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This document is of fairly simple format in that it can be made to print out using an A4 format printer (this is the common paper size available in UK and Europe, which measures 29.7cm by 21.0cm). By "simple" I mean that there are no large diagrams on fold out sheets, which will require multiple A4 pages to print out at full size.

Original document sizes do vary a lot – from the small manuals, which approximate to A5 size (21.0 x 14.8 cm) up to the now obsolete foolscap size (21.6 x 33.0 cm). US documents tend to use their "letter" size paper (21.6 x 27.9 cm). All these sizes can be printed on A4 paper by simply getting Acrobat to shrink or enlarge the pages as necessary. This is done as follows:

1. Select "File – Print" or click on the printer icon. This will bring up the print dialog box.
2. Select the correct printer if necessary.
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Any other problems?

Please get in touch with me at archivist@vmarsmanuals.co.uk.

Richard Hankins, VMARS Archivist, Summer 2004

RECEPTION SET, EDDYSTONE, 730/4 (Z4/ZA 51262)

TECHNICAL HANDBOOK - TECHNICAL DESCRIPTION

This EMER must be read in conjunction with Tels E 742 Part 2 which contains figures and tables to which reference is made.

SUBJECT INDEX

INDEX TO TABLES

INDEX TO FIGURES

Distribution - Class 1190. Code No 3

INTRODUCTION

1. The Eddystone receiver type 730/4 is a high grade single superheterodyne communications receiver, covering the range 480kc/s to 30Mc/s in five bands. It can be operated from a.c. mains or from h.t. and l.t. batteries.

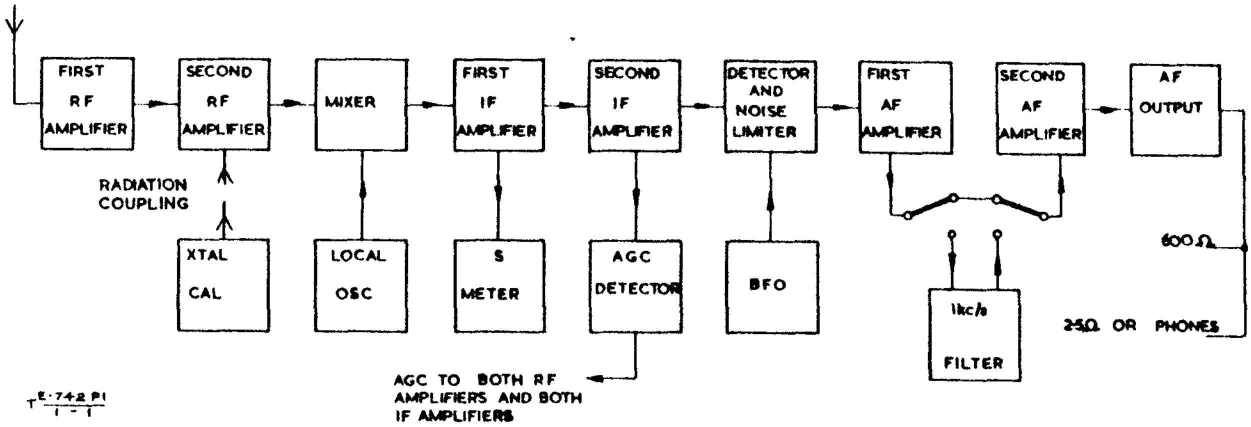

Fig 1 - Receiver block diagram

BRIEF ELECTRICAL DESCRIPTION

2. The block diagram is shown in Fig 1. Two r.f. stages are followed by a mixer with separate oscillator. The mixer coupling to the first i.f. valve may be via a crystal filter if required. Two i.f. stages are used; the i.f. transformers have variable coupling between primary and secondary, providing control of selectivity. After demodulation, the a.f. signal is amplified in two triode stages. An a.f. filter tuned to 1kc/s may be interposed between the triodes. A pentode output stage provides an output to loudspeaker or headphones, and to land-line terminals. When the phone plug is inserted, the loudspeaker is automatically muted, but the 600Ω output remains available.

