WIRELESS SET NO. 46

SERVICE DATA - FIRST ECHELON

Errata

Note: This page will be filed immediately in front of Page 1 of Tels. F 469 Misc. Inst. No. 1.

1. The following corrections will be made to Page 2 of Tels. F 469 Misc. Inst. No. 1, Issue 1, dated 8 Mar. 1948:-

Table 4, column headed "5-way cable":-

Line 1: for "Green" read "Red"

Line 4: for "Red" read "Green"

END

Distribution - Class 870. Code No. 4 (Double)

WIRELESS SET NO. 46

SERVICE DATA—FIRST ECHELON

Notes: 1. This issue, Pages 1 to 6, supersedes Pages 1 to 5 and 1001 of Issue 1 of Tels. F 469/1, dated 28 Mar. 1945. The designation has been changed.

2. For explanation of double distribution see Tels. A 600.

Crystals and coil units

1. Coil units are available to cover the following frequency bands :—

7.9–9.1Mc/s (yellow)	5.0–6.0Mc/s (blue)
6.4–7.6Mc/s (white)	3.6–4.3Mc/s (red)

Any three frequency channels in any one of the above bands may be allocated for a given set. Two crystals are required for each frequency channel : one is for the sender, and is marked on the side with an S followed by the channel frequency in kc/s ; the other is for the receiver oscillator and is marked with an R followed by the channel frequency in kc/s. The crystal is also marked with a coloured dot corresponding with that on the coil units, and with the ZA number. The actual frequency of the crystal itself is also shown in small figures on the top of the crystal.

Frequency range	*Frequency limits*	*Colour marking*
1	7.9—9.1Mc/s	Yellow
2	6.4—7.6Mc/s	White
3	5.0—6.0Mc/s	Blue
4	3.6—4.3Mc/s	Red

Table 1—Frequency range colour coding

Changing frequency channels

2. (*a*) Remove the chassis from its case after loosening evenly, a few turns at a time, the four slotted screws at the corners of the top panel. This must be done very carefully, to avoid damage to the set or the rubber gasket on the case.

(*b*) Remove the crystal retainer and crystals ; also remove the plug-in coil if the new channels are in a different band (different colour spots). The crystals and coil unit should be carefully eased out with the aid of a screwdriver.

(*c*) Plug in the new crystals and coil unit, making sure that the former are all in the correct positions (for sender and receiver, and for channels A, B and C) as marked on the chassis, and that the colour of the spot is the same on all crystals and on the coil unit. The colours are given in Table 1.

(*d*) Plug in a dummy aerial and set the external aerial trimmer knob accurately to 2.5 on the scale, unless the 7.9–9.1Mc/s band is in use, in which case set to 3.0 on the scale. Switch to M.C.W., put on the headphones, switch on the set and keep the send-receive switch depressed.

(*e*) Switch the CHANNELS switch to A, and adjust the pre-set aerial trimmer for channel A (front one) with a screwdriver very slowly and very carefully ; start at maximum (the line on the rotor pointing down towards the coil unit) and turn until the loud tuning note just comes in.

(*f*) Repeat the procedure of (*e*) very carefully on the other two channels in turn.

Test No.	*Details*	*R/T*		*M.C.W.*	
		Send	*Rec.*	*Send*	*Rec.*
1	Total H.T. current	30mA	11mA	40mA	11mA
2	Total L.T. current	0.62A	0.38A	0.62A	0.93A
3	V4A anode voltage	147V	0V	144V	0V
4	V4A screen (pin 4)	85V	0V	80V	0V
5	V1A screen (pin 7)	0V	60V	0	60V
6	V1A pentode anode (pin 3)	0	145V	0	145V
7	V1A screen (pin 4)	0	60V	0	60V
8	V2A screen (pin 4)	0	70V	0	70V
9	V2A anode (pin 3)	0	145V	0	145V
10	V2B screen (pin 4)	0	50V	0	50V
11	V2B anode (pin 3)	0	145V	0	145V
12	V3A anode (pin 3)	90V	0	75V	0
13	V5A screen (pin 4)	150V	0	150V	0
14	V5A anode (pin 3)	148V	0	145V	0
15	V5A anode (pin 7)	148V	0	145V	0
16	T2A sec. No. 1 (hot)	-10.5V	-10.5V	-10.5V	-10.5V
17	T2A sec. No. 2 (hot)	-10.5V	-10.5V	-10.5V	-10.5V
18	Junction of R15A and R17A	-2.2V	-2.2V	-2.2V	-2.2V
19	T3A sec. (hot)	-1.0V	-1.0V	-1.0V	-1.0V
20	V1A filament (pin 8)	0	2.25V	0	2.20V
21	V2A filament (pin 8)	0	2.25V	0	2.20V
22	V2B filament (pin 8)	0	2.25V	0	2.20V
23	V3A filament (pin 8)	2.22V	2.25V	2.22V	2.20V
24	V5A filament (pin 8)	2.35V	0	2.35V	2.32V
25	V4A filament (pin 8)	2.35V	0	2.35V	2.32V

