

# RESTRICTED

ELECTRICAL AND MECHANICAL  
ENGINEERING REGULATIONS  
(By Command of the Army Council)

TELECOMMUNICATIONS  
E 162

## RECEPTION SETS R106, MKS 1 AND 2

### TECHNICAL HANDBOOK - TECHNICAL DESCRIPTION

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INTRODUCTION

1. The R106 is a special purpose high grade superheterodyne receiver for the reception of C.W., M.C.W. and R.T. (A.M.) signals. It has very high stability and resetting accuracy.
2. There are four models of the R106 Mk 1 and one model of the Mk 2. Though most of these incorporate variable selectivity, optional A.V.C., variable pitch C.W. oscillator and signal strength meter, one model does not include crystal selectivity or signal strength meter. The main differences are listed in para 29.

COMPLETE STATION

3. The complete station includes the following items:

- (a) Reception set, R106, Mk 1 or Mk 2
- (b) Coil units as follows:-

- |                   |        |                   |         |
|-------------------|--------|-------------------|---------|
| (i) 50-100kc/s    | Type J | (vi) 1.7-4Mc/s    | Type JD |
| (ii) 100-200kc/s  | Type H | (vii) 3.5-7.3Mc/s | Type JC |
| (iii) 180-430kc/s | Type G | (viii) 7-14Mc/s   | Type JB |
| (iv) 480-960kc/s  | Type F | (ix) 14-30Mc/s    | Type JA |
| (v) 900-2050kc/s  | Type E |                   |         |

- (c) Supply unit, rectifier, No. 5
- (d) Supply unit, vibratory, No. 2
- (e) Receiver, headgear, double, C.H.R.
- (f) Batteries, secondary, portable, 6V, 85Ah.
- (g) Lamps, operator, No. 3
- (h) Connectors, twin, No. 24A.
- (j) Cases, spare valves, No. 4A

BRIEF ELECTRICAL DESCRIPTION

4. Fig 1 shows a block diagram of the receiver. The frequency range is covered in nine bands by separate plug-in coil units. When the crystal filter is not in use the I.F. bandwidth is 3.0kc/s at -6db. With the crystal in circuit the maximum selectivity is 200c/s at -6db.

5. Audio output may be fed to either headphones or a loudspeaker at will. The headphone impedance is 2000Ω and the loudspeaker impedance is 7000Ω. When the loudspeaker is disconnected from the set the output terminals at the rear of the chassis must be short-circuited.

6. The aerial input circuits are designed for coupling to a balanced or unbalanced transmission line of approximately 500Ω impedance, but may be fed from a single wire aerial.

7. The receiver sensitivity over all bands is of the order of 2.0-3.0 microvolts for 1 watt output to a loudspeaker, with 30% modulation.

8. The receiver operates from either a 100 - 250V 50c/s A.C. supply using the Supply unit, rectifier, No. 5 (see Tels K 220/5) or from a 6V D.C. battery supply, using the Supply unit, vibratory, No. 2. The power supplies required are H.T., 250V D.C. at 60mA, and L.T. 6.3V A.C. or D.C. at 3.5A.



9. Terminals are provided at the rear of the chassis for relay control of the receiver when required. These terminals must be short-circuited when not in use.

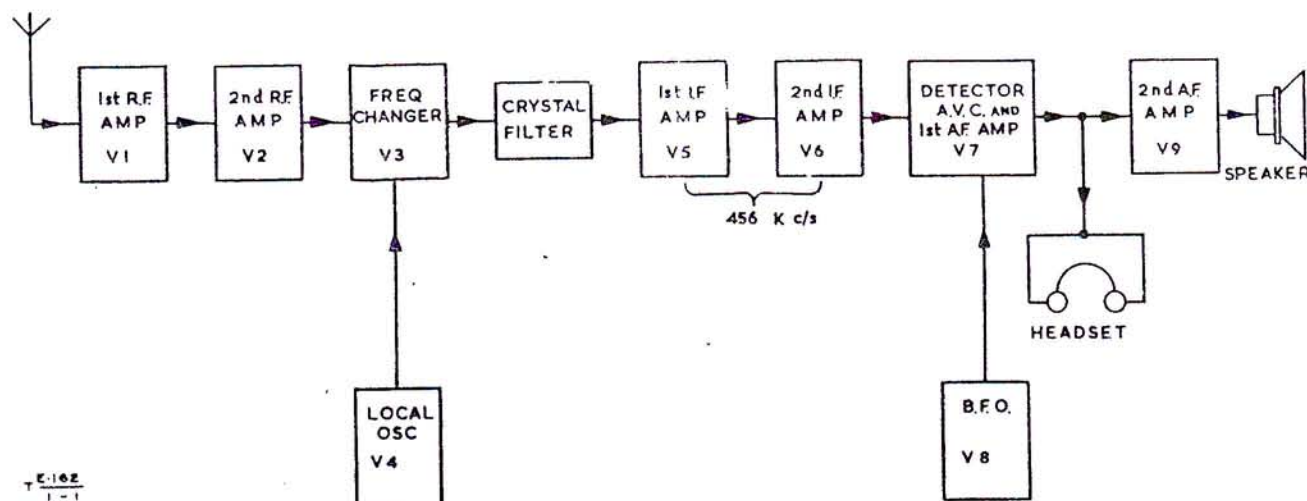


Fig 1 - Block diagram

10. The circuit differences between the Mk 1 and Mk 2 receivers are given in para 29. The changes in components are noted in Table 1001.

BRIEF MECHANICAL DESCRIPTION

11. The receiver normally is provided for table operation and is housed in a steel cabinet with hinged lid. All models can be provided for rack-mounting in which case only the chassis with a stronger front panel is supplied.

12. The physical dimensions of the receiver in its case, complete with one coil unit, are as follows:-

Weight	32lbs	Width	17½ inches
Height	9 inches	Depth	12 inches

The dimensions of individual coil units are as follows:-

Weight	2lbs	Width	10½ inches
Height	2½ inches	Depth	5½ inches

13. The receiver is assembled on a steel chassis to which is attached a steel front panel. The coil units, (see Fig 2), comprise four separately screened cans which house the aerial, R.F., frequency-changer and oscillator coils together with their associated capacitors. All four sections are mounted on a panel, to which is attached a calibration chart, showing the relationship between dial reading and the frequency coverage of the unit. A table is also attached for the recording of station dial settings.

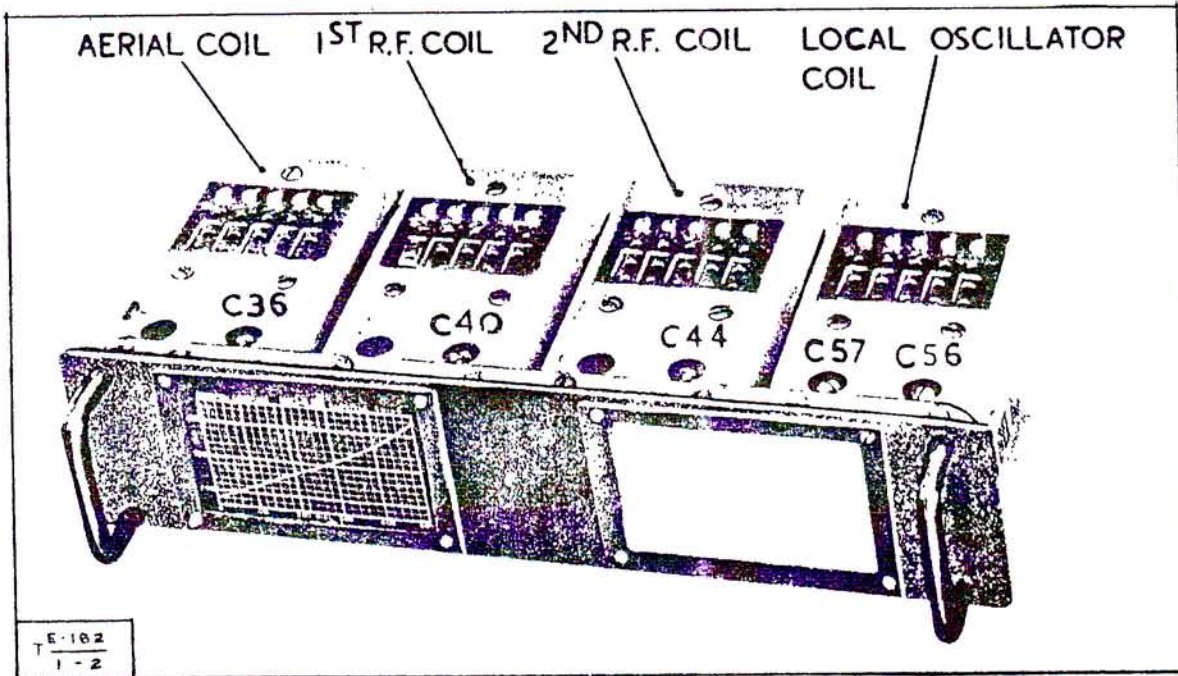


Fig 2 - Typical coil unit

14. The main tuning dial and drive mechanism is designed to provide the highest degree of re-setting and reading accuracy. An effective scale length of over 12 feet is obtained by the use of a 20 to 1 reduction gear. The dial is in two parts, an outer dial engraved with 50 divisions and having 5 equally spaced apertures and an inner dial geared to the outer but rotating on a separate eccentric bearing. The action is such that the numerals appearing through the aperture adjacent to the index indicate the number of divisions that have passed the index. In this way 500 divisions correspond to 10 revolutions of the dial for an angular movement of the driven spindle of  $180^\circ$ . Interpolation to one fifth of a division is easy and the dial may thus be read to one part in 2500. The split, spring-loaded, worm wheel reduction gearing is housed in a substantial die-cast casing. The tuning gang is of very rigid construction, each section being isolated from the case and having its own rotor earth contact.

CONTROLS  
(see Fig 3)

15. With the exception of pre-set components all controls are mounted on the front panel, together with the S-meter, headphone output jack and pilot lamp. The designation, circuit reference and function of each control are given in Table 1. The aerial terminals are placed at the left-hand side of the chassis and are accessible through an opening in the side of the receiver case. The power leads are terminated in a four-pin plug, for use with either of the supply units mentioned in para 3.



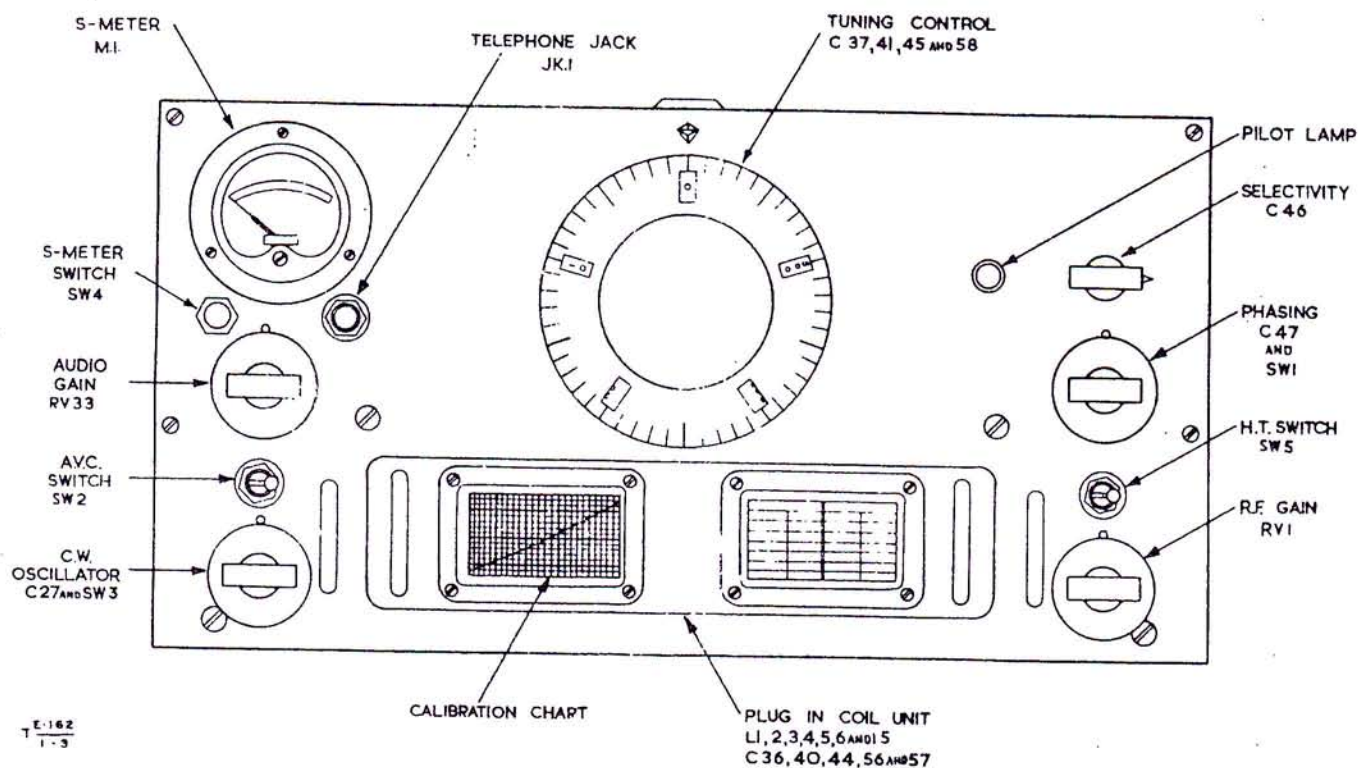


Fig 3 - Front panel controls

Table 1 - Front panel controls

Designation	Circuit reference	Function
Tuning control	C37; C41; C45; C58	Main tuning control. Clockwise rotation increases dial reading and frequency
H.T. switch	SW5	H.T. on/off toggle switch operating from left to right
Plug-in coil	L1 - L6 and L15 C36; C40; C44; C56; C57	R.F. and local oscillator tuned circuits
R.F. GAIN	RV1	Varies the gain of the 2nd R.F. and two I.F. stages, V2, V5 and V6

Table 1 - (contd)

Designation	Circuit reference	Function
AUDIO GAIN	RV33	A.F. volume control
Selectivity control	C46	Controls selectivity of I.F. stages when the crystal filter is in circuit. When crystal filter is not in use this control acts as a normal I.F. trimming capacitor
PHASING control and crystal filter switch	C47 SW1	Rotation from zero opens switch SW1 and brings crystal into operation. This control is then used for eliminating interfering signals
C.W. OSC. control and switch	C27 SW3	Clockwise rotation from zero closes switch in H.T. line to B.F.O., V8. This control varies the pitch of the beat note
A.V.C. switch	SW2	A change-over switch. Disconnects the grids of the R.F. and I.F. valves, V1, V2, V5 and V6 from the signal diode (Switch to left for A.V.C. ON)
S-meter switch	SW4	Normal on/off switch. Connects S-meter in circuit when required

TECHNICAL DESCRIPTION

General

16. The circuit diagram of the R106 Mk 1 is shown in Fig 1001. The aerial, R.F. and oscillator coil circuits shown are for the J type coil unit covering from 50-100kc/s. Fig 1002 shows the respective circuits for all the coil units. The circuit of the R106 Mk 2 is similar to the Mk 1 except as noted in Table 1001 and Fig 1001. Top and bottom views of the chassis are shown in Figs 4 and 5.

