The VMARS Archive

Guidance on using this electronic document

Acrobat Reader version

You need to view this document with Acrobat Reader **version 5.0** or later. It is possible that the document might open with an earlier version of the Acrobat Reader (thus allowing you to get this far!), but is also likely that some pages will not be shown correctly. You can upgrade your Acrobat Reader by direct download from the internet at http://www.adobe.com/products/acrobat/readermain.html or going to http://www.adobe.com/ and navigating from there.

Don't miss the index!

This document has had "bookmarks" added – which provide you with an "on-screen index". These allow you to quickly move to particular parts of the document, a numbered section or maybe the circuit diagrams for instance, merely by clicking on the page title. Click on the "Bookmarks" tab on the left hand side of the Acrobat Viewer window to access this feature – move the cursor over these titles and notice it change shape as you do so. Click on any of these titles to move to that page.

Large diagrams

The large diagrams are given in two formats – in A4 size sheets to allow easy printing, and complete as originally published to allow easy on-screen viewing. These versions are in different sections of the document, which can be found within the bookmarks.

Printing the document on an A4 format printer

The document has been optimised for printing on A4 size paper (this is the common size available in UK and Europe, which measures 29.7cm by 21.0cm). Please follow these steps (these are based on Acrobat Reader version 6.0 – other versions may differ in detail):

1. Work out the page numbers you want to print. If you want to print the whole document, then within "Bookmarks" (see above), first click on "**Front**", and note the page number given at the bottom of the Acrobat window – this will give you the page number of the first page to be printed. Similarly click on "**End of A4 printable copy**", to determine the last page to be printed.

2. Select "File – Print" or click on the printer icon. This will bring up the print dialog box.

3. Select the correct printer if necessary.

4. In the area marked "Print Range" click on the radio button marked "Pages from..", then enter the first and last page numbers worked out in step 1 into the "from" and "to" boxes.

5. In the "Page Handling" area, next to "Page Scaling", select "Fit to paper". The press "OK"

Note that the document is set up for double-sided printing – if you print it out single-sided then you will find a number of blank pages present, which may be removed and reused.

Printing the document on an US Letter format printer

Since A4 and US Letter sizes are similar, it is expected that this document should print satisfactorily on the latter format paper. This has not been tested however, and is not guaranteed. Follow the steps as for A4 printing, and make doubly sure that "Fit to paper" is selected (step 5).

Any other problems?

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

Richard Hankins, VMARS Archivist, Summer 2004

RESTRICTED

B.R. 1746

HANDBOOK FOR TYPE 621

(ARMY WIRELESS SET NO. 46)

1953

RESTRICTED

Attention is called to the penalties attaching to any infraction of the Official Secrets Acts.

B.R. 1746

HANDBOOK FOR TYPE 621

(ARMY WIRELESS SET NO. 46)

ANY SUGGESTIONS FOR AMENDMENTS OR ADDITIONS TO THE BOOK SHOULD BE SUBMITTED THROUGH THE USUAL CHANNELS.

Radio Equipment Department Admiralty
July, 1953 (R.E.1336/52)

★ AMENDMENTS ★

When an amendment to this handbook is promulgated the brief details required below are to be filled in.

AMENDMENT Nº	AUTHORITY (A.F.O. Nº ETC.)	DATE OF INSERTION	INITIALS

ADMIRALTY, S.W.1.
July, 1953.

R.E.1336/52

B.R.1746 "Handbook for Type 621 (Army Wireless Set No. 46)".

E.M.E.R. Telecom. F.460 - Data Summary

E.M.E.R. Telecom. F.462 - General Description

E.M.E.R. Telecom. F.463 - First Echelon Work

E.M.E.R. Telecom. F.464 - Second to Fourth Echelon Work

E.M.E.R. Telecom. F.469 Misc. Inst. No. 1 Service Data - First Echelon

E.M.E.R. Telecom. F.469 Misc. Inst. No. 2 Service Data - Second to Fourth Echelon.

having been approved by My Lords Commissioners of the Admiralty, is hereby promulgated for information and guidance.

By Command of their Lordships.

To:-

Flag Officers and
Commanding Officers
of H.M. Ships and
Vessels concerned.

WIRELESS SET No. 46 (ZA 11622)

DATA SUMMARY

PURPOSE

Man-pack transmitter-receiver, providing R/T and M.C.W. communication. Primarily used during beach operations, but alternatively can be used as a fixed station.

DESCRIPTION

Receiver is four-valve superhet. comprising triode pentode frequency changer, two I.F. stages, diode detector and A.V.C., and output reflexed into 2nd I.F. Sender has one R.F. valve, anode-modulated. Modulator valve driven by triode throat microphone amplifier, which can also act as M.C.W. oscillator. Both local and master oscillators are crystal-controlled. Four frequency bands selected by plug-in coils. Three spot frequencies in each band selected by switching crystals. Set is housed in waterproof steel case; batteries in separate haversack; waterproof haversack provided if necessary.

PHYSICAL DATA

	Set in carrier	*Complete station as carried with one battery*
Weight :	11 lb.	24 lb.
Length :	12½ in.	
Width :	7½ in.	
Height :	4½ in.	

FREQUENCY

Three spot frequencies in one of the following bands :—

Coverage : 3.4—4.3 Mc/s 6.4—7.6 Mc/s
5.0—6.0 Mc/s 7.9—9.1 Mc/s

Internal : I.F. 1,550 kc/s

PERFORMANCE

Range : approx. 10 miles in day time in flat country.
Sender output : 1.5 W.
Receiver sensitivity : 8 μV for 0.1 mW with signal-to-noise ratio of 10 db.
Receiver selectivity : 40 db. attenuation at ± 38 kc/s

T F-460 / 1 - 1

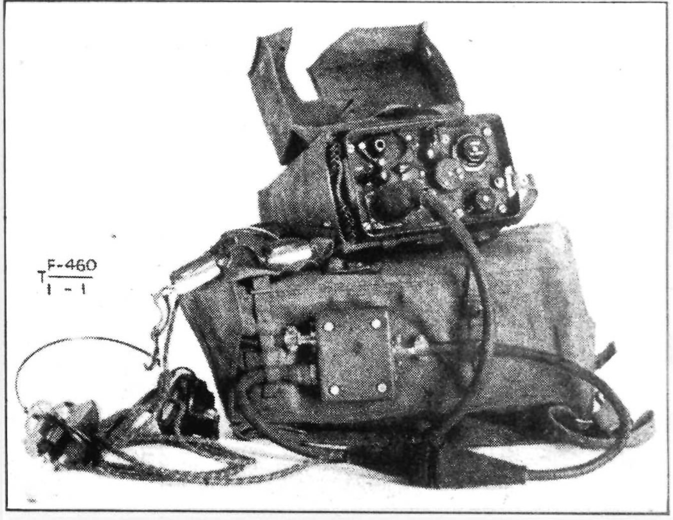


Fig. 1—General view of complete set

Distribution - Class 870. Code No. 4

POWER REQUIREMENTS AND CONSUMPTION

Battery, dry, 162/3V, No. 1 or No. 2.

Service	*H.T.*	*L.T.*
Send R/T	28 mA	550 mA
,, M.C.W.	37 mA	550 mA
Receive R/T	10 mA	350 mA

AERIAL SYSTEM

(a) 9 ft. rod (mobile).

(b) 16 ft. antennae rods F (static).

VALVES

Circuit reference	*Type*	*Function*
V1A	ARTP 2	Frequency changer
V2A	ARP 12	First I.F. amplifier
V2B	ARP 12	Second I.F. and reflexed A.F. amplifier
V3A	AR 8	Double-diode for detector and A.V.C. triode modulation amplifier and M.C.W. oscillator
V4A	ATP 4	Sender oscillator
V5A	ARP 37	Push-pull modulator

END

WIRELESS SET NO. 46

GENERAL DESCRIPTION

PRELIMINARY DESCRIPTION

1. The Wireless set No. 46 is a portable man-pack set for transmission and reception of R/T and M.C.W. signals over any of three pre-set crystal-controlled channels. The sender output is 1·5W.

2. The set is designed to cover the following bands by means of plug-in coils:—

Range 1: 7·9—9·1Mc/s Range 3: 5·0—6·0Mc/s
Range 2: 6·4—7·6Mc/s Range 4: 3·6—4·3Mc/s

Any three frequencies in the band chosen may be obtained by plugging in the appropriate crystals and adjusting three pre-set trimmers. Two crystals (one for send and one for receive) are required for each of the three frequency channels used on the set. The set is thus limited to those frequencies for which crystals are actually available, and the frequency allotment requires to be planned in advance. The operator may change instantly from one to another of the three channels by merely switching over, no readjustment of the aerial trimming being normally required.

3. The range of transmission is approximately 10 miles in day-time over flat country.

4. The set is designed for use with rod aerials 2 to 16 ft. in length. The power supplies are from 162/3V batteries, as used in the No. 18 set.

Brief electrical description

5. The receiver section of this crystal-controlled transceiver consists of four valve stages. V1A (ARTP 2) is the frequency changer, V2A (ARP 12) is the first I.F. amplifier, V2B (ARP 12) is the second I.F. and reflex A.F. amplifier, and the diode sections of V3A (AR 8) are used as the detector and A.V.C. rectifier. The triode section of V3A is used as the sender modulation amplifier. V4A (ATP 4) is the sender crystal-controlled oscillator, and V5A (ARP 37), a double pentode, is a push-pull modulator. The I.F. is 1,550kc/s.

Brief mechanical description

6. The set is in a waterproofed carrying case. The batteries are carried separately in a haversack and the whole is a one-man load. The weight of the complete station is 24 lb. with one battery and the phone assembly. For a fixed station 16 ft. aerial rods weighing 6½ lb. are used.

7. Connections from the battery haversack to the D.L.R. phones and throat microphone are made by means of a snatch plug, those between the set and battery haversack being made by means of a six-point screw plug and multi-core screened cable.

Panel controls

8. All the controls are situated on the top panel of the set. The controls are as follows:—

(*a*) The ON/OFF switch (S3A) with indicator, which shows clearly at a distance.
(*b*) The PRESS TO SEND-PRESS TO RECEIVE control (K1A-B), which switches the set from send to receive. It may be used if necessary for M.C.W. morse transmission up to 12 w.p.m.
(*c*) The CHANNELS switch (S1A-C), which selects the desired channels of the three provided.
(*d*) The R/T—M.C.W. switch (S2A-B).
(*e*) The TRIM AERIAL control (C4A), which is adjusted to tune the aerial circuit.

