OBSOLETE. PUB. SUPP. 68/29.

RESTRICTED

AIR PUBLICATION

2537E

VOLUME 1

2nd Edition, February, 1954

VALVE TESTER CT.80

GENERAL AND TECHNICAL INFORMATION

Prepared by direction of
the Minister of Supply

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Promulgated by Command
of the Air Council

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AIR MINISTRY

61417 258165 8412 2/58 5f td2530 Gp539-2 (A.L.7, Jan. 58)

AMENDMENT RECORD SHEET

To record the incorporation of an Amendment List in this publication, sign against the appropriate A.L. No. and insert the date of incorporation

A.L.No.	AMENDED BY	DATE
1	Kelsen	8/7
2	E. Lmcell	24/11/54
3	E. Lmcell	24/11/54
4	E. Lmcell	24/11/54
5	E. Lmcell.	3 3 55
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DANGER-HIGH VOLTAGE

APPARATUS IS SAFE - *ONLY* IF YOUR APPROACH IS CORRECT

NOTE TO READERS

The subject matter of this publication may be affected by Air Ministry Orders or by " General Orders and Modifications " leaflets in this A.P. If possible, Amendment Lists are issued to correct this publication accordingly, but it is not always practicable to do so. When an Order, or leaflet contradicts any portion of this publication, the Order or leaflet is to be taken as the overriding authority.

The inclusion of references to items of equipment does not constitute authority for demanding the items.

Each leaf (except the original issue of preliminaries) bears the date of issue and the number of the Amendment List with which it was issued. Amended technical information on new leaves which are inserted when this publication is amended will be indicated by triangles, positioned thus ◀.....▶ to show the extent of amended text, and thus ▶◀ to show where text has been deleted. The triangles merely denote a change and are not marks of emphasis. When a Part or Chapter is issued in a completely revised form, the triangles will not appear.

LAYOUT OF A.P. 2537E

VALVE TESTER CT.80

Heavy type indicates the books being issued under this A.P. number; when issued they will be listed in A.P.113 and A.P.2463

VOLUME 1 (2nd Edition)		**General and technical information**
	Part 1	**General information**
	Part 2	**Technical information (servicing)**
	Part 3	**Fault diagnosis**
VOLUME 2		**General orders and modifications**
VOLUME 3		**Equipment schedules and scales**
VOLUME 4		*Inapplicable*
VOLUME 5		*Inapplicable*
VOLUME 6		*Inapplicable*

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The whole of the proposed contents of this Volume are listed on the following page; chapters which are to be issued later are so indicated

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PART 2—TECHNICAL INFORMATION (SERVICING)

PART 3—FAULT DIAGNOSIS

PART I

LEADING PARTICULARS AND GENERAL INFORMATION

LIST OF CHAPTERS

The above list indicates the ultimate contents of the part. The present contents are listed on the page which follows the Contents Marker Card.

LEADING PARTICULARS

Function ... ... The testing of valves to approved limits

Main items of equipment

Description	Item	Stores Ref.
Valve test unit CTA.20	CT.80/1/3	10S/16441
Case of test cards CTA.21	CT.80/2/3	No Stores Ref. No. allocated as cards may be added or removed from cases.
Case of test cards CTA.22	CT.80/3/3	

Operation ... ... The operation has been made very simple by the use of perforated test cards. The appropriate card for the type of valve under test is inserted in the gate switch which automatically makes all the required circuit connections. Thereafter, a rotary switch and a series of electrode switches select the various tests in sequence.

Indications ... ... The results are indicated by the position of a spot on the screen of 2½ in. CRT. (CV2175). Coloured scales indicate whether the valve is within prescribed limits or should be considered unserviceable.

Test valveholders ... The following test valveholders are fitted :—UX4, UX5, UX6, 10, MO, 5C8, B3G, B5, B7, B7G, B8A, B8E, B9A, B9E, American acorn and British acorn. An adaptor (Type 157) is provided to enable sub-miniature wire-ended valves to be tested.

Test cards ... ... A list of the available test cards, in CV numerical order, is given in Appendix 1 of Chapter 1.

Test sequence ... ...
(1) Filament or heater continuity
(2) Electrode insulation—HT off
(3) Heater-cathode insulation
(4) Electrode insulation—HT on
(5) Grid current (gas test)
(6) Emission
(7) Electrode open-circuit

Power supplies ... ... 90 to 130 and 180 to 260 volts single-phase 50 c/s AC.
Consumption—100W approximately (varies with valve under test).

Dimensions and weights

	Height	Width	Depth	Weight
Valve test unit CTA.20	12½ in.	17 in.	18 in.	50 lb. (approx.)
Case of test cards CTA.21	9¼ in.	5½ in.	17½ in.	31 lb. (full)
Case of test cards CTA.22	9¼ in.	5½ in.	17½ in.	3 lb. (empty)

Chapter I

GENERAL DESCRIPTION, SETTING-UP AND OPERATION

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GENERAL DESCRIPTION

Introduction

1. Valve tester CT.80 shown in fig. 1 has been designed primarily for testing valves to approved limits. For this reason the tests applied are as similar as possible to the standard production tests to which all valves are submitted during manufacture before being passed into stock.

2. Operation of the tester has been made very simple by the use of perforated cards. The appropriate card for the type of valve under test is inserted in the gate switch which automatically makes all the required circuit connections. Thereafter, a rotary switch and a series of electrode switches select the various tests in sequence. All the results are indicated by the position of a spot on the screen of a cathode-ray tube, a coloured scale adjacent to the tube face, indicating whether the valve under test is within prescribed limits or should be considered unserviceable.

3. The following test valveholders are fitted :— UX4, UX5, UX6, I0, MO, SC.8, B3G, B5, B7, B7G, B8A, B8G, B9A, B9G, American acorn and British acorn. In addition, an adaptor (Type 157) is provided to enable sub-miniature wire-ended valves to be tested. Two sockets, marked TC.1 and TC.2 together with two flying leads (connectors valve Type 53 and 54) are provided for testing top-cap type valves.

4. The complete tester consists of the following units :—

Description	*Item*	*Stores Ref.*
Valve test unit CTA.20	CT.80/1/3	10S/16441
Case of test cards CTA.21	CT.80/2/3	No Stores Ref. No. allocated as cards may be added or removed from cases.
Case of test cards CTA.22	CT.80/3/3	

A list of the test cards is given in Appendix 1.

Valve defects

5. Valve defects may be divided into three main groups :—

(1) Defects likely to cause complete failure to operate :—

(a) Faulty filament or heater
(b) Short circuits between electrodes
(c) Open-circuited electrodes
(d) Poor emission.

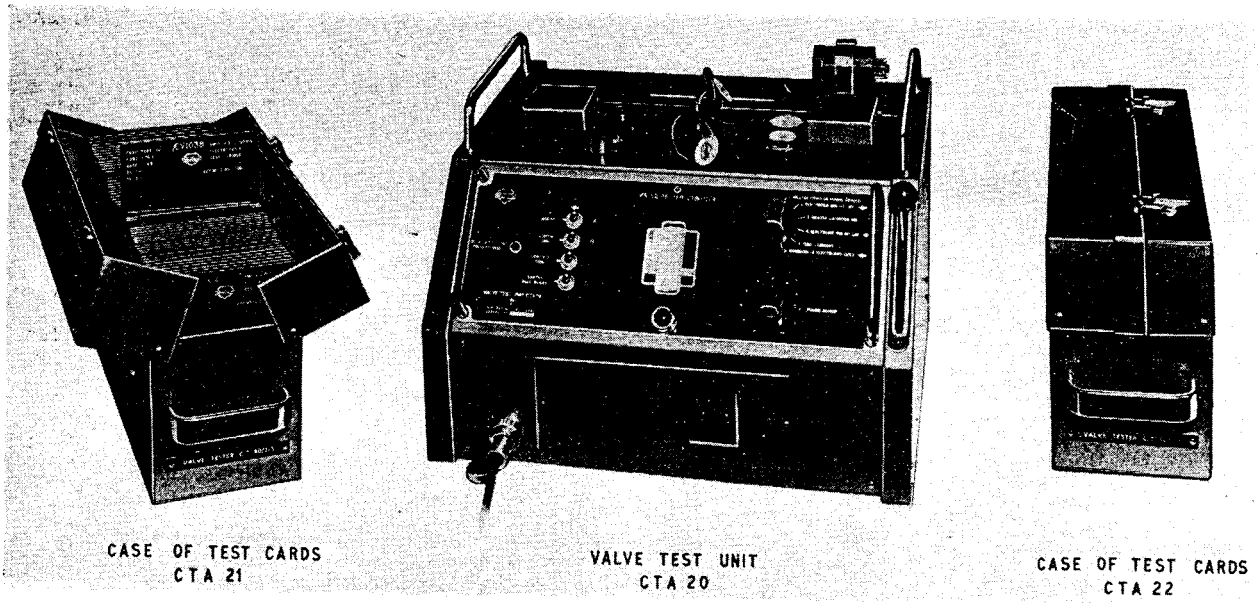

Fig. 1. Valve tester CT.80—general view

(2) Defects likely to result in noise, intermittent operation or instability :—

(a) Faulty insulation between electrodes
(b) Faulty insulation between cathode and heater
(c) Intermittent short circuits between electrodes
(d) Mechanical faults in electrode assembly.

(3) Defects likely to cause poor amplification, distortion or inability to perform normal functions :—

(a) Any of the defects mentioned in (2)
(b) Excessive grid current due to the presence of gas in the valve, or insulation leaks
(c) Poor emission.

The valve tester reveals these faults by means of a series of eliminating tests carried out in a logical sequence.

6. The valve tester can only reveal the condition of the valve itself. It is always possible that even with a valve which by all manufacturer's standards can be considered to be serviceable, the working conditions in its associated equipment are such as to render the valve inoperative.

Test sequence

7. The standard sequence of tests, selected by the TEST SELECTOR switch (*fig.* 2) is as follows :—

(1) Filament or heater continuity
(2) Electrode insulation—HT off
(3) Heater-cathode insulation
(4) Electrode insulation—HT on
(5) Grid current (gas test)
(6) Emission
(7) Electrode open-circuit.

Tests 6 and 7 use position 6 of the TEST SELECTOR switch.

8. The ELECTRODE spring-bias switches A, B, C and D are used only when the TEST SELECTOR is set to positions 2, 4 and 6. Arrows marked adjacent to these positions are a reminder that the ELECTRODE switches are to be used during these tests. The switches are connected to the valve electrodes as follows :—

Switch A	—	Anode
Switch B	—	Screen-grid
Switch C	—	Control-grid
Switch D	—	" Earthy " electrodes.

Protection

9. To prevent damage to the instrument through a fault in the valve under test or due to the incorrect use of the instrument, three protective devices are fitted :—

(1) A fuse connected in the mains input supply to the tester.

(2) An HT overload cut-out connected in circuit with the HT supply to the valve under test. When the cut-out is operated, due to excessive HT current taken by the valve under test, the mains input supply to the tester is broken and the instrument rendered inoperative. The cut-out is reset by pressing the button marked OVERLOAD CUTOUT PRESS TO RESET (*fig.* 2).

(3) A safety switch in the mains input lead, which can be operated only when a test card is inserted in the gate and the gate switch closed. The safety switch is mounted inside the equipment and is not shown in the illustrations.

Test cards

10. A list of the available test cards, in CV numerical order, is given in Appendix 1. Three special test cards are supplied with each tester for use when setting-up or adjusting the instrument.

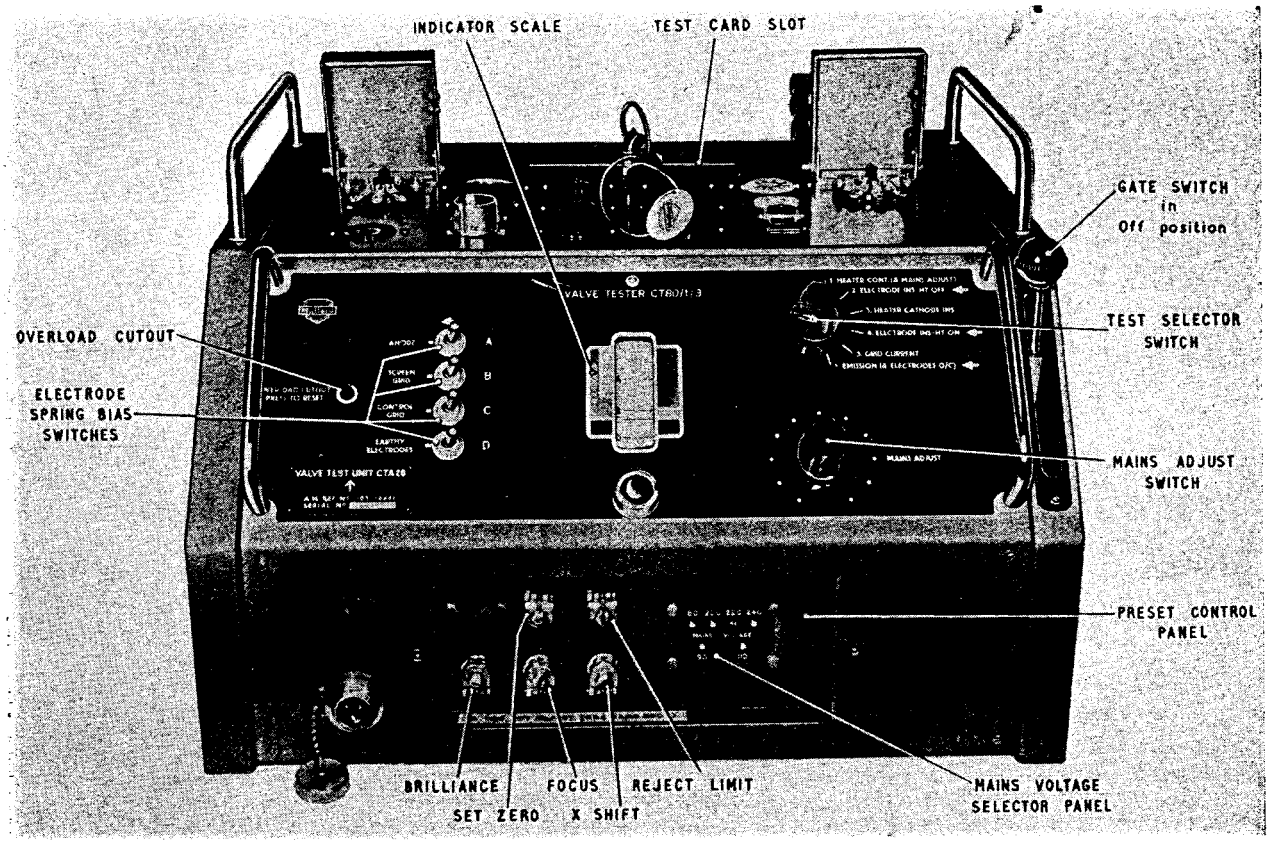

Fig. 2. Valve test unit CTA.20 showing controls

Test card storage cases

11. Two cases (CTA.21 and CTA.22 of *fig.* 1) are provided to store and protect the cards. Care should be taken to keep the cards free from moisture and dirt as inaccurate readings may result due to surface leakage across a portion of the card.

SETTING-UP *(fig. 2, 3 and 4)*

Mains lead

12. A mains lead (connector Type 3429/1, Stores Ref. 10HA/8359) is provided with the instrument. It is essential to connect the earth lead otherwise inaccurate readings may result.

Preset control panel

13. Six preset controls and the mains voltage selector panel are situated behind a removable plate on the front panel of the tester (*fig.* 2 and 4). With the front plate in position, the mains voltage selector panel can be seen through the perspex window.

