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CALIBRATOR, CRYSTAL No. 10

Working Instructions

ZA 32898

The War Office,
Whitehall
June, 1947

SYNOPSIS

The Calibrator, Crystal, No. 10 *is designed primarily for the purpose of setting up a Wireless Set No.* 62 *accurately on a required spot frequency.*

The calibrator functions as a C.W. wavemeter with continuous coverage over a nominal frequency band of 1·5 *Mc/s to* 10 *Mc/s.*

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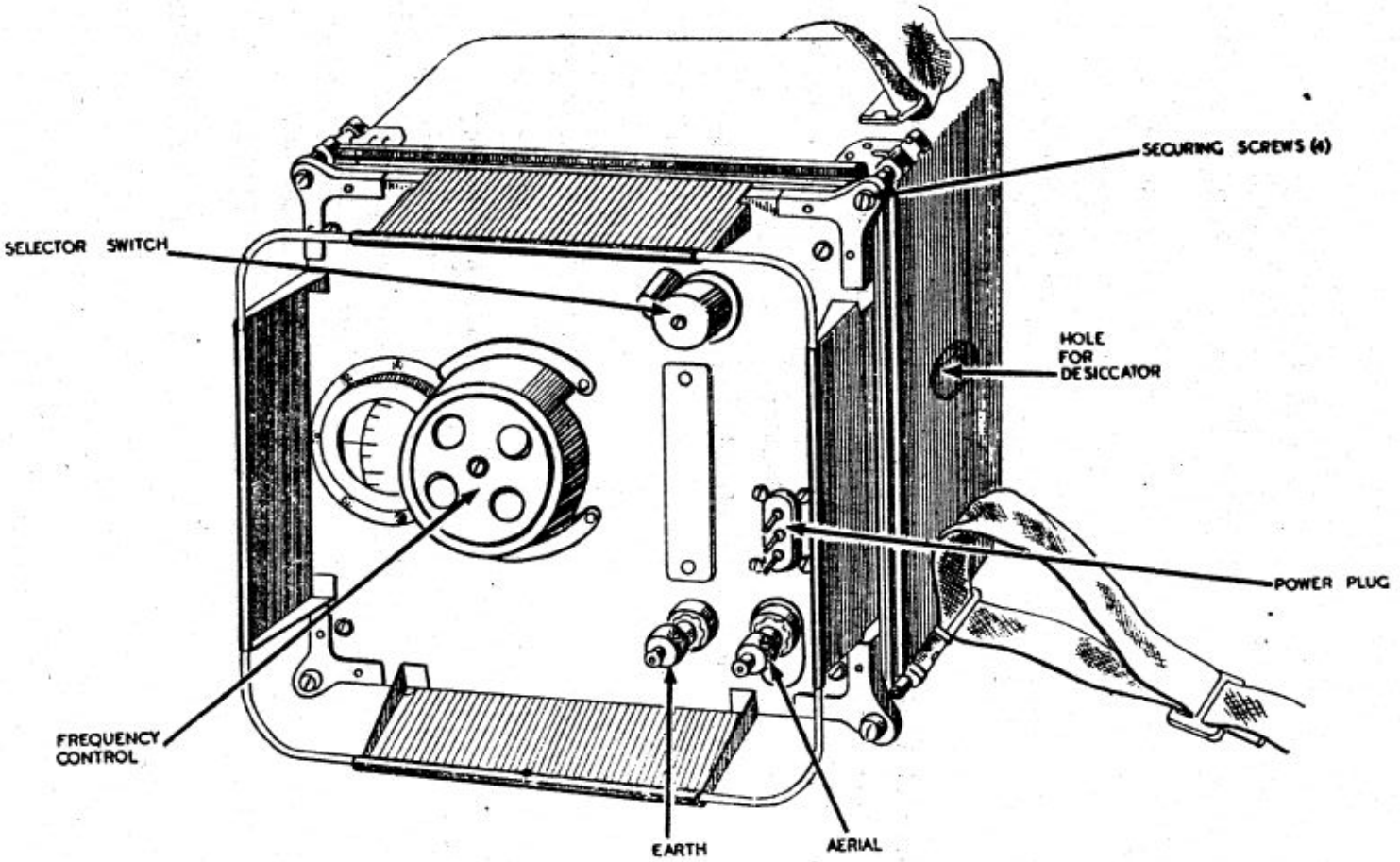

Fig. 1.—Calibrator, Crystal, No. 10—General view

CALIBRATOR, CRYSTAL, No. 10

Working Instructions

CHAPTER I . . GENERAL DESCRIPTION

1. Purpose and facilities

The Calibrator, Crystal, No. 10, which is illustrated in Fig. 1, is designed primarily for the purpose of setting up a Wireless Set No. 62 accurately on a required spot frequency.

