

PHILIPS



CATHODE RAY OSCILLOGRAPH

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TYPE GM 3150

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No. GM 3150

Field of application

The Philips cathode ray oscillograph operating with the Philips oscillograph tube type No. 3957* makes it possible, in view of its flexibility and the exceptionally large frequency-range to which it can be adjusted, to undertake research in very many fields. For instance, a few of the examinations which can be conducted are given below:

1. Analysis of wave forms,
2. Determination of distortion,
3. Adjustment of radio receivers, adjustment of band-pass filters, etc.
4. Examination of rectifiers,
5. Study of surges,
6. Calibration of measuring instruments,
7. Measurement of modulation depth,
8. Plotting valve-characteristics,
9. Study of switching-on and switching-off phenomena,
10. Making L.F. characteristics visible,
etc.

Generally speaking, therefore, this oscillograph is suitable for analysing all periodic currents and voltages within a wide frequency-range.

Operation

As is known, the application of the Braun tube as an oscillograph is based on the control of a narrow beam of electrons by means of *two deflecting organs* at right angles to each other, and where *electrostatic deviation* is applied in two directions, *two pairs* of deflection plates. The beam of electrons produces on the *fluorescent screen* (bright green light) a luminous spot which can be focussed by means of what is called an *electron lens*.

When a periodic voltage is applied to each pair of plates the beam of electrons will deviate in two directions perpendicular to each other, so that *closed figures* will be produced on the fluorescent screen, known as *Lissajou figures*. At a certain frequency of these deflection voltages it is possible to make the figures appear

*) For photographic purposes type No 3958 (blue light) is more suitable.

stationary, so that the wave form of one or both alternating voltages is made visible.

Linear time-base

With normal use as an oscillograph, what is known as a *linear time-base* is used for the horizontal deflection of the cathode ray, making it possible for the voltages applied to the vertical deflection plates to become visible without distortion. This linear time-base is supplied by an incorporated apparatus which is adjustable for different frequencies (10 c/s—150 kc/s). Under the influence of this time-base voltage the beam of electrons travels at a constant speed in a horizontal direction from left to right, returning at the end of the line with great speed to the beginning of the line. If therefore there is no vertical deflection-voltage the cathode ray continuously describes a horizontal line on the fluorescent screen.

Fly-back line

When a vertical deflection-voltage is applied it is usually also present when the cathode ray flies back, so that in this case the fly-back no longer coincides with the line and a closed figure for the horizontal deflection becomes visible.

Stationary image

By exact adjustment of the time-base to a certain frequency ratio with the alternating voltage under examination, it is possible, as already mentioned, to make the Lissajou figure stand still; if there is no such relationship, then the figure moves or turns at a speed which, with an incorrect frequency ratio, may become so great that only a luminous band is visible in the whole time-base area. If, for instance, A.C. of 50 cycles is to be made visible, the time-base will have to scan 50 lines per second, so that for every fiftieth of a second the curve of this A.C. will appear on the screen. Since each cycle is reproduced on exactly the same spot the 50 cycles will be superimposed, so that apparently only one cycle is being shown. In view of the fact that the upper limit of the frequency range of the incorporated time-base device is 150 kc and the input amplifier produces a constant amplification up to 500 kc and still amplifies up to 1500 kc, higher frequencies can also be made visible, but in this case several cycles of the A.C. to be examined will extend lengthwise on the line.

Synchronisation

Since for obtaining stationary images it is necessary to maintain the required frequency ratio very strictly it is essential to ensure synchronism between the time-base device and the voltage to be examined. This is effected by allowing the

voltage under examination to act on the time-base device in such a way that this ratio is locked. Fundamentally, therefore, the procedure is as follows when adjusting the oscillograph:

First the amplitude of the time-base oscillation is correctly adjusted, because variation of this amplitude also entails variation of the time-base frequency. Once the image has been correctly adjusted a modification of the time-base voltage amplitude means an alteration to the time-base frequency.

