperature drift, or any other cause which affects the whole of the local oscillator circuits equally. It cannot, however, compensate for a change affecting one tuned circuit only, e.g., a defective condenser. If, therefore, any component of an oscillator *range* circuit becomes defective, and a replacement component is fitted, the range affected will require re-trimming by adjustment of the appropriate trimming capacitance.

#### AGC switch

**54.** The AGC switch may be marked AVC. It has three positions. In the first the AGC system is switched off, while the other positions provide a slow and a fast AGC response respectively. For listening through during CW reception, for reception of high-speed CW, and for R/T reception, a fast response (short time-constant) is required. For hand-speed CW reception, however, a slow response (long time-constant) generally gives superior results. The AGC switch should, however, be adjusted to give the best results under the particular prevailing conditions.

#### Range switch

**55.** The range switch selects the desired frequency range, and in addition switches the scale lighting, so that only the required band on the frequency scale is illuminated.

#### Noise limiter switch

**56.** The NOISE LIMITER switch gives two degrees of noise limiting and an OFF position. Position 1 gives a degree of noise limiting suitable for R/T reception, where excessive limiting would cause distortion. Position 2 gives greater noise reduction and may be used for R/T reception if the increased distortion can be accepted. Providing the NOISE LIMITER switch is not OFF, the higher degree of limiting is automatically applied when the SYSTEM switch is in any one of the three CW positions.

#### Guard units (tuning units Type 131 and 132)

**57.** The guard unit allows a constant watch to be kept on any single frequency in the band 2 to 7·5 Mc/s while using the main channel on another frequency. Two guard units are provided; unit P (tuning unit Type 131) covers the range 2 to 4·2 Mc/s, and unit Q (tuning unit Type 132) the range 4·1 to 7·5 Mc/s. Each guard unit should theoretically be fitted with a quartz crystal differing by 601·3 kc/s from the frequency allotted to the guard channel, but in practice a crystal differing by 600 kc/s is used, the frequency being 'pulled' as required to give the correct IF of 601·3 kc/s. This is achieved by adjusting the FREQUENCY control on the guard unit.

**58.** The guard unit works in conjunction with the guard mixer valve V4. It includes a two-stage band-pass tuner which couples the aerial circuit to the control-grid of the mixer section of the guard frequency changer valve. It also includes a crystal controlled local oscillator, which works in conjunction with the triode section of the guard frequency changer. The output of the guard frequency changer valve is applied to the common IF stages.

#### Guard channel controls

*Tuning controls*

**59.** Each guard unit has four tuning controls, all of which are simple condenser trimmers. Three of these can be pre-set with a screw-driver type trimming tool, while the fourth, the guard FREQUENCY control (*para.* 57) is fitted with a small knob and scale, marked in arbitrary divisions up to ±5. The pre-set controls are adjusted during the initial alignment procedure at the factory.

*Guard RF gain control*

**60.** The GUARD RF GAIN control is mounted on the front panel. It controls the sensitivity of the guard channel and is so designed that the sensitivity can be reduced to zero. The primary object of this control is to limit the amount of noise introduced by the guard mixer valve. When it has been adjusted the control may remain set for all normal conditions, the sensitivity of both channels being controlled simultaneously by the main channel RF GAIN control. The operation of the GUARD RF GAIN control does not, however, affect the sensitivity of the main channel. When main and guard channels are adjusted to give equal gain, the noise level is only 3 dB higher than with the guard channel switched off.

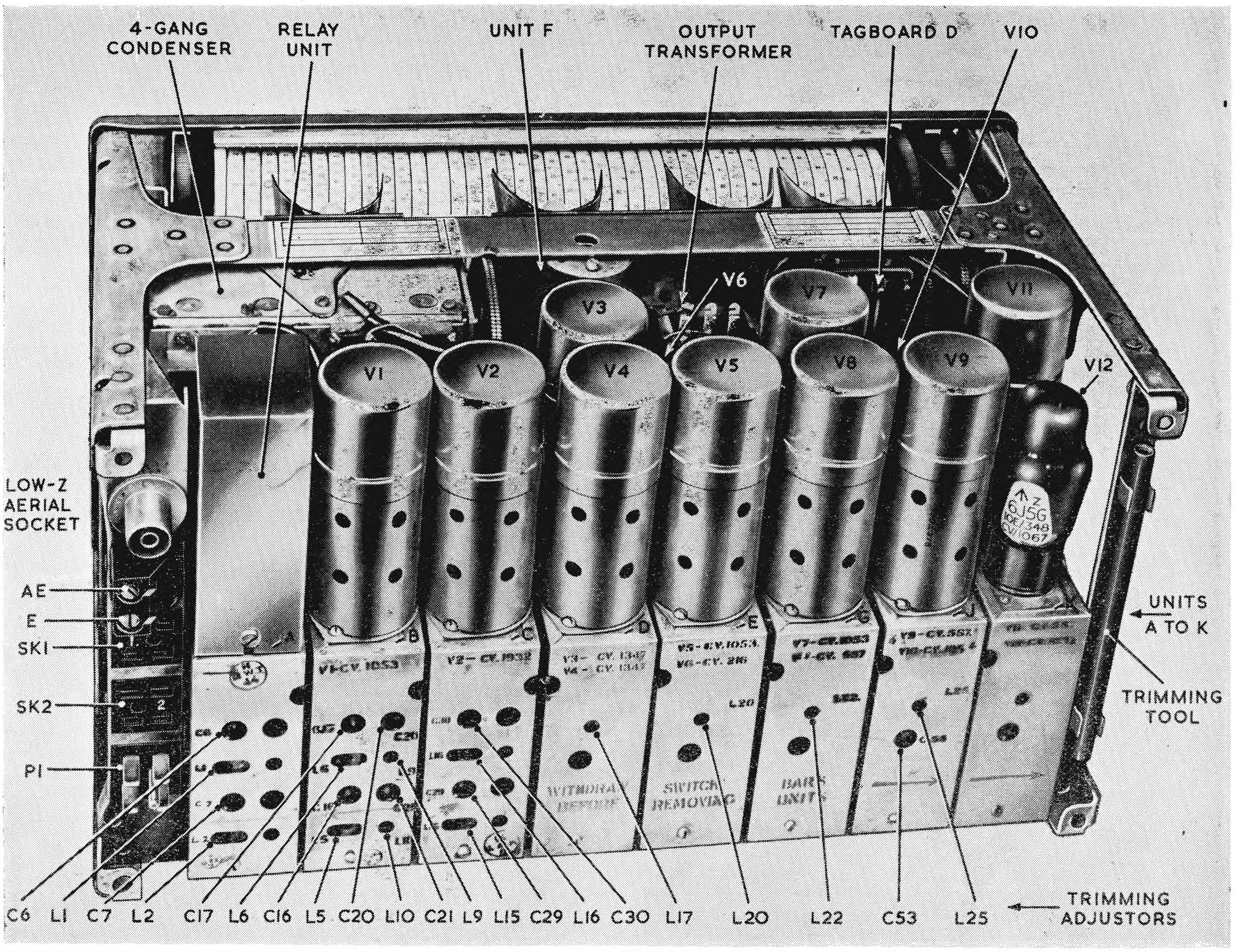



**Fig. 16. Receiver unit Type 88, rear view (dust cover removed)**

*Guard switch*

**61.** The guard switch has three positions.

(1) GUARD ONLY

(2) NORMAL (*guard and main channels both* ON)

(3) GUARD OFF.

When either channel is switched off, a compensating load is thrown into the 80-volt line feeding the screen-grids of the main frequency-changer, guard frequency-changer and first IF valves, in order that the sensitivity of the channel in use shall not require readjustment.

**External connections** (*fig. 16*)

*Aerial input*

**62.** In rack assembly Type 246 the aerial input is either via a 75-ohm coaxial feeder or from 600-ohm feeder lines matched into a 75-ohm coaxial feeder by an aerial transformer. The coaxial feeder is terminated by a plug which mates with a socket on the rear panel of the receiver unit Type 88 (*fig.* 16). The centre terminal of this socket is connected to a tapping point on the first coil of the input circuit of the range in use. Alternative connections, not required in the rack assembly, are provided in the form of open aerial and earth terminals, the aerial being then connected to the top end of the selected range coil. The input impedance is then approximately 600 ohms.

*Other connections*

**63.** AF output, separate RF and IF AGC, and power supply connections are made from a Jones plug and two sockets at the rear of each receiver unit to bracket B (receiver B) or bracket C (receiver A) at the rear of the rack.

## POWER UNIT TYPE 360

**Requirements of receiver unit Type 88**

**64.** The power unit used with the receiver unit Type 88 must be capable of supplying 250 volts HT, 12 volts LT and 55 volts negative grid bias. In rack assembly Type 246 these requirements are fulfilled by the power unit Type 360.

**Description of power unit Type 360**

**65.** The power unit may be operated from 190/240 volt AC mains as in the rack assembly or from a 12-volt battery. When used on an AC mains supply the unit operates in a conventional manner, the input voltage being applied to the

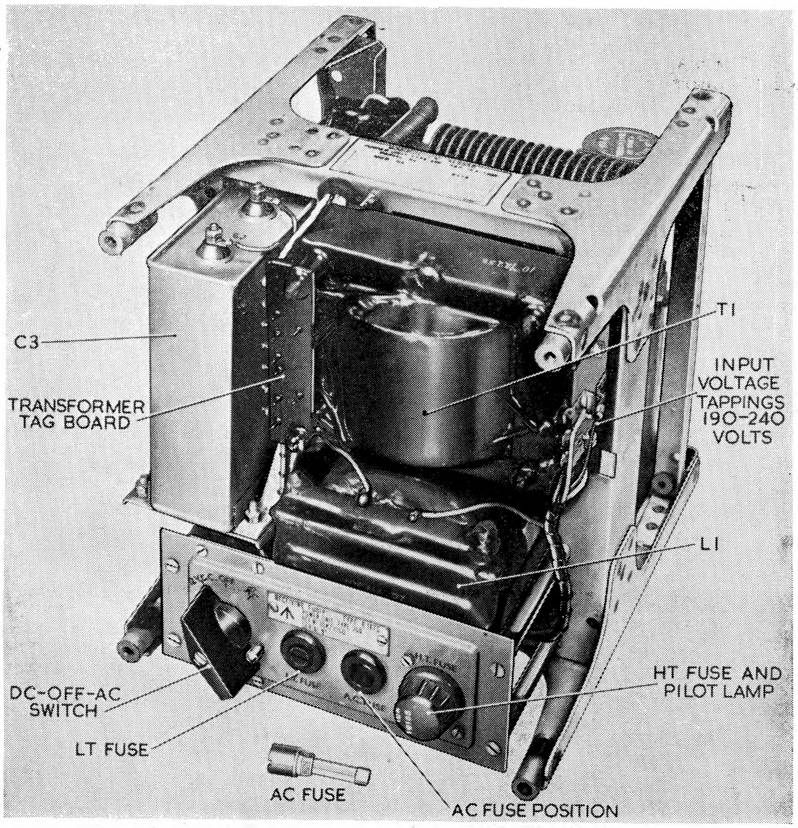



**Fig. 17. Power unit Type 360, front view with dust cover removed**

drimary winding of a transformer through a switch and a 2-amp. fuse. These are shown in the front view of the power unit (*fig.* 17).

**66.** The HT secondary output of the transformer is rectified by a bridge-type metal rectifier, the DC voltage output being 305 volts (nominal). In the receiver unit Type 88 this is divided to provide 250 volts HT and 55 volts grid bias. The HT + output line includes a pilot lamp fuse (*fig.* 17). The LT secondary of the transformer provides a 12-volt AC supply to the valve heaters (*fig.* 13).

**67.** The LT fuse shown in fig. 17 is in the DC input line, which is not used in rack Type 246. A description of the vibrator unit, used in the DC application of the power pack, is given in A.P.2883G, Vol. 1 (2nd Edition), Part 2, Chap. 2.

**External connections**

**68.** The AC inputs to the two power units in the rack are via Jones plugs mounted at the rear of the units and supplied from the power control panel via sockets on rear bracket E. Similarly the HT and LT supplies from the power units are taken to Jones sockets at the rear of the units. These sockets feed the two receiver units Type 88 via plugs mounted on bracket E.

# Chapter 2
# INSTALLATION AND OPERATION

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## LIST OF TABLES



### INSTALLATION

**Rack assemblies Type 252 and 253**

**1.** The basic rack assemblies, Type 252 for incorporation in rack Type 243, and Type 253 for incorporation in rack Type 246, are supplied in large packing cases which can be identified by their size (approximately 6 ft. × 2 ft. × 2 ft. 6 in.). These racks should be unpacked first, then the individual chasses, which make up the assemblies Type 243 or 246, can be slid into place as they are unpacked.

**2.** The appearance of the basic racks has already been described in Part 1, Chap. 1, para. 5 to 8. Included with the racks are the cables, terminated with Jones plugs and sockets for connecting the individual chassis to the rear bracket wiring of the racks. Mating components are also supplied for the connectors which provide input and output terminals on the rack assemblies. In addition screws are supplied for securing the front panels of the individual chassis in the rack assemblies. Cabling for making external connections is not supplied with the rack assemblies. Table 1 gives a list of the replaceable components in racks Type 252 and 253, with a reference to the illustrations in which they are shown.

*Long table*

**3.** The long table which is supplied in the packing case with the basic rack, should be bolted to the front of the rack in the position illustrated in fig. 1, Chap. 1, using the screws, nuts and washers provided. Connection can then be made between the miniature Jones plugs on the long table and the sockets on brackets D (at the rear of the rack), marked MIC and TEL JACKS. Connectors are supplied for this purpose. Although the various connectors are not marked they can be identified by their cable length and respective terminations.

*Power supply panel*

**4.** Connection is made to the Jones plug marked AC MAINS at the rear of this panel, using a socket Type 220, with a cable clamp top, wired to the mains supply. The Jones sockets marked AC, RXA RXB and INDIC are connected to the plugs on rear bracket E, with corresponding labels, using the connectors that are provided.

**Panel (control) Type 788**

**5.** This unit is supplied in a separate small packing case. When unpacked it is secured in the rack, using the four screws provided, and connections are made between the rear panel of the unit and bracket A, joining the plugs and sockets, according to the labels stencilled beside them, with the connectors that are supplied. A list of these rear connections has already been given in Chap. 1, para. 12.

**Receivers**

**6.** A slightly different installation procedure is followed for the receivers, owing to the differences between the R.1968 in rack Type 243 and the R.1475, in rack Type 246.

**R.1968**

**7.** This is supplied in a moisture-proof wrapping and is packed in a case with sorbo rubber shock absorbers, this case in its turn being packed with wood wool or straw in a larger packing case. When unpacked the receiver should be inspected for mechanical damage and to see that all valves are firmly seated in their respective sockets.

*Power supply*

**8.** The power supply components are integral with the receiver, unlike those of the R.1475 which are built into the separate power supply unit Type 360. For use with the rack assemblies the external supply will be 230V, 25/60 c/s, although the power transformer primary may be connected for either 115 or 230V by operation of the toggle switch on the rear panel of the receiver. This switch is protected by a cover plate (*fig.* 11, *Chap.* 1, *Part* 1). To alter the connection of the primary of the transformer, remove the cover plate, throw the switch and replace the cover plate with the reverse side outwards.

*External connections*

**9.** If the receivers are supplied in cabinets they are removed from these for rack mounting. When the two receivers have been secured in the rack in the positions shown in fig. 4, Chap. 1, Part 1 (using the four screws, provided for each receiver, through the holes in the front panels), the external connections can be made. The 75-ohm coaxial feeder from the aerial system (matched to 600-ohm transmission lines by a transformer) is terminated with a plug which mates with socket SK201 at the rear of the receiver. The receiver mains lead is terminated by plug PL201 which mates with the Jones socket marked MAINS AR88B on bracket B at the rear of the rack, for receiver B (the top receiver) or with the socket marked MAINS AR88A on bracket C for receiver A (the lower receiver). The receiver output sockets SK202 mate with corresponding 6-pin miniature Jones plugs on brackets B and C (*fig.* 11, *Chap.* 1, *Part* 1 *shows the connections at the rear of the receiver*).

**R.1475**

**10.** This equipment is supplied in a large transit case, which encloses three smaller cases, for the receiver unit Type 88, the power unit Type 360 and the accessories. These are detailed in A.P. 2883G, Vol. 1 (2nd Edition), Part 1, Chap. 2. Before mounting the receiver unit in the rack, the dust cover should be removed and the output transformer set to tapping 2 for 600-ohm phones. The receiver should be inspected for mechanical damage and to ensure that all the valves are firmly seated in their sockets. The unit should then be secured to the appropriate panel (*fig.* 1, *Chap.* 1, *Part* 1), which may be removed from the rack for this purpose. The two handles are removed from the front panel of the receiver unit, which is then secured to the rack panel by means of the conical nuts at the four corners of the receiver unit front panel. The two handles may then be replaced and used to lift the receiver unit with its attached rack panel. The latter is secured in the rack by means of the four screws provided. Neither the grille supplied to protect the tuning dial, nor the dust cover, are required for rack mounting the receiver.

**Power units Type 360**

**11.** The front and rear covers of the two power units are removed and the mains transformers are set for the correct mains voltage. The power units are then secured to the appropriate rack panel (*fig.* 1, *Chap.* 1, *Part* 1) which may be removed from the rack for this purpose. Use is made of the screws provided for fixing the power unit front covers.

**Rear connections**

*Receiver units Type 88*

**12.** Aerial connections are made to the coaxial sockets at the rear of the two receiver units, and connections for power supplies and receiver outputs are made between the Jones plugs and sockets at the rear of the units and those on rear brackets B (receiver B) or C (receiver A). The connectors at the rear of a receiver unit are shown in fig. 16, Chap. 1, Part 1. The upper Jones socket SK1, at the rear of a receiver unit, provides the unbalanced AF output connections, while the lower socket SK2 provides the balanced AF output and the separate RF and IF AGC connections. These connectors are linked to the corresponding miniature Jones plugs on brackets B and C, labelled OUTPUT 1475 (B OR A) 600Ω UNBAL, and 600Ω BAL AND AGC. The Jones plug PL1 at the rear of a receiver unit is linked to the corresponding socket on bracket B or C, labelled HT AND LT 1475 (B OR A). These sockets are supplied via the rack wiring from the two power units Type 360.

*Power units Type 360*

**13.** At the rear of each power unit are two Jones plugs and two Jones sockets, for making external connections. The upper plug PL1, for battery use, is not required in rack assembly Type 246. The second plug PL2 is the AC mains input. Connectors are provided for linking PL2 in each power unit to corresponding sockets, labelled AC MAINS 1475A and AC MAINS 1475B, on bracket E. Below PL2 on each power unit are two Jones sockets SK1 and SK2. These are alternative output connectors which are wired in parallel. Only one is used in each power unit. It is linked to the plug on bracket E, labelled HT AND LT 1475A or HT AND LT 1475B.

**Note . . .**

*In no circumstances must one power unit be used to supply two receiver units Type* 88. *The power rating of the mains transformer is insufficient to cope with the load.*

## OPERATION

**Headphones**

**14.** Although both types of receiver, R.1968 and R.1475, have front panel telephone jacks, these are not intended for operational use. They may, however, be used when testing the individual receivers. Operationally the special headphones, with ear pieces separately wired to individual plugs, are connected to the receivers via the telephone jacks on the left of the long table. These head sets, telephone, two-way, are made up from the following components:—

| *Nomenclature* | *Quantity* | *Stores Ref.* |
|---|---|---|
| Headband, Type C | 1 | 10A/12160 |
| Receivers, telephone, head, Type 16 | 2 | 10A/12401 |
| Plug, Type 1 | 2 | 10H/488 |
| Cordage instrument 4B | 5 ft. | G.P.O.Spec CW75D |
| Cord, stringing, braided | 3 ft. | 32A/94 |
| Cable sleeve, size 1 × ½ in. red | 4 | |
| Cable sleeve, size 1 × ½ in. black | 4 | |
| Cable end, eye type, channel end, crimping 6 B.A. | 4 | 5K/1597 |
| Cable end, eye type, channel end, crimping 8 B.A. | 4 | 5K/1596 |

**Panel (control) Type 788**

**15.** The switch on the right of this panel determines the function of the rack as described in Chap. 1, para. 11. It is intended that the operator should tune receiver A to the desired CW signal on position 2 (RXA), then to switch to position 4 (RXB) to tune receiver B to the second desired CW signal. One balanced and one unbalanced 600-ohm impedance receiver outputs are taken to the controller's switchboard via the Jones socket connections on bracket F at the rear of the rack. The output from either receiver A or receiver B may therefore be monitored and/or put out to " line " by the supervisor, via the controller's switchboard, while the rack operator can monitor each transmission in turn by switching from position 2 to 4 and vice versa.