14. The functions of the six preset controls are as follows :—

Control	*Function*
A	Mains balance
B	Set zero
C	Reject limit
D	Brilliance
E	Focus
F	Shift

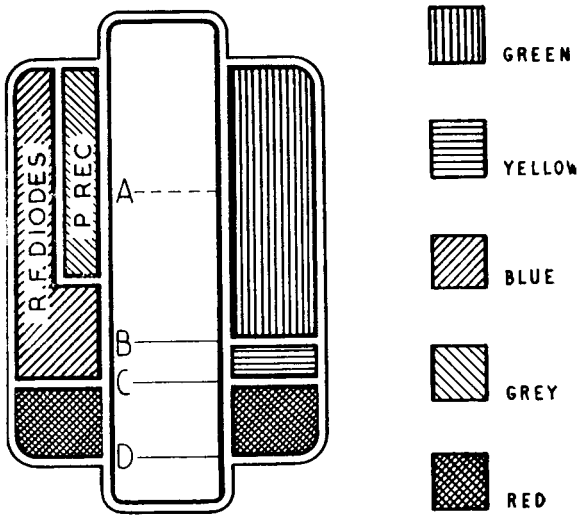

Fig. 3. Indicator scale

Control A is preset by the manufacturers or by a specialised unit using the correct test equipment. No attempt should be made to adjust this control. Control F is provided to enable the spot to be moved laterally so that, in the event of a burnt screen after long periods of service, a fresh part of the screen surface may be used.

Mains adjustment

15. The instrument is designed to operate from single-phase 45 to 65 cycle AC supply of 90 to 130 and 180 to 260 volts. A mains voltage selector tap is provided on the preset control panel (*fig.* 2). Fine adjustment between tappings is obtained by means of the MAINS ADJUST switch (*fig.* 2).

16. To adjust the tester for the correct mains voltage setting :—

(1) Set the mains voltage selector panel to the appropriate supply voltage.

(2) Set the TEST SELECTOR switch to position 1, HEATER CONT. (& MAINS ADJUST).

(3) Insert the MAINS test card and close the GATE SWITCH.

(4) Adjust the MAINS ADJUST switch (*fig.* 2) so that the indicator spot comes as near as possible to and within a few millimetres of the dotted line A (*fig.* 3) across the indicator scale.

In localities where the mains voltage fluctuates, this adjustment should be checked at regular intervals.

Reject limit check

17. The reject limits should be checked on installation and thereafter at regular intervals. To check the reject limit, the REJECT card should be inserted in the gate and the gate switch closed.

(1) With the TEST SELECTOR switch (*fig.* 2) in position 1, HEATER CONT. (& MAINS ADJUST) the indicator spot should come to rest on the reject line C (*fig.* 3).

(2) With the TEST SELECTOR switch (*fig.* 2) in position 6, EMISSION (& ELECTRODE O/C) the spot should come to rest on the base line D (*fig.* 3).

Reject limit adjustment

18. If the indicator spot does not come to rest on lines C and D (*fig.* 3) in the reject limit check (*para.* 17), the following adjustments should be made :—

(1) Set the TEST SELECTOR switch (*fig.* 2) to position 6, EMISSION (& ELECTRODE O/C).

2) Insert the REJECT card and close the GATE SWITCH.

(3) Adjust control B (set zero) (*fig.* 2) until the spot rests on line D (*fig.* 3).

(4) Turn TEST SELECTOR switch to position 1, HEATER CONT. (& MAINS ADJUST), and note position of the spot relative to line C (*fig.* 3).

(5) Turn TEST SELECTOR switch to position 6, EMISSION (& ELECTRODE O/C), and adjust control C (Reject limit) (*fig.* 2) to place the spot twice the distance above or below line D as it was above or below line C (*fig.* 3).

(6) Re-adjust control B until the spot rests on line D.

(7) Turn TEST SELECTOR switch to position 1, HEATER CONT. (& MAINS ADJUST) and check that the spot is now correctly on line C (*fig.* 3).

If necessary repeat the above adjustments. On completion the MAINS test card should be used for a final check and re-adjustment if required.

Warning . . .

No attempt should be made to adjust control A (fig. 2). This control is pre-set by the manufacturers or by a specialised unit using the correct test equipment.

HT supply check

19. To check that the high-tension supply is within operating limits, the HT card should be inserted in the gate and the GATE SWITCH closed.

(1) With the TEST SELECTOR switch (*fig.* 2) in position 6, EMISSION (& ELECTRODE O/C) the indicator spot should come to rest within 3 millimetres ($\frac{1}{8}$ in.) of the dotted line A (*fig.* 3).

OPERATION

Selection of test cards

20. Each test card is labelled with the following information :—

(1) CARD TYPE. This is a card Type number followed by the CV valve Type number. Where more than one card is required for testing a particular valve, the group of cards is identified by the letters A, B or C appearing in the card Type number. These letters indicate the sequence in which the valves must be used, e.g. 167A/CV575, 167B/CV575, 167C/CV575.

(2) BASE. The correct valveholder to be used is indicated by the appropriate code number e.g. B7G.

(3) CARD. This indicates the total number of cards required to test a particular valve and identifies its number in the group, e.g. for a valve requiring a single card this would read 1 of 1. For a valve requiring 3 cards they would read 1 of 3, 2 of 3, and 3 of 3.

(4) TC.1. This indicates the electrode to which this top-cap lead is connected e.g. for top-cap grid the card would be marked G.

(5) TC.2. As TC.1 above.

Note . . .

This socket is normally used only with double top-cap valves and should not be used in place of TC.1.

(6) SWITCH POS. This shows the various positions and sequence in which the TEST SELECTOR switch must be used. Only the positions indicated should be used, otherwise misleading results will be obtained, e.g. 2346.

(7) ELECTRODES. The spring-biased ELECTRODE switches to be used are indicated by the letters A, B, C and D. These switches are used only in positions 2, 4 and 6 of the TEST SELECTOR switch and this is indicated by the small arrow adjacent to these positions. Only the switches indicated should be depressed.

(8) TEST. This indicates the electrode-system under test when using the particular card, e.g. DIODE, TRIODE, etc.

(9) REF. NO. When cards are provisioned they should be ordered quoting the card Type number and the appropriate Ref. No. e.g. Card Type 112/CV1038 Ref. No. 10AD/1700.

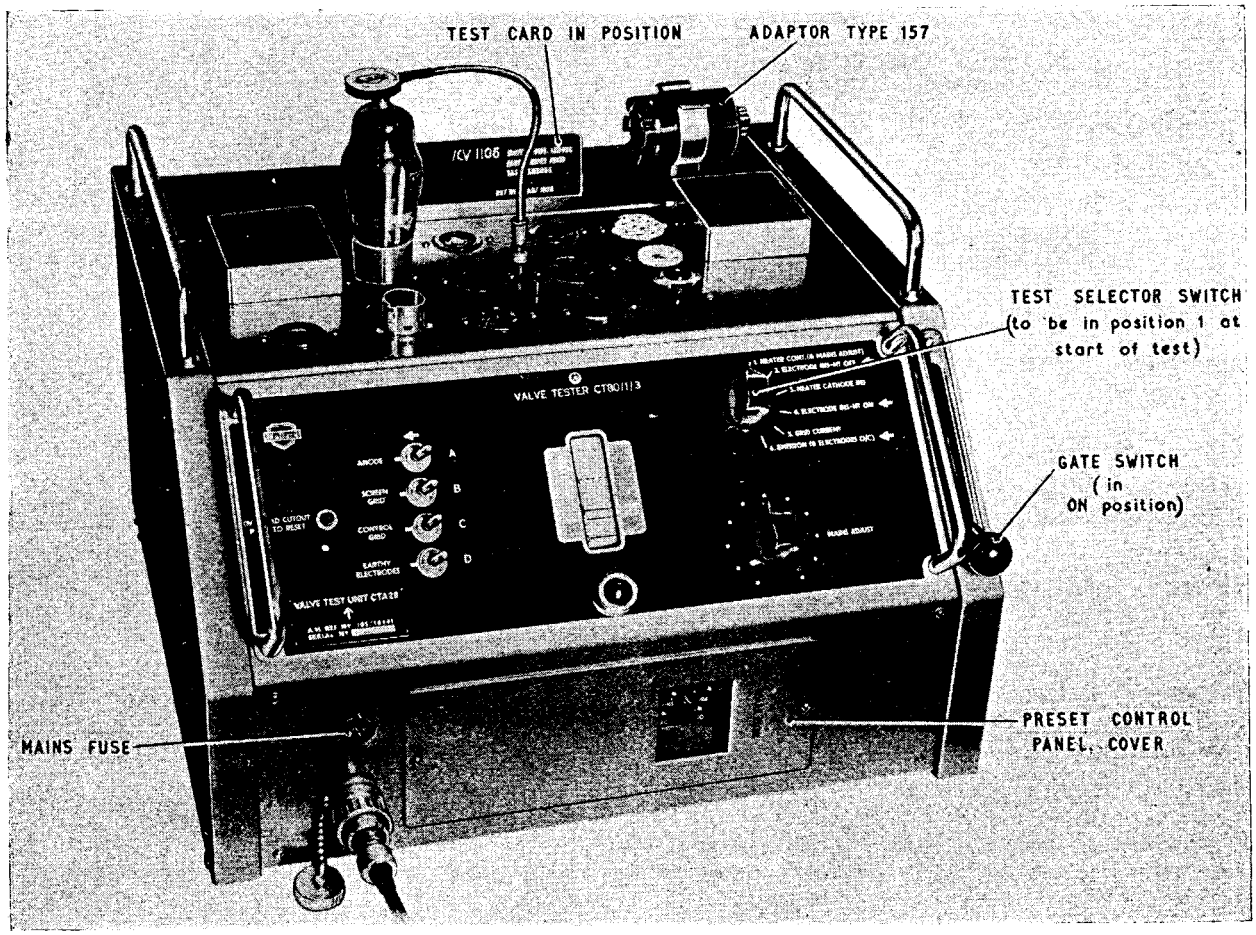

Fig. 4. Valve tester in the " operate " position

Preliminary

21. Always allow sufficient time for the valves in the tester and the valve under test to attain their correct working temperatures. Certain of the older types of valves require up to 40 seconds. Stable conditions are indicated when the spot on the cathode-ray tube comes to rest.

22. For valves with a single top-cap, the socket TC.1 on the top panel is used. For valves with two top-caps the sockets TC.1 and TC.2 are used as shown on the test card.

Indications

23. A cathode-ray tube and vertical scales (*fig.* 3) are used to indicate the results of the various tests. The right-hand scale, sub-divided into three sections, red, yellow and green is used for all tests with the exception of the EMISSION test for RF Diodes and Power Rectifiers for which separate scales are provided on the left of the cathode-ray tube aperture.

24. In all the following tests (except for ELECTRODE O/C test), if the valve is serviceable the indicator spot should remain in the green section of the scale.

25. If the spot moves to the yellow section of the scale, the valve should be suspect and, although it may function in its associated equipment, early renewal is advisable. If the spot moves to the red section, it indicates that the valve is definitely unserviceable and should be renewed.

26. When the appropriate switches are operated during the ELECTRODE O/C test, the spot will make a definite downward movement if the connections to the electrodes are continuous. If they are open circuited the spot will remain stationary in the green section.

Note . . .

A few valves will produce only a very slight downward movement of the spot when switch D is operated.

RF diodes

27. A separate scale marked R.F. DIODES (*fig.* 3) is used for the EMISSION test of these valves. If the spot remains in the blue section the valve is serviceable. If the spot moves to the red section the valve is unserviceable and should be renewed. If, when testing certain diodes, the spot rises above the blue scale the valve is operating at its upper limit and is satisfactory.

Power rectifiers

28. A separate scale marked P.REC. (*fig.* 3) is used for the EMISSION test of these valves. If the spot remains in the grey section, the valve is serviceable. If the spot remains below this section the valve is unserviceable and should be renewed.

29. Serious internal faults in a rectifier may cause excessive HT current to flow during the EMISSION tests and the OVERLOAD CUTOUT (*fig.* 2) will trip. The tester will not operate until the cut-out is reset.

Note . . .

Remove the faulty valve before attempting to reset the cut-out.

30. Certain of the rectifier valves will cause the cut-out to vibrate in the EMISSION test. This is quite normal and the valve is satisfactory if the indicator spot remains in the grey section of the scale.

Valve test procedure

WARNING

Do not insert the valve with the GATE SWITCH closed; HT voltages may be present on exposed valveholder contacts and top-cap connections. For this reason the covers should be kept closed over the acorn holders.

31.

(1) Select the card or cards required for the valve under test. When more than one card is required, cards must be used separately and in alphabetical order (*para.* 20).

(2) Turn the TEST SELECTOR switch to position 1, HEATER CONT. (& MAINS ADJUST).

(3) Insert the card in the gate slot.

(4) Insert the valve in its correct socket as indicated on the card and connect the top-cap(s) if necessary.

(5) Close the GATE SWITCH.

(6) Allow tester and valve under test to warm-up (approximately 40 seconds) (*para.* 21.)

(7) Turn the TEST SELECTOR switch to each position indicated on the card and,

(8) In switch positions 2, 4 and 6 operate the spring-bias ELECTRODE switches indicated on the card.

(9) Restore the GATE SWITCH to the OFF position before attempting to remove the card.

Note . . .

Do not proceed with tests once a fault has been found.

Test No. 1—Filament or heater continuity

32. Set the TEST SELECTOR switch to position 1, HEATER CONT. (& MAINS ADJUST). The indicator spot should move to the green section of the scale indicating that the filament or heater is continuous. If the spot remains in the red section a broken filament or heater is indicated. If it moves to the yellow section, a high resistance filament or heater is indicated and the valve should be considered suspect.

33. If the valve on test has a heater-cathode short circuit, this test may indicate a broken heater. This is because during this test the cathode is at earth potential and, as the heater will also be at earth potential, no deflecting voltage is applied to the cathode-ray tube and the spot will move to the red section of the scale. No harm can be done, however, by proceeding with Test No. 2 and No. 3. Test No. 3 will indicate clearly that the valve under test has a heater-cathode short circuit.

Test No. 2—Electrode insulation—HT off

34. Set TEST SELECTOR switch to position 2, ELECTRODE INS.—(HT OFF). The small arrow adjacent to this position of the switch is a reminder that the ELECTRODE test switches indicated at the top of the card must be operated for this test.

35. The heater supply is not connected to the valve for Test No. 1. Allow sufficient time for the valve under test to attain its correct working temperature (approximately 40 seconds) before proceeding with the following tests.

36. Operate in turn, each ELECTRODE switch indicated on the card and note the position of the spot. Poor insulation or short circuit between the electrode corresponding to the switch annotation and some other electrode or electrodes is indicated by the spot moving out of the green into the yellow or red sections of the scale. If the indicator spot remains in the green section, the electrode insulation may be considered satisfactory.

Test No. 3—Heater-cathode insulation

37. Set the TEST SELECTOR to position 3, HEATER-CATHODE INS. and note the position of the spot. Satisfactory insulation is indicated if the spot remains in the green section of the scale. Bad insulation is indicated if the spot moves into the red section.

Test No. 4—Electrode insulation—HT on

38. Set the TEST SELECTOR switch to position 4, ELECTRODE INS.—HT ON. This test is imilar to Test No. 2 described in para. 34 to 36 but it is made with normal operating voltages applied to the various electrodes. The small arrow adjacent to this position of the test selector switch is a reminder that the ELECTRODE test switches on the card must be operated for this test. Operate in turn, each switch indicated on the card and note the position of the spot.

39. Poor insulation or short circuit between the electrode corresponding to the switch annotation and some other electrode or electrodes is indicated by the spot moving out of the green into the yellow or red sections of the scale. If the indicator spot remains in the green section, the electrode insulation may be considered satisfactory.

