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A.P.2879AF, Vol. 1

AIR MINISTRY

OSCILLOSCOPE TYPE 13A

This is Amendment List No. 3 to A.P.2879AF, Vol. 1

List of Chapters: *delete* "*(To be issued later)*" after the title of Chapter 3 and *write* "(A.L. 3)" in the outer margin against the deletion. *Insert this* Chapter 3 *to follow* Chapter 2.

Record the incorporation of the Amendment List in the Amendment Record Sheet.

Chapter 3

SERVICING INSTRUCTIONS

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INTRODUCTION

1. The oscilloscope Type 13A is an item of general purpose test gear. Major servicing is consequently not carried out by Units. Maintenance action at Units is confined to minor servicing, including replacement of defective cathode-ray tube and valves and of those components which do not affect the calibration circuits of the instrument.

2. Servicing of the calibration circuits is to be carried out only at the appropriate Calibration Centre.

Note . . .

This instrument uses voltages which may be dangerous. In particular, the potential difference between the cathode-ray tube grid and the amplifier HT line is over 1,600V. Do not operate the oscilloscope with the case off unless it is absolutely necessary for servicing purposes to do so; when doing so, use great care and employ a well insulated test prod or screwdriver for investigating the circuits.

DISMANTLING AND RE-ASSEMBLY

Removal of front cover and case

3. Ensure that the mains connector is disconnected from the rear of the instrument, and proceed as follows:—

(1) Release the two clips at the sides of the oscilloscope and lift off the front cover.

(2) Remove the daylight viewing hood and graticule.

(3) Tilt the oscilloscope forward on to the front panel protecting studs.

(4) Unscrew the two slotted case-holding nuts at the rear and lift off the case.

SIGNALS

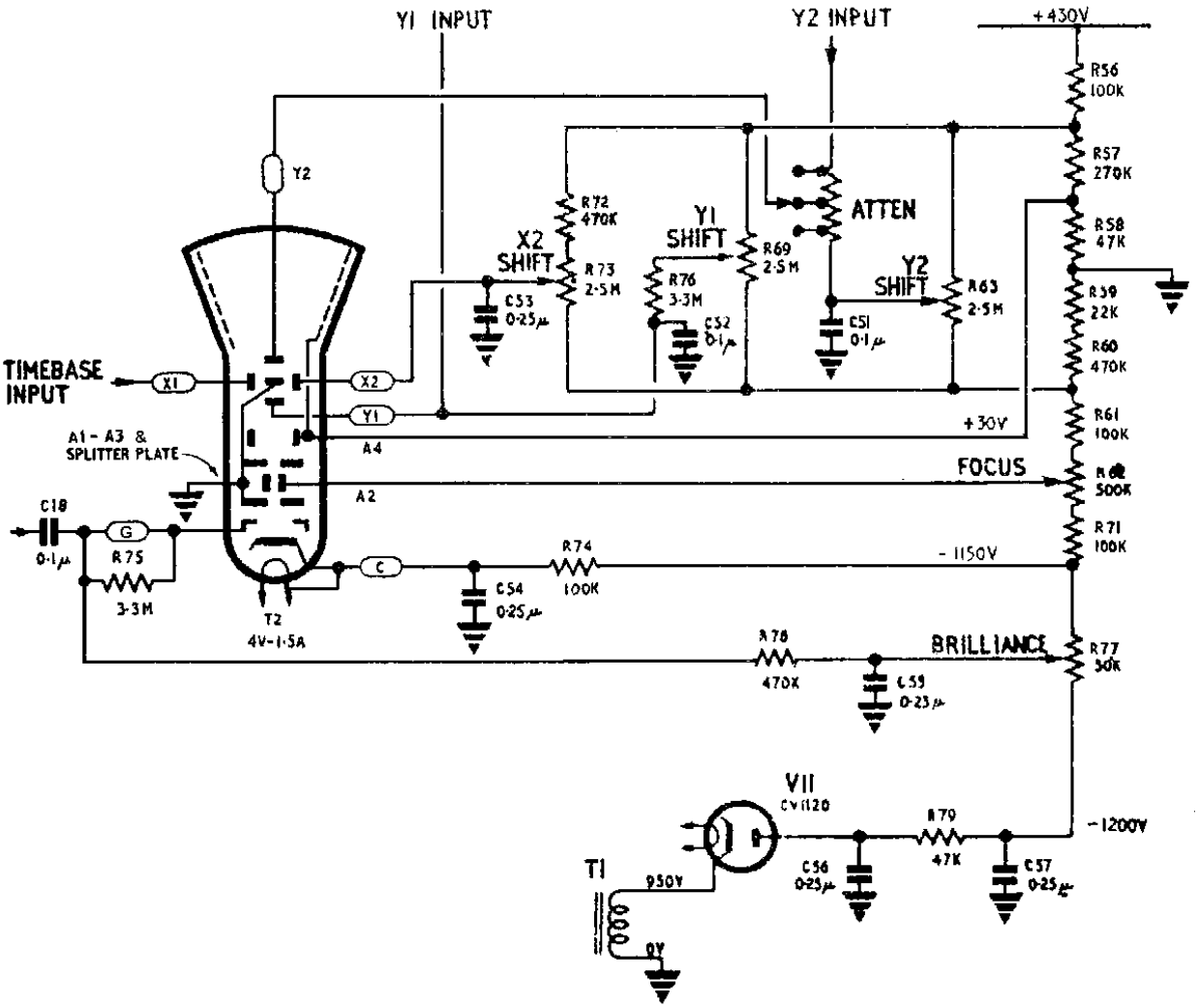
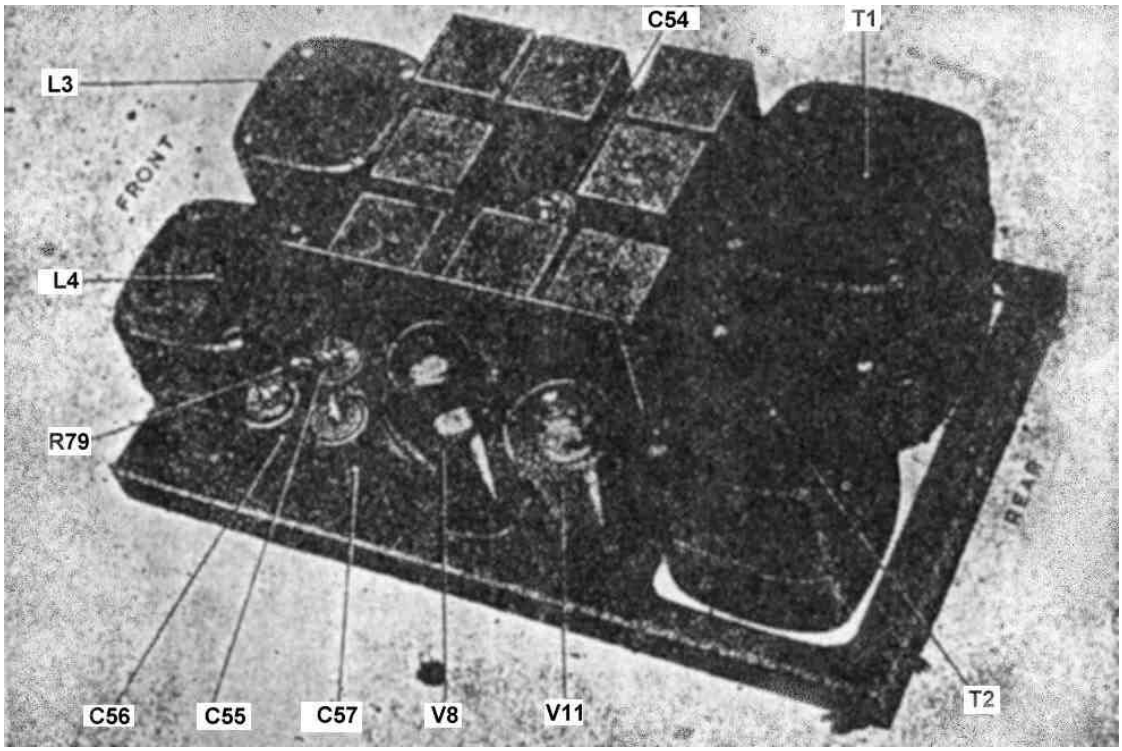


Fig. 1. CRT Network — simplified



Removal of CRT and mumetal shield

4. Proceed as follows:—

(1) Pull out the graticule from its position in front of the CRT screen.

(2) Remove the graticule housing from the front panel by undoing its four securing screws and withdrawing to the front.

(3) Unsolder the red earthing lead from the mumetal CRT shield.

(4) Carefully pull off the 12-pin CRT holder and allow it to hang by its own wiring.

(5) Loosen off the rubber-lined clamp round the base of the CRT by undoing the two 2 B.A. clamp screws.

(6) Withdraw the CRT and shield through the front panel.

Removal of insulating strip

5. Slide out the perforated paxolin insulating strip which covers the components in the amplifier section.

Removal of valves

6. The miniature diodes V1 and V2, which are situated on the front of the timebase assembly (*fig.* 5), should be carefully levered out of their diode holders. For the remaining valves, remove the top cap connector where used, ease off the valve retaining harness and withdraw the valve from its base.

