CIRCUIT DESCRIPTION

CATHODE-RAY TUBE

A double-beam tube V23 is used with the E.H.T. at 2 kV. For photographic purposes, 4 kV is available and is particularly advantageous for high writing speeds.

The CRT is fitted with a magnetic device for adjusting beam brightness and is set correctly at the Factory for equality of beam current when operating at 2 kV. This device also facilitates equalizing of the brightness of the beams when a signal of higher frequency and/or amplitude to one channel which would otherwise result in a diminution of brightness caused by the higher writing speed.

Two brass, felt-lined clamping bands, each with a compensating magnet in a holder extending from the band, are positioned round the neck of the CRT (see Fig. 1), with the magnet pointing towards its base, and positioned radially so that one of them lies between the CRT base contacts marked A2 and Y2.

A1 AMPLIFIER

The input attenuator assembly is contained inside a screening box with external connections made by low-capacity screened cable. Resistors and capacitors for the fixed steps are of 2 per cent tolerance.

For the attenuator, H.F. compensation is controlled by the trimmer C31 and—for the amplifier—by C33 in the negative feedback loop. The amplifier includes valves V9–V13 fed from a common centre-tapped heater supply, V9 and V10 being of the same type.

The screen supply for V9 is derived from the anode voltage of V10, so that any fall in cathode emission caused by a drop in the heater supply will raise the potential of V10 anode and V9 screen, producing a compensating change in the working conditions of V9. Potentiometers, P11 and P12, set the initial voltage at V9 screen and control the degree of compensation.

After the first stage of amplification, the signals at the anode of V9 are superimposed on the d.c. level set by the Y1 SHIFT and A1 VOLTS controls, calibration for A1 VOLTS control being adjusted by P13. Signal and shift voltages are directly coupled from the anode of V9 to the grid of triode V11, a cathode-follower which, in turn, is directly coupled to the grid of V12.

The cathode-follower, having a lower input capacity than V12, has less shunting on the anode load of V9 at high frequencies. To obviate loss of gain in V12 caused by negative feedback in its cathode circuit, that valve is operated in conjunction with V13 to form a long-tail pair. The output from V13 feeds the trigger and synchronizing circuits while V12 anode is directly connected to Y1. Potentiometer P14 adjusts the d.c. potential on Y1 under no-signal conditions. Response curve for this amplifier is given at Fig. 2 (page 10).

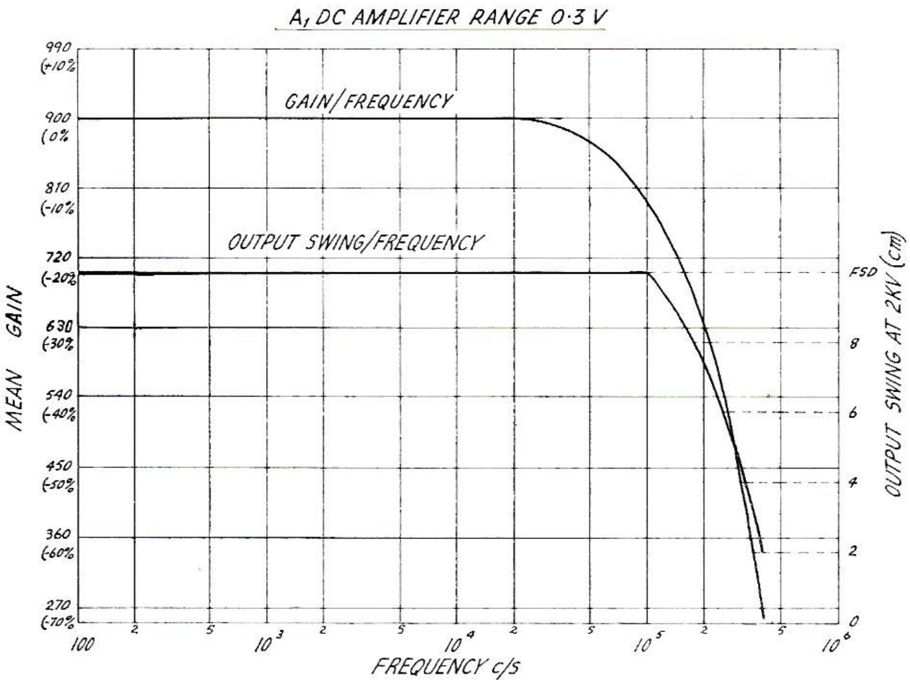


Fig. 2 *Response Curve for A1 Amplifier*

A2 AMPLIFIER

The frequency-compensated input attenuator is controlled by the A2 Sensitivity switch, S13, S14. As in the A1 amplifier, the attenuator has resistors and capacitors of 2 per cent tolerance for the fixed steps. Pre-set capacitor C58 is adjusted to standardize the input capacity of the amplifier valve V21.

The gain of V21 is pre-set by P23 which controls the amount of cathode feedback. Frequency compensation is achieved by adjustment of C65, the pre-set control which reduces the cathode feedback at higher frequencies. The tetrode V22, connected as a cathode-follower, supplies to the anode of V21 an H.T. potential which may be varied by P25 to provide Y2 shift control without affecting the gain of V21.

After amplification, signals are fed to the synchronizing and triggering circuits and direct to the Y2 plate.