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Test No. 5—Grid current (gas test)

40. Set the TEST SELECTOR switch to position 5, GRID CURRENT, and note the position of the spot. If the amount of grid current passed by the valve does not exceed the permissible limit, the indicator spot remains in the green section of the scale. If the valve is passing excessive grid current, indicating that the valve is " soft " (i.e. the amount of gas in the valve is enough to effect appreciably its electrical characteristics), the spot will move into the red section of the scale. In certain types of valve the spot may rise above the top of the green section of the scale or even right off the upper part of the face of the cathode-ray tube. This does not indicate a fault either in the valve or the instrument.

Test No. 6—Emission

41. Set the TEST SELECTOR switch to position 6, EMISSION (& ELECTRODE O/C). Do not operate any electrode switches in this test. The small arrow adjacent to this position refers to ELECTRODE O/C, Test No. 7 described in para. 43, which uses the same position of the TEST SELECTOR switch.

42. If the spot remains in the green section of the scale the emission of the valve is within the prescribed service limits. If the spot moves to the yellow section, the valve is probably still serviceable in some types of equipment, but will require early renewal. A valve which causes the spot to move into the red has emission below the prescribed service limits and should be discarded.

Test No. 7—Open-circuit electrodes

43. Another test with the TEST SELECTOR switch in position 6, checks whether there are any open-circuits in the electrode assemblies. Momentarily depress, in turn, the test electrode switches indicated on the card. As each switch is operated a downward movement of the spot will indicate continuity of the electrodes. Some valves will only produce a very slight movement of the spot when switch D is operated.

Warning . . .

In no circumstances should the ELECTRODE *switches be operated for longer than two seconds in this test as it is necessary to open-circuit certain electrodes and the valve may be damaged due to the other electrodes taking excessive current.*

Chapter 2

CIRCUIT DESCRIPTION

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LIST OF ILLUSTRATIONS

INTRODUCTION

1. The complete circuit of the valve test unit CTA. 20 is shown in fig. 1 (at the end of chapter). The description of the circuit has been broken down under six main sections as follows :—

(1) Indicator circuit
(2) Heater and filament supplies
(3) HT and grid-bias supplies
(4) Valve-holder panel
(5) Valve test circuits
(6) Special test card circuits

Indicator circuit *(fig. 2 at end of chapter)*

2. An electrostatic cathode-ray tube V1 is used in place of the conventional moving coil meter usually employed in valve testers. The voltage appearing across resistor R41, in the various tests, is applied to a DC two-valve paraphase amplifier which supplies the Y-plates of the cathode-ray tube.

3. The HT supply to the amplifier and the CRT are derived from the secondary winding S2 of transformer TR1. Rectifier valves V9 and V10 are used in a voltage-doubling circuit for the supplies to the CRT. V9 also supplies the amplifier valves V2 and V3. Smoothing is provided by the filter circuits R42–C3 and R94–C4. Resistor R93 limits the surge current through V1 and V2 during the frequent switching on required in the use of the instrument. The higher harmonics and transients present in the rectified output of V9 are attenuated by capacitor C14.

4. The voltages for the cathode, grid and first anode of the CRT are obtained from the resistance chain consisting of potentiometers RV1, RV2 and RV3. Of these RV1 is the BRILLIANCE control and RV2 the FOCUS control.

5. The final anode voltage is obtained from the centre-tap of R27 and R28, which are connected between the anodes of V2 and V3 in order to reduce astigmatism. One of the X-plates is connected to the final anode of V1 and the other via R25 to the slider of the potentiometer RV3 (X-SHIFT). This X-plate is also connected via R26 to the final anode in order to reduce the effect of changes in the mean anode potential of V2 and V3.

6. The anode loads of the two amplifier valves V2 and V3 are R29 and R30 ; the variable resistor RV4 (REJECT LIMIT CONTROL) is connected between the anodes to enable the amplifier sensitivity to be adjusted to the required value. The cathodes are strapped together and connected to the resistor chain R36, R38 and RV5. Resistor R36 provides the bias for V2 via the grid leak R41.

7. The input voltage to the amplifier, is applied, via selector switch wafers SWEdb and SWEc, to R41 which is connected to the grid of V2 via the filter circuit R37–C1 and the grid stopper R96.

8. The grid of V3 is fed from the anode of V2 via the potential divider R33, R34 and R35. R35 is returned to the slider of potentiometer RV5 (SET ZERO) to enable the correct bias to be applied to V3. This control also provides vertical shift of the spot for zero setting. Resistor R33 is shorted out during the grid current test (position 5 of switch SWE), to deflect the spot to the centre of the scale. Capacitor C2 together with R35 provides a filter circuit for V3 grid ; R97 is a grid stopper.

9. To prevent any hum deflection from appearing on the CRT :—

(1) C11 is connected between the anodes of V2 and V3.

(2) The indicator circuit is decoupled to earth via capacitor C5.

(3) The cathodes of V2 and V3 are connected to the centre-tap of the heater winding S3 of transformer TR1.

10. All connections associated with the indicator selector switch wafers SWEdb and SWEc are shown in the indicator circuit in order to simplify the breakdown circuits of the individual valve tests described in para. 21 to 36.

HT and grid-bias supplies (*fig. 3*)

11. Positive high tension supplies are obtained from the full-wave rectifier V6 supplied from the secondary winding S1 of the transformer TR1 via gate switch contacts M1 to M6. This winding is centre-tapped and has outputs of 100V–0–100V ; 250V–0–250V and 400V–0–400V. The centre-tap is

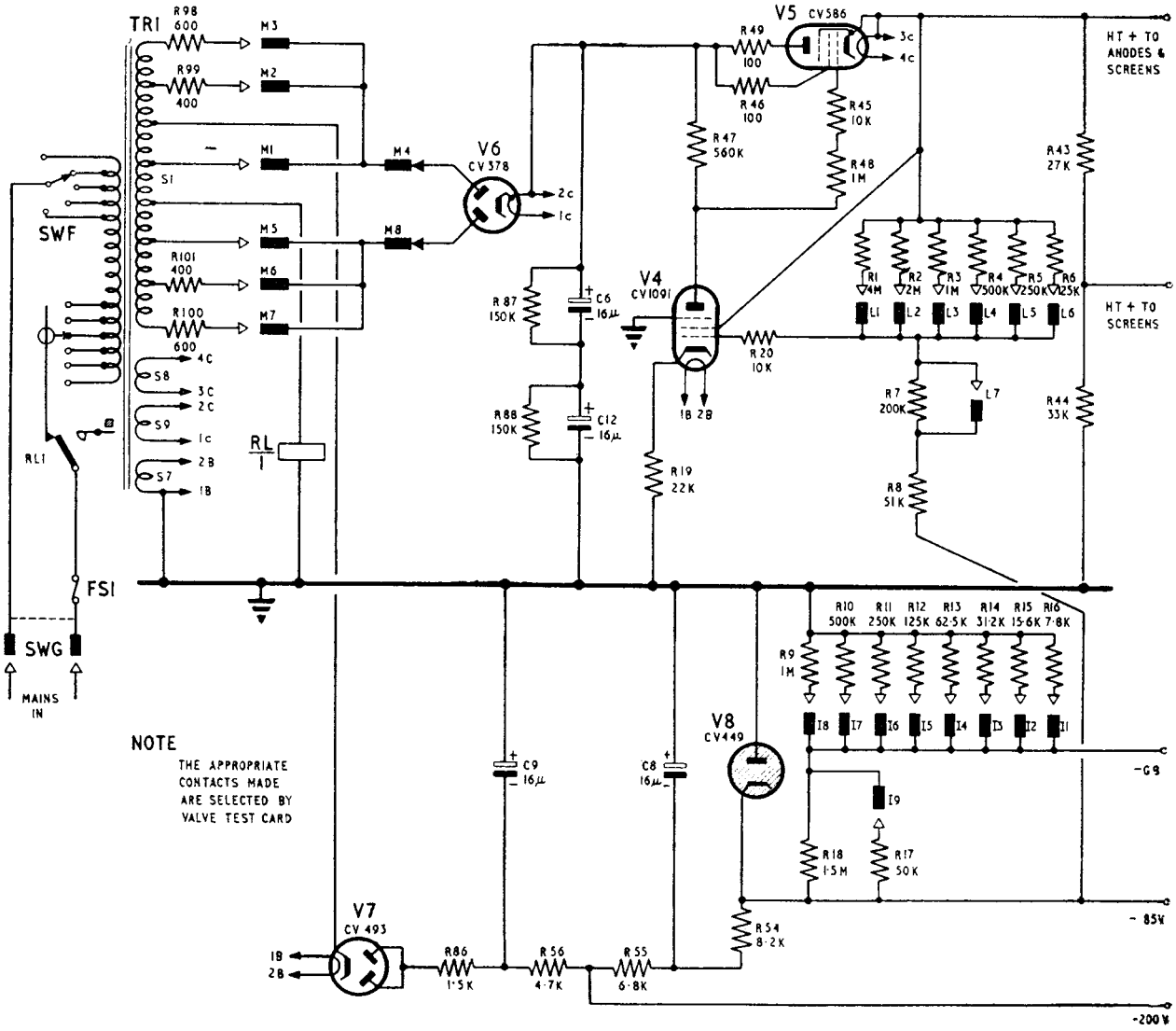


Fig. 3 HT and grid-bias supplies

connected to earth via an overload trip relay RL1. Contacts RL1 are connected in the AC supply to the instrument. The operating current of the relay is approximately 200mA.

12. Resistor R87 and R88 equalise the voltages across the reservoir capacitors C6 and C12. The rectified output is applied via stopper resistor R49 to the anode of the series stabilizer valve V5 which is an output pentode strapped as a triode; R45 and R46 are grid and screen stoppers.

13. The voltage drop in V5 is controlled by V4. The anode load of V4 is connected to the unsmoothed HT supply from the rectifier V6; the cathode load R19 is connected to earth. The reference voltage applied via stopper R20 to the grid of V4 is obtained from the potential divider formed by R8, or R7 and R8 in series, together with one or more of the resistors R1 to R6 inclusive as selected by the gate switch contacts L1 to L6. The positive end of this divider is connected to the cathode of V5 where the stabilized output appears. The negative end is referred to the stabilized potential of negative 85V derived from the reference voltage stabilizer valve V8. The anode of V4 is connected via R48 to the control grid of V5.

14. The potential divided R43 and R44 is used to supply reduced screen voltage, if required, to the valve under test.

15. Negative high-tension voltages and grid-bias supplies are obtained from V7 operated as a half-wave rectifier and supplied from a 200V tap on winding S1. The rectified output is connected to the reservoir capacitor C9 via R86. This resistor limits the current surge when the instrument is switched on. Smoothing is provided by R55, R56 and C8. A negative 200V supply, required for certain tests, is taken from the junction of R55–R56.

16. The stabilizer valve V8 is connected to C8 via the load resistor R54. V8 provides an accurate negative supply for the grid bias of the valve on test.

17. The exact grid-bias voltage required for the particular valve on test is obtained from the junction of the potential divider formed by R18, or R17 and R18 in parallel, together with one or more of the resistors R9 to R16 inclusive as selected by the gate switch contacts I1 to I8.

Heater and filament supplies (*fig. 4*)

18. A 210V supply from the primary winding of transformer TR1 is applied to one of eight primary taps on heater transformer TR2, enabling the voltage of the nine secondary taps to be varied about a nominal value. In this way a complete and accurate range of voltages from 0·28V to 140V is available for selection by the gate switch.

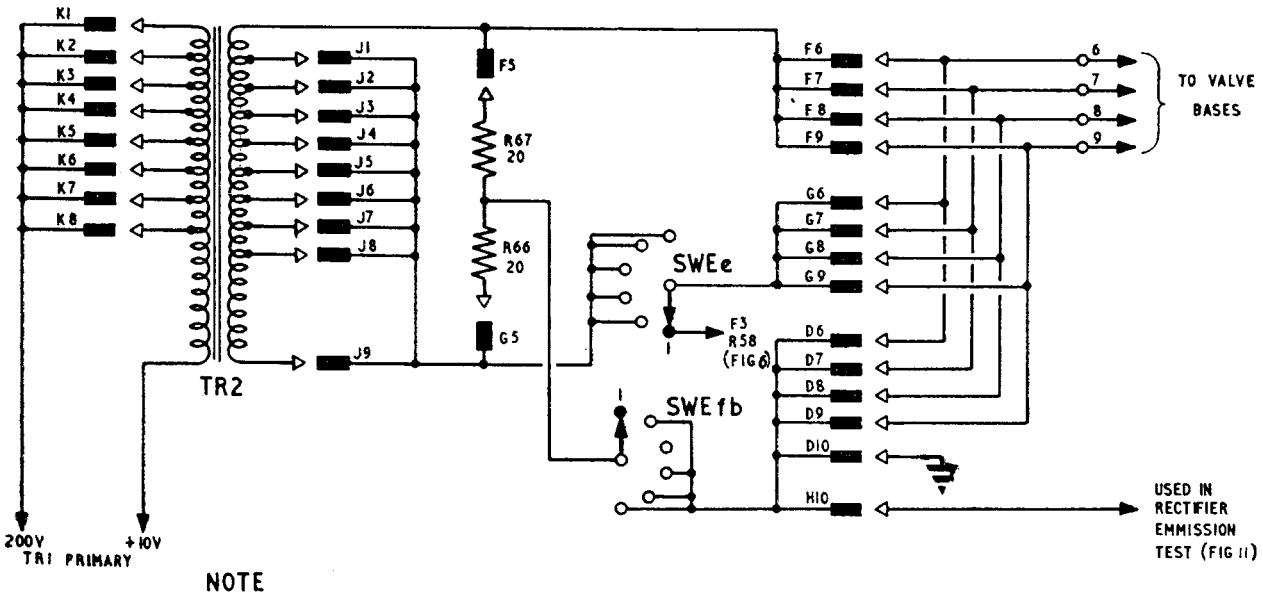


Fig. 4 Heater and filament supplies

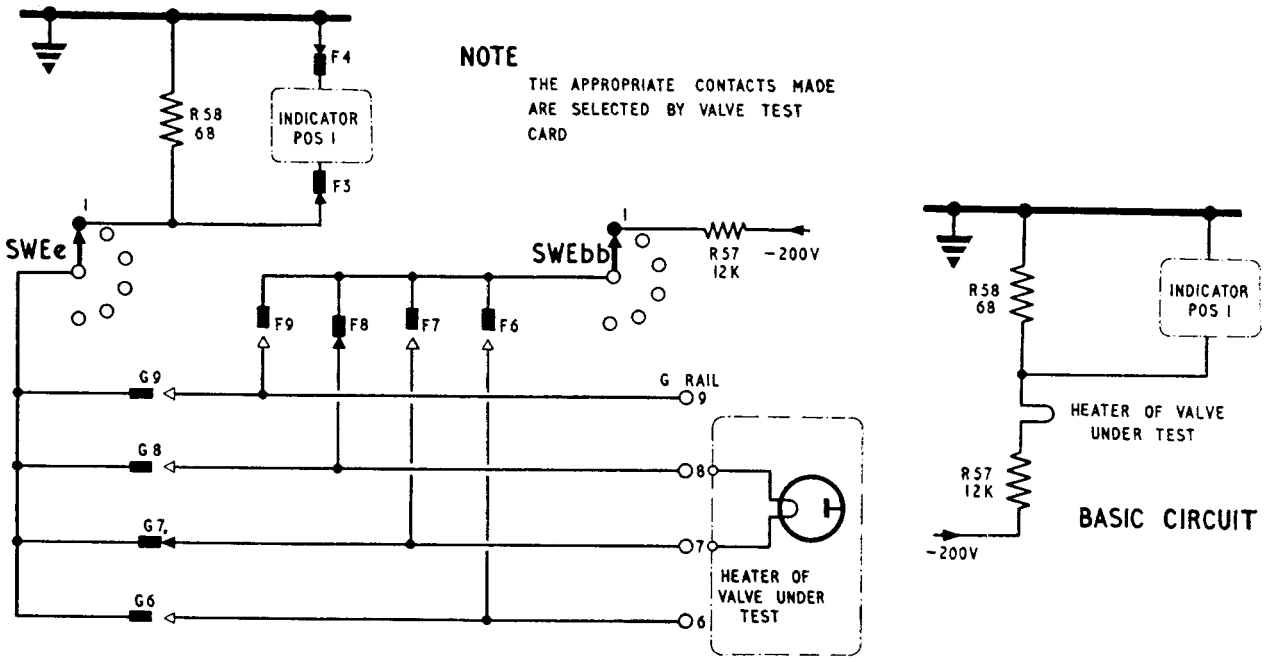


Fig. 5 Heater and filament continuity : circuit

19. Resistors R66 and R67 provide an artificial centre-tap for directly heated valves.

Valve holder panel

20. The connections to the valve holders are shown in the complete circuit of the valve tester (*fig.* 1). The components marked X1-8 are feroxcube beads and are incorporated in the tester to prevent parasitic oscillations in the valve under test.