Table 2—Voltage and current test figures

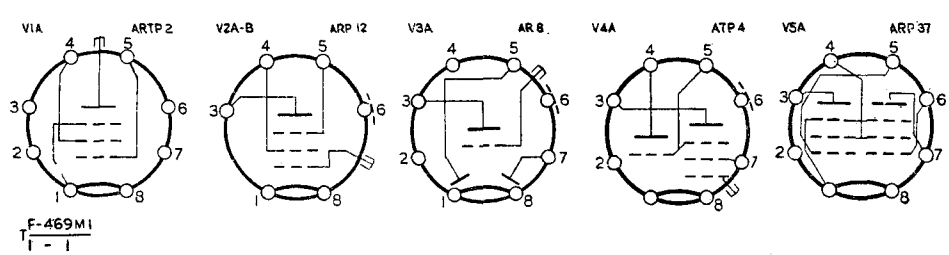


Fig. 1—Valve pins

(*g*) Check that no readjustment of the AERIAL TRIM knob is required when switching over from one channel to another.

(*h*) Make sure that the receiver oscillator is working on all channels, as follows : on touching a screwdriver on and off the aerial socket, loud clicks should be heard, but these should be nearly inaudible when the crystal for the channel in use is removed from its socket.

(*j*) Mark the new frequencies on the frequency record disc attached to the set.

(*k*) Switch off, replace the crystal retainer, and replace the set carefully in its case. Finally screw up the four case-retaining screws, going round each in turn several times, and making sure that the panel is bedding down evenly all round.

During the above process, certain difficulties may occasionally arise. Thus, the correct tuning point in operation (*e*) or (*f*) may appear to be slightly outside the range of the internal trimmer in question ; this can usually be corrected by a very slight adjustment of the AERIAL TRIM knob.

Valve	*Position of K1A-B*	*Electrode*	*Pin*	*Resistance to*	*Ω*
V1A	RECEIVE	G2	7	H.T.+	27k
		A	3	H.T.+	2.3k
		GO	5	Ch.	100k
		AO	4	H.T.+	27k
V2A	RECEIVE	A	3	H.T.+	2.2k
		G2	4	H.T.+	47k
V2B	RECEIVE	A	3	H.T.+	1.7k
		G2	4	H.T.+	150k
V3A	SEND	A	3	H.T.+	47k
		G1	T.C.	Ch.	100k
V4A	SEND	G2	4	H.T.+	11k
		A	5	H.T.+	250
		G1	T.C.	Ch.	47k
V5A	SEND	A1	3	H.T.+	250
		A2	7	H.T.+	200
		G2	4	H.T.+	S.C.

Table 3—Valve pin resistance readings

Voltage and current readings

3. Detailed examination for faulty components is facilitated by comparing voltages and currents with those given in Table 2. Tests Nos. 3 to 15 were measured on an Avometer model 7 on the 400V range, and tests Nos. 16 to 25 on the 10V range of the same instrument. If a voltmeter taking a greater current is used, readings will be rather lower in some cases. The battery voltages were exactly 150V, 3.0V, and 12.0V ; provided that the H.T. and G.B. are reduced in the same proportion, figures may be reduced proportionately when checking on a slightly lower voltage. Figures were taken with the aerial tuned accurately and the set under normal working conditions ; figures for tests Nos. 1 and 4 will vary considerably under the conditions on send. All voltages are measured relative to chassis.

No. of terminal in junction box	*Marking on top plate*	*6-way cable*	*5-way cable*	*Operator's 3-way cable*	*Extra 3-way cable*
1. L.T.+	+3V	Blue	Green		
2. Phones		Yellow		White (green end)	White (green end)
3. H.T.+set		Red			
4. H.T.+batt.	+150V		Red		
5. Mic.		Green		White (red end)	White (red end)
6. G.B.—	−12V	White	Yellow		
7. Case		Black	White		
8. Case			Blue		White (blue end)
9. Case				White (blue end)	

Table 4—Junction box internal connections

Notes: 1. On preproduction models, serial Nos. 1-32, the yellow wire of the 6-way cable was connected to terminal 5 in the junction, and the green wire to terminal 2. Correspondingly, the connections from phones and microphones to the male snatch plug were interchanged.