Aerial and R.F. stages

17. V1 and V2 are conventional R.F. amplifiers. The aerial is transformer coupled to the grid of V1 on all ranges by L1 and L2. V1 and V2 are transformer coupled by L3 and L4. A.V.C. bias is fed to the two stages via R28 and R31 respectively.



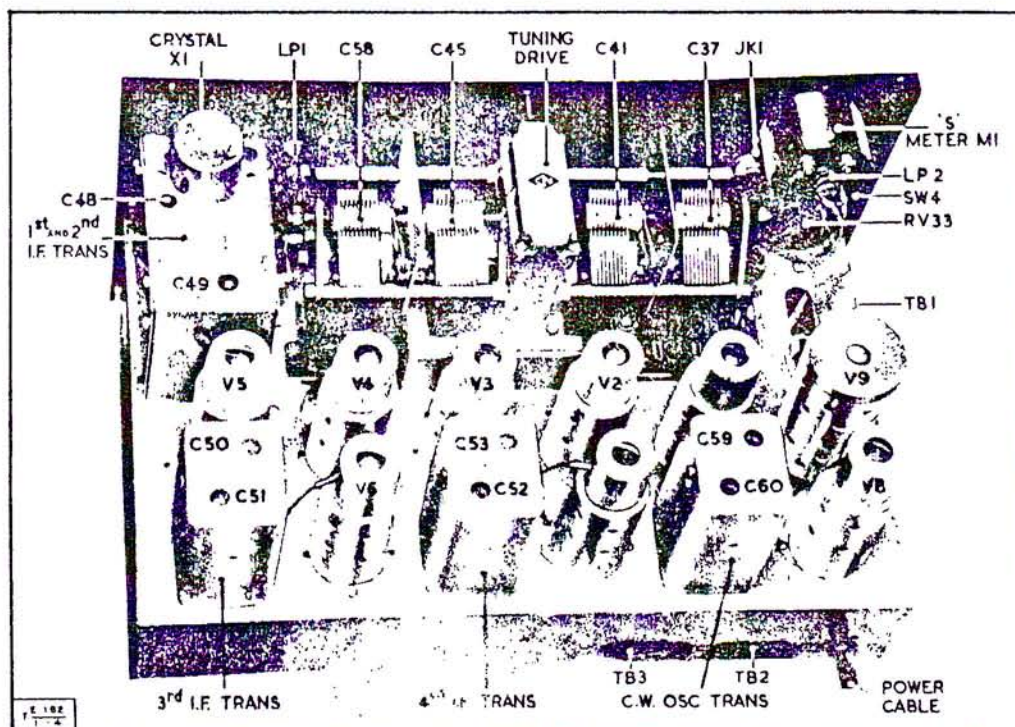


Fig 4 - Chassis, top view

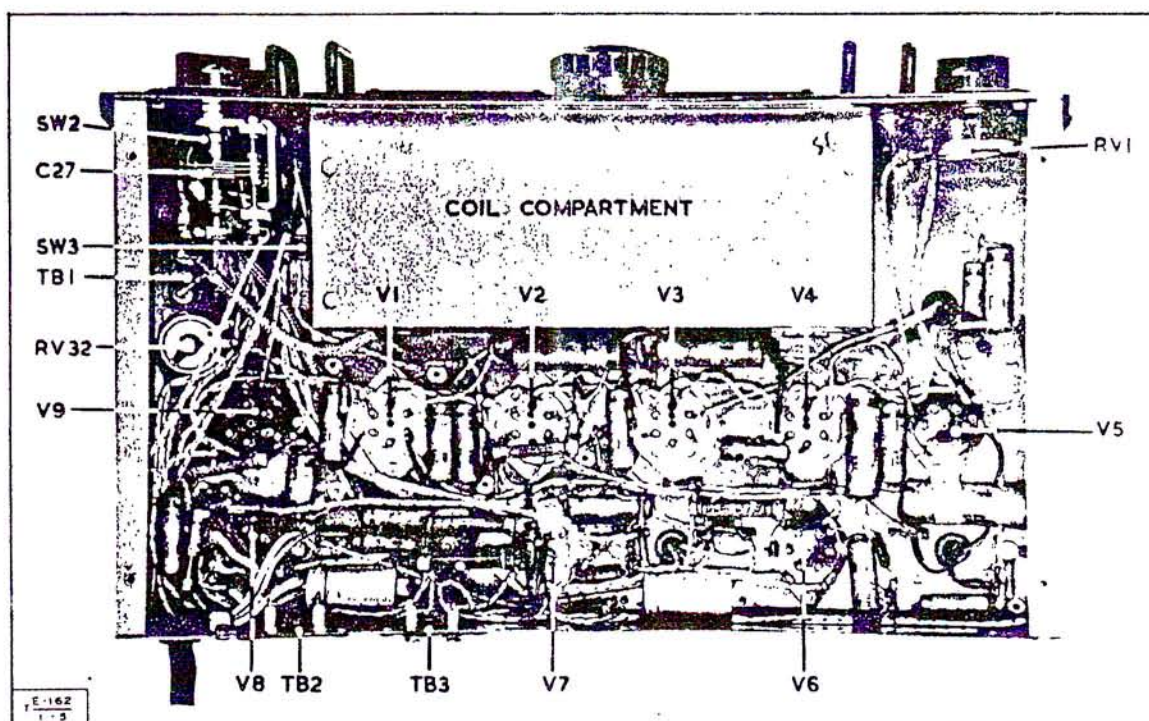


Fig 5 -- Chassis, bottom view



### Gain compensation

18. The R.F. stages are designed to ensure uniform gain throughout the tuning range. High inductance primary coils are used in the interstage R.F. transformers. The coils are designed so that the primary circuit, as a whole, resonates broadly at a frequency outside the low frequency limit of the coil unit. The primary circuit therefore shows increasing impedance as the tuning of the receiver approaches the low frequency end of the band, thus compensating for the decreasing impedance of the secondary.

19. In the 14-30Mc/s band a different arrangement has been employed. The inter-stage R.F. transformer has three windings (see Fig 6). The primary winding is closely coupled to the tuned secondary, being interwound with it and having the same number of turns. A grid winding which consists of a large number of turns of fine wire is also closely coupled to the secondary. This grid winding is resonant outside the low frequency end of the band and compensates for variations in the impedance of the tuned circuit. Gain compensation is not employed on the 50-100kc/s band.

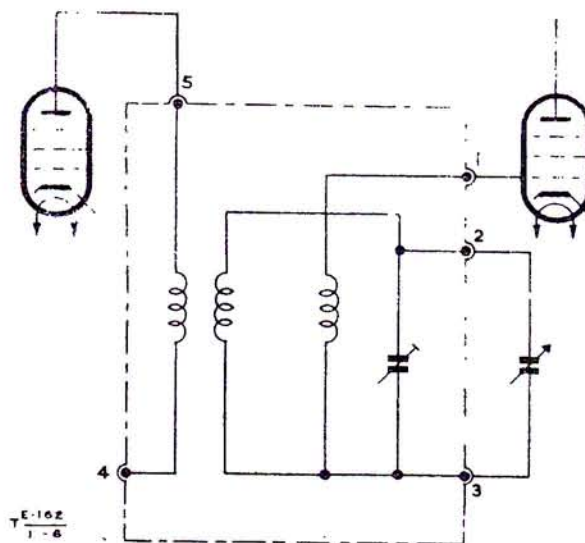


Fig 6 - Gain compensation,  
14-30Mc/s band

### Frequency-changer and local oscillator

20. V2 is coupled to the frequency changer, V3, by the R.F. transformer L5 and L6. A separate local oscillator employing a Hartley circuit is used. The output from the local oscillator, V4, is fed from the cathode via C7 to the screen of V3. The frequency-changer operates with fixed cathode bias and A.V.C. is not applied.

### Frequency drift

21. Frequency drift is minimised by employing high stability components in the tuned circuits and by minimising the effects of any temperature change. Drift due to gradual changes in room temperature is reduced by the use of air dielectric trimmers and tuning capacitors and coil formers having a low temperature coefficient of expansion. The R.F. coil unit is plugged into the set under the chassis to minimise heating from the valves. The temperature in the receiver is also kept down by using a separate power supply unit and a well ventilated cabinet.

### Crystal filter

22. The crystal filter circuit is conventional in design and operates at the nominal I.F. frequency of 456Kc/s. Two controls are provided together with a switch ganged to the phasing control for short-circuiting the crystal when it is not required. With



the crystal in circuit, the bandwidth in the broad position of the selectivity control, is approximately 2.5kc/s and in the sharp position approximately 200c/s, at 6db down. With the crystal in circuit the phasing control can be adjusted to suppress any one interfering signal differing from the desired signal by 300c/s or more. The bridge circuit component values are such that balance is obtained with the phasing control set at approximately the centre of its capacity range. When the crystal is short-circuited by turning the phasing control fully anti-clockwise to zero, the selectivity control acts as a normal I.F. trimmer and should be set for maximum sensitivity.

### I.F. stages

23. The output from the crystal unit is switched to the first I.F. stage, V5, by the tapping on I9. The two I.F. stages, in addition to cathode biasing via R11 and R9 respectively, have A.V.C. applied to their grids through R3 and R8. The gain of the two I.F. stages together with the second A.F. stage is manually controlled by the R.F. gain-control, RV1.

### Detector and A.V.C.

24. The detector and A.V.C. circuit is applied to the first diode of V7. A.V.C. is fed via R19 to the filter circuits of the controlled valves when the A.V.C. switch is ON. When the A.V.C. is switched OFF, the cathode bias of the controlled valves is maintained by the second diode, at approximately the same potential as that existing under no signal conditions with A.V.C. OFF. The by-pass capacitor, C15, in the second diode circuit, removes any stray signal pickup or feedback which could produce partial A.V.C. with the switch in the OFF position.

### A.F. stages

25. The audio amplifier section of Mk 1 is a pentode in the Mk 1 receiver and a triode in the Mk 2 receiver. The anode load R18 and V9 cathode resistor, R25, differ in the two receivers due to different valve characteristics. R16 and R17 are omitted in the Mk 2.

26. The A.F. output from V7 is resistance-capacitance coupled to the grid of V9 for loudspeaker operation. When the headphone plug is inserted in JK1, C18 is disconnected from the grid of V9, which is then earthed through the jack, JK1.

### C.W. oscillator

27. The C.W. oscillator is provided with a variable pitch control on the front panel. This control also operates the switch SW3, in the H.T. line to the valve. Capacitor C20 prevents feedback via the heater circuit.

### S-meter

28. The S-meter operates in a bridge circuit (see Fig 7). It is calibrated in S-units and db above S9. The bridge circuit is initially balanced by R32, so that the meter deflection is zero under no signal conditions with the R.F. gain control set to 9.5. Fig 8 shows the relation between meter readings and the actual signal input to the receiver in microvolts. It will be seen from Fig 8 that each S-unit is equal to a change of approximately 4db. The 40db range above S9 level is used for comparative checks on extremely strong signals.

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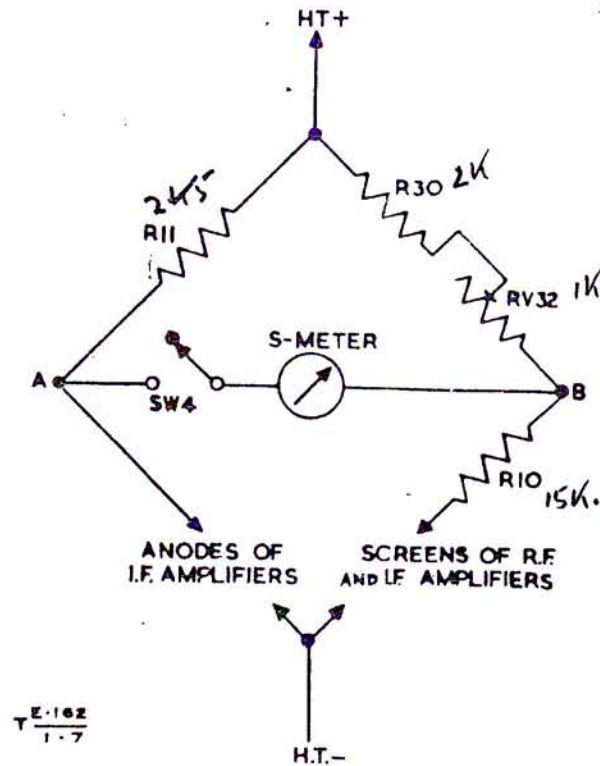


Fig 7 - S-meter, circuit detail

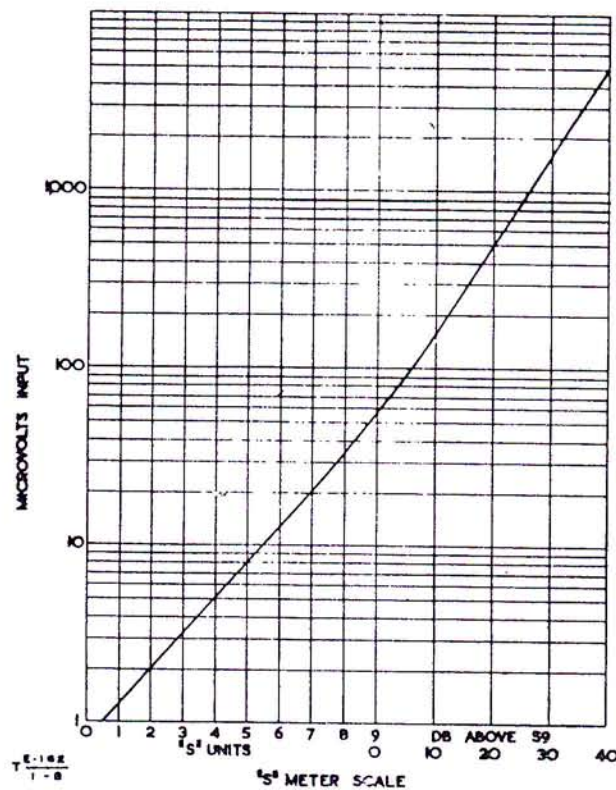


Fig 8 - S-meter, sensitivity curve



Differences between models

29. The foregoing description covers all models, the main differences being listed below:-

R106, Mk 1

- (a) H.R.O. Senior: This is the original model which is complete with amateur bandspread (see para 22), crystal filter and S-meter
- (b) H.R.O. Junior: This is similar to H.R.O. Senior but without the special facilities enumerated in (a) above
- (c) H.R.O.-M: This is similar to the H.R.O. Senior, less bandspread but is provided with a plug-in crystal gate
- (d) H.R.O.-MX: Similar to H.R.O.-M but with built-in crystal gate.

R106, Mk 2

- (a) H.R.O.-5: This is similar to H.R.O.-Mx but uses metal valves instead of glass. (see para 25 and Table 1001 for component changes).

