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

TELECOMMUNICATIONS
F 384

WIRELESS SET NO 31, MK 2

TECHNICAL HANDBOOK - FIELD AND BASE REPAIRS

SUBJECT INDEX

	Page	Para	Serial No.
DISMANTLING REPAIR AND REPLACEMENT	2	1 - 3	
Removal and replacement of front panel	2	1	
Removal and replacement of 5-gang capacitor	3	2	
Replacement of relay RLA	3	3	
ADJUSTMENTS AND SPECIFICATION TESTS	4	4 - 9	
Test equipment	4	4	
Accessories	5	5	
Test conditions	5	6	
Adjustments	6	7	
Receiver and sender alignment	6	7	1 - 8
4.3Mc/s crystal oscillator alignment	6	7	1
Discriminator and 2nd limiter alignment	6	7	2
Alignment of i.f. circuits	7	7	3
Master oscillator calibration	8	7	4
Doubler (V3) and transmitter mixer (V2) alignment	9	7	5
Power amplifier (V1) alignment	9	7	6
Receiver r.f. amplifier (V6) alignment	9	7	7
Discriminator check	10	7	8
Specification tests	10	8 - 9	
Receiver	10	8	1 - 5
I.F. sensitivity	10	8	1
I.F. selectivity	11	8	2
Receiver sensitivity	11	8	3
Automatic frequency control	12	8	4
Audio characteristic	12	8	5
Sender	13	9	1 - 2
R.F. output power	13	9	1
Deviation check	13	9	2

INDEX TO TABLES

Table No		Page
4001	Receiver sensitivity figure	1001
4002	A.F.C. test procedure	1001
4003	Audio output levels	1001

INDEX TO FIGURES

Fig No		Page
4001	Dummy load	1002
4002	Relay RLA	1002
4003	Matching pad	1003
4004	Component detail and assembly of coil formers for L1, L2, L6 and TR1	1004
4005	Assembly and circuit diagram of coil L1 and components ...	1005
4006	Assembly and circuit diagram of coil L2 and components ...	1005
4007	Assembly and circuit diagram of coil L6 and components ...	1006
4008	Assembly and circuit diagram of transformer TR1 and components	1006
4009	Details and arrangement of m.o. transformer L4/L5	1007

DISMANTLING REPAIR AND REPLACEMENT

Removal and replacement of front panel

1. (a) Turn the TUNING knob fully anticlockwise until it strikes the mechanical stop on the variable capacitor worm drive. The line above Channel 0 on the range dial should now be in the centre of the CHANNEL window. Adjust the cursor, by turning the CURSOR ADJUSTMENT with a coin, until it is directly over this line. Lock the TUNING knob by turning the DIAL LOCK clockwise.

(b) Remove valve V1, and slide the dial lamp assembly upwards off its mounting bracket.

(c) Loosen the two grub screws which secure the flexible coupling to the TUNING drive shaft.

(d) Disconnect the four wires to the ON/OFF switch SW3 and the three wires to the VOLUME control RV1.

(e) Disconnect the wire to the aerial socket, the two wires to the earth tag of the co-axial plug PL2 and the six wires to the HEADSET AND HANDSET socket SK1.

(f) Unscrew the cheese-headed and the hexagon headed screws located at each corner of the lower front panel and gently withdraw the front panel about 1 in. from the chassis.

(g) Disconnect the five wires to the press-button switch SW8 (PRESS FOR DIAL LIGHT AND CALIB). The front panel can now be removed.

(h) When the front panel has been replaced, before tightening the grub screws which secure the flexible coupling to the TUNING drive shaft, turn the flexible coupling by hand fully anticlockwise until it strikes the mechanical stop on the variable capacitor worm drive. Provided the TUNING knob is still securely locked as per para (a) above, the variable capacitor is now properly aligned, and the grub screws can be tightened.

Removal and replacement of the 5-gang capacitor (see Fig 2005)

2. (a) Disconnect the wire from L26, goal post inductor, at trimmer C28. Remove C29. Disconnect C31 and the two earthing wires. Disconnect C104 and the wire from XL1 at trimmer C23. Disconnect C12 and earthing wire. Disconnect C13 at trimmer C14, and C5 at trimmer C7. Disconnect C4 and earthing wire. Disconnect C40 and earthing wire. Disconnect wires from trimmer C41 to C39 and V6. Disconnect lead to TR1.

(b) Ensure the TUNING knob is free to rotate.

(c) Loosen the two grub screws and the two Allen screws securing the flexible coupling and slide the coupling as far as possible along the TUNING drive shaft towards the front panel.

(d) Remove the three cheese-headed screws securing the variable capacitor worm gear mechanism to the chassis. These screws are in line across the width of the set to the right of TR3/TR2.

(e) Gently move the mechanism outwards until the flexible coupling is free from the worm shaft. The locating rubber bush at the other end of the mechanism will give sufficiently to allow the worm shaft to slide out from the flexible coupling.

(f) Lift the mechanism upwards and forward out of the rubber bush.

(g) When replacing ensure that the variable capacitor and the TUNING knob are correctly aligned, as per para 1, before securing the flexible coupling to the TUNING drive shaft and the worm shaft.

Replacement of relay RLA

3. The following tests will be applied to a suspect relay (see Fig 4002).

(a)	Nominal coil resistance at 15.6°C	4.4Ω ±5%
(b)	Nominal coil operating voltage	1.1V to 1.5V
(c)	Test operate current	120mA

If the figures obtained are not within the specification the relay should be replaced.