2. The socket marked + 12V on the battery is connected through the case of the set and junction box, and to L.T. —.

3. The socket marked H.T. — on the battery is used to supply grid bias (—12V) to the set.

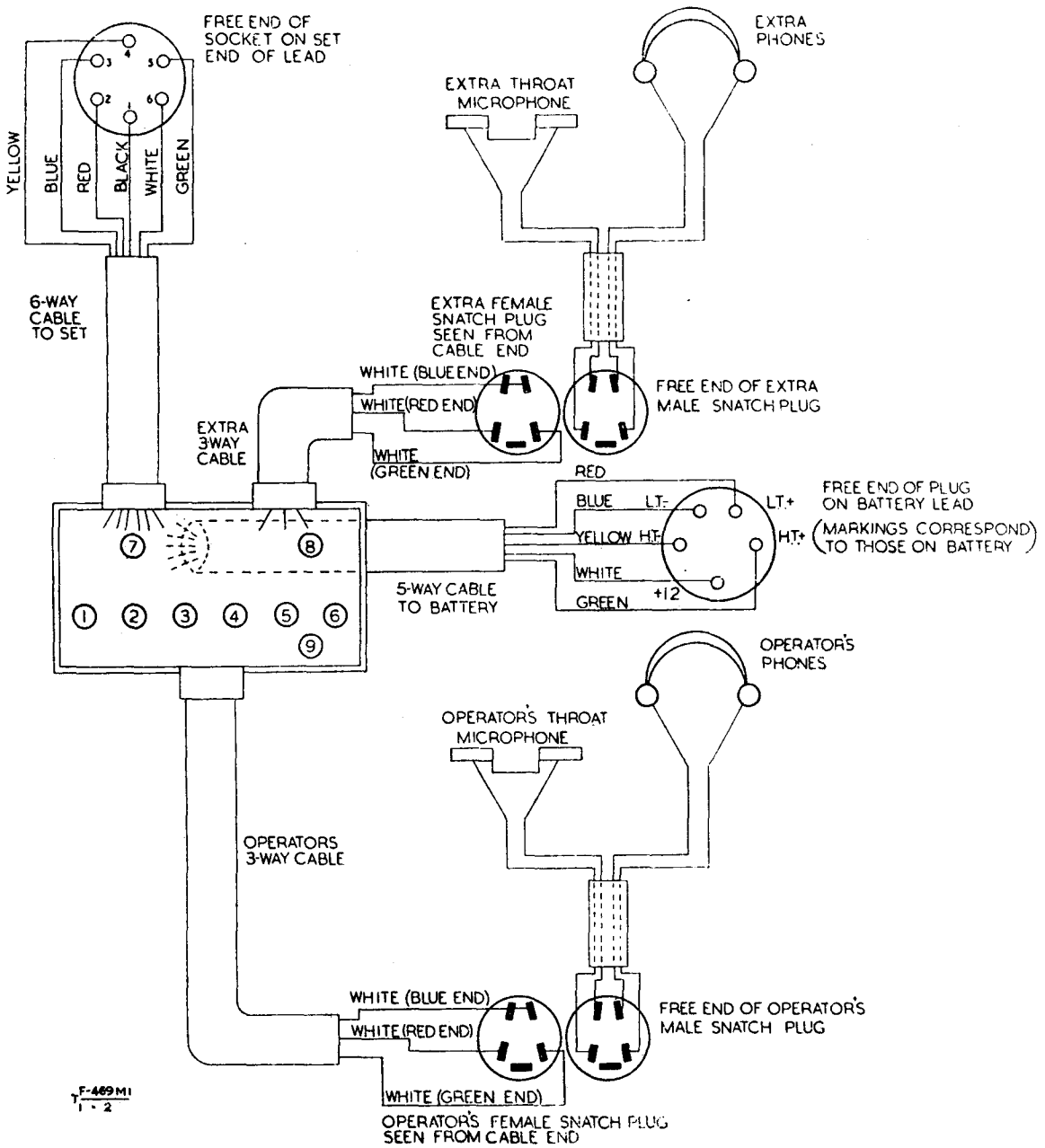


Fig. 2—External connections to set