3. Additional features include a 500kc/s crystal calibrator; a beat frequency oscillator for the reception of CW signals; a cathode follower stage providing an output at the i.f.; an optional noise limiter and an 'S' meter.

4. Power supplies are obtained when using a.c. mains, from a conventional full-wave rectifier circuit. When a battery supply is used, the h.t. still passes through the rectifier smoothing circuit. Certain valves receive stabilised h.t. on mains and battery working when the battery supply exceeds the striking voltage (220V) of the stabiliser valve. The minimum recommended h.t. voltage from a battery supply is 180V.

CONSTRUCTION

Chassis

5. The chassis (see Fig 2502 and 2503) is made in three sections. The centre section is a die-cast alloy box, divided into four compartments. Each compartment houses the coils, trimmers and wafers of the wavechange switch associated with one of the r.f. stages. The aerial coils occupy the rear-most compartment; the first r.f. valve is positioned so that its grid pin is in this compartment, while its anode pin is in the adjacent compartment. A similar form of construction is employed for V2. The mixer valve V3 and the local oscillator valve V4 are situated in the centre of their respective compartments. The layout of the r.f. components is shown in Fig 2504.

6. The wavechange switch is of the short-circuiting type, all contacts except the one in use are short-circuited together and to chassis. Each wafer has an earthing bar of spring wire which presses against the switch shaft.

7. The four-gang tuning capacitor C9 is mounted on the alloy box. It has its own screening cover, on which is mounted the h.t. switch and the crystal calibrator sub-chassis. The height of the tuning capacitor may be adjusted by means of knurled set-screws (two at the front and one at the rear) to accommodate manufacturing tolerances in the dial drive mechanism.

8. On each side of the alloy box is a sub-chassis of pressed steel, supported at its outer edge by a steel frame which also carries the front panel. Viewed from the rear, the left-hand sub-chassis carries the i.f. and a.f. amplifying components; the right-hand sub-chassis carries the b.f.o. and power supply components.

Dial and tuning drive

9. All the tuning and dial drive components are mounted on the front panel. The pointer drive uses a cord and pulley system, but the capacitor drive is by means of double spring-loaded gears to prevent backlash. A heavy fly-wheel mounted on the shaft of the tuning control permits a large portion of the dial to be swept with one flick of the tuning knob.

10. The dial has five scales calibrated in frequency and one calibrated linearly from 0 to 2,500. The latter is used as a logging scale in conjunction with a vernier scale at the top of the dial. The vernier scale is marked 0 to 100, and rotates 25 times for one sweep of the logging scale. A small green lamp, at the high frequency end of each calibrated scale, indicates the frequency range in use. The entire dial is illuminated by three bulbs along its top edge. The brilliance of these bulbs is controlled by a variable resistor at the rear of the receiver.

11. The 'S' meter is mounted at the rear of the dial, only the calibrated portion of its scale being visible from the front. This meter operates only when the selectivity switch is on the narrowest sector.

Cabinet

12. The cabinet is of pressed steel. Most of the top forms a hinged lid, giving access to valves and dial lamps. The cabinet is secured to the chassis by four coin-slotted screws at the rear. Slotted 1/8 in. steel brackets fitted to each end of the cabinet provide for standard 19 in. rack mounting.