POWER SUPPLY UNITS  
(see Figs 1003 and 1004)

30. The Supply unit rectifier, No. 5 (Fig 1003) consists of a standard full-wave rectifier circuit using an indirectly heated rectifier, V1 (CV 1863). The smoothing circuit uses a capacitor input filter C3, L1, followed by a further stage consisting of C4A, C4B and L2. An R.F. choke, L3, is included in the output lead. The H.T. supply is fused in the negative return lead by FS1. (250mA). The primary circuit is tapped for mains supplies from 100-170W and 200-250V A.C. R.F. bypass capacitors C1 and C2 filter the primary circuit. The indicator lamp, LP1, is wired across the L.T. circuit.

31. The Supply unit, vibratory, No. 2 (Fig 1004) comprises a non-synchronous vibrator driven from a 6V battery through an R.F. input filter and spark suppression circuit. The indicator lamp, LP1, is wired into the input circuit. The chopped D.C. from the vibrator is stepped up by T2 and fed to the full-wave cold-cathode rectifier, V1 (CV 692). Comprehensive smoothing circuits are provided to remove all traces of interference from the vibrator circuits.

BANDSPREAD COILS

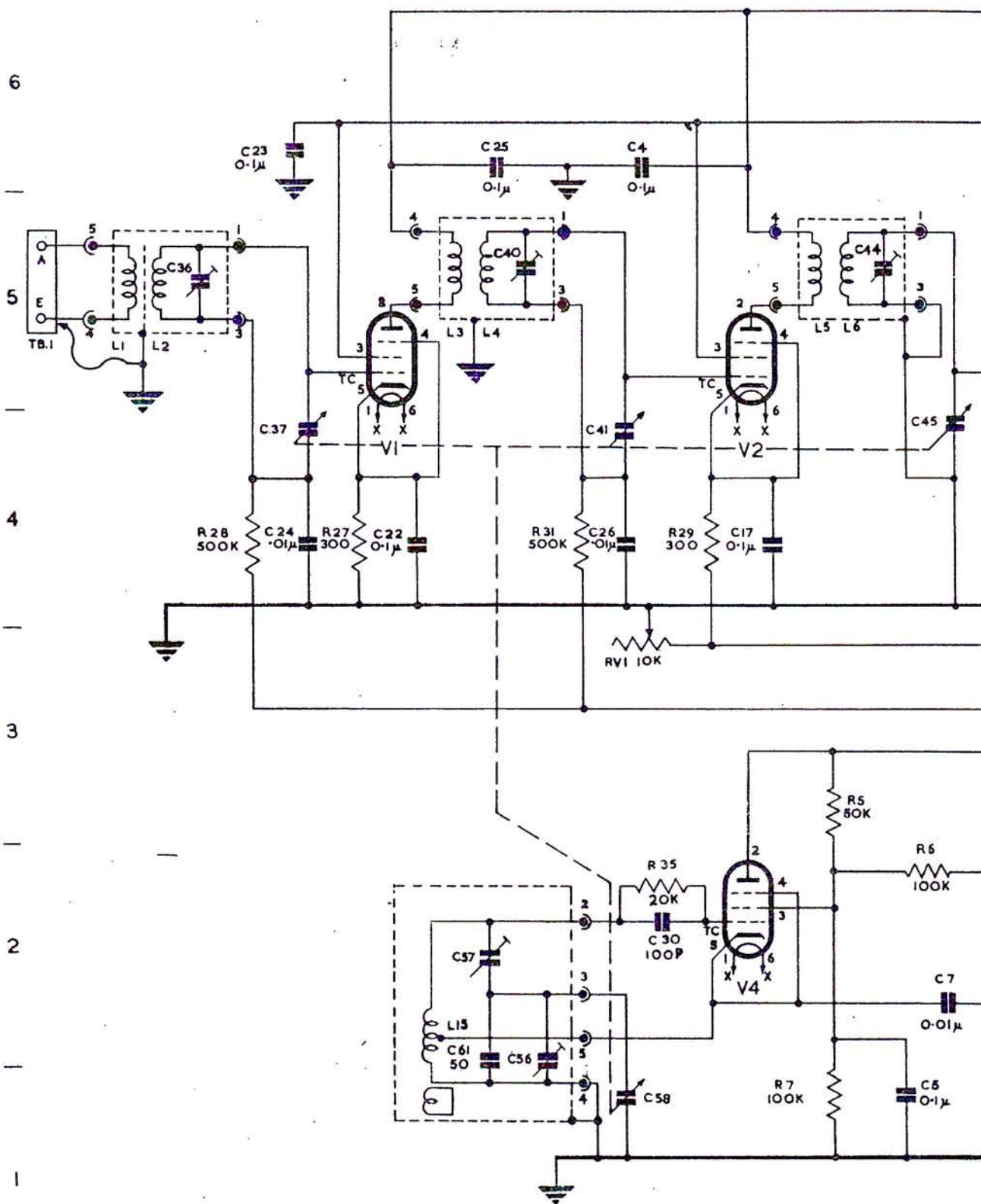
32. Some receivers of either Mk may be equipped with a set of coils giving a bandspread facility. Table 2 shows the frequency coverage of these coils. It will be noted that a portion of the range in each case is extended to cover almost the whole of the tuning dial scale. These coil-sets are aligned for a particular receiver and differ further in that the coil-set for a receiver with metal valves (Mk 2) will not operate with a receiver using glass valves (Mk 1) without realignment.

Table 2 - Bandsread coils

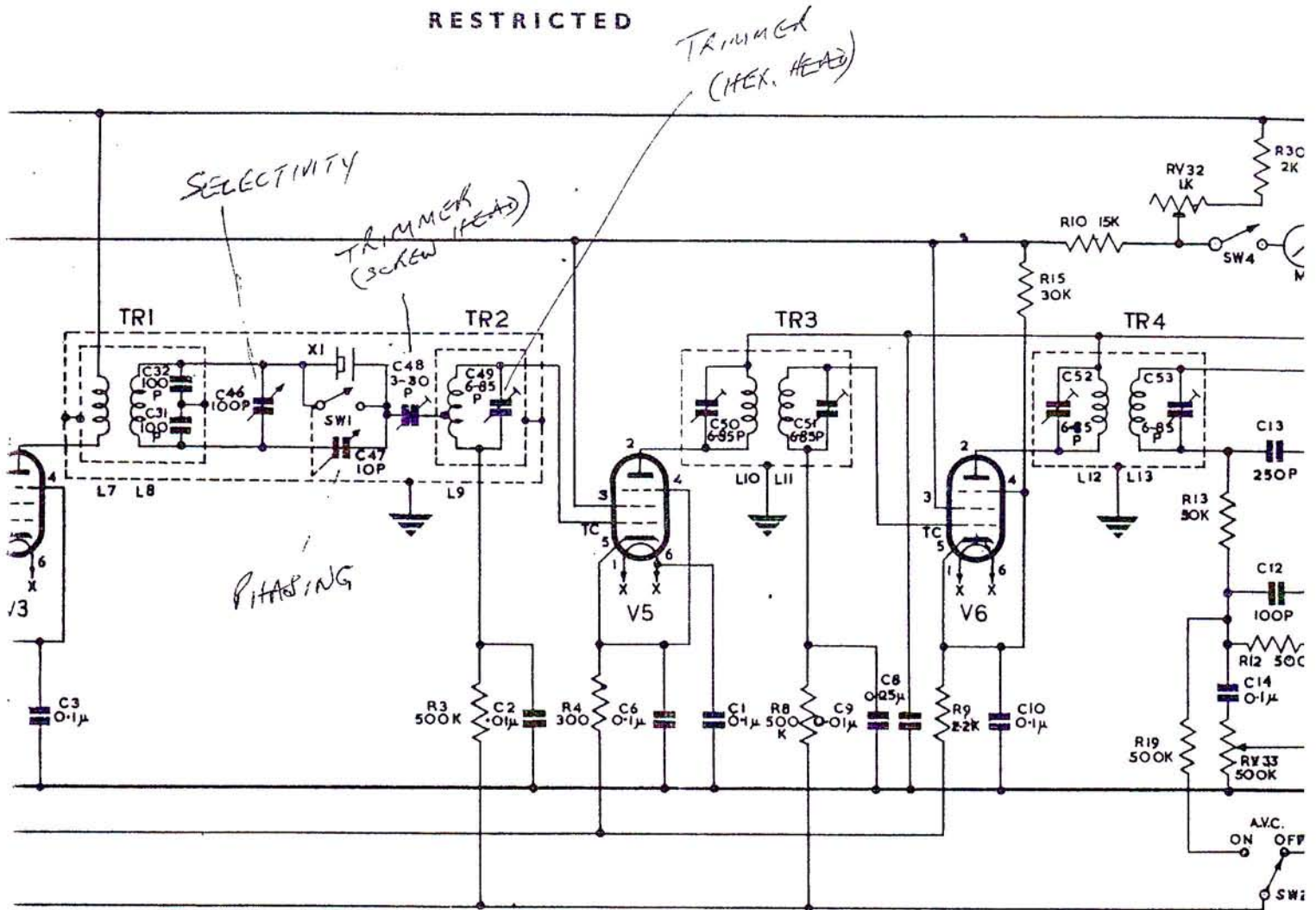
Coil-set	General coverage	Bandsread	Dial
A	14 - 30Mc/s	28 - 29.7Mc/s	50 - 450
B	7 - 14.4Mc/s	14 - 14.4Mc/s	50 - 450
C	3.5 - 7.3Mc/s	7 - 7.3Mc/s	50 - 450
D	1.7 - 4Mc/s	3.5 - 4Mc/s	50 - 450

Note: The next page is Page 1001





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RESISTOR VALUES IN OHMS  
CAPACITOR VALUES IN FARADS  
CVIT SHOWN WITH COIL UNIT J(50-100K $\Omega$ )

MK I	MK II
2V5, V6 = 6D6 (CV1900)	6K7 (CV1942)
4V8 = 6C6 (CV385)	6J7 (CV1936)
= 6B7 (CV1891)	6SQ7 (CV1990)
= 42 (CV609)	6V6GT/G (CV511)
= 20K	OMITTED
= 100K	OMITTED
= 100K	50K
= 500	300

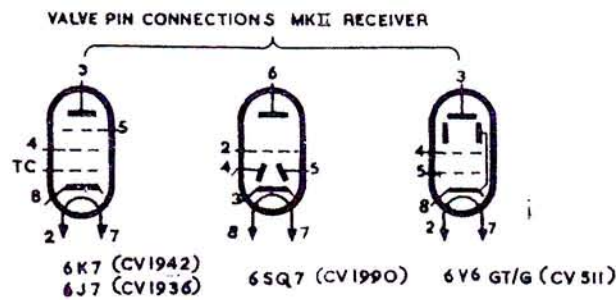
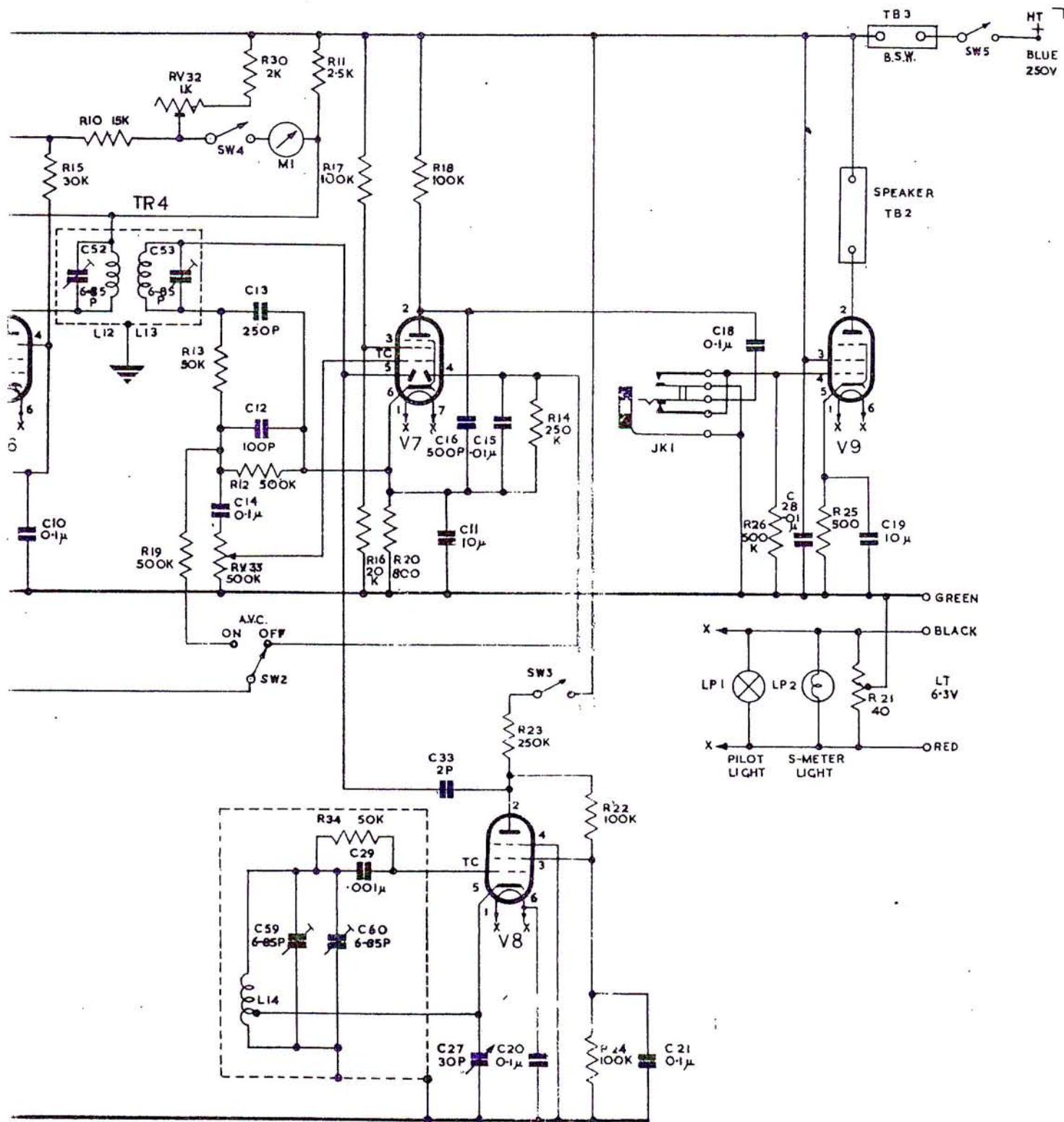