Note . . .

Removal of the cathode-ray tube and the valves gives access to most of the components required in ordinary servicing. Further stages of dismantling may, however, prove necessary to obtain access to some components mounted on the rear of the front panel, or on the power unit. Accordingly, instructions for such dismantling are given in the following paragraphs.

Removal of power unit

7. The power unit may be removed from the remainder of the oscilloscope by the following procedure:—

(1) Loosen the two clamps at the front and rear of the power unit which hold the braided mains leads (Uniflexmet) to the chassis.

(2) Unsolder the leads which connect the remainder of the oscilloscope to the power unit. The leads which have to be removed are shown in fig 3. Make a note of how the

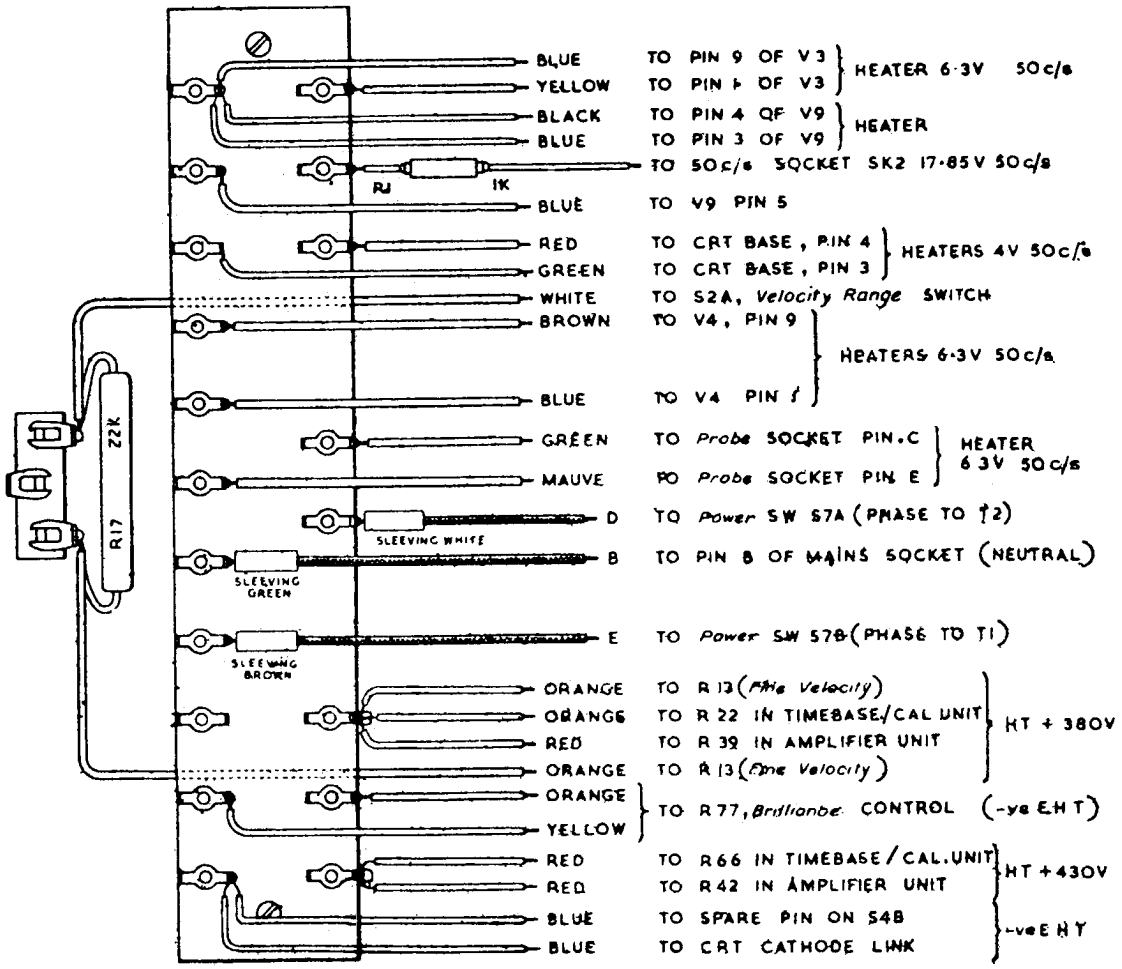


Fig. 3. Power unit connecting panel

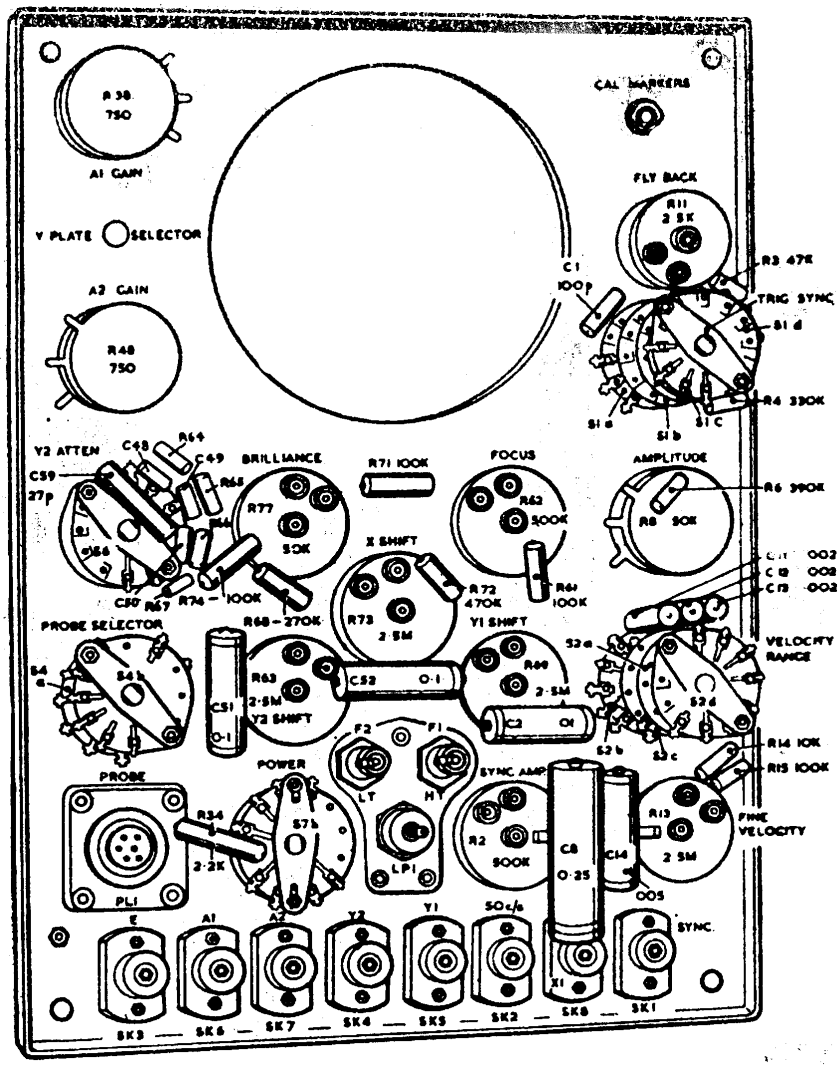


Fig. 4. Front panel—component layout

coloured sleeves on the three braided Uniflexmet leads correspond with other wires attached to the same tags on the panel. This will ensure the correct connection of these leads during re-assembly.

(3) Remove the three screws and nuts which attach the power unit screen to the amplifier plate.

(4) Remove the 16 4 B.A. fixing screws which hold the power unit to the corner plates of the other units. The power unit is now free and may be removed from the remainder of the oscilloscope.

Access to front panel

8. In normal circumstances no attempt should be made to remove the panel. Access to the components mounted on the rear of the front panel can, however, be obtained, once the power unit has been removed, by shifting the panel forward one or two inches from the remaining units, using the following procedure:—

(1) Remove the four so-called front panel protecting studs. (In fact, two are hexagonal domed studs and two are hexagonal domed nuts.)

(2) Turn the CAL. MARKERS switch to OFF and remove the front portion of the switch spindle; this can be done by loosening the forward 4 B.A. holding screw in the coupler and withdrawing spindle and knob together through the panel.

(3) Turn the Y PLATE SELECTOR switch to DC and remove the knob and the fixing nut beneath it.

(4) Ease the front panel forward as far as the wiring will permit, so obtaining access to the components behind it.

Re-assembly of oscilloscope

9. When repair work has been completed the oscilloscope should be re-assembled in the reverse order. Pay particular attention to the correct reconnection of leads to the power unit connecting panel (*fig.* 3). Grease the front panel protecting studs lightly before putting them back. Invert the instrument to shake out any loose pieces of wire or solder before putting back the case.

Dismantling cathode-follower probe

10. Access to the components in the cathode-follower probe may be obtained as follows:—

(1) Remove the ten 8 B.A. countersunk fixing screws which hold the insulating cover on to the probe assembly.

(2) Remove the cover.