Valve test circuits

Heater and filament continuity (fig. 5)

21. In position 1 of the TEST SELECTOR switch SW5 the indicator circuit is connected across R58 via gate switch contacts F3 and F4. The negative 200 volt supply is connected via R58, the heater of the valve under test and R57 to earth. If the heater is continous, the voltage developed across R58 will deflect the CRT spot to the green section of the scale. If the heater is open-circuit no voltage will be developed across R58 and the spot will remain in the red section of the scale.

Note . . .

The heater supply is not connected in this test.

Heater-cathode insulation (fig. 6)

22. The appropriate heater supplies are applied to the valve under test via the gate switch contacts. The valve heater is connected either to the negative 85V supply via R80 and the gate switch contact L9, or to the negative 200V supply via R82 and contact L10. The valve cathode is connected to earth.

23. The voltage to be applied to the indicator circuit is developed across R85 in the resistor chain R83, R84 and R85 connected between the valve heaters and earth (cathode). Resistor R84 in conjunction with capacitor C10 forms a filter circuit to prevent hum from the valve heater appearing on the CRT spot. The sensitivity of the circuit can be adjusted to suit the particular valve under test by switching R84 in or out by gate switch contact M10.

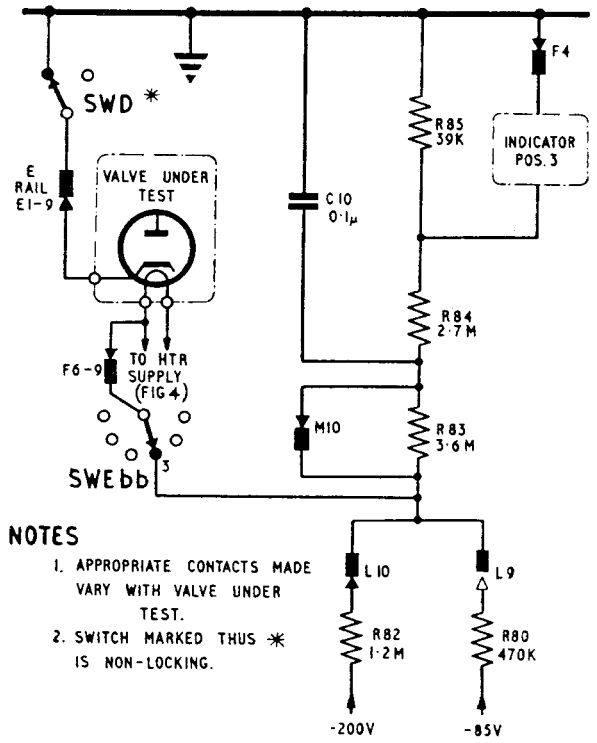


Fig. 6 Heater-cathode insulation : circuit

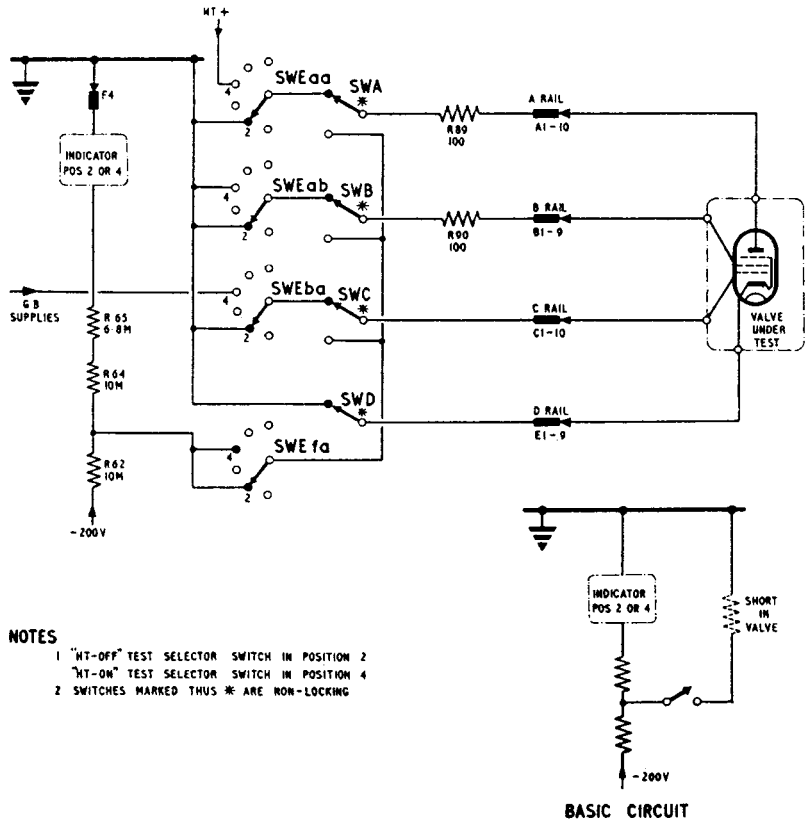


Fig. 7 Electrode insulation : circuit

Electrode insulation (fig. 7)

24. The electrodes to be tested are divided into four groups each of which is selected by a spring-bias switch namely :—

(1) Switch A—ANODE
(2) Switch B—SCREEN
(3) Switch C—CONTROL
(4) Switch D—EARTHY ELECTRODES

25. The electrode insulation can be checked. Under two conditions :—

(1) With HT off (position 2 of switch SWE). The negative test voltage is applied via the spring-bias switches to each of the electrodes in turn with the remaining electrodes connected to earth.

(2) With HT on (position 4 of switch SWE). The negative test voltage is applied via the spring-bias switches to each of the electrodes in turn with the remaining electrodes connected as follows :—

(a) Anode to + HT supply.
(b) Screen and earthy electrodes to earth.
(c) Control grid to the normal grid-bias supply.

26. The indicator is connected across the negative 200V supply via R62, R64 and R65. The selected electrode is shunted across the series network consisting of the indicator, R64 and R65. A short-circuit between the electrode and earth or any other electrode will cause the CRT spot to move into the red section of the scale.

Grid current (gas) test (fig. 8)

27. In position 5 of switch SWE resistor R33 in the indicator circuit is shorted out to deflect the CRT spot to the centre of the green scale.

28. A negative voltage, tapped off a resistor chain consisting of R18 in series with one or more of the resistors R9 to R16 selected by gate switch contacts I1 to I8, is applied via the indicator circuit to the grid of the valve under test. Current flow through the valve, due to the presence of gas, will cause the spot to be deflected downwards.

Emmision and electrode open-circuit

29. To test the emission of all valves listed in Appendix 1 to Chapter 1 other than power rectifiers and RF diodes the circuit shown in fig. 9 is used. Switch SWE is used in position 6. The appropriate HT supply (*fig.* 4) is applied to the anode of the valve under test via stopper resistor R89 (*fig.* 9) and one or more of the resistors R67 to R79 selected by the gate switch contacts G1, G2, H1 to H9. The voltaged drop across the selected resistor(s) is applied to the indicator circuit. The values of the resistors are arranged so that either

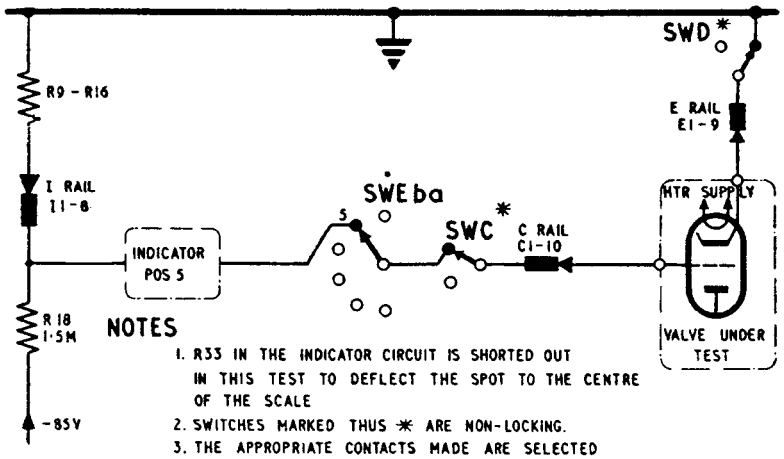


Fig. 8 Grid current (gas) test : circuit

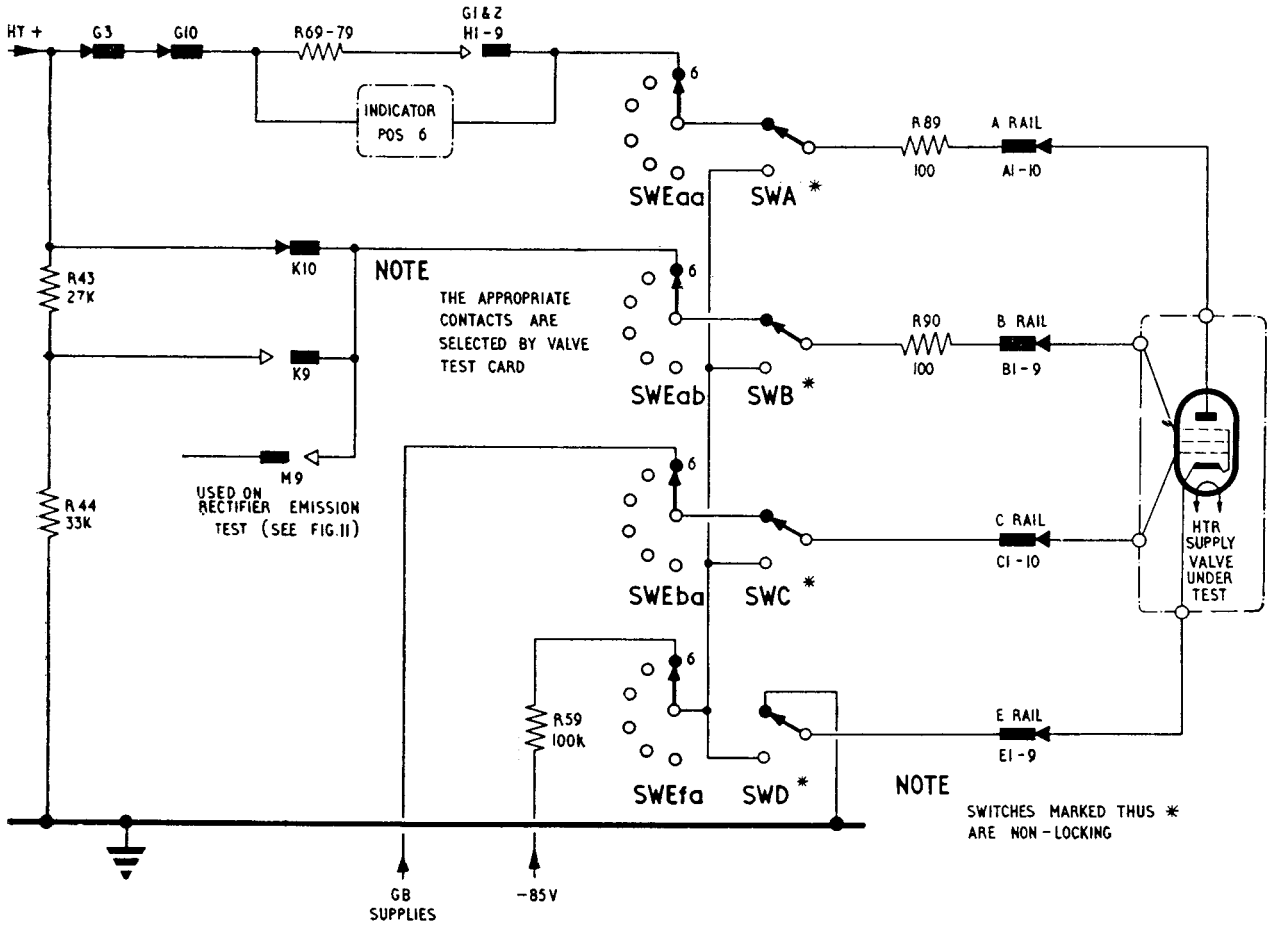


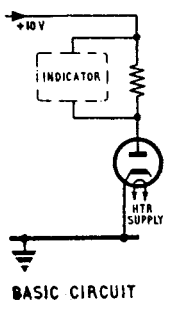
Fig. 9. Emission and electrode O/C : circuit

with one or a combination the correct reject limit can be set to agree with the Service valve specification.

30. The screen supply to the valve under test applied via stopper R90 is obtained either directly from the +HT supply via the gate switch contact K10 or from the junction of R43 and R44 via contact K9.

31. The grid-bias supply is derived from the bias network (*fig.* 4). A stopper resistor is not used in the grid circuit (*fig.* 9). Parasitic oscillations are prevented by the use of feroxcube beads (*para.* 20).

32. Position 6 of switch SWE is also used for the electrode open-circuit test. Negative 85V is applied to each of the electrodes in turn via the electrode switches SWA, SWB, SWC and SWD with the remaining electrodes connected as for the emission test. A downward movement of the CRT spot indicates continuity of the electrode. If the electrode switches are operated for more than 2 seconds the valve under test may be damaged due to the electrodes taking excessive current.



RF diode emission

33. The circuit for testing the emission of RF diodes is shown in fig. 10. The voltage derived from the potentiometer chain R60 to R61 connected across the HT supply is applied via one or more of the resistors R67 to R79 (selected by the gate switch) and R89 to the anode of the diode under test. The cathode of the diode is taken via the appropriate gate switch contacts to earth.

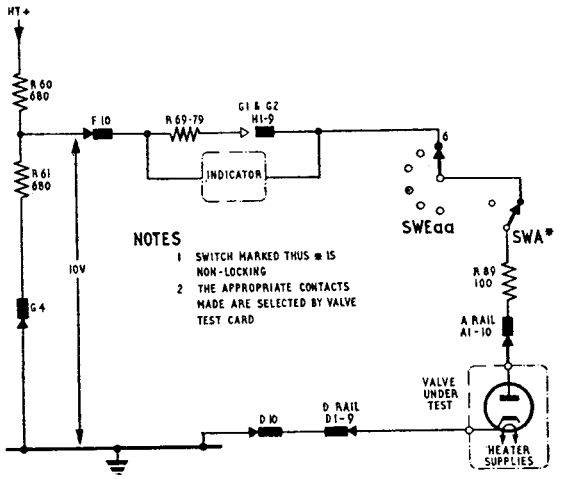


Fig. 10. Diode emission : circuit

34. The voltage developed across the selected resistor(s) R67 to R79 is applied to the indicator circuit and the condition of the diode is indicated by the position of the spot on the CRT.

Power rectifier emission (fig. 11)

35. To avoid the possibility of a rectifier being accepted as " good " because the average rectified current is within the approved limits, all rectifiers are tested as half-wave, the current rectified by each diode being observed. This is achieved by having a separate test card to set up the correct gate switch combination for each diode.