Fig. 1001—Reception set R106, Mk I, circuit diagram





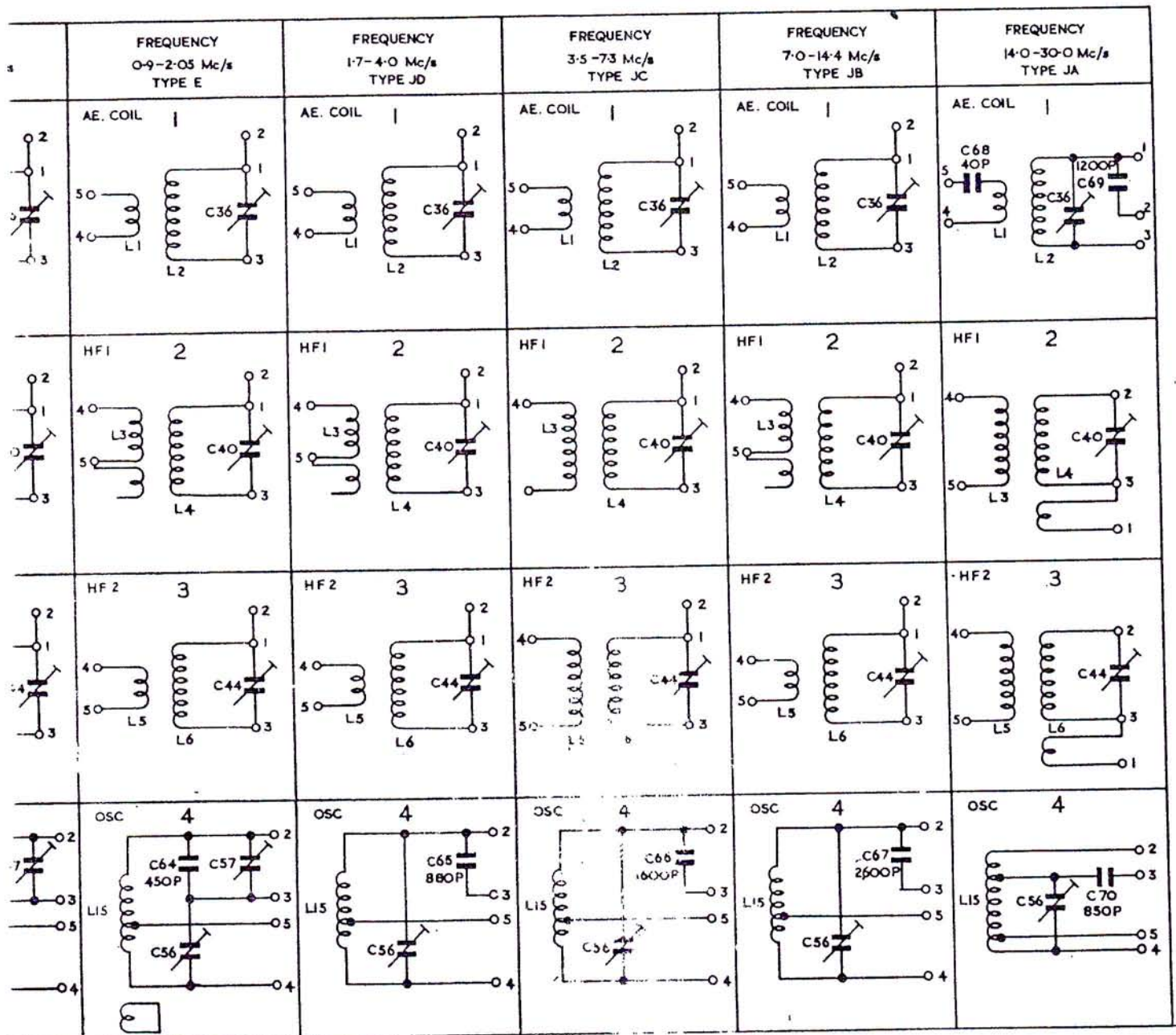
COIL STAGE	FREQUENCY 50-100 Kc/s TYPE J	FREQUENCY 100-200 Kc/s TYPE H	FREQUENCY 180-430 Kc/s TYPE G	FREQUENCY 480-960 Kc/s TYPE F
AERIAL	AE. COIL 1 	AE. COIL 1 	AE. COIL 1 	AE. COIL 1 
FIRST R.F. TRANSFORMER	HF1 2 	HF1 2 	HF1 2 	HF1 2 
SECOND R.F. TRANSFORMER	HF2 3 	HF2 3 	HF2 3 	HF2 3 
LOCAL OSCILLATOR	OSC 4 	OSC 4 	OSC 4 	OSC 4 

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FOR VALUES

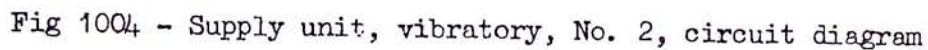
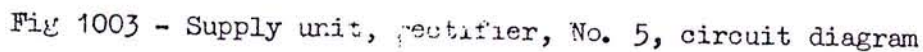
Fig 1002 - J





OF C36, 40, 44, 56 AND 57, SEE TABLE 1002

Individual coil units





# R E S T R I C T E D

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Table 1001 - Components

Circuit ref	Value	Tolerance and rating	Type	Location
RESISTORS				
RV1	10k $\Omega$		1.1/2W Variable	C3
R2	5k $\Omega$	$\pm 10\%$	1/2W	E4
R3	500k $\Omega$	$\pm 10\%$	1/2W	G4
R4	300 $\Omega$	$\pm 10\%$	1/2W	H4
R5	50k $\Omega$	$\pm 10\%$	1/2W	D3
R6	100k $\Omega$	$\pm 10\%$	1/2W	E2
R7	100k $\Omega$	$\pm 10\%$	1/2W	D1
R8	500k $\Omega$	$\pm 10\%$	1/2W	J4
R9	2.2k $\Omega$	$\pm 10\%$	1/2W	J4
R10	15k $\Omega$	$\pm 10\%$	1W	K6
R11	2500 $\Omega$	$\pm 10\%$	1/2W	L6
R12	500k $\Omega$	$\pm 10\%$	1/2W	L4
R13	50k $\Omega$	$\pm 10\%$	1/2W	K5
R14	250k $\Omega$	$\pm 10\%$	1/2W	M4
R15	30k $\Omega$	$\pm 10\%$	1W	K6
R16 Mk 1	20k $\Omega$	$\pm 10\%$	1/2W	L4
R16 Mk 2	Omitted			
R17 Mk 1	100k $\Omega$	$\pm 10\%$	1W	L6
R17 Mk 2	Omitted			
R18	100k $\Omega$	$\pm 10\%$	1W	L6
R18 Mk 2	50k $\Omega$	$\pm 10\%$	1W	L6
R19	500k $\Omega$	$\pm 10\%$	1/2W	K4
R20	800 $\Omega$	$\pm 10\%$	1/2W	L4
R21	60 $\Omega$	$\pm 10\%$	2W	O3
R22	100k $\Omega$	$\pm 10\%$	1/2W	M3
R23	250k $\Omega$	$\pm 10\%$	1/2W	M3
R24	100k $\Omega$	$\pm 10\%$	1/2W	M2
R25 Mk 1	500 $\Omega$	$\pm 10\%$	1W	N4
R25 Mk 2	300 $\Omega$	$\pm 10\%$	1W	N4
R26	500k $\Omega$	$\pm 10\%$	1/2W	N4
R27	300 $\Omega$	$\pm 10\%$	1/2W	B4
R28	500k $\Omega$	$\pm 10\%$	1/2W	B4
R29	300 $\Omega$	$\pm 10\%$	1/2W	D4
R30	2k $\Omega$	$\pm 10\%$	1/2W	L6
R31	500k $\Omega$	$\pm 10\%$	1/2W	C4
RV32	1k $\Omega$		1W Variable	K6
RV33	500k $\Omega$	$\pm 20\%$	2W Variable	K4
R34	50k $\Omega$	$\pm 10\%$	1/2W	L2
R35	20k $\Omega$	$\pm 10\%$	1/2W	D2

Note: R9 varies with individual receivers between 1k $\Omega$  and 5k $\Omega$

Table 1001 - (contd.)

Circuit ref	Value	Tolerance and rating	Type	Location
CAPACITORS				
C1	0.1 $\mu$ F	+20% -10% 400V D.C. wkg		H4
C2	0.01 $\mu$ F	+20% -10% 600V D.C. wkg		H4
C3	0.1 $\mu$ F	+20% -10% 400V D.C. wkg		F4
C4	0.1 $\mu$ F	+20% -10% 600V D.C. wkg		C6
C5	0.1 $\mu$ F	+20% -10% 600V D.C. wkg		E1
C6	0.1 $\mu$ F	+20% -10% 400V D.C. wkg		H4
C7	0.01 $\mu$ F	+20% -10% 600V D.C. wkg		E2
C8	0.25 $\mu$ F	+20% -10% 600V D.C. wkg		J4
C9	0.01 $\mu$ F	+20% -10% 600V D.C. wkg		J4
C10	0.1 $\mu$ F	+20% -10% 400V D.C. wkg		J4
C11	10 $\mu$ F	+15% -0% 50V D.C. wkg		M4
C12	100pF	+5% 500V D.C. wkg		L4
C13	25pF	+10% 500V D.C. wkg		L5
C14	0.1 $\mu$ F	+20% -10% 400V D.C. wkg		K4
C15	0.01 $\mu$ F	+20% -10% 600V D.C. wkg		M4
C16	500pF	+10% 1000V D.C. wkg		M4
C17	0.1 $\mu$ F	+20% -10% 400V D.C. wkg		D4
C18	0.1 $\mu$ F	+20% -10% 600V D.C. wkg		N5
C19	10 $\mu$ F	+15% -0% 50V D.C. wkg		O4
C20	0.1 $\mu$ F	+20% -10% 400V D.C. wkg		M1
C21	0.1 $\mu$ F	+20% -10% 400V D.C. wkg		M1
C22	0.1 $\mu$ F	+20% -10% 400V D.C. wkg		B4
C23	0.1 $\mu$ F	+20% -10% 400V D.C. wkg		B6
C24	0.01 $\mu$ F	+20% -10% 600V D.C. wkg		B4
C25	0.1 $\mu$ F	+20% -10% 600V D.C. wkg		C6
C26	0.01 $\mu$ F	+20% -10% 600V D.C. wkg		C4



Table 1001 - (contd)

Circuit ref	Value	Tolerance and rating	Type	Location
C27	5-35pF		Variable	M1
C28	0.01 $\mu$ F	+20% 600V D.C. wkg -10%		N4
C29	0.001 $\mu$ F	+10% 500V D.C. wkg		L2
C30	100pF	$\pm 5\%$ 500V D.C. wkg		D2
C31	100pF	+5% 500V D.C. wkg		F5
C32	100pF	+5% 500V D.C. wkg		F5
C33	2pF	+50% 500V D.C. wkg		M3
C36	see Table 1002			A5
C37	12-225pF		Variable gang	B4
C40	see Table 1002			C5
C41	12-225pF		Variable gang	C4
C44	see Table 1002			E5
C45	12-225pF		Variable gang	E4
C46	100pF		Variable	G5
C47	10pF		Variable	G5
C48	3-30pF		Trimmer	G5
C49	6-85pF		Trimmer	H5
C50	6-85pF		Trimmer	H5
C51	6-85pF		Trimmer	J5
C52	6-85pF		Trimmer	K5
C53	6-85pF		Trimmer	K5
C56	see Table 1002			C2
C57	see Table 1002			C2
C58	12-225pF		Variable gang	C1
C59	6-85pF		Trimmer	L2
C60	6-85pF		Trimmer	L2
C61	50pF	+5% 500V D.C.		C2
C62	100pF	+5% 500V D.C.	1002 type	G4
C63	350pF	+10% 500V D.C.	1002 type	F4
C64	450pF	+10% 500V D.C.	1002 type	E4
C65	880pF	+10% 500V D.C.	1002 type	JD4
C66	1600pF	+10% 500V D.C.	1002 type	JC4
C67	2600pF	+10% 500V D.C.	1002 type	JB4
C68	40pF	+5% 500V D.C.	1002 type	JA1
C69	1200pF	+10% 500V D.C.	1002 type	JA1
C70	850pF	+10% 500V D.C.	1002 type	JA4

\* measured in situ, see section with value removed &amp; extra leads

max 247

min 24

 $\Delta$  223

Table 1001 - (contd)

Circuit ref	Type Mk 1	Type Mk 2	Location
VALVES			
V1	CV1900 (6D6)	CV1912 (6K7)	B5
V2	CV1900 (6D6)	CV1912 (6K7)	D5
V3	CV585 (6C6)	CV1936 (6J7)	E5
V4	CV585 (6C6)	CV1936 (6J7)	D2
V5	CV1900 (6D6)	CV1912 (6K7)	H5
V6	CV1900 (6D6)	CV1912 (6K7)	J5
V7	CV1891 (6B7)	CV1990 (6SQ7)	L5
V8	CV585 (6C6)	CV1936 (6J7)	M2
V9	CV609 (42)	CV511 (6V6GT/G)	N5

SWITCHES

SW1	Crystal filter switch	G5
SW2	A.G.C. switch (toggle)	L3
SW3	C.W. oscillator H.T. switch (toggle)	M3
SW4	S-meter switch (push-pull)	L6
SW5	H.T. switch (toggle)	O6

Table 1002 - Trimmer and padder capacitors

Coil set	Frequency range	C36	C40	C44	C56	C57
JA	14 - 30Mc/s	5-28pF	5-28pF	5-28pF	5-28pF	-
JB	7 - 14.4Mc/s	5-28pF	5-28pF	5-28pF	6-38pF	-
JC	3.5 - 7.3Mc/s	5-28pF	5-28pF	5-28pF	5-28pF	-
JD	1.7 - 4Mc/s	5-28pF	5-28pF	5-28pF	5-28pF	-
E	900 - 2050kc/s	5-28pF	5-28pF	5-28pF	5-28pF	6-38pF
F	480 - 960kc/s	6-38pF	6-38pF	6-38pF	7-56pF	6-38pF
G	180 - 430kc/s	5-28pF	5-28pF	5-28pF	5-28pF	6-38pF
H	100 - 200kc/s	6-38pF	6-38pF	6-38pF	8.5-75pF	10-97pF
J	50 - 100kc/s	6.5-45pF	6.5-45pF	6.5-45pF	8.5-75pF	8.5-75pF



R E S T R I C T E D

ELECTRICAL AND MECHANICAL  
ENGINEERING REGULATIONS  
(By Command of the Army Council)

TELECOMMUNICATIONS  
E 163

RECEPTION SETS R106, MKS 1 AND 2

TECHNICAL HANDBOOK - UNIT REPAIRS

GENERAL

1. No adjustments, except those detailed in this Regulation, will be made to the receiver by unit repair sections since the accuracy and sensitivity of the set depend on very accurate alignment and adjustment carried out in Base workshops.
2. For technical description, circuit diagrams and component tables, refer to Tels E 162.