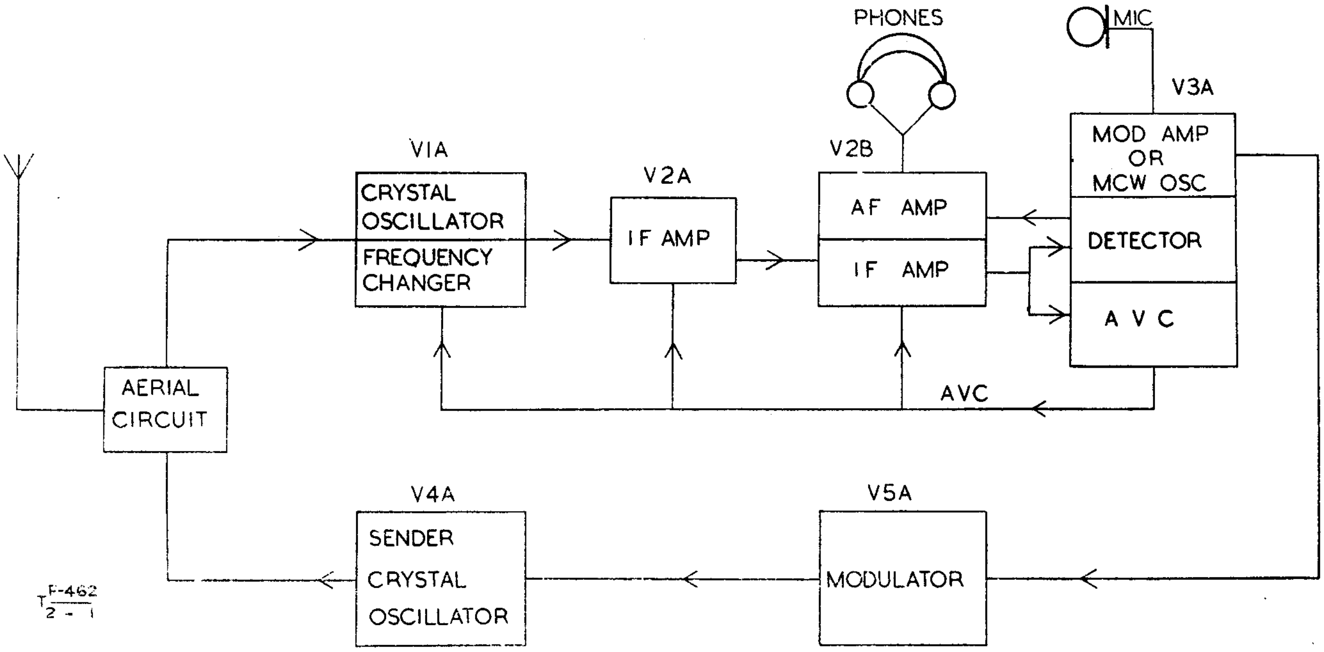


Fig. 1—Block diagram

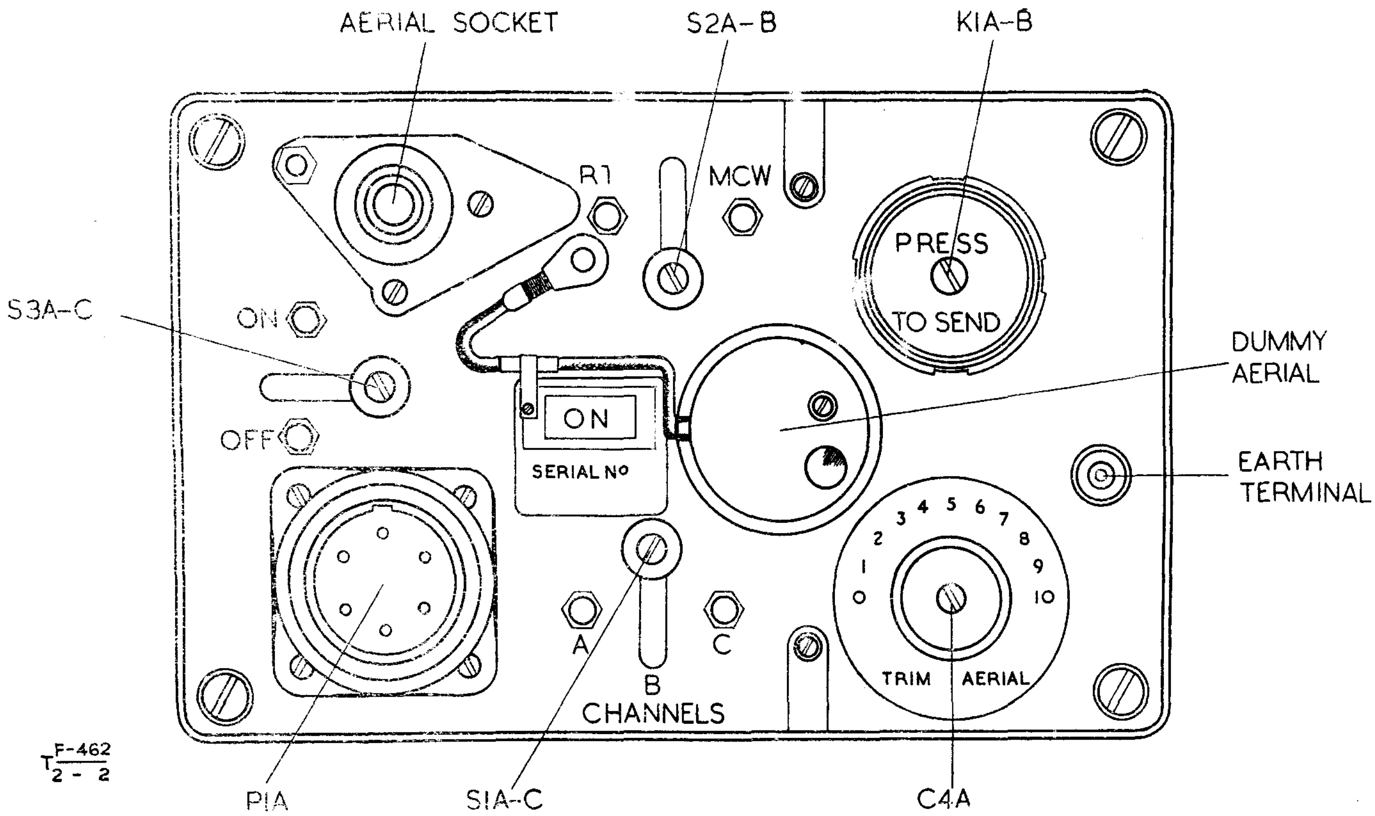


Fig. 2—Front panel

9. The following additional items are on the top panel:—

(*a*) The aerial socket into which the aerial rods are plugged. The aerial adaptor is plugged into this socket when a 16 ft. rod aerial is used.

(*b*) The six-way plug for connections to batteries, headphones and microphone.

(*c*) The dummy aerial may be plugged into the aerial socket in place of the aerial. The lamp B1A indicates the sender output into the dummy aerial.

10. The panel is held to the base by means of four screws. A rubber gasket is provided to make a waterproof joint between the set and its case.

TECHNICAL DESCRIPTION

11. All valves have 2V heaters, with which resistors are inserted in series to permit the valves to be run from the 3V L.T. battery.

Receiver

12. The aerial circuit (which is also used as the aerial circuit of the sender) is tuned by C4A, the external AERIAL TRIM knob of the set. In order to avoid having to retune this external trimmer every time the set is changed from one channel to another, an additional internal trimmer is switched in by the CHANNELS switch; there are three trimmers (C20A, C20B and C20C), pre-set to make the aerial tuning correct for the particular crystals in use. The condenser C9A, in series with the aerial coil, is chosen so that the additional combination acts as an I.F. filter, to prevent direct reception from any interfering station on or near a frequency of 1,550kc/s.

13. The first valve is the frequency changer V1A (ARTP 2). The frequency of the triode oscillator portion is fixed by the receiver crystal; the oscillator anode coil is so arranged that any crystal within the given waveband will oscillate when plugged in, and no retuning of the anode circuit is necessary. The frequency of the oscillator (and of the crystal) is not the same as that of the signals which it is desired to receive, being 1,550kc/s lower than the signal frequency on the three higher frequency bands, and 1,550kc/s higher than the signal frequency on the lowest frequency band.

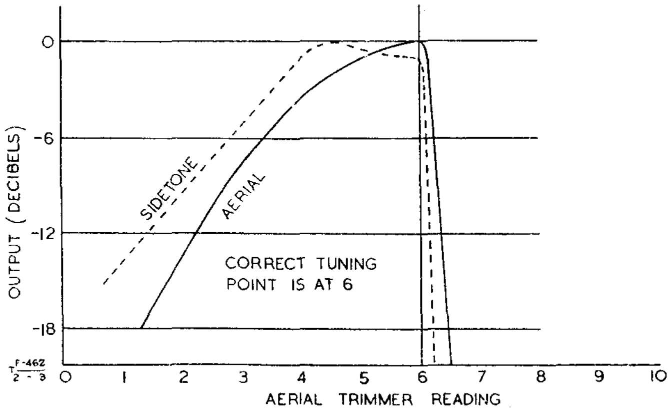


Fig. 3—Graph, aerial trimmer reading/output

This issue replaces and cancels pages 3 and 4 of Issue 2. Paras marked ● are additional.

14. The first I.F. transformer follows the frequency changer and feeds the first I.F. valve V2A (ARP12). This is followed by the second I.F. transformer feeding the second I.F. valve V2B (ARP12); these transformers each employ two tuned circuits and are tuned by adjustment of the position of the iron-dust cores in the moulded coil formers. The I.F. is 1,550kc/s, and it is essential that the transformers should be tuned accurately to this frequency since the signal they are required to amplify is fixed at exactly 1,550kc/s, this being the difference between the frequency crystal in the set and the sender crystal at the distant station. The third I.F. transformer is close-coupled, only one of the circuits being tuned; its screening box is arranged to screen also several other components. This transformer feeds the detector and A.V.C. diodes, which are part of V3A.

15. The detector output is fed to the grid of V2B through R13B, C3B and R6C. V2B acts as a reflex A.F. amplifier and feeds the headphones through the output transformer T1A. Due to the presence of the components R12A and C12A, the anode load of V2B at audio frequencies primarily consists of T1A, that at the intermediate frequency being L5A.

16. The A.V.C. diode feeds bias to the grid of V1A and V2B through the resistors R3A and R10A. C15B is the A.V.C. decoupling condenser.

Sender

17. V4A (ATP4) acts as a crystal-controlled oscillator with a tuned anode circuit. The output transformer T1A is connected to the V4A grid circuit through R7B. Sidetone may thus be heard in the headphones and this gives an indication of the output of the sender oscillator. If C4A is turned down from maximum capacity, the sidetone suddenly becomes loud. This point is the setting of C4A for maximum sender output (see Fig. 1).

18. The small audio-frequency voltage produced by the throat microphone is applied to the triode section of V3A through the 100 : 1 ratio microphone transformer T3A. The output of V3A is applied to the push-pull amplifier V5A through the modulator input transformer T2A. The audio output voltage from V5A is developed across the centre-tapped modulator output auto-transformer T4A and is applied to anode and screen of V4A in series with the H.T. feed.

19. The sender is switched for M.C.W. operation by S2A-B The primary of T3A is then connected into the anode circuit of V3A. This valve stage then acts as an oscillator operating between 1,000c/s and 1,500c/s. The voltage developed across R20A is applied to V5A through T2A, as for R/T working. R20A is chosen to give nearly 100% modulation without over-running V5A, by applying an excessive A.F. input. The modulation wave form on M.C.W. is made non-sinusoidal in order to give a rough note.