ADJUSTMENTS AND SPECIFICATION TESTS

Test equipment

4. The following test equipment will be required:-

Preferred instrument	Suitable alternative
Signal generator, No 12 (SSG 12)	Signal generator, No 1, Mk 3 (SSG 1)
Signal generator, No 13 (SSG 13)	
Wattmeter, absorption, AF, No 1 (Watt: AF 1)	Meters, output power, No 5 (Output meter)
Voltmeter, valve, No 3 (VV 3)	Voltmeter, valve, No 2 (VV2) (see para 7, Ser Nos 1, 5, 6, 7, para 8, Ser Nos 1 and 2; para 9, Ser No 2 and Tels F 382, table 2002) Test set, deviation, FM, No 1A Instrument, testing, electronic, multi-range No 1 Balanced valve voltmeter (see Note) (see para 7, Ser Nos 2, 3, 8, and para 8, Ser Nos 3 and 4)
Test set, deviation, FM, No 2 (Deviation meter)	Test set, deviation, FM, No 1A (Deviation meter)
Oscillator, beat frequency, No 8 (BFO)	Oscillator, beat frequency, No 5 or 7 (BFO)
Wattmeter, absorption, HF, No 2, (Watt: HF 2)	Valve voltmeter across dummy load (see para 9, Ser No 2)
Frequency meter, SCR 211 (SCR 211)	
Instrument, testing, avometer, universal, 46-range, Mk 1 or 50-range (avometer)	
Stabilised power unit (SPU) (see Tels F 364 para 58)	
Testers, valve, avo, CT 160 (Valve tester)	Tester, valve, avo, No 1, Mk 1 and 2 Tester, valve, avo, No 3

Note: If a suitable alternative is not available, a centre-zero balanced valve voltmeter must be made up locally (see Tels F 364 para 57).

Accessories

5. The following accessories will be required:-

Matching pad	Details of a suitable pad for use with the SSG 13 are given in Fig 4002.
Dummy load	Details of a suitable dummy load are given in Fig 4001.

Test conditions

6. All measurements are to be made under the standard test conditions listed below, unless otherwise stated:-

(a) The set must be correctly loaded before switching on.

	Sender h.t.	Receiver h.t.	L.T.
(b) Maximum voltage	150V	90V	4.5V
Normal voltage	140V	85V	4.0V

(c) R.F. input — SSG unmodulated (40Ω impedance).

(d) Audio output — Watt: AF 1, impedance 150Ω, between pin 3 and pin 4 of SK1. Pins 5 and 6 short-circuited. No other load connected.

(e) Volume control at maximum

(f) Standard noise quieting implies a reduction in receiver noise by 20dB.

(g) A.F.C. — Where the specification calls for this to be inoperative, C36 should be short-circuited (6th tag from left on front-panel side of long tag-strip when viewed from rear). Care must be taken to do this without altering the m.o. frequency by introducing stray capacities.

(h) Handset inserted and the set allowed to warm up for about five minutes.

Adjustments

7. Receiver and sender alignment.

Serial No	Operation	Action	Remarks
1	4.3Mc/s crystal oscillator alignment		
a	Condition	Receive	
b	Connections	VV (d.c. connection) to SK2 pin 4 (-ve) and pin 8 (+ve)	
c 1	Method	Press CALIB button and adjust L3 core for maximum reading on VV	If max is less than 30V, screw out core half turn from max position. The new reading must exceed 17V If max is more than 30V, screw out core until 28V is obtained
c 2		Tighten lock-nut	
2	Discriminator and 2nd limiter alignment		
a	Condition	Receive	
b	Connections	VV (balanced) to SK2 pin 7 (+ve) and pin 8 (-ve)	
c 1	Method	Release lock-nuts on L13 and L14	Loosen lock-nuts only so far as to permit free movement of tuning slugs
c 2		Press CALIB button and adjust core of L14 for about +0.5V on VV	
c 3		Adjust L13 for max reading on VV	Keep L14 adjusted for +0.5V

Serial No	Operation	Action	Remarks
c 4		Carefully adjust L14 for zero reading on VV	This must be set accurately as it determines the SSG setting in Serial No 3. Tightening of lock-nuts may affect setting. Adjustments must be continued until zero reading is obtained with lock-nuts tight
c 5		Release CALIB button	
3	Alignment of i.f. circuits		
a	Condition	Receive	
b 1	Connections	SSG 12 to V7 (pin 6) and chassis	
b 2		VV (balanced) as in Serial No 2	
c 1	Method	Release lock-nuts on L7, L8, L9, L10, L11 and L12	Set adjusting screws approx 1/4 in. above top of nuts
c 2		Set SSG to 100mV at 4.3Mc/s approx (unmodulated)	Adjust frequency to give zero reading on VV (see Serial No 2 c4.) SSG is now set to same frequency as the 4.3Mc/s oscillator
c 3		Connect VV to SK2 pin 3 (-ve) and chassis (+ve)	
c 4		Adjust L7, L8, L9, L10, L11 and L12 for max reading on VV	Reduce output of SSG to maintain reading on VV at approx 10V
c 5		Disconnect SSG and repeat Serial No 2 (para 7)	
c 6		Reconnect SSG to V7 (pin 6) and check that L7, L8, L9, L10, L11 and L12 are adjusted for max response as in Serial No 3 c4 (para 7)	

Serial No	Operation	Action	Remarks
c 7		Tighten lock-nuts on L7 to L12	Check that this does not disturb the alignment adjustments by observing the VV reading when each lock-nut is tightened.
4	Master oscillator calibration		
a	Condition	Receive	
b	Connections	Short-circuit A.F.C.	
c 1	Method	Move cursor to centre of window and adjust TUNING control until the calibration mark between channels 36 and 37 is under the cursor	
c 2		Press CALIB button and adjust trimmer C28 for zero beat on 'phones	
c 3		Adjust TUNING control until calibration mark at channel 15 is under cursor	
c 4		Press CALIB button and adjust the goal-post inductor until zero beat is again heard in the 'phones	The goal-post inductor is a bare length of heavy gauge wire which runs from anode of V5 to lower end of L4. Adjustment is made by either moving the position of the tap for large adjustments or by slightly displacing the inductor to one side for small adjustments. Take care in making these adjustments since the goal-post is at h.t. potential.