**16.** If the supervisor at the control position calls the rack operator via the TEL. CALL line the indicator light in the centre of the control panel glows, and the rack operator can maintain two-way communication with the remote position, whilst still monitoring receiver A or B, by switching to position 1 or 5.

**17.** For receiving a single R/T transmission that is subject to fading, the operator can tune the two receivers in the rack to the signal, and he can monitor both receivers simultaneously by switching to position 3 (RXA & RXB). To obtain diversity action, aerials in space diversity should be used, and the receiver plugs, from panels (control) Type 788, must be placed in the DIVERSITY sockets on rear bracket A.

**18.** When the operator has messages for collection he can place them in the message box at the top of the rack, and by operating the indicator switch to the left of his control panel he can switch on the indicator light at the top of the rack and so call attention to it.

**Tuning procedure**

**19.** By operating the switch in the centre of the power control panel to position ON, the operator can supply mains power to the units in the rack. Where receivers Type R.1968 are used, these may be switched on by operating the system switch (*Chap.* 1, *fig.* 12) to position 3 (REC. MOD.) for R/T or MCW, or position 4 (REC. CW) for CW signals. Where receivers Type R.1475 are used, the two power units Type 360 are switched on by operating the switches on the left of the power unit front panels (*Chap.* 1, *fig.* 17) clockwise to the AC position.

**R.1968**

**20.** If the functions of the controls, as outlined in Chap. 1, para. 24, are clearly understood, tuning this receiver should present no difficulty. When receiving CW, maximum AF signals will be achieved if the BFO controls are adjusted for maximum tuning meter readings of 50 micro-amperes with the receivers in a no-signal condition. This condition is easily attained by turning the RF or IF GAIN controls counter-clockwise to zero. For balanced diversity reception this reading should be the same on each receiver since it gives the correct AGC bias to the receivers, for maximum gain.

**21.** For tuning a CW signal the functional switch is in position 4, the SELECTIVITY switch may be in position 3, the NOISE LIMITER—AVC switch in position 1, the RF GAIN control at maximum (fully clockwise) the IF GAIN at from one-third to three-quarters of maximum and the AUDIO GAIN at a level to give a signal of headphone strength. When the signal has been accurately tuned, as indicated by a maximum reading on the tuning meter, the audio beat note may be adjusted to give the desired audio pitch. Depending on the amount of interference being experienced the RF GAIN, SELECTIVITY and NOISE LIMITER controls may then be operated to give the best results attainable. This is obviously a matter for the skill of the operator to decide.

*Aerial trimmer*

**22.** Before tuning on any frequency range the receiver may be adjusted for maximum performance by tuning with this control for maximum background noise. This control may also be used to test whether a signal, that seems out of place, is a fundamental or an *image*. If the maximum signal point coincides with the point of maximum background noise, the signal is a fundamental. If the aerial trimmer does not affect the signal strength, or if it is a maximum at some other point, the signal is an *image*.

*Logging*

**23.** Logging of the frequencies of received transmissions is facilitated by the seven scales of the main tuning dial (one for each of the six bands and a log scale). The two low frequency bands are calibrated in kilocycles and the other four bands in megacycles. The vernier tuning dial is used in conjunction with the log scale on the main dial to give additional figures for logging.

*Summary*

**24.** The tuning procedure is summarized for quick reference in the following paragraph.

(1) Switch receiver on and set the functional switch for the required type of operation.

(2) Set RANGE switch for band required.

(3) Set AERIAL TRIMMER (ANT.) for maximum background noise.

(4) Set SELECTIVITY switch for the required operating conditions (*Chap.* 1, *fig.* 9, *IF selectivity curves*).

(5) Set NOISE LIMITER—AVC switch for the required operating conditions.

(6) Set RF GAIN control fully clockwise and IF GAIN at from two-thirds to three-quarters of maximum gain.

(7) Set AUDIO GAIN control about half way.

(8) Tune in the station.

(9) Reset AUDIO GAIN control to give desired volume.

(10) Reset SELECTIVITY and RF GAIN controls, and NOISE LIMITER controls to suit prevailing conditions.

(11) On CW adjust BFO control to give desired pitch. When a strong CW signal is being received it is necessary to reduce the AUDIO GAIN to decrease the volume. The RF and IF GAIN should only be reduced if:—

(a) The receiver is overloading.

(b) The *receiver* noise level is too high.

(12) The tuning may be locked by turning clockwise the knurled screw directly beneath the tuning knob. Turning the screw moderately tight will lock the tuning. (*See fig.* 12, *Chap.* 1 *for the positions of the controls*).

**R.1475**

*Main channel adjustments*

**25.** Before attempting to tune to the desired frequency the receiver is adjusted to maximum sensitivity on the required RANGE as follows:—

(1) Set the NOISE LIMITER switch to OFF, the AVC switch to FAST and the GUARD switch to GUARD OFF.

(2) Set the SYSTEM switch to the *wide band* CW position and tune the receiver to any loud signal that may be available. This may be either a CW or a R/T signal. In the latter case the SYSTEM switch may be moved to the R/T position in order to switch off the BFO.

(3) Bring the volume down to a comfortable level, using the AF GAIN control, then retune the receiver to a frequency upon which there is no carrier (see the following *Note*) and adjust the RF GAIN control for maximum tolerable noise.

**Note . . .**
*If the system switch is moved to the R/T position, as suggested in* (2), *it should be moved back to the CW wide band position at this point, to ensure that there is no carrier upon the frequency to which the receiver is tuned. A CW or temporarily unmodulated carrier would, of course, be inaudible with the system switch in the R/T position. If no carrier is present the switch may be returned to the R/T position.*

**26.** With the RANGE switch in the desired position the tuning calibration may be checked as follows:—

(1) Set the SYSTEM switch to SCALE CHECK and adjust the tuning scale to the check point nearest to the desired frequency.

(2) The scale trimmer control should then be adjusted until the calibration is correct.

(3) If the desired frequency is near the middle of the particular range, a scale check should also be made at the nearest check point on the other side of the desired frequency.

**27.** The SYSTEM switch is then returned to the required position (CW or R/T) and the desired signal tuned in. While listening out for CW signals, the wide-band position should, if possible, be used. The medium- or narrow-band CW positions may be used, while actually receiving signals, if the prevailing interference level makes it necessary.

*AGC*

**28.** During operation the AGC (AVC) switch should be set in accordance with the prevailing receiving conditions. The SLOW position is generally preferable for receiving hand-speed CW and the FAST position for other purposes. The NOISE LIMITER should be switched on if impulsive noise interference is present.

*Guard channel adjustments*

**29.** If the guard channel facility is to be used, it is necessary to select a crystal unit differing by 600 kc/s from the required guard frequency, and to plug it into the appropriate guard unit, according to the frequency range. Unit P (tuning unit Type 131) covers the range 2 to 4·2 Mc/s, and unit Q (tuning unit Type 132) covers 4·1 to 7·5 Mc/s. After plugging in the crystal, insert the unit into the guard unit housing.

*Tuning*

**30.** The guard frequency tuning controls may be set up either on the desired transmission or by reference to a suitable signal generator or radiating wavemeter. First put the guard switch to GUARD ONLY and adjust the guard unit FREQUENCY control for maximum signal. Then adjust the preset controls (1ST RF and 2ND RF) in turn for maximum signal.

**31.** The guard switch is thrown to NORMAL and the GUARD RF GAIN control adjusted so that a decrease in noise level, which is just perceptible, occurs on switching from NORMAL to GUARD OFF. With the switch returned to NORMAL, the receiver is adjusted for reception on both main and guard channels.

*Harmonic interference*

**32.** When using the receiver with the guard switch in the NORMAL position, interference may be experienced if the guard channel and main channel frequencies are in harmonic relationship. This is due to the signal on the main frequency beating with the fundamental oscillation or harmonics of the guard frequency oscillator. Slight trimming of the guard FREQUENCY control may possibly overcome this interference. Failing that, the guard switch must be thrown to GUARD OFF, in which case, of course, the guard channel facility will not be available.

*Overall calibration check*

**33.** The overall calibration of the receiver may be checked as follows:—

(1) Set the RANGE switch to the 2-3·6 Mc/s range, and the SYSTEM switch to SCALE CHECK.

(2) Commencing at the lowest reading on the scale, rotate the tuning control slowly whilst listening for the crystal check harmonic beat notes. These should occur at 2·4, 3·0 and 3·6 Mc/s, these frequencies being marked on the scale in white figures on a black disc. If exact coincidence is not obtained, adjust the scale trimmer control slightly until the calibration is correct.

**34.** A similar procedure should be followed on all four ranges, the calibration being checked at each check point. If it is found impossible to adjust the calibration on a certain range or ranges, but possible on others, it is probable that a defect has occurred in the range or ranges for which the scale trimmer will not compensate. The most likely source of the trouble is a defect in the oscillator unit C. This should be removed and a serviceable unit fitted in its place. If this is not practicable, the complete receiver unit should be replaced. On the other hand, if it is found impossible to adjust the calibration on all four ranges, it is probable that a defect has occurred in the scale trimmer L30, or in its shunt inductance L30A, or in the associated components and wiring.

**TABLE I**

**List of components, rack assemblies Type 252 and 253**

| Nomenclature | Stores Ref. | Quantity | Where used | Fig. No. |
|---|---|---|---|---|
| Lampholders, bayonet, batten | 5A/351 | 1 | Top of rack | 1, Chap. 1 |
| Sockets, 3-pin, 5A | 5A/3954 | 2 | Power supply panel | 5, Chap. 1 |
| Brackets, Type 189 | 10A/14861 | 12 | with plugs, Type 195 | 4, Chap. 1 |
| Brackets, Type 190 | 10A/14862 | 16 | with sockets, Type 530 | 4, Chap. 1 |
| Microphones, Type 55 | 10A/15982 | 1 | Long table | 8, Chap. 1 |
| Switches, Type 267 | 10F/10685 | 1 | Power supply panel | 5, Chap. 1 |
| Arms, microphone, flexible | 10G/16926 | 1 | Long table | 8, Chap. 1 |
| Plugs, Type 195 (4-pole Jones, bracket type) | 10H/324 | 6 | Rear brackets of rack | 4, Chap. 1 |
| Sockets, Type 530 (4-pole Jones, bracket type) | 10H/4052 | 8 | Rear brackets of rack | 4, Chap. 1 |
| Plugs, Type 266 (4-pole Jones, cable-clamp type) | 10H/794 | 14 | Mating components for sockets Type 530 | |
| Sockets, Type 220 (4-pole Jones, cable-clamp type) | 10H/795 | 11 | Mating components for plugs, Type 195 | |
| Jacks, Type 31 | 10H/2116 | 2 | Long table | 8, Chap. 1 |
| Plugs, Type 678 (6-pole, miniature Jones type, bracket fixing) | 10H/18686 | 2 | Rear brackets B and C | 4, Chap. 1 |
| Plugs, Type P/304/CCT (4-pole miniature Jones, cable-clamp type) | 10H/18803 | 10 | Mating with sockets Type S/304/AB | |
| Sockets, Type S/304/AB (4-pole miniature Jones, bracket type) | 10H/18810 | 10 | Rear brackets of rack | 4, Chap. 1 |
| Plugs, Type 694 (4-pole miniature Jones, bracket type) | 10H/19201 | 10 | Rear brackets of rack | 4, Chap. 1 |
| Sockets, Type 651 (4-pole miniature Jones, cable-clamp type) | 10H/19202 | 14 | Mating with plugs, Type 694 | |
| Fuse holders | | 4 | Power supply panel | 5, Chap. 1 |
| Fuse links | | 4 | Power supply panel | 5, Chap. 1 |
| Lamps, filament, 230V, 15W, pygmy, red | | 1 | Indicator lamp | 1, Chap. 1 |



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# PART 2

# CIRCUIT DETAILS

# Chapter 1

# CIRCUIT DETAILS

## LIST OF CONTENTS



## LIST OF ILLUSTRATIONS



**Rack assembly wiring**

**1.** As mentioned in Part 1, Chap. 1, para. 6 to 9, the rack assemblies Type 252 and 253 are fitted with six rear bracket assemblies on which are mounted Jones type plugs and sockets, interconnected by the rack wiring. These plugs and sockets are shown in their relative positions on the rear brackets (*labelled A to F, from top to bottom*) in fig. 1, which also gives the wiring circuit of the two basic racks.

**2.** The units which make up the rack assemblies Type 243 or 246 are fitted in the basic racks in the positions indicated in Part 1, Chap. 1, fig. 1 and 4, and mentioned in para. 5 and 8 of the same chapter. To facilitate the correct interconnection of the units by means of the flexible connectors terminated with appropriate Jones plugs and sockets, the corresponding plugs and sockets on the rear panels of the unit, and on the rear brackets, have similar labels stencilled beside them. Thus, to trace the interconnection of the circuits of individual units, given in this chapter, all that is necessary is to identify the input or output socket concerned and to trace the interconnection on the rack wiring diagram. Reference to the block diagrams of rack assemblies Type 243 and 246 (*fig.* 2 and 3, *Chap.* 1, *Part* 1) will indicate the interconnection of the units.

NOTES

1. ALL PLUG & SOCKET CONNECTIONS SHOWN VIEWED FROM UNDER SIDE OF PANELS
2. CABLE REFERENCE LETTERS ARE FOR DIAGRAMMATIC PURPOSES ONLY

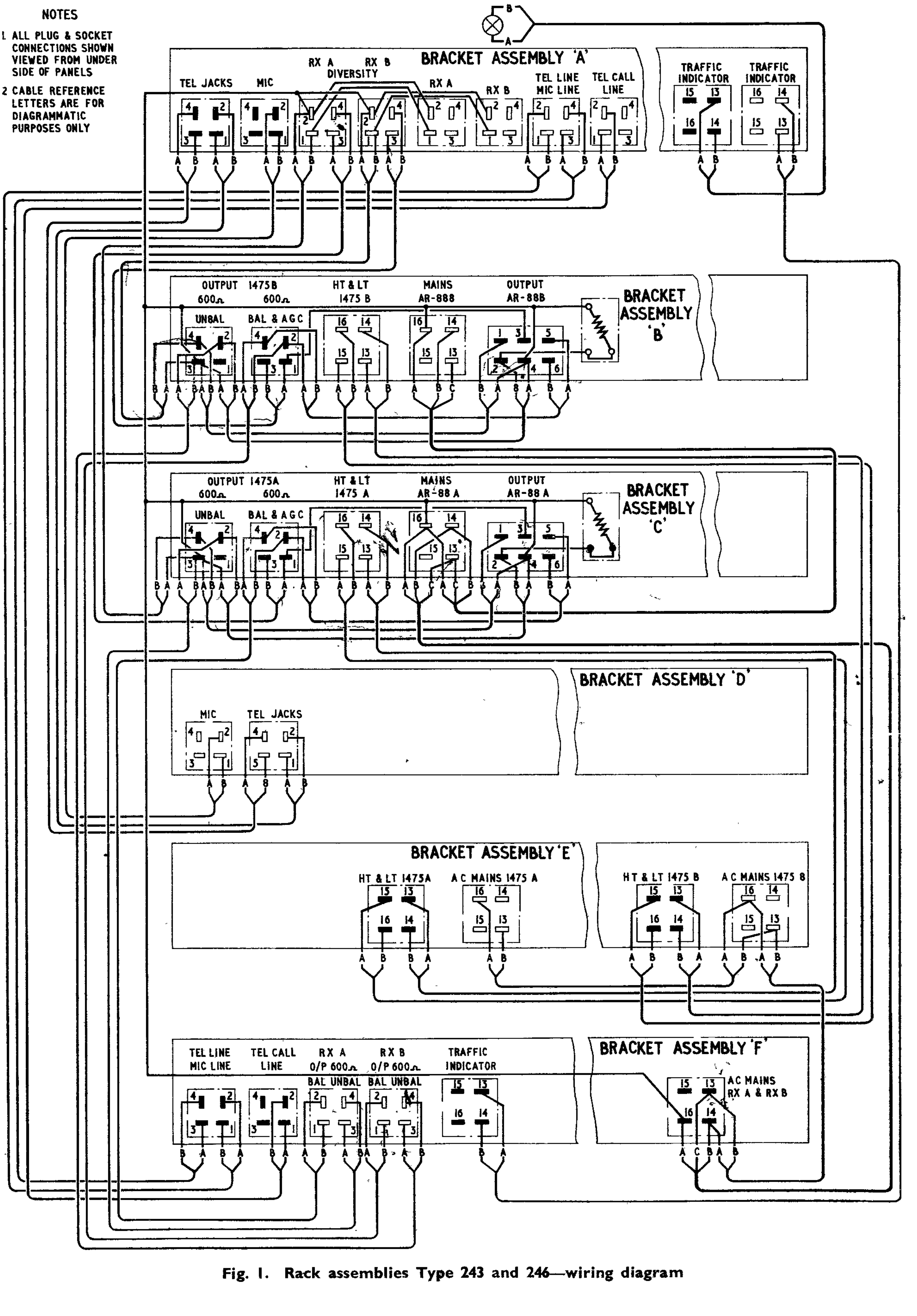



Fig. 1. Rack assemblies Type 243 and 246—wiring diagram

**79.** The input to the AGC rectifying diode D1 (V8) is derived from an impedance matching tap on L23, in the second IF amplifier band-pass circuit, and the resultant rectified current flows through R30, R31 and R32. Under no-signal conditions the triode section of V8 passes a steady anode current and its cathode is at a potential of approximately +30V to earth. During the reception of a signal the bias voltages, developed across R32 and R30, cause the anode current of the triode to fall. The voltages developed across the series resistors R30, R51, R52, in its cathode circuit also fall. Due to the gain of the triode this fall in voltage is greater than the negative-going signal voltage which caused it, and an amplified AGC voltage is provided.

**80.** When the AGC switch is ON, the anode of the AGC diode D3 (V10b) is connected by S14F to a point on potentiometer R83 (RF GAIN control) which is variable, negative to earth. The arrival of a signal drives the cathode of D3 negative, due to the voltage change across R52, and as soon as the cathode is negative to anode, current flows through the diode and applies a negative potential to the IF AGC line. When the AGC switch is OFF, the IF AGC line is manually controlled by the RF GAIN potentiometer R83, and is decoupled to earth by C57 (0·5μF) via S14R. In the AGC ON position, other contacts on S14R connect the anode of D2 (V8) to the junction of R57 and R60 in the RF AGC circuit. The anode of D2 is thus tied to a point 1·5V negative to earth and the diode cannot pass current until the signal voltage drives the cathode of V8 more negative than this potential. When this does occur the diode applies a negative bias greater than the initial 1·5V, to the RF AGC line.

*Manual RF GAIN control delay*

**81.** With AGC OFF the RF amplifier V1 and the guard mixer valve V4 are biased from R83 via R56, R57 and R58, while the IF amplifiers V5 and V7 are biased from R83 via R62 and R59. Initially R83 has no effect on the bias of V1 and V4 since the junction of R57 and R58 is held at —1·5V by reason of current passing through diode D4 (V11) which forms part of the bias potential divider. With the RF GAIN control set at maximum the anode of D4 is at a potential of +5V but this is reduced as the RF GAIN control is turned towards minimum. When this takes place the negative bias applied to the IF amplifiers is immediately increased, but owing to varying current through D4 the bias applied to the RF line remains at —1·5V until the diode anode is at earth potential. A delay of 5V bias on the RF line as compared with the IF line is thereby achieved. When AGC is in use the setting of R83 applies a negative delay voltage (*para.* 80) to the anodes of D3 (V10b) and D2 (V8) thereby providing IF and RF delayed AGC.

*AF amplifier and output stage*

**82.** The input to the AF amplifier valve (*part of V*11) from the demodulator (*part of V*9) is via a conventional AF GAIN control, potentiometer R81 (*para.* 75), while the coupling between V11 and the output triode V12 is via a variable AF filter, already described in para. 72. The output valve feeds into an output transformer providing 600-ohm impedance outputs for telephone sockets on the receiver front panel, and for use in the rack assembly. (*para.* 40 (30)

*Tuning indicator*

**83.** The cathode-ray tuning indicator V13 is operated from the cathode of the AGC DC amplifier (*the triode section of V*8). When the two receivers in the rack are used for diversity reception the strengths of the two AF signals may be balanced by adjusting the RF GAIN controls to give equal deflections of the indicators with equal RF signal inputs.