Send-receive switching

20. Send-receive switching is carried out by means of K1A-B. With S2A at R/T, both H.T. and filament circuits are changed by K1A and K1B respectively. On M.C.W., morse keying is required; therefore only the H.T. is switched, the heater supply to the sender being permanently left on to allow for rapid switching from send to receive.

Batteries

21. The L.T. current taken is 350mA for the receiver valves and 550mA for the sender valves. The H.T. current taken is 10mA on receive, 28mA on send R/T, and 37mA on send M.C.W.

22. The circuit is arranged so that the bias section of the battery is run down at the same average rate as the H.T. section, by means of the resistors R15A, R16A and R17A. The bias value is very important, and non-standard batteries, or batteries which have been in use on other sets, should never be used on the No. 46 set.

23. The point marked +12V on the battery is connected to the chassis and the L.T. –, while the point marked 0V is used to supply the – 12V grid bias.

24. The life of the battery depends upon a number of factors. For example, a battery which has been in stock for six months will usually have a shorter working life.

Telephones and microphones

25. The phones used (type D.L.R. 2) are considerably more sensitive than normal types, and are 500-1,000 Ω impedance at middle audio frequencies. The throat microphone is 30-100 Ω impedance, and gives an output of 1 to 5mV on speech.

Aerial coupling

26. The aerial circuit is primarily designed for matching to a rod aerial about 8 ft. in length, having a capacity of about 20pF and a resistance of 20-60 Ω. Larger aerials are accommodated by inserting a series aerial condenser (in the AERIAL ADAPTOR) which reduces the effective capacity of the larger aerial to about 20pF and also maintains the correct resistive loading on the circuit.

Alterations in positions of R15A and R16A

● 27. In sets of serial numbers given below in para. 28 the positions of R15A and R16A have been reversed. This has been made necessary by a change in the valve characteristics of the later productions of the AR8 used in position V3A. This change necessitates an altered grid bias, which is brought about by the above circuit changes, in order that the correct M.C.W. note may be obtained.

Serial numbers affected

● 28. All sets of serial number above 21489 and

8440	17430	19094	19310	19493	19786	20183
9935	17597	19113	19318	19502	19794	20225
9958	17673	19131	19323	19521	19807	20228
10017	17705	19136	19327	19522	19837	20231
11229	17714	19142	19331	19540	19870	20233
12871	17743	19155	19335	19544	19881	20234
12995	17820	19163	19347	19551	19882	20242
13518	17975	19183	19375	19558	19440	20243
13608	18310	19197	19378	19571	19998	20248
16385	18312	19201	19379	19576	20001	20282
16447	18411	19202	19394	19596	20003	20283
16842	18492	19206	19397	19598	20012	20287
16952	18602	19217	19403	19622	20017	20288
16953	18946	19235	19409	19626	20023	20289
16975	19016	19248	19418	19630	20025	20272
16993	19018	19252	19433	19633	20027	20293
17019	19043	19260	19434	19667	20029	20294
17059	19049	19261	19435	19688	20030	20295
17172	19057	19265	19436	19694	20031	20296
17213	19065	19273	19456	19715	20032	20376
17295	19077	19279	19460	19717	20033	20379
17296	19079	19280	19464	19720	20034	20858
17348	19084	19283	19487	19731	20181	
17374	19088	19303	19488	19750	20182	

RESTRICTED

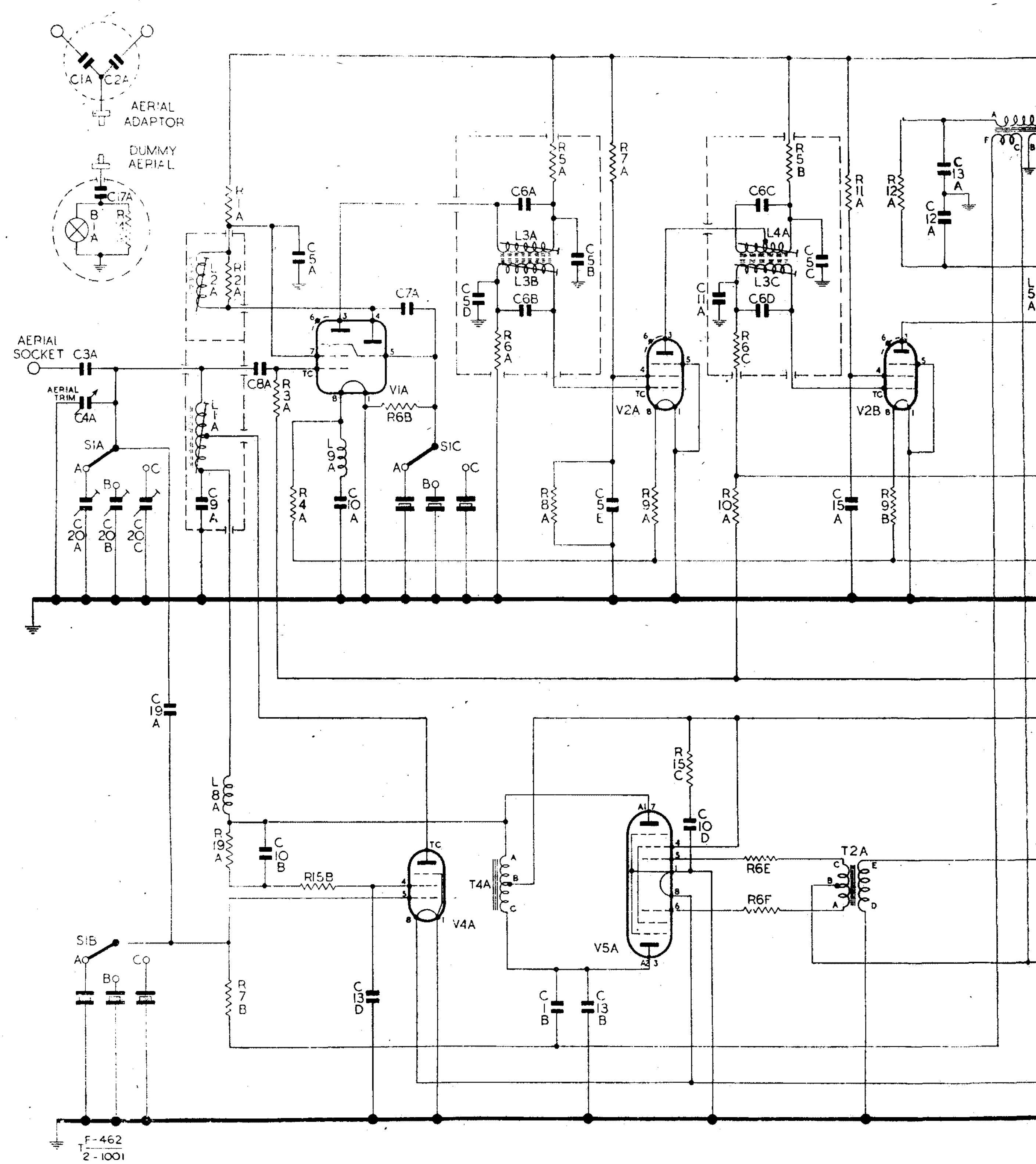
RESTRICTED

Circuit reference	Remarks
	INDUCTORS
L1A	Aerial tuning inductance
L2A	Frequency changer, oscillator, anode inductance
L3A	First I.F. transformer, primary
L3B	,, ,, ,, secondary
L3C	Second I.F. transformer, secondary
L4A	,, ,, ,, primary
L5A	Third I.F. transformer, primary (untuned)
L6A	,, ,, ,, 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 channel, switch
S2A and S2B	3-pole, 2-way, R/T—M.C.W., switch
S3A-C	3-pole, ON/OFF, switch
	VALVES
V1A	ARTP 2, triode-pentode
V2A and V2B	ARP 12, pentode
V3A	AR 8, double-diode-triode
V4A	ATP 4, R.F. pentode
V5A	ARP 37, double pentode
	PLUGS
P1A	6-point battery plug
	KEYS
K1A and K1B	Morse key, send-receive, switch

Circuit reference	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	1kΩ	±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	1·8kΩ	±10%	¼W

Circuit reference	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	0·530pF			
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			

Table 1001—Details of components (Fig. 1001)



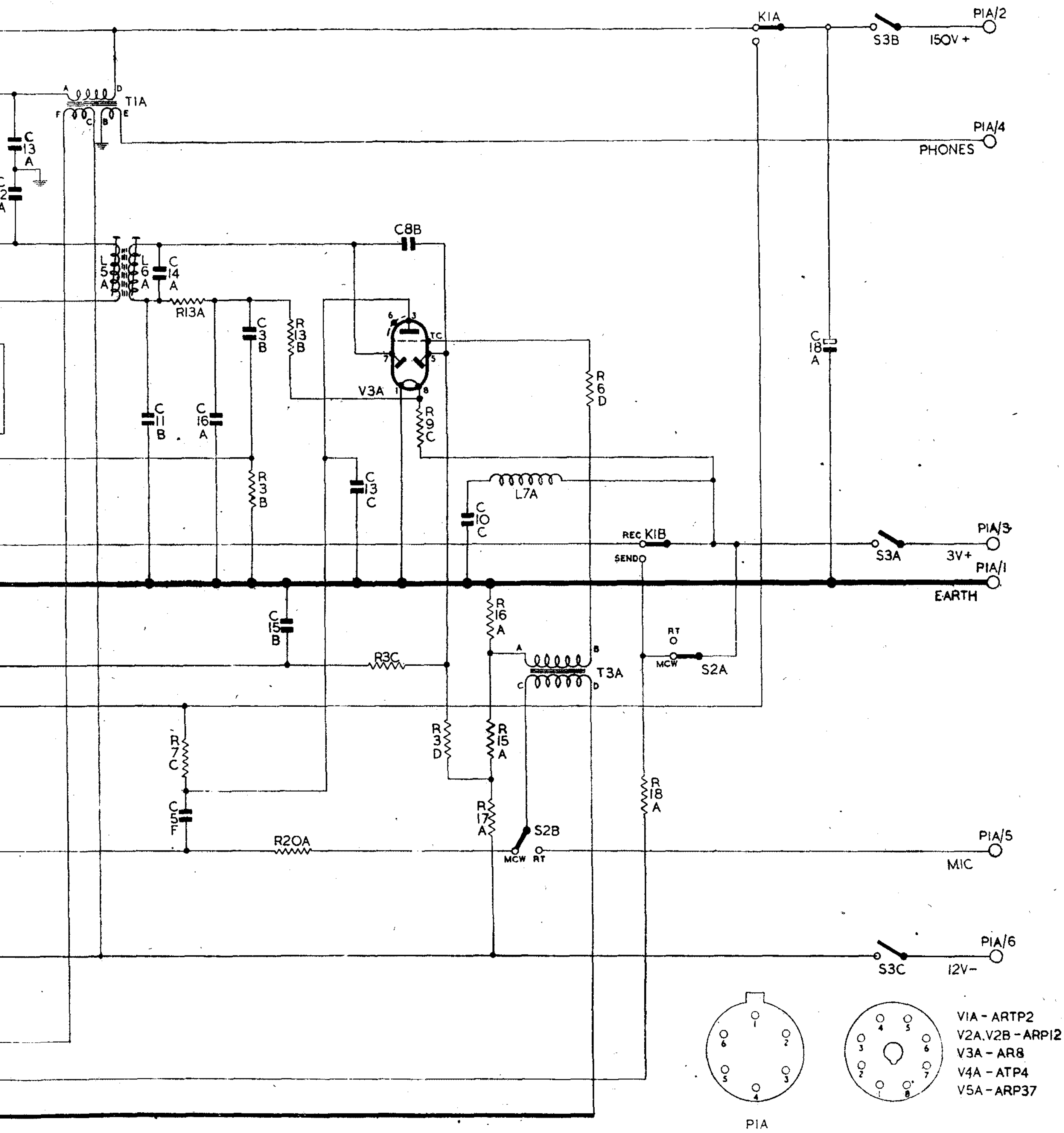
TELG/SRDE/106

Fig. 1001—Circuit

END

This replaces Tels. F 462, Issue 1, dated 5 Apr. 1

RESTRICTED



01—Circuit diagram

END

ted 5 Apr. 1944, which has been amended throughout.