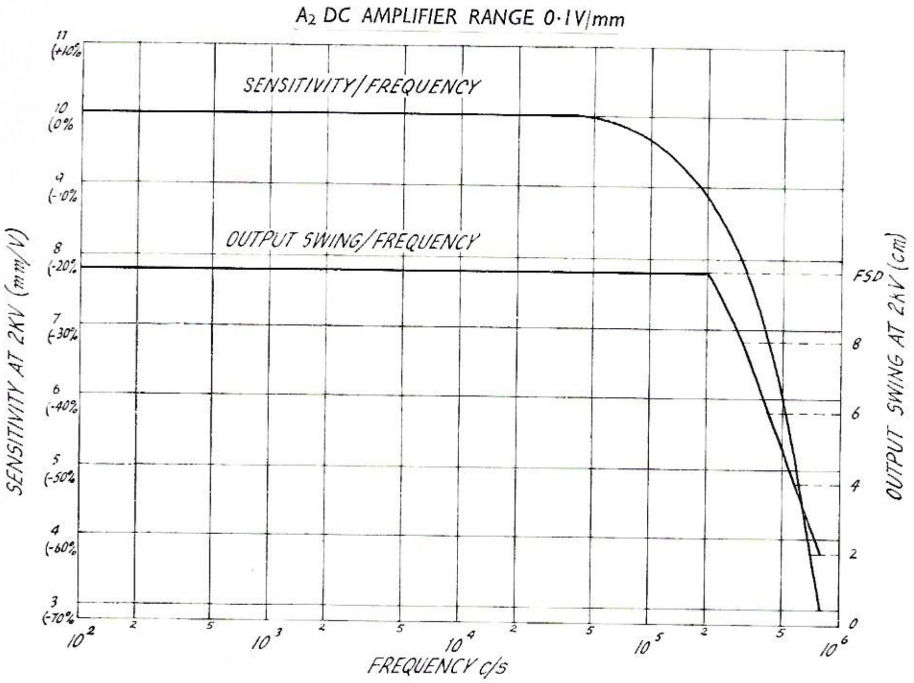


Fig. 3 *Response Curve for A2 Amplifier*

TIME-BASE

General

Four valves are associated with the time-base circuits. Valve V5 is a concertina-type phase splitter and trigger/sync amplifier and V6 governs the time-base frequency. The saw-tooth waveform is produced by V7 and V8, their mode of operation differing for repetitive and triggered time-bases.

Repetitive

A simplified diagram of this circuit is shown in Fig. 4. The Miller valve is V8 while V7 forms its anode load and provides the suppressor switching waveform. At an instant during the scan (forward stroke), V8 is conducting and C11 (or whichever capacitor is selected by S4) will be discharging through R29 and V8 anode until the bottom bend of the Ia/Va characteristic of V8 is reached. When this occurs, the discharge ceases and reduces the grid bias developed across R29 for V7. The fall of anode voltage of V7 through

R35 causes a fall at the suppressor of V8 which cuts off anode current in that valve. There is then no bias to V7 and the cathode current of that valve will flow into C11 and to COMMON via the grid/cathode path of V8 which acts as a diode. Thus, the fly-back stroke, which is very fast because of the low output impedance at the cathode of V7, is initiated. The high anode current in V7 at this instant increases the negative bias on the suppressor of V8 to a high value initially but, as the charging current decreases, this high bias falls also.

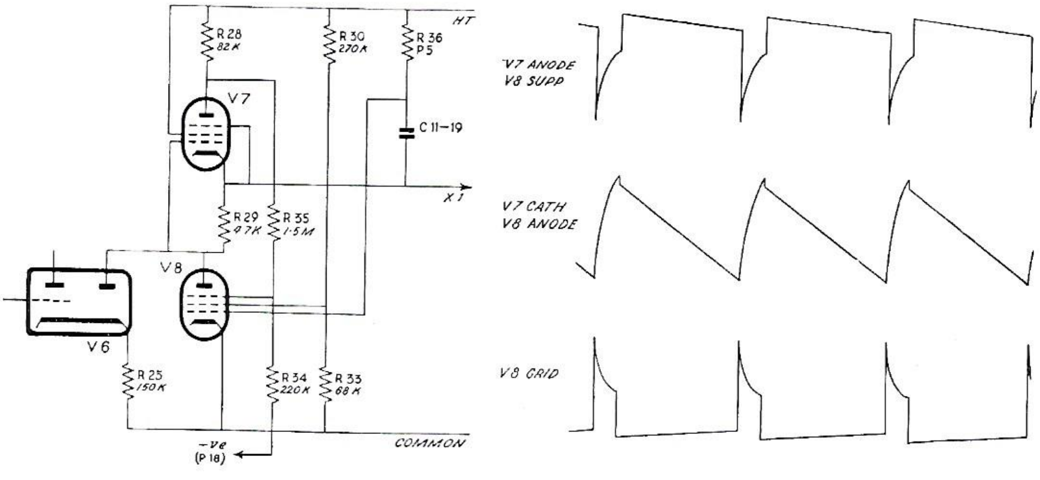


Fig. 4 *Simplified* **Repetitive** *Time-base Circuit*

When the anode of V8 attains a potential equal to that existing at the cathode of V6, the diode sections of V6 conduct and prevent a further rise in the anode voltage of V8. The capacitor charging current ceases and bias is applied to V7 by the diode current flowing through R29, that is, the anode current of V7 is reduced suddenly.

The resulting increase in the anode potential of V7 brings the suppressor of V8 up to cathode potential, allowing that valve to conduct anode current and so reduces the potentials at the anode of V8 and cathode of V7, rendering V6 diodes inoperative. Normal Miller run-down takes place, capacitor C11 discharging through R29 and the anode of V8 to produce a linear fall of voltage at the anode of V8 and cathode of V7. The time-base output is taken to X1 from the cathode of V7.

The point at which the diodes of V6 conduct is determined by the cathode voltage of that valve which, in turn, is governed by the instantaneous grid voltage of its triode section. The d.c. level of the grid is set by the TIME BASE FREQUENCY control and any synchronizing pulses from V5 are superimposed upon this level. Typical voltage waveforms for a repetitive time-base are shown in Fig. 4.