CONTROLS

13. The controls, and their functions, are given in Tables 1 and 2. See also Fig 2 and 3.

Table 1 - Front panel controls

Control nomenclature	Circuit reference	Function
Calibrator switch	SB1 & SB2	To switch on the crystal calibrator and mute the first r.f. stage.
Cursor adjuster	-	To allow the cursor to be moved independently of the main tuning drive and permit it to be set up against the crystal calibrator.
R.F. GAIN	R65	To control the cathode bias of both the r.f. valves and the second i.f. valve.
B.F.O.	C112 & SH	To switch on and control the frequency of the b.f.o. valve V12. (SH is integral with the capacitor moving vane).
CRYSTAL PHASING	C48 & SC	To remove the short-circuit from XTAL B, and tune the filter to either side of the i.f. response curve. (Arranged as C112 & SH).
A.F. GAIN	R40	To control the input to the first a.f. stage V8A.
MAINS	SJ	To switch the a.c. mains ON or OFF. (Double-pole switch in the primary of T8).
A.V.C.	SF	To short-circuit the a.g.c. voltage to earth in the OFF position.
N.L.	SE	To short-circuit the noise limiter diode V9B in the OFF position.
A.F. FILTER	SK	To insert the a.f. filter between the two a.f. amplifying stages V8A and V8B.
SELECTIVITY (The control is marked with four bands. The width of the band indicates the 'band-width')	SD1 & SD2 T1, T3 & T4	(a) To insert a capacitor, C108, as a low-pass filter, in all positions of SD except 'broad'. (SD1B) (b) To switch various resistors into the cathode circuit of V5 to maintain the gain constant with variation of band-width. (SD1F) (c) To switch the 'S' meter into circuit in the 'narrow' position of the switch. (SD2B)

Table 1 - (cont)

Control nomenclature	Circuit reference	Function
Wavechange (labelled 1,2,3,4 & 5)	SA	To select the required coils and indicating lamp.
TUNING	C9	To control the four-gang tuning capacitor.

Table 2 - Rear panel and internal controls

Control nomenclature	Circuit reference	Function
H.T. (Internal switch)	SL	To switch the h.t. ON or OFF after the smoothing circuit. (Primarily to economise on h.t. consumption when using batteries).
'S' METER (Pre-set potentiometer)	R60	To adjust the 'S' meter to zero.
DIAL LAMPS (Pre-set potentiometer)	R70	To control the dial lamp brightness.

POWER CONSUMPTION

14. The consumption of the receiver with the h.t. switch operated is:-

(a) Mains operation: 80W

(b) Battery operation: 5A at 6V and 120mA at 250V.