After this the correct frequency range of the time-base device is selected; then, by means of the vernier control the frequency of the time-base is adjusted in such a way that the luminous figure stands almost still. After that the voltage to be examined is used for synchronisation by means of the knob provided for the purpose. At a certain strength of this action the time-base is synchronised, which will become noticeable by the image *suddenly coming to a stand-still*. If the synchronising voltage applied is too high, over-synchronisation may occur causing the image to move periodically. This phenomenon may also occur when the deviation of the time-base frequency from the correct frequency required is too great.

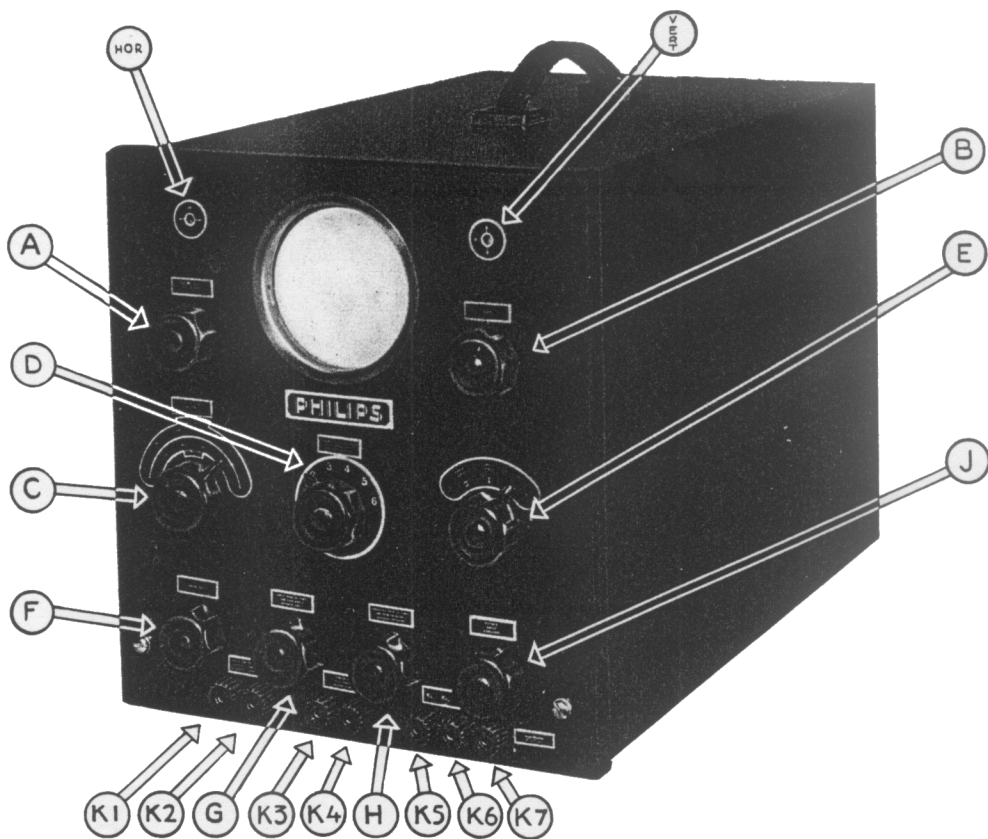


Fig. 2

PHILIPS Cathode ray oscillograph

Switching possibilities

The Philips cathode ray oscillograph is also provided with switching arrangements making it possible to use either the built-in time-base device or a separate one according to choice, whilst it is also possible to synchronise either by means of the voltage to be examined, by a separate source, or by the 50-cycle mains.

Fig. No. 1 indicates the circuit diagram. The time-base device K for the horizontal control of the beam of electrons has two main adjustments, one for the frequency (knob D) and one for the amplitude (knob G). Knob D is the range selector, whilst knob H enables fine adjustment within each range.

Lowest time-base frequency (position 6 of knob D) is 10 c/s, highest frequency is about 150 kc/s (position 1).