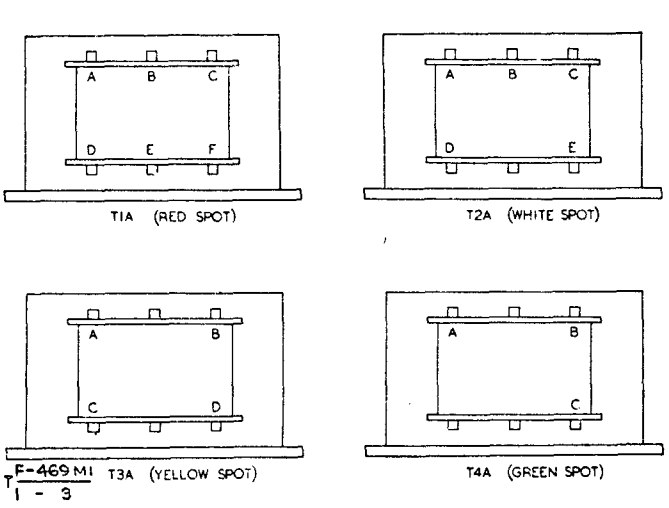


Fig. 3—Views of transformers, looking at tags

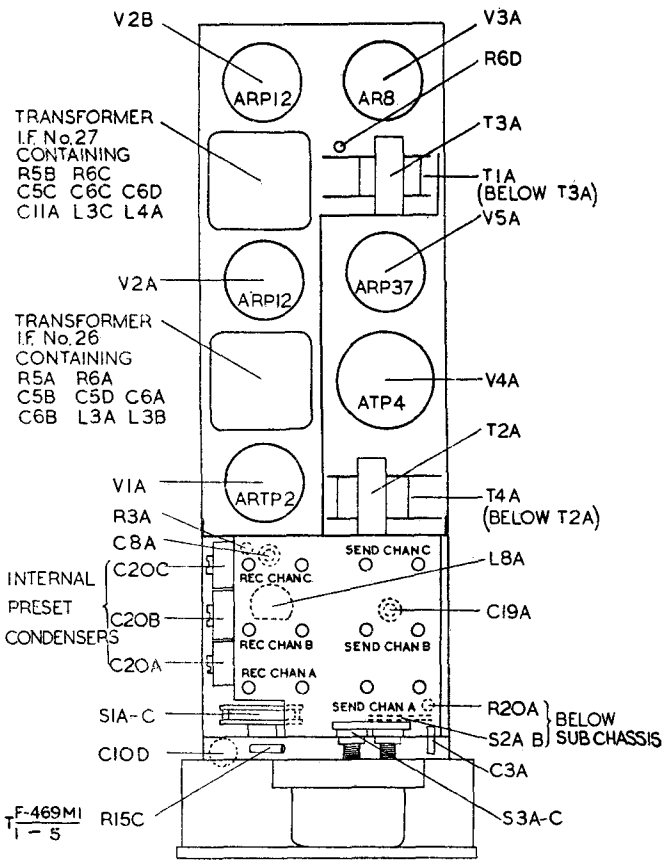


Fig. 5—Component layout, top

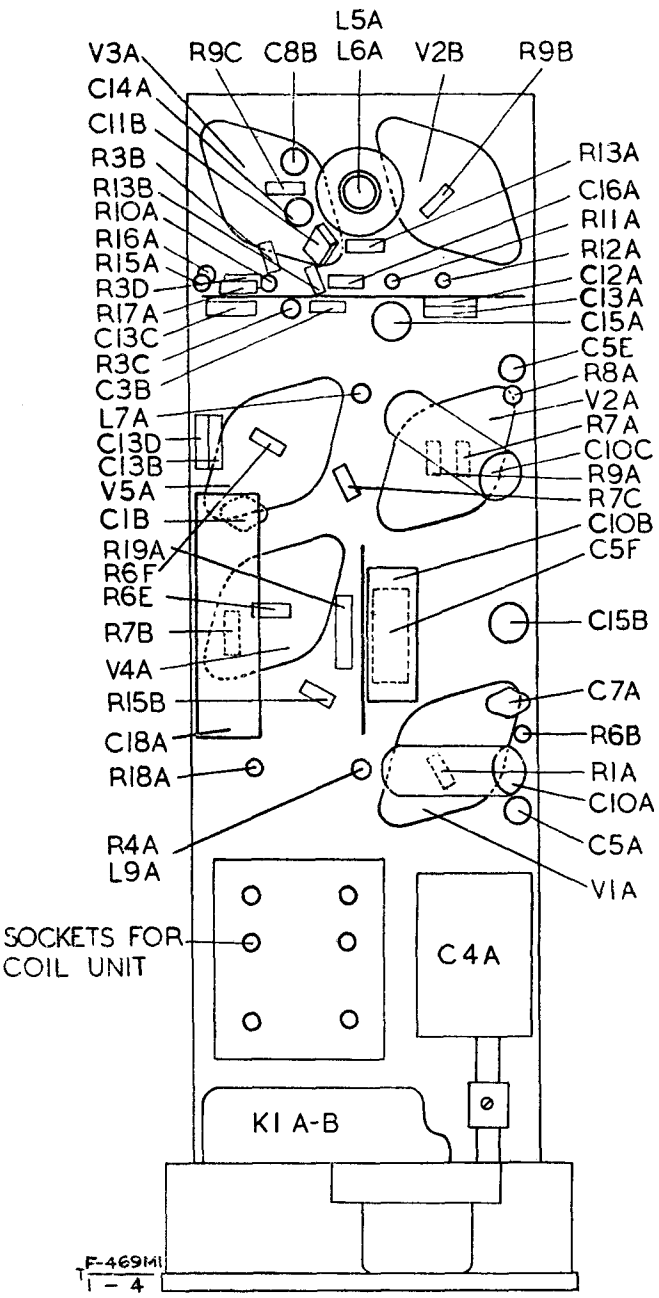


Fig. 4—Component layout, bottom

RESTRICTED

Table 5
Details of components
(Fig. 6)