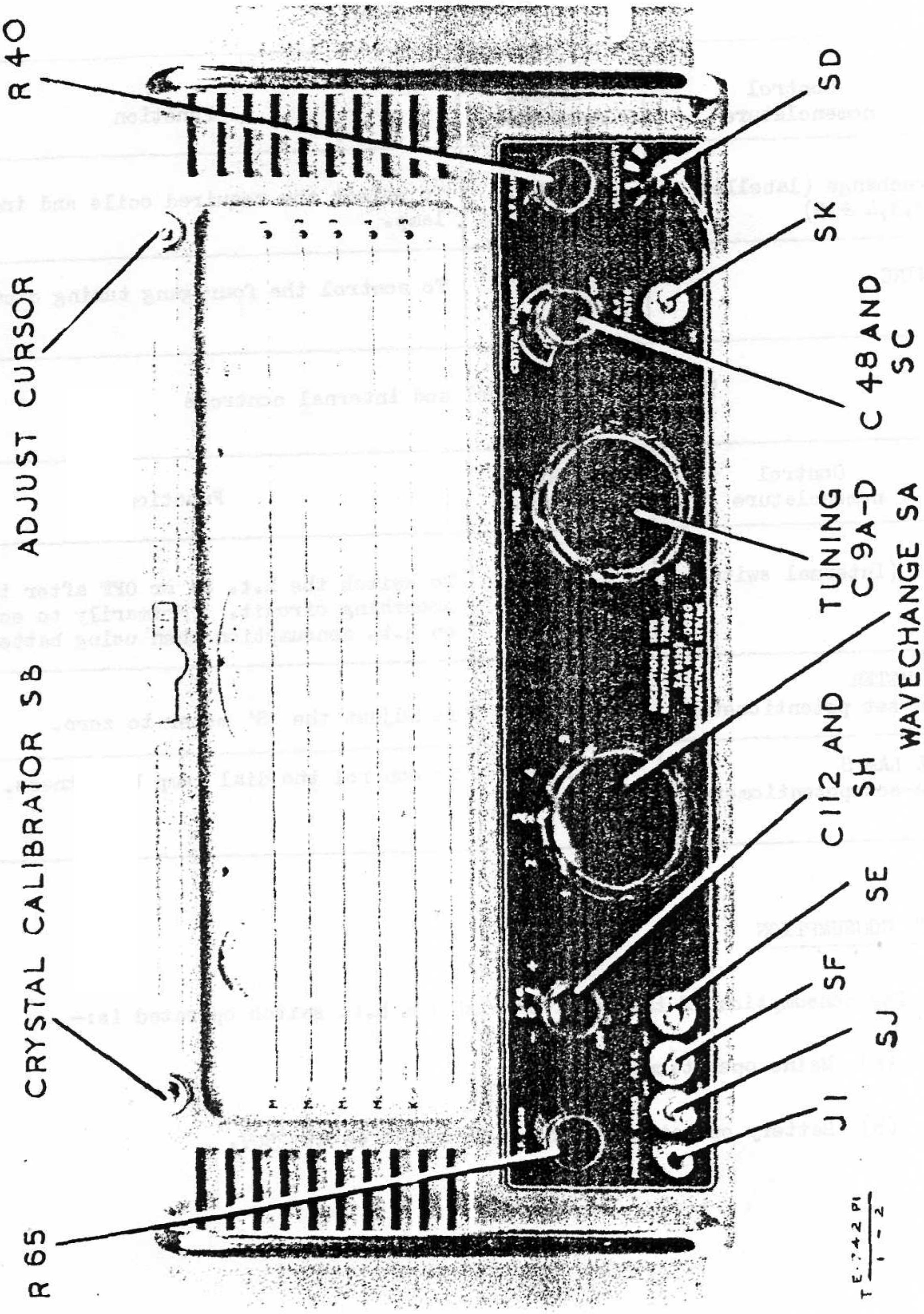

Fig 2 - Front panel controls

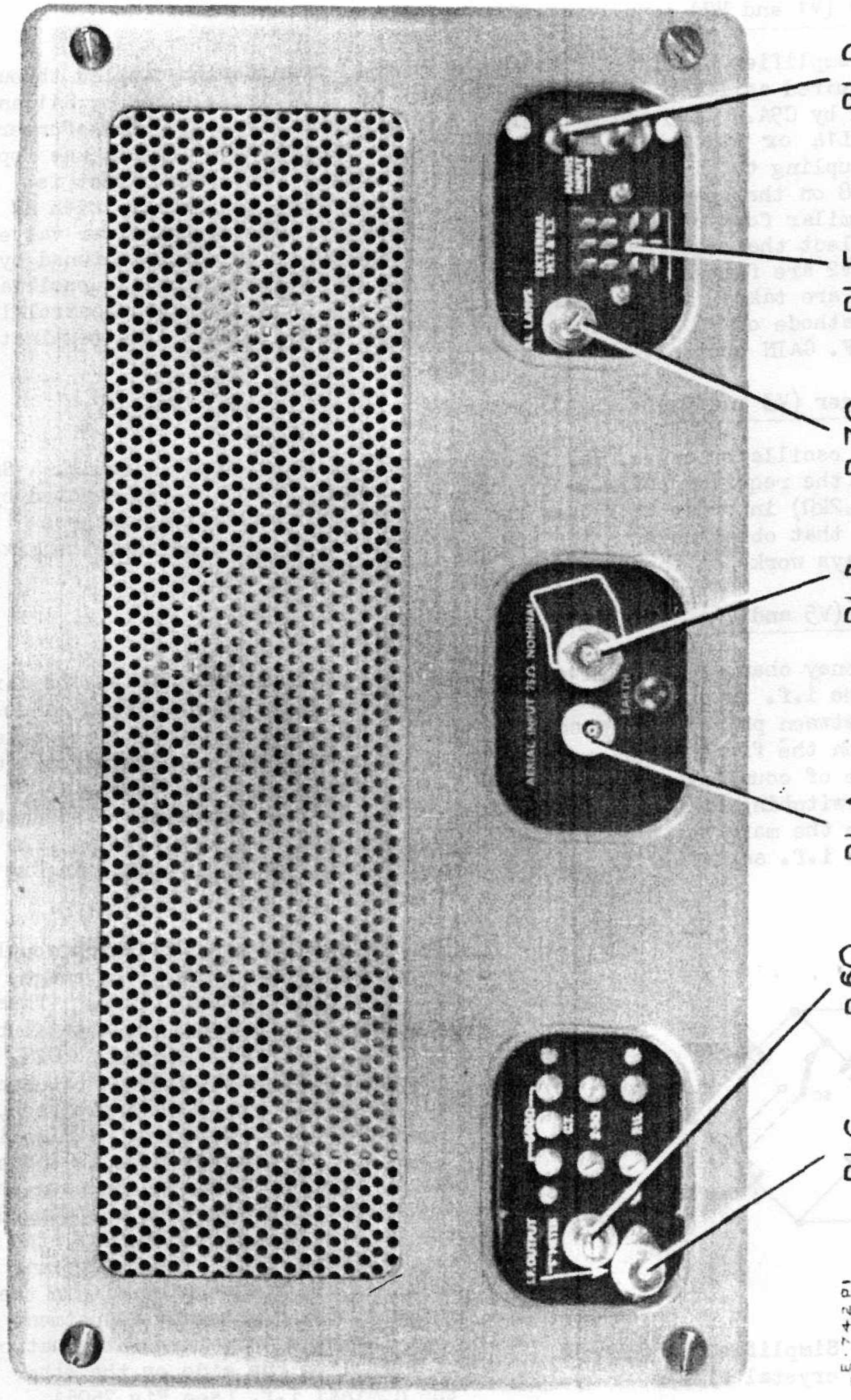

Fig 3 - Rear panel controls

DETAILED ELECTRICAL DESCRIPTION (see Fig 2501)

R.F. amplifier (V1 and V2)

15. The r.f. amplifier consists of V1 and V2 (CV454) transformer coupled throughout. The required aerial coil (L1, L5, L9, L13 or L17) is selected by SA1 and SA2, and tuned by C9A. SA3 and SA4 select the required intervalve transformer (L2, L6, L10, L14 or L18) which is tuned by C9B. L2, L6, L10 and L14 use top-capacitance coupling to give a bandpass characteristic. The same effect is achieved on L18 on the lowest frequency range, by shunting the primary with R7 (150Ω). A similar form of coupling is used between V2 and V3, the mixer valve; SA5 and SA6 select the required transformer, the secondary of which is tuned by C9C. V1 and V2 are fitted with 12Ω grid stoppers to inhibit parasitic oscillations. Their cathodes are taken, via decoupling components, to the r.f. gain control line, to which the cathode of V6 (2nd i.f. valve) is also taken. This line terminates on R65, the R.F. GAIN control.

Frequency changer (V3 and V4)

16. The local oscillator valve, V4, is connected in a tuned anode circuit. SA7 and SA8 select the required coils. L16 and L20 (ranges 4 and 5) are shunted by R54 and R55 (2.2kΩ) in order to reduce the amplitude of oscillation at these frequencies to that obtainable on the other ranges. This ensures that the mixer valve, V3, always works on the same part of its characteristic.