RESTRICTED

WIRELESS SET NO. 46

FIRST ECHELON WORK

Note: This issue, Pages 1 and 2, supersedes Pages 1 and 2 of Issue 1, dated 18 Jan., 1945. Items marked ● in Table 2 have been amended.

ROUTINE TECHNICAL MAINTENANCE

General

1. Ensure that the set is kept clean and that the valves fit tightly in their sockets. Keep the 6-pin plug on the set and the corresponding socket on the lead clean and free from moisture. Check that the snatch plugs are in good condition, that the leads are well soldered to the contacts and that the contacts are satisfactory. The aerial sections should be kept clean and free from corrosion and the parts where they are joined together should be lightly greased with Vaseline.

Waterproofing

2. Good waterproofing is essential in view of the operational requirements of the set. Ensure that the rubber sheath over the 6-pin plug is well seated down. Check that the main case gasket and the gasket on the junction box are in position and that the four screws holding the case to the front panel are evenly tightened so that the panel edge is level.

Voltage and current readings

3. Detailed examination for faulty components is facilitated by comparing voltages and currents with those given in Table 3. Tests Nos. 3 to 15 were measured on an Avometer, universal, 46-range (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.

Maintenance tasks

4. It is recommended that the points mentioned in paras. 1 and 2 should be checked fortnightly by a Signals electrician or instrument mechanic. The readings detailed in para. 3 should be taken fortnightly and a log should be kept for each set so that any abnormal changes may be noted and action taken accordingly.

REPAIR INFORMATION

Fault-finding

5. The output of the sender may be checked by connecting the dummy aerial into the aerial socket. The brightness of illumination of the 6V lamp B1A indicates roughly the sender output. The H.T. current when the sender is accurately tuned should not exceed 35mA on R/T or 45mA on M.C.W.; the rise in current on switching to M.C.W. provides a check of the percentage modulation. This rise should be between 8mA and 11mA. If the H.T. current is excessive, check the bias circuit.

6. In the aerial tuning circuit and the coil units the main difficulty likely to be encountered is, apart from wiring faults, a possible failure to tune with crystals at the extreme limits of the band.

7. Some difficulty may occur in tuning with the 16 ft. F aerial, especially at the highest frequencies. To overcome these difficulties, shorten the lead-in as far as possible; if this does not overcome the fault, use the L terminal on the aerial adaptor in place of the F terminal.

8. When setting up new crystals, it might be found that, with a crystal at the high-frequency end of the band, even with the internal trimmer set to zero, the tuning point comes below 2·0 on the AERIAL TRIM adjustment. After checking all other possible causes of the trouble (e.g., trying another crystal and dummy aerial), break the paper seal (over the hole nearer to the control panel of the set) on the coil unit and turn the core slightly anti-clockwise until tuning is obtained.

9. If a reading greater than 2·5 is required to tune to a crystal at the extreme low-frequency end of the band (with internal trimmer at maximum), this can be accepted, provided the other crystals can be trimmed.

10. If it is found that a receiver crystal near the highest frequency in the band will not oscillate, while others of lower frequency do oscillate, it is possible that L2A (or other oscillator coil) is tuning to too low a frequency. After checking all other possible causes of the trouble, such as trying another valve and crystal of the same or adjacent frequency, and trying the crystal in another channel, break the paper seal over the hole farthest from the control and turn the iron-dust core adjustment slightly anti-clockwise until oscillation is obtained.

Changing the frequency channels: fitting crystals and coil units

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

Mc/s	Mc/s
7·9—9·1 (yellow)	5·0—6·0 (blue)
6·4—7·6 (white)	3·6—4·3 (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

12. The procedure for changing frequency channels is as follows :—

(*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). 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 the 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 (line on rotor pointing down towards 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.

(*g*) Check that no readjustment of the AERIAL TRIM 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 the 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*) above 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.

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	●Red		
2. Phones		Yellow		White (green end)	White (green end)
3. H.T. + set		Red			
4. H.T. + batt.	+150V		●Green		
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 2—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 battery is connected through the case of the set and junction box, and to L.T.—

3. The socket marked H.T.—on battery is used to supply grid bias (—21V) to set.

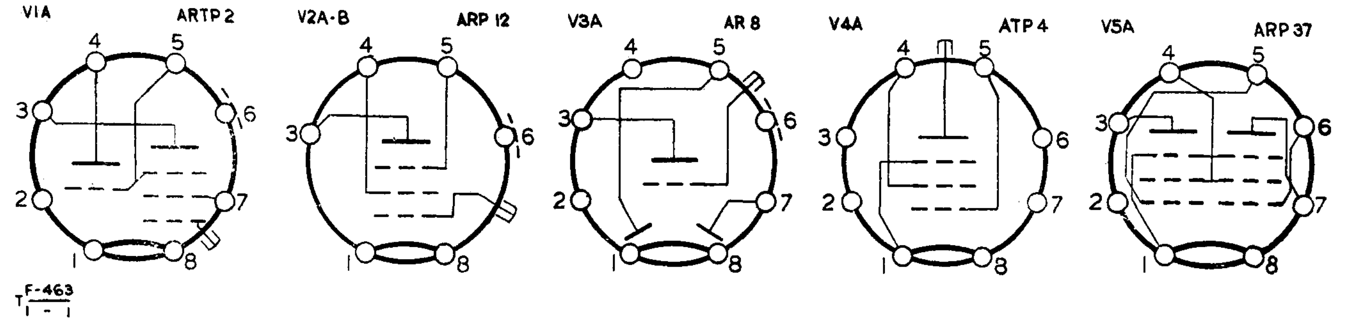


Fig. 1—Valve bases

Test No.		*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	0	144V	0
4	V4A screen (pin 4)	85V	0	80	0
5	V1A screen (pin 7)	0	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 3—Voltage and current test figures

Valve	*Position of K1A-B*	*Electrode*	*Pin*	*Resistance*	
				to	
V1A	RECEIVE	G2	7	HT+	27kΩ
		A	3	HT+	2·3kΩ
		G0	5	Ch	100kΩ
		A0	4	HT+	27kΩ
V2A	RECEIVE	A	3	HT+	2·2kΩ
		G2	4	HT+	47kΩ
V2B	RECEIVE	A	3	HT+	1·7kΩ
		G2	4	HT+	150kΩ
V3A	SEND	A	3	HT+	47kΩ
		G1	TC	Ch	100kΩ
V4A	SEND	G2	4	HT+	11kΩ
		A	5	HT+	250Ω
		G1	TC	Ch	47kΩ
V5A	SEND	A1	3	HT+	250Ω
		A2	7	HT+	200Ω
		G2	4	HT+	S.C.

