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Richard Hankins, VMARS Archivist, Summer 2004

WIRELESS SET C12

TECHNICAL HANDBOOK - TECHNICAL DESCRIPTION

This EMER must be read in conjunction with Tels H 142 Part 2 which contains figures and tables to which reference is made.

Note: This Part 1, Issue 2, together with Part 2, Issue 2, supersedes Issue 1, Pages 1 to 8 and 1001 to 1023, dated 9 Dec 55.

SUBJECT INDEX

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INDEX TO FIGURES

INDEX TO TABLES

Introduction

1. The Wireless set (W.S.) C12 is an interim replacement for the W.S.19. It incorporates most of the latter's facilities, with some refinements. The W.S.C12 provides VOICE/CW reception and transmission (amplitude modulated) in the frequency-range 1.6 - 10Mc/s. This frequency range is divided into two bands: the LF band covers 1.6 - 4.0Mc/s and the HF band covers 4.0 - 10Mc/s. Provision is made for netting to a control station and for flick operation on two predetermined frequencies. An intercommunication (intercomm) amplifier provides intercomm facilities in conjunction with the vehicle harness. Although originally designed for crystal as well as fully-variable operation, the crystal facility is not used in the Service; the changeover switch shaft is not brought out to the front panel, the panel hole being covered by a metal plug. There is no equivalent in the W.S.C12 of the v.h.f. B - set, used for short-range communication, in the W.S.19. This facility was to have been provided by W.S.B45; it is unlikely that this wireless set will now be fitted, and inter-vehicle communication will be by the infantry set ie W.S.B47.

2. The maximum r.f. power output on both VOICE and CW is 4.4W between 6 and 8Mc/s, falling to 3W at 10Mc/s and 2.7W at 2Mc/s. Improvements in the efficiency of the aerial coupling circuits and the increase in power output have resulted in a greater range being obtainable than with the W.S.19. Aerial tuning unit (a.t.u.) No 5 couples the W.S.C12 to rod or vertical wire aerials: separate tuning arrangements

are provided for each flick position. The power supply unit (p.s.u.) is available in two versions for 12V or 24V operation: the output in each case is the same, although the units differ somewhat in construction, and the 24V unit has a much higher consumption.

Installations

3. W.S.C12 can be used with wireless control harness type A (see Tels L 770 - 9) or type B (see Tels L 780 - 9), and becomes the A-set of such an installation. Full details of the connectors, unit layout etc of each installation are given in the relevant Comms Inst EMER for the vehicle concerned. A special connector, Adaptor connectors, 12 point, No 1, has been made available to enable the wireless set to be used with the W.S.19 type of harness. Junction box '0', described in Tels L 782, is used when the wireless set is to be operated without a harness, as in certain B vehicle and static installations.

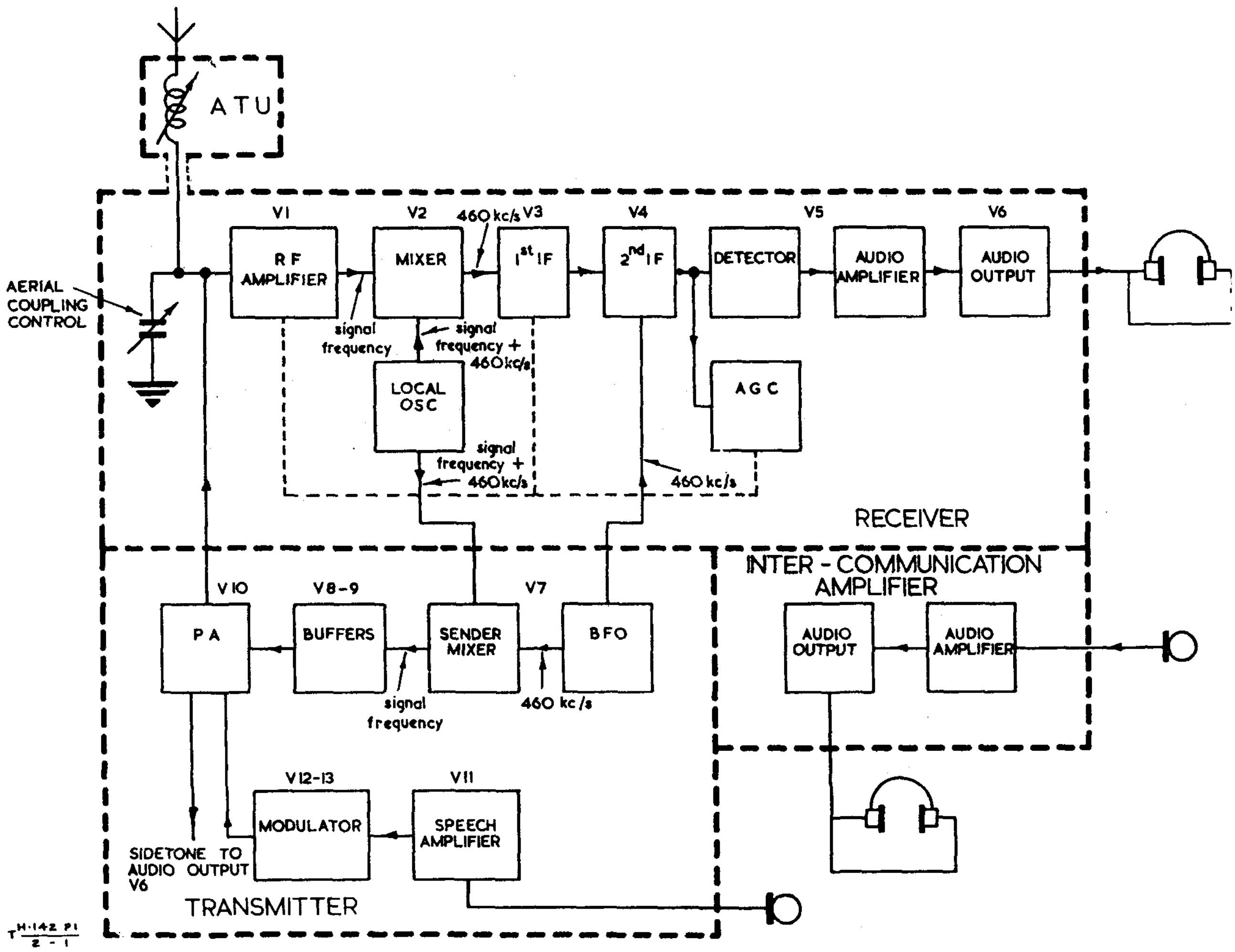


Fig 1 - Block diagram

BRIEF ELECTRICAL DESCRIPTION (see Fig 1)

4. The receiver is a single superheterodyne, using an i.f. of 460kc/s. An electrical flick system enables a quick change to be made from one operating frequency to another; the flick frequencies may both be in the HF band, or may both be in the LF band, or one may be in each band. To achieve this two ganged capacitors are provided, so that in each tunable stage of the receiver two variable capacitors are available; one tuning control is coded A and coloured blue, the other is coded B and coloured red. The set is netted in the usual way on the required frequencies; instant changeover is then possible by operation of the bandswitch, which has four positions: A LF, B LF, B HF and A HF.

5. The sender uses the sender-mixer principle, in which the output of the receiver local oscillator (operating at 460kc/s (the i.f.) above the signal frequency) is mixed with the output of the receiver b.f.o. operating at the i.f. The resultant difference frequency is that of the required sender signal; this is filtered from the other mixer products and applied via a driver stage to the r.f. power amplifier (p.a.). Modulation power is provided by a two-stage push-pull amplifier, and is applied to both anode and screen of the p.a. valve. As in the receiver, two variable capacitors are available in each tuned circuit for flick operation.

6. The intercomm amplifier has two conventional stages with negative feedback applied to them. It is virtually independent of the rest of the wireless set except for its power supplies.

7. Power is supplied to the set from a p.s.u., which uses a vibrator pack to produce a 250V output (HT1) and a rotary convertor to produce a 400V output (HT2). The l.t. supply to the set is taken directly from the battery (12V p.s.u.) or via a resistance mat (24V p.s.u.). A voltage control system prevents damage to the valves in the event of the battery voltage rising above a certain level. In all, three versions of the p.s.u. have been produced; the original 24V model has been redesigned to prevent overheating, and only about 60 of these early models are in existence. They may be recognized by the broad yellow band painted across the front panel.

Detailed power consumption

8. The current supplied by the battery to the wireless set, with the various p.s.u. is shown in Table 1.

Mode of operation	Current, in amperes	
	12V p.s.u.	24V p.s.u.
Receiver (transmitter and intercomm heaters off)	5	3.2
Receiver (transmitter and intercomm heater on)	7.2	6
Send, VOICE (unmodulated)	17.2	10.5

Table 1 - Supply current

Control or connector	Circuit ref (Fig 2001)	Function
	WIRELESS SETS (Fig 2)	
FREQUENCY A	C10, C27, C68 and C76	Controls the 'A' ganged capacitor
FREQUENCY B	C7, C24, C66 and C74	Controls the 'B' ganged capacitor
AE COUPLING A	C59	Tunes the p.a. stage in the A flick position
AE COUPLING B	C61	Tunes the p.a. stage in the B flick position
HET TONE	RV2	Sets the b.f.o. frequency (operative in CW position of SC)
A LF, B LF, B HF, A HF (bandswitch)	SA	Selects the flick and frequency band to be used
REC ONLY/REC TRANSMIT & I/C (standby switch)	SE	In the REC ONLY position switches off the transmitter and intercomm heaters
MO/XTAL	SB	Not used
GAIN	RV1	{A.F. control on VOICE {R.F. control on CW
METER SWITCH LT/HT1/HT2/AE CURRENT/DRIVE/AGC	SD	Selects metering point
POWER INPUT	PLC	Connected to output socket of p.s.u. by 12 point cable
A.T.U. D.C. CONTROL	PLB	Carries operating voltages for a.t.u. relays, and AE CURRENT metering
A.T.U. R.F.	PLD	Connected to RF input on a.t.u. by co-ax lead
	POWER SUPPLY UNIT (Figs 3 and 4)	
24V (12V) INPUT	PLE	Connects p.s.u. to battery via 2 point connector
POWER OUTPUT	SKTC	Connected to wireless set via 12 point connector
OFF/START/ON	SA	ON/OFF switch with an intermediate position giving momentarily reduced input voltage
	AERIAL TUNING UNIT (Fig 5)	
TUNING A	L1	Controls A flick on aerial tuning unit
TUNING B	L2	Controls B flick on aerial tuning unit