## POWER UNIT TYPE 360

**Circuit details**

**84.** A complete circuit diagram of the power unit Type 360, used in conjunction with the receiver unit Type 88, is given in fig. 4. The vibrator unit, enclosed in a dotted line in fig. 4, is not used in rack assembly Type 246 and is not described in this A.P. A full description is, however, available in A.P.2883G, Vol. 1, Part 2, Chap. 2. Reference to the simplified circuit diagram (*fig.* 11) will show that the only complexity in the circuit is due to the arrangements for switching from an AC to a DC input, again not required in rack assembly Type 246, which uses a 230V AC input. With the switch, on the left-hand side of the front panel, in the AC position (*clockwise from the front*) the AC input, from the power control panel (*fig.* 2) via the rack wiring (*fig.* 1) and Jones plug P2 (*fig.* 11), is applied to the primary of the mains transformer T1 (*via S1F and S6*). The output from the HT secondary (*via S3R*) is rectified by a bridge-type metal rectifier, smoothed in a conventional circuit C2, L1, C1, C3 and applied to the output sockets SK1 and SK2 via a pilot lamp fuse. Resistor R1 (300K), across the smoothing capacitors C1, C2, serves as a discharge path when the power unit is switched off. Capacitor C3 is discharged via the switch (S2F) and R2 (56K). The 12V AC output from the LT secondary of the transformer is selected by switch wafers S4 and S5, and applied to sockets SK1 and SK2, one side being earthed. The HT negative line is not earthed since it provides negative bias for the receiver units. It is, however, decoupled to earth by C4 (2μF).

## PANELS (CONTROL) TYPE 788

**Circuit details**

**85.** The 600-ohm impedance AF outputs from the two receivers in the rack are conveyed by the rack wiring (*fig.* 1) from the plugs on rear brackets B and C (*from receivers B and A respectively*) to the sockets on rear bracket A. If diversity action is required the plugs from the control panel are placed in the RXA & RXB DIVERSITY sockets; if not they are placed in the sockets marked RXA and RXB. Connections are also made between the control panel and the TRAFFIC INDICATOR, the control panel and the long table (*telephone headsets and microphone*) and the control panel and the external telephone line (*via the connection on rear bracket F*).

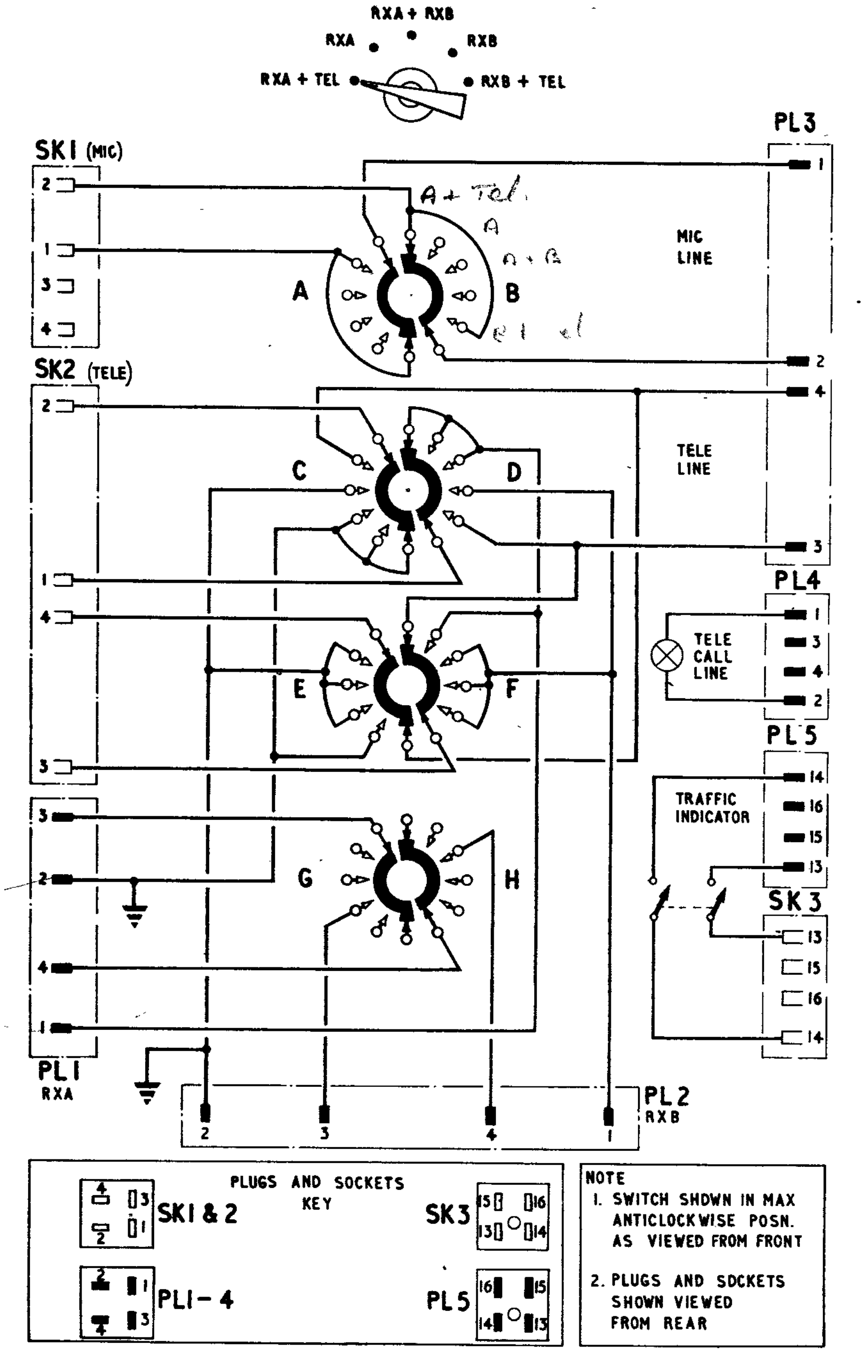



**Fig. 5. Panels (control) Type 788—circuit**

**86.** A circuit diagram of the control panel is given in fig. 5. An outline of the functions of the panel has already been given in Part 1, Chap. 1, para. 11. The TRAFFIC INDICATOR switch completes the circuit between plug PL5 and socket SK3 for the indicator lamp mounted on top of the rack. Plug PL4 connects the indicator light to the external telephone call line. Plugs PL1 and PL2 carry the AF and AGC lines, from receivers A and B respectively, to the selector switch. Sockets SK1 and SK2 provide the connections to the microphone and the two telephone headsets connected to the long table. Fig. 6 gives the long table circuit.

**87.** The five positions of the functional switch on the control panel provide the following facilities:—

(1) RXA & TEL

(a) Switch wafers A and B complete the microphone circuit from SK1 to PL3.

(b) Headset A (terminals 1 and 2 of SK2) is connected to receiver A (terminals 1 and 2 of PL1) via switch wafers D and C.

(c) Headset B (terminals 3 and 4 of SK2) is

**Power supply control panel**

**3.** This panel is described in Part 1, Chap. 1, para. 10. A circuit diagram is given in fig. 2. The mains input from the external supply is made to the Jones type plug marked AC MAINS, which is mounted on the rear panel of the unit. The receiver and traffic indicator lamp outputs are made from the sockets marked AC RXA RXB and INDIC, on the power unit rear panel, to corresponding plugs on bracket F (*fig.* 1).

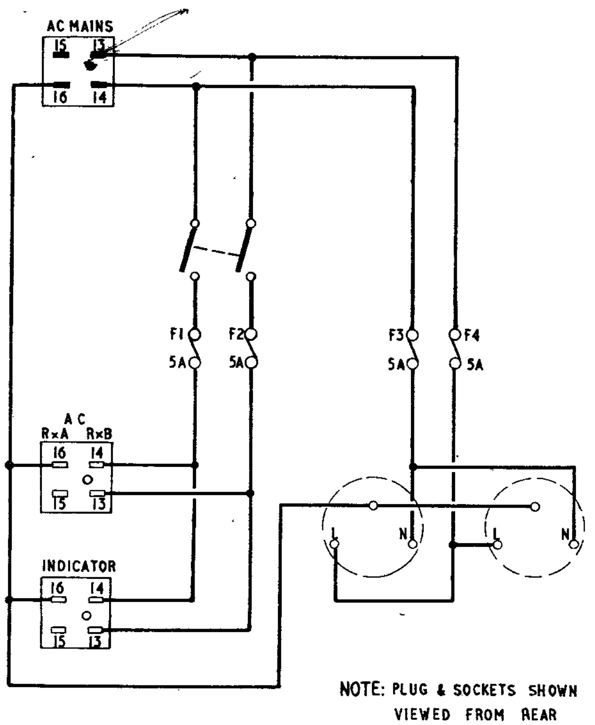



**Fig. 2. Power control panel—circuit**

## RECEIVER TYPE R.1968

**Brief details of circuit**

**4.** The circuit diagram of this receiver (used in rack assembly Type 243) is given in fig. 7. It consists of two pentode stages of RF amplification (CV1978), a triode local oscillator (CV1933) a pentagrid frequency-changer (CV1966), three pentode stages of IF amplification (CV1978), a double-diode demodulator and AGC valve (CV1930), a double-diode noise limiter (CV1930), a triode BFO (CV1933) for CW reception, a pentode AF amplifier (CV591) and a pentode output stage (CV509 or CV510) which provides two unbalanced 600-ohm AF outputs and one balanced 600-ohm AF output. The conventional power supply uses a directly heated full-wave rectifier (CV1856), while a neon voltage regulator (CV216) provides a stabilized HT supply for the local oscillator and BFO anodes and the screen grids of the frequency changer and IF amplifier valves.

**Aerial input**

**5.** The aerial input is via a 75-ohm coaxial feeder. If 600-ohm transmission lines are used a matching transformer is required. A coaxial socket (SK201), for the aerial input connector, is fitted to the right-hand side of the rear panel of the chassis (*fig.* 11, *Chap.* 1, *Part* 1). The centre connector of SK201 is connected to the terminal marked A on the aerial terminal board TB1; the outer connector is earthed to chassis. The centre terminal of TB1 may be connected to the third terminal, (*marked G*) which is earthed, by an external link. Internally the two terminals are bridged by a 1 megohm resistor. When a coaxial feeder is in use, as in the present application, the external link is left in position. When a balanced feeder is used the link is disconnected, and the 1 megohm resistor (R202) then provides a static leak. The aerial coil primaries are protected from damage, due to high voltages, by the neon spark gap (CV651), connected between terminals A and centre of terminal board TB1. This neon protector will break down with an applied potential of approximately 50 volts RMS. (Since no further stocks of this neon are available, it should be removed when it becomes unserviceable. The set will then rely on the 1 megohm static leak).

**RF tuned circuits**

**6.** Frequency ranges 1 (73 to 205 kc/s) and 2 (195 to 550 kc/s) are not designed for a balanced aerial input and the ends of the aerial coils remote from the aerials on these ranges are earthed to chassis. On ranges 3 to 6 (1480 to 30500 kc/s) the remote ends of the coils are returned to the centre terminal of TB1, where the earth connection for an unbalanced feeder is provided by the link, while R202 provides a leakage path to earth for a balanced feeder system. Range switch wafer S16R selects the connection for the aerial end of the appropriate coil and S15F selects the connection for the earthy end (*fig.* 7).

**7.** Switch wafers S13F (V1), S9F (V2) and S5F (V4) select the grid coils for the RF range required, while the associated switch wafers, S14R, S10R and S6R, short-circuit to chassis the coils for the remaining ranges. On ranges 1 to 4, which are transformer-coupled, the anode coils are selected by S12R (V1) and S8R (V2), and the associated switch wafers S11F and S7F provide the HT connection. Ranges 5 and 6 are capacitance coupled via the appropriate contacts on S12R and S8R.

**8.** In the local oscillator (V3) section, which uses a parallel-fed, modified Hartley circuit, the anode connections are selected by range switch wafer S3F, and the grid connections by S2R. The associated switch wafers S4R and S1F short-circuit to chassis ranges which are not in use.

**Tuning condenser**

**9.** Each gang of the four-gang TUNING condenser is made up of a small capacitance section and a larger capacitance section (C6 + C3, C40 + C35 and C70 + C77 for the RF and FC stages, and C49 + C50 for the LO stage), the values being given in fig. 7. The positions of these capacitors are shown in the layout diagram for the top of the chassis (*Part* 3, *Chap.* 1, *fig.* 1). On positions 1 to 4 of the RANGE switch both the larger and the smaller tuning capacitors are in circuit, but on ranges

5 and 6 only the smaller one is used, so as to provide bandspread on the higher frequencies. This supplements the mechanical bandspread incorporated in the single knob tuning control.

#### Aerial trimmer

**10.** A front panel control C2 (3 to 25pF) permits accurate adjustment of the grid circuit of V1, the first RF amplifier. This ensures maximum sensitivity on all ranges and with any aerial system.

#### IF wavetrap

**11.** A series-tuned wavetrap circuit L57-C12, adjusted to the intermediate frequency (735kc/s) is connected in parallel with the V1 anode coil (L61) on range 3 (1480 to 4400 kc/s), to form a shunt acceptor circuit for interfering second harmonic IF signals, In addition the response of L61 is damped by the parallel resistor R58 (5·6K).

#### RF amplifier stages

**12.** The RF amplifier stages (V1, V2) are designed to provide ample selectivity before the frequency changer (V4) in order to minimize cross-modulation and blocking effects from strong interfering signals. They also provide a high degree of image signal suppression. The gain of the first valve is made as high as practicable to provide optimum signal-to-noise ratio. Thus, although each tuned circuit in the receiver contributes some noise, the contributions of the following stages are negligible compared with that of the first stage.

#### Screening

**13.** The four-gang tuning condenser, the local oscillator section and the RF amplifier and frequency changer sections are all screened to minimize oscillator radiation. The IF stages are also screened, so that coupling is only possible through the aerial circuit. Stray capacitances could, however, cause coupling of IF harmonic signals from the aerial circuit to the control grid of V1, so the IF wavetrap is placed in the anode circuit of V1 (*para.* 11).

#### Local oscillator and frequency changer

**14.** The local oscillator (V3) is aligned to track with the RF amplifier at 735 kc/s higher than the signal frequency. The oscillator frequency is injected into the pentagrid frequency-changer (V4), via capacitor C53 (6·8pF), and the 735 kc/s IF signal is produced in the anode circuit of V4. The oscillator anode voltage and the screen voltages of the frequency-changer and IF amplifier valves (V4 to7) are regulated by V13 to provide maximum stability under conditions of varying mains voltage.

#### IF crystal filter

**15.** The frequency changer anode circuit (T3) is tuned to the intermediate frequency. The secondary of T3 (L33) is coupled to the first IF grid circuit (V5) by a balanced link circuit. A 735 kc/s crystal (A1 *in fig.* 7) is connected in one arm of the link circuit and a neutralizing capacitor (C75) is connected in the other arm. In positions 1 and 2 of the SELECTIVITY switch the crystal is short-circuited by switch wafer S20R, while in positions 3, 4 and 5 the crystal is in circuit, and the link circuit couples T3 (L33) and T4 (L34) in the grid circuit of V5. The three switch positions (3, 4 and 5) give increased selectivity by varying the input tapping on L34. On switch positions 4 and 5 respectively, C129 + C80, and C81, are connected in parallel with the appropriate tappings on L34 by switch wafer S19F. The adjustments on L34, C80 and C81 thus provide for control of the IF bandwidths on switch positions 3, 4 and 5 respectively. The impedances of the coils in the link circuit are such that the crystal selectivity characteristic is not impracticably sharp. The five degrees of IF selectivity are given in the leading particulars (*Part* 1, *Chap.* 1) and shown in Part 1, Chap. 1, fig. 9.

#### IF amplifiers

**16.** Three stages of IF amplification are used (V5, V6 and V7). In addition to the functions already described the SELECTIVITY switch varies the coupling between the first and second, and the second and third IF amplifier stages, on switch positions 1 and 2, by means of operations decided by switch wafers S18R and S17R, thus providing the requisite bandwidth on these two switch positions. V5 is coupled to V6 via T5 (L35, L36) and T6 (L37,L38). These transformers are band-pass coupled. A fixed capacitive top-coupling is used between L36 and L37 and the bandwidth is varied by the removal of series inductances (L39 from L36 and L40 from L37) at the earthy ends of the coupled circuits. These series inductances are in circuit only on SELECTIVITY switch position 1 (wafer S18R).

**17.** V6 is coupled to V7 by T7 (L41 ,L42) and T8 (L43, L44) by a similar band-pass coupling. The series inductors on the broad bandwidth position of the SELECTIVITY switch (position 1) are L45 and L46, and the associated switch wafer is S17F. V7 is coupled to the demodulator stage (V8a) by a single IF transformer T9 (L47, L48).

#### Gain controls

**18.** RF, IF, AF and automatic gain controls are provided. The control grids of the RF amplifiers (V1, V2) and the first and second IF amplifiers (V5, V6) are connected to a common line, controlled by either the AGC voltage or the manual RF GAIN control, depending upon the setting of the NOISE LIMITER—AVC switch (S21F, S22R). Starting from the fully counter-clockwise position these settings are:—

(1) Manual gain control only

(2) Manual gain control with noise limitation

(3) AGC with noise limitation

(4) AGC only

**19.** In the interests of frequency stability the frequency changer (V4) is not connected to either the AGC nor to the manual RF GAIN control. Similarly no control is applied to the third IF stage (V7) so that a good AGC characteristic with little overload distortion is obtained. The AUDIO GAIN control is described is para. 28.

##### *RF gain control and AGC*

**20.** The RF GAIN control (R46) is part of a potential divider between the HT negative line and chassis. On positions 1 and 2 of the NOISE LIMITER

—AVC switch the AGC diode (V8b) is short-circuited by switch wafer S22R and the slider of potentiometer R46 is connected to the common grid bias line (*para.* 18). This line is also connected to a positive potential via R210 (10 megohms) but on manual gain the potential divider effect ensures a negative bias. On positions 3 and 4 of the NL—AVC switch the AGC diode is in circuit and the negative potential from R46 is applied as a delay bias to the cathode of the diode. When receiving CW the output from the BFO (V12) is applied to the third IF valve (V7) via the self-capacitance of two probes marked A—B on the circuit diagram (*fig.* 7). This provides a comparatively high detector excitation voltage with small electrical coupling to the oscillator circuit. When receiving CW on AGC, with the RF GAIN control fully clockwise, the positive potential applied to the AGC diode anode via R210, and the negative potential applied to the cathode via R46, give a delay bias slightly above the BFO excitation voltage, so that switching on the BFO does not reduce the sensitivity of the receiver.

*Diversity IF gain control*

**21.** In addition to being subjected to the RF GAIN control the first and second IF amplifiers (V5 and V6) are affected by the DIVERSITY IF GAIN control, which is provided primarily for balancing the gains of the two receivers when they are used for diversity reception with their AGC lines coupled. The cathode bias resistors R205 and R207 of V5 and V6 are returned to chassis through the control potentiometer R206, thus enabling the gains of these two valves to be varied.

**Output meter**

**22.** To enable the gains of the two receivers to be balanced a 0—300 microammeter (M201) is inserted in series with the load of the demodulator diode (V8A). The gains are balanced when an equal signal to each receiver produces the same reading on the two meters. Equal signals will also produce the same AGC voltage, so that when the AGC lines of the two receivers are connected, via terminal boards TB2 (terminals 5) and sockets SK202 (sockets 3), the receiver with the weaker signal will have its gain reduced by the AGC voltage from the other receiver, and a better signal-to-noise ratio will result in the combined output. Meter M201 is also used for tuning the receivers when they are used separately. The maximum reading attainable indicates the correct tuning point, for any signal. On CW the BFO is adjusted to give an initial reading of 50 microamps. in the no-signal condition, to give the correct level of detector excitation.

**Beat frequency oscillator**

**23.** The BFO (V12) is a parallel-fed triode Colpitts oscillator, electrostatically coupled to the final IF stage (*para.* 20). On the CW position (4) of the receiver function switch (S23R) the stabilized HT supply from V13 is applied to the BFO anode. A front panel control (C86), labelled B.F.O. ADJ. is provided to enable the oscillator frequency, and therefore the resultant AF beat note, to be varied.

**Noise limiter**

**24.** The noise limiter (NL) switch S21F, is ganged to the AVC (AGC) switch S22R and on positions 2 and 3 of the switch it provides for the use of the noise limiter on CW and modulated reception, respectively, when pulse type interference is being encountered. The noise limiter circuit utilizes a double-diode valve V9 connected across the NL control R48 (part of the demodulator diode load) so as to provide a variable suppressor for noise voltages, in conjunction with C109 and C110. The circuit is bridged by S21F on switch positions 1 and 4.