Serial No	Operation	Action	Remarks
c 5		Return TUNING control to upper calibration mark and repeat the procedure until zero beat is heard on both calibration positions.	In practice absolute zero beat is very difficult to obtain. The adjustments may therefore be made to a low audio-frequency beat note. Over the whole tuning range the calibration error must not exceed 0.025%, ie ±10kc/s.
5	Doubler (V3) and transmitter mixer (V2) alignment		
a	Condition	Send	
b	Connections	VV to SK2 pin 5 (-ve) and chassis (+ve)	
c 1	Method	Tune set to channel 35	
c 2		Adjust C23 and C14 for max reading on VV	This must not be less than 10V. If the power amplifier circuit (V1) is considerably out of alignment, C7 may have to be adjusted for a VV reading of 10V.
6	Power amplifier (V1) alignment		
a	Condition	Send	
b	Connections	VV to SK2 pin 6 (-ve) and chassis (+ve)	
c 1	Method	Adjust C7 for max reading on VV	This must not be less than 20V. The alignment of anode circuit of V6 will have some effect on this reading and it may be necessary to adjust C41 to obtain 20V.
7	Receiver r.f. amplifier (V6) alignment		
a	Condition	Receive	

Serial No	Operation	Action	Remarks
b	Connections	VV to SK2 pin 3 (-ve) and chassis (+ve)	
c 1	Method	Adjust C41 for max reading on VV	This adjustment is made on noise, and must be made while signals are not being received.
8	Discriminator check		
a	Condition	Receive	
b	Connections	VV (balanced) to SK2 pin 7 and chassis	
c 1	Method	Tune the receiver over the whole band	Ensure that signals are not being picked up by the receiver. The VV reading should not be greater than ±1.0V. If the VV reading is greater than ±1.0V, slightly readjust L8 and L9 to bring it within these limits

Specification tests

8. Receiver

Serial No	Operation	Action	Remarks
1	I.F. sensitivity		
a	Condition	Receive	
b 1	Connections	VV to SK2 pin 3 (-ve) and chassis	
b 2		SSG 12 to V7 (pin 6) and chassis	
c 1	Method	Inject 50μV at approx 4.3Mc/s and adjust SSG frequency for max reading on VV	

Serial No	Operation	Action	Remarks
c 2		Adjust input for 10V on VV	Input must not exceed 30μV
2	I.F. selectivity		
a	Condition	Receive	
b	Connections	VV and SSG 12 as in Serial No 1 (para 8)	
c 1	Method	Adjust SSG for 10V on VV	Note the input voltage and SSG frequency F_0
c 2		Increase output of SSG by 6dB and increase frequency from F_0 until VV again reads 10V	Note new frequency F_1
c 3		Repeat test, decreasing frequency from F_0	Note new frequency F_2
			The frequency differences, $(F_1 - F_0)$ and $(F_0 - F_2)$ must be greater than 15kc/s, ie the bandwidth at 6dB must be greater than 30kc/s.
			When SSG 1 is used, F_1, F_2 and F_0 must be determined with SCR 211
3	Receiver sensitivity		
a	Condition	Receive	
b 1	Connections	Watt: AF 1 to SK1 pin 3 and pin 4	Handset removed
b 2		Short-circuit SK1 pin 5 and pin 6	
b 3		SSG 13 to co-axial aerial socket	7.5Ω output impedance via matching pad
b 4		VV (balanced) to SK2 pin 7 and chassis	

Serial No	Operation	Action	Remarks
c 1	Method	Set SSG to unmodulated frequencies shown in Table 4001 and tune for zero reading on VV	Watt: AF 1 readings of noise for various input levels should be as in Table 4001
4	Automatic frequency control		
a 1	Condition	Receive	Receiver h.t. to be 78V
a 2		A.F.C. short-circuited	
b	Connections	As in Serial No 3 (para 8)	
c 1	Method	Inject 2μV at 40.2Mc/s (channel 1)	
c 2		Tune set for zero reading on VV	
c 3		Reduce input to zero	Note noise output 'N'μW
c 4		Increase input to give standard noise quieting	Standard noise quieting = $\frac{1}{100}$ 'N'μW
c 5		Reconnect AFC and tune SSG to 35kc/s above resonance	Noise output should be $\frac{1}{10}$ 'N'μW or less, ie 10dB noise quieting
c 6		Repeat for 35kc/s below resonance	Noise output should be $\frac{1}{10}$ 'N'μW or less Table 4002 summarizes test procedure. If SSG 1 is used, 35kc/s above and below resonance should be determined using SCR 211
5	Audio characteristic		
a	Condition	Receive	
b 1	Connections	Watt: AF 1 to SK1 pin 3 and 4	
b 2		Short-circuit SK1 pin 5 and 6	

Serial No	Operation	Action	Remarks
b 3		BFO (10Ω impedance) to chassis and junction of R52 and R49	Junction of R52 and R49 is 4th tag left on front panel side of long tag strip viewed from rear.
c 1	Method	BFO output constant at 3V	Watt: AF 1 should read as in Table 4003

9. Sender

Serial No	Operation	Action	Remarks
1	R.F. output power		
a	Condition	Send	
b	Connections	Watt: HF 2 to co-axial plug on front panel	Dummy load removed
c 1	Method	R.F.output at any frequency should be greater than 0.3W	If a wattmeter is not available then the r.f. output measured with VV across dummy load should be greater than 3.5V. If the r.f. output varies unduly, the set should be tuned to minimum output and C7 adjusted slightly. This will increase output at this frequency. Tune the set now to max output and adjust C14 slightly. This will reduce output at this frequency and also increase minimum output slightly.
2	Deviation check		
a 1	Condition	Send	