Table 2 – Controls and connectors

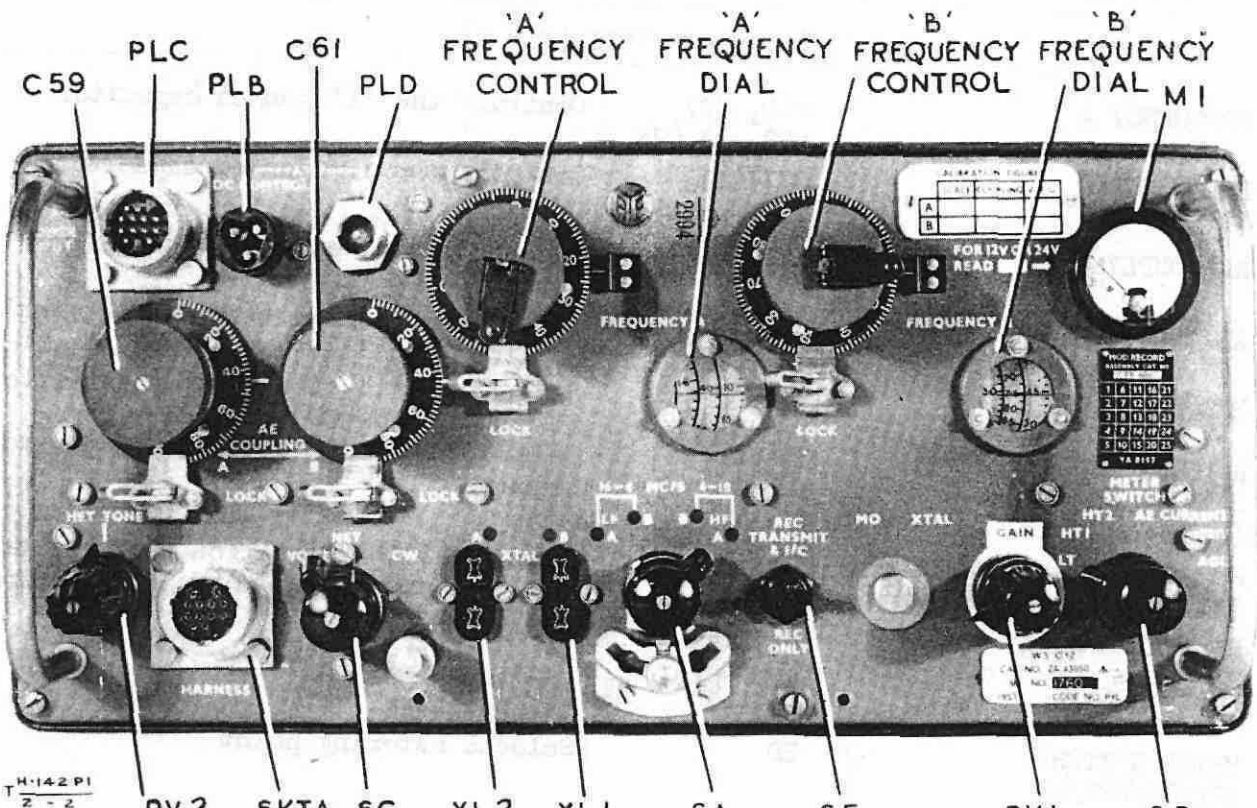


Fig 2 - W.S. C12 - panel controls

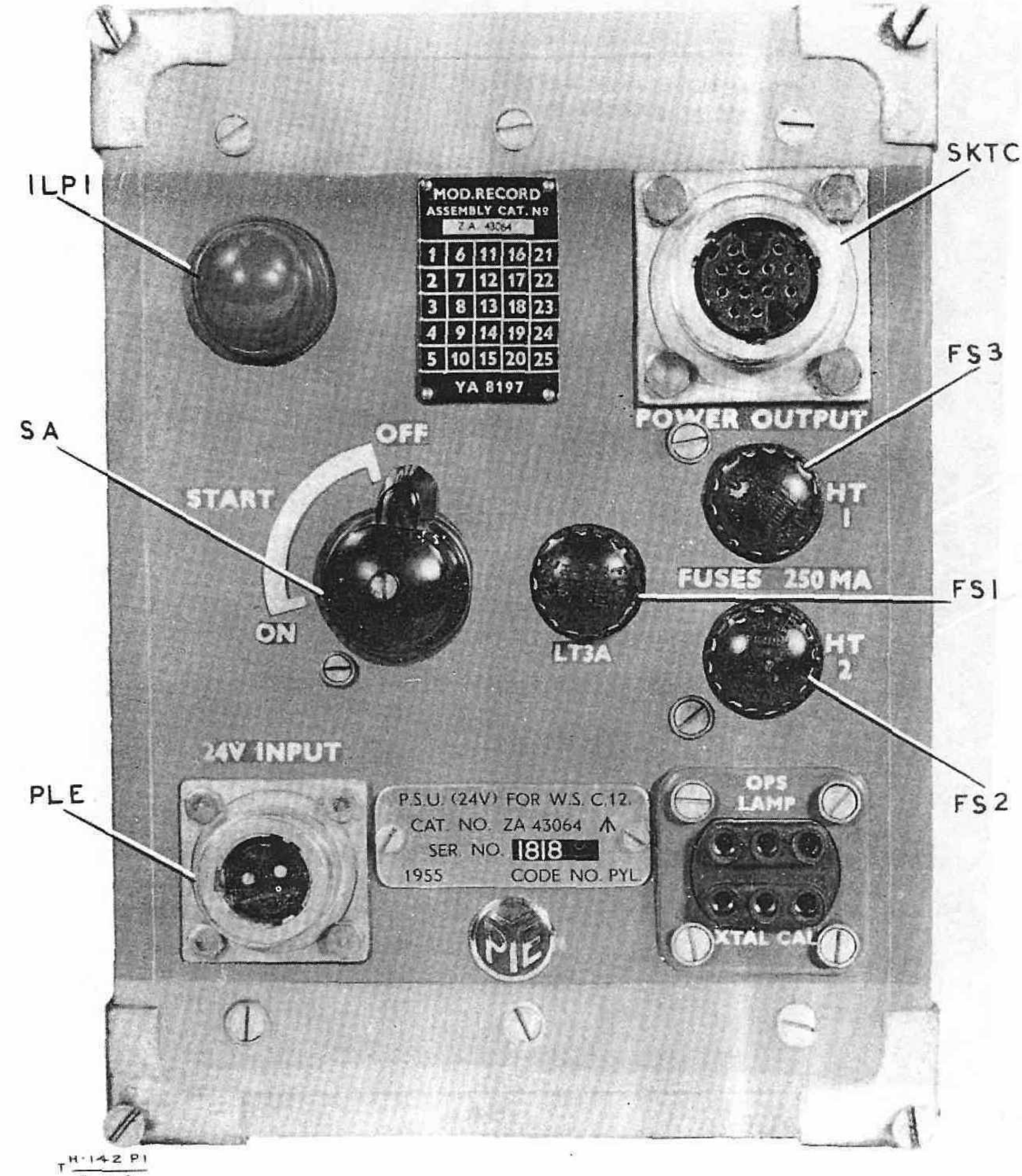


Fig 3 - 12V and 24V (yellow band) p.s.u. - panel layout

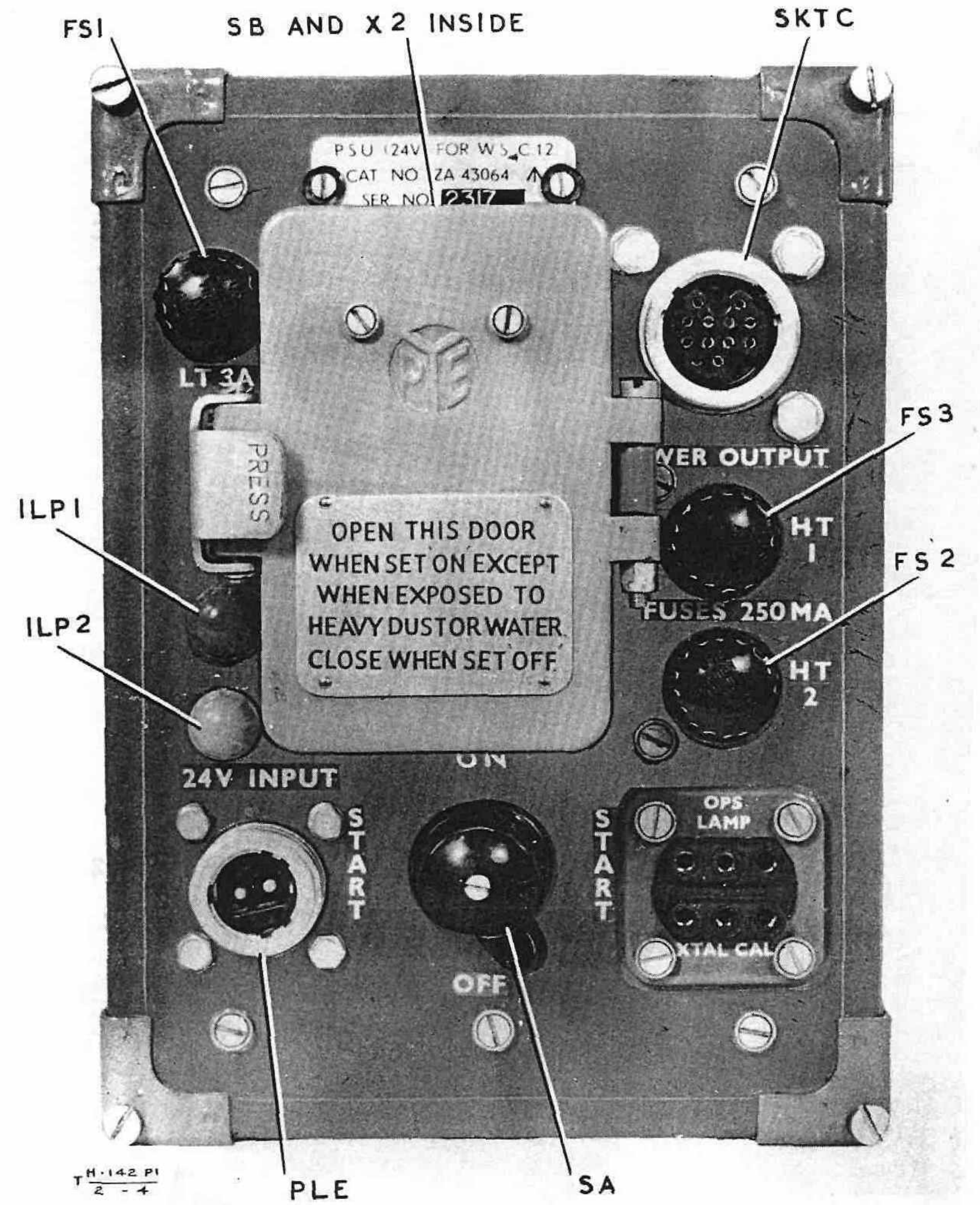


Fig 4 - 24V p.s.u. - panel layout

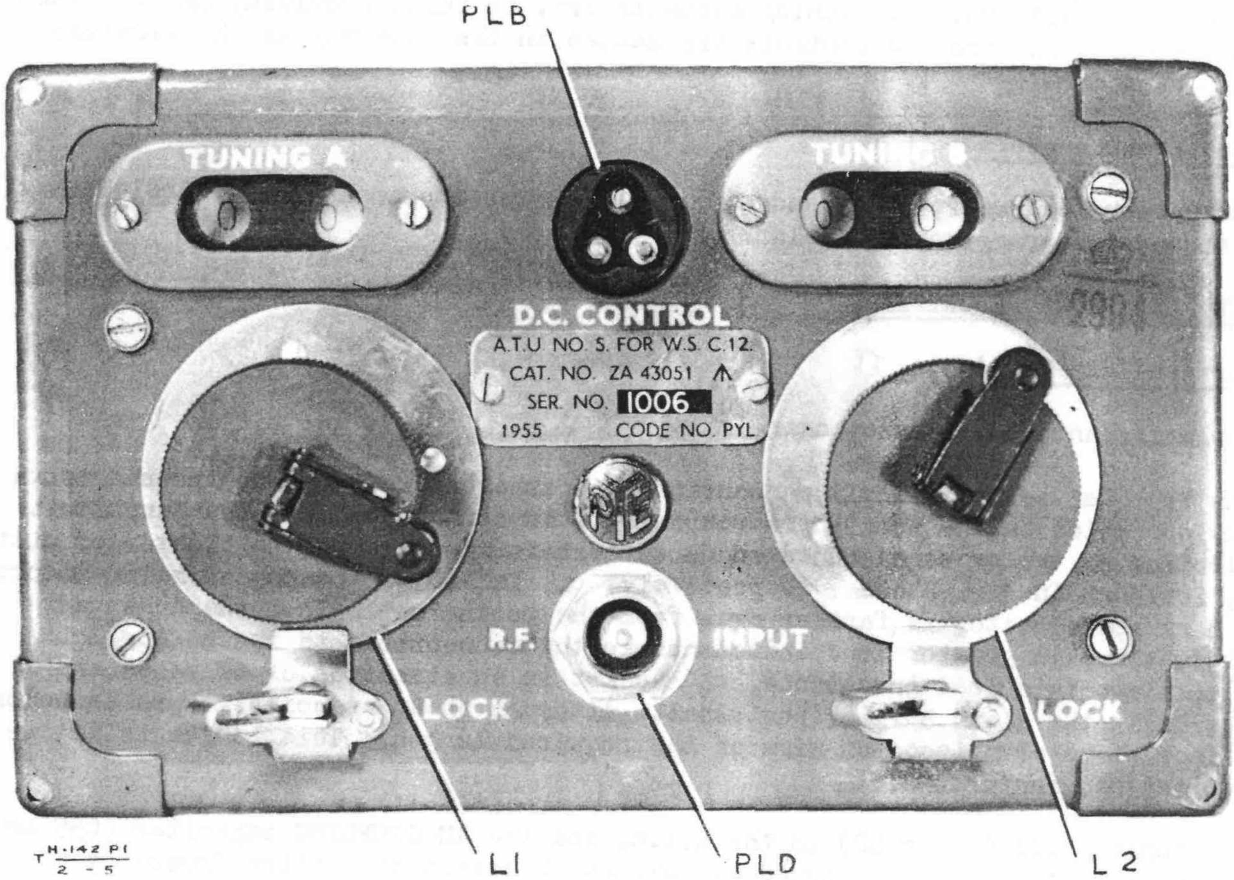


Fig 5 - A.T.U. No 5 - panel layout

Construction

9. The wireless set is built on a conventional aluminium dish chassis, with aluminium screening compartments. The chassis is housed in a pressed aluminium case, of the same size and physical form as the case used for W.S.19. This has been done to facilitate replacement of W.S.19 by W.S.C12 in AFV installations. The front edge of the case is recessed, the recess being filled with a sealing compound, which, when the panel is in place, prevents ingress of moisture. All controls on the panel are of the sealed type; the construction of one such component is shown in Tels H 144 Fig 1.

10. The p.s.u. is similarly constructed, and is housed in a case of approximately the same size as its W.S.19 counterpart. The 24V versions have an extra projection at front and rear.

11. The (a.t.u.) is housed in a case similar to that of the p.s.u., but, unlike the W.S.19, the tuning element is a coil of silver-plated wire having a contact riding on it (as in the W.S.22). Two tuning elements are, in fact, provided, one for each flick position. The case and controls are sealed in the same way as the wireless set and p.s.u.

Controls and connectors

12. The various controls, plugs and sockets on the front panel of the wireless set, a.t.u. and p.s.u. are given in Table 2 (see page 5).

DETAILED ELECTRICAL DESCRIPTION

Receiver (see Fig 2001)

R.F. amplifier and frequency changer

13. The receiver is basically a conventional superheterodyne, but the requirements of flick operation and netting introduce certain complications into the circuitry. The selection of the required tuned anode circuit for V1, and the oscillator circuit for V2, is shown in Figs 6 and 7 respectively. L4 and L8 are compensating inductors: as the B ganged capacitor is farther away from the