The calibrator functions as a C.W. wavemeter with continuous coverage over a nominal frequency band of 1·5 Mc/s to 10 Mc/s.

The calibrator power supplies are obtained from the socket engraved XTAL CAL on the Wireless Set No. 62.

The following facilities are available :—

(1) Selector switch in " 500 Kc/s " position.

A crystal controlled oscillator which provides fixed frequency signals of 500 Kc/s and all harmonics of 500 Kc/s to beyond 10 Mc/s.

(2) Selector switch in " DIAL " position.

In addition to the 500 Kc/s oscillator, a second and variable oscillator (250 Kc/s–500 Kc/s) is brought into circuit. This enables all intermediate frequencies between 500 Kc/s and 10 Mc/s to be produced—these frequencies are indicated on a calibrated dial on the front panel.

For identification purposes, the calibrator signal is modulated at about one cycle per second by means of a neon tube.

The output from the calibrator is taken from the terminal engraved AERIAL on the front panel.

2. Description

The calibrator is contained in a metal case (7 ins. × 7½ ins. × 4 ins.) which has a protective rail around the front panel. The instrument, together with connecting leads, may be carried in a Satchels Signal No. 1T or No. 1.

When in use, the calibrator may be placed in any convenient position, or may be rigidly attached to the Wireless Set No. 62 by means of a webbing strap.

Waterproof gaskets permit the equipment to be used under extreme conditions of humidity and spray : a desiccator may be fitted to ensure that the inside of the calibrator is maintained in a dry condition.

The selector switch on the front panel has three positions :—

(1) OFF

(2) 500 Kc/s—to select the 500 Kc/s crystal controlled oscillator alone.

(3) DIAL— to select the 250 Kc/s to 500 Kc/s variable oscillator and the 500 Kc/s crystal controlled oscillator together.

When the selector switch is in the DIAL position, both oscillators are in circuit. The frequency of the variable oscillator may be adjusted by a front panel control which also rotates a calibrated dial—see Fig. 2. The engraved figures on this dial indicate the first and second decimal

places of the frequency in megacyles to which the calibrator has been set. Four marks between adjacent figures on the dial enable the third decimal place of the frequency in megacyles to be read—i.e. these latter marks are 2 Kc/s apart.

3. Frequency range

(1) 500 Kc/s to 10 Mc/s—by 500 Kc/s increments.

(2) Continuous 1·5 Mc/s to 10 Mc/s (nominal).

The calibrator may actually be used up to 30 Mc/s.

4. Power supply and consumption

The calibrator is connected by Connectors, 3-point, No. 67, to the 3-point socket marked XTAL CAL at the bottom right-hand corner of the Wireless Set No. 62. This supplies the calibrator with 12 volts D.C. and 300 volts D.C.

Consumption :

Calibrator switched to 500 Kc/s	10 mA H.T.
Calibrator switched to DIAL	15 mA H.T.
L.T.	0·3 A.

5. Controls

(1) Selector switch : 3 way, OFF—500 Kc/s—DIAL.

(2) Frequency control : frequency indicated on rotating dial.

(3) Power plug : 3-point.

(4) AERIAL : Output terminal.

(5) EARTH : Terminal.

There is also a 3 wire power connector (Connector, 3-point, No. 67), and a screened lead (Connector Twin No. 321) to take the calibrator output to the aerial terminal of the Wireless Set No. 62. These are stowed in a Satchel Signals No. 1T or No. 1.

6. Weights and dimensions

Weight : 5 lbs.

Dimensions (overall) : 7 ins. × 7½ ins. × 4 ins.