MINOR REPAIRS

Precautions when changing components

11. Some of the resistors used in this instrument have very short leads. Consequently, when soldering a new resistor into position, care must be taken not to overheat it or its value will alter. It is advisable to attach a crocodile clip near the end of the resistor to absorb some of the heat from the soldering iron.

12. When changing any of the larger condensers use a hot, well-tinned soldering-iron to solder the connecting lead to the condenser terminal. Make the joint quickly and cool it by blowing. If the terminal is overheated the internal connection will come unsoldered and the condenser will be open-circuited.

Cleaning switch contacts

13. The contacts and rotor blades on the wafer switches are silver-plated; never use abrasive materials to clean them or damage will result after repeated operation. They are best cleaned with carbon tetrachloride to which a few drops of light oil have been added.

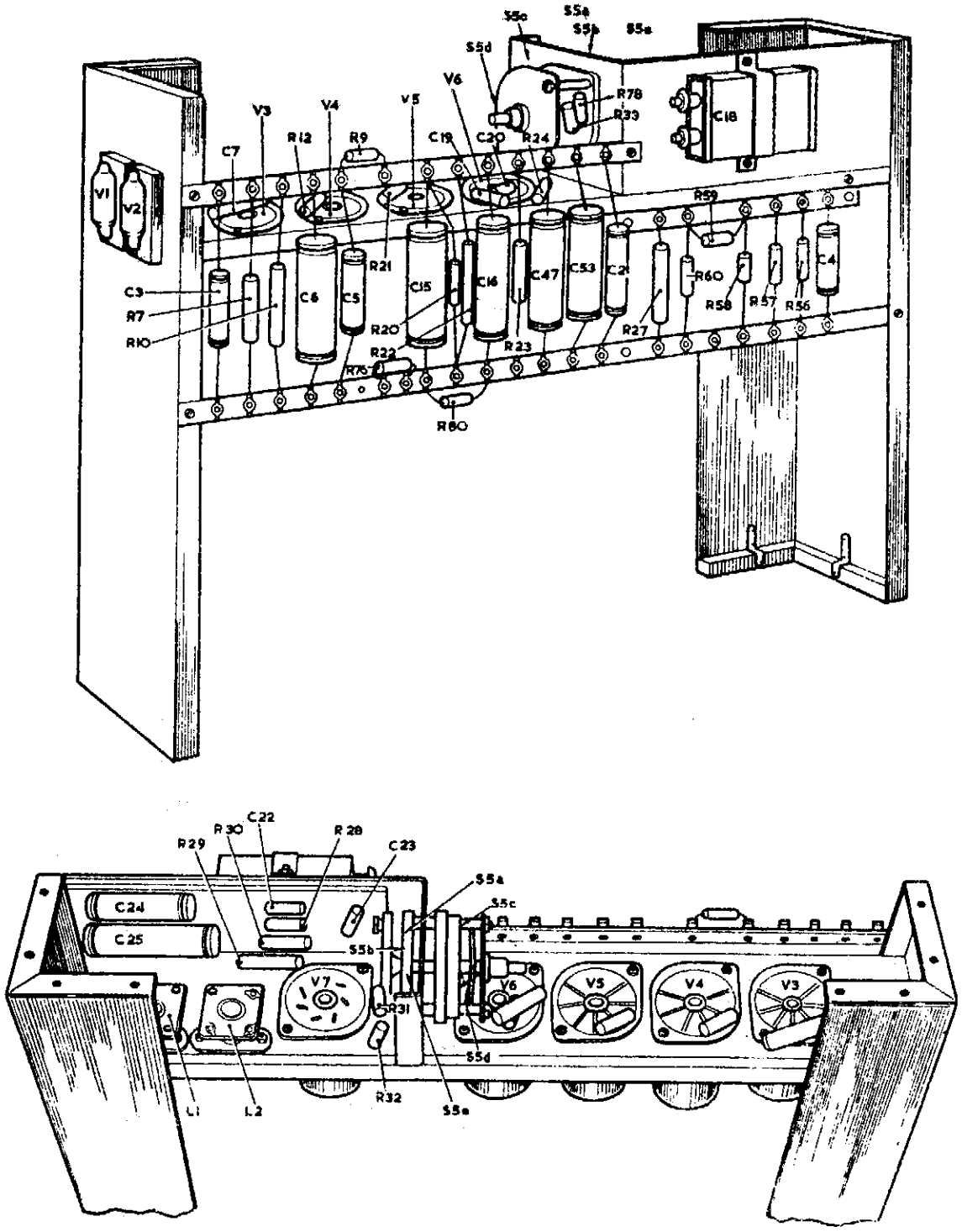


Fig. 5. Timebase calibrator assembly — component layout

FAULT-FINDING

General

14. Most faults likely to arise on the oscilloscope are easy to diagnose from the appearance of the traces themselves and by the action produced by operating the different controls. When starting to localize a fault, refer to the circuit description and diagram in Chap. 1 and proceed by intelligent deduction to narrow down the fault to one stage of the circuit. Then resort to a detailed check of voltages and component values in order to find the defective items.

15. Figs. 2, 4, 5, 7 and 8 are component layout diagrams which will help to locate particular components. Table 2 gives details of the valves used in the oscilloscope, and fig. 9 shows their base connections. Table 1 gives approximate values of

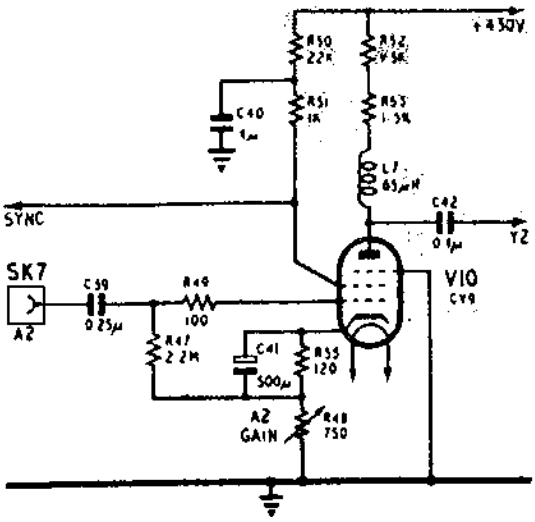


Fig. 6. Amplifier circuit—simplified

voltages to be expected at certain points in the circuit. In addition, the following paragraphs give some general advice on tracing faults.

No trace

16. When no spot can be seen even when the oscilloscope has been fully switched on, and the fuses are not blown, refer to fig. 1 and carry out the following tests in succession until the trouble is rectified :—

(1) Check the BRILLIANCE and SHIFT controls to make sure that the absence of a spot is not merely due to their misadjustment.

(2) With the case off, inspect the base of the CRT to see whether the heater is glowing

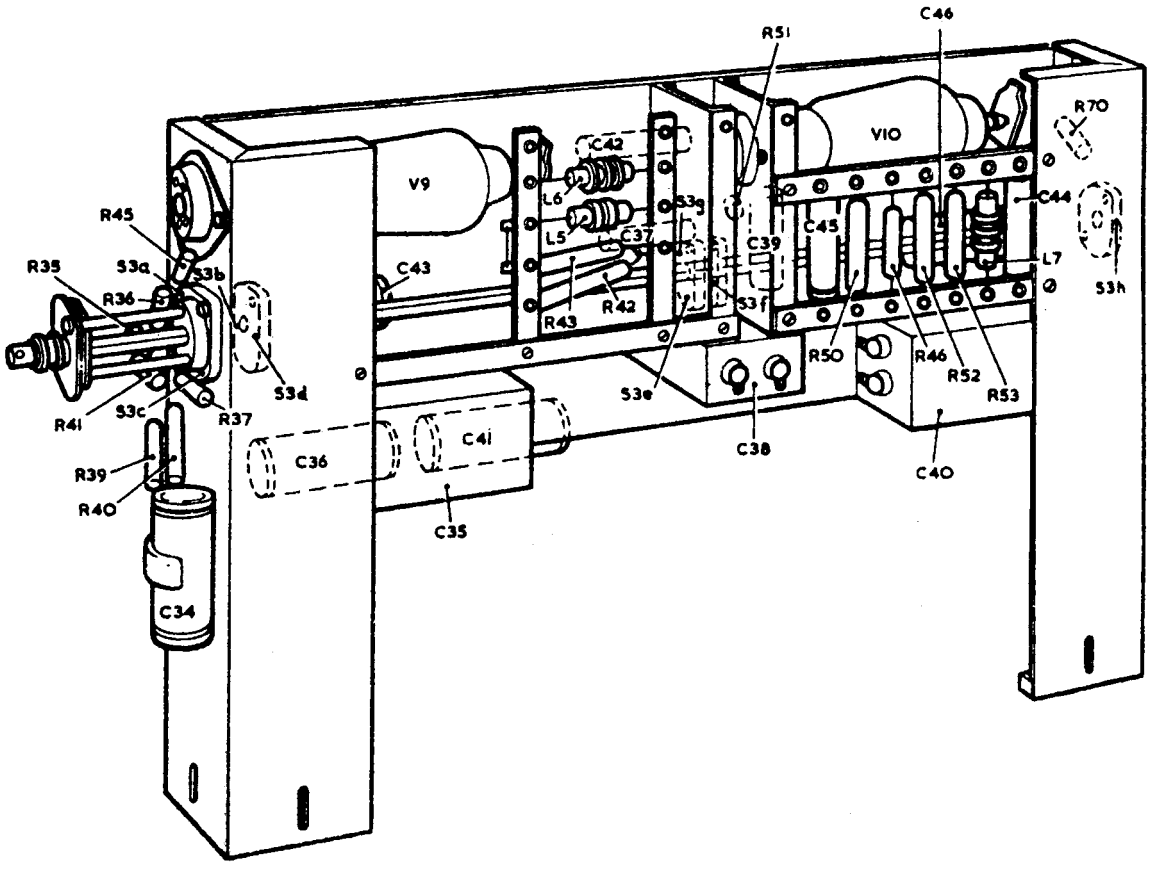
(3) Check that negative EHT is being applied to the CRT cathode and grid. Use a high-sensitivity testmeter or electrostatic voltmeter capable of reading up to 1,200V DC, and using well-insulated test-prods measure the voltages to ground at the CATH. and GRID links on the tube connecting link panel at the rear of the oscilloscope. The approximate voltages to be expected on a serviceable instrument are shown in Table 1.