**25.** With the slider of R48 fully clockwise (*top in fig.* 7) noise pulses in excess of 100 per cent modulation are suppressed. As the control is turned counter-clockwise, the noise interference is limited to continuously lower percentages of modulation, so that in the fully counter-clockwise position the noise limiter is operative on any degree of modulation.

**26.** Capacitors C109 and C110 are charged via R35 to a negative potential equivalent to the mean modulation level determined by the setting of the slider of R48. Owing to the long time constant of R35 and C109-110 the charge on the capacitors is unable to follow the voltage developed across R48 by transient impulses. Under steady signal conditions diode V9b passes anode current, modulated by the signal, because its cathode is connected via R50 and R35 to a point on R48 negative to the diode anode, on all positions of the NL control except fully counter-clockwise. The signal voltage fluctuations across C109-110 are applied to the AF amplifier via switch S21F.

**27.** With the application of a noise pulse in excess of the normal modulation level the anode of V9b is driven sharply negative, while the cathode is held at the potential across C109-110. V9b is therefore cut off and the noise pulse is suppressed, apart from a residual induced voltage, passing through the inter-electrode self-capacitance of the valve. This drives the cathode of V9b, and therefore of V9a, negative compared with the charge on C109-110, so diode V9a passes current and clips the residual noise pulse, by developing an opposing voltage across the load resistor R50.

**Audio gain control**

**28.** The output from the demodulator diode V8a is applied to the AUDIO GAIN control via C116, either directly or through the noise limiter circuit depending on the setting of switch S21F (NL). The AUDIO GAIN control operates conventionally and is used to adjust the AF output to the desired level, by varying the input to the AF amplifier pentode valve V10.

**Output stage**

**29.** The output pentode V11 is resistance-capacitance coupled from the AF amplifier V10. Both valves are biased from the negative HT line, via a potential divider, to ensure stable operation. V11 operates into output transformer T201, which has three 600-ohm impedance output windings, one of which is tapped to provide negative feedback into the cathode circuit of V10. This winding also feeds one or more low impedance headphone jacks on the receiver front panel, and provides the AF output which is applied to panels (control) Type 788 via the rack wiring (*socket SK202 terminal* 1). The other two secondary windings on T201 provide a balanced 600-ohm output and an unbalanced 600-ohm output via socket SK202 and the rack wiring to rear bracket F at the bottom of the rack.

#### Power supply

**30.** The power supply is integral with the receiver. It consists of a conventional layout of power transformer T1, a directly heated full-wave rectifier valve (V14) and a condenser-input smoothing circuit C96, L50, C97, L49, C98. Apart from the valve all these components are enclosed in screening cans to obviate mains hum. Resistors R208 and R209 are wired in series between HT+ and earth to discharge the smoothing capacitors when the receiver is switched off. A resistor chain R43, R44 and R45 provides negative bias voltages for the RF GAIN control, V10 and V11. Stabilized HT for V3 and V12 anodes and the screen grids of V4, V5, V6 and V7 is provided by V13. The switch S25 on the left-hand side of the rear panel of the receiver should be in the 234V position, connecting the power transformer primaries in series. The octal plug J1, on the rear panel, bridges gaps in the mains and heater wiring. It provides for operation with alternative power supplies not used in the rack assemblies. The mains input is via a 1·5A cartridge type fuse (F1), while the MAINS ON-OFF switch S24 is mounted at the rear of the functional switch S23R.

### RECEIVER UNIT TYPE 88

#### Mechanical assembly

**31.** The mechanical assembly of this unit is described and illustrated in detail in A.P.2883G, Vol. 1 (2nd Edition), Part 2, Chap. 1. The chassis is of rigid construction, an essential requirement for maintaining the accuracy of calibration, with the panel assembly mounted in front and most of the components mounted in eight units which plug in at the rear. A dust cover, perforated along the upper edge for ventilation, encloses the chassis.

#### Panel assembly

**32.** The front panel is illustrated in Part 1, Chap. 1, fig. 14. Mounted at the bottom, by means of six screws, is a sub-assembly which carries the SYSTEM switch, the NOISE LIMITER and AVC switches, the LF (AF) GAIN and GUARD RF GAIN potentiometers, and the SCALE TRIMMER inductance with its control knob. Two telephone jacks are mounted on the right-hand side. These are connected in parallel to the unbalanced 600-ohm impedance winding of the output transformer.

**33.** At the top the front panel is cut away to accommodate the range scale window and to allow the tuning and range controls to protrude. These controls and the cylindrical range scale are mounted on the vertical part of the chassis. On the left-hand centre of the front panel is a sub-assembly secured by four screws. It consists of the scale lock, the HF (RF) GAIN control and the GUARD switch. The cathode-ray tuning indicator V13, which is mounted on the chassis, protrudes through the centre of the front panel and is protected by a hood secured by two knurled screws. On the right-hand side is the housing for the guard unit. Spring contacts make connection when the unit is pushed into position.

#### Components mounted on chassis

*Range scale*

**34.** The spindle passing through the scale drum is secured at both ends by bolts which fit inside ball bearings mounted on plates attached to the chassis. Scale lamps with shades are fitted to the chassis behind the scale. The scale lock consists of a pair of brake blocks fitted with springs to return them to the OFF position. In the ON position the brake blocks bear upon each side of the knurled tuning control.

*Tuning condenser*

**35.** The four-gang tuning condenser, mounted in the upper right-hand sector of the chassis, is driven from the tuning control on the left of the front panel through anti-backlash gearing and a countershaft. The drive pinion, mounted on the tapered condenser shaft, is a tight fit and, if it should be necessary to remove it, care must be exercised to avoid damaging the condenser gang and the pinion.

**36.** Three groups of components are mounted on the casing of the tuning condenser.

(1) Tagboard B, carrying the negative-temperature-coefficient capacitors C107, C108, C110, associated with the tuned circuit of the local oscillator V2.

(2) Tagboard A, carrying R5, R6 and C4 (grid circuit of V1). This tagboard is screened.

(3) Thermally-controlled preset capacitor C116 (trimmer for LO tuning condenser).

*Other components*

**37.** On the left-hand side of the chassis (viewed from the front) is a small tagboard (C) carrying R59, R62, R61, R52, R75 at the top and R56, R57, R60, R58, R51 at the bottom (reading left to right). C100 is on the right of the board. All these components are associated with the AGC and tuning indicator (V13), and with the negative HT line.

**38.** The output transformer, associated with V12, together with a small tagboard carrying R50 (in series with the balanced AF output winding) and another tagboard D, carrying resistors R74, R65, R25, R54 (reading from left to right) are mounted to the right as viewed from the rear of the chassis. R65 and R64 form a potential divider from HT+ to chassis, for supplying screen voltage (80V) to V1, V3 and V5, while R25 and R54 are resistors associated with the voltage stabilizer valve V6.

**39.** The lower portion of the chassis is occupied by eight 10-way sockets which mate with plugs on units A, B, C, D, E, G, J, K (*para.* 42). Each

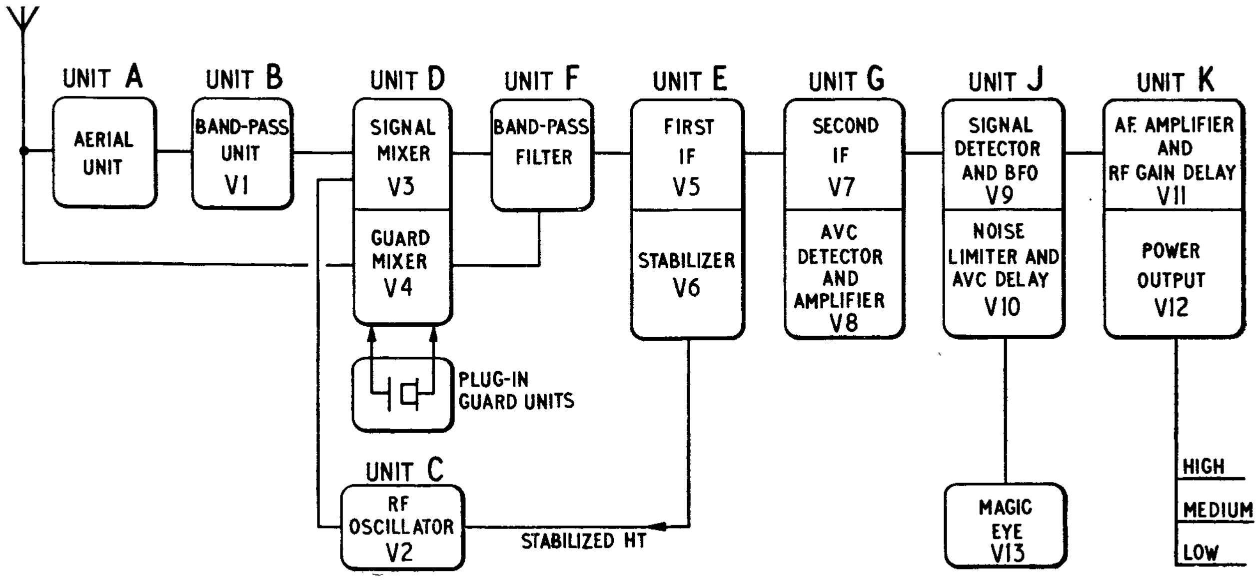



**Fig. 3. Receiver unit Type 88—block layout**

of these plug-in units is secured in position by four screws, two of which are " captive " on the upper edge of the unit itself, and two " captive " on a bar on the underside of the chassis.

*External connections*

**40.** On the left of the chassis, as viewed from the rear (*Part* 1, *Chap.* 1, *fig.* 16), are mounted the inlet and outlet connectors for all external connections other than the telephone jacks. Reading from top to bottom these are:—

(1) Coaxial socket SK3 for the 75-ohm aerial plug.

(2) Aerial and earth terminal block for high impedance aerial (*not required with the rack assemblies Type* 243 *and* 246).

(3) Jones socket SK1, numbered:—

13—relay keying (*not required with rack assemblies*).
14—output, high level, for 600-ohm phones. This is the unbalanced output which is conveyed to rear bracket F.
15—earth.
16—output, low level, for 20,000, 600 or 150-ohm phones. This is the unbalanced output which feeds the front panel phone jacks and also the panel (control) Type 788.

The terminals numbered 13, 14, 15 and 16 on SK1 are connected to terminals, numbered 1, 2, 3 and 4 respectively, of the 600Ω UNBAL. miniature Jones plugs on rear brackets B and C (*for receivers B and A*) of the rack assemblies.

(4) Jones plug P1, numbered:—
13—earth.
14—12V supply line to heaters.
15—negative HT.
16—positive HT.

These terminals are connected to corresponding terminals of the Jones sockets labelled HT LT 1475B or HT LT 1475A on rear brackets B or C respectively. These sockets are fed from the two power units Type 360 via plugs on rear bracket E and the rack wiring.

*Unit F*

**41.** A small unit, referred to as Unit F, is mounted directly upon the chassis near the centre (behind V3, when viewed from the rear). This unit (a small cylindrical can) contains L19 and C52, part of the first IF band-pass filter.

**Plug-in units**

**42.** Either of the two guard units (P or Q) may be plugged into position from the front of the receiver. The valve holders, switch units and small components for the various stages of the receiver unit are mounted in the eight units which plug into the rear of the chassis (*para.* 39). Fig. 3 gives a block diagram showing the functions of these units, while fig. 8 gives the chassis circuits which link the units. Viewed from the rear, and taken in order from left to right the units are:—

| *Unit* | *Function* |
|---|---|
| A | Aerial unit |
| B | RF amplifier unit |
| C | Local oscillator unit |
| D | Mixer unit |
| E | First IF unit |
| G | Second IF unit |
| J | BFO unit |
| K | Output unit |

**43.** These rear units are of uniform size, but they differ in the number and type of valves plugged into them, and in the arrangement of the perforations for access to the circuit trimmers. Annotations on the screening cans, adjacent to the perforations, give the circuit references of these trimmers.

**44.** Inside each unit is a rectangular wafer upon which all its components are mounted. The rotary switch units, mounted in the middle of each wafer, have self-centring rotating portions, to permit alignment upon the actuating switch bar, for the RANGE or SYSTEM switch respectively, which passes through the appropriate plug-in units. The RANGE switch bar is inserted from the right-hand side of the chassis, viewed from the front, and is actuated by the thumb-operated RANGE switch through a link action with a toggle device, which locks the switch in the selected position. The SYSTEM switch bar is inserted from the left-hand side of the chassis and is operated by the control knob through a bevel gear and suitable link arms.

**Note . . .**

*The switch bars must be removed, by unscrewing "keep-screws," fitted to their exposed ends, and then withdrawing the bars horizontally with a pair of pliers, before any attempt is made to remove the plug-in units concerned.*

**Switch units**

**45.** Switch unit S1F, which controls the scale lighting, is mounted directly upon the chassis. The units which make up the RANGE switch are fitted in plug-in units A, B and C. Unit A contains S2F, S2R, S3R; unit B contains S4R, S4F, S5R, while unit C contains S6R, S6F, S7R and SF7. The units which make up the SYSTEM switch are fitted in plug-in units, D, E, G, J and K. Unit D contains S8R and S8F (S8R is not used); unit E contains S9F, S9R; unit G contains S10R, S10F; unit J contains S11R, S11F, and unit K contains S12R, S12F.

**Note . . .**

(1) *F denotes contacts mounted on the front of the switch wafer and R contacts mounted on the rear surface.*

(2) *The only direct connection between any of the plug-in units is a short length of copper wire from C26 in unit C to a valve pin (V3 mixer-grid) in unit D. This connection must be unsoldered from the pin before any attempt is made to withdraw unit C or D. The screening cans are cut away to facilitate this operation.*

**Circuit details**

**46.** For full details of the layout and circuitry of the individual plug-in units, reference must be made to A.P.2883G, Vol. 1, Part 2, Chap. 1. A simplified circuit diagram of the complete receiving unit Type 88 is given in fig. 9 while fig. 10 gives the full circuit, showing the components included in the various smaller units. In fig. 10 the plug-in units are shown enclosed with a broken line and the points at which the internal circuits join the chassis circuits (*fig.* 8) are indicated by the pin number on the 10-point connector between plug-in unit and chassis.

*Aerial unit A (tuning unit Type 145)*

**47.** The valve holder on top of this unit houses the aerial attenuator relay. Since the rack assemblies Type 243 and 246 are not designed for two-way communication, in conjunction with a transmitter, no provision is made for external operation of the relay, but it must be left in position since its contacts complete the receiver aerial circuits and the relay is operated internally by S10R on the SCALE CHECK position of the SYSTEM switch. A plug-in flexible connection is taken from the top of Unit A to C95, the aerial tuning section of the four-gang tuning condenser. The inductors and trimming capacitors for the four frequency ranges may be identified on the circuit diagram (*fig.* 10). For identification on the actual plug-in units the circuit references of the trimmers are stencilled on the screening cans adjacent to the holes provided for the trimming tools, on all the units.

*RF amplifier unit B (tuning unit Type 146)*

**48.** The valve can on top of this unit houses the RF amplifier valve V1. The principal components inside are the inductors and trimming capacitors for the four ranges of "RF to mixer" band-pass coupling units. These can be identified on the circuit diagram (*fig.* 10). From the top of unit B are brought two flexible screened connections; one to C96, the RF amplifier section of the four gang tuning condenser and one to the top cap (control-grid) of valve V3.

*Local oscillator unit C (oscillator unit Type 171)*

**49.** The valve can on top of this unit houses the main channel oscillator valve V2. Mounted on the wafer inside are the four ranges of LO inductors with their trimmer capacitors, four switch units and a thermal compensator represented in the circuit diagrams (*fig.* 9 *and* 10) by L30A and C115. This compensator takes the form of a bi-metal strip in close proximity to a fixed plate (providing a capacitance referred to as C115) and to an inductor (L30A). As the bi-metal strip is distorted in response to temperature changes it varies the capacitance and inductance so as to maintain a constant frequency response. A flexible connection from the LO section (C98) of the four-gang tuning condenser is made from a socket on top of the unit.

*Mixer unit D (mixer unit Type 11)*

**50.** The valve can at the rear of this unit houses V4 (the guard mixer valve), while the front valve can screens V3 (the main channel mixer valve). The principal components, on the wafer inside, are the first two tuned circuits of the first IF band-pass filter, with the associated unit of the SYSTEM switch, which varies the IF selectivity. This switch unit (S8F) also switches off the guard mixer valve V4 when in the SCALE CHECK position.

*First IF unit E (IF unit Type 37)*

**51.** On the top of this unit the can at the rear screens V5, while the LO HT stabilizer valve V6 plugs in at the front. On the wafer inside are the switch units and other components for the second IF band-pass filter. Switch unit S9F varies the IF selectivity and switch unit S9R switches off the screen HT of the RF amplifying valve V1 in the SCALE CHECK position of the SYSTEM switch.

*Unit F (inductor-capacitor unit Type 88)*

**52.** This contains the third coupled circuit L19—C52 of the first IF band-pass filter. L19 is an IF transformer with the primary coupled to the previous circuit of the filter (L18) via C42. C52 is in parallel with the secondary of the transformer, which is connected at one end to the top cap (control-grid) of V5 by a flexible connector, while the other end is connected to the AGC line.

*Second IF unit G (IF unit Type 38)*

**53.** The final amplifier V7 is at the front of this unit and the AGC detector and amplifier V8 is at the rear, both housed in screening cans. The principal components on the wafer are the switch units S10R and S10F, and the third IF band-pass filter. Switch unit S10R energizes the attenuator relay (*para.* 47) when in the SCALE CHECK positon. S10F varies the selectivity of the third IF band-pass filter.

*BFO unit J (oscillator unit Type 170)*

**54.** At the rear of this unit is V9, the BFO and demodulator valve, which is screened, while the unscreened V10 (noise limiter and AGC delay double diode) is at the front. The principal components on the wafer are switch unit S11R, with the associated BFO circuit components, including the quartz crystal, a standard A.M. 600 kc/s plug-in type, and S11F which operates in the AGC and noise limiter circuits. In the SCALE CHECK position S11R connects the BFO harmonic output to the RF band-pass circuit of V1.

*Output unit K (output unit Type 45)*

**55.** The unscreened power amplifier valve V12 is at the rear of this unit and the screened AF amplifier valve V11 is at the front. On the wafer are the switch units (S12 and S12F) and associated components for varying the AF selectivity. The output from the power amplifier valve is applied to the output transformer, mounted on the chassis, and thence to the output sockets SK1 and SK2 (*para.* 40).

*Guard units P and Q (tuning units Type 131 and 132)*

**56.** The circuit and layout of components in these two units are almost identical but the component references and valves are different (*fig.* 10). All connections between the receiver chassis and the guard unit in use are made through ten contacts, on the underside of the unit, which engage with spring finger contacts in the guard unit housing on the chassis. Each unit is supplied complete except for the crystal. The holder for this may be observed to the left of the internal screen of the unit, when the top cover is removed.

**Functions of circuit**

*Circuit diagrams*

**57.** Fig. 9 gives a simplified circuit diagram intended to show the circuit layout and to facilitate tracing the signal, supply and control circuits throughout the receiver. Fig. 10 is a full circuit diagram, showing the components included in the individual plug-in units and the pin numbers of the connections with the main receiver chassis. In the following description of the circuitry, reference is made mainly to the simplified circuit diagram, but when plug-in unit pin numbers are quoted the reference is to fig. 10.

*Aerial attenuator relay*

**58.** The connection from the aerial input coaxial socket SK3 to the selected aerial circuit is made through contacts on relay RL1, a P.O. type relay with a rectangular screening can, mounted on an octal base, upon the aerial unit A. The operating coil of the relay is fed from the HT+ line through current limiting resistors R2 and R1, when switch S10R, in unit G, completes the circuit to chassis on the SCALE CHECK position (4) of the SYSTEM switch. This operation interrupts the aerial circuit at the relay contacts and prevents incoming signals from breaking through and being confused with the scale-checking harmonics from the BFO (to V1 anode circuit via switch S9F and capacitor C13).

*Guard channel input circuit*

**59.** The low potential ends of the primary windings of the aerial range inductors are all common (*contact* 1 *on unit A*) and are connected to contact 10 on the guard unit housing. When no guard unit is plugged in, this point is earthed via spring contact X (*fig.* 10) and contacts 6 on unit A. The insertion of a guard unit opens the spring contact X and connects the primary winding of the guard unit input circuit in series with the selected main channel primary circuit. The guard unit RF signal is then applied to the guard channel mixer valve V4 via contacts 6 and 8 on the guard unit housing.