I.F. amplifier (V5 and V6)

17. The frequency changer is followed by two stages of amplification at the i.f. (450kc/s). The i.f. transformers associated with these stages are arranged so that the coupling between primary and secondary can be varied by rotation of the selectivity control on the front panel. In order to avoid the change in gain consequent upon the change of coupling, the bias on V5 is decreased, as the coupling is increased, by switching different resistors into the cathode circuit. The switch, SD is ganged to the main shaft of the SELECTIVITY control (see Fig 2503). The response of the i.f. amplifier is shown in Fig 2505, and the layout of SD in Fig 2506.

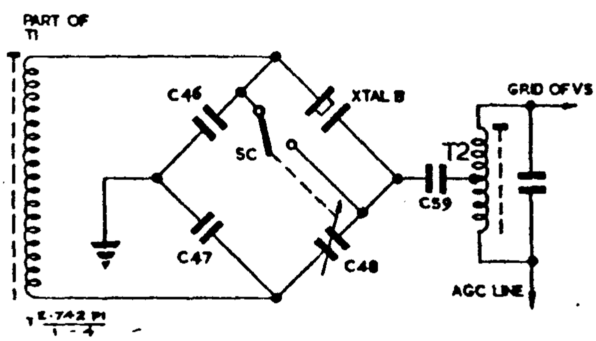

Fig 4 - Simplified circuit of crystal filter

18. Between T1 and T2, which couple the mixer to the first i.f. stage, is interposed a crystal filter. This is normally inoperative, the crystal being shorted by a switch ganged to C48, the CRYSTAL PHASING capacitor. As soon as C48 is moved from the OFF position, the short-circuit is removed; a simplified circuit of the arrangement is shown in Fig 4, from which it can be seen that the output is taken from one diagonal of the bridge formed by C46, C47, the crystal, and C48. The bridge may be balanced for frequencies within the range of the crystal by adjustment of C48, giving a very large attenuation of signal on one side or the other of the nominal i.f. (see Fig 2505).

Demodulator, noise limiter and a.g.c. (V7A, V9B and V7B)

19. The demodulator circuit incorporated a peak noise limiter, controlled by SE (N.L.) on the front panel. A simplified circuit is shown in Fig 5.