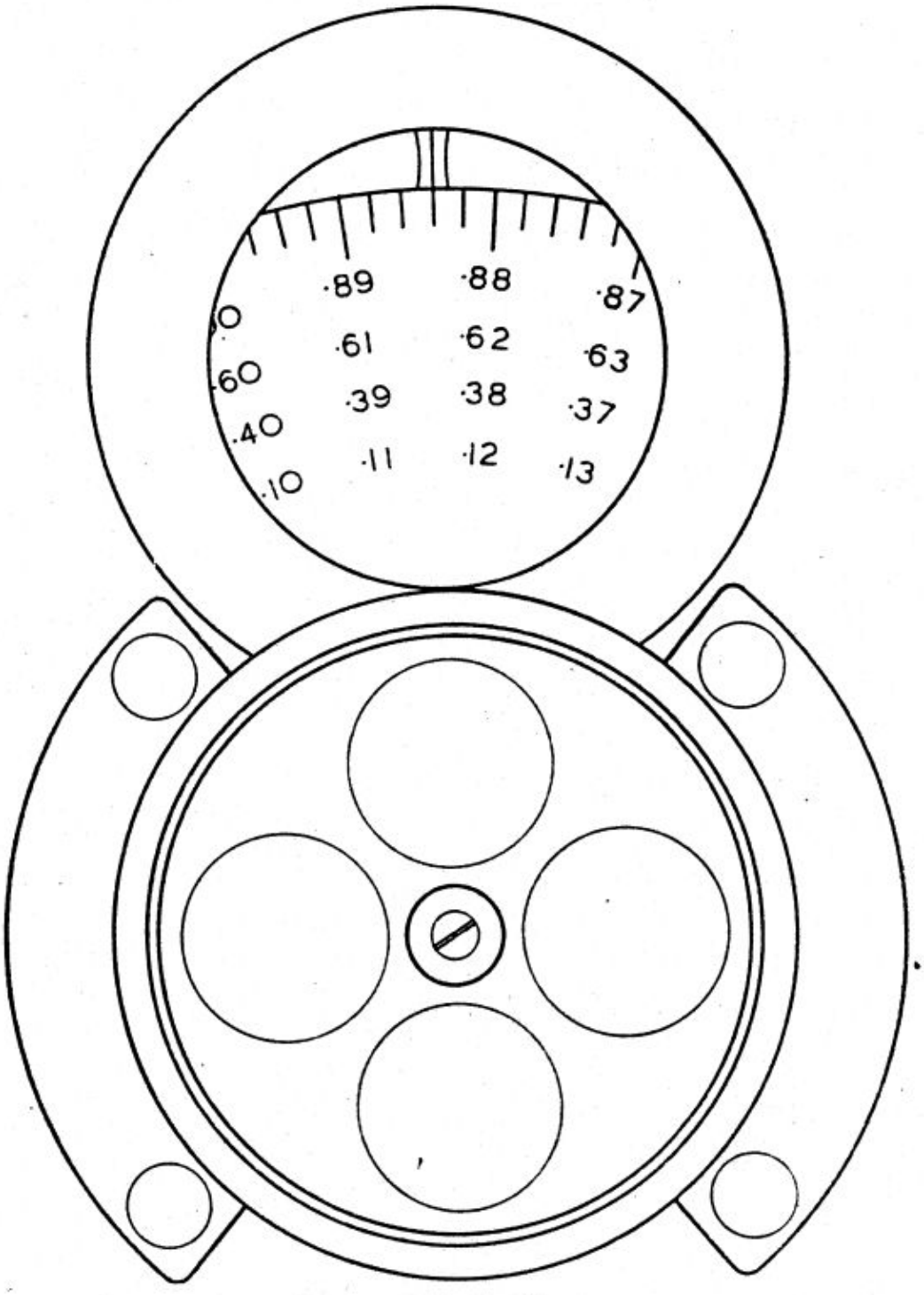

Fig. 2—Dial of calibrator

CHAPTER II . OPERATOR'S INSTRUCTIONS

7. Connecting up

It is assumed that the Wireless Set No. 62 has been connected up and switched on as described in the appropriate working instructions.

(1) By means of Connector, 3-point, No. 67, connect the calibrator to the XTAL CAL socket at the bottom right-hand corner of the Wireless Set No. 62.

(2) Disconnect the aerial from the Wireless Set No. 62.

(3) By means of Connector, Twin, No. 321, connect the AERIAL and EARTH terminals of the calibrator to the corresponding terminals of the Wireless Set No. 62. The spade terminals of the connector must be attached to the wireless set (red to AERIAL, black to EARTH), and the corresponding pin terminations to the calibrator.