Table 4—Valve pin resistance readings

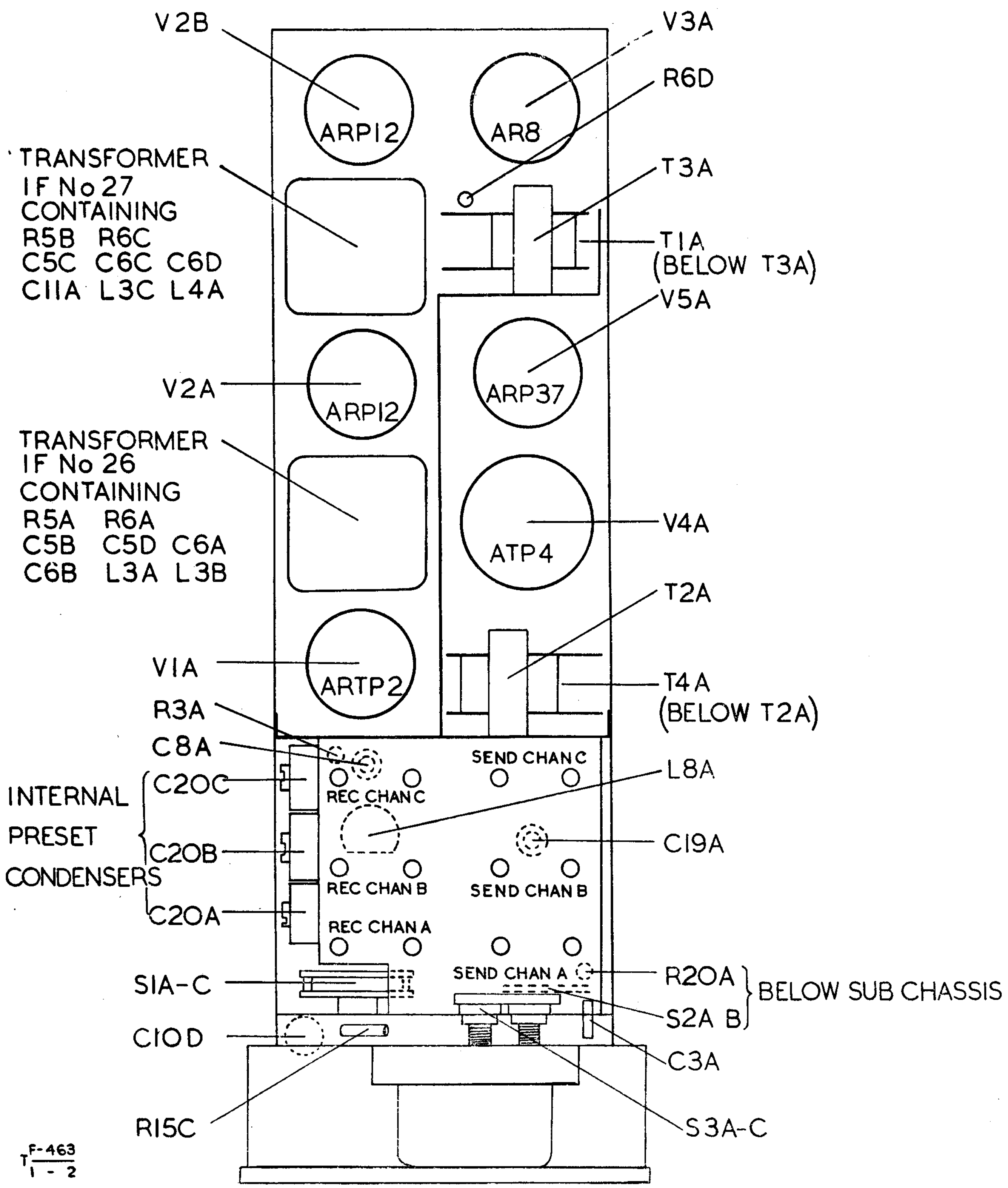


Fig. 2—Top component layout diagram

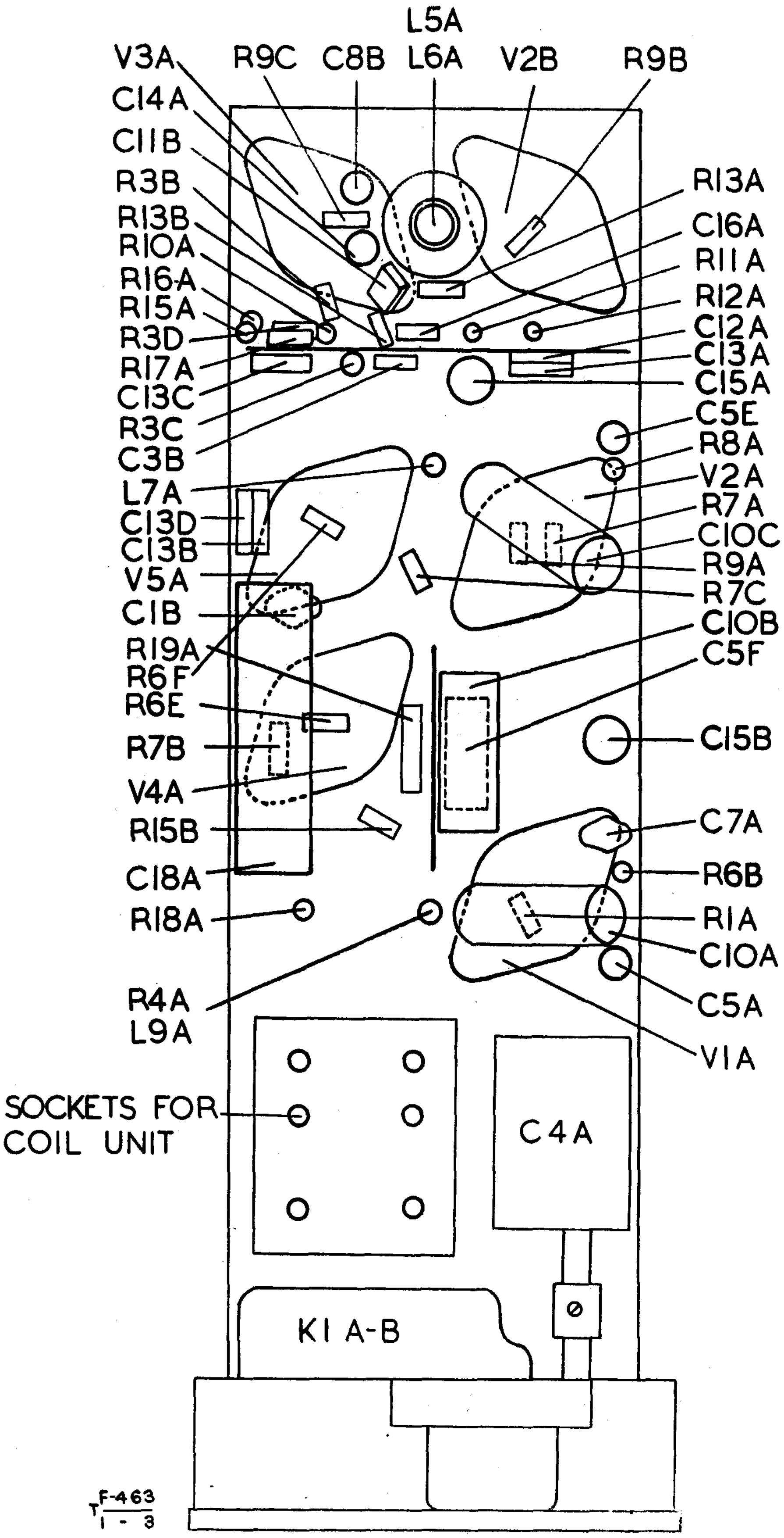


Fig. 3—Bottom component layout diagram

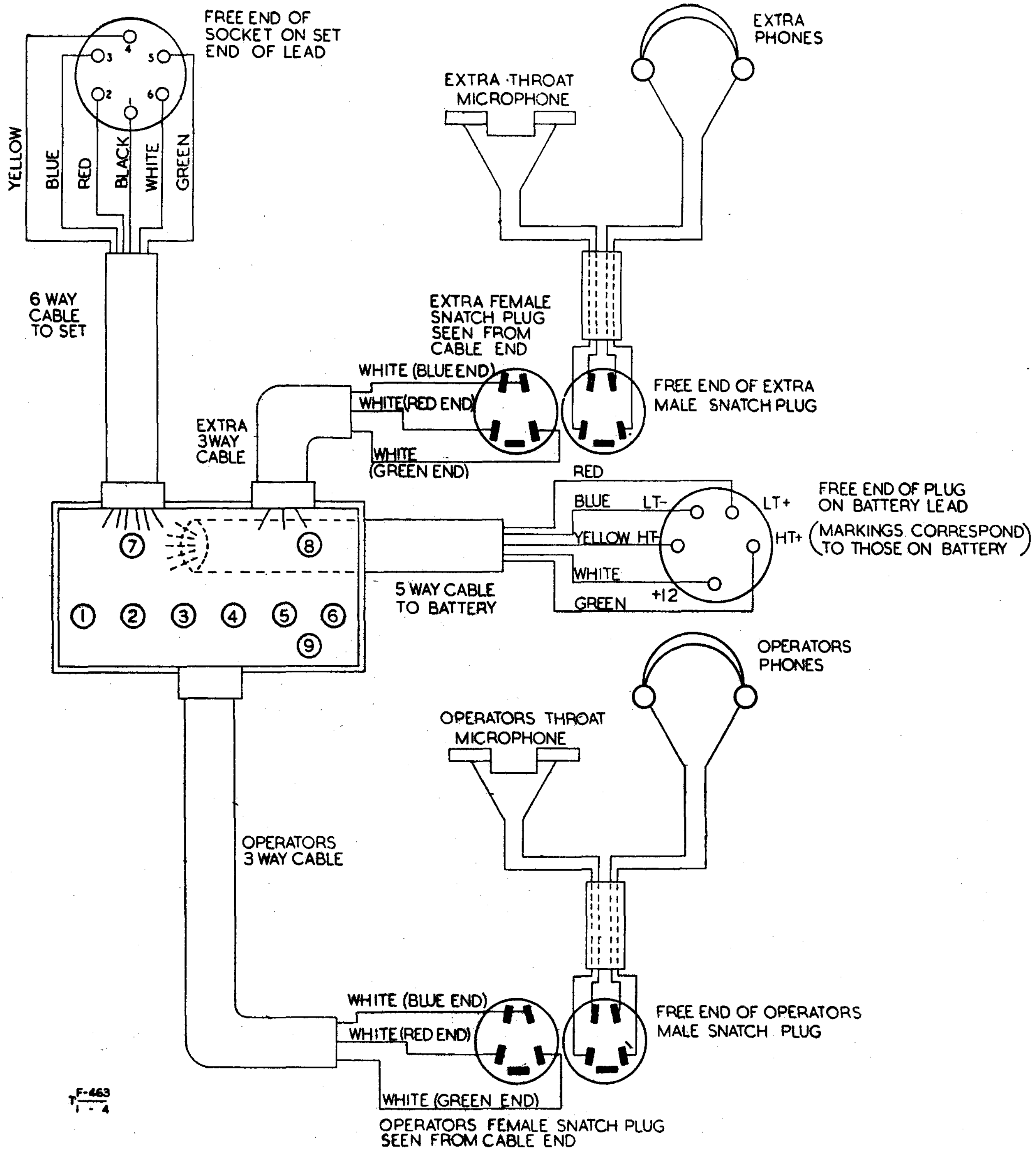


Fig. 4—External connections to set

END

WIRELESS SET No. 46

SECOND TO FOURTH ECHELON WORK

ALIGNMENT AND PERFORMANCE TESTING

I.F. alignment

1. When testing 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, which may be either :—

(*a*) A special oscillator for 1,550kc/s±0.01%, or

(*b*) another No. 46 set switched to the same channel as the set on test, and fixed at send R/T, which will cause an I.F. signal to be generated by V1A, and will give a squeak when the strength of signal is suitable. Usually no aerial is required if the second set is in the same room.

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 bandwidth 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.

Performance testing

2. The following performance testing procedure (paras. 5 to 22) is extracted from C.I.E.M.E. specification R.S./PROV/4109.

Preliminary tests

3. 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

4. Where reference is made to normal and used battery voltages, the voltages indicated are those stated below :—

(*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. 8B.

Normal voltages should be used except where specified.

SENDER TESTS

Current consumption

5. Using normal supply voltages, 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.

Output

6. The dummy aerial should consist of a condenser of 20pF (±0.5pF) in series with a resistance of 10Ω (±2%). The resistance and the meter must be connected on the *cold* side of the condenser. Alternatively, the current may be measured by a valve voltmeter connected across the 10Ω resistor. The aerial current or voltage across the 10Ω resistor on R/T or M.C.W., as indicated on the thermo-ammeter or valve voltmeter, must not be less than that shown in Table 1 with normal batteries (the current on an averate set is 10–20% above these figures). With used batteries the current must not be below 50% of the figures given in Table 1.

Carrier frequency	*Aerial current*	*Voltage measured across* 10Ω
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 current test figures

Noise

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

Modulation

8. 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 75% with a frequency between 1,000 and 1,500c/s. With used batteries this figure should not be less than 50%. Reading 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 value.

Tuning

9. The position 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

10. 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%. Frequency should not change by more than 0.01% from its value at 20°C. when the set is subjected to any temperature between 0°C. and 40°C.

Sidetone

11. The sidetone level on M.C.W. should be between 0.02 and 0.06mW, measured at the receiver output terminals in 500Ω termination. The sidetone level should be within the same limits on R/T with 70% modulation at 1,000c/s.

RECEIVER TESTS

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.

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.

Mc/s	*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. 1000 and onwards.

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 imputs 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 1,550 kc/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*) by +4 kc/s and (*b*) by -4 kc/s. The output reading in each case should be less than 0.1mW. A normal 6db. bandwidth 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 bandwidth should not exceed 15kc/s. This operation should then be repeated for bandwidth on 40db.; the bandwidth should not exceed 75kc/s.

FINAL TEST OF COMPLETE EQUIPMENT

20. When completed, the set should be given a functional test; this may be carried out between two sets at about 100 yd. apart, in which case a single B section should be used on each set as an aerial. The functional test should cover R/T and M.C.W. communication on at least three frequencies, absence of distortion on R/T and satisfactory morse signalling on M.C.W. up to 3 w.p.m. being confirmed.

21. All crystals and coil units intended for use with any W.S. No. 46, whether forming part of a station or supplied as spares, should be subjected to a test under working conditions.