(4) If no EHT is present, suspect the condensers C54 to C57, the rectifier V11 and the transformer T1. If the CRT grid is found to have a positive potential, suspect leakage in the blackout coupling condenser C.18.

(5) Check the potentials of the remaining CRT electrodes at the CRT base. They should be approximately as shown in Table 1.

(6) Earth the deflector plates at the links on the tube connecting link panel at the rear, being careful to turn the VELOCITY RANGE switch to X × 1. If the spot now appears, the trouble is due to an internal disconnection in the deflector plate input circuits, possibly in one of the switch wafers.

(7) Finally, suspect the CRT itself, and test by substitution.



Poor focus

17. If good focus cannot be obtained within the range of the FOCUS control, check the voltage at the focussing anode A2, the voltage should vary from −250V to −740V approximately as the FOCUS control is turned from one end of its travel to the other, as measured with the test meter Type D. If the voltages found are widely different from these values, switch off and check the resistances R56 to R62, R71 and R77 forming the EHT chain, including the FOCUS potentiometer R62 itself.

18. Bad focus may be due to the CRT having become soft; test by substitution.

No shift

19. If any shift control becomes ineffective, check the appropriate shift potentiometer and its associated components. The shift potentiometers are R73 for X-shift, R69 for Y1-shift. and R63 for Y2-shift (*fig.* 1). Remember that the Y-shift controls will always be ineffective on DC connection except when the external circuit has an unusually high impedance.

Failure of timebase

20. For a simplified diagram of the timebase circuits, see Chap. 1, fig. 6. First make sure that the TRIG.-SYNC. switch is in one of its free-running positions. If the timebase fails in only one position of the VELOCITY RANGE switch, check the corresponding timebase condenser in the series C9—C13. If, however, the timebase fails on all velocity ranges, measure the timebase HT voltage, then check the AMPLITUDE potentiometer R8 and the FINE VELOCITY potentiometer R13. Note that on some ranges the timebase stops if the AMPLITUDE control is turned up too far. Next test the valves V3, V4 and V5 by substitution. In the last resort make a systematic check of voltages and component values right through the timebase stages.

Amplifier faults

21. Fig. 6 gives a simplified circuit diagram of the Y2 amplifier stage; the Y1 amplifier stage is very similar except for the screen circuit. The circuit is shown with the Y PLATE SELECTOR switch turned to A1 A2.

22. Faults in the amplifier stages which are not simply due to valve failure (test by substitution) may be traced by earthing the input terminals and carrying out a systematic check of components and of voltages at the different electrodes, using Table 1.

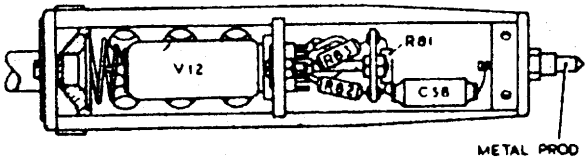


Fig. 8. Cathode-follower probe — component layout

TABLE 1

Voltages at test points

The table of voltages given below is not intended to be exhaustive but should be useful for diagnosis of most faults. It must, however, be pointed out that slight divergencies from these figures will not necessarily indicate abnormal operating conditions; particularly in the case of CRT electrode voltages discrepancies may be considerable, and the voltages given in the table are to serve merely as guides to the order of magnitude to be expected. Another cause for discrepancies is in the not sharply definable central setting of potentiometer controls; hence, discretion should be used in allowing for the effects of these factors, including component tolerances and supply variations.

"NORMAL" POSITIONS

Except where indicated otherwise, measurements are to be taken with controls in the following positions:—

Control	Position
POWER SWITCH	H.T.
CAL. MARKERS	OFF
FLYBACK	Centralized
TRIG. SYNC.	50 c/s
AMPLITUDE	Centralized
VELOCITY RANGE	1 kc/s
FINE VELOCITY	Position 10
SYNC. AMP.	Centralized
Y1 SHIFT Y2 SHIFT X SHIFT	Centralized
FOCUS BRILLIANCE	Both controls adjusted to give clear trace Brilliance not to be at max.
A1 A2 GAIN	Fully clockwise (Max.)
Y PLATE SELECTOR	A1 A2
Y2 ATTEN.	÷1
PROBE SELECTOR	OFF

Note . . .

Min. position = fully counter-clockwise.

Max. position = fully clockwise.

All measurements are taken with test meter Type D. Unless otherwise stated the 1000V DC range is used. All voltages and polarities are referred to chassis. The mains voltage supply should be 230 or 115V AC.

TABLE 1—*Contd.*

POWER UNIT

Control positions	Point of measurement	Voltage
BRILLIANCE to max. FOCUS to min.	Top tag of C55	-940
Normal	V8 cathode pin	+500
Normal	Junction L3 and L4	+470
Normal	R26, 1 KΩ vitreous—yellow	+460
Normal	R26 blue	+430

TABLE 1—*Contd*

CATHODE-RAY TUBE

Location	Control positions	Point of measurement	Voltage
Tube socket	FOCUS at min.	A2 pin	−250
	FOCUS centralized		−440
	FOCUS at max.		−740
	Normal	A4 pin	
CRT link panel	X2 SHIFT min.	X2 terminal	−190
	X2 SHIFT max		+100
	Y1 SHIFT min.	Y1 terminal	+ 40
	Y1 SHIFT max		− 35
	Y2 SHIFT min.	Y2 terminal	− 30
	Y2 SHIFT max		+ 30
	BRILLIANCE min.	GRID terminal	−800
	BRILLIANCE central		−780
	BRILLIANCE max.		−760
	Normal	CATHODE terminal	−820

TABLE 1—*Contd.*

TIME BASE

HT measured on slider of flyback control = 410V

Controls	Unit	Valve	Electrode	Pin No.	Voltage
Normal	TB driver	V3	Anode	3	+ 55
			Screen	2	+110
		V4	Anode	3	+420
			Screen	2	+420
			Cathode	6	+175
Normal	TB valve	V5	Anode	3	+175
			Screen	2	+335
VELOCITY RANGE to ×30			Cathode	6	+ 3 (on 10V DC range)
CALIBRATOR MARKER switch to 10 μS	Calibrator	V6	Anode (*a*)	2	+310
			Anode (*b*)	5	+ 50
		V7	Anode (*a*)	2	+185
			Anode (*b*)	5	+290

TABLE 1—*Contd.*

AMPLIFIER

Main HT line volts measured at high potential end of R42 = 430V

Controls	Valve	Electrode	Pin No.	Voltage	Remarks
Normal	V9	Anode	Top cap	+215	N.B.—Cathode volts of V9 and V10 measured on 100V DC range
		Screen	7	+300	
		Cathode	6	+ 10	
A1 GAIN at min.		Anode	Top cap	+250	
		Screen	7	+320	
		Cathode	6	+57·5	
Normal	V10	Anode	Top cap	+250	
		Screen	7	+275	
		Cathode	6	+ 10	
A2 GAIN at min.		Anode	Top cap	+280	
		Screen	7	+290	
		Cathode	6	+ 52	

PROBE

Measured at probe socket Pin 1 with probe withdrawn, PROBE SELECTOR switch to Y1 Y2 : *HT supply* = +320V.

TABLE 2

List of valves

Circuit Ref.	Type	Old Service number	Stores Ref.	Nearest commercial equivalent	Base	Heater voltage	Function
V1	CV1092	VR92	10CV/1092	EA50	Special	6·3	Negative sync. diode
V2	CV1092	VR92	10CV/1092	EA50	Special	6·3	Positive sync. diode
V3	CV1091	VR91	10CV/1091	EF50	B9G	6·3	Multivibrator pentode
V4	CV173	—	10CV/173	DDR2	B9G	6·3	Multivibrator pentode
V5	CV1091	VR91	10CV/1091	EF50	B9G	6·3	Miller timebase pentode
V6	CV1988	6SN7GT	10CV/1988	6SN7GT	IO	6·3	Double-triode, calibrator switching valve
V7	CV1988	6SN7GT	10CV/1988	6SN7GT	IO	6·3	Double-triode, cal. oscillator and shaper

TABLE 2—Contd.