36. The selected voltage is applied from the secondary winding S1 of transformer TR1 to the anode of the rectifier under test, the second anode in the case of full wave rectifier is connected to the cathode. The rectified output is applied to the anode of the V5.

37. In this circuit V5 (used as a series stabilizer in the HT supply circuit *fig.* 4) is used as a load resistor controlled by V4 (*fig.* 11). The cathode of V5 is connected to earth via a resistor chain consisting of R60, R61 or R68 (selected by the gate switch contacts G10, F10 and E10) one or more of the resistors R67 to R79, and R89.

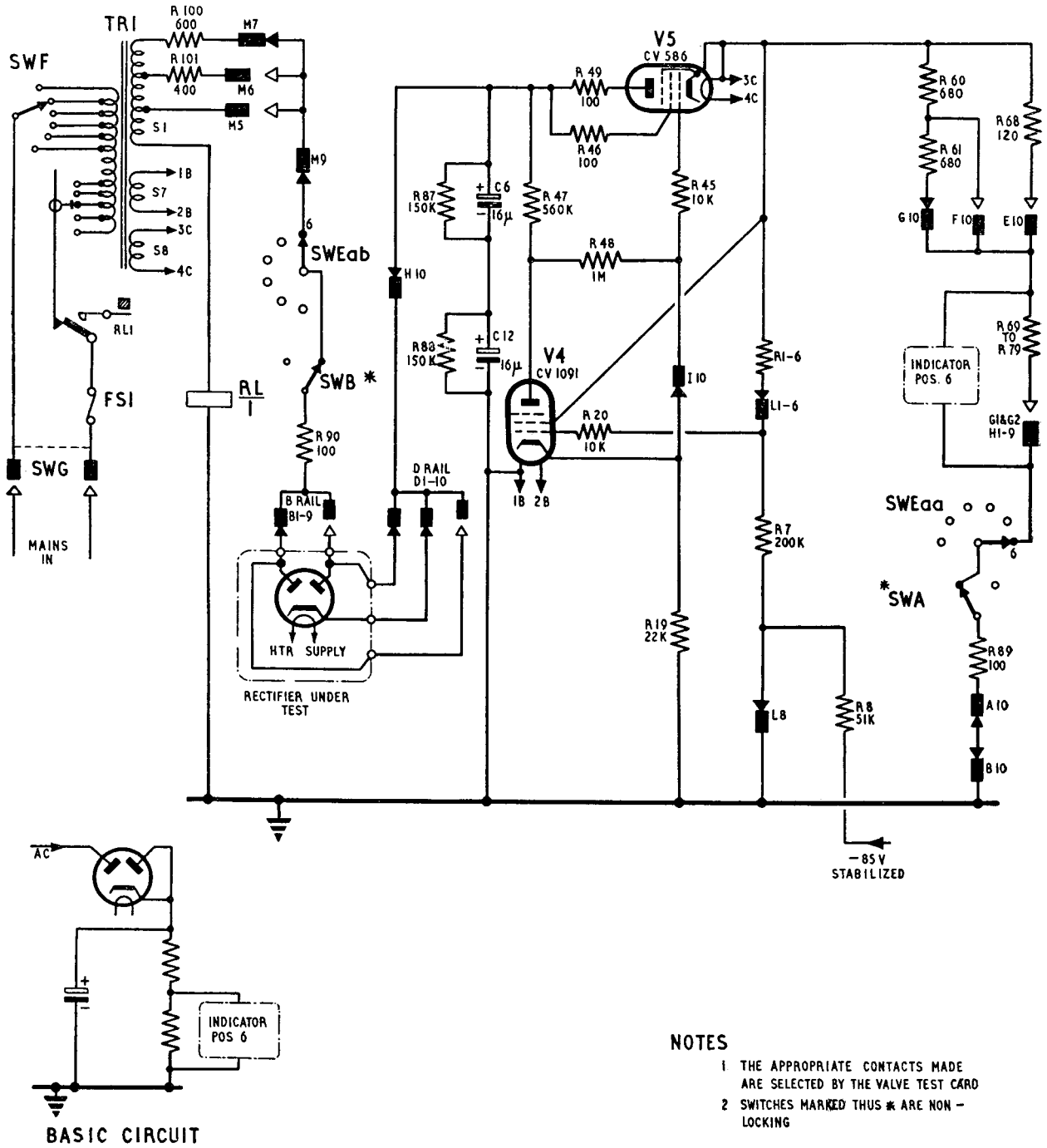


Fig. 11. Power rectifier emission : circuit

38. The control grid of V4 is set to the required potential (to suit the particular rectifier valve under test) by means of the potential divider, consisting of one or more of the resistors R1 to R6 in series with R7, connected between the cathode of V5 and earth. The proportion of this voltage appearing at the cathode of V4, is applied to the grid of V5.

39. The voltage developed across the selected resistor(s) R67 to R69 is applied to the indicator circuit.

Special test card circuits

Mains balance

40. A bridge network (*fig.* 12) is used to ensure that the instrument is adjusted to the mains input voltage. With the MAINS test card inserted in the gate and the gate switch closed, the AC mains is connected to the primary winding of transformer TR1 via the selector panel and the MAINS ADJUST switch SWF.

41. The 200V output from the secondary winding S1 is rectified by V7 and applied across the bridge circuit. One side of the indicator is held at negative 85V by the voltage reference stabilizer V8. The other side is connected via the filter circuit R51–C7 to the junction of RV6 and R53.

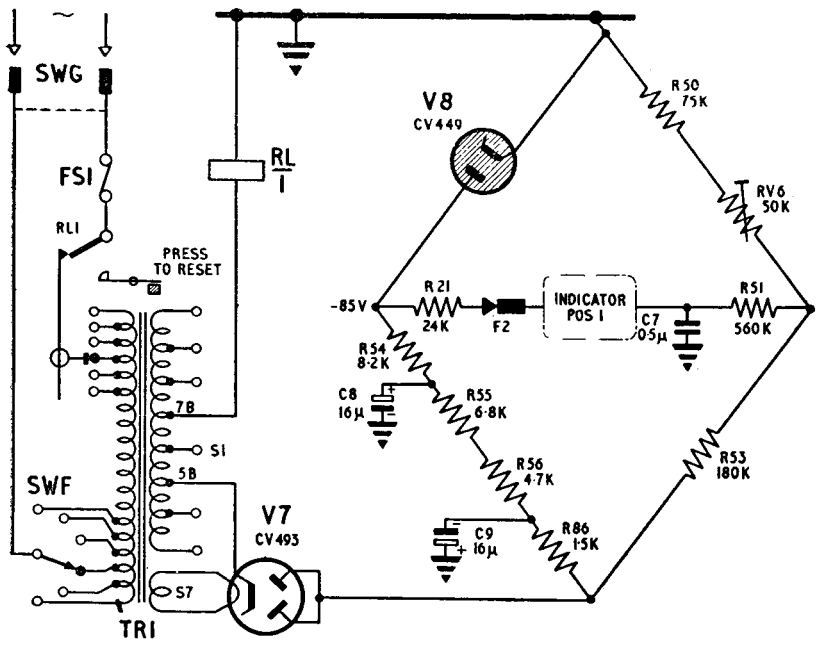


Fig. 12. Mains balance : circuit

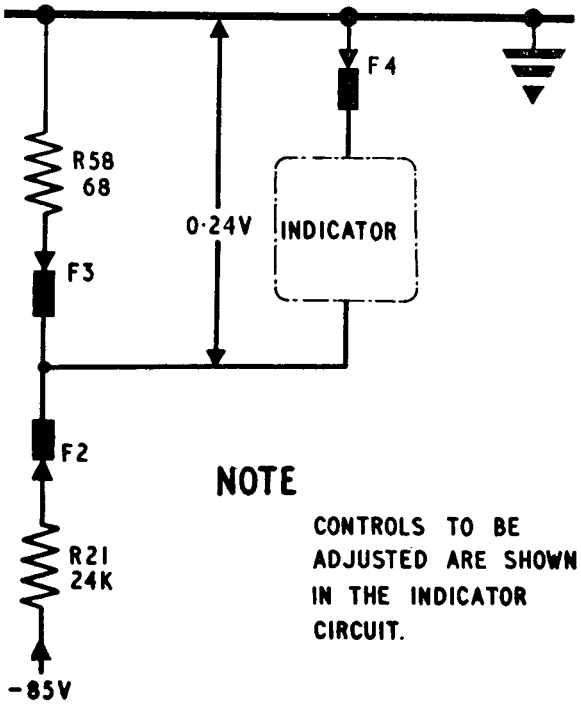


Fig. 13. Reject limit adjust : circuit

42. Adjustment of the mains input tapping will alter the voltage across the bridge and consequently will alter the voltage at the junction of RV6 and R53. When the CRT spot is positioned on the dotted line across the tube face, the instrument is adjusted correctly.

43. Initially the bridge circuit is calibrated by the manufacturers or by Units authorized to repair test equipment and who possess a sub-standard voltmeter.

44. The mains voltage, monitored by a sub-standard voltmeter, is applied to the appropriate taps on transformer TR1. Variable resistor RV6 is adjusted until the CRT spot is on the dotted line across the tube face.

Note . . .

This adjustment must not be carried out by unauthorized personnel.

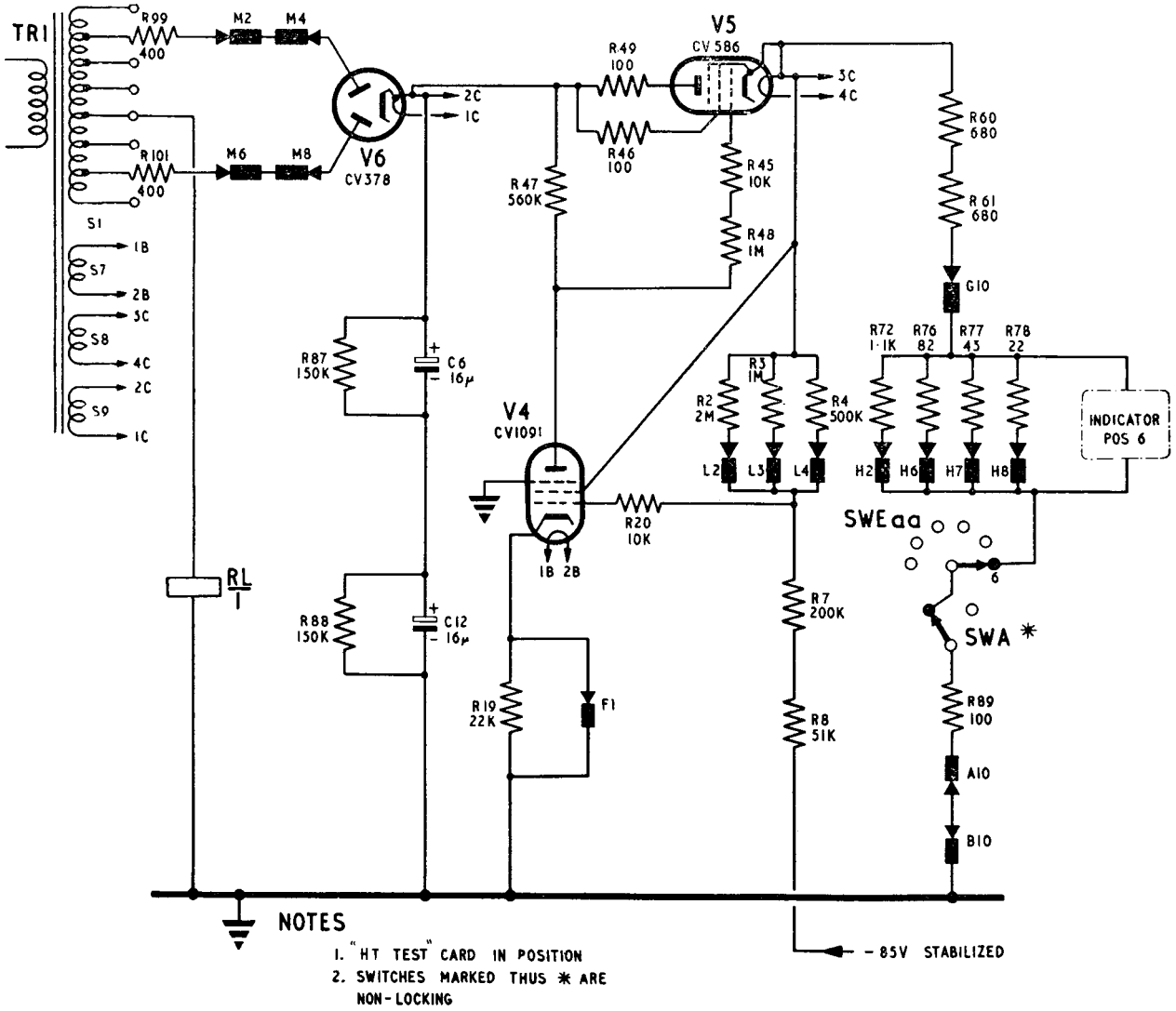


Fig. 14. HT check : circuit

Reject limit adjust (fig. 13)

45. In order to adjust the sensitivity of the indicator circuit (*fig.* 2) by the procedure described in Chapter 1 para. 18, an accurate test voltage is required. This is derived from a potential chain consisting of high stability resistors R21 and R58 (*fig.* 13) connected across the negative 85V stabilized supply. Contacts F2, F3 and F4 are set up by inserting the REJECT test card.

HT check

46. When the HT test card is inserted in the gate switch, the circuit shown in fig. 14 is set up. This test is used to ensure that the valves V4, V5 and V6 are functioning correctly.

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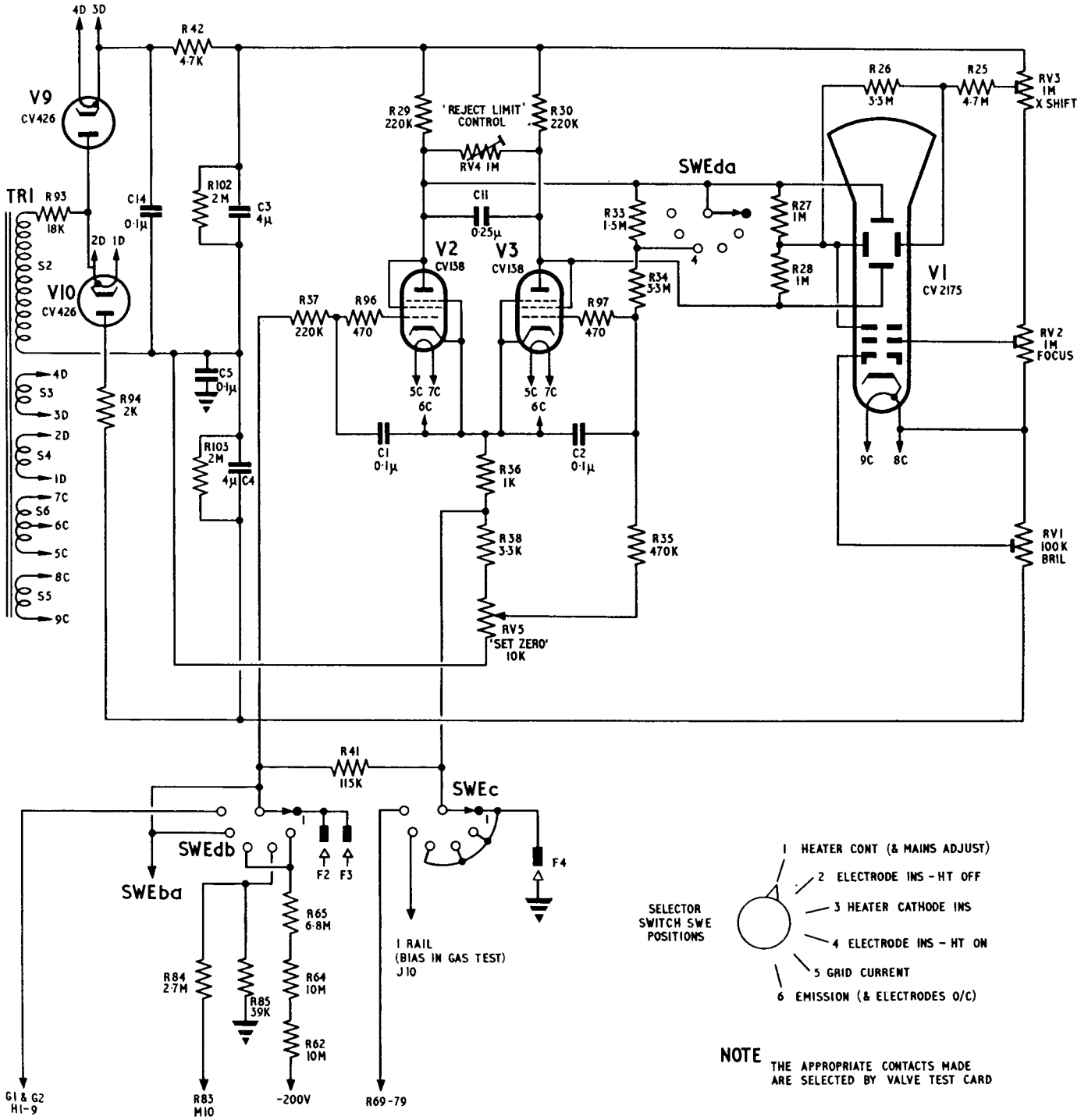

Fig.2 Indicator circuit

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RESTRICTED

Chapter 3

CONSTRUCTIONAL DETAILS

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

VALVE TEST UNIT CTA.20

General

1. The components comprising this unit are mounted in a metal case of robust construction. The approximate overall dimensions are height 12½ in., width 17 in., depth 18 in., and the approximate weight is 50 lb. A general view of the unit is shown in fig. 1 of Chap. 1.