Switching positions are also provided (knob C) enabling external time-base to be used. The change-over switch C makes it possible to use the oscillograph in the following ways:

- Position 1: Internal time-base — internal synchronisation
- " 2: internal time-base — external synchronisation
- " 3: external time-base — internal synchronisation
- " 4: external time-base — internal synchronisation
(but with synchronisation without an amplifier, to avoid interfering signals)
- " 5: internal time-base — 50-cycle synchronisation
- " 6: external time-base — 50-cycle synchronisation

In this way practically all possibilities have been included, giving the oscillograph a very great flexibility.

Deflection

For vertical deflection a 3-valve amplifier is provided the first valve of which acts as a normal amplifier stage, and the other two as a push-pull amplifier. This amplifier is so designed that it has an exceptionally flat characteristic, so that the lowest as well as the highest frequencies are amplified without amplitude distortion.

The switch knob E makes it possible to use at will one or both amplifier stages or to apply the voltage to be examined direct to the deflection plates. The positions from left to right are as follows:

Position	Amplifier stages	Input voltage*
1	2-stage amplifier switched on	5 mV _{eff}
2	1 amplifier stage switched on	80 mV _{eff}
3	The voltage to be examined applied direct to the deflection plates	10 V _{eff}

*) Required input voltage for 1 cm picture height.

It should be noted that the change-over from position 1 to position 2 displaces the phase of the image by 180° .

The amplitude of the voltage applied is regulated by means of the potentiometer J. In this way the vertical amplitude of the image is also regulated without distortion. When the voltage to be examined is applied direct to the deflection plates this control does not operate. In the event of the load being too high for the voltage-source applied, owing to the resistance of the potentiometer, the potentiometer may be cut out by means of a switch that is operated when the knob is turned to the left as far as it will go. In this case another connecting terminal must be used (see instructions for use).

Adjustment of the cathode ray tube

The intensity of the beam is regulated by knob A with which the negative bias of the grid electrode (and consequently the spot brightness) is controlled. When turned to the left as far as possible the mains-switch of the apparatus is operated. Strict care must be taken that the spot brightness is as low as possible so that the fluorescent screen may have a long life. Special care should be taken that the spot never stands still, because otherwise, especially with a great beam-intensity, a burnt spot on the screen would be the result.

Focussing of the beam is effected by means of knob B, so that the lens voltage of the electron-optical system of the tube is controlled by a potentiometer. For centring the spot, adjusting potentiometers are provided by means of which the spot can be displaced in horizontal and vertical directions. These adjustments must be effected by means of a screw-driver and once completed they need not be repeated. The tube itself can be turned in its longitudinal axis in order to make the image vertical.

The tube is exceptionally well screened against external magnetic and electrical influences by being encased in an iron cylinder. The whole apparatus is very compact and sturdily built and is provided with a universal transformer so that it can be used on all A.C. mains. The anode voltage of the Braun tube is about 1200 volts, so that connection of the apparatus with the case open is dangerous. The apparatus has been designed in such a manner that with normal use there is no danger.