8. Setting up the Wireless Set No. 62.

Referring to the Wireless Set No. 62, set the controls as follows:—

(1) SYSTEM switch to " NET ".

(2) Supply switch to " ALL ON ".

(3) GAIN control fully clockwise.

(4) Frequency RANGE switch to range required.

(5) FREQUENCY dial to whole or half Mc/s point nearest to the ordered frequency.

(6) AE COUPLING control to 0.

(7) AE TUNING to figure given in the table below.

Freq. Mc/s ..	1·6	2·0	2·5	3·0	3·5	4·0	4·5	5·0
AE. TUNING ..	980	800	560	410	320	270	230	200
Freq. Mc/s ..	5·5	6·0	6·5	7·0	7·5	8·0	9·0	10·0
AE. TUNING ..	184	160	145	133	124	113	085	080

After switching on, allow the set at least 15 minutes to warm up before using the calibrator.

9. Using the Calibrator

(1) Place the calibrator selector switch to the " 500 Kc/s " position. Allow half a minute for the valves to warm up.

(2) On the Wireless Set No. 62, turn the FREQUENCY dial slowly about the whole or half Mc/s point (near the ordered frequency) until a slow pulsing whistle is heard in the phones of the Wireless Set No. 62. It may be necessary to reduce the GAIN of the Wireless Set No. 62 to enable the whistle to be heard clearly: the strength should be adjusted to about R2.

(3) On the Wireless Set No. 62, adjust the AE TUNING control for maximum sensitivity, maintaining the output at strength R2 by means of the GAIN control. Now adjust the Wireless Set No. 62 FREQUENCY control to obtain zero beat.

NOTE :—It is most important to ensure that the Wireless Set No. 62 aerial circuit is correctly tuned, otherwise a spurious signal of similar strength to the correct signal may be heard.

(4) Note the calibration error of the Wireless Set No. 62 FREQUENCY dial.

(5) Now place the calibrator selector switch to the DIAL position, and rotate the calibrator dial until one of the four scales (see Fig. 2) indicates the first, second and third decimal places of the ordered frequency in megacycles (e.g. for an ordered frequency of 8·384 Mc/s, set the dial to ·384, the last figure being obtained by interpolation. It will be noted that the dial will have the same position for 6·384 Mc/s or 7·384 Mc/s etc.).

(6) On the Wireless Set No. 62, turn the FREQUENCY dial slowly in the direction of the ordered frequency, the approximate position of which should be known from the calibration error observed in (4) above. Close to this position a calibrator whistle should be audible : this may be recognized by its one cycle per second pulsing. In order to hear this whistle clearly, it may be necessary to turn the Wireless Set No. 62 GAIN control up and re-tune the AE TUNING. This, however, should only be necessary at the upper end of the 4–10 Mc/s band.

(7) On the Wireless Set No. 62, adjust the FREQUENCY dial for zero beat. The Wireless Set No. 62 is now set up to ordered frequency.

NOTES : 1. In the neighbourhood of ·25 Mc/s and ·75 Mc/s, i.e. at one end of the scale, the calibrator is producing two frequencies which lie very close together, finally coinciding when the dial is actually set to ·25 Mc/s or ·75 Mc/s.

When such frequencies are to be set up, it is essential to check that the correct calibrator output frequency is being used by finding BOTH signals and then tuning to the required signal.

2. The gain of the Wireless Set No. 62 should always be kept as low as possible.

3. On the Wireless Set No. 62, if flick working is desired, the method of setting up the flick controls is exactly the same as when netting in the normal way.

CHAPTER III . . . . . MAINTENANCE

10. General

The accompanying Record Sheet has been designed as a means of recording completion of maintenance tasks, repairs and inspections.

It has been produced separately as Army Form B.2661—Unit Maintenance Log, and will cover a period of 24 weeks. This form has now been promulgated in Army Orders and may be obtained on indent in the normal manner.

The completion of maintenance tasks will be recorded by initialling in the space provided. Minor repairs and valve replacements will be recorded on the reverse side of Army Form B.2661.

Further instructions for the Unit Commander are promulgated in A.C.I. 1076 of 1945.