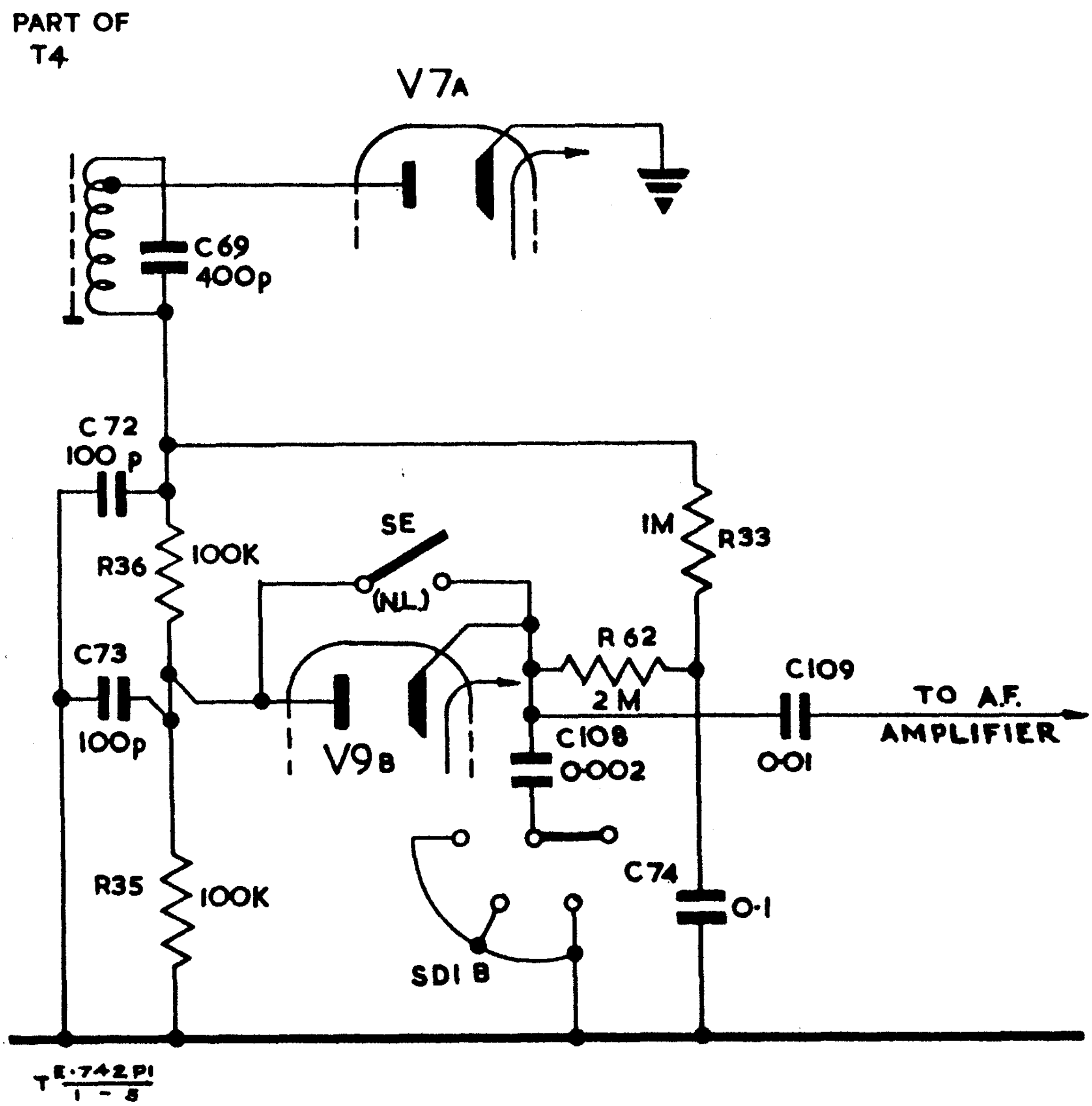

Fig 5 - Simplified circuit of detector and noise limiter

20. With SE closed, the a.f. output of the demodulator is developed across R35 and passed to the a.f. amplifier. With SE open, the a.f. signal must pass through V9B. Consider the static conditions when a c.w. signal is being received. The potential across the whole diode load (R35 + R36) will be, say, -5V with respect to earth. Once C74 is charged the potential on the cathode of V9B will also be -5V. The anode potential is however only -2.5V, since it is taken from the junction of R35 and R36, so that the diode conducts. When the signal is modulated, 100% modulation will cause the anode of V9B to swing between 0 and -5V; because of the long time constant of R33 and C74 the cathode will remain at substantially -5V. The a.f. signal will therefore pass through the diode.

21. Suppose now a burst of noise appears in the i.f. output. After rectification, it will appear as a 'spike' on the a.f. and will drive the anode of V9B more negative than before. The long time constant of the cathode circuit ensures an unchanged bias condition. For the instant of the noise spike the diode is cut off, as the anode potential is negative with respect to the cathode and thus no a.f. can be transmitted to the a.f. amplifier.

22. A.G.C. is produced by rectifying the i.f. output from V6 anode in V7B. A fixed voltage delay of some 12V is obtained by returning the cathode of V7B to a point 12V positive to earth at the junction of R72 and R73.

A.F. amplifier and output (V8 and V15)

23. V8 is a double triode; between the anode of V8A and the grid of V8B an a.f. filter tuned to 1kc/s may be connected. This filter is provided for c.w. reception, and has a bandwidth of 100c/s at 6dB down (see Fig 2507). Used in conjunction with the beat frequency oscillator tuning (see para 28) and the crystal filter, the a.f. filter can provide reception substantially free from interference.