SETTING-UP INSTRUCTIONS

3. The receiver is set up for normal operation as follows:-
  - (a) Ensure that the appropriate power supply unit is connected to the set, but it is at this stage switched OFF. For operation from 100-250V A.C. mains use the Supply unit, rectifier, No. 5, and for 6V D.C. battery operation use the Supply unit, vibratory, No. 2.
  - (b) Select the appropriate plug-in coil unit and insert it in position in the receiver (see para 3, Tels E 162).
  - (c) Connect the loudspeaker, if required, to the terminals at the rear of the set. If a loudspeaker is not used, these terminals must be short-circuited. Do not stand the loudspeaker on the receiver cabinet.
  - (d) The aerial terminals are located on the left-hand side of the receiver. If a single wire aerial or unbalanced feeder line is to be used, connect the aerial or feeder lead to the terminal nearest the front panel and connect the flexible earth lead to the other terminal. If a balanced transmission line is used, connect it to both terminals and in this case, the flexible earth lead is not used.
  - (e) Switch on the P.S.U. and switch on the H.T. to the receiver at SW5; (terminals BSW at the back must be short-circuited if the receiver is not to be used on a relay system).
  - (f) Tune the receiver by setting the dial to the scale reading given by the calibration chart on the coil unit for the frequency desired.
  - (g) Set the R.F. GAIN, RV1 and AUDIO GAIN, RV33 to give the required output level.
  - (h) The selectivity control, C46, when used with the crystal filter in circuit gives minimum selectivity in the vertical position. Selectivity is increased by rotating the knob either way. When the crystal filter is not in use, this control acts as an I.F. trimmer, and should be set to give maximum volume.

- (j) The PHASING control and crystal filter switch is used when receiving C.W. or M.C.W. In position 0 the crystal is short-circuited; in any other position the PHASING control may be used to eliminate any one interfering station more than 300c/s away from the required station.
- (k) The C.W. OSC. switch and control is used on C.W. to give an audible note, or on M.C.W. to assist in the location of a weak station. Rotating the control varies the pitch of the beat note.
- (l) The A.V.C. switch, SW2, may be used as required on R.T. or M.C.W. A.V.C. should not be used when the C.W. oscillator is in operation.

4. If it is desired to change the coil unit while the set is in operation, the H.T. must first be switched OFF at switch SW5.

ROUTINE TECHNICAL MAINTENANCE

Receiver

5. Daily:-

- (a) Check all controls for smoothness of action and freedom from backlash, especially the main tuning control. If the tuning control is defective, report immediately. Do not remove the wormwheel casing.
- (b) Clean the outside of the case. Examine external cables and plugs ensuring that these are in good condition and that all connections are tight.

6. Monthly:-

- (a) Remove the receiver from its case and remove the baseplate. Brush out all dust, being careful not to disturb any R.F. wiring or damage the vanes of the tuning capacitor. Remove the coil unit and clean out the coil compartment. If a portable air blower is available, use this in preference to a brush for cleaning the equipment.
- (b) Check all valves for loose top caps and bases, replacing any that are defective. Ensure that all valve pins make good contact with their sockets. Test all valves.
- (c) Examine all soldered joints, repairing any that are loose or broken. Check that all components are firmly mounted and that no fixing nuts or screws are loose.
- (d) Ensure that the contacts on all coil units and in the coil compartment are clean and make good contact with each coil unit in position in turn. Clean the sliding earth contacts on each gang of the tuning capacitor and lubricate with a trace of grease PX 7.
- (e) Check the calibration of the receiver on all bands, using either the Wavemeter, class D, or the Frequency meter, SCR 211. If re-calibration or re-alignment is necessary, the set must be returned to Base workshops.



Power supply unit7. Monthly:-

Remove the P.S.U. from its case and clean it thoroughly. Check all connecting wires and soldered joints and check the continuity of all choke and transformer windings. Check the external cable to mains or battery. Check all input and output voltages on load. If both types of P.S.U. are held, both units should be checked.

Unit maintenance record

8. On completion of maintenance the appropriate entry will be made on AF 1266 (see Table 1003).

FAULT FINDING

9. In the event of a fault occurring on the receiver, it may be localised:-

- (a) by observing the action of the controls
- (b) by making the voltage and resistance checks detailed in Table 1001
- (c) by detailed testing of components.

10. Table 1001 has been drawn up for a Mk 1 receiver. The corresponding values for the Mk 2 receiver should generally be similar. Where the values differ widely, both are noted. The readings were taken under the following conditions, using Instrument testing, AVO, universal, 46 range, Mk 1 or 2 range.

- (a) S-meter switch OFF
- (b) AUDIO GAIN at 10
- (c) A.V.C. OFF
- (d) C.W. oscillator OFF
- (e) Selectivity set vertical
- (f) PHASING at 5
- (g) R.F. GAIN at 10
- (h) H.T. ON
- (j) No phones in use and loudspeaker terminals linked
- (k) Coil unit for 50-100kc/s range.

11. Table 1002 gives a number of possible faults and the action required.

Note: The next page is Page 1001.

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Table 1001 - Voltage and resistance test figures

Valve	Electrode	Valve base pin No.		D.C. voltage to chassis		Resistance to chassis		Remarks
		Mk 1	Mk 2	Mk 1	Mk 2	Mk 1	Mk 2	
V1	Anode Screen Cathode Grid	2 3 5 T/C	3 4 8 T/C	250 100 3.0 -	220 85	30k $\Omega$ 24k $\Omega$ 300 $\Omega$ 750k $\Omega$	40k $\Omega$	1.5M $\Omega$ with A.V.C. ON
V2	Anode Screen Cathode Grid	2 3 5 T/C	3 4 8 -	250 100 1.5 -	220 85	30k $\Omega$ 24k $\Omega$ 300 $\Omega$ - 10k $\Omega$ 750k $\Omega$	40k $\Omega$	Maximum with minimum R.F. gain
V3	Anode Screen Cathode Grid	2 3 5 T/C	3 4 8 T/C	250 65 3.0 -	220 85	30k $\Omega$ 200k $\Omega$ 5k $\Omega$ 80 $\Omega$	40k $\Omega$	
V4	Anode Screen Cathode Grid	2 3 5 T/C	3 4 8 T/C	250 100 - -2.4	220 85	30k $\Omega$ 50k $\Omega$ - 20k $\Omega$	40k $\Omega$	
V5	Anode Screen Cathode Grid	2 3 5 T/C	3 4 8 T/C	220 100 2.6- 33 -	200 85	30k $\Omega$ 24k $\Omega$ 300 $\Omega$ - 10k $\Omega$ 750k $\Omega$	40k $\Omega$	Maximum with minimum R.F. gain 1.5M $\Omega$ with A.V.C. ON
V6	Anode Screen Cathode Grid	2 3 5 T/C	3 4 8 T/C	220 100 12- 40 -	200 85	30k $\Omega$ 24k $\Omega$ 2.6 $\Omega$ - 12k $\Omega$ 750k $\Omega$	40k $\Omega$	Maximum with minimum R.F. gain 1.5M $\Omega$ with A.V.C. ON
V7	Anode Screen Cathode Grid	2 3 6 T/C	6 - 3 2	75 35 1.2 -	150	220k $\Omega$ 20k $\Omega$ 800 $\Omega$ 500k $\Omega$	100k $\Omega$	Mk 1 only With maximum A.F. gain
V8	Anode Screen Cathode Grid	2 3 5 T/C	3 4 8 T/C	25 12 - -		150k $\Omega$ 85k $\Omega$ - 50k $\Omega$		With C.W. oscillator switched on
V9	Anode Screen Cathode Grid	2 3 5 4	3 4 8 5	250 250 15 -	220 220 12	30k $\Omega$ 30k $\Omega$ 500 $\Omega$ 500k $\Omega$	40k $\Omega$ 40k $\Omega$ 300 $\Omega$	



Table 1002 - Fault location

Symptom	Possible fault	Action
1. Set dead	(a) Fault in power supply unit or leads	<ol style="list-style-type: none"> <li>1. Examine all power leads and plugs</li> <li>2. (a) Test power unit fuses and indicator lamp. Check rectifier valve. Test SW1, C1, C2 and power transformer.</li> <li>(b) On D.C. working check battery volts. Recharge if necessary. Check fuse and test switch</li> </ol>
2. Set dead, but pilot lamp lights up	(a) No H.T. on receiver	<ol style="list-style-type: none"> <li>1. Test switch on receiver and examine external connecting leads from P.S.U.</li> <li>2. Test P.S.U. as follows:- <ol style="list-style-type: none"> <li>(a) A.C. working: test fuse F1, V1 (CV1863), C3, C4A, C4B, L1, L2 and L3. Test secondary windings of transformer</li> <li>(b) D.C. working: if vibrator not functioning replace with known good one. Test V1A. (CV692) by replacement with known good one. Test all associated smoothing components.</li> </ol> </li> </ol>
3. Set dead but H.T. and L.T. present	(a) Faults in A.F. stages  (b) Faulty phones or loudspeaker	<ol style="list-style-type: none"> <li>1. Check voltage on pins of V7 and V9 (see Table 1001) Test valves by replacing them with known good ones</li> <li>2. Test loudspeaker and output transformer or phones. Examine jack JK1 for good contact</li> </ol>

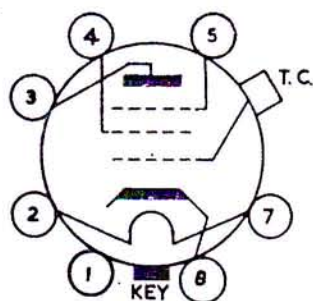
Table 1002 - (contd)

Sympton	Possible fault	Action
4. No signals but noise present	<p>(a) Fault in local oscillator</p> <p>(b) Fault in R.F. stages</p> <p>(c) Fault in I.F. or detector stages</p>	<p>1. Measure voltage at pins of V<sub>4</sub> (see Table 1) Test V<sub>4</sub> by replacement with known good one. If coil unit is suspected change frequency band and report as necessary.</p> <p>2. Measure voltages on pins of V<sub>1</sub>, V<sub>2</sub> and V<sub>3</sub> (see Table 1) replace valves with known good ones. Test receiver on another frequency band</p> <p>3. Measure volts at pins of V<sub>5</sub>, V<sub>6</sub> and V<sub>7</sub>. Test valves by replacement with known good ones</p>
5. Low sensitivity	<p>(a) Low H.T. volts</p> <p>(b) Valve faults</p> <p>(c) Fault in R.F. or I.F. stages</p> <p>(d) Faulty aerial system</p>	<p>Check supply voltage. Test P.S.U. and replace any faulty components</p> <p>Replace all valves one at a time. Always replace the old valve if sensitivity does not improve</p> <p>Take action as detailed in 4 above</p> <p>Inspect and repair aerial system</p>

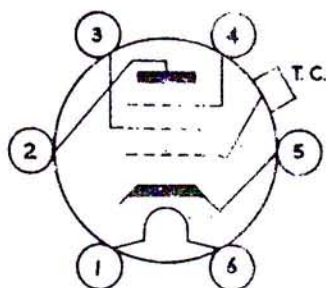


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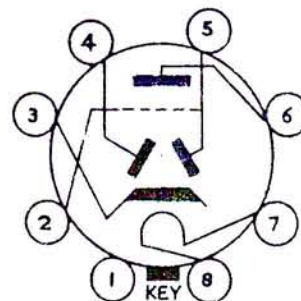
Page 1004



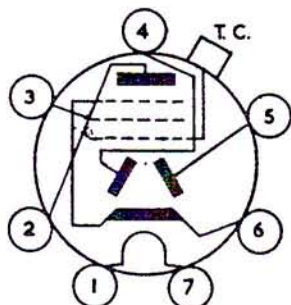
6K7 AND 6J7  
CV 1942 AND CV 1936



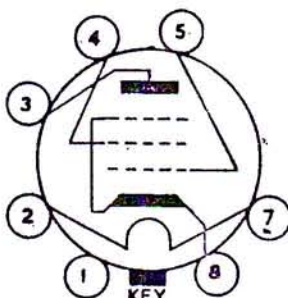
6D6 AND 6C6  
CV 1900 AND CV 585



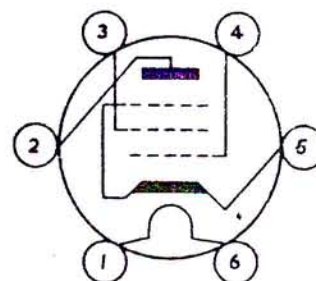
6S.Q7  
CV 1990



6B7  
CV 1891



6V6 - G/GT  
CV 511



42  
CV 609

E-163  
T-1-1001

PIN NUMBERS VIEWED  
FROM UNDERSIDE OF BASE

Fig 1001 - Valve bases

57/Maint/4016

END



ELECTRICAL AND MECHANICAL  
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(By Command of the Army Council)

RESTRICTED

TELECOMMUNICATIONS  
E 164

RECEPTION SET R 106

TECHNICAL HANDBOOK - FIELD AND BASE REPAIRS

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R E S T R I C T E D

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ELECTRICAL AND MECHANICAL  
ENGINEERING REGULATIONS

INTRODUCTION

1. This regulation should be used in conjunction with Tels E 162 and E 163 which contain the technical description, circuit diagram, component values and unit repair information.

MECHANICAL ADJUSTMENTS AND REPLACEMENTS

Removal of ganged capacitor assembly \*  
(Figs 1 and 2)

2. Remove the four panel retaining screws from the front panel and the three screws from the rear of the case. Lift the cabinet clear of the chassis. Turn the tuning dial anticlockwise beyond zero so that the dial stop A is engaged and the capacitor vanes are fully meshed. Loosen the grub screw securing the dial to the drive shaft and remove the dial. Do not disturb the annular ring gear within the dial. Unsolder the leads to the capacitor sections. Remove the four bolts securing the capacitor assembly baseplate to the mounting shelf and withdraw the whole assembly from the chassis. To replace the assembly, reverse the procedure detailed above.

Dismantling the drive assembly

3. Remove the dial and ganged capacitor assembly as detailed in para 2. The correct relative positions of the two parts of the dial are shown in Fig 1. Care must be taken to ensure that, with the dial window displaying the 0 at 11 o'clock, the two retaining springs are in the position shown in Fig 1 and the dial grub screw is at 3 o'clock, when seen from the front of the dial. The two springs must not be above the opposite sides of the holes in the dial, which position will show a 0 in the dial window but with the grub screw lying almost opposite the 0. If assembled incorrectly the springs will be stretched against the sides of the holes instead of travelling clockwise across the space provided.

4. Remove the top cover of the gearcasing by removing the four screws, B. Secure the two halves of the split pinion, C, with a piece of stiff wire wrapped around the teeth. Remove the four screws, D, from the drive shaft bush, E and remove the bush. The drive shaft and worm gear can be freed from the pinion and withdrawn from the gear housing bringing with it the two washers, spring and ball bearing.

5. To replace the assembly reverse the procedure detailed above. Note the word 'top' embossed on the drive shaft bush. Correct orientation of this bush is essential to obtain the correct positioning of the eccentric bearing supporting the numbered dial plate.

\* See 1945 notes at back for better description.

Some other documents suggest remove/replace dial at 250.  
The springs are straight. May need to "fiddle" & take off/on  
when replacing to get zero correct.