tuning coils than the A ganged capacitor, there is greater lead inductance in the connections to the B gang. L4 and L8 simulate this lead inductance, and assist in equalization of response and calibration in the A and B flick positions. Although shown as coils, these inductors may in fact be merely pieces of wire of the required length. This length is determined during manufacture.

14. The tuning coil (L1 or L2) in the a.t.u. and the AE COUPLING capacitor (C59 or C61) in the set, form a series tuned circuit which covers the entire frequency range of the set. The input to V1, the r.f. amplifier, is taken from across the AE COUPLING capacitor, and applied to the grid of the valve via L1, C1 and L2. L1 resonates with its own self-capacitance to provide a measure of harmonic suppression. L1 is mounted in a screening can, fixed to the rear of the panel, which also covers the rear of the aerial input plug. The output of the r.f. amplifier is passed to the frequency changer V2, a triode-heptode. The triode portion of this valve is connected as a tuned anode oscillator operating at 460kc/s above the signal frequency. The output of the oscillator is connected externally to the screened injection grid of the heptode portion. The received signal is applied to the grid nearest the cathode; this gives a useful amount of signal frequency amplification.

I.F. amplifier

15. The i.f. of 460kc/s is filtered from the other mixer products at the anode of V2 and applied to an i.f. amplifier consisting of V3 and V4. V1 and V3 share the same cathode and screen circuit components. With the system switch at VOICE both valves receive bias from the a.g.c. line; when the set is switched to NET or CW the GAIN control RV1 supplies a variable bias to the grid of both valves. This bias is obtained from a tapping on the common cathode resistor which with R17 forms a potential divider network across the HT1 supply. In the VOICE position of the system switch the lower portion of the common cathode resistor is short-circuited to earth, reducing the standing bias on V1 and V3 and allowing greater control of the valve gain by the a.g.c. voltage.