Circuit Ref.	Type	Old Service number	Stores Ref.	Nearest Commercial equivalent	Base	Heater voltage	Function
V8	CV378	—	10CV/378	R231	IO	5·0	Double-diode, Full-wave rectifier
V9	CV9	—	10CV/9	AL60	B7	4·0	Pentode, A1 amplifier
V10	CV9	—	10CV/9	AL60	B7	4·0	Pentode, A2 amplifier
V11	CV1120	VU120	10CV/1120	SU2150A	B4	2·0	Diode, half-wave EHT rectifier
V12	CV136	—	10CV/136	DDR7	B7G	6·3	Pentode, Cath. follower probe valve
CRT1	CV1596	VCR516A	10CV/1596	—	12-pin spigot	4·0	Twin-beam CRT

TABLE 3

List of resistors

Circuit Ref.	Description	Value (Ohms)	Tol. (%)	Rating (Watts)	A.M. Storne Ref.	Incer-serv. Ref.	Remarks
R1	Fixed, composition	1K	20	¼	10W/1867	Z.222005	
R2	Type 1319	500K	10	1½	10W/1319	—	Carbon pot. (SYNC. AMP.)
R3	Fixed, composition	47K	20	¼	10W/1882	Z.222215	
R4	Fixed, composition	330K	20	½	10W/8828	Z.223101	
R5	Fixed, composition	1M	20	¼	10W/1889	Z.223164	
R6	Fixed, composition	390K	10	¾	10W/9612	Z.223114	
R7	Fixed, wirewound	10K	5	3	10W/8025	Z.244097	
R8	Variable, wirewound	50K	10	3	10W/Z272556	Z.272556	(AMPLITUDE)
R9	Fixed, composition	27K	10	½	10W/646	Z.222185	
R10	Fixed, wirewound	22K	5	6	10W/15051	Z.244129	
R11	Variable, composition	2·5K	10	¾	10W/Z261419	Z.261419	Carbon pot. (FLYBACK)
R12	Fixed, composition	220	20	¼	10W/8327	Z.221152	
R13	Variable, composition	2·5M	10	¾	10W/Z262947	Z.262947	Carbon pot. (FINE VELOCITY)
R14	Fixed, composition	10K	20	¼	10W/1955	Z.222131	
R15	Fixed, composition	100K	20	½	10W/6840	Z.223039	
R16	Fixed, composition	2·2M	20	¼	10W/16005	Z.223205	
R17	Fixed, wirewound	22K	6	5	10W/15051	Z.244129	
R18	Fixed, composition	1M	20	¼	10W/1889	Z.223164	
R19	Fixed, composition.	10M	20	¼	10W/10360	Z.223290	
R20	Fixed, composition	220K	20	½	10W/6471	Z.223081	
R21	Fixed, composition	330	20	¼	10W/6082	Z.221174	

TABLE 3—*contd.*

Circuit Ref.	Description	Value (Ohms)	Tol. (%)	Rating (Watts)	A.M. Stores Ref.	Inter-serv. Ref.	Remarks
R22	Fixed, wirewound	47K	5	5	10W/16377	Z.244150	
R23	Fixed, wirewound	47K	5	5	10W/16377	Z.244150	
R24	Fixed, composition	470K	20	½	10W/1884	Z.223122	
R25	Fixed, composition	820K	10	½	10W/699	Z.223155	
R26	Fixed, wirewound	1K	5	3	10W/6687	Z.244001	
R27	Fixed, wirewound	4·7K	5	6	10W/16816	Z.244066	
R28	Fixed, composition	47K	20	½	10W/1882	Z.222215	
R29	Fixed, wirewound	10K	5	3	10W/8025	Z.244097	
R30	Fixed, composition	3·3K	20	½	10W/7736	Z.222069	
R31	Fixed, composition	220K	20	½	10W/1399	Z.223080	
R32	Fixed, composition	3·3M	20	½	10W/1891	Z.223227	
R33	Fixed, composition	220	20	½	10W/8327	Z.221152	
R34	Fixed, wirewound	2·2K	5	3	10W/16430	Z.244033	
R35	Fixed, composition	2·2M	20	½	10W/16005	Z.223205	
R36	Fixed, composition	100	20	½	10W/1858	Z.221110	
R37	Fixed, composition	56	5	½	10W/9174	Z.221078	
R38	Variable, wirewound	750	10	3	10W/Z271763	Z.271763	(A1 GAIN)
R39	Fixed, wirewound	22K	5	6	10W/15051	Z.244129	
R40	Fixed, wirewound	22K	5	6	10W/15051	Z.244129	
R41	Fixed, composition	1K	20	½	10W/1867	Z.222005	
R42	Fixed, wirewound	1·5K	10	6	10W/9362	Z.244019	

TABLE 3—*contd.*

Circuit Ref.	Description	Value (Ohms)	Tol. (%)	Rating (Watts)	A.M. Stores Ref.	Inter-serv. Ref.	Remarks
R43	Fixed, wirewound	1·5K	10	6	10W/9362	Z.244019	
R44	Fixed, composition	22	20	¼	10W/10333	Z.221026	
R45	Fixed, composition	120	10	½	10W/1312	Z.221123	
R46	Fixed, wirewound	8·2K	5	3	10W/17060	Z.244089	
R47	Fixed, composition	2·2M	20	¼	10W/16005	Z.223205	
R48	Variable, wirewound	750	10	3	10W/Z271763	Z.271763	(A2 GAIN)
R49	Fixed, composition	100	10	¼	10W/1858	Z.221110	
R50	Fixed, wirewound	22K	5	6	10W/15051	Z.244129	
R51	Fixed, composition	1K	20	¼	10W/1867	Z.222005	
R52	Fixed, wirewound	1·5K	10	6	10W/9362	Z.244019	
R53	Fixed, wirewound	1·5K	10	6	10W/9362	Z.244019	
R54	Fixed, composition	22	20	¼	10W/10333	Z.221026	
R55	Fixed, composition	120	10	½	10W/1312	Z.221123	
R56	Fixed, composition	100K	20	½	10W/6840	Z.223039	
R57	Fixed, composition	270K	10	½	10W/589	Z.223093	
R58	Fixed, composition	47K	20	¼	10W/1882	Z.222215	
R59	Fixed, composition	22K	20	¼	10W/841	Z.222171	
R60	Fixed, composition	470K	20	½	10W/6320	Z.223123	
R61	Fixed, composition	100K	20	½	10W/6840	Z.223039	
R62	Type 9787	500K	10	1½	10W/1319	—	Carbon pot. (FOCUS)
R63	Variable, composition	2·5M	10	¾	10W/Z262947	Z.262947	Carbon pot. (Y2 SHIFT)

TABLE 3—*contd.*

Circuit Ref.	Description	Value (Ohms)	Tol. (%)	Rating (Watts)	A.M. Stores Ref.	Inter-serv. Ref.	Remarks
R64	Fixed, composition	2·2M	5	¼	10W/15295	Z.223203	
R65	Fixed, composition	1·1M	5	½	10W/17127	Z.223170	
R66	Fixed, composition	560K	5	¼	10W/8973	Z.223131	
R67	Fixed, composition	270K	5	½	10W/10496	Z.223090	
R68	Fixed, composition	270K	5	½	10W/10496	Z.223090	
R69	Variable, composition	2·5M	10	¾	10W/Z262947	Z.262947	Carbon pot. (Y1 SHIFT)
R70	Fixed, composition	3·3M	20	¼	10W/1891	Z.223227	
R71	Fixed, composition	100K	20	¼	10W/6840	Z.223039	
R72	Fixed, composition	470K	20	¼	10W/1884	Z.223122	
R73	Variable, composition	2·5M	10	¾	10W/Z262947	Z.262947	Carbon pot. (X SHIFT)
R74	Fixed, composition	100K	20	¼	10W/6840	Z.223039	
R75	Fixed, composition	3·3M	20	¼	10W/1891	Z.223227	
R76	Fixed, composition	470K	20	¼	10W/1884	Z.223122	
R77	Type 3988	50K	10	1½	10W/15279	—	Carbon pot. (BRILLIANCE)
R78	Fixed, composition	10K	20	¼	10W/1955	Z.222131	
R79	Fixed, composition	47K	20	¼	10W/1882	Z.222215	
R80	Fixed, composition	3·3M	20	¼	10W/1891	Z.223227	
R81	Fixed, composition	2·2M	20	¼	10W/16005	Z.223205	
R82	Fixed, composition	470	10	½	10W/690	Z.221194	
R83	Fixed, composition	470	10	½	10W/690	Z.221194	