Serial No	Operation	Action	Remarks
a 2		Microphone capsule removed from holder	
b 1	Connections	BFO (600Ω impedance) OUTPUT to SK1 pin 2 EARTH to SK1 pin 4	
b 2		VV to SK1 pins 2 and 6	Isolated from chassis and earth
b 3		Deviation meter across dummy load	
c 1	Method	Tune to 44Mc/s (channel 20)	Input for 10kc/s deviation at 1,000 c/s must not be greater than 0.2V

Note: The next page is Page 1001

Table 4001 - Receiver sensitivity figures

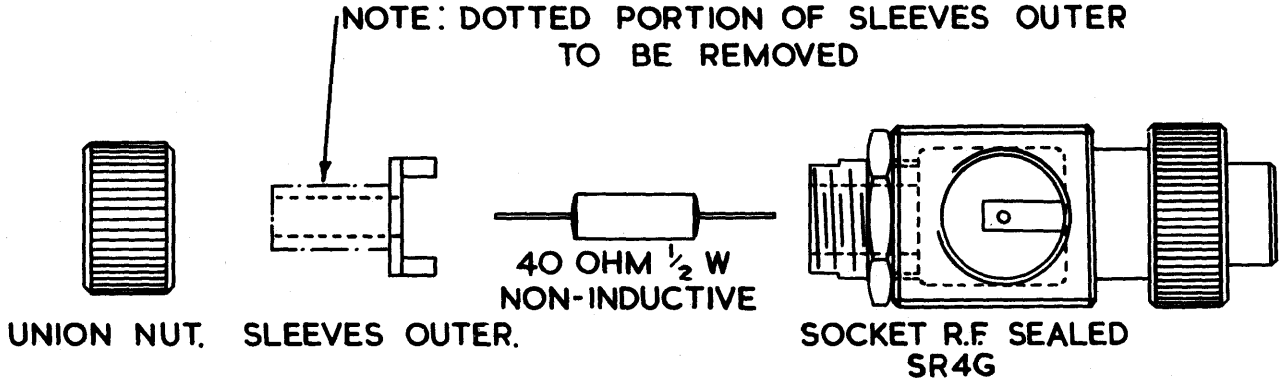
Channel	Frequency	Input	Output
1	40.2Mc/s	4 - 5μV	Minimum
1	40.2Mc/s	Zero	'X'μW
1	40.2Mc/s	Less than 5.5μV	1/100 of 'X'μW
20	44.0Mc/s	4 - 5μV	Minimum
20	44.0Mc/s	Zero	'Y'μW
20	44.0Mc/s	Less than 5.5μV	1/100 of 'Y'μW
39	47.8Mc/s	4 - 5μV	Minimum
39	47.8Mc/s	Zero	'Z'μW
39	47.8Mc/s	Less than 5.5μV	1/100 of 'Z'μW

Table 4002 - A.F.C. test procedure

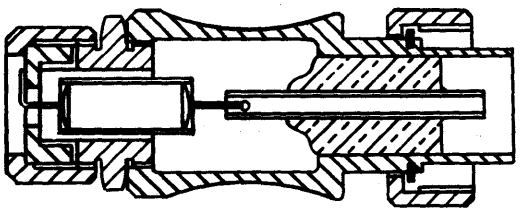
Frequency	Input	Output
40.2Mc/s	2μV	Minimum
40.2Mc/s	Zero	'N'μW
40.2Mc/s	'X'μV	1/100 of 'N'μW
40.235Mc/s	'X'μV	1/10 of 'N'μW
40.165Mc/s	'X'μV	1/10 of 'N'μW

Table 4003 - Audio output levels

Input frequency	Output
500c/s	Not less than 2mW
2,500c/s	Not less than 2mW
8,000c/s	Not more than 0.5mW