Circ. ref.	*Remarks*
	INDUCTORS
L1A	Aerial tuning inductor
L2A	Frequency-changer, oscillator, anode inductor
L3A	First I.F. transformer, primary
L3B	First I.F. transformer, secondary
L3C	Second I.F. transformer, secondary
L4A	Second I.F. transformer, primary
L5A	Third I.F. transformer, primary (untuned)
L6A	Third I.F. transformer, secondary
L7A	Filament choke, V3A
L8A	R.F. choke, sender oscillator anode
L9A	Filament choke, V1A
	TRANSFORMERS
T1A	Output transformer
T2A	Modulator input transformer
T3A	Microphone transformer
T4A	Modulator output transformer
	SWITCHES
S1A–C	3-pole, 3-way, crystal CHANNELS switch
S2A and S2B	3-pole, 2-way, R/T–M.C.W. switches
S3A–C	3-pole, ON/OFF switch
	VALVES
V1A	ARTP2, triode-pentode
V2A and V2B	ARP12, R.F. pentodes
V3A	AR8, double-diode-triode
V4A	ATP4, R.F. pentode
V5A	ARP37, double-pentode
	MISCELLANEOUS
P1A	6-point, battery plug
K1A and K1B	Morse key, send-receive, switches

Circ. ref.	*Capacity*	*Tolerance*	*Working voltage*	*Remarks*
CONDENSERS				
C1A–B	20pF	±2½%		Ceramic
C2A	40pF	±5%		
C3A–B	0.001μF			
C4A	40pF			Variable
C5A–F	0.01μF			
C6A–D	40pF			
C7A	2pF			
C8A–B	30pF	±10%	500V	
C9A Range 1	0.0029μF			
,, 2	0.0018μF			
,, 3	0.0011μF			
,, 4	530pF			
C10A–D	0.1μF		250V	
C11A–B	0.0003μF			
C12A	0.001μF		350V	
C13A–D	0.002μF			
C14A	50pF			
C15A–B	0.05μF			
C16A	0.0001μF	±10%	350V	
C17A	15pF	± 5%		Ceramic
C18A	8μF		500V	Electrolytic
C19A	1pF			
C20A–C	40pF			

Circ. ref.	*Value*	*Tolerance*	*Wattage*
RESISTORS			
R1A	27kΩ	±10%	¼W
R2A Range 1	39kΩ		
,, 2	33kΩ	±10%	
,, 3	15kΩ		
,, 4	15kΩ		
R3A–D	1MΩ	±10%	¼W
R4A	3MΩ		
R5A–B	2.2kΩ	±10%	
R6A–F	100kΩ	±10%	¼W
R7A–C	47kΩ	±10%	¼W
R8A	100kΩ	±10%	¼W
R9A–C	12kΩ	± 5%	¼W
R10A	2.2MΩ	±10%	¼W
R11A	150kΩ	±10%	¼W
R12A	1,000Ω	±10%	¼W
R13A–B	330kΩ	±10%	¼W
R14A	100Ω	±10%	
R15A–C	100Ω	±10%	¼W
R16A	68Ω	±10%	¼W
R17A	680Ω	±10%	¼W
R18A	1Ω		
R19A	10kΩ	±10%	¼W
R20A	1,800Ω	±10%	¼W

Table 5—Details of components (see Fig. 6)