*RF amplifier*

**60.** The RF amplifier is designed to provide sufficient selectivity to eliminate cross-modulation and blocking effects from strong, interfering signals. Inductively-coupled band-pass filters are used between the RF amplifying valve V1 and the main channel mixer valve V3. Sufficient amplification is achieved to make the noise contribution of circuits following V1 negligible in comparison with the thermal agitation and "shot-effect" noise generated in the V1 circuit, so as to provide optimum signal-to-noise ratio.

*RF GAIN control*

**61.** A variable bias is applied to the control grid of V1 through R10 and R5 from the manual RF GAIN control R83 (between HT— and chassis). This control is part of the AGC and manual delay network R45, R56, R62, R61, R57 and R60, associated with the AGC and manual delay diodes D2, D3 and D4 (*para.* 78-81). The negative bias voltage from R83, the delay voltage from D4 and the AGC bias voltage from V8, combine to determine the final bias voltage applied to V1. Thus the initial sensitivity is decided by R83, but the AGC over-rides the manual setting when the incoming signal strength is sufficient to overload the receiver. The RF section of the guard mixer valve V4 is also connected to this bias line via R10 and R76.

#### *Local oscillator (main channel)*

**62.** In order to make full use of the high discrimination tuning scale, special care has been taken to ensure maximum stability of the local oscillator frequency under conditions of ambient temperature variations. Ceramic insulation is used at all important points and the tuning coils and condenser are compensated for thermal drift. In addition the oscillator and mixer valves are very loosely coupled to the oscillatory circuit so that variations in valve constants have no appreciable effect on the frequency.

**63.** The tuning condenser is compensated at the maximum capacitance end of its range by a capacitor having a negative temperature coefficient (C107—C110 in parallel) mounted on the screening cover of the tuning condenser. To compensate at the minimum capacitance end of the range a bi-metal strip compensator (C116) is used; this is also mounted on the cover of the tuning condenser. A similar compensator (C115) is mounted inside the local oscillator unit C (*para.* 49) to compensate for temperature variation of the capacitances and inductances in this unit. The operation of C115, by a change in temperature, varies the inductance of L30A, which is connected in parallel with the manual SCALE TRIMMER inductance L30.

**64.** Finally, the HT supply to the local oscillator valve V3 is stabilized by the neon voltage regulator V6 (Type CV216), to keep the oscillator free from frequency instability due to voltage variations in the supply.

#### *RANGE switch*

**65.** The range switch operates the scale lighting switch unit S1F, mounted directly upon the chassis, and the switch units S2F, S2R, S3R, S4R, S4F, S5R, S6R, S7F, S7R and S6F (*fig.* 10), which are mounted inside the various plug-in units (*para.* 45). These switch units select the required range in a conventional manner and no difficulty will be experienced in reading the circuit diagram (*fig.* 10) if it is borne in mind that the switch units are shown in position 1 and the angular rotation between each successive switch contact is twenty degrees (approximately).

**66.** Noteworthy points are:—

(1) *Aerial circuit.* The switch unit S2R takes the RF signal input from the coaxial socket SK3, via contacts on the relay RL1, to a low-impedance tapping on the selected primary winding. S2F is associated with the high impedance aerial, not used with the rack assemblies.

(2) *Main channel input circuit.* The switch unit S3R connects the first section (C95) of the tuning condenser, and the grid of V1 (via R6 and C4) to the selected secondary winding of the input circuit. Secondary windings for ranges of lower frequency than the selected range are short-circuited to chassis by S3R.

(3) *RF amplifier band-pass coupling to mixer stage.* A separate band-pass filter is provided for each range. The anode coils of V1 are selected by S4R and the secondary windings of the coupling by S4F, which connects them to the second section (C96) of the tuning condenser and also short-circuits to chassis ranges of lower frequency than that selected. Switch unit S5R similarly selects the inductors and trimmers for the final section of the band-pass coupling and connects the required range to the control grid of the hexode section of the main channel mixer valve V3 and also to the third section (C97) of the tuning condenser.

(4) *Local oscillator switching.* Switch unit S6R selects the V2 anode coil of the Meissner type oscillatory circuit. The HT supply to the common line is broken by the GUARD switch (wafer S15R) in the GUARD ONLY position, but is completed in the NORMAL and GUARD OFF positions. Switch unit S6F selects the required V2 grid coil with its parallel trimmer and also makes the connection to the oscillator section (C98) of the tuning condenser. S7R switches in appropriate padding capacitors while S7F makes connections to manual SCALE TRIMMER inductor L30, with the thermally controlled L30A in parallel.

#### *Main mixer stage*

**67.** The local oscillations generated by V2 are applied to the grid of the triode section of V3, connected internally to the mixer grid of the hexode section. The triode anode of V3 is earthed. The main channel signal from V1, via the band-pass coupling, is applied to the control grid of the V3 hexode section, and the 601·3 kc/s IF output of this section is applied to the first IF band-pass filter. The main channel may be switched off by putting the GUARD switch (wafer S15R) to GUARD ONLY, and thereby interrupting the voltage supply to V3 screening grids.

#### *Guard mixer stage*

**68.** The guard channel input is applied to the control grid of the hexode section of V4, which is biased from the RF AGC line. Additional control is provided by potentiometer R82 (GUARD RF GAIN) which enables the screening grid potential of V4 to be varied. The triode section of V4 is the guard channel crystal-controlled local oscillator. The output from the guard mixer valve is fed into the second tuned circuit of the first IF band-pass filter. The valve is cathode biased to a state of anode current cut-off from potential divider R20—R19:—

(1) When no guard unit is plugged in, due to an open circuit between contacts 4 and 5 on the guard unit housing.

(2) When the GUARD channel is switched OFF by GUARD switch S15R.

(3) When the GUARD channel is switched OFF by the SYSTEM switch (S8F) in the SCALE CHECK position.

*IF amplifier*

**69.** Two stages of IF amplification are provided (V5 and V7) with a total of eight tuned circuits (*fig.* 9). Two degrees of IF selectivity (5 kc/s for R/T, MCW and broad band CW, and 3 kc/s for use with the AF filters) may be obtained by varying the IF band-pass coupling, a function of the SYSTEM switch.

*System switch*

**70.** This consists of switch units S8F, S9F, S9R, S10F, S10R, S11F, S11R, S12F and S12R. It gives three degrees of CW selectivity, wide-band R/T selectivity, and provides the SCALE CHECK facility, the BFO being switched ON for CW and OFF for R/T and S/C. Position 1 is the 300 c/s CW position, 2 the 1·2 kc/s CW position, 3 the 3 kc/s CW position, 4 the S/C position and 5 the R/T position. The angular rotation between switch contacts is approximately 20 deg.

**71.** The IF bandwidth is broadened from 3 to 5 kc/s on positions 3, 4 and 5 by switching additional coupling capacitors into the first, second and third IF band-pass circuits, utilizing contacts on switch units S8F, S9F and S10F respectively.

**72.** The AF selectivity is varied by switch units S12R and S12F, on switch positions 1, 2 and 3, by altering the constants of the AF filter which couples the AF amplifier valve V11 to the output valve V12. In position 1 the inductor L27 and the associated capacitors (*fig.* 9) may be analysed as a $\pi$-section low pass filter (pass band 300 c/s). In position 2, L27 is tapped and the capacitive coupling is altered to give a pass band of 1·2 kc/s. In positions 3 to 5, L27 in the anode circuit of V11, the coupling capacitor C84, and L28 in the grid circuit of V12, may be analysed as a high-pass $\pi$-section filter (pass band 3 kc/s).

**73.** The SCALE CHECK position of the SYSTEM switch (S8F) renders the guard mixer valve inoperative (*para.* 68). The RF amplifying valve V1 is also rendered inoperative because S9R disconnects the screen grid from the +80V line. The attenuator relay RL1 is energized from the HT line via S10R. These operations prevent guard channel oscillator harmonics and RF signals from being confused with the BFO scale-checking harmonics which are injected into the band-pass filter following V1, from L26 in the anode circuit of V9, via S11R. Finally, in the S/C position, the bias applied to the IF valves is reduced by the operation of S9F, which connects the IF AVC line to a point (at the junction of R70 and R72) only slightly negative to earth so that the IF stages operate in their most sensitive condition during scale checking.

*Beat frequency oscillator*

**74.** The BFO valve is the triode section of the double-diode triode V9. The oscillations are crystal controlled but a trimmer capacitor (C55) is provided so that the frequency of oscillation may be adjusted exactly to 600 kc/s, since the accuracy of the scale-checking system depends upon this. The BFO valve is switched off in the R/T position of the SYSTEM switch (S11R), by interrupting the anode HT supply.

*Demodulator*

**75.** One of the diode sections of the valve V9 is used as the signal demodulator. With the BFO switched on, there is sufficient coupling between the BFO and demodulator circuits, in unit J, to produce an AF beat note in the demodulator output. The anode impedance of the diode is matched into the IF tuned circuit L24—C77 by a tapping on L24. The demodulator load consists of R74 and R42 in series, by-passed for IF by C70. When in circuit, the NOISE LIMITER suppresses noise voltages across R74. The AF signal across R42 is applied to the AF amplifier V11 via C68, R43 and the AF GAIN control potentiometer R81, which is by-passed for IF by C69.

*Noise limiter*

**76.** The operation of the NOISE LIMITER diode V10a is determined by the SYSTEM switch (S11F) and the NOISE LIMITER switch S13. In position 1 of S11F and S13 (*fig.* 9 *and* 10) the anode of V10a is connected via R39 to the negative potential end of R74 (this potential being due to rectified signal current), while the cathode of V10a is connected to the junction of R74 and R42, but owing to the time-constant of C67—R39—R40 the charge is unable to follow transient impulses. If such a pulse develops sufficient voltage across R74—R42 to drive the junction of these two resistors negative to the standing charge on C67, the cathode of V10a is driven negative to its anode, so that the diode passes current and suppresses the noise voltage across R74.

**77.** Position 1 of the SYSTEM switch (300 c/s AF bandwidth) gives a greater AF input to V11 than positions 2 to 5, to compensate for the attenuation in the AF filter. On positions 2 to 5, S11F connects R41 (560K) in parallel with R42 (1M) in the demodulator diode load. This reduces the AF input to V11. On position 5, other contacts on S11F open circuit the connection from R40 to chassis. This increases the noise limiter time-constant for the reception of R/T, to avoid clipping high frequency audio signals. Operating the NOISE LIMITER switch S13 to position 2 connects R40 to chassis, regardless of the position of S11F, so that the increased noise reduction facility is available on R/T. In position 3 (OFF) S13 disconnects C67 from earth and the noise limiter becomes non-operative.

*AGC system (fig. 9)*

**78.** To improve the signal-to-noise ratio in the receiver, separate RF and IF AGC circuits are used, so that the AGC voltage applied to the RF stage can be delayed until an appreciable AGC voltage has been applied to the IF stages. A DC amplified system is used and sufficient control is available without controlling the mixer valve. This eliminates frequency variation in the mixer valve and prevents overloading at high input levels.

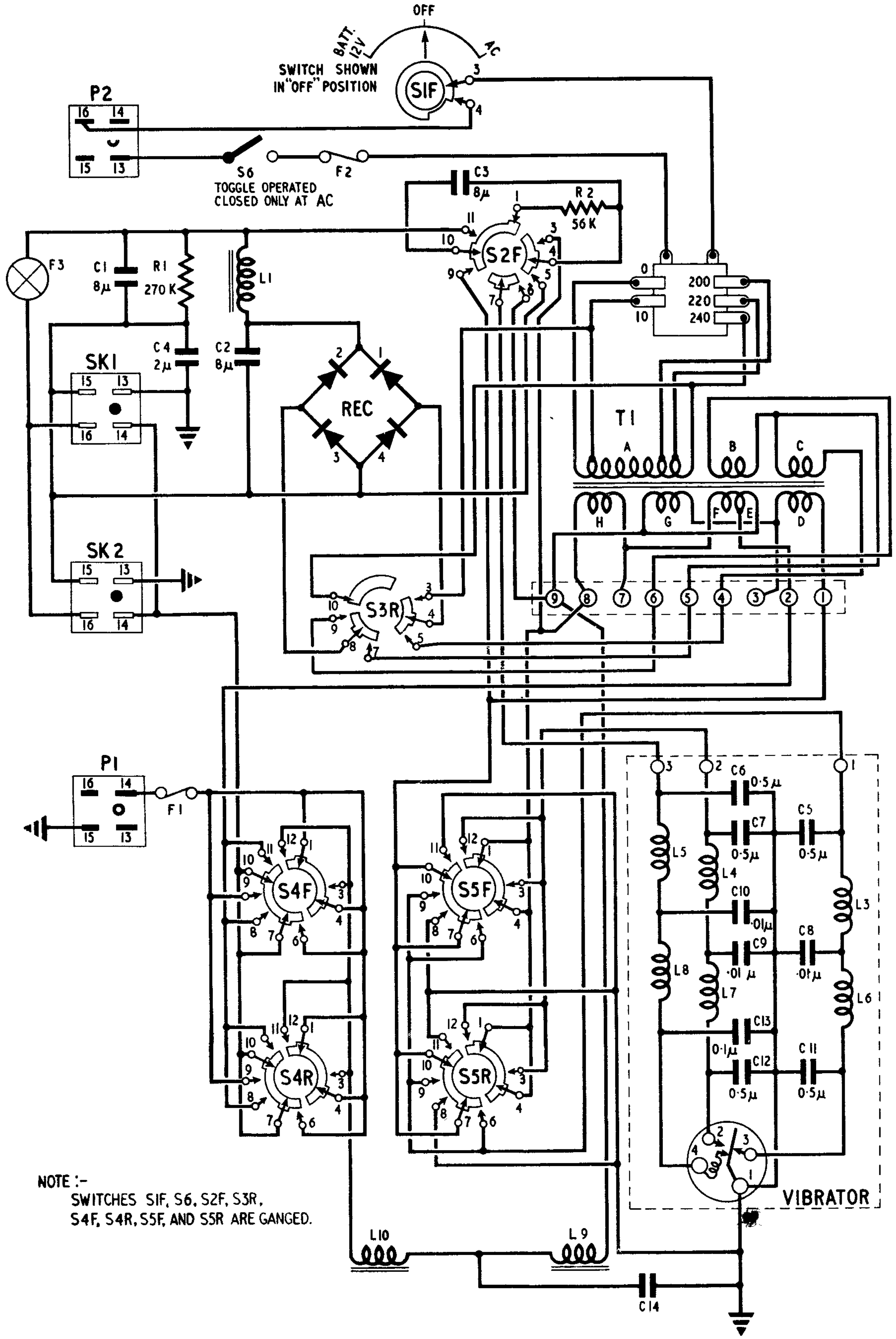



**Fig. 4. Power unit Type 360—circuit**

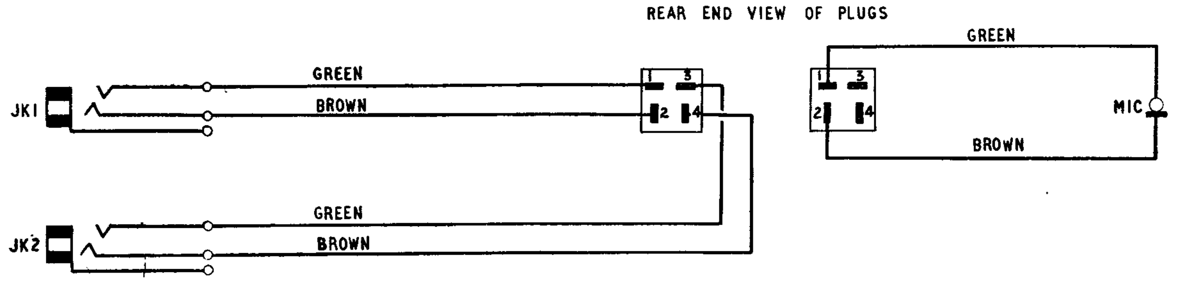



**Fig. 6. Long table—circuit**

connected to the external line (terminals 3 and 4 of PL3) via switch wafers F and E.

(2) RXA

(a) The microphone circuit is broken.

(b) Headset A is connected to receiver A via switch wafers D and C.

(c) Headset B is also connected to receiver A via switch wafers F and E.

(3) RXA & RXB

(a) The microphone circuit is broken.

(b) Headset A is connected to receiver A via switch wafers D and C.

(c) Headset B is connected to receiver B (terminals 1 and 2 of PL2) via switch wafers F and E.

(4) RXB

(a) The microphone circuit is broken.

(b) Headset A is connected to receiver B via wafers D and C.

(c) Headset B is also connected to receiver B via wafers F and E.

(5) RXB & TEL

(a) The microphone circuit is completed by wafers A and B.

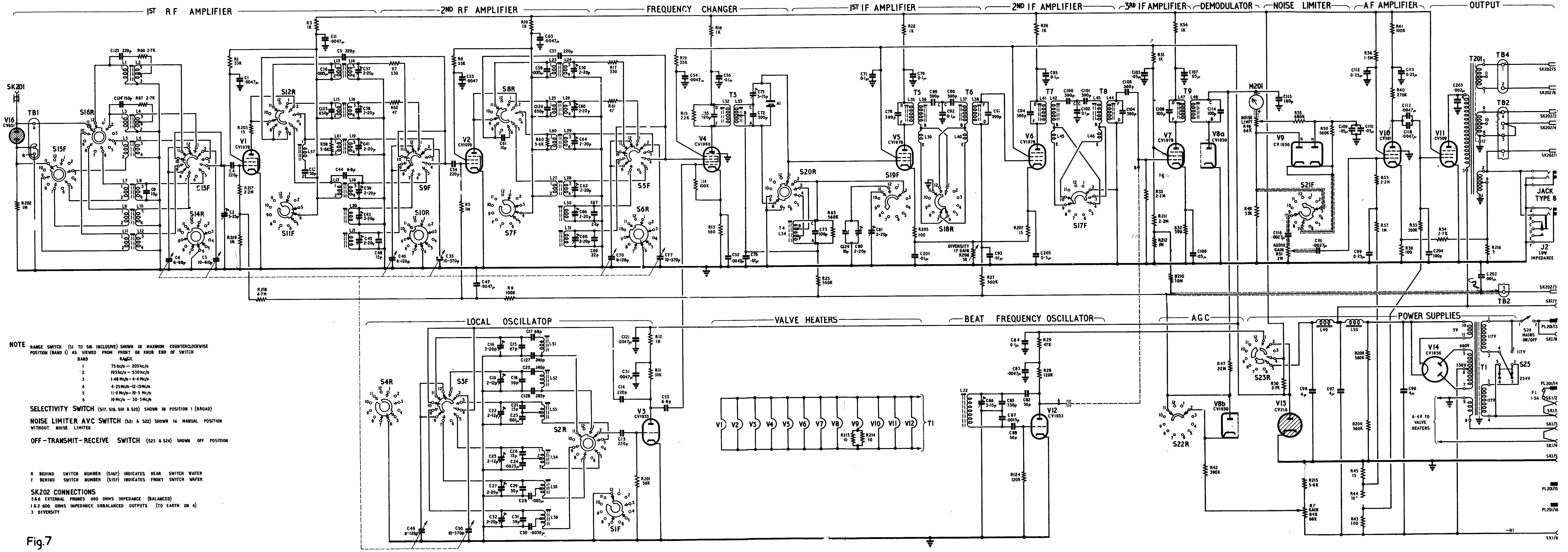
(b) Headset A is connected to the external line by wafers D and C.

(c) Headset B is connected to receiver B by wafers F and E.

**88.** In position (3) of the switch, wafer G joins terminals number 3 of PL1 and PL2(AGC for R.1968 and RF AGC for R.1475) while wafer H joins terminals number 4 of PL1 and PL2 (IF AGC for R.1475). Thus the two receivers in the rack may be connected for diversity reception, if the appropriate connections have been made on rear bracket A (*para.* 85).