COMPONENT PARTS OF DUMMY LOAD

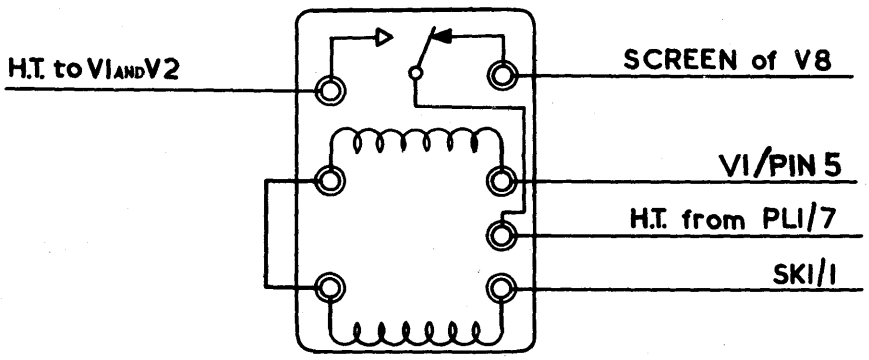


SECTIONED VIEW OF ASSEMBLED DUMMY LOAD

T F·384 / 1-4001

NOTE: RESISTOR TO BE SOLDERED IN PLACE USING MINIMUM LENGTH OF LEADS

Fig 4001 - Dummy load

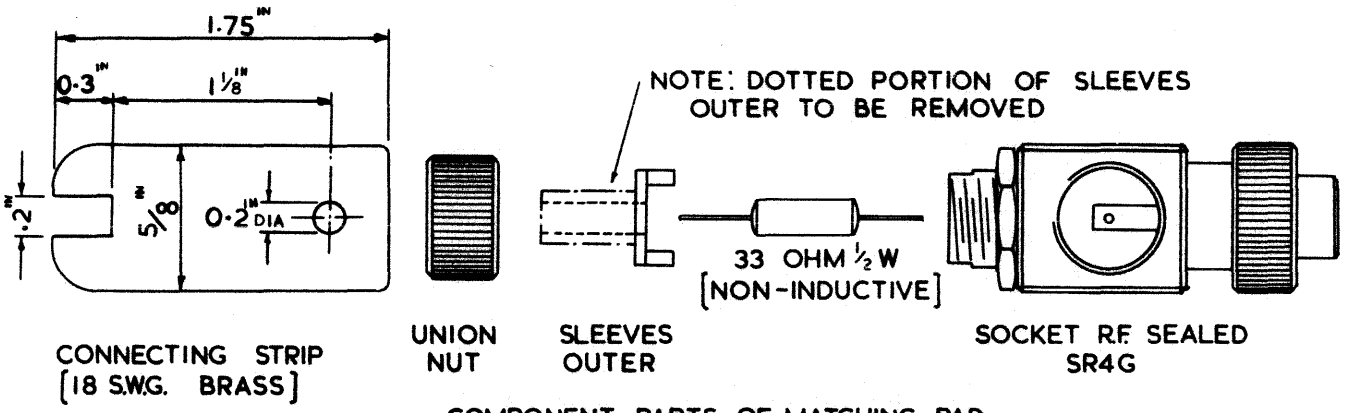


RELAY VIEWED FROM BOTTOM OF CHASSIS

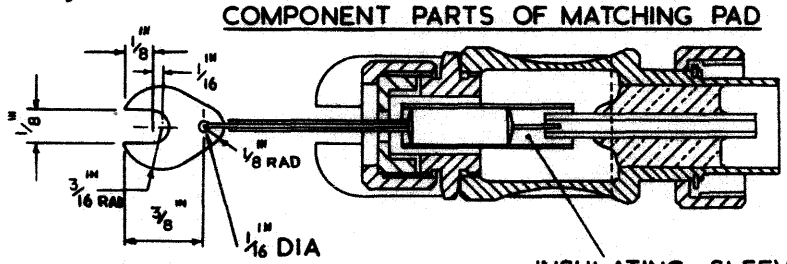
T F·384 / 1-4002

FUNCTION: H.T. SWITCHING. TYPE: SIEMENS SM8
TEST OPERATE CURRENT: 120mA RESISTANCE: 4·4 ohms

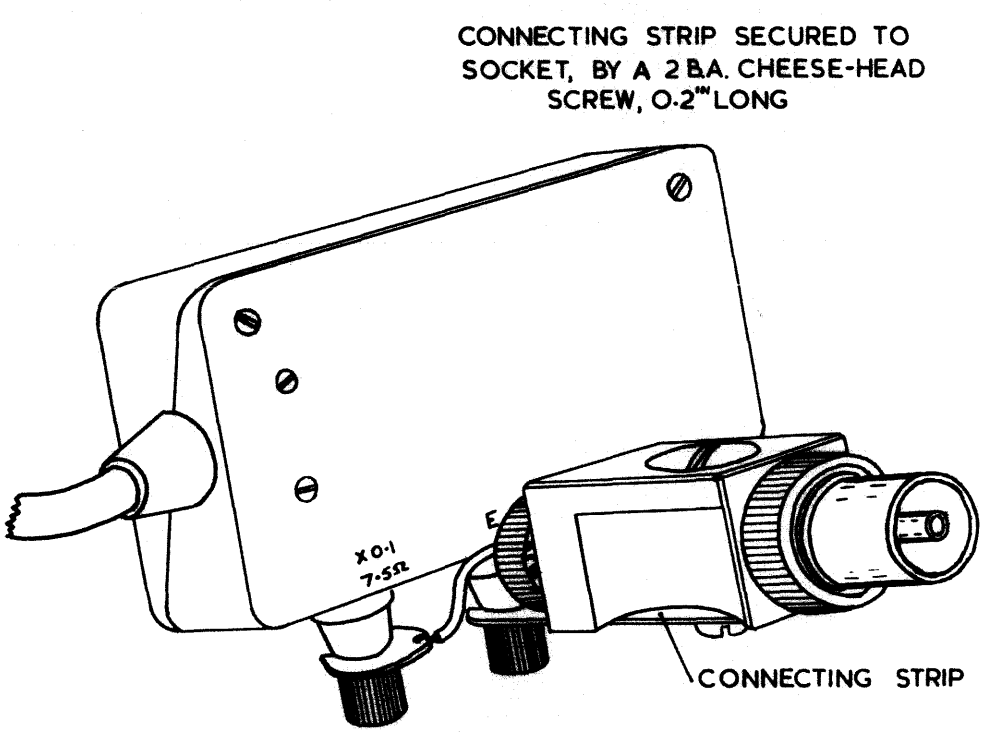
Fig 4002 - Relay R1A



COMPONENT PARTS OF MATCHING PAD



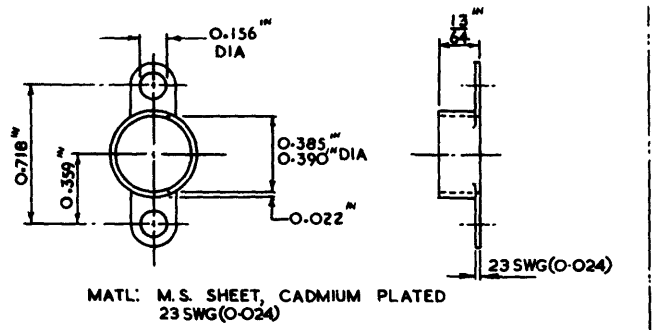
SECTIONED VIEW OF ASSEMBLED MATCHING PAD