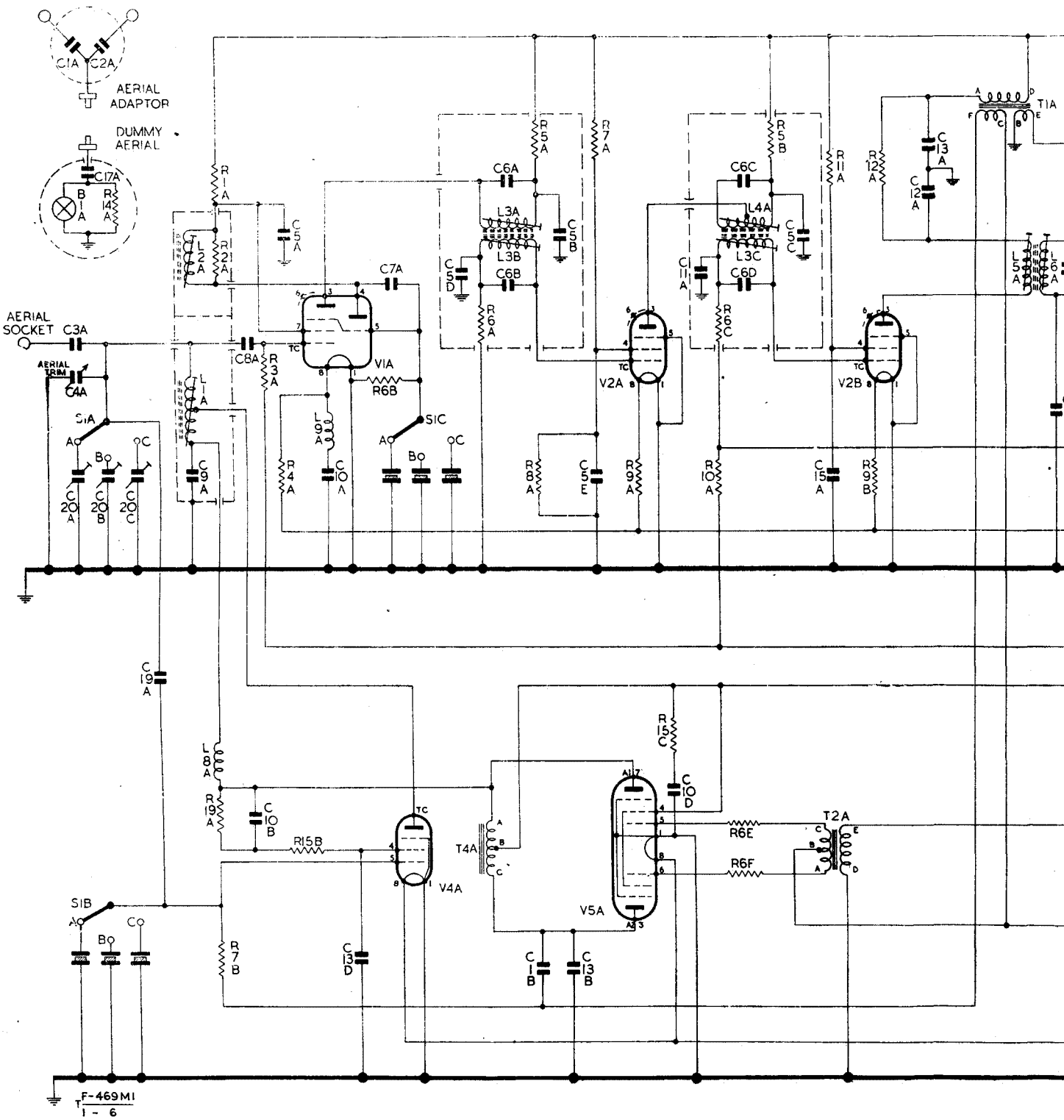
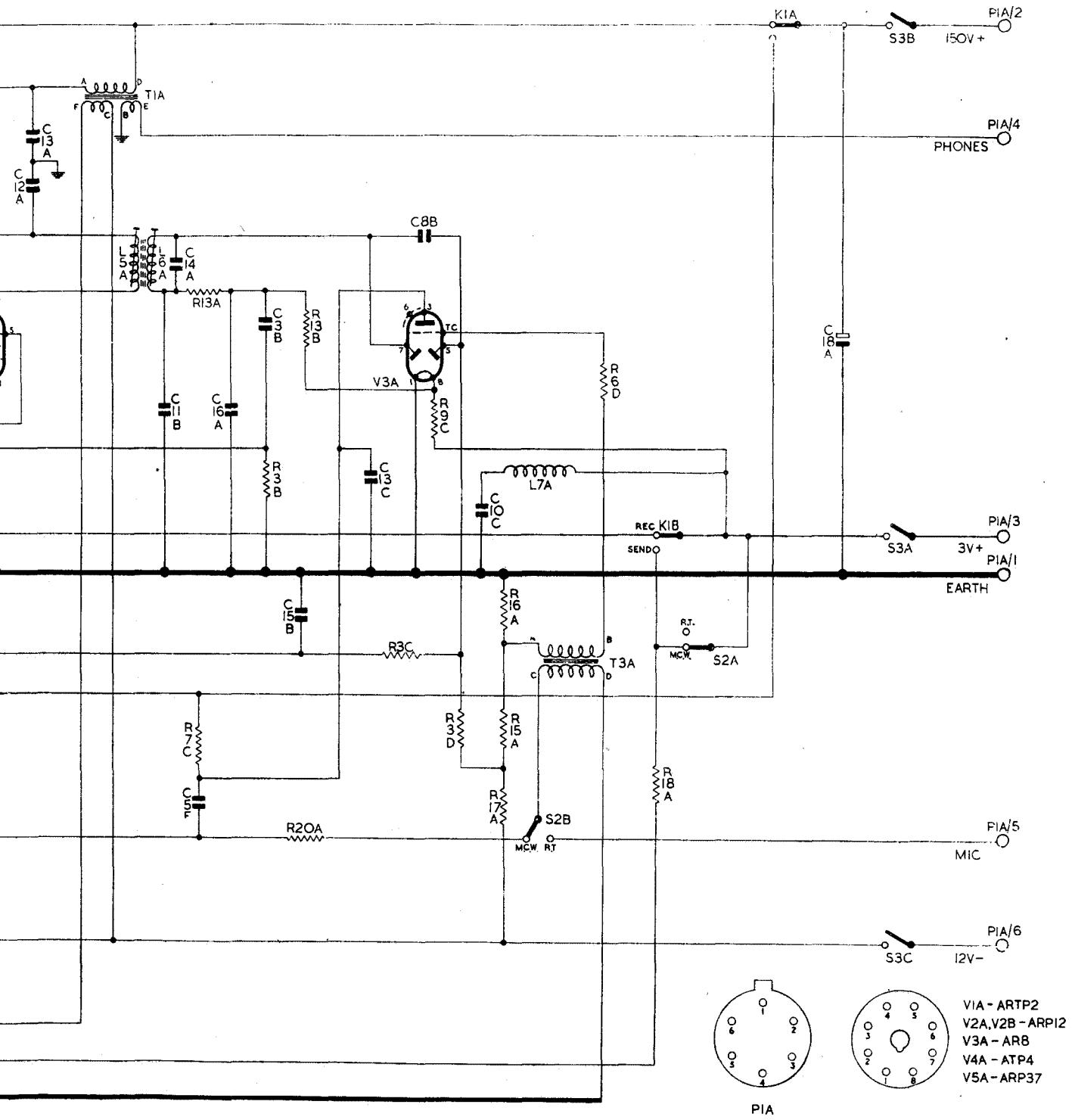