Triggered

A simplified diagram of this circuit is shown in Fig. 5. Valve V8 is operated as a screen-coupled phantastron with V7 as its anode load. In the stable state, the anode current of V8 is cut off by a negative suppressor voltage, its grid is at cathode potential approximately and is taking grid current via the timing resistors R36 and P5, while heavy screen current keeps the screen voltage down to about +ve 20 V. The anode potential of V8 is held by the diodes of V6 at the cathode potential of that valve, the diode current passing through V7.

To initiate the run-down, a negative-going signal must be received from the trigger amplifier. When this occurs, the cathode potential of V6 falls and with it, via V6 diodes, the anode of V8 and cathode of V7. This fall in potential is coupled by C11 (or whichever capacitor is selected by S4) to the grid of V8, reducing the screen current. The rise in screen potential, through R37, C70 makes the suppressor less negative. If the triggering signal is of sufficient amplitude, this rise in suppressor potential will permit anode current to flow. Thus, a further reduction of screen current gives an increased potential to the screen and suppressor, the cumulative action resulting in the anode of V8 being fully conductive.

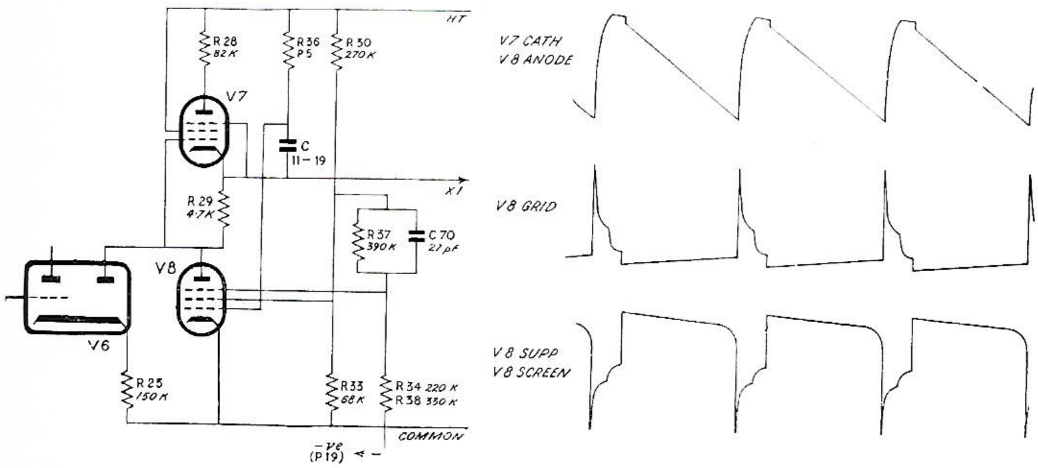


Fig. 5 *Simplified Triggered Time-base Circuit*

During this switching action, the anode voltage of V8 drops sufficiently to cut off the diodes of V6. Since the grid of V8 is in the Miller operating condition, having been driven there by the trigger signal, and the anode of V8 is conducting, the linear run-down begins and continues until the anode of V8 'bottoms', when discharge current of C11 will cease. The screen current of V8 rises rapidly (as the grid voltage leaks away) so that the suppressor cuts off the anode current of V8. Valve V7 then has no grid/cathode bias and recharges C11 rapidly through the diode formed by the grid/cathode path of V8. The rising potential at the anode of V8 is limited by the diodes of V6 conducting to complete the fly-back; the circuit is then ready for re-triggering. Typical voltage waveforms are shown above.

INTENSITY MODULATION

The modulating voltages on the grid of the CRT are derived from the balanced detector valve V18, which is mounted on a small sub-chassis because it operates at almost the full negative E.H.T. voltage. Valve V18 is coupled via the low-value, high-voltage capacitor C43 to a Hartley oscillator V19. Consequently, the CRT beam is cut off while this oscillator is functioning. The second half of V19 and C49 provide decoupling for the oscillator cathode.

The oscillator valve V19 which operates at a frequency of about 4 Mc/s is itself controlled by the bias developed across R107 by the anode current of V20 and is able to function only when the anode current of V20 is cut off.

The anode current of V20 is controlled as described below in accordance with the setting of the four-position Intensity Modulation Selector switch.

OFF. Valve V20 anode conducts, V19 is inoperative and beam current is controlled entirely by the BRIGHTNESS control.

ELEC. The anode current of V20 is controlled by a signal connected between INTENSITY MOD and COMMON terminals: a negative d.c. or negative pulse of above 10 V will cut off the anode current of V20, and, hence, the CRT beam current. Alternating inputs above 7 V r.m.s. will cause the beam to be switched at rates up to 100 kc/s and, thus, a suitable external circuit may be employed to provide time calibration.

MECH. At this setting, a short circuit applied by an external switch across the INTENSITY MOD and COMMON terminals cuts off the screen supply to V20 and thus allows V19 to operate and cut off the beam current. The electrical load on an external contactor is resistive and is less than 2 mA at 70 V.

TRIGGER BRIGHT-UP. At this setting, the grid circuit of V20 is connected to a frequency-compensated potential divider between V8 screen and the junction of R89/P18. Potentiometer P24 pre-sets the quiescent bias on V20 grid sufficiently negative to prevent conduction. Thus, the beam is cut off until the time-base is triggered when a positive pulse from the screen circuit of V8 is fed via R32 and C37 to the grid circuit of V20, resulting in the switching on of the CRT beam. This position is intended for use when operating the time-base in the triggered mode and permits photography of transient phenomena without danger of fogging and also protects the CRT screen from possible damage caused by the spots remaining stationary.

Minimum interference with the displayed waveform is assured by this method employed to provide, for example, Time markers by intensity modulation and, for this reason, intensity modulation is preferable to Time markers superimposed as amplitude modulation.

POWER SUPPLIES

General

The instrument is designed to operate from 50 c/s to 100 c/s supplies of 105 V to 130 V or 200 V to 250 V and is stabilized against variations of up to $\pm 10\%$ on the mean voltage for each tapping range, that is, 110 V, 125 V or 207 V, 225 V and 245 V. The return path of all circuits (COMMON) is isolated from the chassis except for a 470 pF capacitor and a removable link on the side panel.