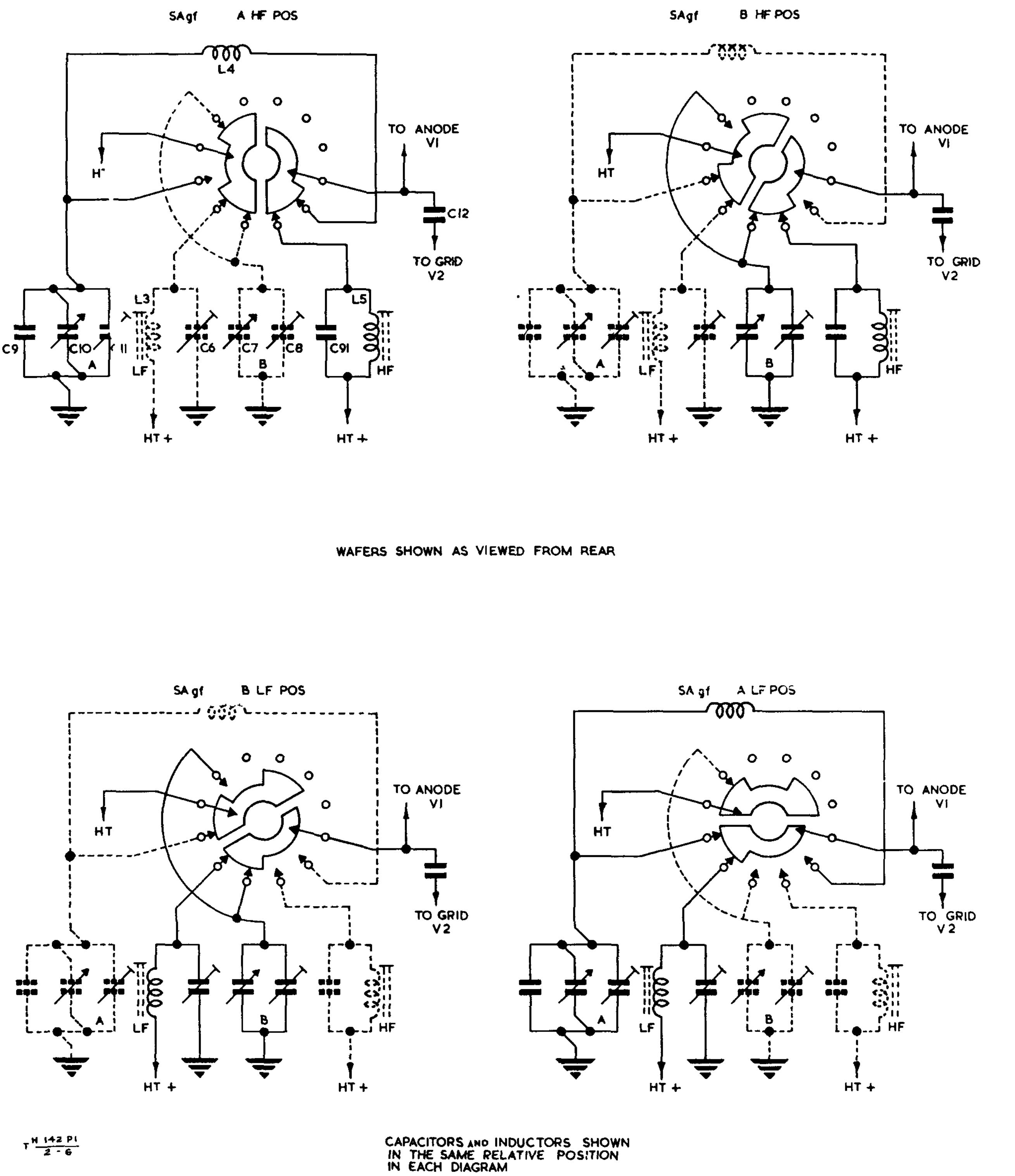


Fig 6 - SAgf flick positions

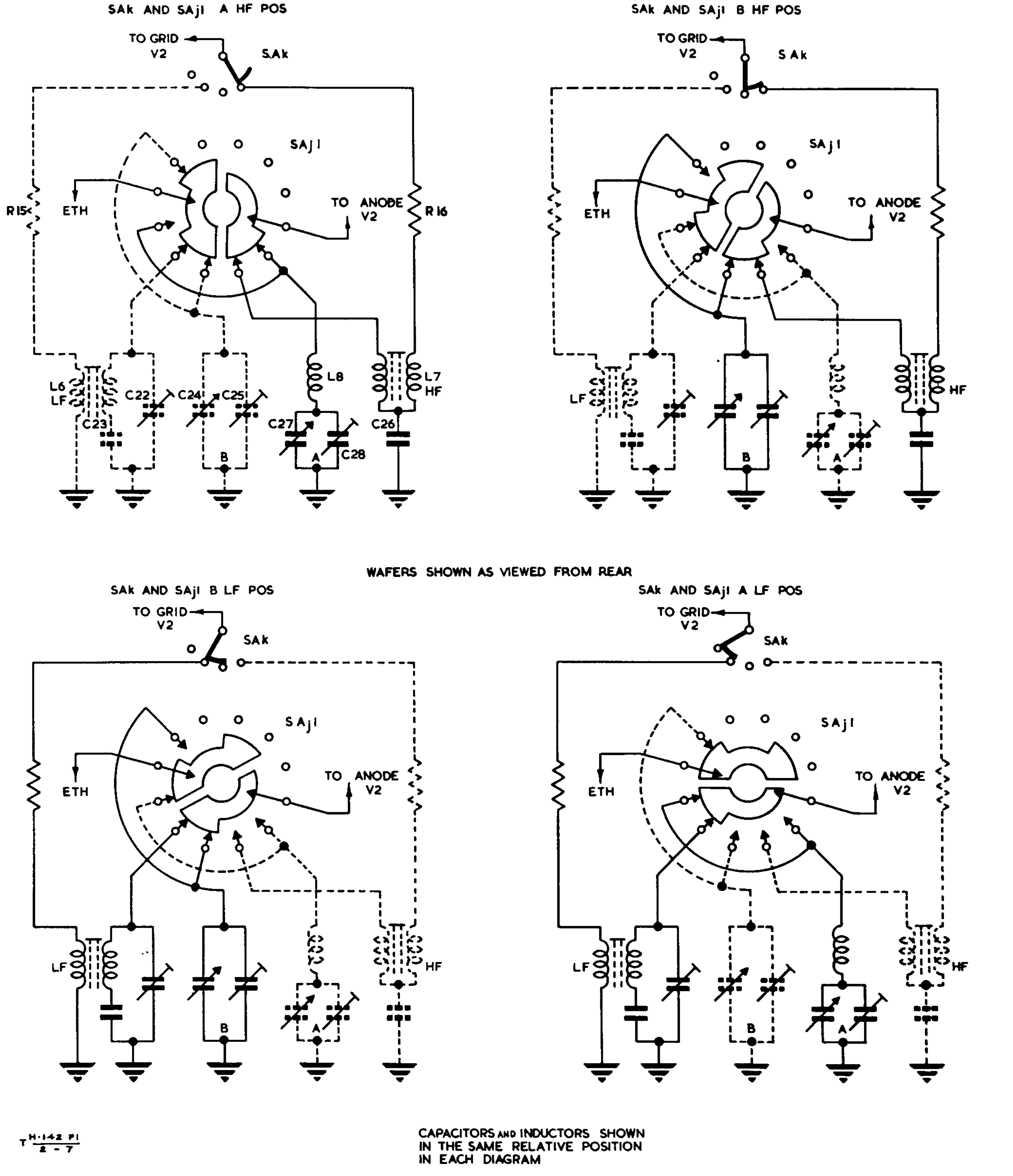


Fig 7 - SAjl and SAk flick positions

16. V4 receives a constant grid bias of -2V derived from the p.s.u. The b.f.o. voltage for NET and CW working is injected into its cathode circuit (see also para 21).

Demodulator, a.g.c. and 1st a.f. amplifier

17. The output of V4 is passed to the second detector diode section of V5 via T3, and to the a.g.c. diode section via C43. This method of supplying the a.g.c. rectifier results in a sharper indication of tuning in the AGC position of the meter switch than if the input to the diode were taken from the secondary of the over-coupled i.f. transformer. A simplified diagram of the bias, a.g.c. and gain control connections is given in Fig 8 for the VOICE position of the system switch: the corresponding connections when the set is switched to NET or CW are shown in Fig 9.

18. A peak noise limiter is connected between the anode of V5 and the second detector load resistor R31. The voltage across R30, R31 and R34 consists of the sum of the standing bias (due to the triode current of V5 and the steady current through the network R32, R34) and the a.f. and d.c. components of the demodulated signal. The d.c. component is blocked by C44 and C47 in series and the a.f. portion is fed to the grid of V5, together with any noise spikes which may be present. This signal is amplified in V5. Should the amplified signal at the anode of V5 at any time exceed the sum of the a.f. and d.c. components at the R31 end of RV1, the rectifier will conduct and provide a measure of negative feedback to V5. It can be seen that the noise limiter can differentiate only to a slight degree between high frequency noise pulses and the required a.f., and it is thus possible to produce a large amount of harmonic (non-linear) distortion in the output by overloading V5. This begins to occur at approximately 250mW output.

Output stage

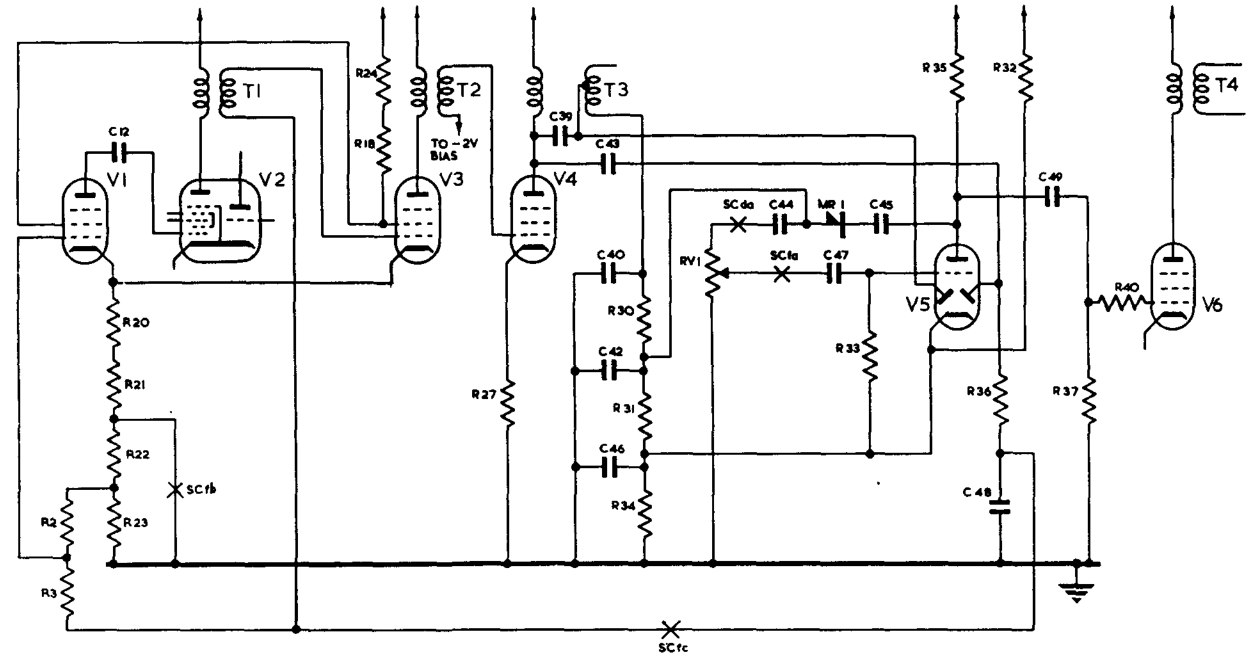
19. V5 is resistance-capacitance coupled to the output valve V6, and frequency selective negative feedback is employed to reduce the amplitude of a.f. voltages above 1kc/s. Sidetone from the transmitter is injected into the grid circuit of V6.