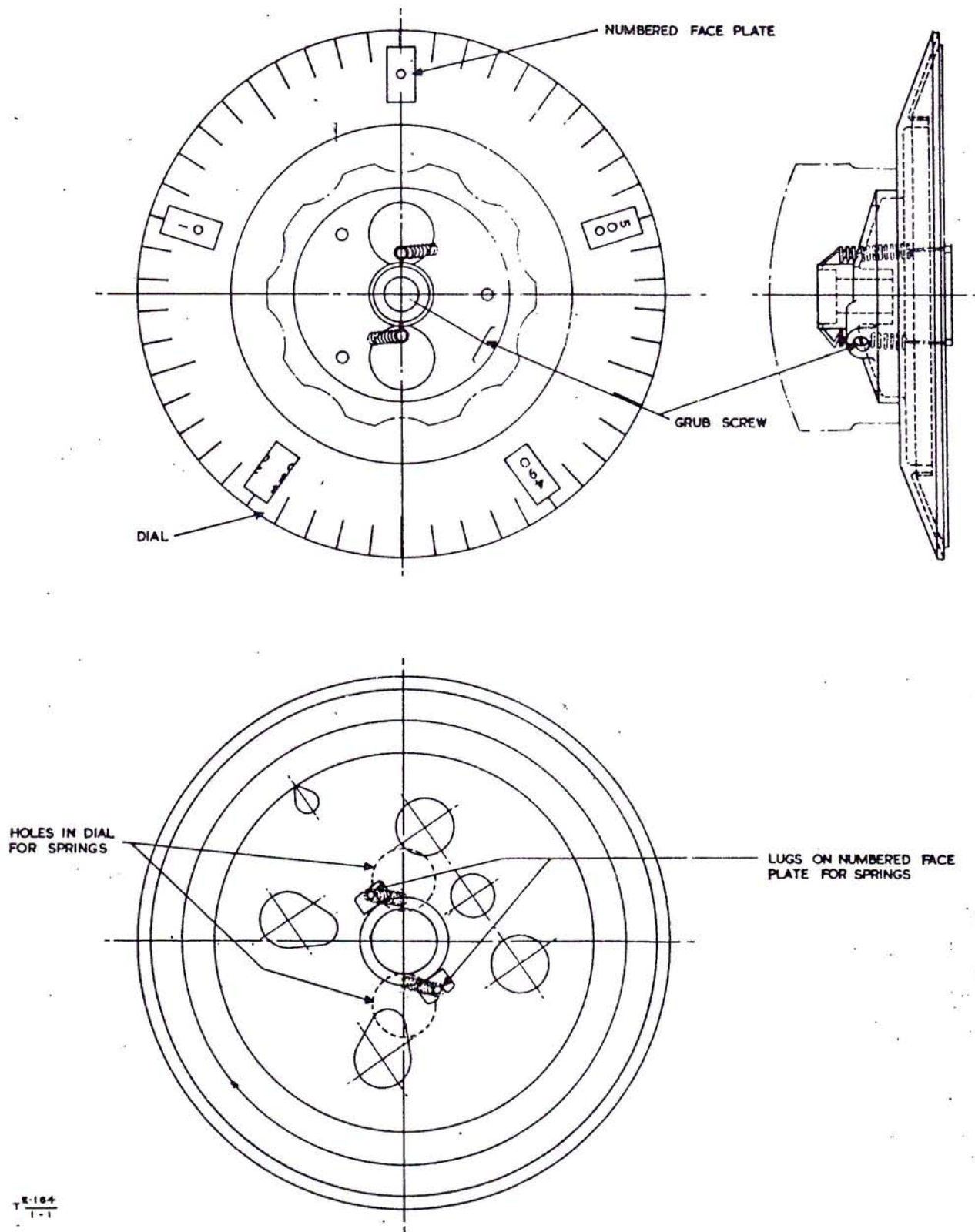


Fig 1 - Slow motion drive

Dismantling the gang capacitor  
(Fig 2)

6. The gang must not be dismantled unless absolutely necessary. Each pair of rotors and stators are carefully matched and it is important that each section is marked before dismantling to ensure reassembly in the same order.

7. Remove the gang assembly from the set as in para 2. Remove the gearcase top cover and the drive shaft bush, E. Secure the two halves of the split gear, C, by a piece of copper wire wrapped around the teeth. Remove the drive spindle as detailed in para 4.

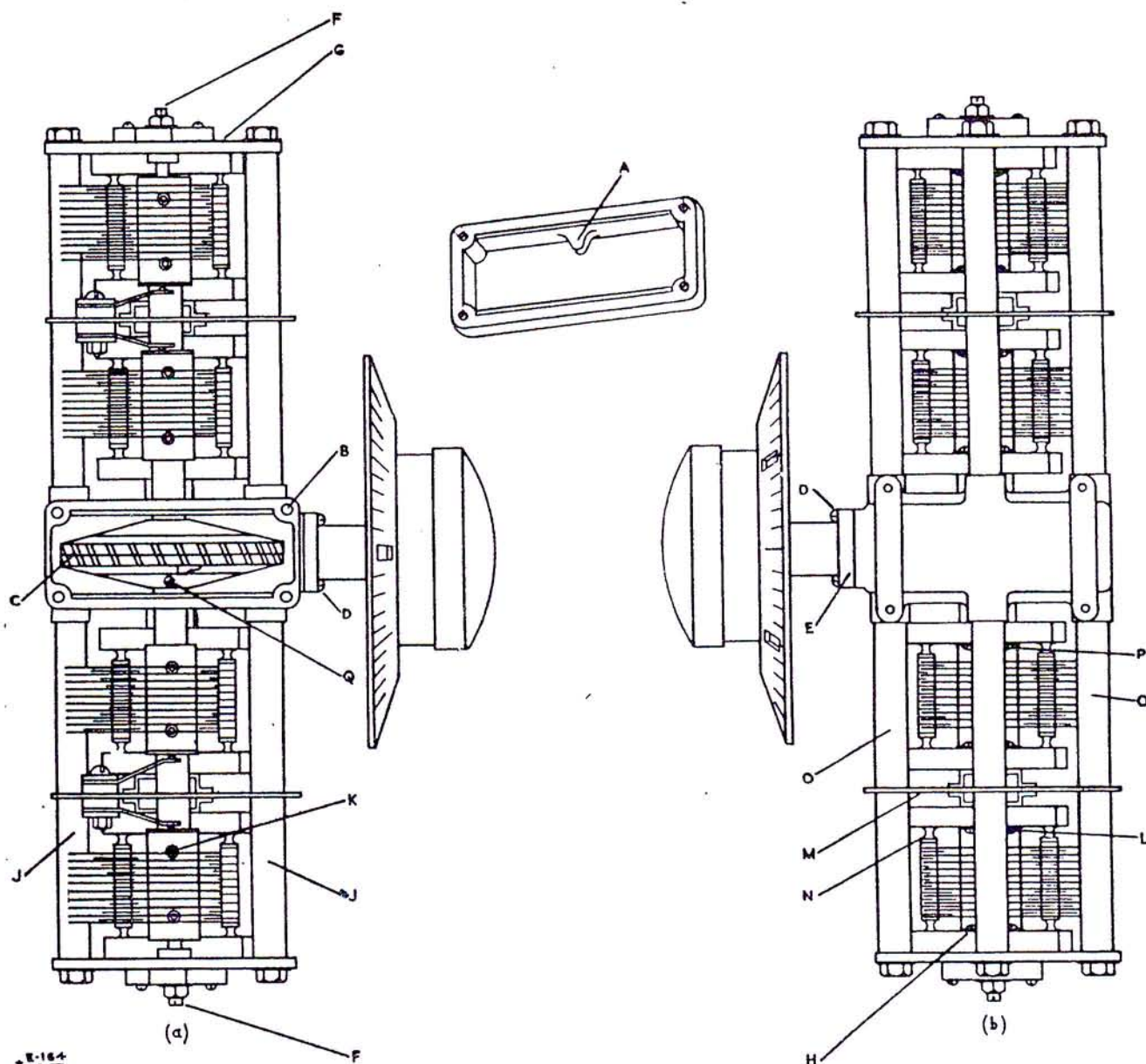


Fig 2 - Gang capacitor assembly



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8. Slacken off the bearing screws, F and remove the three nuts from the end plates, G. Remove the two screws, H, securing the outer stator insulator bars to the endplates. Remove the endplates and spacers, J.
9. Loosen the Allen-screws, K, securing the outer rotors to the spindle and remove the rotors taking care not to distort the vanes. Remove the screws, L, securing the inner stator insulator bars to the screens, M, and remove the screens complete with outer stators, N and spacing pieces, O.
10. Remove the screws, P, securing the inner stator insulator bars to the gearbox and remove the inner stator assemblies.
11. Loosen the Allen-screws securing the inner rotors to the spindle and remove the rotor taking care not to distort the vanes.
12. Loosen the setscrews, Q, securing the large drive gear to the spindle and remove the spindle. Note that the gear is a die-casting and should be handled carefully and not allowed to drop out of the gearbox.
13. Reassembly is carried out by reversing the procedure detailed above but without tightening the rotor setscrews until the endplate bearing screws have been adjusted as follows.
14. After assembling the endplates and tightening the securing nuts, locate the spindle centrally between the bearings by slackening off one bearing screw and tightening the other until all end play is just taken up leaving the spindle to rotate quite freely between centres. The bearing screws must not be over-tightened.
15. The rotors can now be lined up with their respective stators ensuring that the vanes are centrally located and the setscrews tightened. Check that the position of any stator relative to the remainder is the same by lining up at the maximum capacity with the front edges of the vanes in line.
16. Replace the drive spindle with thrust spring, washers, bearing and cover, ensuring that the latter is the correct way round. Replace the large gearbox cover temporarily.
17. Position the rotors so that the 'toes' of the rotors are about  $\frac{3}{32}$  inch below the 'toes' of the stators (ie just over the maximum capacity position). Rotate the drive spindle clockwise until the dial stop is engaged; remove the gearbox lid and tighten the setscrews in the large gear wheel. Do not overtighten the screws or damage to the spindle will result.

### ALIGNMENT AND SPECIFICATION TESTING

#### General

18. Models having air-spaced I.F. trimmers generally require very little adjustment as a result of day to day use and must not be disturbed if the I.F. amplifier has not been repaired. The alignment of sets having compression type trimmers must be checked each time the receiver undergoes repair. In the former case, it is necessary only to check the alignment to the crystal frequency (see para 24).
19. All adjustments and tests on this receiver must be carried out in a screened cage.



## R E S T R I C T E D

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### Test equipment

20. The following test equipment is required for alignment and specification testing:-

- (a) A frequency meter covering 125kc/s to 30Mc/s.  
(eg Frequency meter, SCR 211)
- (b) An audio-frequency oscillator  
(eg Oscillator, beat frequency, No.5, 7 or 8)
- (c) An output power meter for measuring powers up to 5,000mW, at 7,000 ohms  
(eg Wattmeter, absorption, A.F., No. 1 or Meters, output power, No. 3)
- (d) A 1,000 ohms per volt multimeter  
(eg Instruments, testing, avometer, universal, 50 range)
- (e) Signal generators covering the frequency range 85kc/s to 30Mc/s.  
(eg Signal generator, No. 12 (or Signal generator, No. 1)  
and Signal generator, No. 15 (or Signal generator, No. 2)).
- (f) A 1 : 1 ratio isolating transformer  
(eg WY 0089)
- (g) Loudspeaker or headphones to match 7,000 ohms.

### Test conditions

21. Unless otherwise stated, the output meter set to 7,000Ω impedance will be connected across the secondary of the isolating transformer, the primary of the transformer being connected to the loudspeaker terminals. For all R.F. tests and adjustments the signal generator will be modulated to a depth of 30% at 400 c/s for I.F. tests it will be modulated 30% at 140 c/s and for crystal tests it will be modulated 30% at 90 c/s.

22. The H.T. voltage must be 250V± 10V, and the A.F. voltage 6.3V. The R.F. gain-control must be set at position 10 and the S-meter must be switched off.

### I.F. and crystal filter alignment

23. Set the receiver controls as follows. A.F. gain to position 10, C.W. oscillator off, A.V.C. off, tuning dial to 0, selectivity control to maximum signal ie approximately vertical and phasing off. Connect the loudspeaker (or headphones) across the output meter and the signal generator, set up as in para 21, direct to the grid of V3. Short-circuit V4 grid to chassis. Insert coil unit E. Using the frequency meter, tune the signal generator to exactly 456kc/s and with an input of 1mV, which should be reduced as necessary during alignment to avoid overloading, line up all I.F. transformers for maximum output.

24. Tune the signal generator to 2Mc/s, switch off the modulation, and switch on the C.W. oscillator. Set the phasing control to the mid-position and turn the selectivity control fully clockwise. Remove the short-circuit from the grid of V4. Tune the receiver for peak output, and set the C.W. oscillator control for approximately a 1kc/s beat note. Then tune the receiver through zero beat to a 1kc/s note on the other side, increasing the signal generator output as necessary to keep the volume constant. The phasing control must now be set for minimum output and this setting noted. Retune to the crystal peak frequency, switch off the C.W. oscillator and switch on the signal generator modulation. Retune all I.F. transformers for maximum output. The I.F. circuits are now aligned to the crystal frequency; the response must be checked as follows and must agree with Table 1.



25. With connections as in para 23 but with the loudspeaker disconnected and the lead to V3 grid removed, set the signal generator to 456kc/s on the main dial. Tune the incremental dial for maximum output, varying the selectivity control as necessary. This setting should not then be disturbed during this test. Set the signal generator output to 100 $\mu$ V, and the A.F. gain for 200mW on the output meter. Increase the input to 200 $\mu$ V. Using the signal generator main dial, detune on either side of the peak until the output meter again shows 200mW. The frequency difference of the two settings is the bandwidth at 6db down. Repeat for 20, 40 and 60db down and for 6db down with the selectivity control fully clockwise, detuning the signal generator about 20kc/s before increasing the input and decreasing the input before tuning through the peak, to avoid damage to the output meter (Table 1, items a to e)