The power load is carried by three transformers; T1 and T3 supply the heater circuits and the third transformer T2 provides the H.T. and E.H.T. potentials and CRT heater supply. To assure maximum reliability, T2, which has a C-core, is oil-filled and no electrolytic capacitors are employed in the oscillograph. Two 3 A fuses are arranged in the primary circuit of the transformers and another, F3, rated at 500 mA, in the high-tension secondary of T2. The fourth fuse F4 is located in the primary circuit of T2 and is rated at 2 A.

+ve 650 V H.T. Circuit

The positive supply for the time-base and amplifiers is obtained from a voltage-doubler system and is electronically stabilized by a circuit incorporating a Metrosil bridge. A simplified diagram of these circuits is shown in Fig. 6.

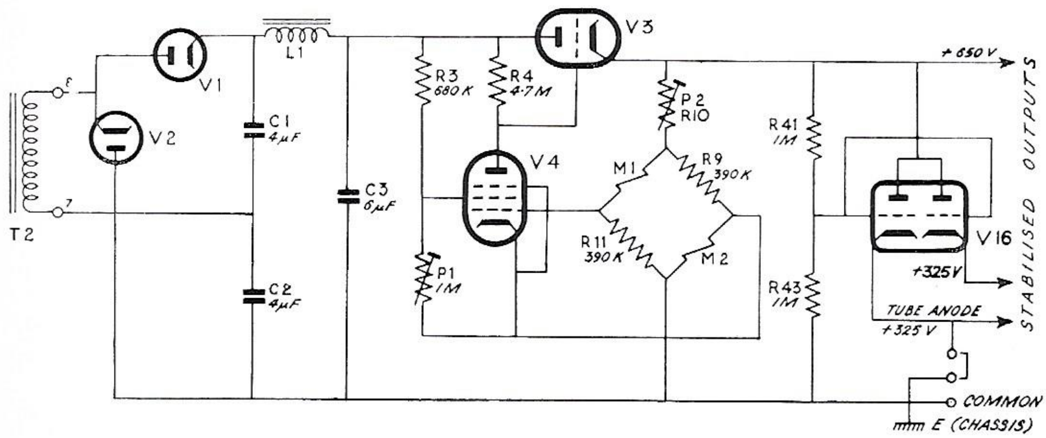


Fig. 6 *Simplified H.T. Circuit*

By returning the negative terminal of C2 to COMMON, the potentials developed across C1 and C2 become additive and, after smoothing provided by the choke input filter L1, C3, supply 900 V to the stabilizing circuit. A small decrease in the potential of the 650 V H.T. line will increase the resistance of Metrosils M1 and M2 and, hence, the grid-cathode potential of V4. The rise in voltage of V4 anode is coupled to the control grid of V3 increasing its conductance and so minimizing the change in voltage of the H.T. line.

Additional stabilization and smoothing is provided by feeding the screen grid of V4 with a portion of the voltage at V3 anode. Potentiometer P2 sets the voltage level whilst P1 governs the degree of stabilization.

2 kV and 4 kV E.H.T. Circuit

This stabilized negative supply for the CRT is obtained from the half-wave rectifier V14 in conjunction with C39. The positive return is through V15 (shunted by R73) and the screen grid of this valve is fed from a potential divider across the stabilized 650 V supply. Stabilization is achieved by feeding the grid of V15 with a portion of the E.H.T. voltage.

Smoothing is obtained by feeding also to the grid of V15 a ripple voltage coupled by C40. Valve V15 operates as a cathode-follower and reduces the ripple to approximately 10 V at 4 kV.

The alternative operating potential of 4 kV has been provided to make possible the high writing speeds necessary for the observation and photography of certain transient phenomena. Transition from the normal 2 kV to the 4 kV operating condition is effected by transposing, to the right, the three plugs located in the panel behind the rear trap-door in the case. The instrument must be switched off before transposing these plugs (see page 8).

With the links positioned for 4 kV operation, the full E.H.T. secondary of T2 is used whereas in the 2 kV position, half of this winding is employed. Voltage adjustment is provided by pre-set controls for both 2 kV and 4 kV operation by variations of bias on V15. In the 2 kV position, potentiometer P17 is used and on the 4 kV position P16.

Heater Circuits

Ten separate heater windings are provided by the three mains transformers.

On T3, tags 27–28 are tied to +ve 650 V and feed V3; tags 30–31 and 32–33 feed the voltage doubler rectifiers V2 and V1 and are tied to their respective cathodes; tags 34–35 feed V4 and are tied to its cathode.

On T2, tags 36–37 feed the CRT and V18 and are tied to the CRT cathode potential; tags 11–12 feed V14 and are connected to its cathode.

On T1, tags 18A–18B supply V22 and are connected to its cathode through R137; tags 16–17 feed V6 and are tied to its cathode through R125; tags 19–20 are connected to +ve 325 V and supply V16, V7, V19; tags 21–22 are centre-tapped to common through R133, R134 and supply V5, V8, V9, V10, V11, V12, V13, V15, V20 and V21.

SERVICING

Caution: Do not touch any part of the circuit while the power supply is connected to the instrument. When the oscillograph is switched off, not less than two minutes must be allowed to elapse before touching any part of the wiring. Some tags of the CRT holder and terminals on the side panels carry very high potentials. Contact with such points is dangerous.

REMOVING THE INSTRUMENT CASE AND BOTTOM COVER

Switch off the oscillograph. Disconnect the instrument power plug from the mains supply.

Remove the four screws which hold the instrument case to the chassis. Grip the rear of the case between the palms of the hands, lift slightly, then retract the case from the guide-channels in the bottom tray.

If the bottom cover hampers adjustments, remove it by taking out four 2 B.A. screws which hold it to the instrument.