24. The cathode resistor of V8B is not by-passed to provide current negative feedback to this stage. Additional voltage feedback is provided by connecting the anode of the output valve (V15) to the anode of V8B by a resistor R46.

25. Three outputs at a.f. are available from V15. One output, at 600Ω impedance, centre-tapped, may be used to feed a land-line via normal telephone circuits. A second output, at 2.5Ω impedance, is provided for loud speaker reception. The third output, to headphones, is taken via C84 and R49 from the anode of V15, the output voltage being developed across R50 to earth. A switched phone jack is used, so that insertion of the headphone plug mutes the loudspeaker.

Additional facilities

Crystal calibrator (V10)

26. V10 is connected in a Pierce crystal oscillator circuit of 500kc/s fundamental frequency. Coupling between the calibrator and the second r.f. stage is by means of stray radiation, assisted by a lead running along the calibrator power lead and tied to the frame of C9 opposite the second r.f. section C9B.

27. The calibrator is inoperative until SB, a push-switch mounted at the top left-hand corner of the front panel, is operated. One contact of SB short-circuits a 3MΩ resistor R76 in the anode of V10; the other removes a short-circuit from R74,

a 100kΩ resistor in the cathode lead of the r.f. amplifier V1. The latter resistor increases the bias on V1, and mutes the receiver to incoming signals. The 3MΩ resistor in V10 anode acts as a 'keep-alive' resistor and, at the same time, prevents cathode poisoning.

Beat frequency oscillator (V12)

28. The b.f.o. consists of V12, connected in a cathode-coupled Hartley circuit, tuned to the nominal i.f. of 450kc/s. The tuned circuit is short-circuited (by a switch ganged to C112) in the OFF position of the b.f.o. control; the effective tuning range of C112 is ±3kc/s. The b.f.o. voltage is injected at the demodulator anode via C110.

I.F. output (V11)

29. V11 provides an output at the i.f. into an impedance of approximately 80Ω. This output may be used to feed c.f.s. equipment, eg Receiver adaptor, field, c.f.s., or may provide one input to a space diversity detector system. V11 is triode connected in a cathode-follower circuit.

'S' meter and diode (V9A)

30. On the most selective position of the bandwidth control, a sensitivity meter is switched into circuit. The meter is in series with diode V9A, and measures, in effect, the screen voltage of the first i.f. valve, V5. The scale of the meter is calibrated in 'R' values (1R=6dB) above a minimum threshold value, determined by the noise in the r.f. stages. It is set up by short-circuiting the aerial and earth terminals of the receiver, turning the r.f. gain to maximum and setting R60 for zero on the meter. Under these conditions V5, which is a.g.c. controlled, is working with minimum bias and consequently maximum screen current. The voltage at the junction of R23 and R27 is at a minimum. When a signal is received the a.g.c. voltage increases and the voltage at the junction increases. The diode is included to stabilise the 'S' meter zero position.

Power supplies

31. The receiver can be operated from a.c. mains or from h.t. and l.t. batteries. In the a.c. role, a conventional full-wave rectifier followed by a capacitance input filter is used to supply h.t. directly to all valves except the local oscillator (V4), the b.f.o. (V12) and the screen of the mixer V3. These valves are supplied with h.t. stabilised by V14 (CV216).

32. The heaters of all valves except V9 are supplied from a common 6V winding (X-X). V9 receives l.t. from a separate 6V winding (Y-Y), the centre-tap of which is taken to a point about 4V positive with respect to earth. This prevents heater emission and reduces hum when the noise limiter is used.

33. A shorting socket is provided for use with a.c. mains supply. The supplies from the mains transformer are brought out to a 12-point Jones plug at the rear of the chassis, and the circuit back to the h.t. and l.t. rails is completed via the shorting socket.

34. When the set is to be supplied from batteries the shorting socket is removed and the socket to which the batteries are connected is put in its place. The h.t. smoothing circuit is still in circuit, but the heater of V9 is no longer raised above earth.