The following is a list of maintenance tasks to be carried out by the operator. The frequency with which they are to be carried out will be detailed by the Unit Commander. The tasks are laid down as suggestions to the Unit Commander, and he may omit or add to them at his discretion. It is advised, however, that all these tasks are carried out, especially in the case of new equipments.

11. Suggested daily tasks

(1) Ensure that all external parts of the calibrator are in a scrupulously clean condition.

(2) Ensure that the 3-point power plug on the calibrator and the corresponding 3-point socket on the Wireless Set No. 62 are clean and bright.

(3) Clean the metal parts of the Connector, 3-point, No. 67, and make sure that it is fitted firmly in place.

(4) Clean the AERIAL and EARTH terminals on the calibrator. Keep the ends of the Connector, Twin, No. 321 clean and check that there is no sign of wear or fraying. Keep the spade terminals flat and the pin terminals straight.

(5) Check the action of the selector switch and ensure that the grub screw at the side is firm.

(6) Check the action of the frequency control. The two grub screws may be tightened by inserting a screwdriver through the hole in the protecting flange.

(7) Check the operation of the calibrator in accordance with Chapter II—Operator's instructions.

TYPE OF EQUIPMENT ----------

SERIAL Nº OF EQUIPMENT

NOTE - UNIT TASKS ARE DETAILED IN WORKING INSTRUCTIONS

UNIT MAINTENANCE LOG.

DATE (WEEK ENDING)	1 DAY	2 DAY	3 DAY	4 DAY	5 DAY	6 DAY	7 DAY

1ST ECHELON MAINTENANCE LOG.

INITIAL	DATE

NOTE - 1ST ECHELON TASKS ARE DETAILED IN RELEVANT EMER

INITIAL	DATE

INITIAL	DATE

INITIAL	DATE

INITIAL	DATE

INITIAL	DATE

Specimen Army Form B.2661—Front

REPAIR RECORD.

(E.G. VALVE REPLACEMENTS, MAJOR REPAIRS R.E.M.E. INSPECTIONS, ETC)

DATE	REMARKS.

Specimen Army Form B.2661—Back.

12. The desiccator

The purpose of a desiccator is to absorb residual moisture from an hermetically sealed container. Such a desiccator may be screwed into the case of the calibrator in the position shown in Fig. 1.

When dry, the active indicator inside the desiccator is bright blue in colour, but after subjection to moisture it becomes pink. The colour of the active element is observable at all times through a window at the back of the desiccator, so that when examining the condition of the element it is not necessary to remove the desiccator from the case of the calibrator.

A damp or exhausted desiccator may be replaced simply by unscrewing it from its normal position and then fitting the spare one. Before a new desiccator is fitted, however, it should if possible be dried thoroughly until its colour is bright blue, and then screwed quickly and firmly into position before the damp atmosphere has had time to affect its colour.

If a desiccator is fitted to this instrument the colour should be checked daily and an exhausted desiccator should be changed provided an absolutely dry replacement is available.

If it becomes necessary to withdraw the calibrator chassis from its case to perform maintenance, then the desiccator should be changed after the chassis has been refitted and screwed down with all four retaining screws.

13. Removal of chassis

The chassis should not be removed from its case, except in emergency, to investigate a specific fault as described in the following fault finding table.

To remove the chassis, withdraw the four outermost securing screws (see Fig. 1) and lift the chassis out of its case by means of the metal corner brackets.

WARNING: Before removing the chassis from the case, set the dial to ·25. This will protect the variable condenser by enmeshing its moving vanes.

The interior of the calibrator is shown in Fig. 3 on Page 11.

WARNING: Referring to Fig. 3. DO NOT TOUCH the heater voltage potentiometer or the oscillator circuit trimmer.

14. Valves

The positions of the three valves, the neon and the crystal, are shown in Fig. 3.

The valves are screened by metal cans which may be removed by turning slightly in a anti-clockwise direction and then pulling gently. The valves themselves may be withdrawn from their holders by means of a slight pull: no lateral movement must be used, as this would probably result in breaking the metal to glass seal.

Before removing valve V2 it will be necessary to remove the neon V1.

15. Fault location

(1) General

The following fault finding table is intended as an operator's guide to the simpler faults which might occur on the crystal

calibrator. The circuit diagram of the calibrator is given in Fig. 4.

It is assumed that the calibrator is connected to a Wireless Set No. 62, which has been correctly set up according to the appropriate working instructions.