650 V STABILIZED SUPPLY

The load stability of the 650 V supply can be checked by drawing an extra 20 mA with resistors (32·5 kΩ, 15 W) from the H.T. coil to COMMON. For this test, the supply to the instrument must be the exact mean voltage of the tapping range in use. The change in potential should not exceed ± 1 V. If it does so, carry out the procedure given below.

Use a Variac and set the voltage applied to the instrument to the mean value of the tapping range used. Adjust P1 and P2 (see Fig. 8) for an H.T. line of 650 V. Vary the applied voltage by ± 10 per cent when the H.T. line should not alter by more than ± 2 V. If 'under-stabilized', reduce the voltage by adjusting P1 and restore it to 650 V by adjusting P2; if 'over-stabilized', increase the voltage by adjusting P1 and restore it to 650 V by adjusting P2.

E.H.T. SUPPLY

With the E.H.T. links set for 2 kV, connect a 1000 V electrostatic meter from the anode (top cap) of V15 to COMMON and adjust P17 (see Fig. 9) for a reading of 550 V. Measure the E.H.T. voltage with a 2 kV electrostatic meter between the anode (top cap) of V14 and COMMON, checking that it is $-$ve 1650 V ± 100 V.

Apply an audio-frequency voltage between the A2 INPUT and COMMON terminals and adjust its amplitude and/or A2 SENSITIVITY control to obtain a deflection of 6 cm.

Switch off the power to the instrument and change the E.H.T. links to the 4 kV setting. Switch on and adjust P16 (Fig. 9) until a deflection of exactly 3 cm is obtained, checking that the voltage across V15 does not exceed 1000 V.

SETTING UP THE A1 AMPLIFIER

Grid Current

With no connection to the A1 terminals, check that the vertical trace movement does not exceed 2 cm when the A1 Volts Range switch is changed from position 100 to position 0·3.

D.C. Level

Connect an Avometer Model 8 on 1000 V range from the grid of V12 to the grid of V13 (pin 7) and adjust Y1 SHIFT and/or A1 VOLTS until the meter indicates zero on a range not greater than 10 V full scale deflection. Bring the trace to the horizontal centre line, using P14 (see Fig. 8) and maintaining the grid-to-grid voltage at zero by altering the shift controls when necessary. Remove the meter.

Heater Compensation

Reduce the mains input to the instrument by 10 per cent from the mean value of the tapping range in use, note any trace movement and return the mains to the mean value. If the movement was greater than 2 mm and downwards, move P11 (Fig. 8) clockwise and restore the trace to centre line with P12 (Fig. 8).

Re-check and readjust until the trace moves less than 2 mm for a 10 per cent mains change. Repeat the checks with an increase of 10 per cent and, if necessary, make further adjustments to P11 and P12 until the trace remains within ±2 mm of the centre line throughout the range of ±10 per cent on the mean mains voltage.

A1 Volts Calibration

Apply a standard 50 c/s input of 5 V ±3 per cent peak-to-peak between A1 INPUT d.c. and COMMON terminals with the A1 Volts Range set to 10. Adjust P13 (Fig. 8) until the amplitude measured with the A1 VOLTS control is correct. Other ranges should be checked with suitable standard inputs and an accuracy of ±10 per cent obtained throughout by alterations to P13.

Square-wave Response, H.F.

Set A1 Volts Range to 0·3, Time Range to 150 μsec and Sync Selector to TRIGGERED Y1. Apply to the A1 INPUT d.c. terminal a 12 kc/s square wave (maximum rise-time 0·2 μsec) of an amplitude to give a 4 cm deflection. Adjust the TRIGGER or SYNC control to obtain a steady display with the TIME BASE FREQUENCY control at or near its fully counter-clockwise position and adjust C33 (Fig. 8) until overshoot is not visible.

Turn the A1 Volts Range to 1, increase the input to restore a 4 cm deflection and adjust C31 (Fig. 8) until again the overshoot is zero.

Switch to other ranges in turn with suitable inputs and check that the overshoot or undershoot is never greater than 5 per cent and that the rise-time remains approximately constant. Note which range has the longest rise-time, that is, undershoots most.

Frequency Response

With the A1 Volts Range switch at the setting giving the longest rise-time, apply a sinusoidal input to the A1 d.c. terminal to give a 3 cm deflection at 1 kc/s.

Maintaining this level of input, check that the gain does not fall by more than the percentages given below for the frequencies quoted:

90 kc/s	200 kc/s	300 kc/s	400 kc/s
10%	30%	50%	70%

Using the INPUT a.c. terminal, the gain at 50 c/s should be within 10 per cent of that at 1 kc/s.