22. The dummy aerial, which is intended to indicate when batteries require to be changed, should be checked with normal and used battery voltages as given in para. 4 to see that the bulb lights with normal batteries but gives a very dim glow on used ones.

FAULT-FINDING

Aerial current

23. Connect a 0–200mA aerial ammeter (thermo-ammeter) between the aerial socket and the dummy aerial plug, taking care to minimize stray capacity by using very short leads and keeping the meter away from earthed objects. When tuned in the usual way, by sidetone, the normal reading ranges from about 140mA at 9Mc/s to 80mA at 3.6Mc/s (these figures are also approximately correct for current into the actual 8-section aerial). The reading should rise slightly (about 5%) when switched to M.C.W., and should rise by 20–25% on R/T with loud sounds at the microphone. The H.T. current when the sender is accurately tuned should not exceed 35mA on R/T or 45mA on M.C.W.; the rise in current (which should be 8-11mA) on switching to M.C.W. provides a check on the percentage modulation.

Modulator circuits

24. Faults in the modulator can best be tested with an A.F. generator with attenuator, as in Table 3. In each case the aerial current reading should rise with the input given, by between 15% and 25%, indicating 80–100% modulation.

Point of injection	*Frequency*	*Input voltage*
In place of microphone*	1kc/s	4mV
,, ,, ,, ,,	400c/s or 4kc/s	8mV
To *hot* end of T3A secondary	1kc/s	300mV
,, ,, ,, ,, T2A primary	1kc/s	3mV
,, either grid of ARP 37	1kc/s	7mV

Table 3 — A.F. generator tests

Note: * Generator output impedance must be approximately 30Ω for this test.

25. The modulation may also be examined by feeding a C.R.O. from the aerial socket through a 20pF condenser, with a resistor of about 1,000Ω shunted across the input terminal of the oscillograph. The M.C.W. wave form is not sinusoidal and peak-to-peak modulation is normally 80–90%.

NORMAL RECEIVER CHECK TESTS

Sensitivity

26. An audio output meter, capable of reading 0.1mW and having an impedance of about 500Ω is required. (Note: If a larger output were used for the tests, some A.V.C. action might be present and give rise to false results. As an alternative, 0.5mW may be used if the generator will provide 70% modulation.) The R.F. signal generator is connected through a 20pF condenser to the aerial socket; the generator is tuned in to the set and C4A must be adjusted for maximum output. With 30% modulation at 400c/s, the input required for 0.1mW output should be about 5μV on all bands; if the generator is fully modulated with speech, signals should be intelligible at about 1μV input. If the input is increased to 1mV or 10mV, the output should be approximately between 0.25mW and 2mW.

27. Faults can best be located by testing each stage as in Table 4. In each case, the signal generator or heat frequency oscillator will be connected to the point stated through the condenser specified; the input figure given is that for 0.1mW output.

Frequency	*Point of injection*	*Through given capacity*	*Input voltage*
1kc/s	*Hot* end of C11B	0.1μF	0.25V
400c/s or 3kc/s	,, ,, ,, ,,	0.1μF	0.5V
1kc/s	V2B grid	0.1μF	75mV
1,550kc/s	V2B grid	0.001μF	70mV
1,550kc/s	V2A grid	0.1μF	700μV
1,550kc/s	V1A grid	0.1μF	20μV
1,550kc/s	Aerial socket	20pF	10–100mV
R.F. signal	V1A grid	0.1μF	30μV

Table 4 — Fault location tests

COMPONENT SPECIFICATIONS

Transformers

28. T1A, the output transformer, is constructed as follows :—

(*a*)	*Barrel*	3 layers of Kraft paper, 0.007 in. thick × $\frac{9}{16}$ in. wide.
(*b*)	*First primary*	3,000 turns of 44 S.W.G. (0.0032 in.), enamelled copper wire.
(*c*)	*Insulation*	3 turns of 0.0015 in. Kraft paper.
(*d*)	*Second primary*	3,000 turns of 44 S.W.G. (0.0032 in.), enamelled copper wire.
(*e*)	*Insulation*	3 turns of 0.0015 in. Kraft paper.
(*f*)	*Secondary*	400 turns of 40 S.W.G. (0.0048 in.), enamelled copper wire.
(*g*)	*Covering*	1 layer of oiled silk, $\frac{5}{8}$ in. wide, secured with Egyptian tape, $\frac{1}{2}$ in wide.
(*h*)	*Impregnation*	Assembly to be impregnated with one coat Symons S.475 varnish and then dipped in Trinidite compound, type H.M.P. (coating not to exceed $\frac{1}{16}$ in.). Core to be marked with red spot before and after impregnation.
(*j*)	*Connections*	Leads to be brought out with 18/40 d.c.c. copper wire, green or red, $\frac{1}{2}$ in. long, to tags :— A — First primary, inner B — Secondary, inner C — Second primary, inner D — First primary, outer E — Secondary, outer F — Second primary, outer
(*k*)	*Resistance*	First primary, 600Ω (A to D) Second primary 700Ω (C to F) Secondary 50Ω (B to E)
(*l*)	*Inductance*	First primary 6H, measured with 1V, A.C. Second primary 6 H at 400 c/s.

29. T2A, the modulator input transformer, is constructed as follows :—

(*a*)	*Barrel*	3 layers of Kraft paper, 0.007 in. thick × $\frac{9}{16}$ in. wide.
(*b*)	*Primary*	1,000 turns of 44 S.W.G. (0.0032 in.), enamelled copper wire.
(*c*)	*Insulation*	2 turns of 0.0015 in. Kraft paper.
(*d*)	*Secondary*	6,000 turns of 44 S.W.G. (0.0032 in.), enamelled copper wire, tapped at centre.
(*e*)	*Covering*	1 layer of oiled silk, $\frac{5}{8}$ in. wide, secured with Egyptian tape, $\frac{1}{2}$ in. wide.
(*f*)	*Impregnation*	Assembly to be impregnated with one coat of Symons S.475 varnish and then dipped in Trinidite compound, type H.M.P. (coating not to exceed $\frac{1}{16}$ in.). Core to be marked with white spot before and after impregnation.
(*g*)	*Connections*	Leads to be brought out with 18/40 d.c.c. copper wire, red or green, $\frac{1}{2}$ in. long, to tags :— A — Secondary, inner B — Secondary, centre tap C — Secondary, outer D — Primary, outer E — Primary, inner
(*h*)	*Resistance*	Primary 180Ω Secondary, inner half (A to B) 700Ω, outer half (B to C) 800Ω
(*j*)	*Inductance*	Primary 5 H, measured with 1V, A.C. at 400 c/s.

30. T3A, the microphone transformer, is constructed as follows :—

(*a*)	*Barrel*	3 layers of Kraft paper, 0.0007 in. thick × $\frac{9}{16}$ in. wide.
(*b*)	*Primary*	60 turns of 40 S.W.G. (0.0048 in.), enamelled copper wire.
(*c*)	*Insulation*	2 turns of 0.0015 in. Kraft paper.
(*d*)	*Secondary*	6,000 turns of 44 S.W.G. (0.0032 in.), enamelled copper wire.
(*e*)	*Covering*	1 layer of oiled silk, $\frac{5}{8}$ in. wide, secured with Egyptian tape, $\frac{1}{2}$ in. wide.
(*f*)	*Impregnation*	Assembly to be impregnated with one coat of Symons S.475 varnish, and then dipped in Trinidite compound, type H.M.P. (coating not to exceed $\frac{1}{16}$ in.). Core to be marked with yellow spot before and after impregnation.
(*g*)	*Connections*	Leads to be brought out with 18/40 d.c.c. copper wire, red or green, $\frac{1}{2}$ in. long, to tags :— A — Secondary, inner B — Secondary, outer C — Primary, inner D — Primary, outer
(*h*)	*Resistance*	Primary 4.5Ω (C to D) Secondary 1350Ω (A to B).
(*j*)	*Inductance*	Primary 18mH, measured with 1V, A.C. at 400c/s.

31. T4A, the modulation auto-transformer, is constructed as follows :—

(*a*)	*Barrel*	3 layers of Kraft paper 0.007 in. thick × $\frac{9}{16}$ in. wide.
(*b*)	*Winding*	4,000 turns of 40 S.W.G. (0.0048 in.), enamelled copper wire, tapped at centre.
(*c*)	*Covering*	1 layer of oiled silk, $\frac{5}{8}$ in. wide, secured with Egyptian tape, $\frac{1}{2}$ in. wide.
(*d*)	*Impregnation*	Assembly to be impregnated with one coat of Symons S.475 varnish and then dipped in Trinidite compound, type H.M.P. (coating not to exceed $\frac{1}{16}$ in.).
(*e*)	*Connections*	Leads to be brought out with 18/40 d.c.c. copper wire, red or green, $\frac{1}{2}$ in. long, to tags :— A — Centre tap B — Outer C — Inner
(*f*)	*Resistance*	Outer half 250Ω (B to A) Inner half 200Ω (C to B)
(*g*)	*Inductance*	Each half 2H; measured with 1V, A.C. at 400c/s with 20mA, D.C. flowing.