The fault finding tables describe the action to be taken when various symptoms are recognized; these instructions may be performed without special apparatus and will enable most simple faults to be localised: other faults must be reported in order that they may be repaired by a mechanic equipped with suitable apparatus.

(2) Warning

It is essential that the operator does not indulge in indiscriminate probing in the equipment, as such treatment is likely to produce faults rather than to cure them. Any alteration in the relative positions of wires and components will upset the calibration of the equipment.

(3) System

It is important that the tests are carried out methodically and in the correct order. As a fault is discovered, correct it and see that the test that led to its discovery gives correct results before proceeding to the next test.

(4) External faults

It should be remembered that external faults are far more common than internal faults. If the equipment fails, look for faults in the following order :—

(a) Faults in the setting of switches or knobs

(b) External faults—connectors, etc.

(c) Internal faults.

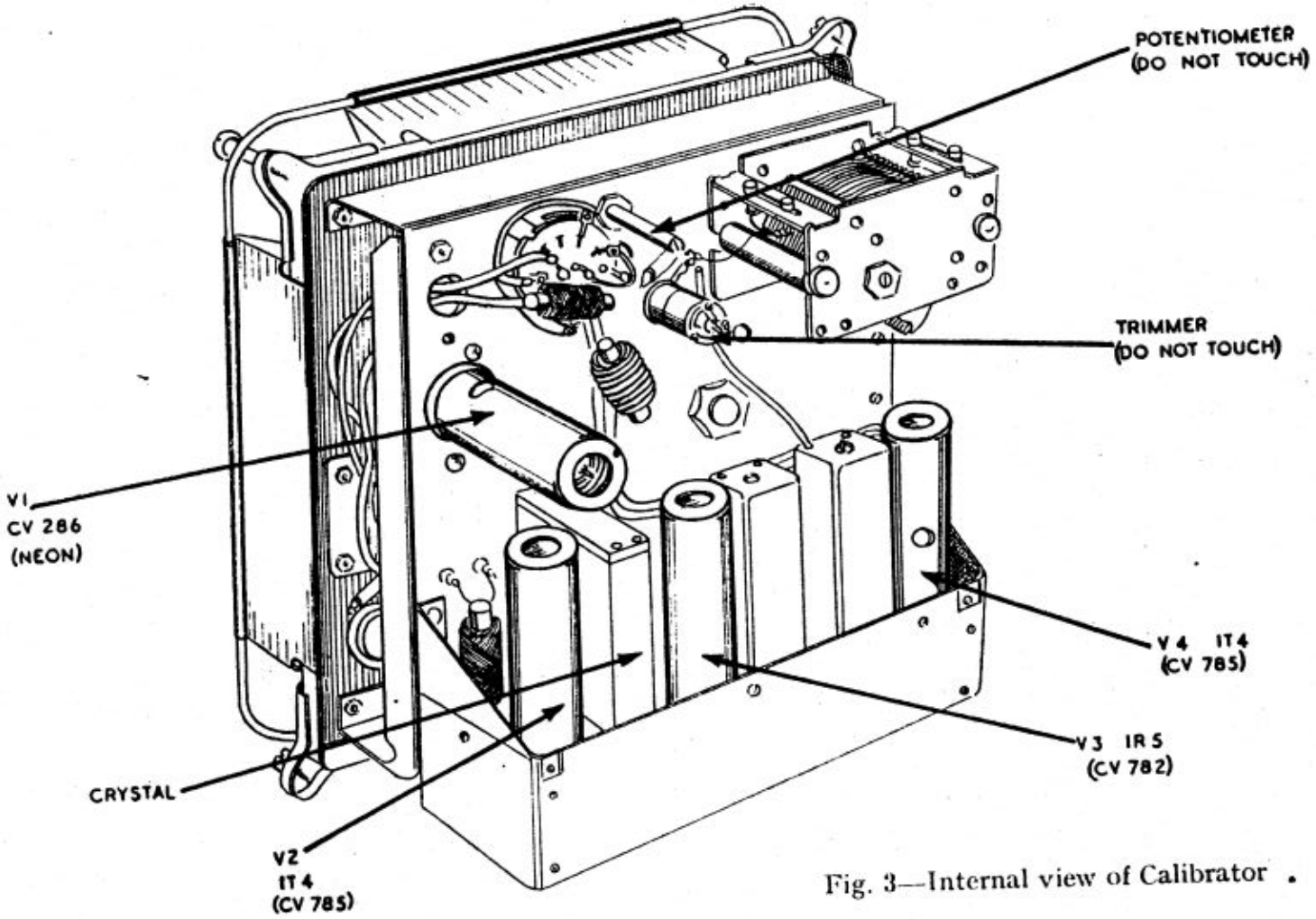

Fig. 3—Internal view of Calibrator

FAULT FINDING TABLE

Symptom (1)	*Possible Fault* (2)	*Action* (3)
With selector switch to 500 kc/s position		
(*a*) No whistle due to 500 Kc/s can be heard anywhere	(*a*) Defective Connector 3-point No. 67 or Connector Twin No. 321	Clean terminations and check contacts.
	(*b*) No voltage at Wireless Set No. 62 XTAL CAL terminals	Check by connecting calibrator to another W.S. No. 62 NOTE :—When the calibrator is first switched on, a change in note of the W.S. No. 62 generator should be noticeable.
	(*c*) Crystal not making good contact in its holder	Check contacts—see Fig. 3, page 11
	(*d*) Valve V2 (1T4) crystal - oscillator defective	Make trial replacement
	(*e*) Valve V3 (1R5) mixer defective	(*a*) Make trial replacement (*b*) Report