SETTING UP THE A2 AMPLIFIER

Sensitivity

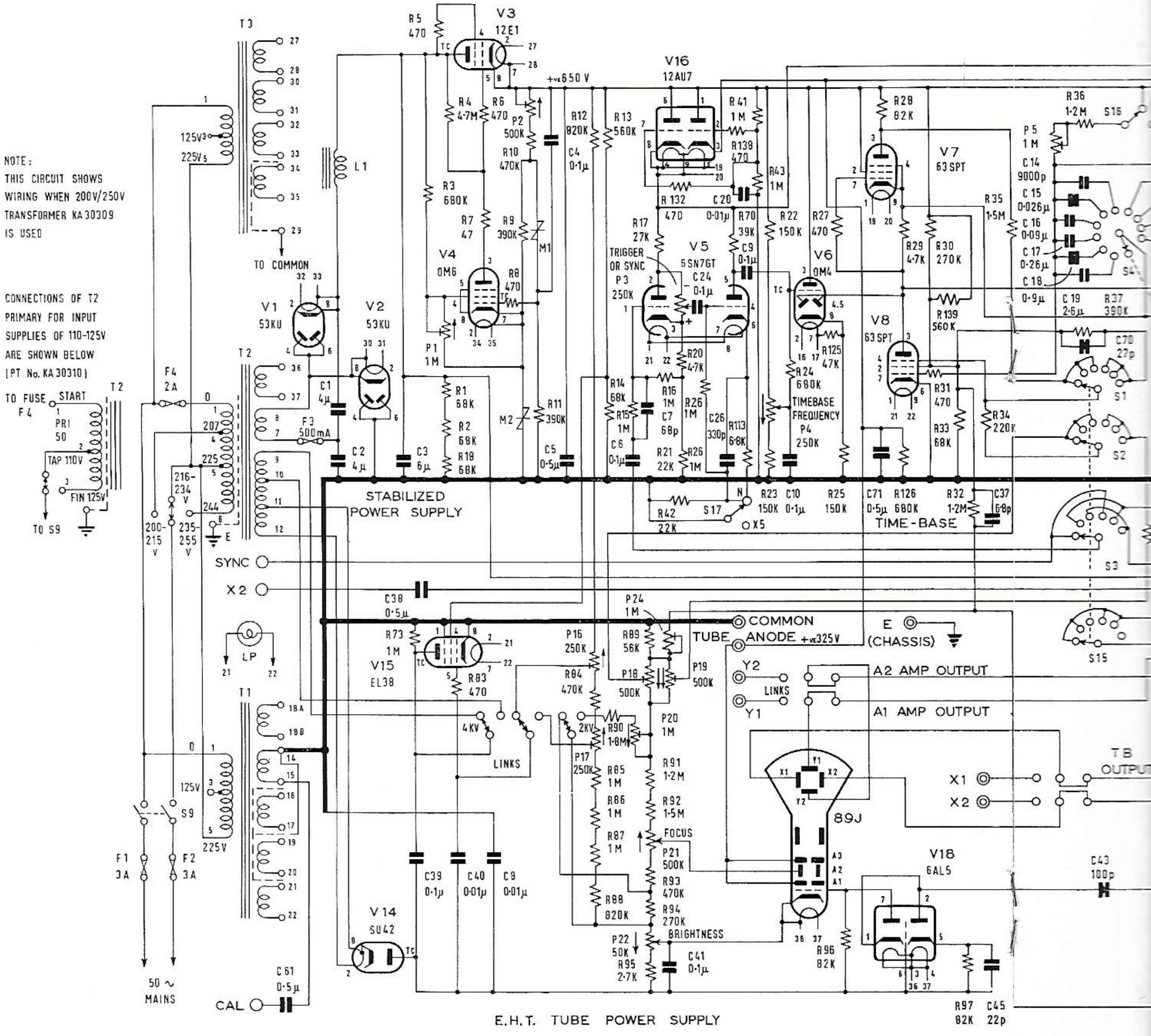
Apply a standard input of 5 V ±3 per cent peak-to-peak to the A2 and COMMON terminals with the A2 Sensitivity switch at 0·1 V/mm. Adjust P23 (see Fig. 8) to obtain a 50 mm deflection.

Check other ranges with suitable standard inputs and obtain an accuracy of ±10 per cent throughout by further adjustments of P23 where necessary.

Square-wave Response, H.F.

With the A2 Sensitivity switch at 0·1 V/mm, apply a 12 kc/s square wave voltage (maximum rise-time 0·2 μsec) to the input to give a 3 cm trace and adjust C65 (Fig. 8) to the point where the overshoot is not visible.

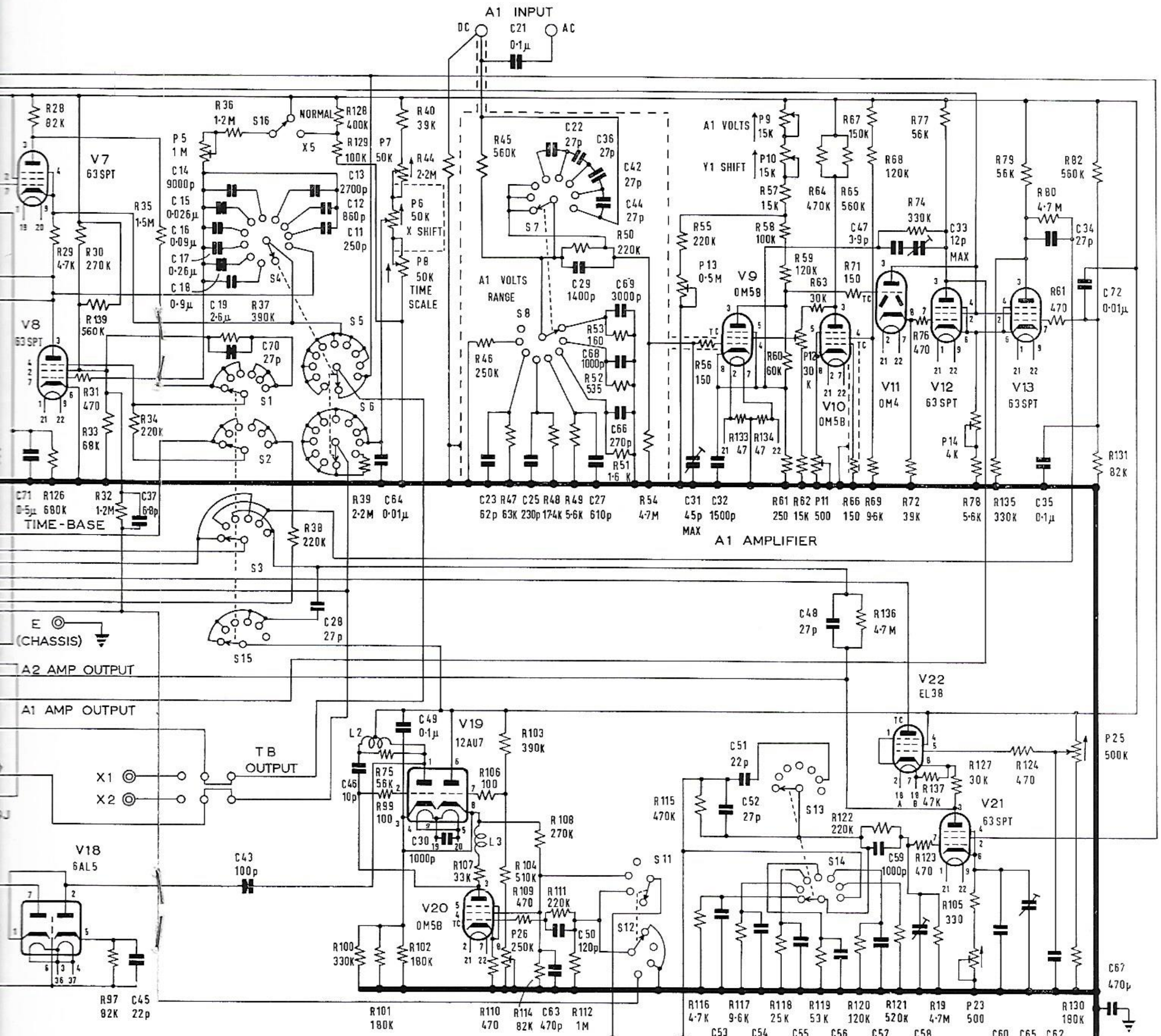
Change to the 0·2 V/mm range, increase the input to restore a 3 cm display and adjust C58 (Fig. 8) to give zero overshoot.