Beat frequency oscillator

20. The triode portion of V7 is connected as a tuned grid oscillator. In the CW position of the system switch the frequency of oscillation can be varied ±2.5kc/s from the nominal 460kc/s by means of RV2. Movement of this control varies the constants of the tuned circuit by nature of the reflected impedance.

21. The output of the b.f.o. is injected into the cathode circuit of V4 across R27. In order to prevent undue negative feedback in V4 with consequent loss of gain, the injection resistor is made small (22Ω). This in itself is insufficient to provide enough bias for V4, and a separate -2V supply is generated in the p.s.u. and applied to the earthy end of T2. This voltage is decoupled by C33 and R25.

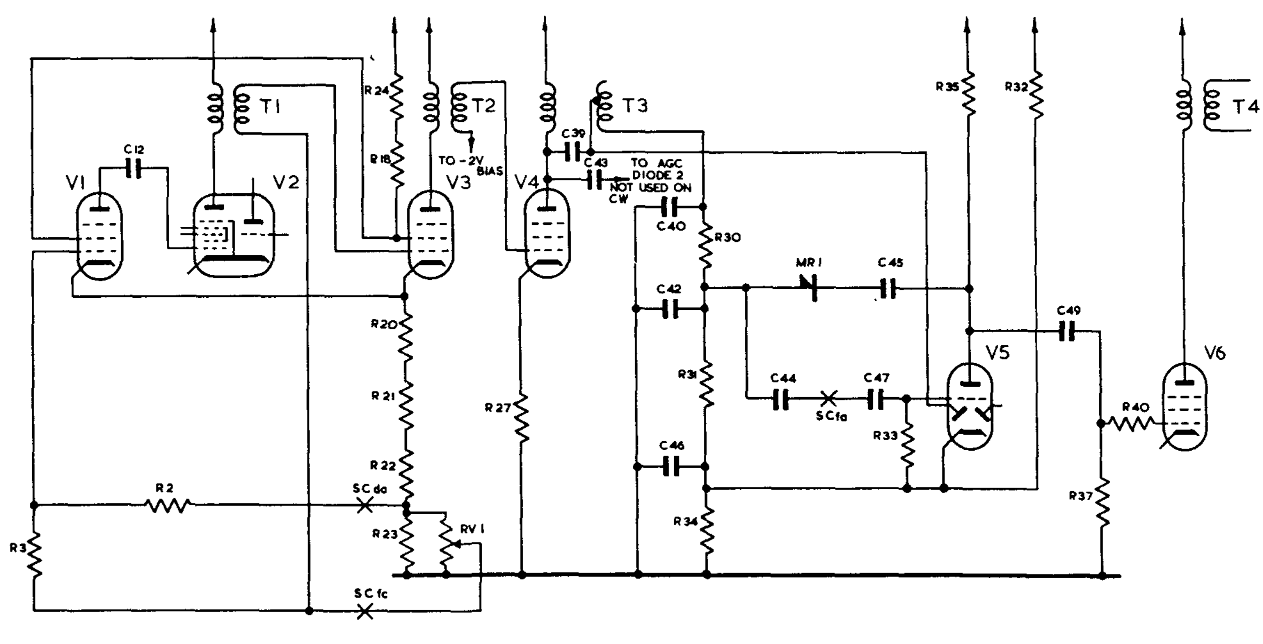
22. In the CW and NET positions of the system switch SC the triode portion of V7 received its h.t. directly from the HT1 line. In the VOICE position the b.f.o. is required only when the set is sending, and h.t. is supplied to the valve via one springset of the send/receive relay RLC. Another wafer (SCdb) of the system switch ensures that when the set is sending or being netted the variable tuning circuit is removed.



CROSSES INDICATE POSITION OF SWITCHES THE UNUSED POSITIONS OF WHICH ARE NOT SHOWN FOR CLARITY

T H-142 P1 / 2-8

Fig 8 - VOICE role - a.g.c., simplified circuit



CROSSES INDICATE POSITION OF SWITCHES THE UNUSED POSITIONS OF WHICH ARE NOT SHOWN FOR CLARITY

T H-142 P1 / 2-9

Fig 9 - NET and CW role - r.f. bias, simplified circuit

Sender (see Fig 2001)

Sender/mixer

23. As mentioned in para 5 the sender uses the sender mixer principle. The output of the local oscillator in the receiver is fed to the first injector grid of V7, in series with a -2V bias voltage derived from the same source as that used for biassing V4 (see para 21). The output of the b.f.o., at the intermediate frequency, is applied to the second injector grid. Thus, at the heptode anode of V7, amongst other mixer products, is a signal of the same frequency as that to which the receiver r.f. circuits are tuned.

Buffer stage

24. The wanted signal is selected by a tuned anode circuit, shown in each of its four switched position in Fig 10, and fed to V8 and V9 in parallel. Note that, as in the receiver tuned circuits, compensating inductors are provided to equalize the response on A and B flick positions. The output from V8 only is used in the LF positions of the bandswitch, but in the HF positions the output of V9 is connected in parallel with it, in order to obtain sufficient drive to operate the p.a. valve V10.

Power amplifier

25. This is fed from a tuned anode stage, the switching of which is shown in Fig 11. In the VOICE position of the system switch, V10 is anode and screen modulated by means of the output of the modulator appearing across the secondary of T5. In the CW position, keying is effected by interrupting the h.t. to the anode and screen of V10 by means of a springset on RLC. The anode of V10 is coupled to the aerial circuits via C60, the load L9 being shunted by R82. This resistor damps the response of L9 to keying transients and prevents key-clicks when the pressel is operated for VOICE operation.

Sidetone

26. To obtain sidetone, part of the a.f. voltage developed across the bias resistor of V10, is fed to the grid of V6 where it is amplified and passed to the harness or headphones.

Modulator

27. The secondary of the microphone transformer T6 is shunted by two equal resistors in series, their centre tap being connected to earth. This gives the effect of a centre tapped transformer, and hence a push-pull input is applied to V11. This is a double triode, and its balanced output is applied to V12 and V13, which feed the primary of the modulation transformer T5. HT1 to the double triode and the output valves' screens is applied only when the system switch is in the VOICE position. HT2 to the output valves' anodes is supplied via the VOICE position of SCba when $\frac{\text{RLC}}{3}$ is energised by operation of the pressel switch.