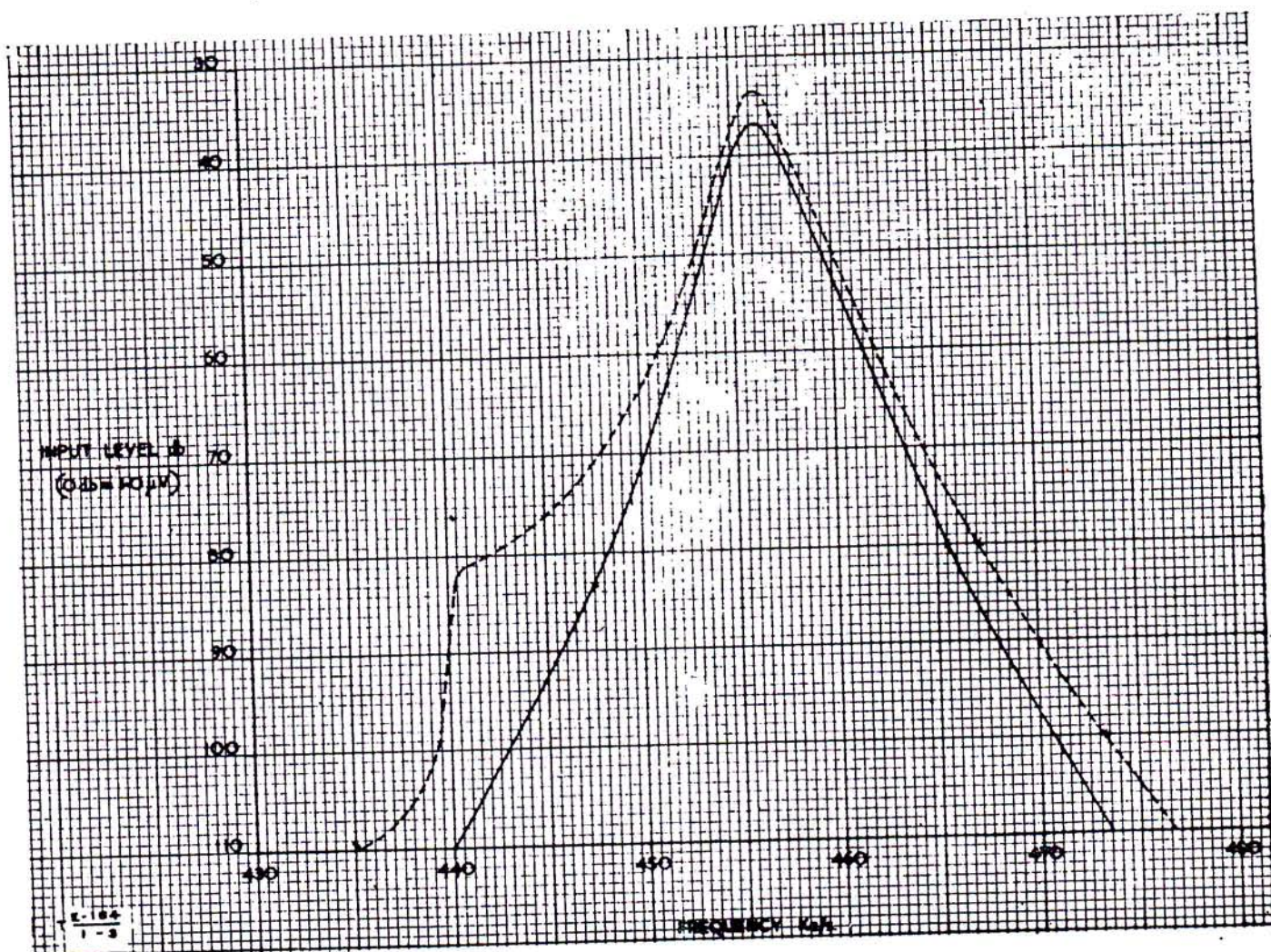


Fig 3 - I.F. Response curve



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26. The I.F. response must be symmetrical and free from double humping. If either of these faults appears to be present, plot the entire I.F. curve. A specimen curve is reproduced at Fig 3. The dotted portion shows incipient double humping. This can be cured by careful adjustment of C48 but as this trimmer seriously affects the gain of the amplifier, a compromise must be made between gain and ideal curve shape. Asymmetry can be cured by very slight adjustments to the other I.F. transformers; increasing the primary capacitance and decreasing the secondary - or vice versa - will usually clear the fault.

27. No hard and fast figure of I.F. gain can be given for the R106, as it is dependent on the value of R9, which can be anything from 1k $\Omega$  to 5k $\Omega$  and is chosen in manufacture to give a satisfactory overall performance. If, however, an output of 1W cannot be obtained with conditions as in para 25 for an input of 100 $\mu$ V, with R.F. and A.F. gain-controls at maximum, the I.F. or A.F. stages require attention.

## Crystal filter check

28. With the connections as in para 25 but with the phasing control at the setting noted in para 24 set the main dial of the signal generator to 456kc/s. Adjust the incremental dial to the crystal peak frequency, as shown, by maximum output on the output meter. With a 400 $\mu$ V input, adjust the A.F. gain-control for 50mW output. Increase the input to 800 $\mu$ V and detune the incremental dial for 50mW on the output meter. Switch off the modulation, remove the signal generator output lead from V3 and with the frequency meter loosely coupled to it, determine the signal generator frequency, increasing the output if necessary to obtain a clear beat note. Repeat on the other side of the response curve. The difference in frequency is the bandwidth at 6db down and should agree with Table 1 (item f).

Item	Attenuation	Bandwidth	Control settings and test conditions
a	6db	Not less than 3.5kc/s	Phasing control at 0, selectivity control set for maximum signal, signal generator modulated 30% at 140 c/s
b	20db	Not more than 8.5kc/s	
c	40db	Not more than 16kc/s	
d	60db	Not more than 25kc	
e	6db	Not more than 2.5kc/s	Selectivity control fully clockwise. Phasing at 0
f	6db	Not more than 0.4kc/s	Phasing at noted setting, any position of selectivity control

\*  
2.9  
6.4  
10.8

Table 1 - I.F. response data

\* ARRL : 2 stages iron core

## C.W. oscillator alignment

29. With connections as in para 23 tune the signal generator for peak output. Switch off the modulation and switch on the C.W. oscillator. Zero beat should be found with this control at position 9. Trimmers C59 and C60 must be adjusted to give this result.



C57 is in coil E only

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### R.F. alignment

30. Nine R.F. coil units are provided with the receiver. They are aligned in manufacture as a complete equipment and should not normally require any adjustment in service. If however a coil unit is replaced the alignment should be checked in the following manner.

Coil units E to J

50 kHz - 2.0  
29.5 - 30.0 MHz

31. With the C.W. oscillator in position 9, R.F. gain at 9, A.F. gain at 10, A.V.C. off, phasing at 0, selectivity control vertical and the loudspeaker connected across the output meter, turn the tuning dial to 490 and loosely couple the frequency meter, set to the frequency indicated on the coil unit calibration chart, to the aerial terminal of the receiver. Adjust C56 for zero beat. Rotate the tuning dial to 50 and reset the frequency meter. Adjust C57 (padding condenser) for zero beat. If this adjustment proves insufficient, the short-circuited turn, coupled to L15, must be adjusted. Turning this in the general direction of the winding increases the inductance and against the general direction of the winding decreases the inductance. This is a critical adjustment and must be carefully carried out.

32. When the local oscillator has been adjusted at the L.F. end of the band, the H.F. end test must be repeated and when the H.F. end tested again, until the calibration over the whole of the band is within  $\pm 3\%$  of the indicated frequency.

Note: As frequency meter SCR 2 does not cover 90 kc/s it will be necessary with coil unit J to check the second harmonic of the signal generator, tuned to 90 kc/s, against the SCR 2:1 tuned to 180 kc/s.

33. The R.F. stages can now be aligned to the local oscillator. Switch off the C.W. oscillator and replace the frequency meter by the signal generator. Switch on the modulation and set the output to 40  $\mu$ V at approximately the frequency indicated by 490 on the receiver tuning dial. Set the tuning dial at 490 and tune the signal generator for maximum output on the output meter, reducing A.F. gain as necessary. C36, C40 and C44 must now be adjusted for maximum output. No L.F. adjustments are provided for these coil units.

Coil units JA to JD

2.0 Coils

SD = 17.40

34. The calibration procedure at the H.F. end of the band is identical with that for coil units E to J (para 31), except that for coil unit JA two settings of C56 are possible. The lower capacitance value is correct ie local oscillator frequency higher than signal frequency.

35. Calibration at the L.F. end is accomplished by moving either a small turn inside the coil, or, in the case of coil unit JD screwing a brass slug into or out of the coil. The coil inductance is maximum when the counter-turn runs in the same direction as the main winding, or the brass slug is screwed out of the coil. It is at a minimum when the counter-turn moves in the opposite direction to the main winding, or when the brass slug is at the centre of the coil. Neither of these are critical adjustments. As in the case of coil units E to J, calibration adjustments should be repeated at each end of the band until the calibration is within  $\pm 3\%$  of the indicated frequency.

36. R.F. stage alignment is similar to that for coil units E to J, the trimmers concerned being C36, C40 and C44 and the L.F. end adjustment is made by a counter-turn as in para 35. Adjustments should be repeated at both ends of the band until the R.F. stages are in track with the oscillator.



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### R.F. performance.

37. For all these tests the controls must be set as follows except where otherwise stated: R.F. gain at 10, A.F. gain set for 1W output, S-meter, phasing, and A.V.C. off. The selectivity control must be set for maximum output and the loudspeaker disconnected. The signal generator must be connected to the aerial terminal via a 500Ω resistor and the earth terminal connected to chassis. All valve shields must be in place, the lid closed and the bottom in place.

### Sensitivity

38. The sensitivity must agree with column 3 of Table 2.

### Second-channel selectivity

39. At each of the frequencies in column 2 of Table 2, set the A.F. gain to give an output of 1W with an input of 10μV from the signal generator. The receiver must be tuned exactly to resonance. The signal generator is now tuned approximately to the second-channel frequency in column 4 and the signal generator output increased by the amount shown in column 5. The signal generator is now tuned for maximum A.F. output at the second-channel frequency; this output should not exceed 1W. Check that the signal generator output has not varied with the change of frequency and if necessary reset at the new frequency.

### Signal-to-noise ratio

40. With conditions as in para 37 and with an input of 10μV at each frequency in column 2 of Table 2, switch off the signal generator modulation. The resultant A.F. output due to noise must not exceed 10mW.

### C.W. sensitivity

41. With conditions as in para 37 tune the set to each of the frequencies in column 2 of Table 2. Connect the loudspeaker across the output meter, switch off the signal generator modulation and switch on the C.W. oscillator. Set C.W. oscillator for a beat note of approximately 1kc/s, reduce the signal generator input to 2μV and remove the loudspeaker. The output must not be less than 1W.

### A.V.C.

42. With conditions as in para 37 but with A.V.C. switched on, apply 10μV from the signal generator to the receiver. Set the A.F. gain control for 10mW output. Increase the input to 100,000μV. The output must not exceed 1W.

### A.F. response

43. In order to obtain the low voltages necessary for this test a simple 10 to 1 attenuator (see Fig 4) must be manufactured locally. Connect the B.F.O. via the attenuator to the junction of R13 and C12 and to chassis. With the A.F. gain control set for 1W output, the A.F. response must be as shown in Table 3.



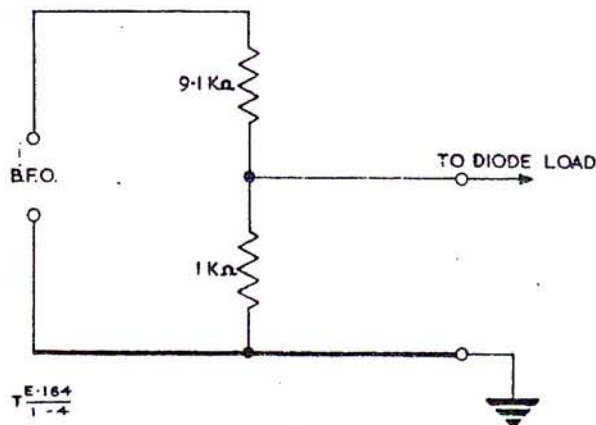


Fig 4 - B.F.O. attenuator

Coil unit (1)	Frequency (2)	Input (max) (3)	Second-channel frequency (4)	Second-channel ratio (min) (5)
JA	24Mc/s	4μV	24.912Mc/s	25db
JB	14Mc/s	4μV	14.912Mc/s	50db
JC	7Mc/s	4μV	7.912Mc/s	70db
JD	3.8Mc/s	4μV	4.712Mc/s	80db
E	1.95Mc/s	4μV	2.862Mc/s	80db
F	0.9Mc/s	4μV	1.812Mc/s	80db
G	0.4Mc/s	3μV	1.312Mc/s	80db
H	0.19Mc/s	3μV	1.102Mc/s	80db
J	0.09Mc/s	3μV	1.002Mc/s	80db

Table 2 - R.F. performance data

Frequency	Input to diode load (max)	Attenuation relative to 1kc/s
0.1kc/s	1V	+10.5db
0.2kc/s	0.45V	+3.5db
0.5kc/s	0.35V	+0.2db
1kc/s	0.3V	0db
2kc/s	0.35V	+0.2db
4kc/s	0.45V	+3.5db
6kc/s	0.5V	+4.0db
8kc/s	0.6V	+6.0db

Table 3 - A.F. response data

Note: The next page is Page 1001

Table 1001 - Specimen AF G3504

Tests recorded correspond with those detailed  
in Tels E 164 against the para numbers shown.

Para	Spec figure	Fig obtained	Pass
25	As Table 1 (a - e)		
28	As Table 1 (f)		
29	Position 9		
38	As column 3, Table 2		
39	As column 5, Table 2		
40	Not more than 10mW		
41	Not less than 1W		
42	Not more than 1W		
43	As column 2, Table 3		
Result of test			
Signature . . . . .			

Table 1002 - Coil winding data

Coil and winding	Wire gauge (B and S)	No. of turns	Spacing	Inductance	D.C. resistance
Range 50-100kc/s, coil unit J					
Aerial					
Pri	32 ESS	125	1/4 inch wave	200μH	3.3Ω
Sec	5/41 Litz	1350	3/8 inch wave	21.7mH	78.6Ω
1st R.F.					
Pri	32 ESS	75	1/4 inch wave	81μH	2Ω
Sec	5/41 Litz	1350	3/8 inch wave	26.8mH	78.6Ω
2nd R.F.					
Pri	32 DS	6.5	60 t.p.i.	1.09μH	0.2Ω
Sec	5/41 Litz	1395	3/8 inch wave	24.5mH	78.6Ω
L.O.					
Pins 2-4	32 ESS	301	7/32 inch wave	1.52μH	10Ω
Pins 2-5	tap	267		726μH	1Ω

Position of tap 1/4 turns from start of winding



Table 1002 - Coil winding data (contd)

Coil and winding	Wire gauge (B and S)	No. of turns	Spacing	Inductance	D.C. resistance
Range 100-200kc/s, coil unit H					
Aerial					
Pri	32 ESS	156	1/4 inch wave	511 $\mu$ H	10 $\Omega$
Sec	32 ESS	720	5/16 inch wave	6.83mH	22 $\Omega$
1st R.F.					
Pri	38 ESS	2770	7/16 inch wave	15.4mH	33 $\Omega$
Sec	38 ESS	730	3/8 inch wave	8.32mH	25 $\Omega$
2nd R.F.					
Pri	32 DS	10	60 t.p.i.	22.2 $\mu$ H	53 $\Omega$
Sec	32 ESS	724	3/8 inch wave	7.73mH	23 $\Omega$
L.O.					
Pins 2-4	32 ESS	270	1/4 inch wave	1mH	19 $\Omega$
Pins 2-5	(tap)	227		0.787mH	20 $\Omega$
Position of tap 43 turns from start of winding					
Range 180-430kc/s, coil unit G					
Aerial					
Pri	32 ESS	87	3/16 inch wave	1.67 $\mu$ H	2.6 $\Omega$
Sec	32 ESS	402	3/16 inch wave	3mH	14.5 $\Omega$
1st R.F.					
Pri	38 ESS	2000	3/8 inch wave	42.7mH	210 $\Omega$
Sec	32 ESS	402	1/4 inch wave	3.1mH	14.5 $\Omega$
2nd R.F.					
Pri	32 EN	8	60 t.p.i.	1.63 $\mu$ H	0.2 $\Omega$
Sec	32 ESS	402	1/4 inch wave	3.05mH	14.5 $\Omega$
L.O. Pins					
Pins 2-4	32 ESS	202	1/4 inch wave	605 $\mu$ H	6.5 $\Omega$
Pins 2-5	(tap)	134		305 $\mu$ H	4.5 $\Omega$
Position of tap 68 turns from start of winding					