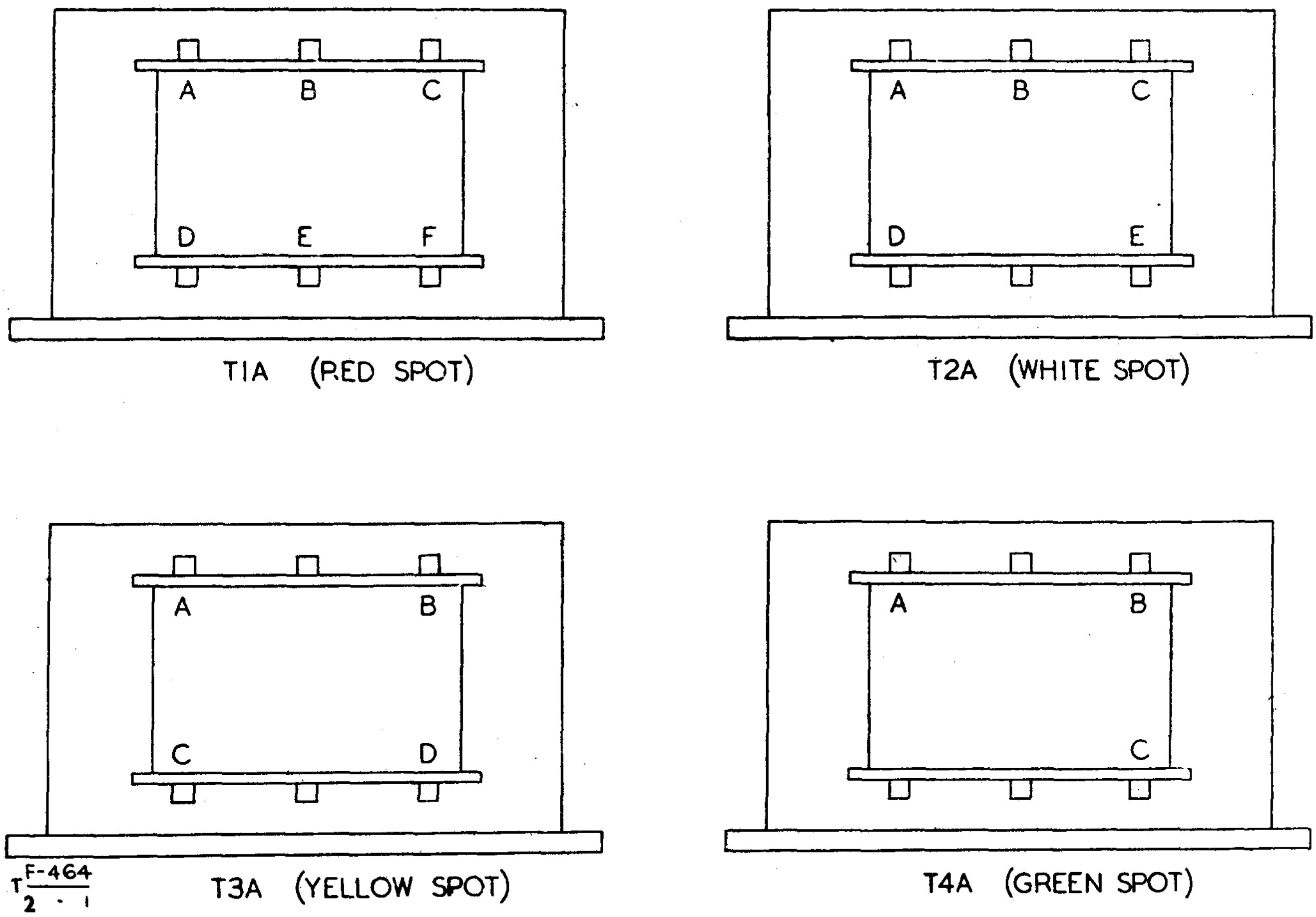


Fig. 1 — View of transformers, looking at tags

Coils

32. The aerial coil L1A is wound in a different way for each of the four ranges. On range 1 (7.9—9.1 Mc/s) it consists of 20 turns of 26 S.W.G., d.s.c. copper wire, tapped at 16½ turns, and has a total inductance of 3.05μH without core. On range 2 (6.4—7.6Mc/s) it has 25 turns of 28 S.W.G., d.s.c. copper wire, tapped at 17½ turns, with an inductance of 4.7μH without core. On range 3 (5.0—6.0 Mc/s) it consists of 34 turns of 30 S.W.G., d.s.c. copper wire, tapped at 21½ turns, and has a total inductance of 7.7μH without core. On range 4 (3.6—4.3 Mc/s) it consists of 46 turns of 38 S.W.G., d.s.c. copper wire, tapped at 29½ turns, and has total inductance of 16.5μH without core.

33. The oscillator coil L2A is wound in three different ways for the four ranges, the same coil being used for ranges 2 and 4. On range 1 it has 40 turns of 38 S.W.G., s.s.c., enamelled copper wire and its inductance is 13.5μH without core. On ranges 2 and 4 it consists of 53 turns of 38 S.W.G., s.s.c., enamelled copper wire and its inductance is 20μH without core. On range 3 it is wave-wound in two sections, each of 30 turns of 38 S.W.G., s.s.c., enamelled copper wire, and its inductance is 32μH without core.

34. There are two types of coils used in the first and second I.F. transformers. The first type L3A–C are marked with red paint and the second L4A with green. The first I.F. transformer has two red coils; the upper of the second transformer is red and the lower one is green. The coils have two sections, the first section being nearer to the base of the former. Each section of the red coil consists of 62 turns of 10/47 S.W.G., d.s.c., enamelled copper wire, wave-wound. The total inductance of the coil is 130μH. The first section of the green coil consists of 77 turns of 10/47 S.W.G., d.s.c., enamelled copper wire, wave-wound. The second section has 42 turns of similar wire, wave-wound. The total inductance is 130μH and the inductance of the first section is 87μH.

35. The third I.F. transformer has a primary winding L5A of 100 turns of 10/47 S.W.G., d.s.c., enamelled copper wire, wave-wound, and a secondary winding L6A of 85 turns. The inductance of the primary is 140μH, and that of the secondary is 100μH.

END

RESTRICTED

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

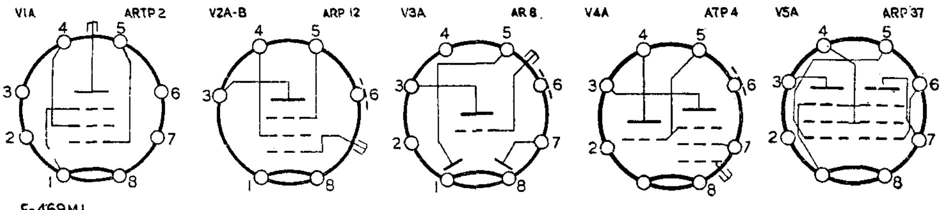


Fig. 1—Valve pins

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

(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.