S1 S2 S3 AND S15 GANGED	SYNC SELECTOR
S4 S5 AND S6 GANGED	TIME RANGE
S7 AND S8 GANGED	A1 VOLTS RANGE
S9	MAINS ON/OFF
S11 AND S12 GANGED	INTENSITY MOD SELECTOR
S13 AND S14 GANGED	A2 SENSITIVITY
S16 AND S17 GANGED	TIME SCALE X5

NOTE: 1 ALL SWITCHES ARE SHOWN IN COUNTER-CLOCKWISE POSITION AS VIEWED FROM SPINDLE END
2 METALIZING PINS OF 0M6 63SPT AND 0M4 VALVES TOGETHER WITH CAN CONNECTIONS ARE ALL CONNECTED TO 'COMMON'. SCREENING CAN FOR 6AL5 IS NOT CONNECTED
3 A1 ATTENUATOR SCREEN IS CONNECTED TO 'COMMON' NOT 'E' (CHASSIS)
4 CHASSIS MUST CONNECT TO 'COMMON' OR 'TUBE ANODE' BY SIDE TERMINAL PANEL ONLY

CIRCUIT DIAGRAM



-CLOCKWISE POSITION AS VIEWED FROM SPINDLE END

D OM4 VALVES TOGETHER WITH CAN CONNECTIONS

EENING CAN FOR 6AL5 IS NOT CONNECTED

ED TO 'COMMON' NOT 'E' (CHASSIS)

OR TUBE ANODE' BY SIDE TERMINAL PANEL ONLY

CIRCUIT DIAGRAM

Switch to other ranges in turn and with suitable inputs, check that the overshoot or undershoot is never greater than 5 per cent and that the rise-time remains approximately constant. Note which range has the longest rise-time, that is, undershoots most.

Frequency Response

With the A2 Sensitivity switch on the range giving the longest rise-time, apply a sinusoidal input to A2 to give a 3 cm deflection at 1 kc/s. Maintaining this level of input, check that the gain does not fall by more than the percentages given below for the quoted frequencies:

180 kc/s	400 kc/s	600 kc/s	800 kc/s
10%	30%	50%	70%

PANEL LIGHT

To remove the 6 V bulb which illuminates the name-plate, detach the raising member by squeezing the two end-pieces inwards; remove the four screws adjacent to the rubber feet and take off the base-plate. Do not remove the case.

Withdraw the bulb in its rubber moulding by making a quarter-turn to bring the two lugs on the moulding into line with corresponding cut-outs in the metal box.

SETTING UP THE TIME-BASE

Repetitive

Set the E.H.T. links to 4 kV, Sync Selector to REPETITIVE EXT, Time Range to 50 msec, TIME SCALE to 0 and TIME BASE FREQUENCY and X SHIFT controls fully counter-clockwise. Adjust P19 (Fig. 9) to bring the right-hand end of the trace to the centre vertical graticule line. Set the X SHIFT control fully clockwise and check that the left-hand end of the trace, which should be at least 4 cm in length, is within ½ cm of the centre line.

Switch off the power supply and change the E.H.T. links to the 2 kV setting. Switch on and return the X SHIFT control to its fully counter-clockwise position. Adjust P20 to bring the right-hand end of the trace to the centre line and, if this involves much alteration, check the E.H.T. supply. If necessary, reset and repeat this setting-up procedure for the time-base.

Triggered

Position the E.H.T. links to 2 kV, put the Sync Selector to TRIGGERED EXT, the Normal/X5 switch to X5. Set P5 to its mid-position and P24 fully counter-clockwise. Put the TIME SCALE to 0 and the TIME BASE FREQUENCY and X SHIFT control fully counter-clockwise. Adjust P19 (see Fig. 9) until the time-base ceases to free-run on any Time Range. Check that trace length, when triggered, is not less than 7 cm. In particular, check that the time-base does not free-run with the Intensity Modulation Selector in the TRIGGER BRIGHT-UP position.

Time Scale Calibration

Note: Any generator or Time Marker used for Time calibration should have a frequency accuracy of ±1 per cent or better.