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Table 1002 - Coil winding data (contd)

Coil and winding	Wire gauge (B and S)	No. of turns	Spacing	Inductance	D.C. resistance
Range 480-960kc/s, coil unit F					
Aerial					
Pri	30 DS	37	3/16 inch wave	25.5μH	0.7Ω
Sec	10/41 Litz	143	3/16 inch wave	377.0μH	3.8Ω
1st R.F.					
Pri	32 ESS	676	1/4 inch wave	48.5mH	45Ω
Sec	10/41 Litz	143	3/16 inch wave	387μH	3.8Ω
Cap	26 DS	1			
2nd R.F.					
Pri	30 DS	6	60 t.p.i.	1.36μH	0.1Ω
Sec	10/41 Litz	143	3/16 inch wave	379μH	3.8Ω
L.O. Pins					
Pins 2-4	10/41 Litz	95	3/16 inch wave	110μH	2.4Ω
Pins 2-5		29		79.5μH	0.8Ω
Position of tap 66 turns from start of winding					
Range 900-2050kc/s, coil unit E					
Aerial					
Pri	30 DS	22	3/8 inch wave	11.6μH	0.4Ω
Sec	10/41 Litz	81	3/8 inch wave	120μH	2.2Ω
1st R.F.					
Pri	36 ESS	465	1/4 inch wave	2.12mH	27Ω
Sec	10/41 Litz	81	3/16 inch wave	120μH	2.1Ω
Cap	26 DS	1			
2nd R.F.					
Pri	30 DS	16	60 t.p.i.	4.9μH	0.3Ω
Sec	10/41 Litz	81	5/32 inch wave	120μH	2.1Ω
L.O. Pins					
Pins 2-4	10/41 Litz	62	3/16 inch wave	79.2μH	1.7Ω
Pins 2-5		13		48μH	0.4Ω
Position of tap 49 turns from start of winding					



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Table 1002 - Coil winding data (contd)

Coil and winding	Wire gauge (B and S)	No. of turns	Spacing	Inductance	D.C. resistance
Range 1.7-4Mc/s, coil unit JD					
Aerial					
Pri	32 DS	10	60 t.p.i.	4.98 $\mu$ H	0.6 $\Omega$
Sec	28 EN	40	60 t.p.i.	35.8 $\mu$ H	0.8 $\Omega$
1st R.F.					
Pri	36 ESS	257	3/16 inch wave	61.5 $\mu$ H	14.0 $\Omega$
Sec	28 EN	40	60 t.p.i.	35.9 $\mu$ H	0.8 $\Omega$
2nd R.F.					
Pri	36 ESS	257	3/16 inch wave	615.3 $\mu$ H	14 $\Omega$
Sec	28 EN	40	60 t.p.i.	35.7 $\mu$ H	0.18 $\Omega$
L.O. Pins					
Pins 2-4 (slug out)	28 EN	37	60 t.p.i.	30.9 $\mu$ H	0.8 $\Omega$
(slug in)				37.6 $\mu$ H	
Pins 2-5 (slug in)		30		19.1 $\mu$ H	0.6 $\Omega$
Position of tap 6.5/6 turns from start of winding					
Range 3.5 -7.3Mc/s, coil unit JC 1" $\Phi$					
Aerial					
Pri	32 DS	5	Close wound	1.7 $\mu$ H	0.4 $\Omega$
Sec	24 EN	21.1/2	24 t.p.i.	8.97 $\mu$ H	0.2 $\Omega$
1st R.F.					
Pri	36 ESS	125	1/4 inch wave	156 $\mu$ H	6.4 $\Omega$
Sec	24 EN	21.7/8	24 t.p.i.	9.46 $\mu$ H	0.2 $\Omega$
2nd R.F.					
Pri	36 ESS	125	1/4 inch wave	156 $\mu$ H	6.4 $\Omega$
Sec	24 EN	21.7/8	24 t.p.i.	10.2 $\mu$ H	0.2 $\Omega$
L.O. Pins					
Pins 2-4	24 EN	19.1/2	24 t.p.i.	7.69 $\mu$ H	0.2 $\Omega$
Pins 2-5		15.3/4		5.67 $\mu$ H	0.16 $\Omega$
Position of tap 3.3/4 turns from start of winding					

Table 1002 - Coil winding data (contd)

Coil and winding	Wire gauge (B and S)	No. of turns	Spacing	Inductance	D.C. resistance
Range 7-14.4Mc/s, coil unit JB					
Aerial					
Pri	32 DS	4	Close wound	1.22 $\mu$ H	0.3 $\Omega$
Sec	24 EN	7	24 t.p.i.	1.38 $\mu$ H	0.1 $\Omega$
Cap	26 DS	1/2			
1st R.F.					
Pri	36 ESS	65	1/4 inch wave	39.1 $\mu$ H	3.3 $\Omega$
Sec	24 EN	8.11/16	24 t.p.i.	2.3 $\mu$ H	0.1 $\Omega$
Cap	32 DS	1/2			
2nd R.F.					
Pri	32 DS	2.3/4	24 t.p.i.	0.653 $\mu$ H	0.1 $\Omega$
Sec	24 EN	7.1/2	24 t.p.i.	2.163 $\mu$ H	0.1 $\Omega$
L.O. Pins					
Pins 2-4	22 EN	10	24 t.p.i.	2.0 $\mu$ H	-
Pins 2-5		7.1/6		0.537 $\mu$ H	-
Position of tap 2.5/6 turns from start of winding					
Range 14-30Mc/s, coil unit JA					
Aerial					
Pri	32 DS	5	Close wound	0.523 $\mu$ H	0.1 $\Omega$
Sec	22 EN	5	24 t.p.i.	0.661 $\mu$ H	-
1st R.F.					
Pri	36 DS	9.1/2	24 t.p.i.	1.35 $\mu$ H	0.7 $\Omega$
Sec	22 EN	10	24 t.p.i.	0.314 $\mu$ H	-
Ter	40 EN	50	230 t.p.i.	49.3 $\mu$ H	9.7 $\Omega$
2nd R.F.					
Pri	36 DS	9.1/2	24 t.p.i.	1.33 $\mu$ H	0.7 $\Omega$
Sec	22 EN	10	24 t.p.i.	0.283 $\mu$ H	-
Ter	40 EN	50	230 t.p.i.	48.6 $\mu$ H	9.7 $\Omega$
L.O. Pins					
Pins 2-4	22 EN	6.1/3	24 t.p.i.	0.780 $\mu$ H	-
Pins 2-5	(tap 1)	4.1/3			-
	(tap 2)	1.7/12			-
Position of taps. 2 turns and 4.3/4 turns from start of winding					



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Table 1002 - Coil winding data (contd)

Coil and winding	Wire gauge (B and S)	No. of turns	Spacing	Inductance	D.C. resistance
1st and 2nd I.F. transformer (L7/8 and L9)					
Pri } input	10/41 Litz	235	3/16 inch wave	1.5mH	7.3Ω
Sec } output	10/41 Litz	235	3/16 inch wave	1.5mH	7.3Ω
	10/41 Litz	297	3/16 inch wave	1.93mH	10Ω
tap	10/41 Litz	233		1.48mH	7.2Ω
3rd I.F. transformer (L10/11)					
Pri	10/41 Litz	260	3/16 inch wave	1.57mH	7.6Ω
Sec	10/41 Litz	260	3/16 inch wave	1.57mH	7.6Ω
4th I.F. transformer (L12/13)					
Pri	10/41 Litz	260	3/16 inch wave	1.57mH	7.6Ω
Sec	10/41 Litz	260	3/16 inch wave	1.57mH	7.6Ω
C.W. oscillator transformer					
Overall	32 ESS	223	1/4 inch wave	860μH	7.1Ω
Tap		152		470μH	4.9Ω

N.B. The coils should be measured to the following tolerances.

Coils E, F and G should be wound without the iron dust core; this should be inserted when measuring the coil inductance and its position varied to give the inductance figure stated to within 2%. Cores should be locked in position with YC 00600 wax, sealing, iron dust core.

Coil JA. The local oscillator coil should be wound to the limits shown.

All other coils should be wound to within 3% of the stated value. Their actual value will be dependent upon the position of the counter turn (paras 35-36) or the short-circuited turn (para 31).

57/Maint/4016

END

## **RECEPTION SET R-106, MKS. I AND II**

### **SECOND TO FOURTH ECHELON WORK**

*This information is provisional and is supplied for guidance pending the issue of more complete instructions. All errors of a Technical nature should be reported in accordance with E.N.E.R. Tels. AY-009.*

### **MECHANICAL ADJUSTMENTS**

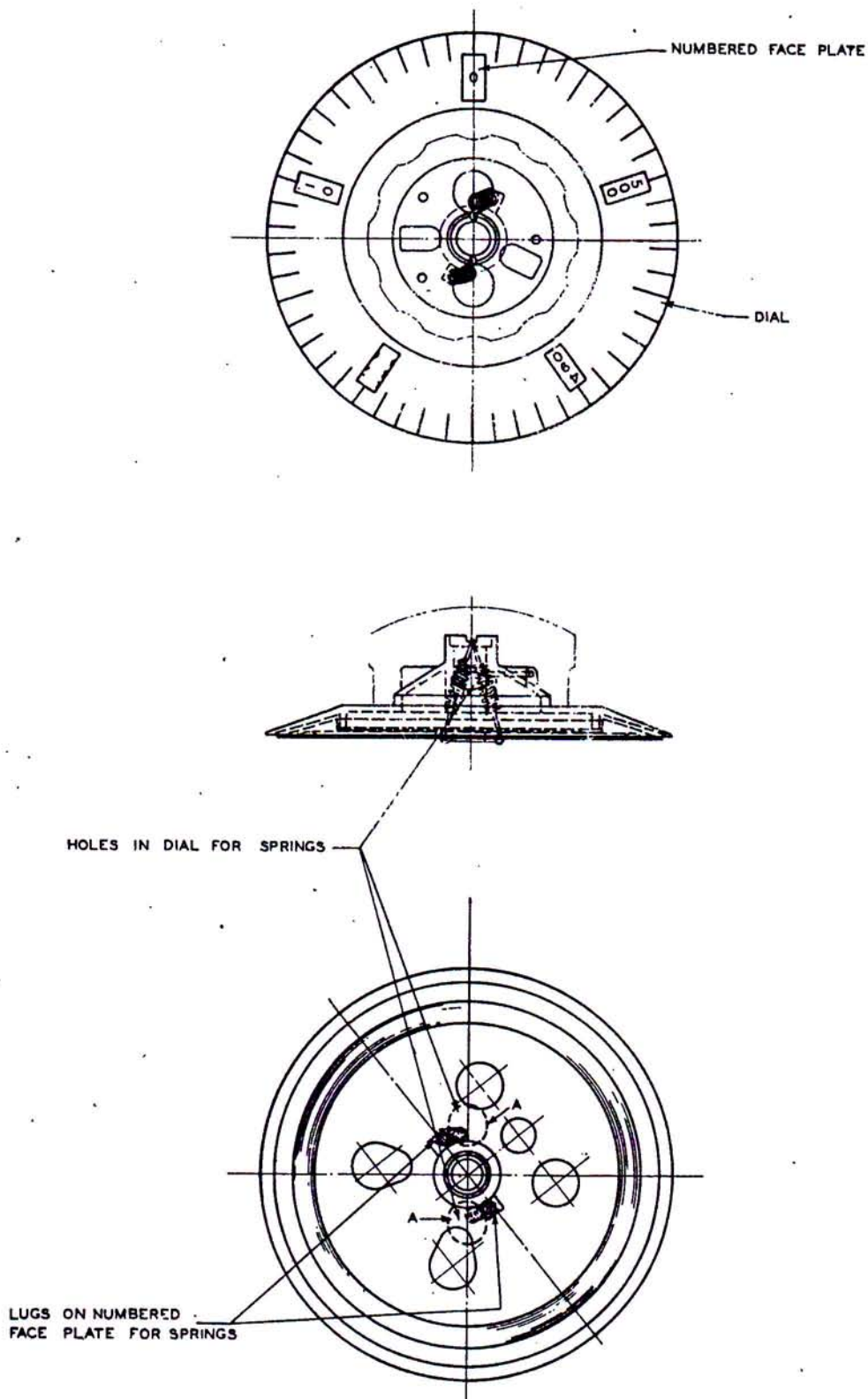
**To remove Cover.**

1. (a) Remove three screws at the back of the cabinet.
- (b) Remove the four small screws around the edge of the front panel, remove the clamping strips at the sides and angle strip along the top of the panel, thus releasing the cover.
- (c) Lift cover from the receiver leaving the chassis with the front panel attached.

**To remove the Tuning Dial.**

2. (a) This should not be attempted unless absolutely necessary, e.g. if removal of front panel is required.
- (b) Care must be taken when removing and replacing the dial, that the relative positions of the numbered face plate and tuning handle are not altered in any way.
- (c) Turn the dial so that the gang condenser is fully closed and the drive stop is engaged.
- (d) The dial will now be with the zero window about five divisions to the left of the pointer on the front panel, and the grub screw located at 3 o'clock on the tuning handle.
- (e) Slacken the grub screw and pull the dial forward at the same time easing the numbered face plate gently forward from the rear. Do not rotate the handle but apply a straight pull only and take care that the two parts of the dial do not become separated or the springs detached..





T GY-704/1

FIG. 1. SLOW MOTION DRIVE

**To replace Tuning Dial.**

3. (a) Ensure that the gang is fully closed with the drive stop engaged.
- (b) Taking care that the two parts of the dial are not disturbed, replace it with the zero window five divisions to the left of the pointer.

**NOTE:** The grub screw should now be at 3 o'clock. If it is not, the relative positions of the two parts of the dial have been disturbed, and must be corrected to preserve the correct operation of the epicyclic drive (see para. 4).

- (c) Tighten grub screw.

**Details of Tuning Dial.**

4. The correct Relative Positions of the Dial and Numbered Face Plate when the condenser is at maximum capacity are shown in Fig. 1. The lugs for the springs on the face plate must be as shown in Fig. 1 relative to the recesses in the dial plate. They should NOT be above the opposite sides of the recesses, (at A.A.) which will show the same numbers in the dial windows but the grub screw would then be almost opposite the zero window. If assembled incorrectly the springs will stretch against the sides of the recesses instead of travelling clockwise across them.

**To remove Front Panel.**

5. (a) Remove Coil Unit.
- (b) Remove tuning dial as described in para. 2.
- (c) Remove all other controls, S Meter switch (S4) and phone jack (JK1).
- (d) Remove four large and four small screws.
- (e) Lift off the panel.

**To remove Main Gang.**

6. (a) Remove dial.
- (b) Disconnect all soldered connections.
- (c) Remove the four retaining screws at base of gear box.
- (d) Lift out gang.