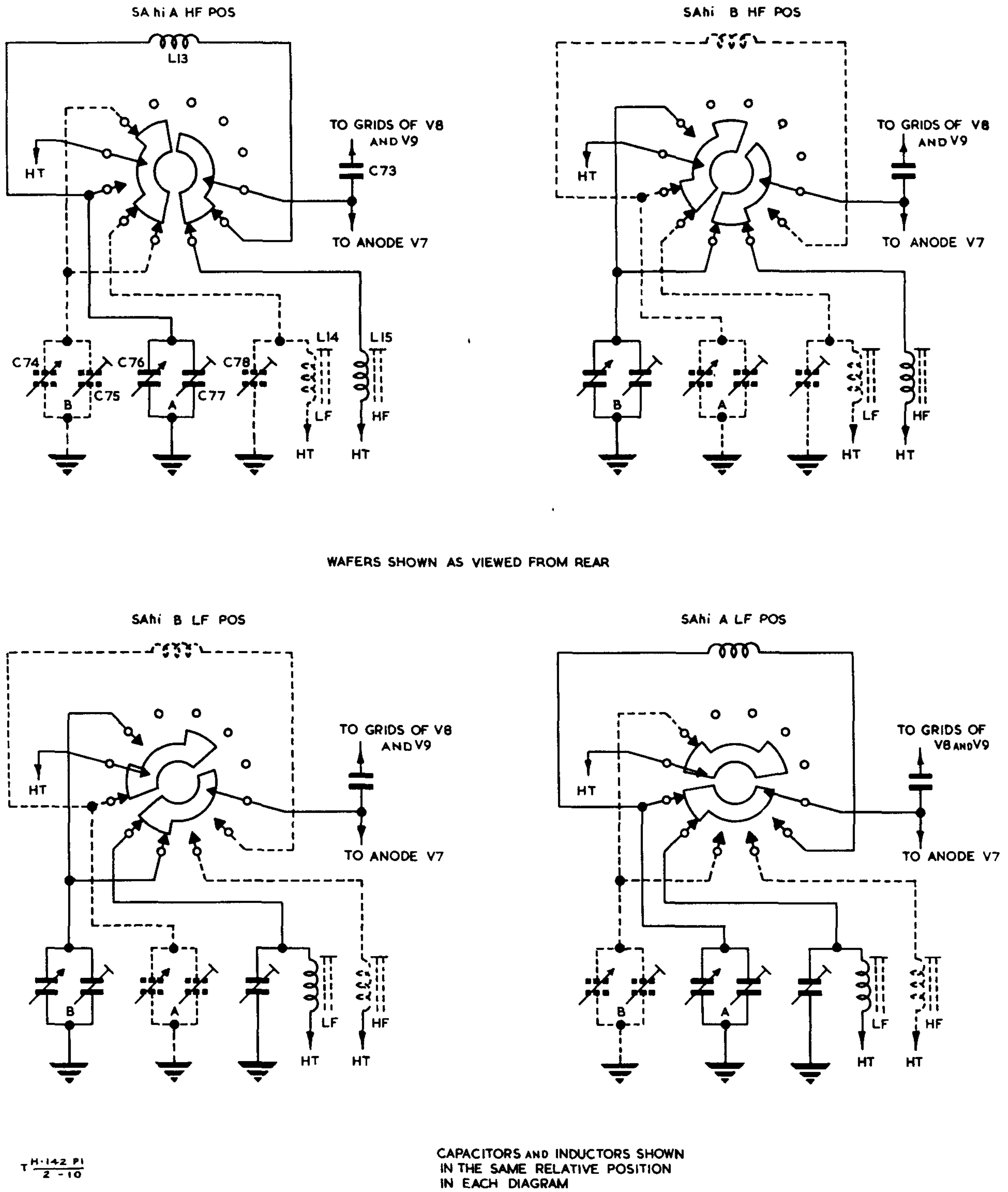
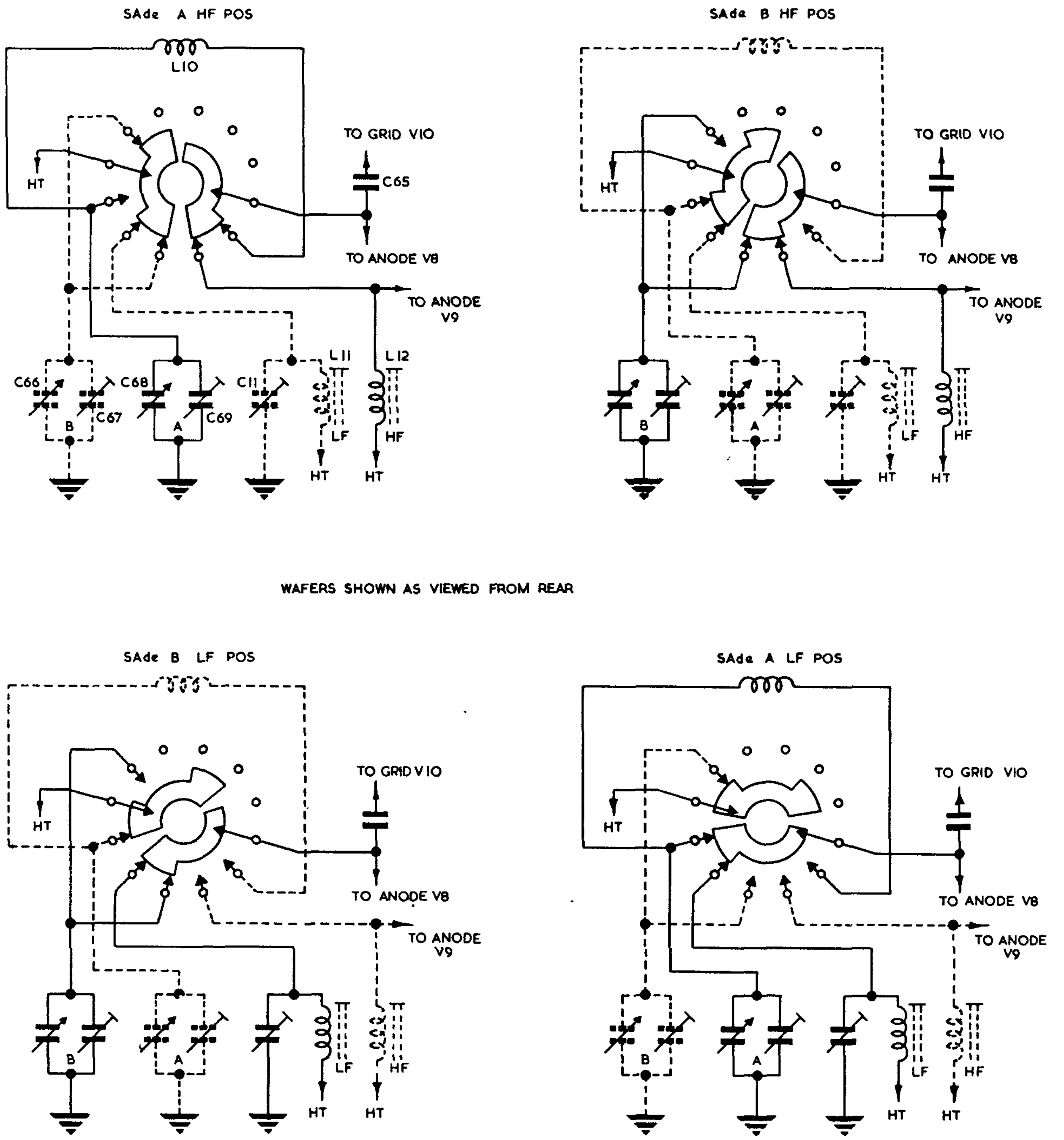


Fig 10 - SAhi flick positions



T H-142 P1 2-11

CAPACITORS AND INDUCTORS SHOWN
IN THE SAME RELATIVE POSITION
IN EACH DIAGRAM

Fig 11 – SAde flick positions

Intercomm amplifier

28. The intercomm amplifier is independent of the remainder of the set except for power supplies. It is a straightforward two valve two-stage arrangement, resistance-capacitance coupled, with input and output transformers. Some negative feedback is introduced by making part of the anode loads of V14 and V15 common to both valves. A small capacitor shunted across the input transformer secondary produces a peak in the a.f. response at about 1kc/s. A switch in harness A enables the output of the amplifier to be fed back to its input, thus providing an oscillator which is used for calling purposes. Because some transformers have their windings connected in the wrong phase, this calling facility does not always function. The action necessary to correct this is detailed in Tels H 149 Misc Instr No 2.

Power supplies and switching (Figs 12 and 1001)

29. The p.s.u. (see paras 32-36) supplies h.t. at approximately 250V (HT1) and 400V (HT2), bias at -2V and voltage controlled l.t. at 12V. The valve heaters are split into two chains (Fig 1001). The heaters of V1 to V7 and V17 are supplied from pin G of the power input plug PLC. They are connected in series-parallel, V17 being a barretter used in series with V2 to stabilise the heater current of the frequency changer. The heaters of V8 to V15 are connected in a similar series-parallel network and are supplied with l.t. only when the standby switch SE is in the REC TRANSMIT & I/C position.

H.T. supplies when set is receiving

30. When the pressel switch is unoperated, RLC, the send/receive relay, is in the position shown in Fig 12. HT1 is applied directly to V6, V5, V2, V14 and V15. HT1 is applied via RLC2 normal to V1, V3 and V4.. With the system switch SC in the VOICE position HT1 is applied via SCec to the anodes of the speech amplifier V11 and the screens of the modulator output valves V12 and V13. With SC at VOICE, no HT1 is applied to the triode portion of V7, the sender mixer valve, but in the NET and CW positions of SC it is connected via SCdc, in order that V7 may provide the heterodyning voltage required for netting and the reception of c.w. signals. In the CW position the frequency of the oscillator can be varied by means of variable damping, applied by means of an earth connection through SCdb and RLC1 normal. In the NET position the centre-frequency of 460kc/s is required for netting and the earth connection is removed.

Switching to send

31. SE is switched to REC TRANSMIT & I/C thereby supplying the sender etc heaters with l.t. (see para 29). Operation of the pressel switch in the handset earths the send/receive relay RLC in the wireless set. RLC has three contacts with function as follows:-

(a) RLC1 (Fig 1001) applies earth via SCbb in the VOICE or CW position (but not in the NET position) to RLB in the p.s.u. RLB operates and its contact completes the l.t. circuit of the rotary convertor, which starts.