TABLE 4

List of capacitors

Circuit Ref.	Description	Value	Tol. (%)	Rating (V. DC)	A.M. Stores Ref.	Inter-serv. Ref.	Remarks
C1	Fixed ceramic	100 pF	10	500	10C/14674	Z.132300	—
C2	Fixed paper	·01 μF	20	1000	10C/16170	Z.115282	—
C3	Fixed paper	·001 μF	20	1000	10C/16167	Z.115279	—
C4	Fixed paper	·1 μF	20	500	10C/16174	Z.115286	—
C5	Fixed paper	·1 μF	20	500	10C/16174	Z.115286	—
C6	Fixed paper	·25 μF	20	500	10C/15083	Z.115128	Tubular, wire ends
C7	Fixed ceramic	470 pF	10	500	10C/16537	Z.132405	—
C8	Fixed paper	·25 μF	20	500	10C/15083	Z.115128	Tubular, wire ends
C9	Fixed ceramic	2·2 pF	25	500	10C/15166	Z.132250	—
C10	Fixed ceramic	100 pF	10	500	10C/14674	Z.132300	—
C11	Fixed paper	·002 μF	20	1000	10C/16168	Z.115280	—
C12	Fixed paper	·002 μF	20	1000	10C/16168	Z.115280	—
C13	Fixed paper	·002 μF	20	1000	10C/16168	Z.115280	—
C14	Fixed paper	·005 μF	20	1000	10C/14751	Z.115006	Tubular, wire ends
C15	Fixed paper	·25 μF	20	350	10C/15082	Z.115126	Tubular
C16	Fixed paper	·25 μF	20	500	10C/15083	Z.115128	Tubular, wire ends
C17	Type 4501	4 μF	20	600	10C/13734	—	Paper, block
C18	Fixed paper	·1 μF	20	1500	10C/Z111458	Z.111458	Block
C19	Fixed ceramic	100 pF	10	500	10C/14674	Z.132300	—
C20	Fixed ceramic	27 pF	10	500	10C/15832	Z.132439	—
C21	Fixed paper	·1 μF	20	500	10C/16174	Z.115286	—
C22	Fixed ceramic	22 pF	10	500	10C/14587	Z.132277	—
C23	Fixed ceramic	22 pF	10	500	10C/14587	Z.132277	—
C24	Fixed paper	·005 μF	20	1000	10C/14751	Z.115006	Tubular, wire ends
C25	Fixed paper	·1 μF	20	500	10C/16174	Z.115286	—
C26	Type 4501	4 μF	20	600	10C/13734	—	Paper, block
C27	Type 4501	4 μF	20	600	10C/13734	—	Paper, block
C28	Type 4501	4 μF	20	600	10C/13734	—	Paper, block
C29	Type 4501	4 μF	20	600	10C/13734	—	Paper, block
C30	Type 4501	4 μF	20	600	10C/13734	—	Paper, block
C31	Type 4501	4 μF	20	600	10C/13734	—	Paper, block

TABLE 4—contd.

Circuit Ref.	Description	Value	Tol. (%)	Rating (V. DC)	A.M. Stores Ref.	Inter-serv. Ref.	Remarks
C32	Type 4501	4 μF	20	600	10C/13734	—	Paper, block
C33	—	—	—	—	—	—	—
C34	Fixed paper	·25 μF	20	500	10C/15083	Z.115128	Tubular, wire ends
C35	Type 4501	4 μF	20	600	10C/13734	—	Paper, block
C36	Fixed electrolytic	500 μF	+50, −20	12	10C/15966	Z.145236	Metal cased, tubular
C37	Fixed paper	·1 μF	20	500	10C/16174	Z.115286	—
C38	Fixed paper	1 μF	20	600	10C/14962	Z.112154	Block
C39	Fixed paper	·25 μF	20	350	10C/15082	Z.115126	Tubular
C40	Fixed paper	4 μF	20	600	10C/14758	Z.112528	Block
C41	Fixed electrolytic	500 μF	+50 −20	12	10C/15966	Z.145236	Metal cased, tubular
C42	Fixed paper	·1 μF	20	500	10C/16174	Z.115286	—
C43	Fixed paper	·25 μF	20	500	10C/15083	Z.115128	Tubular, wire ends
C44	Fixed paper	·1 μF	20	500	10C/16174	Z.115286	—
C45	Fixed paper	·1 μF	20	500	10C/16174	Z.115286	—
C46	Fixed paper	·25 μF	20	500	10C/15083	Z.115128	Tubular, wire ends
C47	Fixed paper	·5 μF	20	350	10C/16178	Z.115290	—
C48	Fixed ceramic	22 pF	10	500	10C/14587	Z.132277	—
C49	Fixed ceramic	10 pF	10	500	10C/15168	Z.132426	Tubular, insulated
C50	Fixed ceramic	2·2 pF	25	500	10C/15166	Z.132250	—
C51	Fixed paper	·1 μF	20	500	10C/16174	Z.115286	—
C52	Fixed paper	·1 μF	20	500	10C/16174	Z.115286	—
C53	Fixed paper	·25 μF	20	500	10C/15083	Z.115128	—
C54	Fixed paper	·25 μF	20	1500	10C/16024	Z.116243	Tubular, impregnated
C55	Fixed paper	·25 μF	20	1500	10C/16024	Z.116243	Tubular, impregnated
C56	Fixed paper	·25 μF	20	1500	10C/16024	Z.116243	Tubular, impregnated
C57	Fixed paper	·25 μF	20	1500	10C/16024	Z.116243	Tubular, impregnated
C58	Type 5190	·02 μF	25	350	10C/15201	—	Paper, tubular
C59	Fixed ceramic	27 pF	10	500	10C/15832	Z.132439	—