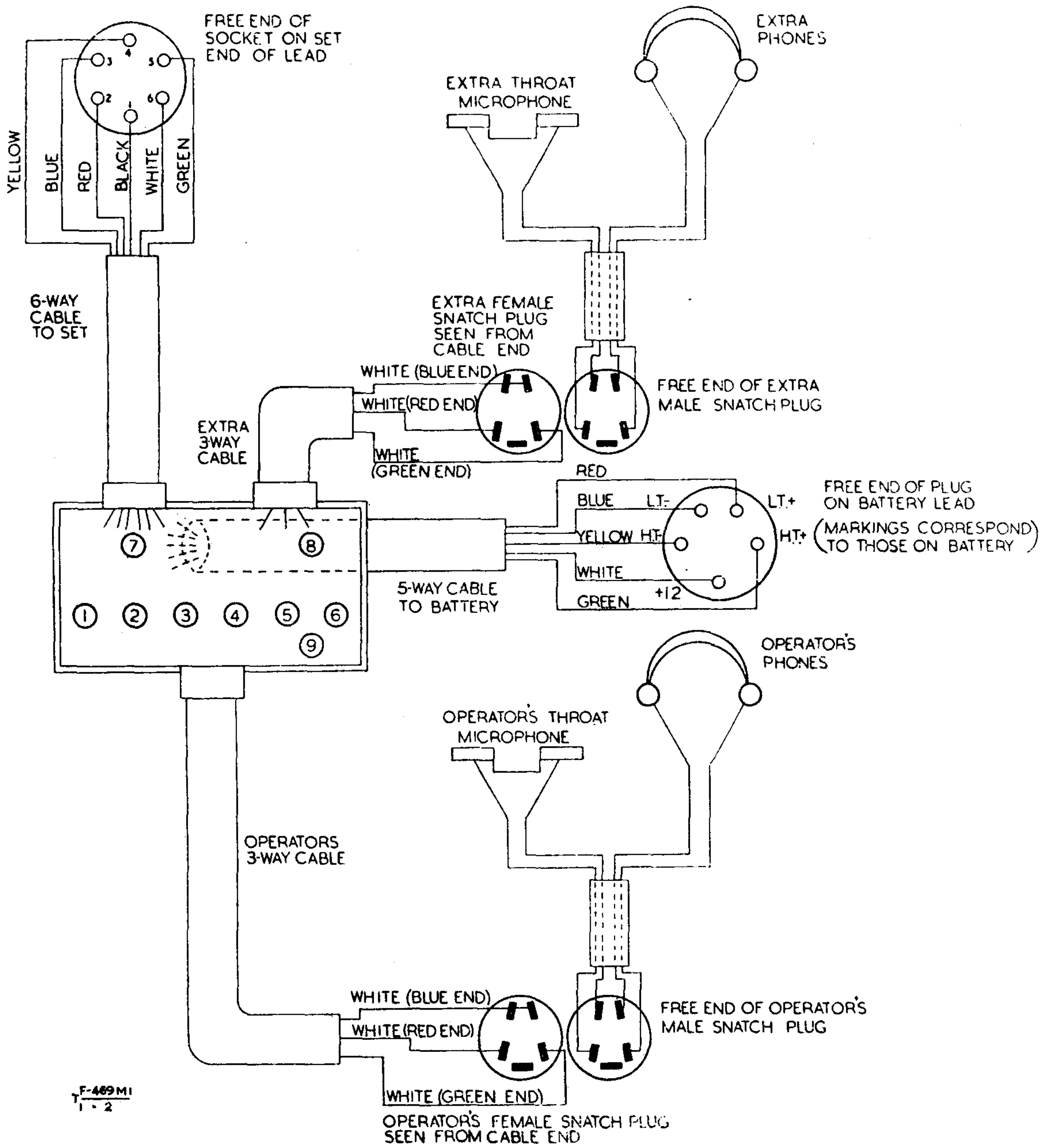


Fig. 2—External connections to set

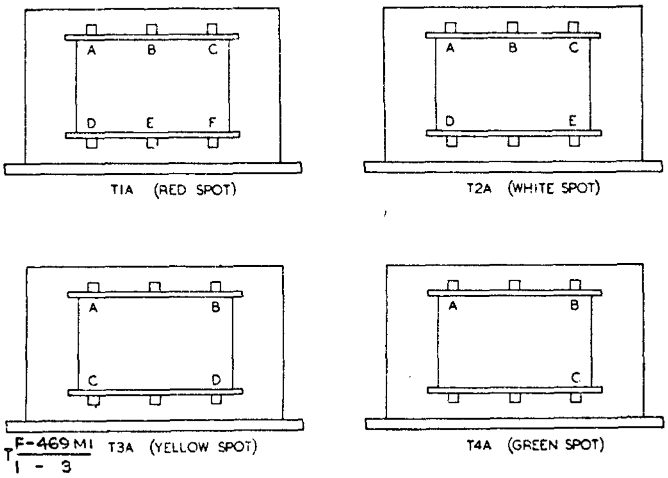


Fig. 3—Views of transformers, looking at tags

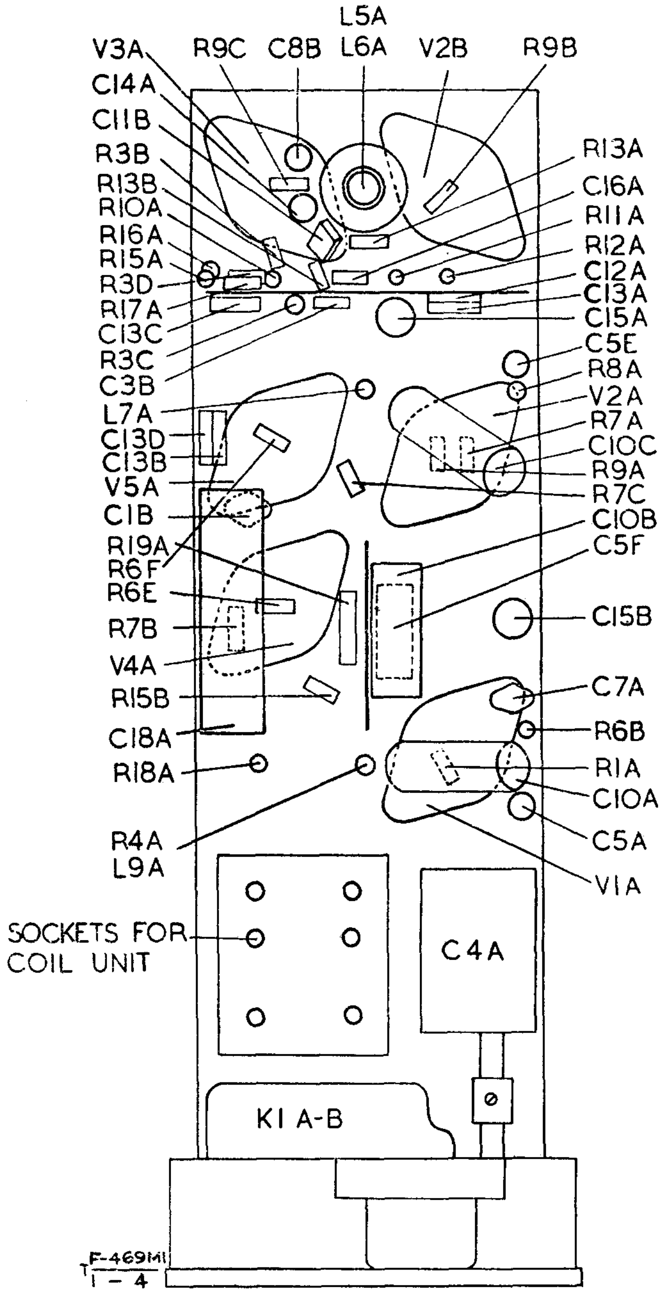


Fig. 4—Component layout, bottom

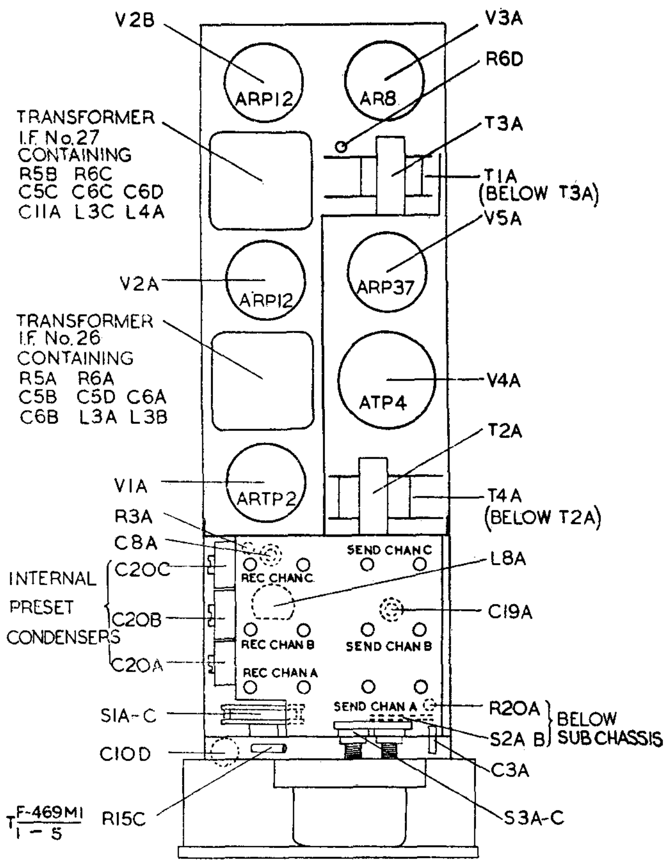


Fig. 5—Component layout, top

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)

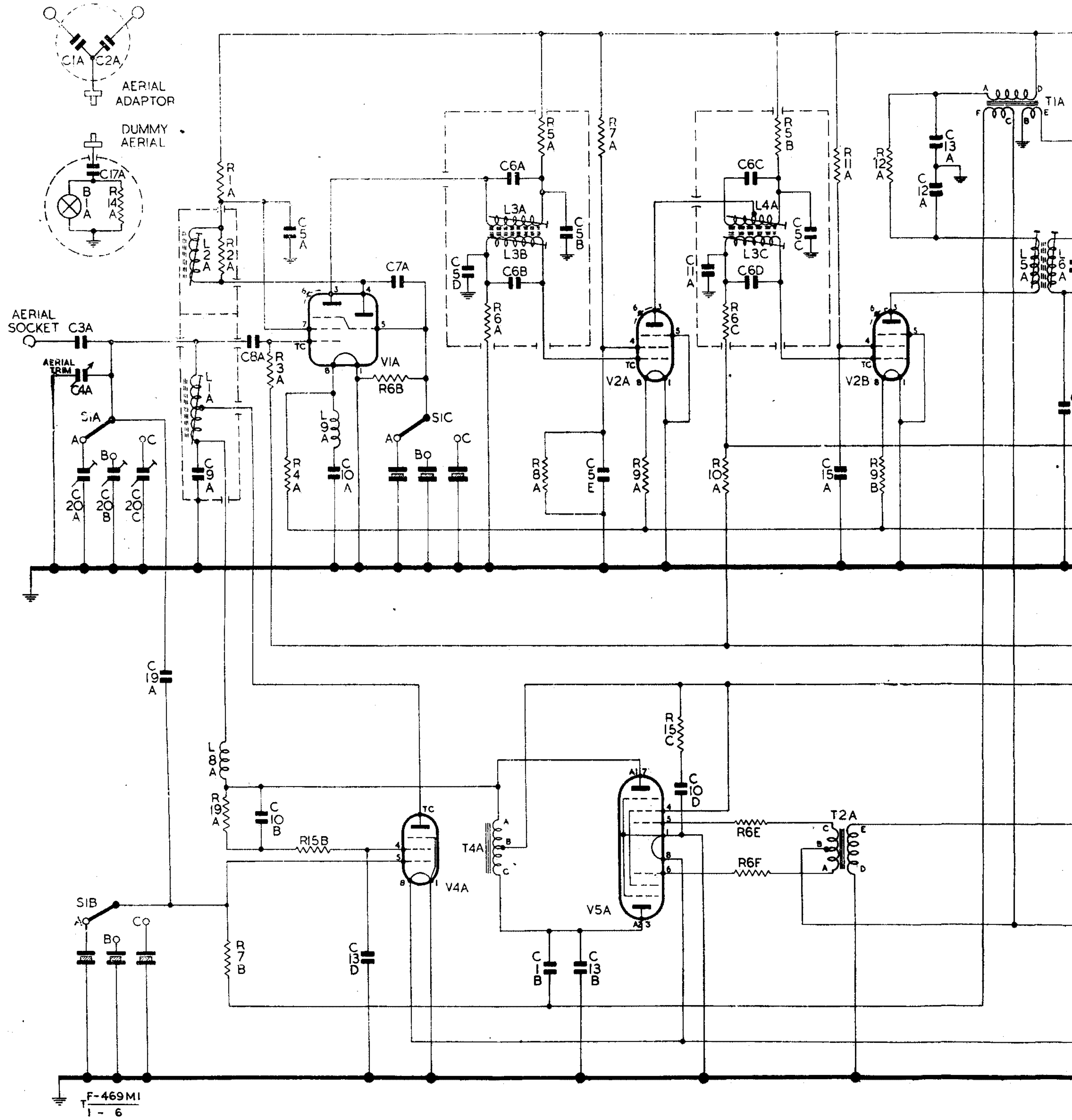
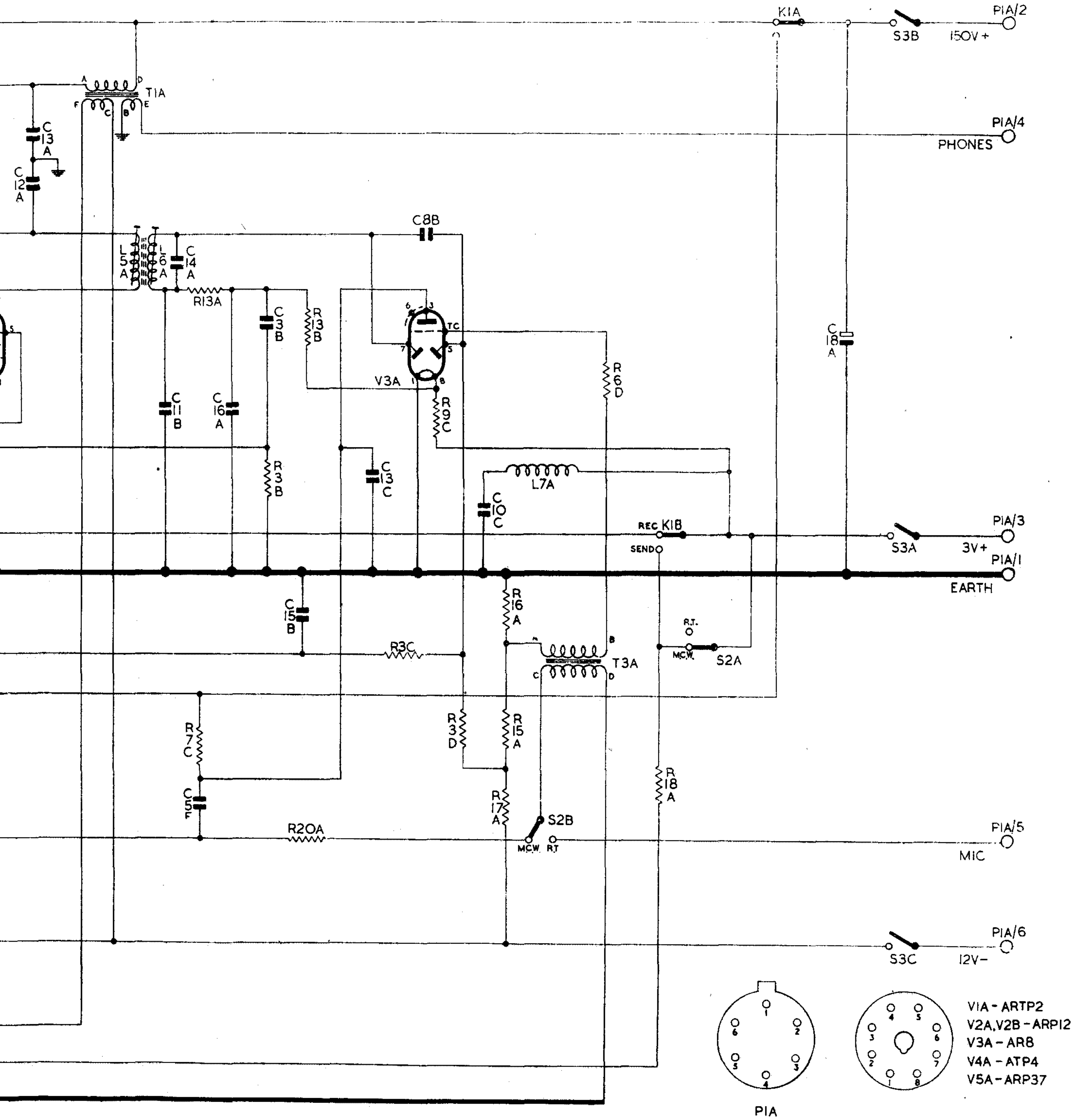


Fig. 6—Circuit diag

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

RESTRICTED