PICTORIAL VIEW OF MATCHING PAD COUPLED TO R.F. OUTPUT LEAD OF SIGNAL GENERATOR No 13

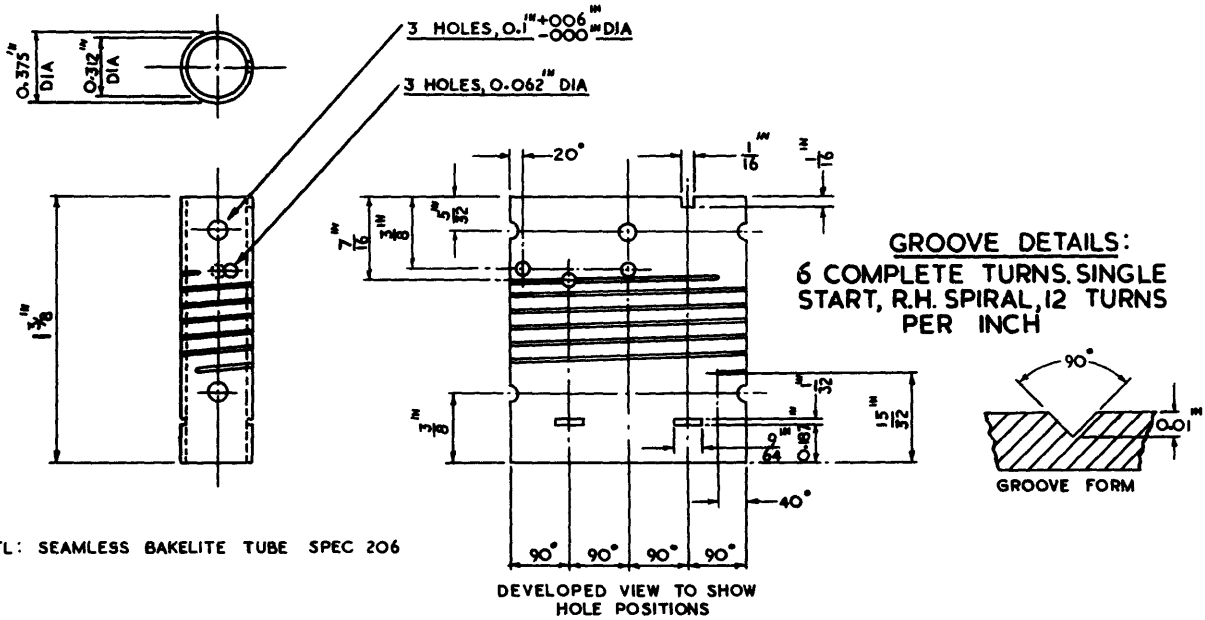
T F·384 / 1-4003

Fig 4003 - Matching pad



MATL: M.S. SHEET, CADMIUM PLATED 23 SWG(0.024)

BRACKET DETAILS

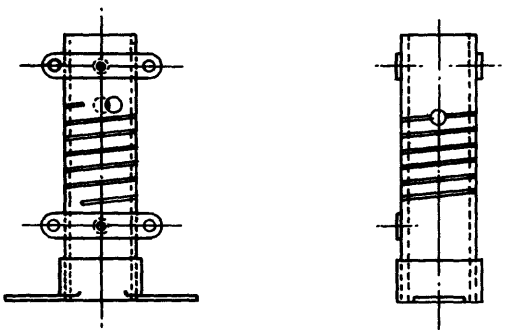


GROOVE DETAILS:
6 COMPLETE TURNS. SINGLE START, R.H. SPIRAL, 12 TURNS PER INCH

MATL: SEAMLESS BAKELITE TUBE SPEC 206

DEVELOPED VIEW TO SHOW HOLE POSITIONS

FORMER DETAILS



FORMER SECURED IN BRACKET BY ARALDITE 'D' AND HARDENER 951.