F.S./8
Dmd 6350 452890 375 12/54 AB 539/3 8938




NOTE RANGE SWITCH (S1 TO S16 INCLUSIVE) SHOWN IN MAXIMUM COUNTERCLOCKWISE POSITION (BAND 1) AS VIEWED FROM FRONT OR KNOB END OF SWITCH

| BAND | RANGE |
|---|---|
| 1 | 73 kc/s — 205 kc/s |
| 2 | 195 kc/s — 530 kc/s |
| 3 | 1·48 Mc/s — 4·4 Mc/s |
| 4 | 4·25 Mc/s — 12·15 Mc/s |
| 5 | 11·9 Mc/s — 19·5 Mc/s |
| 6 | 19 Mc/s — 30·5 Mc/s |

SELECTIVITY SWITCH (S17, S18, S19 & S20) SHOWN IN POSITION 1 (BROAD)

NOISE LIMITER AVC SWITCH (S21 & S22) SHOWN IN MANUAL POSITION WITHOUT NOISE LIMITER

OFF-TRANSMIT-RECEIVE SWITCH (S23 & S24) SHOWN OFF POSITION

R BEHIND SWITCH NUMBER (S16R) INDICATES REAR SWITCH WAFER
F BEHIND SWITCH NUMBER (S15F) INDICATES FRONT SWITCH WAFER

**SK202 CONNECTIONS**
5 & 6 EXTERNAL PHONES 600 OHMS IMPEDANCE (BALANCED)
1 & 2 600 OHMS IMPEDANCE UNBALANCED OUTPUTS (TO EARTH ON 4)
3 DIVERSITY

Fig. 7

Receiver Type R. 1968 — circuit

Fig. 7

Dmd 6351 452891 375 12/54 AB 979/3 8939

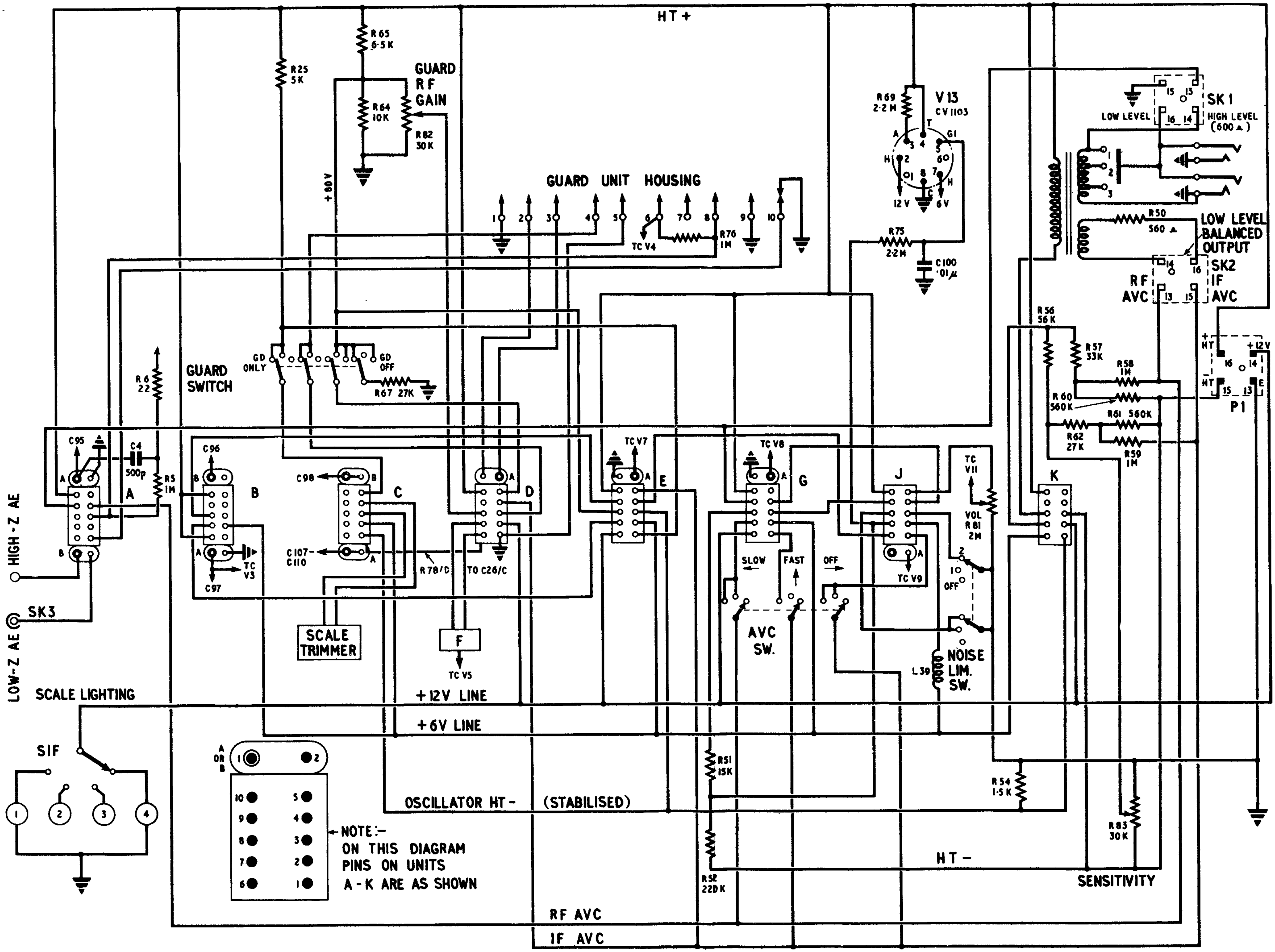
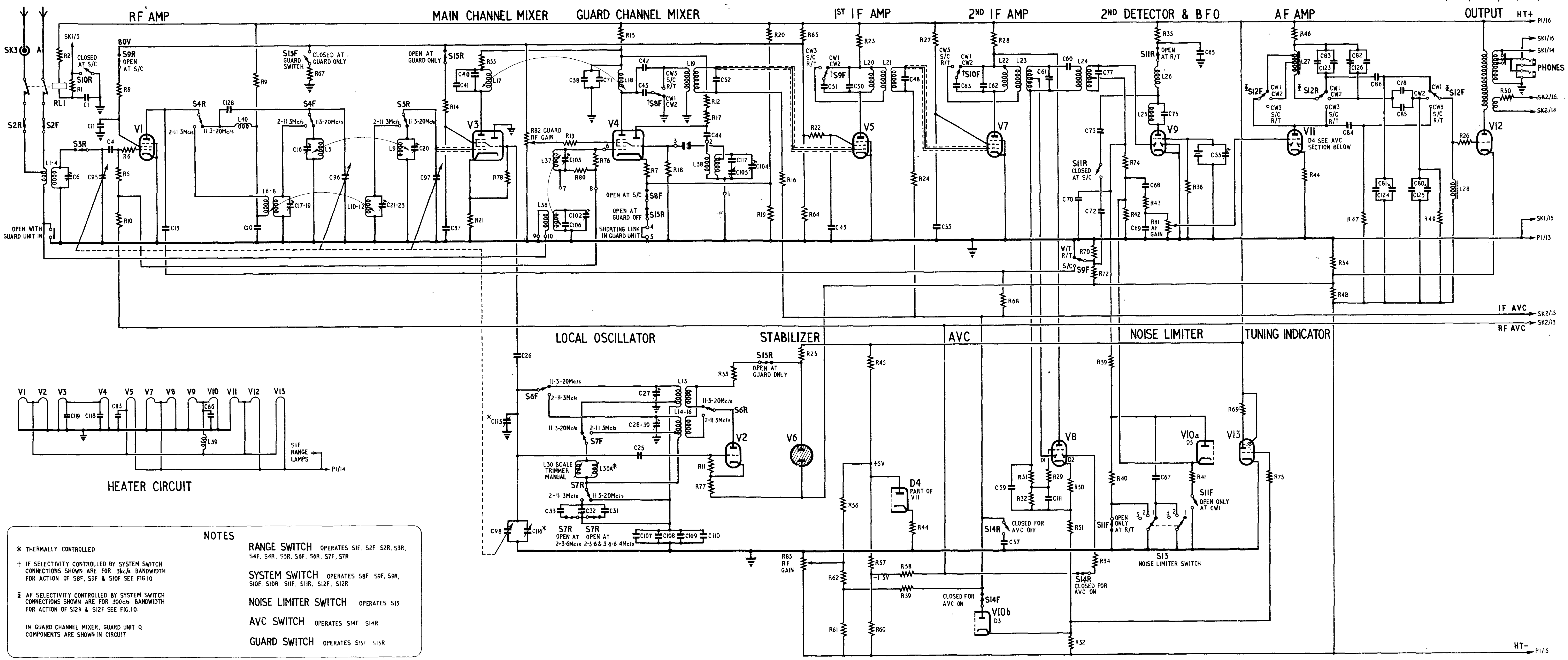



Fig. 8. (A.L. 2, Aug, 54) Fig. 8.

Receiver unit Type 88 - chassis circuits




NOTES

✱ THERMALLY CONTROLLED

† IF SELECTIVITY CONTROLLED BY SYSTEM SWITCH CONNECTIONS SHOWN ARE FOR 3kc/s BANDWIDTH FOR ACTION OF S8F, S9F & S10F SEE FIG 10

‡ AF SELECTIVITY CONTROLLED BY SYSTEM SWITCH CONNECTIONS SHOWN ARE FOR 300c/s BANDWIDTH FOR ACTION OF S12R & S12F SEE FIG. 10.

IN GUARD CHANNEL MIXER, GUARD UNIT Q COMPONENTS ARE SHOWN IN CIRCUIT

RANGE SWITCH OPERATES S1F, S2F S2R, S3R, S4F, S4R, S5R, S6F, S6R, S7F, S7R

SYSTEM SWITCH OPERATES S8F S9F, S9R, S10F, S10R S11F, S11R, S12F, S12R

NOISE LIMITER SWITCH OPERATES S13

AVC SWITCH OPERATES S14F S14R

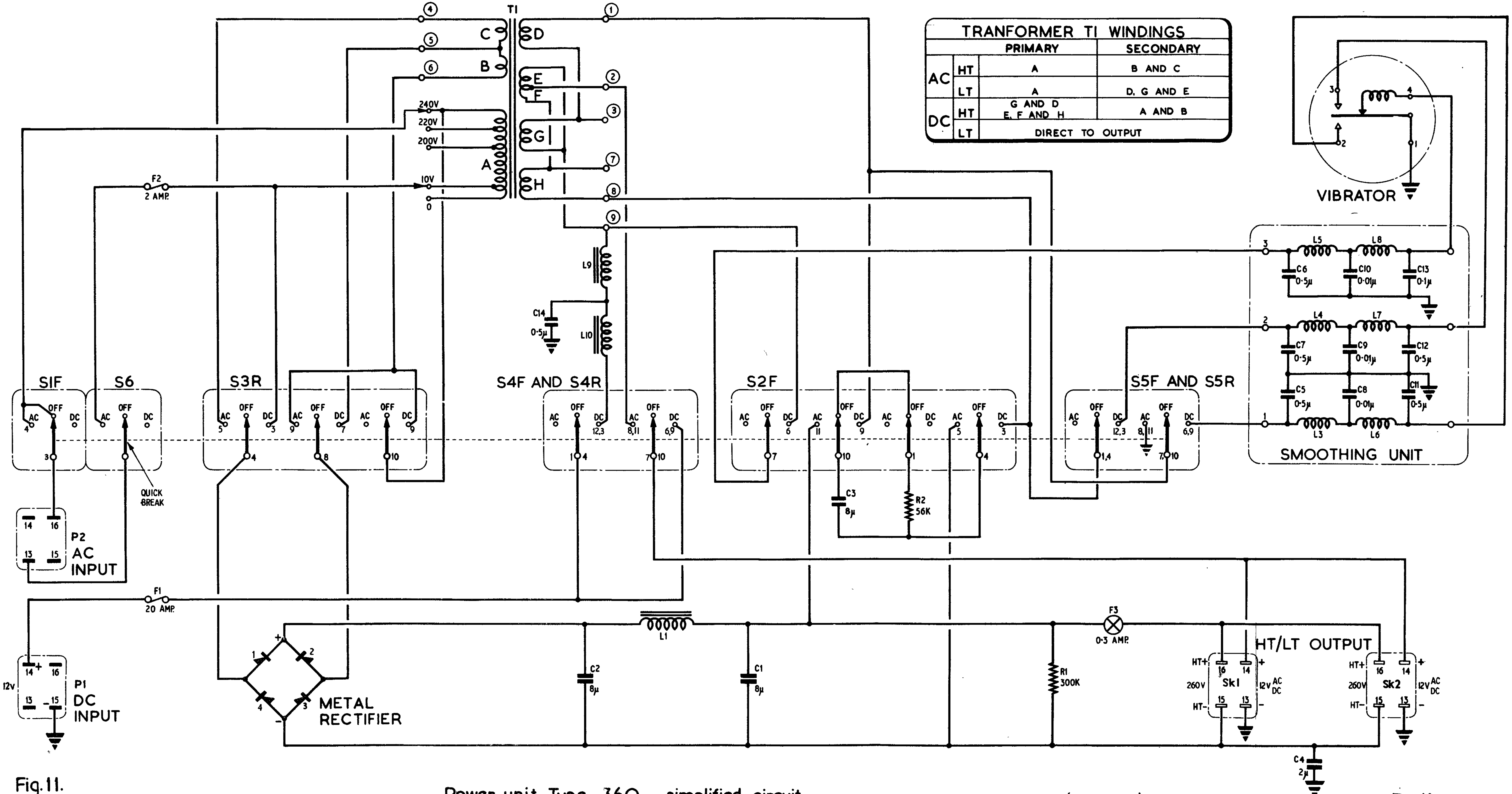
GUARD SWITCH OPERATES S15F S15R

Fig. 9. Receiver unit Type 88 - simplified circuit Fig. 9.

Fig. 10

Receiver unit Type 88 - circuit

Fig. 10.




| TRANFORMER T1 WINDINGS | | PRIMARY | SECONDARY |
|---|---|---|---|
| AC | HT | A | B AND C |
| | LT | A | D, G AND E |
| DC | HT | G AND D E, F AND H | A AND B |
| | LT | DIRECT TO OUTPUT | |

Fig. 11.

Power unit Type 360 – simplified circuit

(A.L.2, Aug. 54)

Fig. 11.

## PART 3

# SERVICING INFORMATION

Dmd 6006 446949 250 1/55 AB539/3 8873

# Chapter I

# SERVICING INFORMATION

## LIST OF CONTENTS



## LIST OF TABLES



## LIST OF ILLUSTRATIONS



**Rack assemblies Type 252 and 253**

**1.** The only servicing required on the basic racks is the standard mechanical and electrical checking procedure. This consists of:—

(1) removing dust,

(2) checking nuts and bolts for tightness and panel fasteners for efficient operation,

(3) visual checking of the state of the insulation on the inter-unit wiring, cleated to the rack frame,

(4) manual checking of the mechanical operation of the AC MAINS switch, on the power control panel,

(5) with the units mounted in the racks, converting them to Type 243 or 246, the rear bracket plugs and sockets should be pushed firmly home.

**Individual units**

**2.** The standard checking procedure—dusting, pushing home plugs and sockets and testing the operation of the controls—may be carried out on the units whilst they are in the racks, when the side and rear panels have been removed. For thorough cleaning and servicing the units may be removed from the racks, after removing the front panel fixing screws and disconnecting the rear plugs and sockets.

**TABLE 1**
**Recommended servicing equipment**

| Stores Ref. | Nomenclature | Purpose |
|---|---|---|
| 10AF/98 | Wattmeters, absorption, Type CT44 | Receiver output test |
| 10L/238 | Attenuator units, Type 26 | Receiver input test |
| 10S/1 | Testmeters, Type F | General testing |
| 10S/647 | Signal generators, Type 56 | Receiver alignment |
| 10S/831 | Oscilloscopes, Type 13A | Receiver alignment |
| 10S/16209 | Output units, signal generator | Receiver alignment |
| 10S/16341 | Impedance bridges, Type 6 | Component tests |
| 10S/16388 | Testers valve, Type CT80 | Valve tests |
| 10V/16083 | Oscillators ganging | IF bandwidth alignment |
| 11OT/16 | Frequency meters, SCR211 | Frequency standard |

**Servicing equipment**

**3.** A list of the recommended servicing equipment for use on the rack assemblies is given in Table 1. The inclusion of the list in this A.P. is for information only and gives no authority for demanding the items. When requisitioning these items, or spares for servicing, reference should be made to Vol. 3 of this A.P. or to A.P.1086.

**4.** In addition, a test bench adaptor is required for testing the receivers, Type R.1968. This adaptor is fitted with connectors to mate with the receiver mains plug PL201 and output socket SK 202, corresponding with the connectors on the rear brackets of the rack assembly. Two line drawings and a circuit diagram of the adaptor unit are given in A.P.2566D, Vol. 1, Part 3, Chap. 2, fig. 1 and 2. The unit provides ON/OFF switching for the AC mains supply to the receiver under test, and has front panel terminals and headphone sockets for the balanced and unbalanced AF outputs from the receiver. In addition, provision is made for varying the AGC time constant of the receiver under test, by progressively switching in capacitors of increasing value.

**Fault finding**

**5.** The fuse panel is the obvious starting place for fault finding, to ensure that the power supply is actually reaching the equipment. The receiver fuses may be checked

(1) at the rear of the receivers Type R.1968,

(2) on the front panels of the power units Type 360 for the receiving units Type R.1475.

**6.** Assuming that the power supplies are present, faulty connections between the units may result in erratic or non-operation of the equipment. The plug and socket connections may be checked manually, and reference may be made to the rack wiring diagrams (*fig.* 1, 2, 5, *and* 6 *of Part* 2, *Chap.* 1) to facilitate point-to-point continuity checks in the rack, the power control panel, the panel (control) Type 788 and the long table. The block diagrams of racks Type 243 and 246 (*fig.* 2 *and* 3 *respectively, of Part* 1, *Chap.* 1) show the basic interconnections of the units in the racks, while full details and circuits of the receivers are given in Part 2. Chap. 1.

**RECEIVER TYPE R.1968**

**7.** The testing and servicing specification for this receiver closely follows that of the R.1967 and other versions of the RCA AR88 series of general purpose communications receivers, given in detail in A.P. 2566D, Vol. 1, Part 3, Chap. 2. Although the R. 1967 and R.1968 appear superficially the same, the major components of the two types are not interchangeable. The main differences are:—

(1) The use in the R.1968 of a mains transformer with a primary winding in two halves, connected, by switch S25, in series for 234V operation and in parallel for 117V operation, as compared with a mains transformer with a tapped primary winding in the R.1967, the tapping being selected, by a different type switch S25, to suit the mains voltage.

(2) The IF of the R.1968 is 735 kc/s, while that of the R.1967 is 455 kc/s. This entails differences in the IF transformers, which have similar circuit reference numbers in the two receivers.

(3) The frequency ranges for the two types are different, so that the RF and oscillator components are not the same in the two receivers.