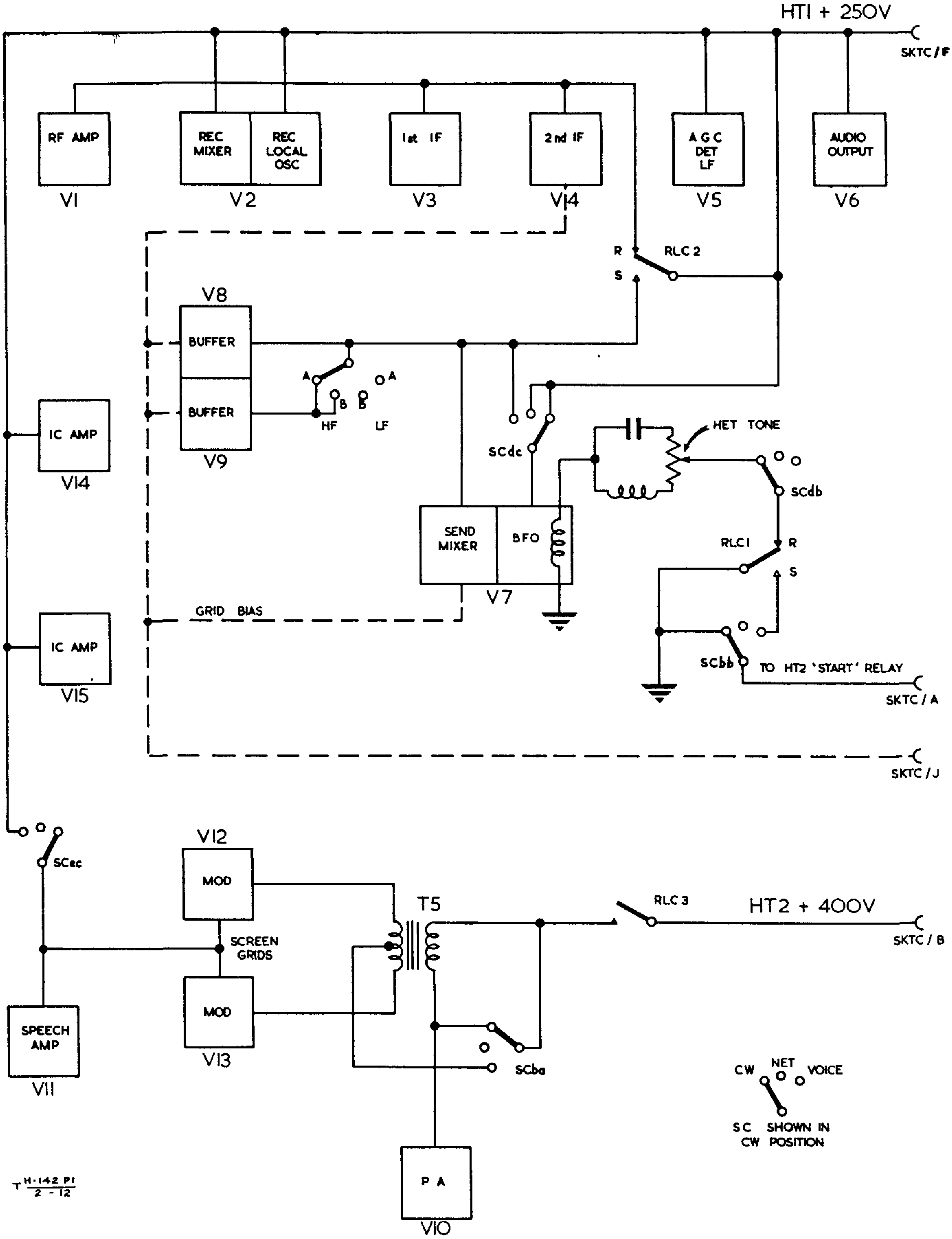


Fig 12 - Send/receive switching

(b) RLC2 (Fig 12) removes the h.t. from receiver valves V1, V3 and V4, thus muting the receiver. It applies h.t. to the heptode section of V7, to the buffer amplifier V8 and to V9 if SA is in either HF position. If SC is in the VOICE position h.t. is applied to the b.f.o. section of the sender mixer for as long as the pressel switch is operated; if SC is in the CW position h.t. is applied to the b.f.o. irrespective of the state of the pressel switch.

(c) RLC3 (Fig 12) applies the 400V HT2 to the p.a. valve V10. With the system switch at CW the secondary of the modulator transformer T5 is short-circuited by SCba. In the VOICE position SCba connects HT2 to the centre-tap of T5 primary, thus supplying the modulator output valves V12 and V13, and removes the short circuit from T5 secondary, so that V10 receives its HT2 via this winding.

Power supply units (Figs 2006 and 2009)

32. To produce the HT1 supply the p.s.u. uses a non-synchronous vibrator feeding a transformer, the tappings on which can be arranged for 12V or 24V working. The output of the transformer (about 180V) is applied to two half-wave rectifiers arranged as a voltage doubler, the valve heaters being supplied from a 7V winding on the transformer. Smoothing is conventional; the h.t. negative return to earth is completed by R8, and the -2V bias supply is taken from across this resistor. HT2 is obtained from a rotary convertor, which is switched by RLB1 (see para 31).

33. RLA is a slave relay operated by a contact of a voltage sensitive relay in the harness. The harness relay releases at 25.5V (12.75V) on a rising voltage, and operates at 23.5V (11.75V) on a falling voltage. With the harness relay released, RLA is released, and dropper resistors are inserted into the heater and vibrator supply leads. When the battery voltage falls to a safe value the voltage control relay operates. RLA operates and its contacts short circuit the dropping resistors.

34. There are two main types of p.s.u. one for 12V and the other for 24V working. The circuit of the latest 12V model is shown in Fig 2006. On serial numbers prior to 1100 the circuit is slightly different. The l.t. side of the rotary convertor is voltage controlled by means of resistors R7 and R13, and RLA3. These resistors are placed between C3 and RLB1. The reason for their removal is that sufficient HT2 voltage cannot be obtained. RLA3 was subsequently placed across RLA1 to provide greater contact area; this further reduced voltage drop.

35. The first 24V p.s.u.s are identical with the modified 12V version ie, they follow the circuit of Fig 2006 except that:-

(a) The vibrator and rotary convertor are 24V types, and the transformer tappings are arranged for 24V working.

(b) The l.t. fuse is 3A.

(c) In order to avoid making a wireless set special to a particular voltage power unit, the excess 12V heater supply is dropped in a pair of mat-type resistors R5 and R10. These resistors are mounted at the rear of the case.

(d) The pilot lamp resistors are different in value.

(e) An extra resistor R12 is added in series with the operator's lamp socket.

These changes are shown inset on Fig 2006. p.s.u. wired in this fashion bear serial numbers 1763 - 1822 inclusive. They may be readily identified by a broad yellow band painted across the front panel.

36. The 24V 'yellow-band' p.s.u. was found to be unsatisfactory in service because of overheating. The later 24V p.s.u. is wired as shown in Fig 2009. The principal changes (both electrical and mechanical) are:-

(a) A fan has been added to assist in cooling the voltage dropping resistors. This fan is controlled by a microswitch SB, which is operated by opening the door behind which the fan and filters are mounted. With the door closed, the fan is inoperative and a yellow warning lamp ILP2, lights. The set must not be used in this condition if the ambient temperature exceeds 20°C.

(b) The OFF/START/ON switch, SA, is of a different type, having two START positions, so that operation may be clockwise or anti-clockwise from ON to OFF and vice-versa. <u>It should be noted that on neither model should any pause be made at the START position of SA.</u>

(c) RLB is a heavy-duty type relay, having much more rugged contacts than those of the relay fitted to the early 12V model.

(d) Extra suppressor capacitors have been fitted across the battery input.

(e) A stand-off grille has been fitted to the rear of the case so that the metal surface against which the resistors R5 and R10 rest is held clear of any object against which the p.s.u. may be pushed. The rear of the case is then cooled by convection because of the chimney effect between the grille and the case.

<u>Aerial tuning unit (Fig 2012)</u>

37. This is designed to match the tuned output stage of the sender to rod aerials of various lengths and also to long vertical aerials. Matching is not equally effective at all frequencies, and the power output tends to fall at the high frequency end with long aerials, and at the low frequency end with short aerials. Table 3 shows the points at which the power falls by 3dB for various aerial lengths, relative to the mid-band power output.

Length of aerial in ft	Tuning range Mc/s
8	2.1 - 10.0
12	1.9 - 10.0
32	1.6 - 6.5

Table 3 - Aerial tuning - restriction of frequency range

38. As in the set proper, components are duplicated to facilitate flick operation. One wafer of the bandswitch in the set applies 12V to either RLE or RLF. With RLF operated L1 is in circuit; operation of RLE and release of RLF brings L2 into circuit in its place. The coil in use is indicated by a light appearing behind the calibrated scale of the appropriate AERIAL TUNING control. When RLE is operated, RLD in the set is also operated, and its contact changes over from C59 to C61, thus bringing the B AE COUPLING capacitor into circuit.

39. A toroidal current transformer, having the lead to the aerial terminal passing through its centre, has induced into it a voltage proportional to the aerial current flowing. This is rectified in V1 and V2, and the resultant d.c. is applied to the set meter via a contact on PLB and the meter switch.

Metering

40. The meter switch on the set has six positions, the first, second and third of which (LT, HT1, HT2) require no description. The fourth position, AE CURRENT, operates as described above. In the fifth position, DRIVE, the meter measures the voltage, due to grid current, developed across part of the grid leak of the p.a. valve. In the sixth position the meter measures the voltage developed across part of the common cathode load of V1 and V3. These valves are controlled on their grids from the a.g.c. line, and the cathode current flowing is roughly inversely proportional to the control applied. Thus a low meter reading indicates a high degree of a.g.c. and hence a strong signal.