EXTERIOR SURFACES TO BE POLISHED AND TO HAVE ALL SHARP EDGES RADIUSED

T F·384 / 1-4004

ASSEMBLY OF FORMER, BRACKET AND EYELETS

Fig 4004 - Component detail and assembly of coil formers for L1, L2, L6 and TR1

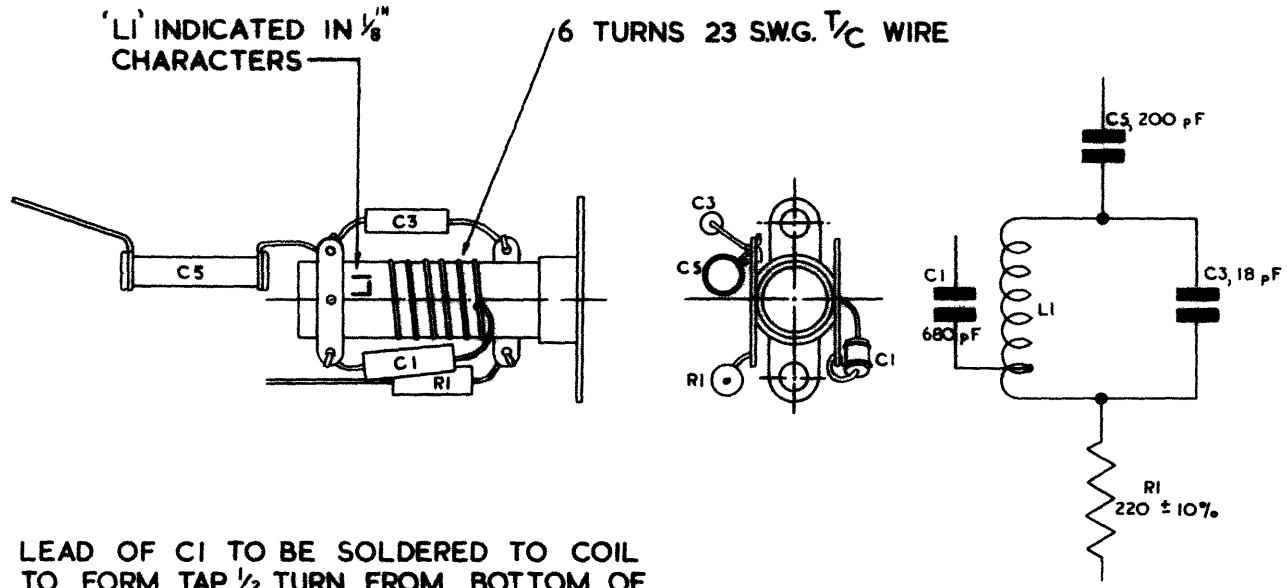


Fig 4005 - Assembly and circuit diagram of coil L1 and components

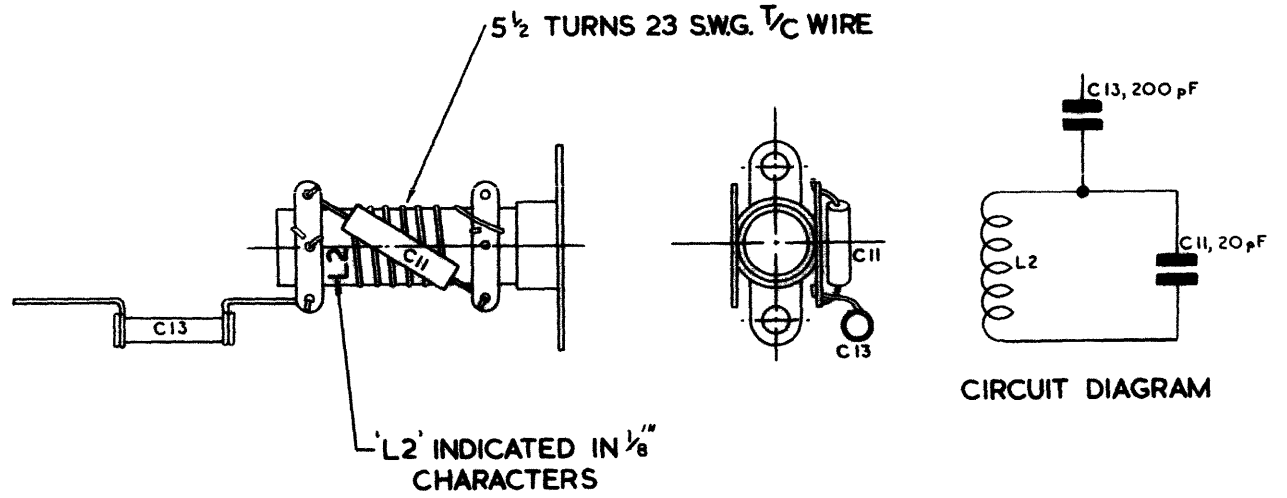
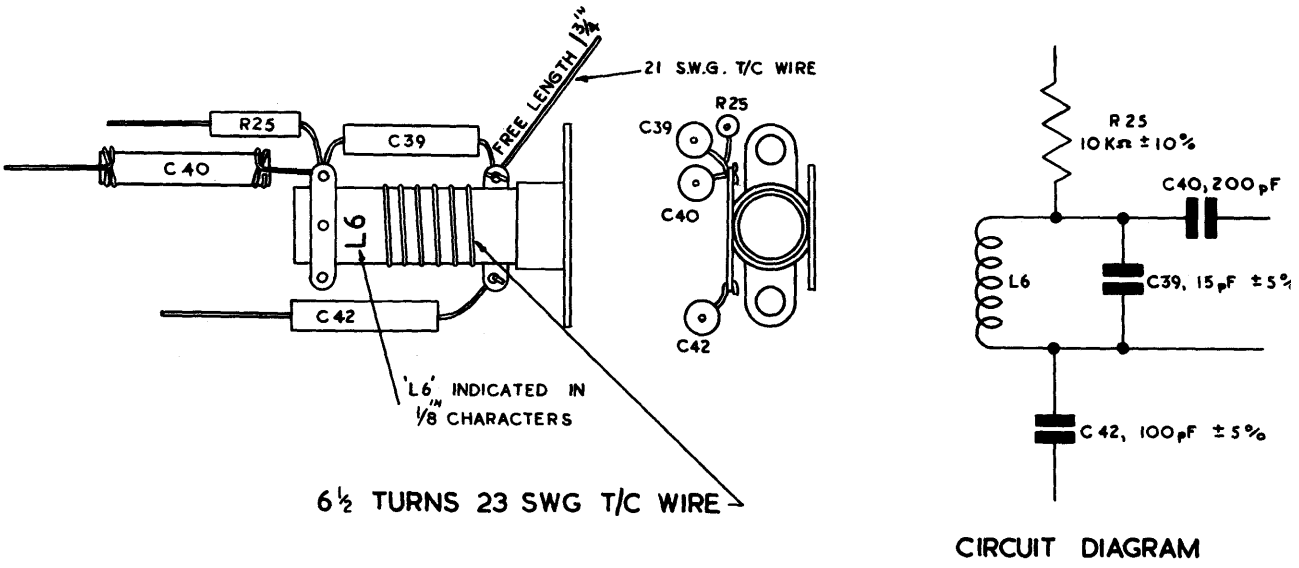


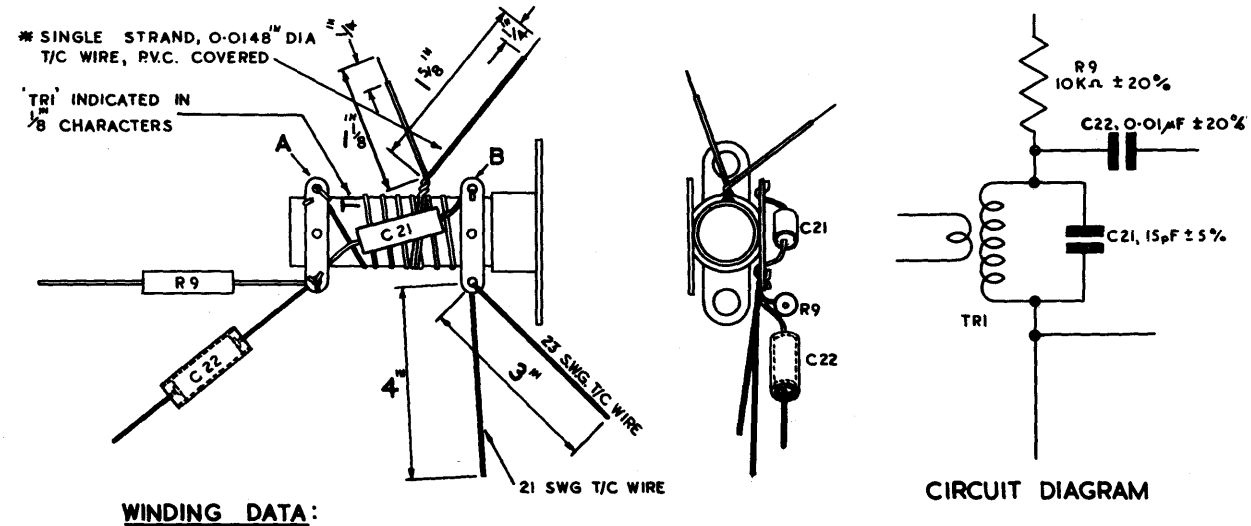
Fig 4006 - Assembly and circuit diagram of coil L2 and components