**8.** The layout diagrams for the R.1968 above and beneath the chassis, are given in fig. 1 and 2. The circuit of the receiver is given in fig. 7 of Part 2,

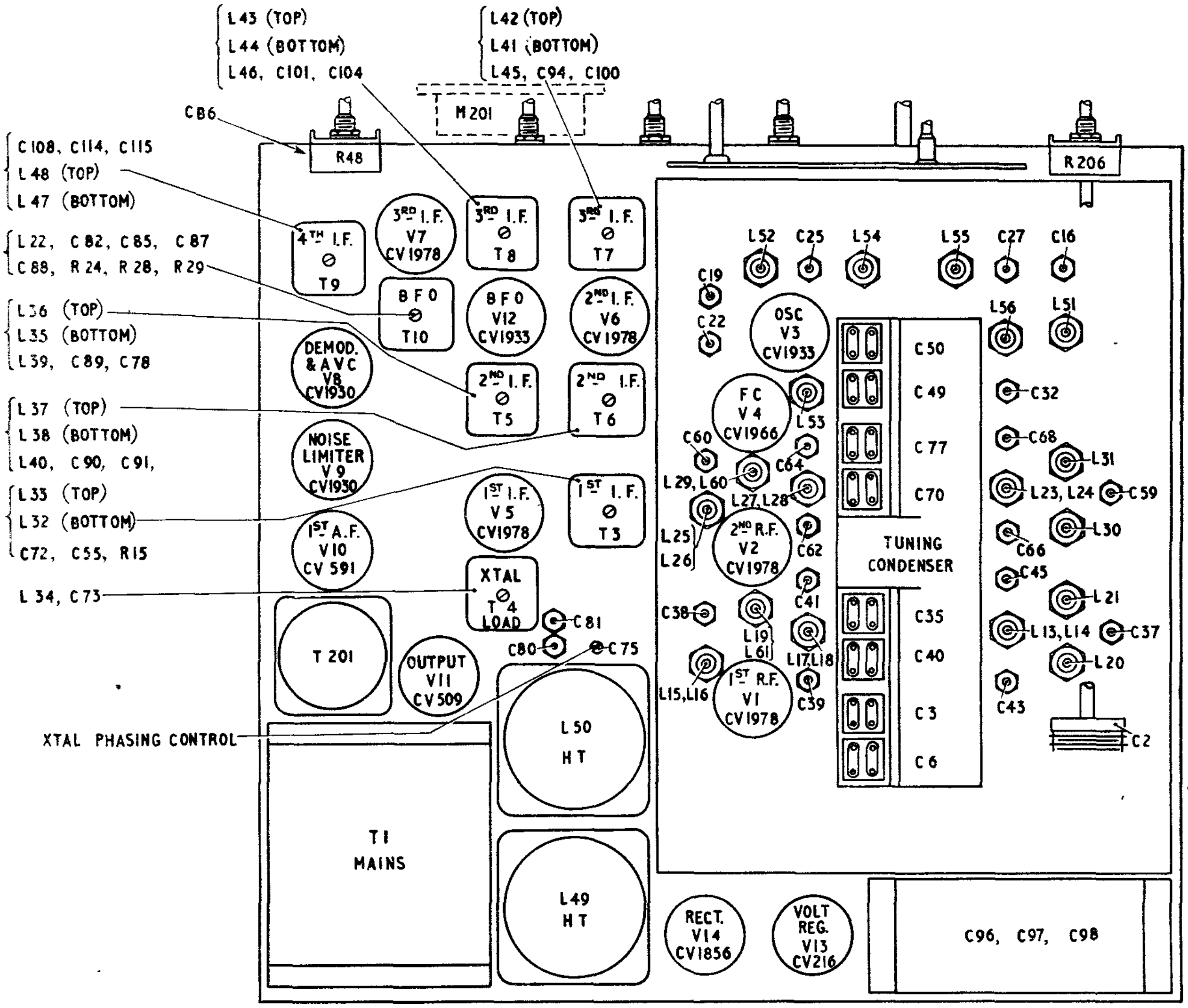



**Fig. 1. R.1968—Top layout of chassis with covers removed**

Chap. 1. With these additions the servicing information given in A.P.2566D, Vol. 1, Part 3, Chap. 2, will be found adequate for the R.1968. An abridged version of this information is given in the following paragraphs to cater for those occasions on which the A.P.2566D is not available.

#### Functional tests

**9.** Connect the test bench adaptor to the mains and plug in the receiver under test. Plug in a pair of headphones and connect an output voltmeter across them on the adaptor terminals.

##### *Input and output tests*

**10.** Check all inlet and outlet points as follows:—

(1) *Mains input*
Check the mains switch (S24), ganged with the functional switch (S23) for efficient operation and positive action. The transformer input switch (S25) should be in the 234V position. The AC power input with the receiver operational should be approximately 100 watts ($\pm$10 per cent).

(2) *Aerial socket and aerial-earth tagboard (TB1)*
Inject a modulated signal at the receiver aerial input socket (SK201) to check that a connection exists. Check the electrical connection of the earth terminal (G) on TB1 to chassis. Check (with an ohm-meter) that the centre terminal of TB1 is connected to the aerial terminal (A) via the aerial coupling coils, but not connected to earth (G) except through the 1M static leak (R202), on all positions of the RANGE switch but 1 and 2. On ranges 1 and 2 there should be continuity from the aerial terminal to earth via aerial coils L1 and L3, respectively. On these ranges the centre terminal of TB1 should show continuity to earth only, through R202.

**Note . . .**
*The external shorting link should be removed*

*for the duration of this test* (*sub-para.* (2)) *and replaced at the completion of the test.*

(3) *AF outputs*
Check for the presence of the unbalanced AF output at the receiver front panel headphone sockets and for balanced and unbalanced AF outputs at the test bench adaptor headphone sockets.

(4) *Diversity terminal*
Apply 40V, negative with respect to chassis, to the AGC LINE EXTERNAL terminal on the test bench adaptor, with the AGC switch in the EXTERNAL position. The receiver should be rendered inoperative.

(5) *External cableform*
If the previous tests have been unsuccessful, check for continuity from the terminals on the receiver rear panel (TB2 and TB4) to the appropriate connections on socket SK202 (*see fig.* 7, *Chap.* 1, *Part* 2), and check for short circuits between the terminals on TB2 and TB4 (*shown on fig.* 11 *of Part* 1, *Chap.* 1).

*Controls*

**11.** Check all controls for correct operation. The TUNING control should move freely, with a fly-wheel action and with immediate clutch action on the tuning condenser drive in both directions. Adjust the dials and cursors for accurate alignment if necessary, at the LF end of the tuning range (maximum capacitance).

**12.** All switches should be tested for freedom from noise in operation, and, in the case of multi-position switches, for correct mating in either direction. It is important to check for a good earth connection on the range switch spindle. If the insertion of the blade of a screwdriver between the chassis and the earthing spring, whilst listening to a signal, causes no change in note, a good earth connection obviously exists. Also clean the front spindle bush.

**13.** All potentiometers should be tested for correct functioning and freedom from scratchiness in operation.

**Component tests**

*Valves*

**14.** A noticeable decrease in the sensitivity of the receiver usually indicates reduced emission in the valves. The valves may be removed and tested in a valve tester or new valves may be substituted one at a time for comparison purposes, after ensuring that there are no faulty components in the associated circuits which could cause damage to the new valves. The voltages at the individual valve pins provide a reliable guide for fault diagnosis. These voltages vary considerably with the control settings, so it is advisable to take a specimen set of readings with the receiver working normally and the controls at fixed settings. These settings may then be repeated when taking test readings for comparison with the specimen set. Table 2 gives a specimen set of readings. The positions of the valve bases, with the chassis inverted, are given in fig. 2, and table 4 of Chap. 1, Part 1 gives the valve base connections.

**TABLE 2**
**Valve electrode voltages—R.1968**

| Valve | Stage | Type | Anode Pin | Anode Volts | Screen Pin | Screen Volts | Cathode Pin | Cathode Volts |
|---|---|---|---|---|---|---|---|---|
| V1 | 1st RF amplifier | CV1978 | 8 | 235 | 6 | 150 | 3 or 5 | 0 |
| V2 | 2nd RF amplifier | CV1978 | 8 | 235 | 6 | 150 | 3 or 5 | 0 |
| V3 | Oscillator | CV1933 | 3 | 110 | — | — | 8 | 0 |
| V4 | Frequency changer | CV1966 | 3 | 235 | 4 | 50 | 6 | 2 |
| V5 | 1st IF amplifier | CV1978 | 8 | 235 | 6 | 150 | 3 or 5 | 0·7 |
| V6 | 2nd IF amplifier | CV1978 | 8 | 235 | 6 | 150 | 3 or 5 | 1·3 |
| V7 | 3rd IF amplifier | CV1978 | 8 | 235 | 6 | 150 | 3 or 5 | 3·1 |
| V8 | Demodulator | CV1930 | 3 and 5 | — | — | — | 4 and 8 | — |
| V9 | Noise limiter | CV1930 | 3 and 5 | — | — | — | 4 and 8 | — |
| V10 | 1st AF amplifier | CV591 | 8 | 83 | 6 | 34 | 5 | 0 |
| V11 | AF output | CV509 | 3 | 256 | 4 | 240 | 8 | 0 |
| V12 | BFO | CV1933 | 3 | 40 | — | — | 8 | 0 |
| V13 | Neon stabilizer | CV216 | 5 | 150 | — | — | 2 | 0 |
| V14 | Rectifier | CV1856 | 4 and 6 | AC | — | — | 2 and 8 | 300 |
| | Heater line | | 6·3V | AC | | | | |
| V16 | Static discharge neon | CV651 | This neon should glow upon application of 60V RMS. Faulty neons should be discarded and reliance for static discharge placed on R202, since no neon replacements are available. | | | | | |

**Note . . .**
*General tolerance on all voltages is* ± 20 *per cent except for heaters where it is* ± 0.3V.

**15.** Reduced emission from the rectifier valve V14 will give low readings. Faulty components will also affect the readings, thus enabling a diagnosis of the fault to be made. Suspected components may be tested in accordance with standard practice, using the test gear listed in Table 1. All resistors should show test values in accordance with their original tolerances, when measured with an ohm-meter or impedance bridge. All capacitors should show an insulation resistance of 40M at 500V, and a capacity bridge test should show capacitances to the original tolerances. The smoothing chokes L49 and L50 should have an insulation resistance (winding to case) of 40M at 500V. A common fault in these chokes is a short circuit between turns. This may be indicated by a continuity test. The normal resistance is 400 ohms (approx.).

**RF unit**

**16.** The RF unit, consisting of the tuning condenser, tuning unit, range switch and all the RF and oscillator coils and trimmers, is mounted on a separate base which bolts to the main base. The various coils and trimmers on this base may be removed by unscrewing the single nut which screws on to the individual mounting bushings. These nuts are accessible, for most of the components, from the top of the chassis when the RF section screening cover has been removed. If, however, a major repair is to be carried out, as, for example, replacing the range switch, it is necessary first to remove the complete RF unit from the receiver. Since this is likely to be an infrequent occurrence the procedure is omitted from this A.P. but is included in A.P.2566D, Vol. 1, Part 3, Chap. 2, para. 12.

**Alignment of tuned circuits**

**17.** Alignment of the tuned circuits will be necessary if repairs have been made to them, or if associated components have been replaced, although the replacement of single valves does not necessitate re-alignment. In addition periodic re-alignment is necessary because the Q of dust-cored inductances decreases with the passage of time, causing a deterioration in the performance of the receiver.

**18.** Special tools are provided with each receiver. A small wrench is held in a spring clip on the right-hand side of the main chassis. This wrench fits the set screws in all knobs except the main tuning knob, for which a small screwdriver is required. Tools for the alignment of the RF and IF tuned circuits are mounted in fuse clips on either side of the gang condenser cover, and are accessible after removing the large RF unit cover. The shorter of the two tools is for the adjustment of all the RF and IF inductors, while the longer one is for the adjustment of the plunger type trimmer capacitors. One end of the longer tool is for turning the lock-nut on the trimmer and the other end has a hook for engaging in the hole in the end of the plunger. After adjustment, the lock-nut should be securely tightened.

**IF alignment**

**19.** The IF transformers are aligned, in the order 4th, 3rd, 2nd and 1st, for a symmetrical response, as displayed on the CRO Type 13A, to a frequency sweep signal from the ganging oscillator (10V/16083). The sweep voltage for the oscillator is derived from the CRO (described in A.P.2879AF).

*Receiver controls*

**20.** The initial settings are as follows:—

(1) function switch to REC. MOD.,

(2) RANGE switch to position 2,

(3) TUNING to HF end of range,

(4) RF GAIN to maximum, IF GAIN $\frac{1}{3}$ to $\frac{1}{4}$ back from maximum and AUDIO GAIN to a convenient level,

(5) SELECTIVITY switch to position 3 and NOISE LIMITER control fully clockwise,

(6) AVC - NL switch to AVC,

(7) connect the output meter and headphones to the receiver via the test bench adaptor.

*Alignment procedure*

**Note . . .**
*Discussions are in progress with a view to improving this procedure and it is anticipated that this section of the A.P. will be amended later.*

**21.** (1) Connect the modulated 735 kc/s output from the SCR211 frequency meter to pin 4 of V7 (control grid of 3rd IF amplifier) and tune L47-L48 (*T9 in fig.* 1) for a maximum reading on the tuning meter M201 (an input of 40-50 millivolts is required for a 50 micro-amp. reading). This gives an accurate reference point for the succeeding alignment steps.

(2) Disconnect the frequency meter. Remove the frequency changer (V4) and insert the wire end of a 0·1μF tubular capacitor in socket 8 (control grid) of V4 valveholder, then re-insert the valve. Connect the output of the sweep oscillator to the free end of the capacitor.

(3) Connect the terminal (A1) for the upper deflector plate of the CRO to tag C on the underside of T9. The lower deflector plate is connected to earth.

(4) Observe the CRO trace. Since the accuracy of the oscillator is not outstanding, and since the IF crystal frequency varies in different receivers the most satisfactory method of obtaining the correct centre frequency for the sweep oscillator is to adjust the crystal loading and phasing slightly to get true crystal action, and then to rock the oscillator tuning control about the IF of 735 kc/s, to position the CRO display in the centre of the graticule.

**Note . . .**
*The sweep oscillator should be set to run as*

*slowly as possible, because at sweep frequencies above 20 c/s the crystal "ring" is very pronounced.*

**22.** Assuming that the output from T9 is satisfactory remove the 0·1μF capacitor from V4 valveholder and connect the sweep oscillator to pin 4 of V6 (2nd IF amplifier). With the SELECTIVITY switch in position 2 (checking frequently in position 1 for symmetrical expansion of the waveform), adjust L41, L42, L43 and L44 (T7 and T8) for the best response on the CRO, adjusting the GAIN control on the CRO to avoid overloading and distortion in the amplifiers, otherwise misleading traces will occur.

**23.** Inject the sweep oscillator output to pin 4 of V5 (1st IF amplifier) and adjust L35, L36, L37 and L38 (T5 and T6). Switch to SELECTIVITY switch position 1 to check the response. If distortion is present a slight compromise in the adjustment of the transformers may be required.

*Crystal phasing control*

**24.** Before tuning the first IF transformer the crystal phasing control C75 must be set to approximately one half of its maximum capacitance (approximately its final setting) so as to avoid having to change it appreciably later, since this would detune the first IF transformer slightly.

**25.** To align the 1st IF transformer (T3), remove the frequency changer (V4). insert the wire end of the 0·1μF tubular capacitor in socket 8 (control grid) of V4 valve holder, then reinsert the valve. Connect the output of the sweep oscillator to the free end of the capacitor and tune L32 and L33.

**26.** At this stage it is advisable to check on SELECTIVITY switch positions 1, 2 and 3. The IF bandwidths should be 16kc/s, 8kc/s and 4 kc/s, on positions 1 to 3 respectively. Fig. 9 of Chap. 1, Part 1 gives the selectivity curves. The responses should be equally disposed about the centre frequency on the CRO display in a similar manner to these curves on fig. 9. The general tolerance on bandwidths is ±20 per cent. Since switching in the crystal on positions 3 to 5 introduces a slight loading on the tuned circuits some compromise tuning adjustments may be necessary on positions 1, 2 and 3.

**Adjustment of crystal loading and phasing circuit**

**27.** (1) With the SELECTIVITY switch in position 3 inject into V4, from the frequency meter, a signal 7 kc/s away from the IF, i.e., 742 kc/s, and adjust C75 (*fig.* 1) for a minimum reading on the tuning meter.

(2) Disconnect the frequency meter and inject a signal at the 735 kc/s IF from the sweep oscillator into V4 via the 0·1μF capacitor.

(3) Adjust the "crystal load" L34 (T4) for a symmetrical response on the CRO. This adjustment is very critical and it is advisable slightly to re-adjust C75 and L34 alternately for a satisfactory response.

(4) If unsuccessful, try adjusting L32-L33 (T3) in conjunction with C75 and L34, referring frequently to positions 1 and 2 on the SELECTIVITY switch, as any adjustments to L32-L33 will affect the response in those positions.

(5) Continue these adjustments, "playing off" one adjustment against another until a compromise between all three positions is obtained. The response in position 3 should be slightly double-humped.

**28.** Turn the SELECTIVITY switch to position 4 and the function switch to REC. MOD. Inject the sweep oscillator output into V4 and adjust C81 for optimum response (i.e., a symmetrical round-topped curve on the CRO). Turn the SELECTIVITY switch to position 5 and similarly adjust trimmer C80. The bandwidths for switch positions 4 and 5 should be 2 kc/s and 550 c/s respectively.

**BFO adjustment**

**29.** The BFO adjustment for zero beat may be carried out conveniently at this point as follows:—

(1) Turn the receiver function switch to REC. MOD.

(2) Inject a 735 kc/s signal from the signal generator Type 56 at the control grid of V4 and rock the signal generator tuning for maximum deflection of the receiver tuning meter, with the SELECTIVITY switch in position 5.

(3) Set the front panel trimmer C86, labelled B.F.O., to half capacity and check that the pointer of the knob is vertical. Switch the receiver to REC. CW.

(4) Adjust L22 (on top of the BFO transformer T10) for zero beat (the receiver tuning meter gives an accurate indication of this). Switch to REC. MOD.

(5) Recheck the bandwidths on completion.

**30.** The IF sensitivity may be checked, at the beginning and completion of the alignment procedure by finding the strength of signal required at the control grid of V4 to produce a reading of 50 microamps. on the tuning meter, with the SELECTIVITY switch in position 2, and AVC switch to MANUAL.

**Oscillator alignment**

**31.** Any alteration of the IF tuning will make it necessary to check the oscillator tuning.

(1) Line up the condenser gang mechanically as follows:—

(a) Loosen the flexible coupling between the dial drive and the main gang.

(b) Set the gang to the fully meshed position and the main dial to zero (LF end).

(c) Retighten the flexible coupling.

(2) Check that a 100 degree movement on the vernier scale moves the drive exactly one division on the main dial. Wear on the driving gears will result in this balance "running out" over the complete range with consequent

inability to track correctly.

(3) Drop a short insulated wire connected to the output from the SCR211 frequency meter into the receiver. This gives sufficient input for accurate settings and does not necessitate removal of the main gang cover.

(4) Connect the headphones and output meter to the test bench adaptor.

(5) Line up the oscillator on all bands by injecting the frequencies detailed in Table 3 and adjusting the trimmers given in the table, to produce a maximum output with the RF GAIN control at minimum, IF GAIN at $\frac{1}{3}$ to $\frac{1}{4}$ back from maximum and AUDIO GAIN at a suitable level.

(6) Repeat on each range until the oscillator is correctly adjusted at both ends of the scale, so that the dial readings correspond with the generator frequencies.

**TABLE 3**
**Oscillator alignment—R.1968**

| Range | Position of dial (kc/s) | Generator frequency (kc/s) | Adjustment trimmer |
|---|---|---|---|
| 1 | 74 | 74 | L51 (black) |
| 1 | 200 | 200 | C16 (black) |
| 2 | 200 | 200 | L52 (red) |
| 2 | 545 | 545 | C19 (red) |
| 3 | 1,500 | 1,500 | L53 (white) |
| 3 | 4,350 | 4,350 | C22 (white) |
| 4 | 4,300 | 4,300 | L54 (yellow) |
| 4 | 12,100 | 12,100 | C25 (yellow) |
| 5 | 12,000 | 12,000 | L55 (green) |
| 5 | 19,400 | 19,400 | C27 (green) |
| 6 | 19,100 | 19,100 | L56 (blue) |
| 6 | 30,400 | 30,400 | C32 (blue) |

**Note . . .**
*If more than one signal is obtainable, on ranges 1, 2 and 3 take the most counter-clockwise on the trimmer; on ranges 4, 5 and 6 take the most clockwise. This is necessary because the oscillator tracks above the signal frequency on all bands, and on all coils, except 4, 5 and 6 bands (L54, L55 and L56) turning the core clockwise increases the inductance. On the three coils mentioned above, turning the core clockwise decreases the inductance.*

**RF alignment**

**32.** When the IF and oscillator stages are in alignment the RF stages may be tuned for maximum output, with the RF GAIN control at maximum the AUDIO GAIN at a suitable level and backing off the IF GAIN as the output is increased, to prevent overloading. The signal is injected at the aerial socket SK201 and the trimmers are adjusted in accordance with Table 4.

**TABLE 4**
**RF alignment—R.1968**

| Range | Generator frequency and dial reading (kc/s) | Adjust trimmer | Trimmer colour |
|---|---|---|---|
| 1 | 195 | C37, C59, aerial trimmer | Black |
| 1 | 80 | L2, L14, L24 | Black |
| 2 | 500 | C38, C60, aerial trimmer | Red |
| 2 | 205 | L4, L16, L26 | Red |
| 3 | 4,250 | C41, C64, aerial trimmer | White |
| 3 | 1,600 | L6, L19, L29 | White |
| 4 | 11,900 | C39, C62, aerial trimmer | Yellow |
| 4 | 4,400 | L8, L18, L28 | Yellow |
| 5 | 19,000 | C43, C66, aerial trimmer | Green |
| 5 | 12,150 | L10,L20, L30 | Green |
| 6 | 30,000 | C45, C68, aerial trimmer | Blue |
| 6 | 19,500 | L12, L21, L31 | Blue |

**RECEIVING EQUIPMENT TYPE R.1475**

**33.** For testing this equipment on the bench, the dust covers must be removed from the receiving unit Type 88 and its associated power unit Type 360 which may then be linked by connectors made up from the components supplied in the transit case Type 77 (*see A.P.*2883G, *Vol.* 1 (2*nd Edition*), *Part* 1, *Chap.* 2). The outputs from the power unit Type 360 may be checked on either of the output sockets. There should be 260V HT (approx.) between connectors 16 (HT+) and 15 (HT—) and 12V AC between 14 (live) and 13 (earth). Connector 15 must not be earthed since it supplies the 55V negative bias line in the receiving unit.