Front panel

2. All the normal operating controls are fitted on the sloping portion of the front panel (*fig.* 1). The centre is occupied by the CRT face and the scale and beneath it is the pilot lamp. A perspex protection cover is fitted on the panel in front of the CRT.

3. To the right of the scale are the TEST SELECTOR switch SWE and the MAINS ADJUST switch SWF. To the left of the scale are the four spring-loaded ELECTRODE switches SWA, SWB, SWC and SWD. On the left of these switches is a small push-button which mechanically resets the OVERLOAD CUTOUT.

4. Two handles are provided to protect the controls when the unit is upturned for servicing.

5. The control annotations, the indicator scale and the stores nomenclature are marked on an anodized aluminium plate fitted to the panel.

6. The cathode-ray tube assembly is secured to the rear of the front panel with three retaining plates. The assembly comprises the CRT, a rubber mask and a conical metal screen to which is fixed the CRT holder. The fixed resistors associated with the tube HT supplies are mounted on the back of the holder.

7. The lower portion of the front panel carries a removable plate behind which are situated the preset controls (*fig.* 2). Control RV6 is mounted on a small bracket secured to the rear of the preset control panel and access to the slotted shaft is through a hole normally obscured by a small removable plate. This is an added precaution to prevent this control being inadvertently adjusted.

8. To the right of the preset controls is the mains voltage selector panel. A perspex window fitted in the front removable plate enables the voltage selector panel to be seen when the plate is in position. A spare fuse is secured in a clip fixed to the rear of the plate.

9. Mounted on the left of the lower half of the front panel are the mains fuse holder FS1 and the mains input plug.

Valveholder panel

10. All the test valveholders are mounted on the top panel (*fig.* 3) which is secured to each side

chassis member with two screws. These screws are accessible only when the two side covers are removed.

11. The wiring to the valveholders is arranged so that with the two front screws removed and the rear two slackened off, the panel is free to hinge upwards giving access to the underside of the panel.

the rear of the valveholder panel. The base of the adaptor is designed to fit in the IO valveholder. Eight silver-plated beryllium copper contacts complete the circuit to wire-ended type valves.

Covers

16. For ease of servicing the internal components, four removable covers are provided, two side, one

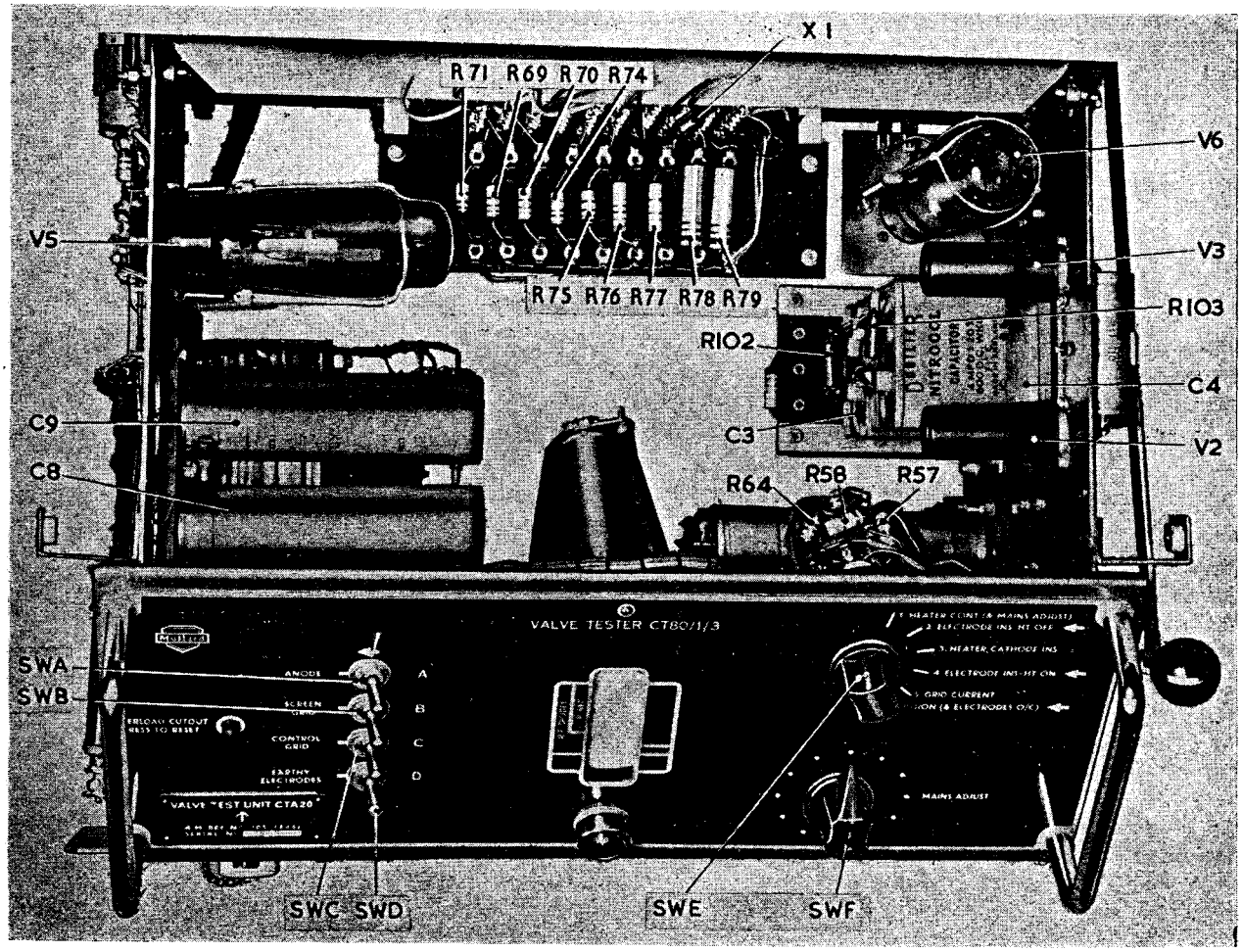

Fig. 1. Valve test unit CTA.20—top

12. The feroxcube beads X2 to X8 are secured in the correct position in the wiring by rubber sleeves.

13. The connections to the acorn valveholders are on the top of the panel and, as it is possible to have high voltages on these connections when valves other than acorn types are being tested, protection covers are fitted. These covers have spring-loaded hinges which are designed to lock in both the closed and open positions.

14. Two sockets T.C.1 and T.C.2 are provided for the flying leads for the top cap connections. These leads are fitted with spring-loaded caps (caps valve Type 127 Stores Ref. 10AD/278) designed to accommodate B3G, MO and IO type valves.

15. The adaptor Type 157 is accommodated, when not in use, in a spring-loaded clip fitted to

rear and one bottom. The bottom cover, with louvres to allow adequate ventilation, is secured to the front panel with two screws and to the rear cover with three screws.

17. Each side cover is held in position by two screws at the top, and two pins at the bottom which engage in slots in the side members of the chassis. Carrying handles fitted to the sidecovers also protect the valveholder panel. On the right-hand side cover a slot is provided, with an escutcheon plate, through which the gate switch lever (*fig.* 5) is inserted when the cover is in position.

18. The rear cover is secured to the chassis with four screws. A right-angled extension at the top of the cover carries two dowel pins which locate in holes in the valveholder panel. A slot in this extension allows the test card to be inserted in the gate switch. A flange on the lower edge

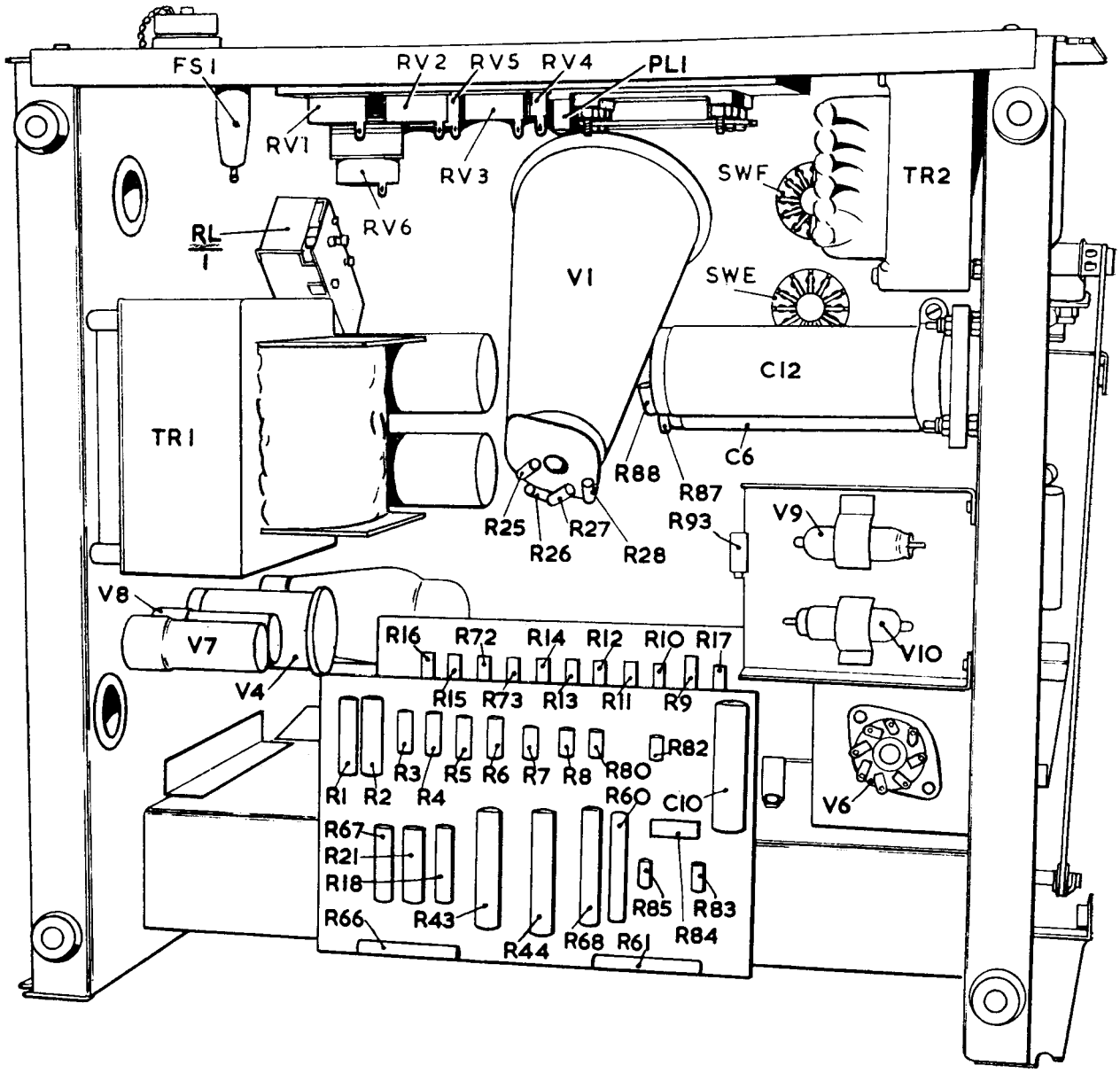

Fig. 2. Valve test unit CTA.20—underside

of the cover carries three hank-bushes for the screws which secure the bottom cover in position.

Main chassis

19. Views of the main chassis are shown in fig. 1, 2, 4 and 5. On the left-hand side (*fig.* 4) are mounted the mains transformer TR1, all the components associated with the positive and negative HT supplies, regulator valve V4, series stabilizer valve V5, negative supply rectifier V7 and the voltage reference stabilizer V8.

20. On the right-hand side of the chassis (*fig.* 5) are the gate switch actuating mechanism (*para.* 26 to 28), the heater transformer TR2, and the paraphase amplifier valves V2 and V3 together with their associated components. On the inside of this panel two small shelves are fitted; one holds the two wire-ended rectifier valves V9 and V10 and on the other is mounted the HT rectifier V6. This valve is fitted on this side of the chassis for convenience of assembly; all its associated components are located on the left-hand side of the chassis.

21. The fixed contacts of the gate switch (*para.* 24 *and* 25) are mounted on a panel at the rear of the unit. Situated on the back of this panel are three paxolin tagboards on which are mounted all the components associated with the gate switch contacts.

22. The top panel holds resistors R69 to R71 and R74 to R79 inclusive which are used in the anode circuit of the valve to be tested. Mounted on the centre tagboard are the grid-bias resistors

R9 to R16 and two anode resistors R72 and R73 which could not be accommodated on the top tagboard. The lower tagboard holds resistors R1 to R8 which supply voltage to the control grid of the regulator valve V4; R43 and R48 the screen potentiometer supply; R60, R61 and R68 used in the power rectifier and diode emission tests; R66 and R67 the artificial centre-tap for directly heated valves; R80, R82, R84 and R85 and capacitator C10 used in the heater continuity and heater-cathode insulation tests.

25. When the appropriate test card is inserted in the gate, only the contacts selected by the perforations in the card are made when the gate switch is closed.