TABLE 5

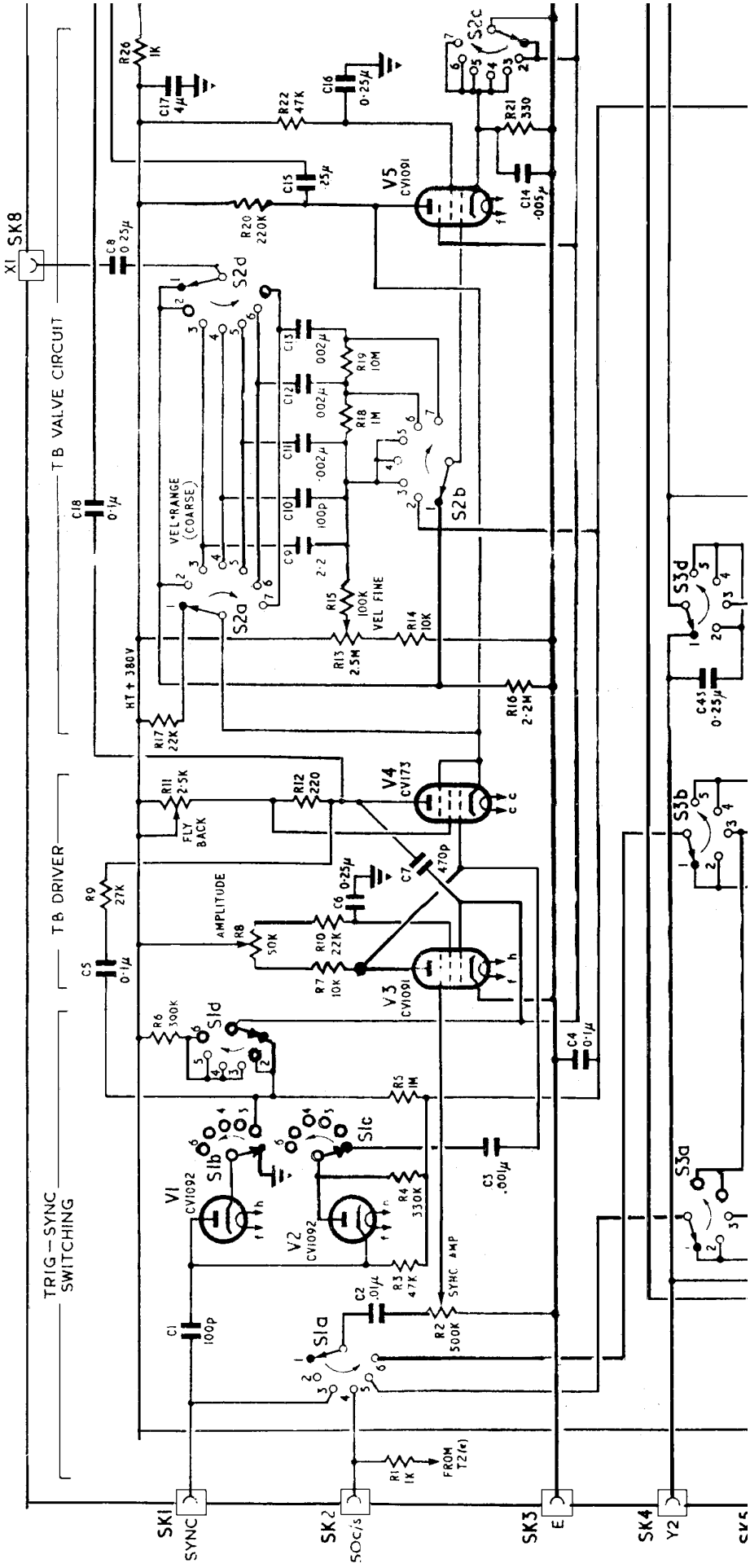
List of connectors

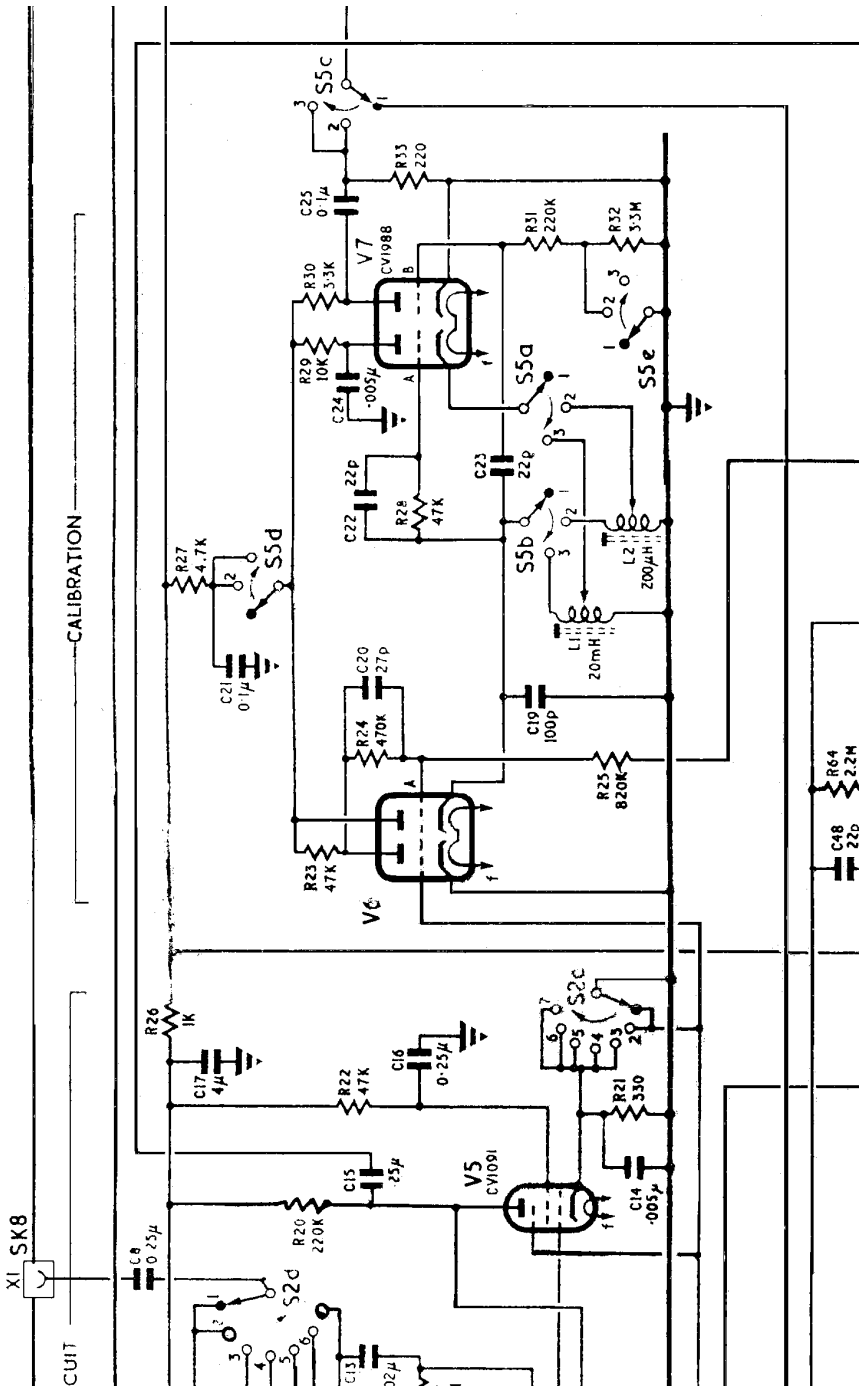
Type	A.M. Stores Ref.	Purpose	Remarks
3309	10HA/6169	Oscilloscope lead	Coloured WHITE
3310	10HA/6170	Oscilloscope lead	Coloured MAUVE
3311	10HA/6171	Oscilloscope lead	Coloured BLUE
3312	10HA/6172	Oscilloscope lead	Coloured GREEN
3313	10HA/6173	Oscilloscope lead	Coloured YELLOW
3314	10HA/6174	Oscilloscope lead	Coloured ORANGE
B8/50/E1	10HA/9041	C.F. Probe connector	—
3429	10HA/8240	Mains connector	Three-core

TABLE 6

List of miscellaneous items

Circuit Ref.	Description	A.M. Stores Ref.	Remarks
T1	Transformer Type 2778	10K/16868	Mains transformer (HT)
T2	Transformer Type 2777	10K/16867	Mains transformer (LT)
F1 and F2	Fuses Type 13	10H/10269	2 A. cartridge, *for 230V mains*
	OR Fuses Type 28	10H/180	3 A. cartridge, *for 115V mains*
L3 and L4	Chokes Type 893	10C/18705	10H, HT smoothing
LP1	Lamp filament MES	5L/2130	6·5V clear
—	Lampholder Type 47	10A/12811	Includes opaque red cap
—	Knobs Type 30	10A/12241	Pointer knobs, for controls
—	Visor Type 41	10AT/28	Daylight viewing hood
—	Scale Type 124	10AL/85	Ruled graticule




CALIBRATION
CUIT
X1 SK8
S5c
S5a
S5b
S5d
S5e
S2c
S2d
V7 CV1988
V6
V5 CV1091
R33 220
R31 220K
R32 3·3M
R30 3·3K
R29 10K
R28 47K
R27 4·7K
R26 1K
R25 820K
R24 470K
R23 47K
R22 47K
R21 330
R20 220K
R64 2·2M
C25 0·1μ
C24 ·005μ
C23 22p
C22 22p
C21 0·1μ
C20 27p
C19 100p
C17 4μ
C16 0·25μ
C15 ·25μ
C14 ·005μ
C48 22p
L2 200μH
L1 20mH