**Functional tests**

**34.** With the receiving unit connected to the power unit and a pair of 600-ohm headphones plugged into one of the front panel sockets the equipment may be tested as follows:—

(1) Connect the power unit to the mains and check the operation of the switch between the OFF and AC positions.

(2) Inject a modulated signal from the signal generator and check the operation of all controls. The production of noise when operating switches and potentiometers usually indicates wear, or the need for cleaning.

(3) If the receiver has shown a marked decrease in sensitivity the valves may be removed for testing, or they may be replaced one by one, observing the usual precautions against damage to a new valve by inserting it in a faulty circuit.

(4) The diversity connection may be tested by applying 40V negative to chassis, to SK2/15 (IF AGC) and then to SK2/13 (RF AGC). In each case the receiver should be rendered inoperative.

(5) The balanced output connection may be tested by connecting a pair of 600-ohm headphones between SK2/16 and SK2/14.

**Fault finding**

**35.** To assist in fault finding, reference may be made to the block layout and circuits of the receiving unit (*fig.* 3, 8, 9 *and* 10 *of Part* 2, *Chap.* 1). The valve base connections are given in Table 5 of Part 1, Chap. 1. It is recommended that specimen sets of voltage readings should be taken at the valve pins when the receivers are working efficiently, for comparison with readings when the receivers are faulty. Since the valve bases are not readily accessible beneath the chassis, a thin wire probe, with the insulation stripped off at the end, may be inserted in the pin sockets after removing a valve, after which the valve may be replaced for taking the reading. In the case of a "dead" receiver the faulty stage may be diagnosed by injecting a signal at the top caps of successive valves until the faulty stage is eliminated.

**Removal of plug-in units**

**36.** If the diagnosis indicates a fault in one of the plug-in units it will have to be removed. Before removing any of the units A, B or C it is necessary to withdraw the RANGE switch bar, and before removing unit D, E, G, J or K to withdraw the SYSTEM switch bar, otherwise the switch bars may be bent and the switch wafers in the units damaged. The full procedure is as follows:—

(1) Remove the small fixing screw with its spring washer, and withdraw the bar with a pair of pliers. Replace the securing screw and washer to prevent loss.

(2) For removing unit C or D unsolder the connecting lead.

(3) Remove the valves, or, on unit A, the relay unit.

(4) Remove plug-in leads from the top of the unit.

(5) Slacken off, from the rear, the two captive screws at the top of the unit.

(6) With the receiver inverted slacken off, from the front, the two captive screws at the base of the unit.

(7) Withdraw the unit.

**Re-alignment of receiver**

**37.** Periodic checks should be made on the sensitivity of the receiver, by ascertaining the input signal from a generator, required to produce a standard output. Inefficient valves may be eliminated by substitution, but deterioration of the tuned circuits with the passage of time will make re-alignment necessary. Major repairs and replacements will also necessitate retuning. Scale trimming is a day-to-day operation already described in Part 1, Chap. 1, para. 44, 45 and 53.

**IF alignment**

**38.** There are two methods of IF alignment:—

(1) using a crystal-controlled frequency meter on 601·3 kc/s.

(2) using a signal generator adjusted to give maximum output on the higher side-band of the crystal-controlled BFO heterodyne note, with the 300 c/s filter in use.

**39.** To ensure a symmetrical response the alignment must be performed with the IF circuits switched to narrow band selectivity, but to prevent cut-off of the AF modulation of the signal generator the output and heterodyne wafer switches (units J and K) must be in the 5 kc/s R/T position. To provide this combination of IF and AF selectivity the normal SYSTEM switch bar must be removed and replaced by a special short bar (*supplied only to servicing Units*) operating only in units J and K.

***Method 1—crystal-controlled input***

**40.** (1) Connect the 601·3kc/s output from the frequency meter to the control grid of V3.

(2) Set the controls as follows:—

| | | |
|---|---|---|
| (a) | RANGE switch | 2·0—3·6 Mc/s |
| (b) | RF GAIN control | Maximum |
| (c) | GUARD switch | OFF |
| (d) | NOISE LIMITER switch | OFF |
| (e) | AVC switch | OFF |
| (f) | AF GAIN control | To a convenient level (e.g., 10mW) |

(3) Set SYSTEM switch to 300 c/s position, then remove switch bar and insert special short bar.

(4) Return SYSTEM switch to R/T position.

(5) Tune IF circuits for maximum output using a modulated input. Commence at L24 and work back to the frequency changer (L17). Adjust the input as necessary to prevent overloading.

(6) Return the SYSTEM switch to the 300 c/s position, remove the special switch bar and replace the normal bar.

*Method 2—higher side-band input*

**41.** (1) Connect the signal generator to the control grid of V3.

(2) Set the controls as in para. 40 (2).

(3) Set the SYSTEM switch to the cw 300 c/s filter position.

(4) Inject a CW signal of about 595 kc/s and tune the signal generator slowly towards the higher frequency end of the scale. As the signal generator approaches that of the BFO a beat note will be heard which will rise to a maximum at 598·7 kc/s, fall to zero at 600 kc/s and rise to a second maximum at 601·3 kc/s. This second maximum is the correct alignment frequency.

(5) Remove SYSTEM switch bar and replace by the special short one.

(6) Repeat steps outlined in para. 40 (5) and (6).

**Adjustment of BFO**

**42.** (1) Inject a 600 kc/s crystal-controlled signal into the control grid of V3, with the SYSTEM switch at 5 kc/s CW, and the GUARD, NOISE LIMITER and AVC switches at OFF.

(2) Adjust the RF and AF GAIN controls until a low beat note is heard.

(3) Adjust the voltage at the control grid of V9 to a peak amplitude of about 8 volts by varying the screw core in L25.

(4) Adjust the trimmer capacitor C55 to give zero beat at 600 kc/s. The range of adjustment is about 50 c/s. The tuning indicator will show the null point.

(5) Re-check the output voltage at the control grid of V9 and if necessary repeat the adjustments to L25 and C55, always finishing with the frequency adjustment.

**Calibration**

*Approximate alignment of LO*

**43.** To prevent confusion with image signals the local oscillator is aligned approximately, at two points on each range. For this purpose a straight line is drawn across the middle of the escutcheon window from the outside, using removable ink which must be erased after the actual calibration has been performed. The control settings are as follows:—

| | | |
|---|---|---|
| (1) | RF GAIN control | Maximum |
| (2) | GUARD switch | OFF |
| (3) | NOISE LIMITER switch | OFF |
| (4) | AVC switch | FAST |
| (5) | SYSTEM switch | CW 5 kc/s |
| (6) | AF GAIN control | To a convenient level. |
| (7) | *Scale trimmer* | Zero |

**44.** The procedure is explained with reference to the 11·3 to 20 Mc/s range. A similar procedure is adopted for the other ranges, the appropriate frequencies and trimming adjusters being given in Table 5.

(1) Turn the receiver scale until 11·73 Mc/s appears at the centre line on the escutcheon window.

(2) Inject a signal of 11·73 Mc/s from the signal generator to the control grid of V3.

(3) Adjust the core of L13 until a beat note is heard.

(4) Ensure that this is not the image frequency by tuning the signal generator to 12·93 Mc/s. A beat note will be heard if the oscillator is correctly adjusted to 12·33 Mc/s.

(5) Assuming this is so, turn the receiver scale until 19·1 Mc/s appears at the centre line of the escutcheon window. Adjust trimmer capacitor C27 until a beat note is heard. Ensure that this is not an image frequency by tuning the signal generator to 20·3 Mc/s where a signal should be heard. If this is correct retune the scale to 11·73 Mc/s and repeat the process.

**TABLE 5**
**Approximate alignment of LO—R.1475**

| Range in Mc/s | Frequency in Mc/s | Trimmer | Image check |
|---|---|---|---|
| 11·3—20 | 11·73 | L13 | 12·93 |
| | 19·1 | C27 | 20·3 |
| 6·4—11·3 | 6·65 | L14 | 7·85 |
| | 10·8 | C28 | 12·0 |
| 3·6—6·4 | 3·74 | L15 | 4·94 |
| | 6·12 | C29 | 7·32 |
| 2 —3·6 | 2·08 | L16 | 3·28 |
| | 3·47 | C30 | 4·67 |

*Final alignment of LO*

**45.** The actual calibration requires the use of a frequency meter. The control settings are as given in para. 43 and the input signal is applied to the control grid of V3. Again the procedure is explained with reference to the 11·3 to 20 Mc/s range, while Table 6 gives the frequencies and trimmers for the other ranges.

(1) Switch the frequency meter to 0·5 Mc/s harmonic sequence.

(2) Set the receiver to 11·5 Mc/s (using the temporary straight line (*para.* 43)).

(3) Adjust L13 until a low beat note is heard. Only a small adjustment should be necessary as the circuit has already been aligned to signal generator accuracy.

(4) Set the receiver to 19·5 Mc/s and adjust C27 until the beat note is heard.

(5) Repeat these adjustments, then tune the receiver to zero beat at 20 Mc/s and mark the window opposite the 20 Mc/s calibration on the scale.

(6) Having located this point, turn the scale towards the low frequency end and mark the window at 0·5 Mc/s intervals each time a zero beat is tuned in.

**TABLE 6**
**Final alignment of LO—R.1475**

| Range in Mc/s | Frequency in Mc/s | Trimmer | Calibration interval |
|---|---|---|---|
| 11·3—20 | 11·5<br>19·5 | L13<br>C27 | 0·5 Mc/s |
| 6·4—11·3 | 6·5<br>11·0 | L14<br>C28 | 0·5 Mc/s |
| 3·6—6·4 | 4·0<br>6·0 | L15<br>C29 | 200 kc/s |
| 2 —3·6 | 2·0<br>3·5 | L16<br>C30 | 100 kc/s |

**46.** The window is then removed and the existing cursor line removed from the inside, after which a smooth curve is drawn on the inside, linking the calibration points marked on the outside. Care must be taken to avoid parallax errors due to the thickness of the window. Finally the temporary straight line on the outside of the window is erased and the window refitted to the receiver.

*Alignment of RF circuits*

**47.** With the output modulated to a depth of 30 per cent, the signal generator is matched into the 45 ohms impedance at the receiver aerial socket The control settings are as follows:—

| | | |
|---|---|---|
| (1) | RF GAIN | Maximum |
| (2) | AF GAIN | To a convenient level |
| (3) | NOISE LIMITER switch | OFF |
| (4) | AVC switch | OFF |
| (5) | GUARD switch | OFF |
| (6) | SYSTEM switch | R/T |
| (7) | *Scale trimmer* | Zero |

**48.** The trimming adjustments are made in the order given in Table 7. On each range the procedure is repeated until optimum ganging is obtained. On the 11·3 to 20 Mc/s range successive adjustments should be made, rocking the main tuning control for maximum output, to prevent pulling of the LO frequency.

**TABLE 7**
**RF alignment—R.1475**

| Range | Frequency in Mc/s | Adjust FC grid | RF anode | Aerial |
|---|---|---|---|---|
| 11·3—20 | 19·13 | C20 | C16 | C6 |
| | 11·73 | L9 | L5 | L1 |
| 6·4—11·3 | 10·81 | C21 | C17 | C7 |
| | 6·65 | L10 | L6 | L2 |
| 3·6—6·4 | 6·12 | C22 | C18 | C8 |
| | 3·74 | L11 | L7 | L3 |
| 2 —3·6 | 3·47 | C23 | C19 | C9 |
| | 2·08 | L12 | L8 | L4 |

**Guard unit alignment**

**49.** Set the controls as follows:—

| | | |
|---|---|---|
| (1) | RF GAIN | Maximum |
| (2) | AF GAIN | To a convenient level |
| (3) | SYSTEM switch | CW 5 kc/s |
| (4) | GUARD switch | GUARD ONLY |
| (5) | AVC switch | OFF |
| (6) | NOISE LIMITER switch | OFF |
| (7) | Guard sensitivity (RF GAIN) | Maximum |

*Unit P (2 to 4·2 Mc/s)*

**50.** (1) Insert crystal of 3·6 Mc/s in the guard unit.

(2) Insert guard unit in receiver.

(3) Set frequency trimmer to +5 (fully clockwise).

(4) Inject an unmodulated signal of 4·2 Mc/s.

(5) Rotate oscillator trimmer until oscillations just commence. If oscillations will not start the inductance of oscillator coil L33 is probably too large and the core should be unscrewed slightly to promote oscillations.

(6) Return frequency trimmer to zero (this should vary the beat note.).

(7) Trim first and second RF trimmer for maximum output. Some confusion may arise because a false maximum appears as the second RF is tuned through the oscillator frequency but as the real maximum is much larger it can easily be identified.

(8) Repeat the above sequence injecting a signal at 2·0 Mc/s and using a crystal of 2·6 Mc/s.

*Unit Q (4·1 to 7·5 Mc/s)*

**51.** The procedure for guard unit Q is identical with that outlined in para. 50, but the crystal frequencies are 4·7 and 6·9 Mc/s respectively.

**Performance specification**

**52.** The tests carried out by the manufacturer to ensure that the receivers attain the performance specified for Service use are not required for normal servicing and are not included in this A.P. They are, however, available in A.P.2883G, Vol. 1 (*2nd Edition*), Part 2, Chap. 3.



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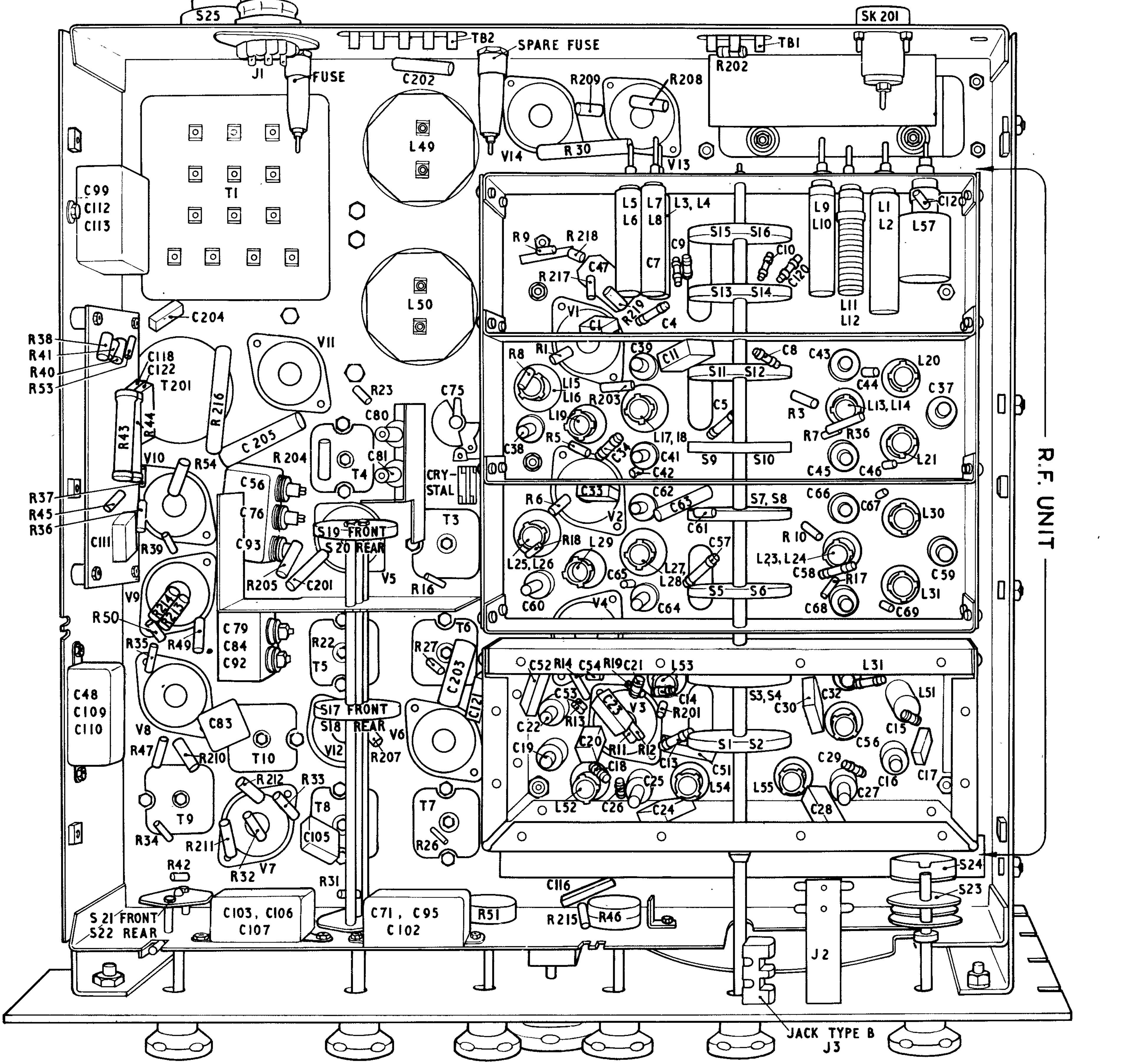


Fig. 4 Receiver type R.1967 bottom layout of chassis

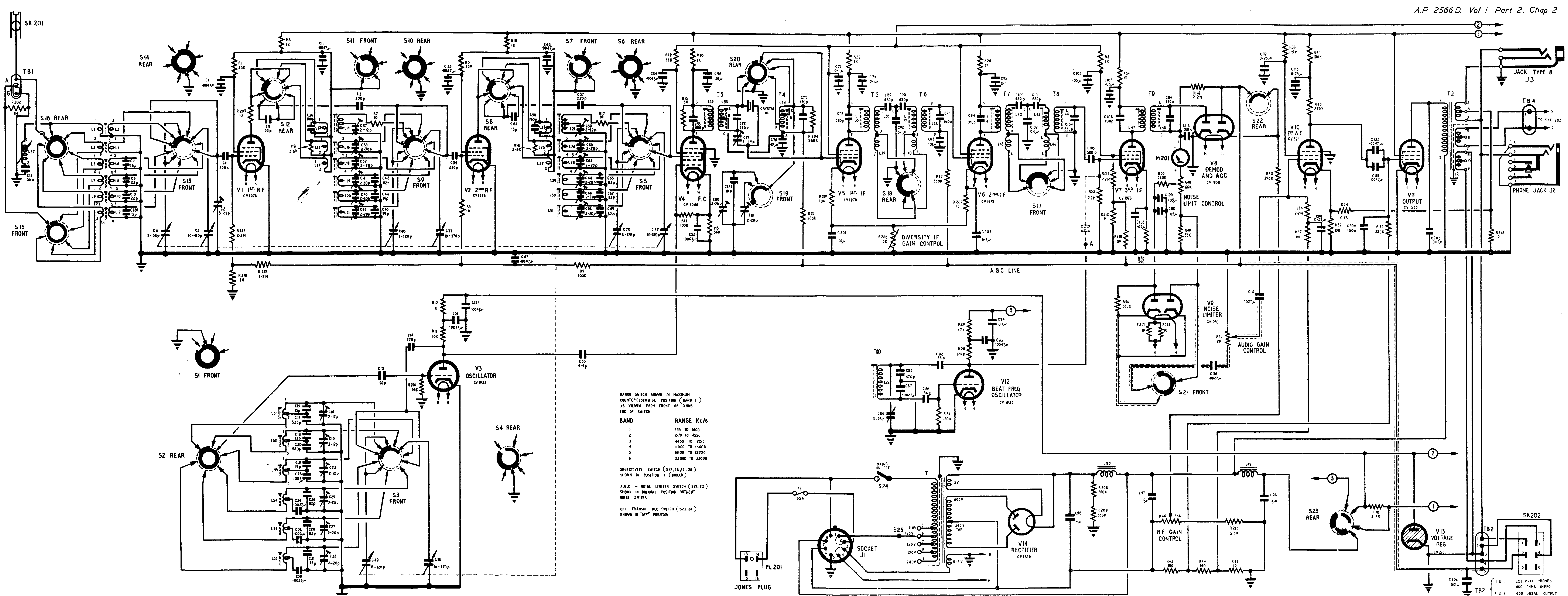


Fig. 6

Receiver Type R.1967 – circuit

(AL 8, May 54)

Fig. 6