Note: The next page is Page 1001

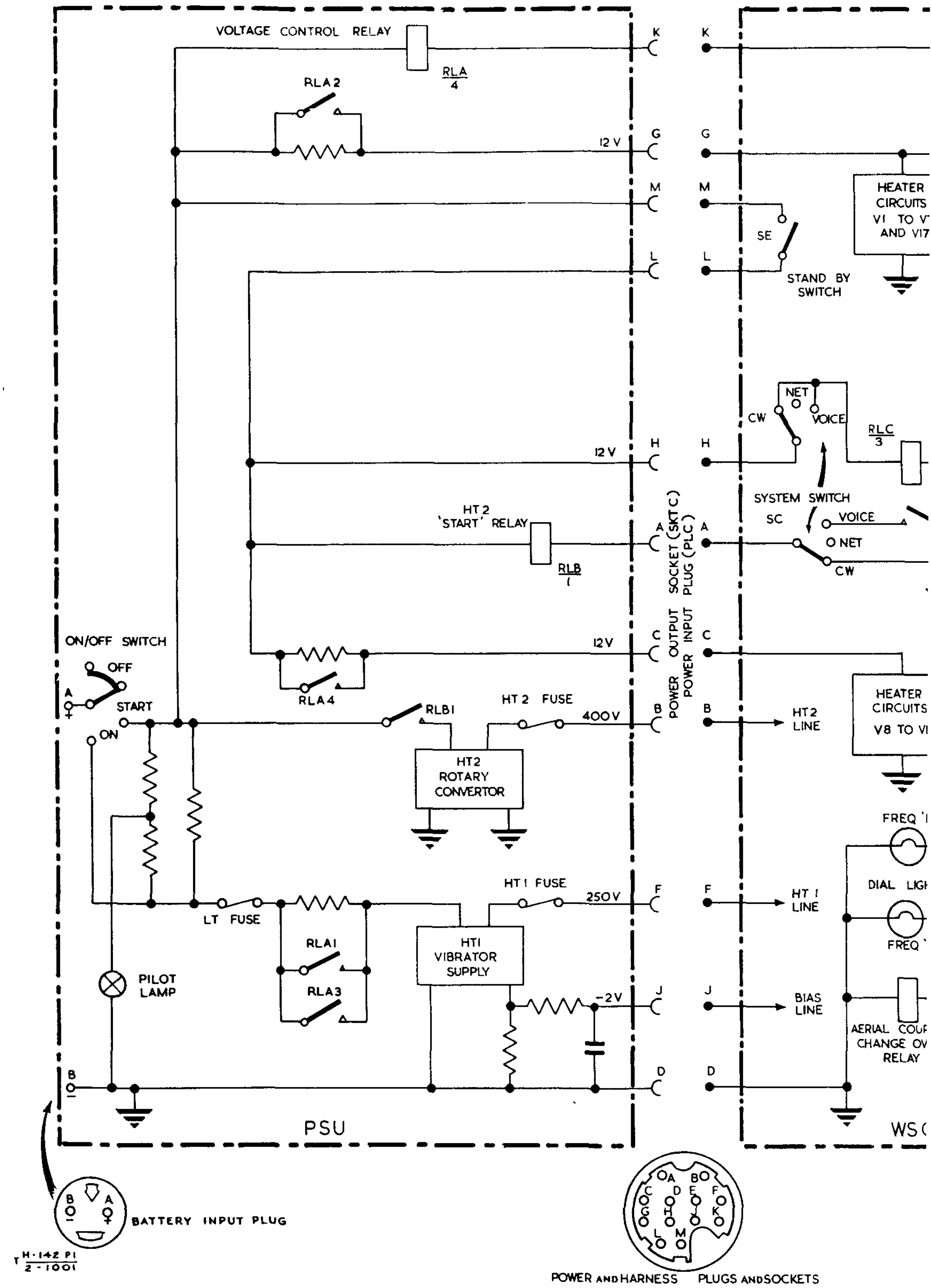
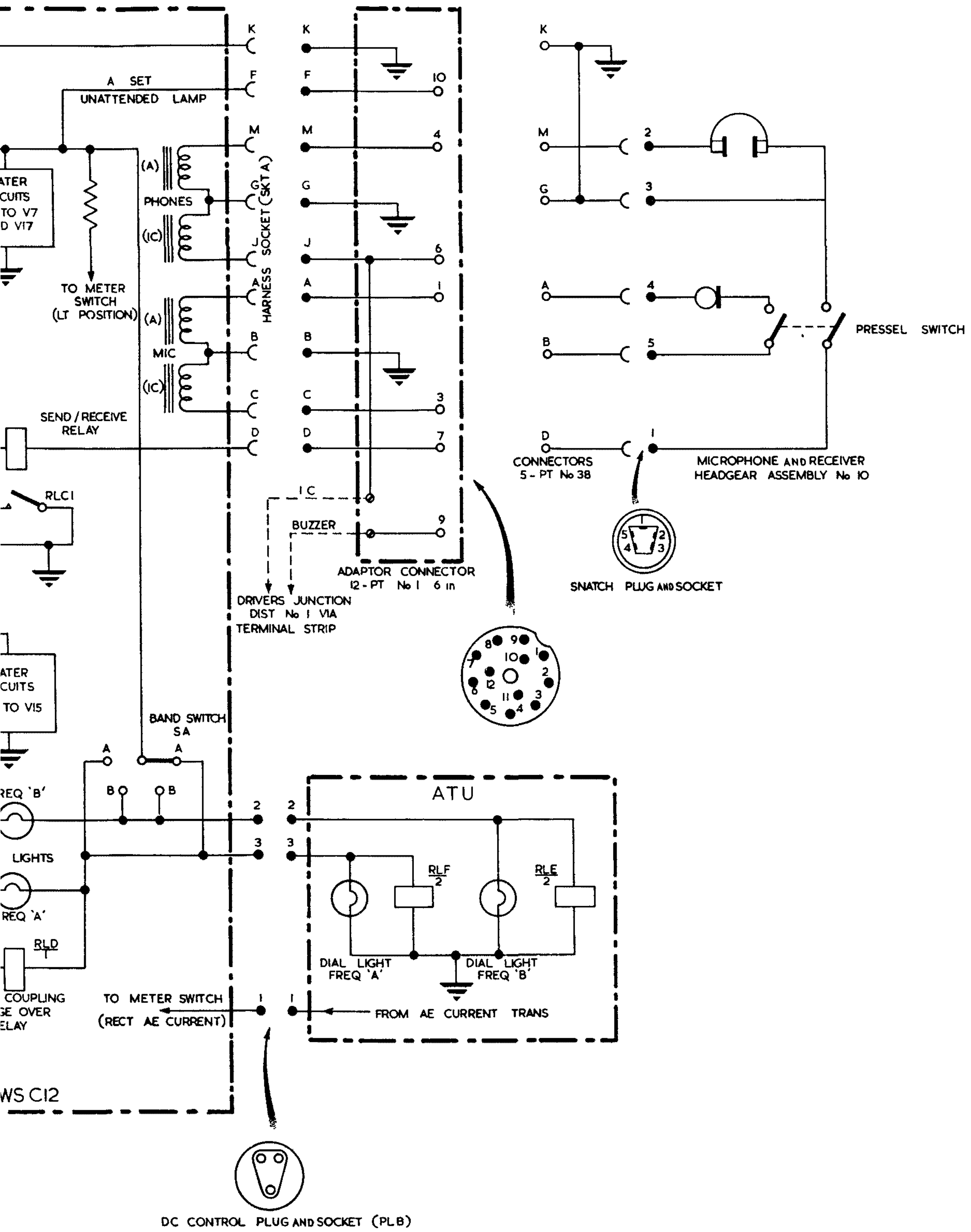


Fig 1001 - Switching and



d power supplies - simplified circuit

END of Part 1

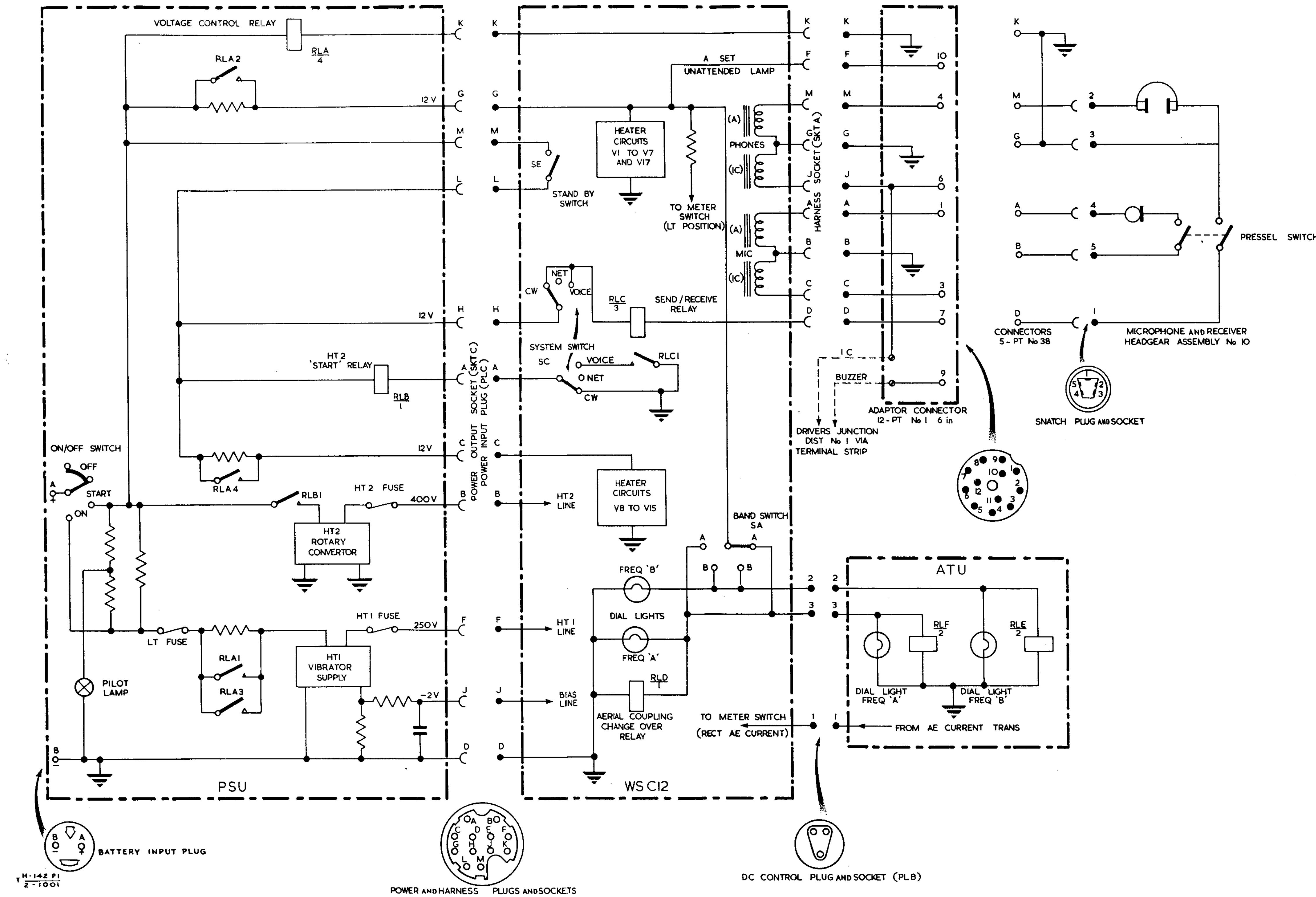


Fig 1001 - Switching and power supplies - simplified circuit

END of Part 1