Fig. 6—Circuit diagr

END

RESTRICTED



ig. 6—Circuit diagram

END

RESTRICTED

Fig. 6
Circuit diagram

WIRELESS SET NO. 46

SERVICE DATA—SECOND TO FOURTH ECHELON

Notes: 1. This issue supersedes Pages 1 and 2 of Issue 1 of Tels. F 469/2, dated 3 Mar. 1945. The designation has been changed.
2. For double distribution see Tels. A 600

ALIGNMENT AND PERFORMANCE TESTING.

I.F. alignment

1. When checking I.F. alignment, it is essential to adjust the signal generator to within ± 1kc/s of 1,550kc/s. The signal generator should be tuned carefully for zero beat with a crystal-controlled oscillator. The signal generator should be connected to the aerial socket through a 20pF condenser. The I.F. cores can then be adjusted for maximum output, care being taken always to keep the input from the generator low (around 0·1mW). The band-width for —6db. (i.e., generator input doubled) is about 10kc/s, and that for —40db. is about 60kc/s; the peak of the curve must be symmetrical about the 1,550kc/s point.

Preliminary tests

2. The following mechanical and resistance tests should be carried out before the main electrical tests:—

(*a*) Examine the combined morse key and send-receive switch for alignment, and measure the movement at the centre of the control knob. This movement should be between 0·035 in. and 0·022 in.

(*b*) The contact resistance should be less than 0·005Ω.

(*c*) Apply test weights of ½ lb. and 1½ lb. to the operating knob. With the ½ lb. weight applied, the key should not move down to the stop.

(*d*) Measure the insulation resistance at selected points in the wiring with a 250V Megger. Insulation between any separated circuits or between any live circuit and earth should exceed 20MΩ.

Battery voltages

3. Where reference is made to normal and used battery voltages, the voltages indicated are as follows:—

(*a*) Normal voltages are H.T. 150V, L.T. 3V, G.B. 12V.

(*b*) Used voltages are H.T. 100V, L.T. 2·25V, G.B. 8V.

Normal voltages should be used except where otherwise specified.

SENDER TESTS

Current consumption

4. Using normal supply voltage, check the power consumption with the sender correctly tuned. The L.T. current should not exceed 0·68A, and the H.T. current should not exceed 36mA on R/T, or 46mA on M.C.W. transmission at any frequency.

Power output

5. The dummy aerial consists of a condenser of 20pF (±0·5pF) in series with a resistor of 10Ω (± 2%). Alternatively, the current may be measured by a valve voltmeter connected across the 10Ω resistor. The aerial current or voltage measured across the 10Ω resistor on R/T or M.C.W., as indicated by a thermoammeter or valve voltmeter or by the valve voltmeter connected across the 10Ω, must not be less than that shown in Table 1 with normal batteries; (the current on an average set is 10-20% above these figures). With used batteries the current must not be below one-half of the figures in Table 1.

Carrier frequency	*Aerial current*	*Voltage*
3·6Mc/s	60mA	0·60V
4·3 „	75 „	0·75 „
5·0 „	65 „	0·65 „
6·0 „	90 „	0·90 „
6·4 „	75 „	0·75 „
7·6 „	100 „	1·00 „
7·9 „	90 „	0·90 „
9·1 „	110 „	1·10 „

Table 1—Aerial output

Noise

6. Confirm by a listening check with a sensitive receiver that noise is absent from the R/T carrier.

Modulation

7. Disconnect the throat microphone. Apply an input of 5mV from a 30Ω source across the microphone transformer primary winding. The R/T carrier should be modulated at least 80% with an input frequency between 600c/s and 2,000c/s. With an input frequency of 300c/s or 4,000c/s, the modulation depth should not be less than 50%. On M.C.W. the modulation should be at least 73% with a frequency between 1,000 and 1,500c/s. With used batteries this figure should not be less than 50%. Readings of modulation depth should be taken by observation of the modulation envelope on a C.R.O. The M.C.W. modulation envelope is not sinusoidal and readings are of peak values.