Gate actuating mechanism

26. The mechanism, with the gate switch in the open position, is shown in fig. 5. The gate switch lever is screwed into a steel block which is coupled to the gate pin by the link bar. The link bar is mounted eccentrically in relation to the block pivot

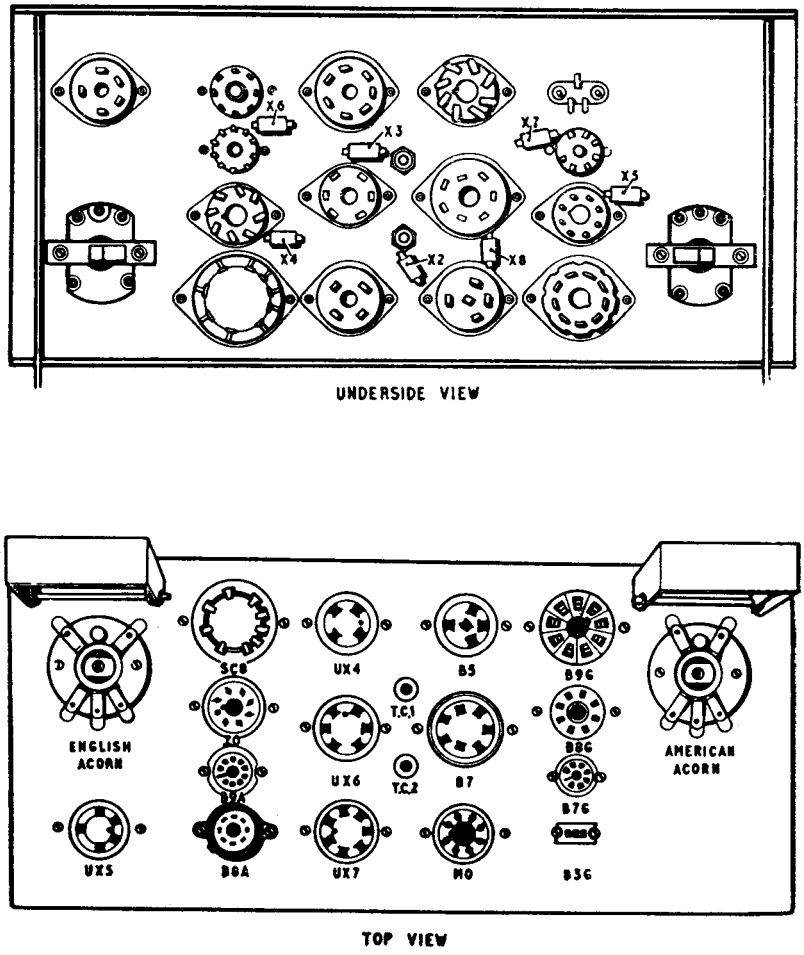

Fig. 3. Valveholder panel

23. Retaining springs or spring-loaded screening cans are fitted to secure the valves in the unit.

Gate switch

Contacts

24. The gate switch consists of 130 pairs of contacts each pair comprising a fixed and a movable contact, arranged in thirteen rows of ten pairs. The 130 movable contacts are individually spring-loaded and are mounted on a plate (*fig.* 6) which is hinged so that it may be moved bodily in relation to the fixed contacts.

so that when the lever is depressed the moving half of the gate is pulled forward.

27. With the gate in the open position the " C " spring, located between the gate pin and the guide plates, holds the moving half of the gate in its position of rest. The movement is limited by the action of the rubber buffer on the steel block.

28. When the gate switch lever is depressed and it passes out of line with the link bar in the downward direction (i.e. past the top dead centre) the gate is closed and locked against the stop pin by the tension of the " C " spring.

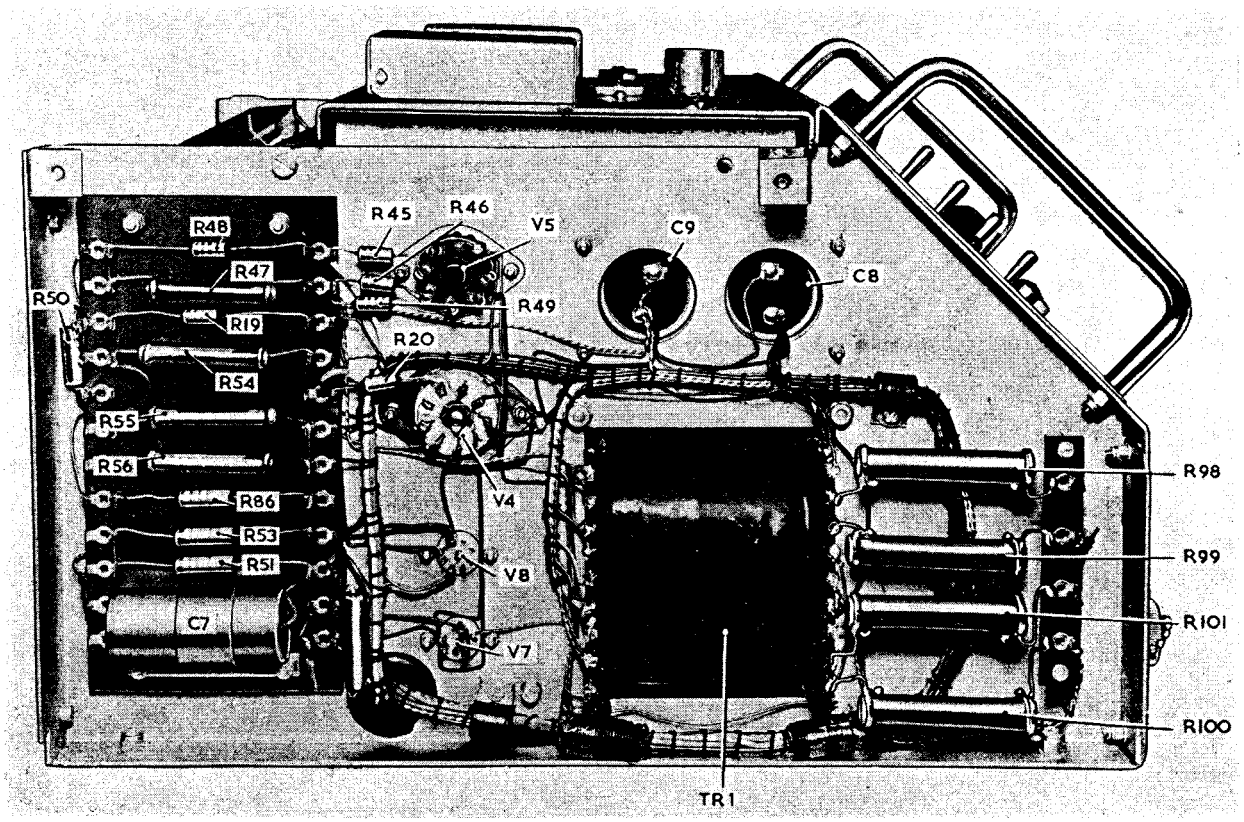

Fig. 4. Valve test unit CTA.20—left-hand side

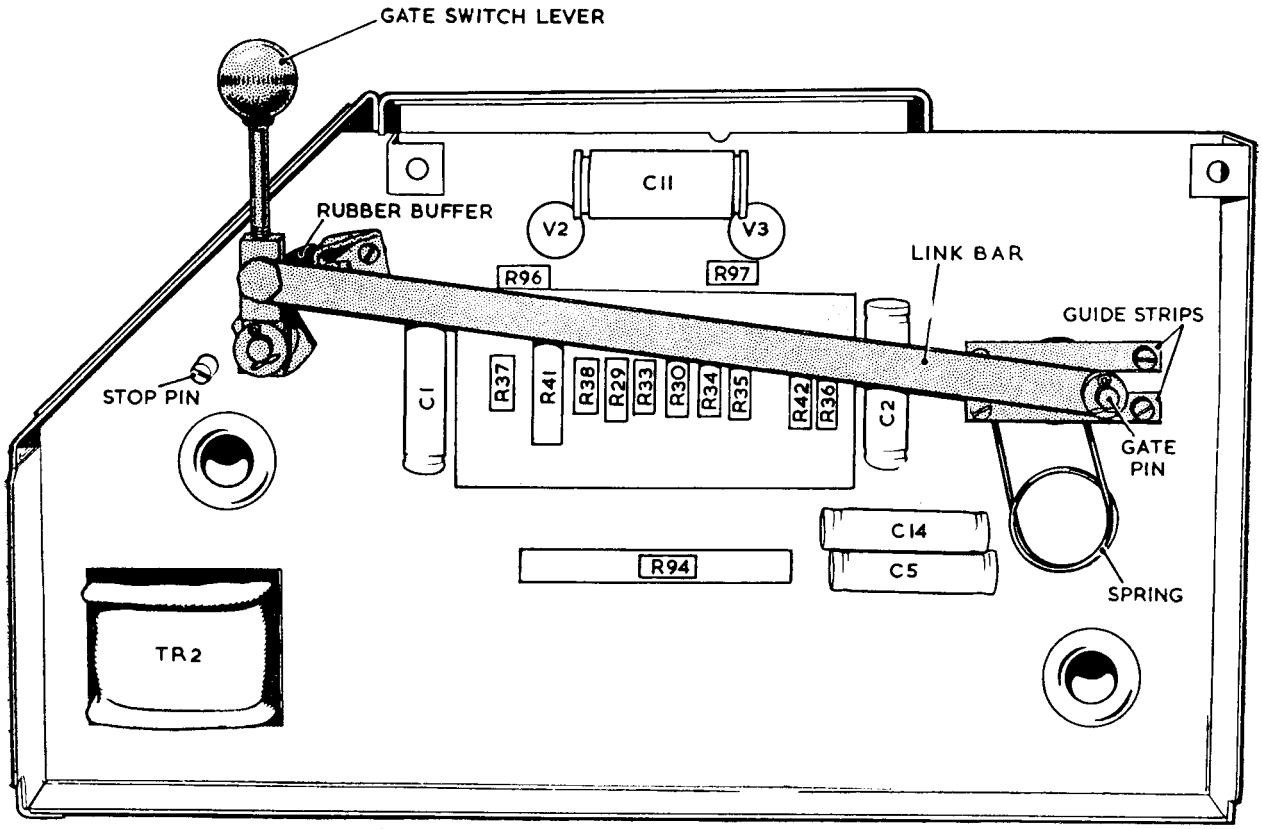

Fig. 5. Valve test unit CTA.20—right-hand side

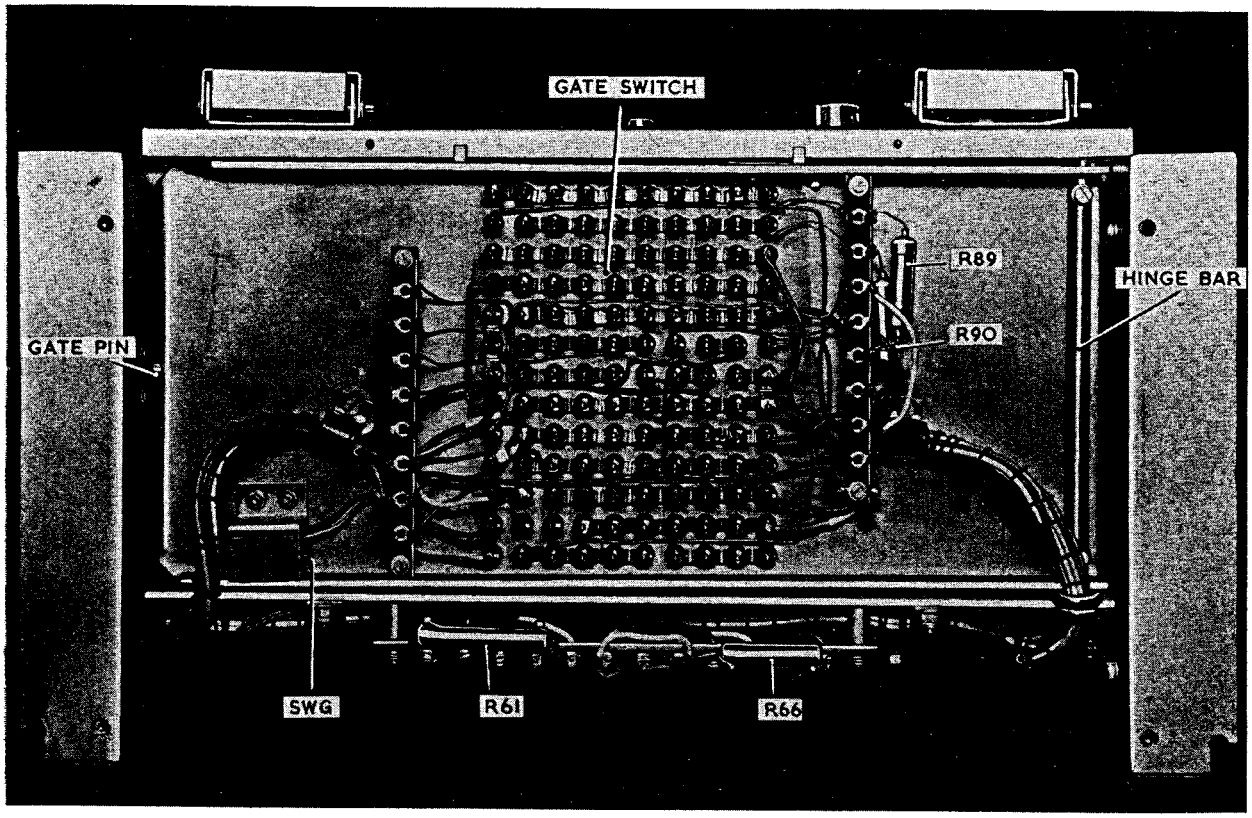

Fig. 6. Valve test unit CTA.20—rear

Gate switch suspension

29. The moving half of the gate switch is hinged to the fixed half at the left-hand side (*fig.* 6) and is positioned on the right-hand side by the guide plates (*fig.* 5) and the " C " spring.

Safety switch

30. A double-pole switch SW11 (*fig.* 7) consisting of two sets of contacts on each half of the gate forms the mains on/off switch. A pivoted insulating shutter is interposed between the sets of contacts so that, should the gate switch lever be depressed without a card in position, power will not be applied to the circuit. Only the correct insertion of the card will move the shutter clear and allow the contacts to make when the gate is closed.

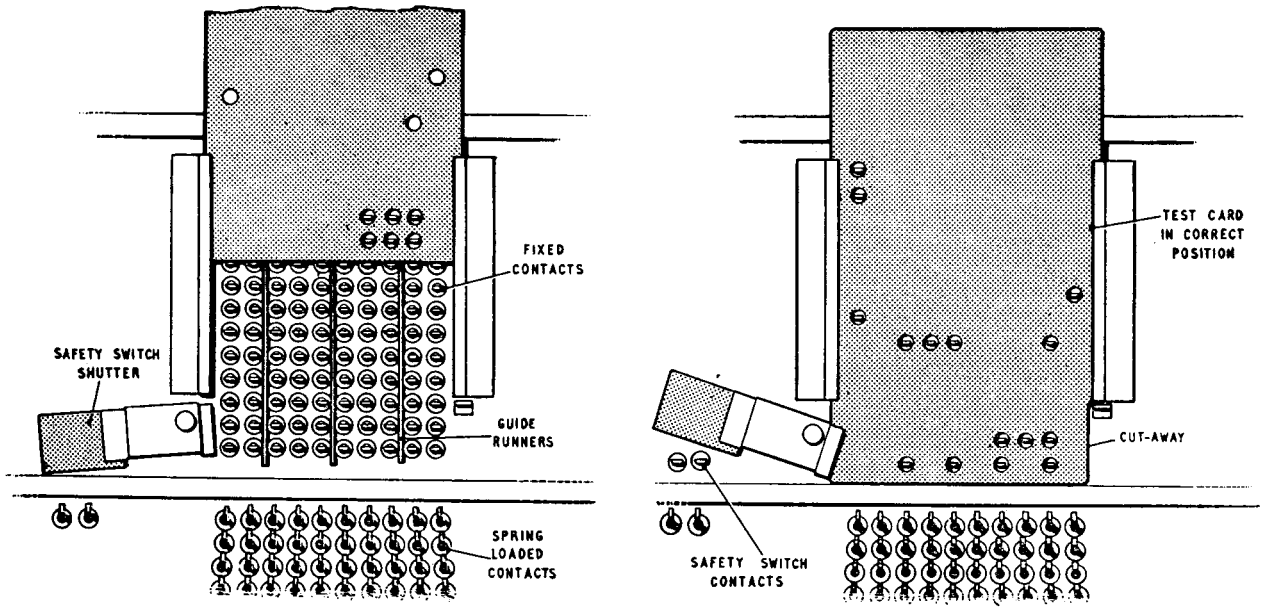

Fig. 7. Gate switch dismantled showing contacts and safety device

CASES OF TEST CARDS CTA.21 AND CTA.22

31. This nomenclature is given to the cases when they are issued complete with the appropriate number of test cards. Stores Ref. Nos. have not been allocated since the number of test cards will vary as cards for new valves become available and cards for obsolete valves are destroyed. The empty case is classified as case for cards contact selector Stores Ref. 10AP/190. A separate Stores Ref. No. is allocated to each test card.