(*b*) Whistles due to 500 Kc/s can be heard, but no 1 cycle per second pulsing audible	Neon V1 (CV286) defective	(*a*) Make trial replacement of neon (*b*) Report
With selector switch to DIAL, attempt to tune as described in this working instruction		
No dial whistles audible	(*a*) Calibrator error	Rotate calibrator tuning knob through its full range when a whistle should be heard at some settings—report
	(*b*) Valve V4 (1T4) variable oscillator defective	(*a*) Make trial replacement (*b*) Report

APPENDIX I

COMPONENTS LIST

Circuit Reference	*Value*	*Description*
CONDENSERS		
C1	0·001uF	Moulded
C2	0·1uF	
C3	0·1uF	
C4	5 pF	Pearl type
C5	0·1uF	Stud
C6	56pF	
C7	0·1uF	Stud
C8	0·1uF	Stud
C9	0·1uF	Stud
C10	120pF	Ceramic
C11	0·1uF	Stud
C12	56pF	Ceramic
C13	270pF	Ceramic
C14	390pF	Ceramic
C15	120pF	Ceramic
C16	390pF	Ceramic
C17	270pF	Ceramic
C18	0·1uF	Stud
C19	0·01uF	Moulded
C20	0·1uF	Stud
C21	0·1uF	Stud
C22	0·1uF	Stud
C23	0·1uF	Stud
C24	33pF	Ceramic
C25	3-30pF	Trimmer
C26	487pF	Single Sec.
C27	33pF	Ceramic
C28	0·1uF	Stud

APPENDIX I—contd.

Circuit Reference	*Value*	*Tolerance*	*Description*
RESISTORS			
R1	10 M ohm	¼W	Ceramic
R2	27 K ohm	¼W	Ceramic
R3	47 K ohm	¼W	Ceramic
R4	47 K ohm	¼W	Ceramic
R5	4·7 M ohm	¼W	Ceramic
R6	100 K ohm	¼W	Ceramic
R7	47 K ohm	¼W	Ceramic
R8	4·7 K ohm	¼W	Ceramic
R9	47 K ohm	¼W	Ceramic
R10	1·0 K ohm	¼W	Ceramic
R11	22 K ohm	¼W	Ceramic
R12	1·0 K ohm	¼W	Ceramic
R13	10 ohms	¼W	Ceramic
R14	47 K ohm	¼W	Ceramic
R15	22 K ohm	¼W	Ceramic
R16	270 K ohm	¼W	Ceramic
R17	1 K ohm	¼W	Ceramic
R18	47 K ohm	¼W	Ceramic
R19	22 ohm	¼W	Wirewound
RV1	6 ohm		Pot.
R20	30 ohm	6W	Wirewound
VALVES			
V1			Neon CV286
V2			Valve 1T4 (CV785)
V3			Valve 1R5 (CV782)
V4			Valve 1T4 (CV785)
INDUCTANCES			
L1			Choke
L2			Choke
L3			Choke
L4			Choke
L5	2 uH		Choke
L6			Filter coil
L7			Filter coil
L8			Filter coil
L9			Choke
L10			Choke
L11			Heater choke
L12			Osc. coil
SWITCHES			
S1			3 pole, 3 way switch
CRYSTAL			
XL1			Crystal 500 Kc/s