Put the E.H.T. links to 2 kV, A1 VOLTS RANGE to 30, the Sync Selector to TRIGGERED Y1, the Normal/X5 switch to NORMAL and the TIME RANGE to 50 msec. Connect an audio generator to A1 INPUT d.c. terminals, tune to 400 c/s and adjust the output to give a deflection of 4 cm. Turn the TIME BASE FREQUENCY control fully counter-clockwise and adjust TRIGGER or SYNC control until the time-base just fires consistently. Set the TIME SCALE to 0 and bring the second peak of the waveform to the centre vertical graticule line by using the X SHIFT control.

Adjust P5 (see Fig. 9) until exactly 8 cycles are obtained between 0 and 2 of the outer TIME SCALE calibration. The other ranges should be within ±10 per cent of the data given below:

Time Range	Frequency	Cycles Displayed	Time Scale
1500 msec	2 c/s	2	0–10 (inner)
500 msec	10 c/s	2	0–2 (outer)
150 msec	100 c/s	6	0–6 (inner)
15 msec	1 kc/s	6	0–6 (inner)
5 msec	2 kc/s	4	0–2 (outer)
1500 μsec	10 kc/s	6	0–6 (inner)
500 μsec	20 kc/s	4	0–2 (outer)
150 μsec	100 kc/s	6	0–6 (inner)

On 1500 μsec range, check that Normal/X5 switch gives a reduction in sweep velocity of 5:1 ±3 per cent.

Sync Checks

Switch the Sync Selector to REPETITIVE EXT, apply a sinusoidal 10 V peak-to-peak signal to the SYNC and A2 terminals and check that the trace can be synchronized on every Time Range setting at NORMAL speed with suitable frequencies from 20 c/s upwards.

Note: The start of the trace should be negative, that is, downwards, when the TRIGGER or SYNC control is set in the negative direction.

Repeat the test with the Sync Selector on REPETITIVE Y2. Change the input to the A1 INPUT d.c., set the Sync Selector to REPETITIVE Y1 and again check synchronization of the trace. Use a 1 cm deflection in both instances. Always use 6 cycles of signal displayed on screen.

Trigger Checks

Switch the Sync Selector to TRIGGERED EXT, apply a sinusoidal 10 V peak-to-peak signal to the SYNC and A2 terminals and check that the time-base can be triggered by frequencies above 20 c/s by adjusting the TRIGGER or SYNC control. For frequencies between 2 and 20 c/s, apply a 20 V signal.

Change the Sync Selector to TRIGGERED Y2 when the time-base should operate with a 1 cm deflection for frequencies above 20 c/s and with 2 cm deflection from 2 to 20 c/s.

Repeat the last step with the generator connected to the A1 INPUT d.c. terminal and the Sync Selector at TRIGGERED Y1. Use 6 cycles of signal displayed on screen. On any range, check that the signal used to trigger at NORMAL speed also triggers at X5 speed.

Trigger Delay

Put the Sync Selector to TRIGGERED EXT, the Time Range to 150 μsec and TIME BASE FREQUENCY control fully counter-clockwise. Transpose the side-panel Y1 link to the left and connect a 470 kΩ resistor from the associated terminal to the TUBE ANODE terminal and a 1000 pF capacitor from Y1 to the SYNC terminal.

Apply a negative 1 μsec square pulse (maximum rise time 0·2 μsec) to the SYNC terminal and turn the TRIGGER or SYNC control in the −ve direction until the time-base fires consistently.

Note: The displayed pulse should have a flat top, indicating a trigger delay of less than 1 μsec.

Repeat the test with a positive pulse and SYNC or TRIGGER in the positive direction. Remove the added components and change back the Y1 link.

SETTING UP THE INTENSITY MODULATION

With the Intensity Modulation Selector positioned at OFF and an Avometer Model 8 on the 1000 V range connected between COMMON and V19 cathodes (pins 3 and 8), adjust P26 (see Fig. 9) to obtain a reading of 400 V.

With the Selector at TRIGGER BRIGHT-UP, any Time Range (X5 position), the Sync Selector in a TRIGGERED position and no input signal, carefully adjust P24 (Fig. 9) so that the spots just disappear.

Check that, when the Selector is in the TRIGGERED position, the fly-back is suppressed on all ranges, except that when using the time-base as a divider circuit, a small amount (2 cm approx.) of fly-back is allowable at the right-hand end of the trace on ranges faster than 5 msec.

Check that turning the Intensity Modulation Selector to the TRIGGER BRIGHT-UP position does not materially shorten the time-base length.

CALIBRATION VOLTAGE

To check the 50 V peak-to-peak winding of T1, connect a suitable voltmeter between the CAL and COMMON terminals.

Note: If the voltage is checked with a low-resistance meter, the reactance (6370 Ω) of the capacitor C61 (0·5 μF) must be taken into account.

BEAM BRIGHTNESS EQUALIZER

Caution: Do not touch any part of the circuit while the power supply is connected to the instrument. When the oscillograph is switched off, two minutes, at least, must be allowed to elapse before touching any part of the wiring. Some tags of the CRT holder and terminals on the side panels carry very high potentials. Contact with such points is dangerous.

Remove the instrument case from the chassis as described on page 17.

Remove the four screws securing the aluminium casting on which the leather carrying handle is mounted, thus obtaining access to an arcuate cover in the Mumetal screen.

Remove this screen and slacken off the two clamp screws of the magnetic adjuster.

With the instrument switched on and the BRIGHTNESS control set so that the two traces are just visible, carefully slide the magnet assembly up and down the tube neck until both beams are of equal brightness. Put back the arcuate cover in the Mumetal screen and re-check the brightness.

To correct for lowered beam brightness resulting from a greater signal excursion on one beam, adjust the brightness with appropriate signals applied to the inputs of the amplifiers as already outlined. If the operating voltage of the instrument is changed from 2 kV to 4 kV or vice versa, re-check these adjustments. Alternatively, make the adjustment initially so that at either setting of the tube supply a reasonable compensation is maintained.

If the magnets are removed from their holders, care must be taken to replace them the same way round.