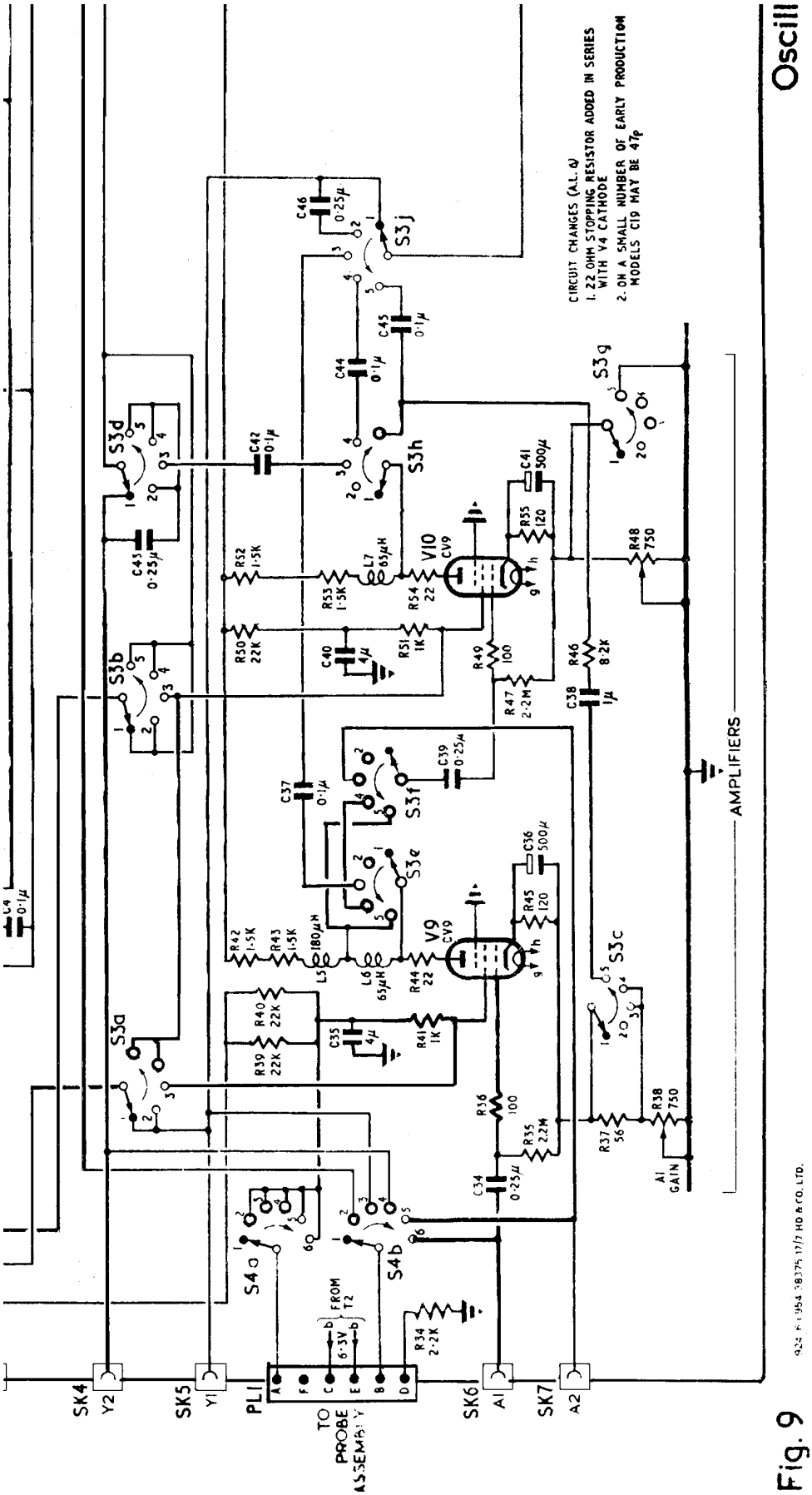
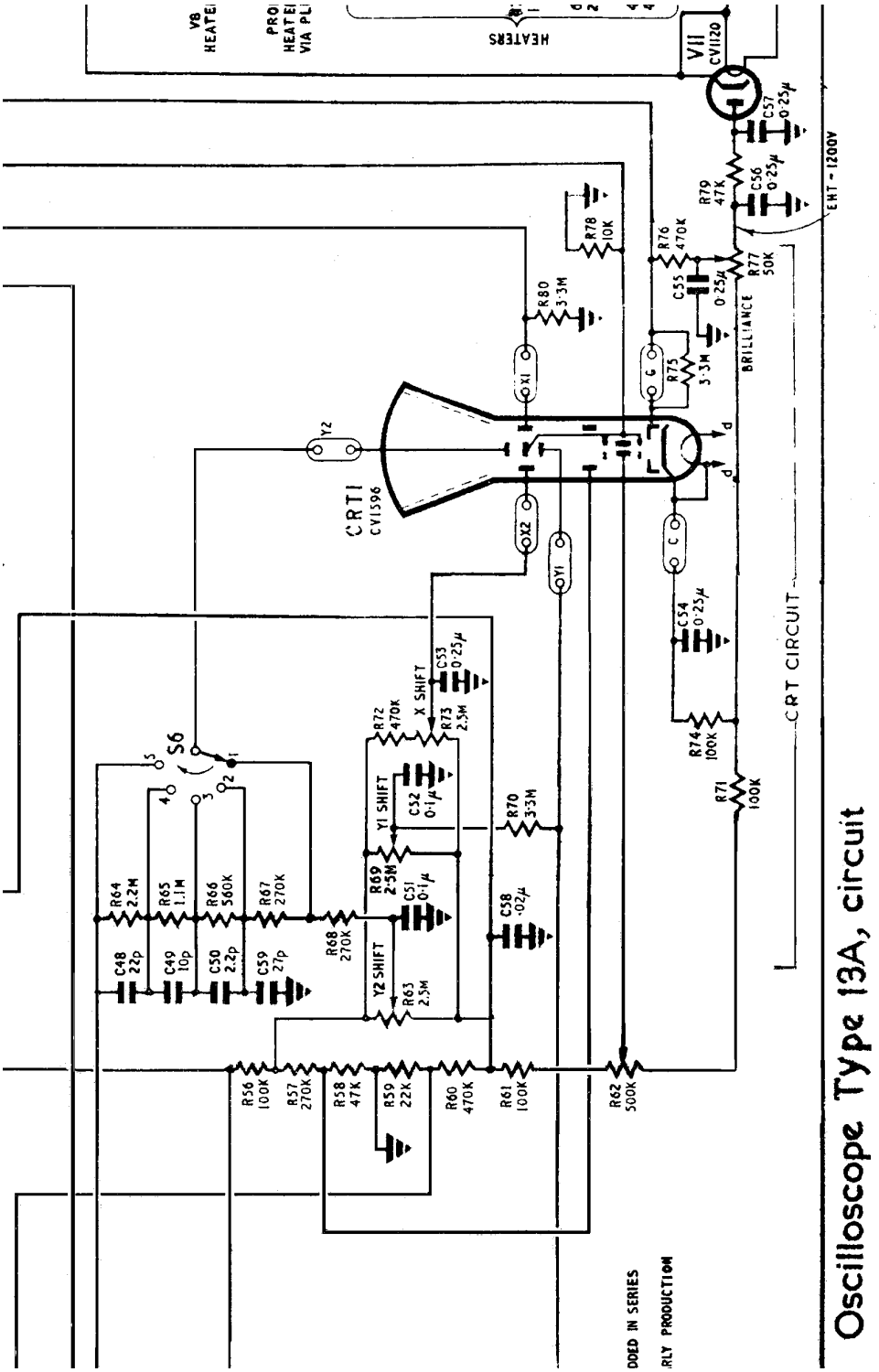


Fig. 9


HEATERS
V11
CV1120
C57 0·25μ
C56 0·25μ
R79 47K
R78 10K
R76 470K
R77 50K
R80 3·3M
C55 0·25μ
R75 3·3M
BRILLIANCE
EHT - 1200V
CRT1
CV1596
Y2
X1
X2
Y1
G
C
d
C54 0·25μ
CRT CIRCUIT
R74 100K
R71 100K
C53 0·25μ
X SHIFT
R72 470K
R73 2·5M
S6
Y1 SHIFT
C52 0·1μ
R70 3·3M
R64 2·2M
R65 1·1M
R66 560K
R67 270K
R69 2·5M
C51 0·1μ
C58 ·02μ
R68 270K
C48 22p
C49 10p
C50 2·2p
C59 27p
Y2 SHIFT
R63 2·5M
R56 100K
R57 270K
R58 47K
R59 22K
R60 470K
R61 100K
R62 500K
Oscilloscope Type 13A, circuit

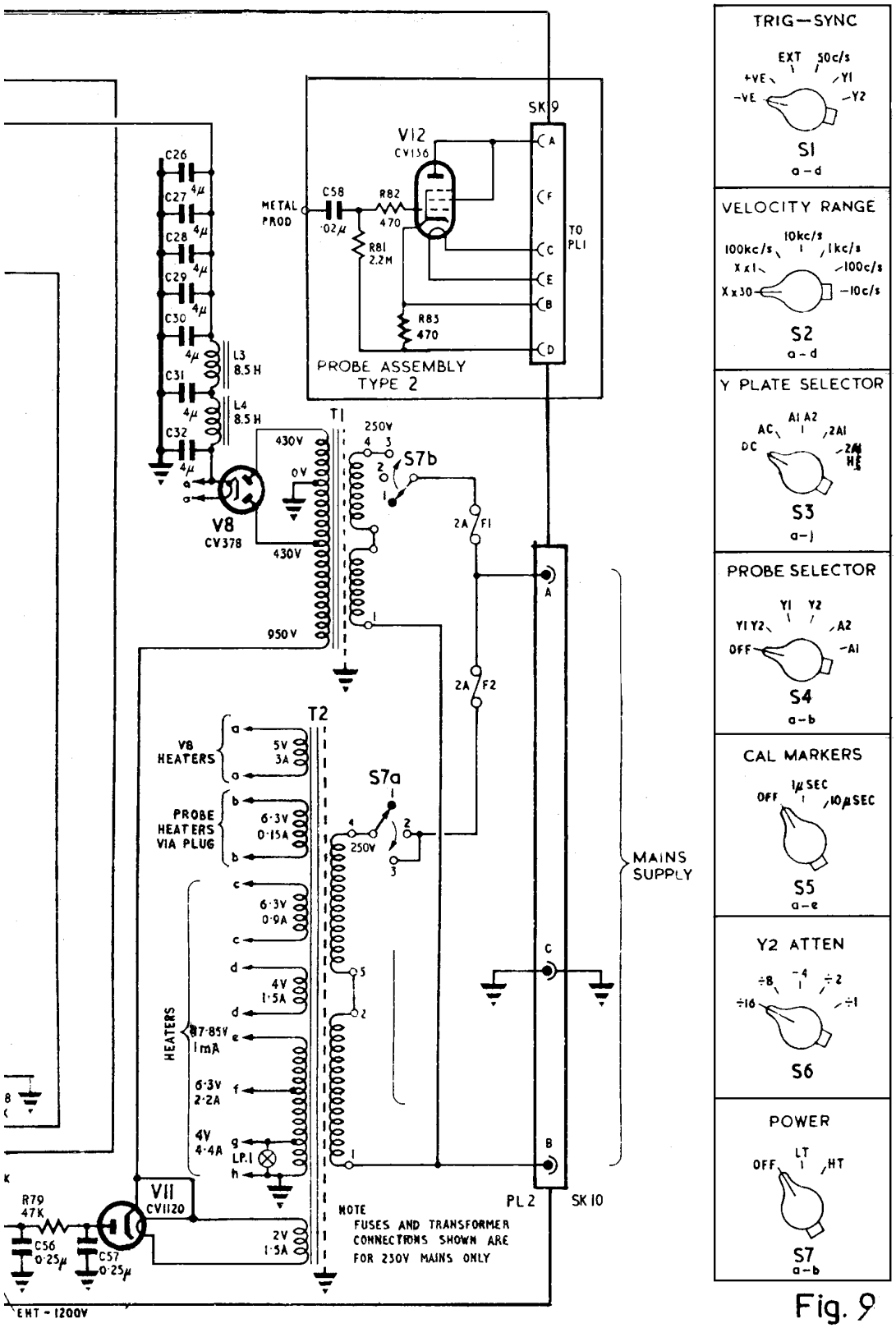


Fig. 9