Case for cards contact selector

32. The case is made of 18 s.w.g. aluminium sheet. The approximate overall dimensions are height $9\frac{1}{4}$ in., width $5\frac{1}{2}$ in., depth $17\frac{1}{2}$ in., and the approximate weights are empty—3 lb., when completely filled with test cards—31 lb.

33. Partitions are fitted to segregate the cards into batches and to prevent them falling to the bottom of the case. The lid is made in two parts to provide easy access to the cards.

Cards contact selector

34. The test cards are made of sheet paxolin, thickness $\frac{1}{64}$ in., width 5 in. and length $8\frac{1}{4}$ in. This material is used because of its electrical properties; its mechanical strength is poor and deteriorates with age, consequently the cards must be handled carefully to prevent damage.

35. The relevant testing information is stamped on the top of each card. A cut-away (*fig.* 7) in the lower left-hand corner allows the card, when correctly inserted, to drop to the bottom of the gate switch.

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PART 2

TECHNICAL INFORMATION (SERVICING)

LIST OF CHAPTERS

The above list indicates the ultimate contents of the Part. The present contents are listed on the page which follows the Contents Marker Card.

Chapter I

MINOR SERVICING

LIST OF CONTENTS

General

1. Complete servicing information for this instrument as laid down by the manufacturers is only available at R.A.F. Calibration Centres, to which the instrument should be returned for all repairs affecting its calibration. Accordingly, only sufficient information is provided in this chapter to open up the instrument for examination, to dismantle the gate switch and to clean the gate switch contacts.

2. The internal components are readily accessible by removing the four metal covers and hinging the top panel upwards. For components location reference should be made to the illustrations in Chapter 3, Part 1. The spare fuse is located in a clip fitted to the back of the preset control cover plate.

Covers

3. Before removing the covers, make sure that the instrument is disconnected from the mains. Care must be exercised when removing the covers to avoid damage to the components.

4. The bottom cover, which will provide access to all valves and the pilot lamp, may be removed by taking out the five countersunk screws.

5. After the bottom cover has been removed, the rear cover may be removed by taking the four retaining screws and gently withdrawing the cover until the two dowel pins are disengaged from the top panel.

6. Each side cover is secured by two screws at the top and two pins at the bottom which engage in slots on the main chassis. Before attempting to remove the right-hand cover unscrew and remove the gate switch lever. After removing the two retaining screws, ease the cover outwards and, with a downward movement, disengage the two pins.

Top panel

7. Having removed all the covers, the top panel may be removed by taking out the four retaining screws. However, for most purposes it will be sufficient to hinge the panel upwards by removing the two front screws and slackening the rear two. This will allow easy access to the interior of the instrument.

Cathode-ray tube assembly

8. To remove the cathode-ray tube assembly, take off the bottom cover and slacken off the three retaining plates. Rotate the assembly until the slots in the metal screen are opposite the retaining plates. The assembly may now be removed.

9. Having removed the assembly the cathode-ray tube may be withdrawn by pressing on the tube spigot.

Note . . .

Before removing the assembly it is advisable to note its approximate orientation relative to the retaining plates and so simplify the procedure of replacing the assembly in its correct position.

Gate switch

Dismantling and re-assembly

10. When handling the gate great care must be taken not to damage the contacts or the copper foil connecting straps. Before attempting to dismantle the gate switch reference should be made to fig. 6 and 7 of Chapter 3, Part 1.

11. To dismantle the gate switch remove the split pin holding the link bar to the gate pin. Remove the hinge bar by unscrewing the two $1\frac{1}{2}$-in. 4BA bolts which pass through the two pillars fixed to the rear member of the main chassis. Two springs fitted over the pillars are interposed between the two halves of the gate switch and care should be taken when unscrewing the bolts that the moving half of the switch does not spring outwards and damage the contacts. The moving half of the gate is now free and can be removed by disengaging the gate pin from the guide plates and the " C " spring.

Note . . .

Difficulty may be experienced in removing the gate due to tightness of the cable-forms restricting its movement. In this event, loosening the cable-form clips on the underside of the chassis should allow sufficient movement to enable the gate to be disengaged.

12. To assemble the gate, insert the gate pin between the guide plates and through the small loop in the " C " spring. Bring the moving half of the gate into position, making sure that the two springs are fitted on the pillars, and replace the hinge bar. In order to align the moving half of the gate, two $\frac{1}{8}$ in. holes have been drilled in both the fixed and moving halves of the gate. When the moving half of the gate is correctly positioned, both sets of holes should be in line. This can be checked by inserting the shanks of $\frac{1}{8}$ in. drills in each set of holes. Should it be necessary, the gate can be realigned by adjusting the position of the guide plates. Particular care must be taken to ensure that the moving half of the gate does not become trapped between the pillars and the hinge bar. The link bar can now be replaced and secured by the split pin.

Cleaning the contacts

13. If it is necessary to clean the contacts they should be cleaned with a soft brush or cloth. On no account must they be cleaned with carbon tetrachloride (or similar cleaning agent) as this will remove the protective grease on the contact springs. Care should be taken not to displace the contacts as this will result in incorrect mating which could adversely affect the performance of the instrument.

PART 3

FAULT DIAGNOSIS

LIST OF CHAPTERS

The above list indicates the ultimate contents of the Part. The present contents are listed on the page which follows the Contents Marker Card.

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Chapter 1

GENERAL FAULT-FINDING INFORMATION

LIST OF CONTENTS

LIST OF TABLES

Introduction

1. The information in this chapter is intended as a guide to assist in diagnosing faults from readily observed indications. It is emphasized that the repairs should only be undertaken by suitably qualified personnel.

2. The instrument must be returned to an R.A.F. Calibration Centre through the normal channels for repairs which affect its calibration.

Fault diagnosis using test cards

3. A summary of possible faults which may be diagnosed from the cathode-ray tube indications using the three test cards MAINS, REJECT and HT is shown in Table 1. Additional indications using known good valves with their appropriate test cards are also shown.

TABLE 1

Fault Diagnosis

All circuit references refer to fig. 1 of Part 1, Chapter 2. Faults which affect the calibration accuracy of the instrument are printed in italics.

Card in use	Indication	Possible fault
MAINS	No indicator spot— Pilot lamp not lighting	1. Mains off. 2. Mains fuse (FS1) blown or bad contact in holder. 3. Card incorrectly inserted in gate. 4. Gate switch not closed. 5. Defective MAINS ADJUST switch.
	Indicator spot— Pilot lamp lighting	1. Mains tap in incorrect position. 2. X-SHIFT control (RV3) out of adjustment. 3. BRILLIANCE control (RV1) out of adjustment. 4. V9 (CV426) and/or V10 (CV426) defective. 5. V7 (CV493) defective or making bad contact in holder. 6. Cathode-ray tube (CV2175) defective or making bad contact in holder. 7. C3, C4, C8 and/or C9 short-circuited. 8. C1 and/or C2 low insulation (less than 20 megohm.). 9. *V8 (CV449) defective.* 10. *R41 open circuit.*
	Spot remains in red section	1. OVERLOAD CUTOUT in out position. 2. V2 (CV138) and/or V3 (CV138) defective.
	No spot movement when altering MAINS ADJUST control	1. Gate switch contact F2 not making or very high resistance contact.

Table 1—continued

Card in use	Indication	Possible fault
	Spot rises after a time necessitating alteration of MAINS ADJUST switch and/or mains selector panel.	1. C8 and/or C9 defective. 2. *V8 (CV449) defective.*
	Spot very high with a known mains input voltage applied to the appropriate tap	1. C5 low insulation. 2. C1 and/or C2 defective.
	Spot very low with a known mains input voltage applied to the appropriate tap	1. C3 and/or C4 low insulation.
	Distorted or elongated spot	1. C5 open-circuit.
REJECT	Spot out of prescribed limits	1. SET ZERO (RV5) and REJECT LIMIT (RV4) controls out of adjustment. (See Part 1, Chap. 1, Para. 18.) 2. V2 (CV138) and/or V3 (CV138) defective.
	Inability to set up REJECT limits	1. C1 and/or C2 defective. 2. *R41 defective.* 3. *R21 or R58 defective.*
	Spot remains stationary when switching from pos. 1 to pos. 6 of the TEST SELECTOR switch	1. Gate switch contact F2 not making 2. *Resistor R21 open circuit.* 3. Short on the −85 volt line.
	Spot moves up when switching from pos. 1 to pos. 6 of the TEST SELECTOR switch	1. Gate switch contact F4 not making.
H.T.	Spot out of prescribed limits (i.e. within ±3 mm. of dotted line A)	1. OVERLOAD CUTOUT in out position. 2. V2 (CV138), V3 (CV138), V4 (CV1091), V5 (CV586) or V6 (CV378) defective. 3. Gate switch contact F1 not making. 4. Defective TEST SELECTOR switch.
VALVE TEST Using known good valves with their appropriate test cards	No indicator spot in pos. 6 of TEST SELECTOR switch.	1. V4 (CV1091) defective.
	Low emission all valves	1. V2 (CV138), V3 (CV138) or V6 (CV378) defective. 2. Defective TEST SELECTOR switch.
	Spot off top of tube in positions 2, 4 and 6 of TEST SELECTOR switch.	1. *R41 open-circuit.*
	Spot off top of tube in pos. 5 of the TEST SELECTOR switch	See Part 1, Chap. 1, para. 40.

Voltage readings

4. Voltage readings at various points of the tester using a test meter Type F (Ref. No. 10S/1) are given in Table 2. All readings are taken with the HT card in the gate and with the tester correctly adjusted to the mains input voltage.

WARNING

High voltages are associated with the cathode-ray tube and the rectifier valves V9 and V10; great care must be exercised when testing the instrument with the covers removed.

TABLE 2

Voltage readings

Measured between chassis and	Voltage	Tolerance (volts)
V4 anode	85	± 5
V4 cathode	0	
V5 anode	265	±30
V5 screen	265	±30
V5 cathode	95	± 5
V8 anode	85	± 2
Junction of R43/R44	52	± 3
Junction of C9/R56/R86	−220	±10

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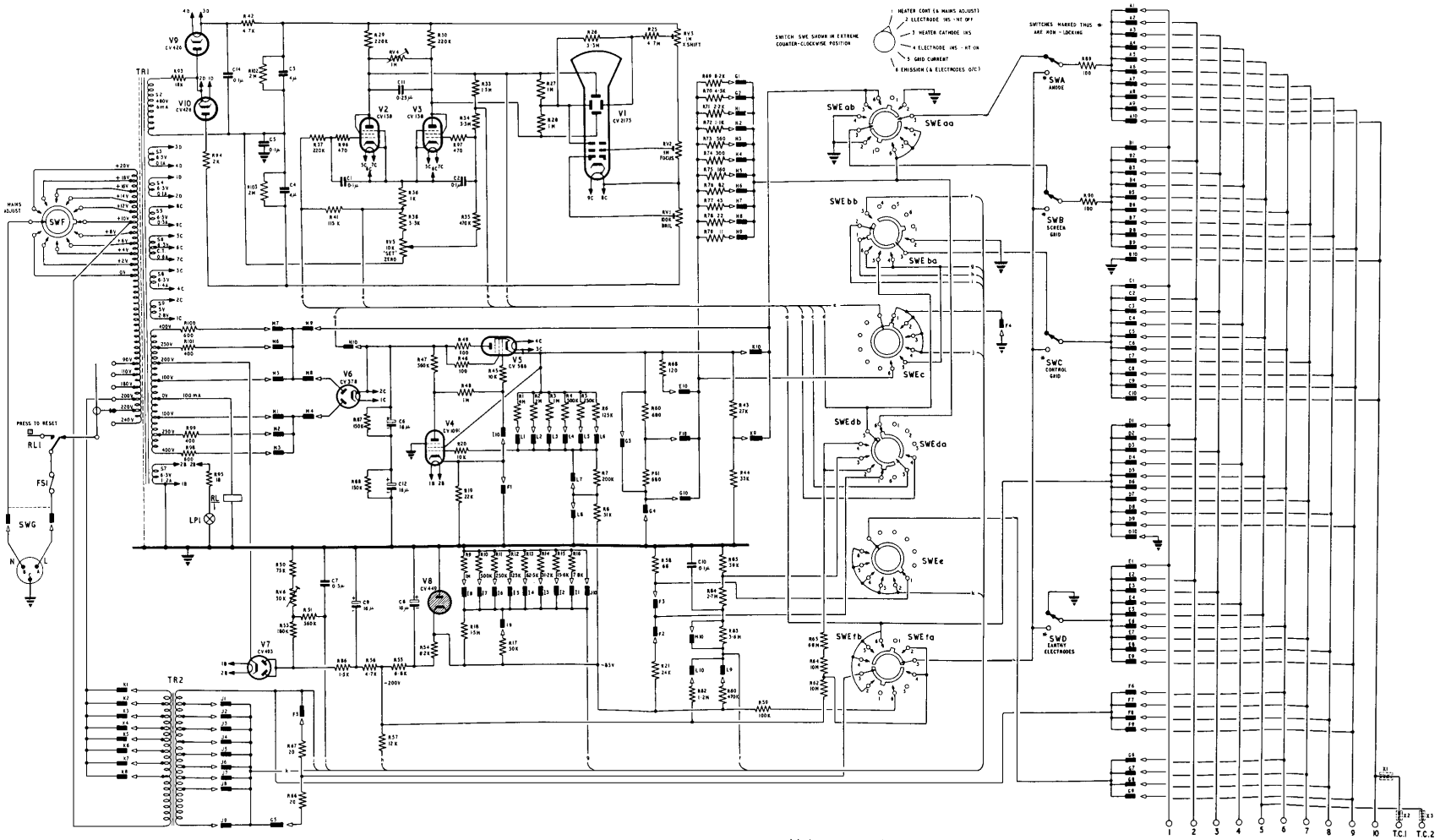

Fig. 1

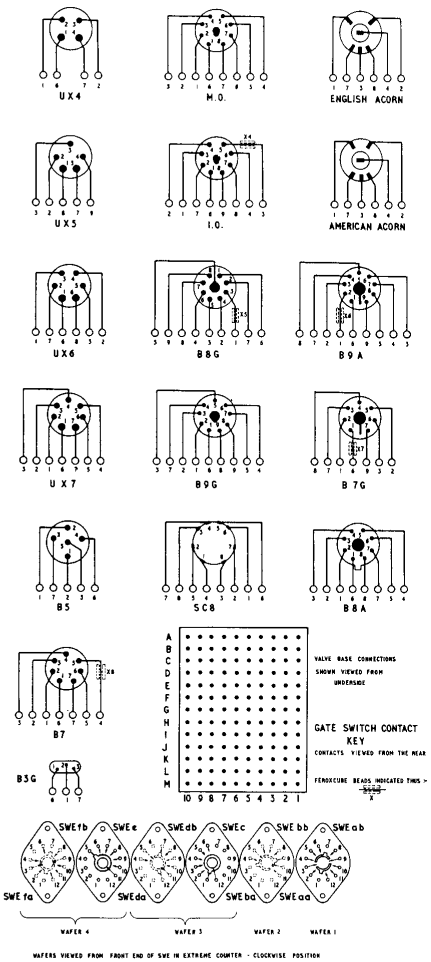

Fig. I.
(A.L.2, Jun. 54)

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