T F·384 / 1-4007

COIL TO BE VACUUM WAX IMPREGNATED AFTER WINDING BUT BEFORE ASSEMBLY OF COMPONENTS

Fig 4007 - Assembly and circuit diagram of coil L6 and components



WINDING DATA:

PRIMARY: 6 TURNS 23 S.W.G. T/C WIRE. ENDS OF PRIMARY WINDING SOLDERED TO TAG EYELETS A AND B

SECONDARY: 2 TURNS 1/0148" IN POSITION SHOWN. ENDS TWISTED TOGETHER ONCE, & SECURED WITH VARNISH. *

T F·384 / 1-4008

TRANSFORMER TO BE VACUUM WAX IMPREGNATED AFTER WINDING PRIMARY BUT BEFORE WINDING SECONDARY & ASSEMBLING COMPONENTS.

Fig 4008 - Assembly and circuit diagram of transformer TR1 and components

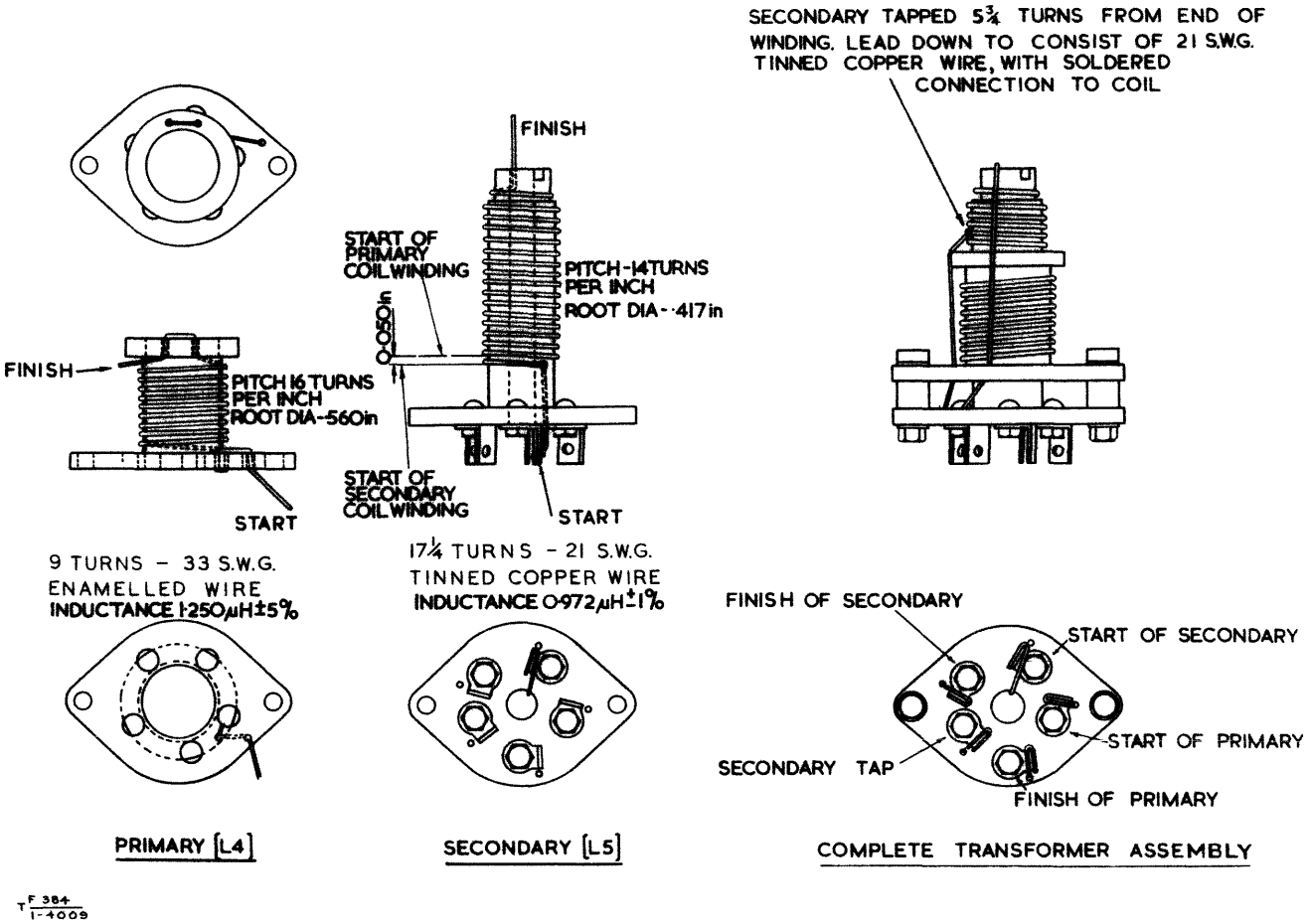


Fig 4009 - Details and arrangement of m.o. transformer L4/L5

267/8/556

END