Tuning

8. The positions of cores of coils and the settings of the variable condensers used for trimming should not be at the extreme ends of their adjustments for any frequency.

Frequency drift

9. At 20°C. the deviation from the nominal frequency marked on the crystal should not exceed ±0·015%, including the effects of switching on from cold and of reducing the supply voltage by 25%. When the set is subjected to any temperature between 0°C. and 40°C., the frequency should not change by more than 0·01% from its value at 20°C.

Sidetone

10. The sidetone level on M.C.W. should be between 0·02 and 0·06mW.

RECEIVER TESTS

11. The valves and battery voltages are the same as for the sender tests and the dummy aerial consists of a 20pF (±0·5pF) condenser inserted between the signal generator output (10-15Ω impedance) and the aerial socket. The crystals used

for the local oscillator control should have frequencies such as to give an I.F. of 1·55Mc/s when receiving signal frequencies corresponding to those specified for tests of the sender. The signal generator should be modulated at 30% at 400c/s except where otherwise specified; the output must be measured on a 500Ω output meter (which must be capable of reading 10μW) connected in place of the phones.

Current consumption

12. With normal battery voltages, the L.T. current should not exceed 0·42A for R/T conditions, and 1A for M.C.W. conditions. The H.T. current should not exceed 13mA at any frequency on R/T or M.C.W.

Sensitivity

13. The R.F. input from the signal generator required to give 0·1mW output should not exceed the figures given in Table 2. With used batteries the output for double the input levels given in the tables should not be less than 10μW.

Signal-to-noise ratio

14. When the inputs specified in Table 2 are applied, the drop in output level when the modulation is switched off should not be less than 10db.

Frequency	*Max. signal generator output for output of A.F.—1mW*	*Min. second channel signal suppression*	*Min. I.F. rejection*
9·1	5μV	35db.	66db. (80db.)
7·9	8μV	40db.	66db. (80db.)
7·6	5μV	38db.	66db. (80db.)
6·4	8μV	44db.	66db. (80db.)
6·0	4μV	46db.	66db. (80db.)
5·0	7μV	56db.	66db. (80db.)
4·3	4μV	26db.	66db. (70db.)
3·6	7μV	30db.	66db. (70db.)

Table 2—Test figures for receiver

Note.—Figures for I.F. rejection given in brackets apply for coil units supplied with equipments bearing serial Nos. 1,000 and onwards.

Second channel selectivity

15. When sensitivity measurements are made as in para. 13, the input required at the second channel frequency for 0·1mW output should be higher than the normal sensitivity input by figures not less than those given in Table 2.

I.F. signal rejection

16. Apply the signal generator output as for the sensitivity tests but with the signal generator tuned to the I.F. The relation of such figures to the normal sensitivity figures should not be less than those given in Table 2.

A.V.C. and output levels

17. Adjust the receiver to receive signals at 7·6Mc/s and tune the signal generator accurately to the receiver, using a 5mV R.F. signal. The receiver output should be within ± 6db. of 0·5mW at all inputs from 20μV to 20mV.

Acoustic response

18. Carry out this test at 7·6Mc/s. The signal generator should be set to give an output of 100μV and modulated to a depth of 30% at 1,000c/s. At any frequency between 400 and 3,000c/s, the receiver output should be within 8db. of that obtained at 1,000c/s.

Adjacent channel selectivity

19. Tune the signal generator to within ±0·5kc/s of 1,550kc/s (using a crystal monitor) and set up the receiver for 7·6Mc/s. Remove the frequency—changer grid connector and connect the signal generator lead to the frequency-changer grid in series with a 0·001μF condenser. Connect a 1,000Ω resistor between grid and the clip on the F.C. grid lead. Adjust the generator input so that the receiver output is 0·1mW; an input of about 20μV will be required. Detune the signal generator from 1,550kc/s. Increase the output by 6db. and alter the frequency, (*a*) + 4kc/s and (*b*) — 4kc/s. The output reading in each case should be less than 0·1mW. (*c*) A normal band-width measurement should then be made (first tuning the generator for maximum output and then finding the difference in frequency in kc/s between the two generator tuning points at which 0·1mW output is obtained with input increased by 6db.). The band-width should not exceed 15kc/s. (*d*) The operation (*c*) should then be repeated for band-width at 40db.; the band-width should not exceed 75kc/s.

END