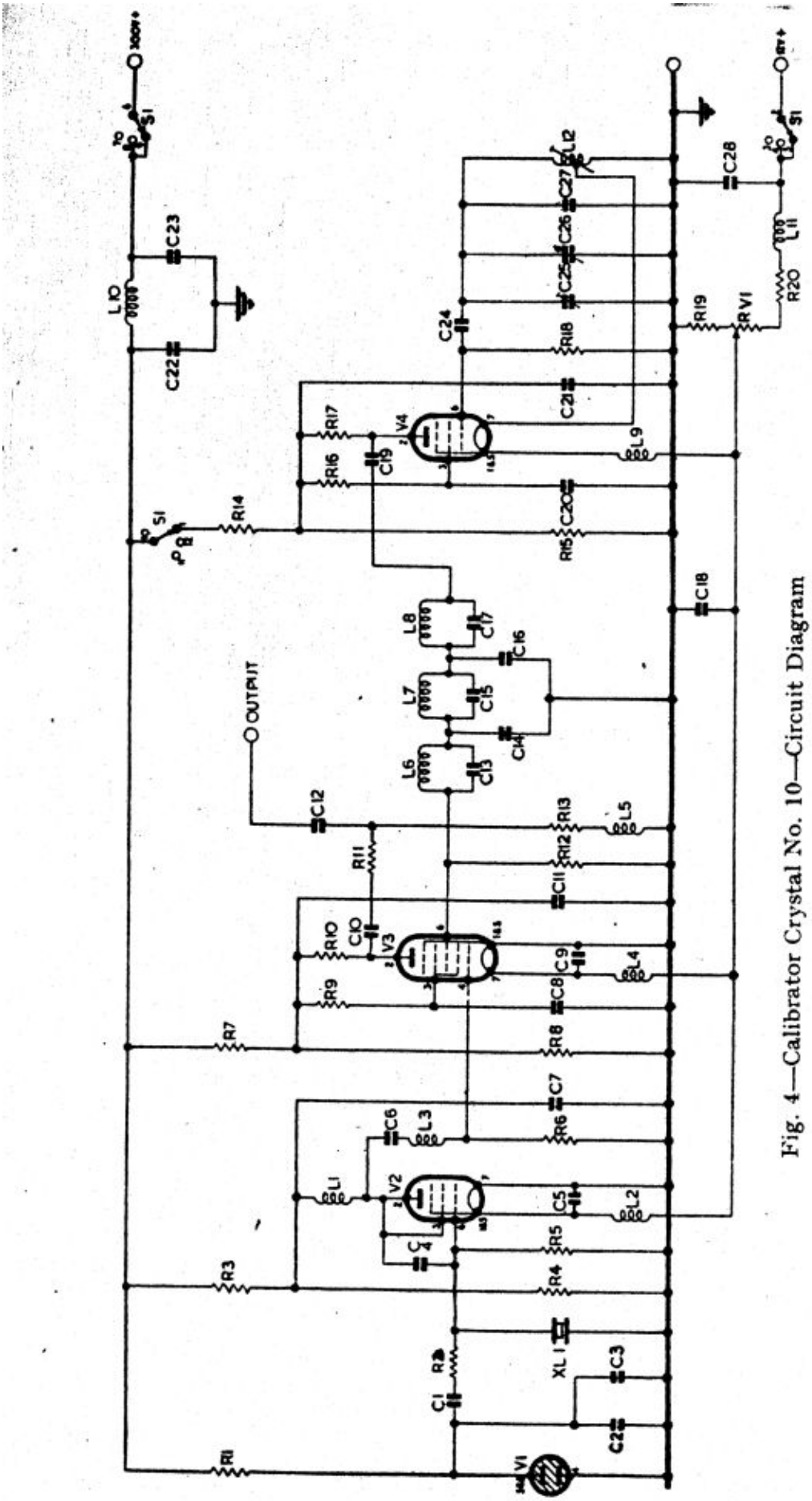

Fig. 4—Calibrator Crystal No. 10—Circuit Diagram

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