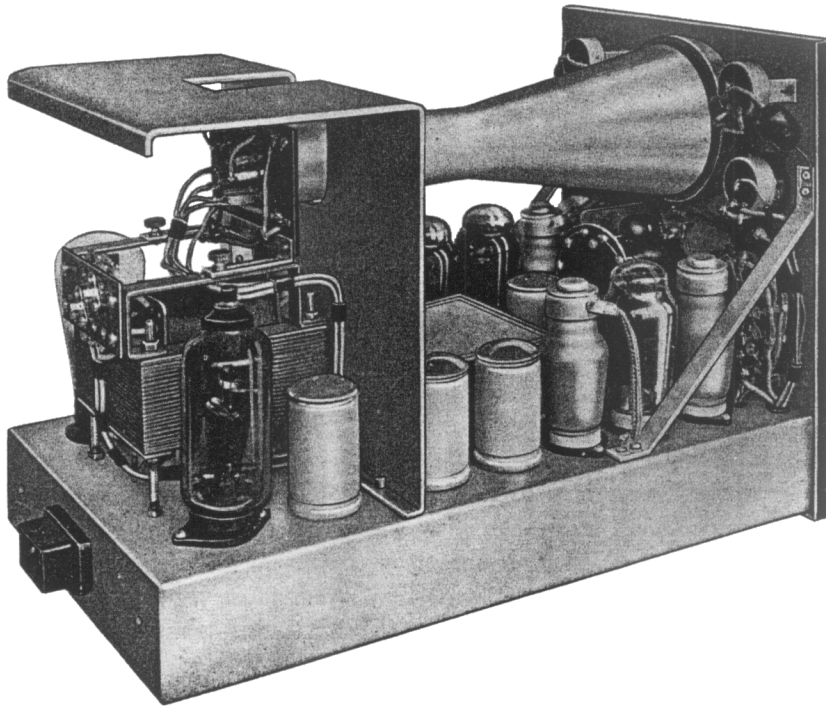


Fig. 3

Interior showing clearly the position of the valves
and the sturdy mechanical construction.

Instructions for use

1. The voltage to be examined is (in normal cases) applied to terminals K5 and K7 (earth).
2. After adjustment of the correct voltage on the mains-transformer the apparatus is closed again and the earth-terminal earthed. Only after this has been done may the apparatus be connected to the mains.
3. The apparatus is switched on by turning the knob A slightly to the right.
4. After a minute has elapsed the knob A is turned till a luminous spot is just discernible. (Switch C at position 3).
5. This spot must now be focussed as sharply as possible by means of knob B.
6. The spot has to be centred on the horizontal axis by means of a small screw-driver.
7. The spot must be centred in the same way on the vertical axis.
8. According to requirement one of the positions of switch C is selected. For normal use, i.e. with internal time-base and internal synchronisation, this position is No. 1.

9. The amplitude of the time-base is now adjusted by means of knob G.
10. The frequency of the time-base to be selected must be of the same magnitude as the frequency of the voltage to be examined.
11. One of the positions of knob E is now selected in accordance with the magnitude of the voltage to be examined. When using positions 1 or 2 potentiometer J must be employed. When the latter is turned to the right amplitude increases. If the picture is too large, even after the knob has been turned back, the switching position 1 of knob E must be changed over to position 2 or even to position 3.
12. The frequency of the time-base is now adjusted as accurately as possible by means of knob H. In most cases the picture will wander slowly even with very accurate adjustment.
13. If the synchronising voltage is now made effective by turning knob F to the right the image will be fixed.

VALVE EQUIPMENT:

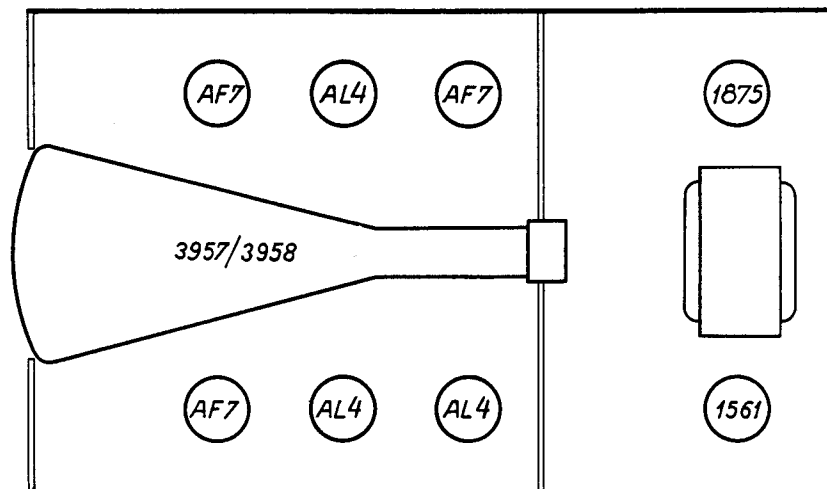


Fig. 4

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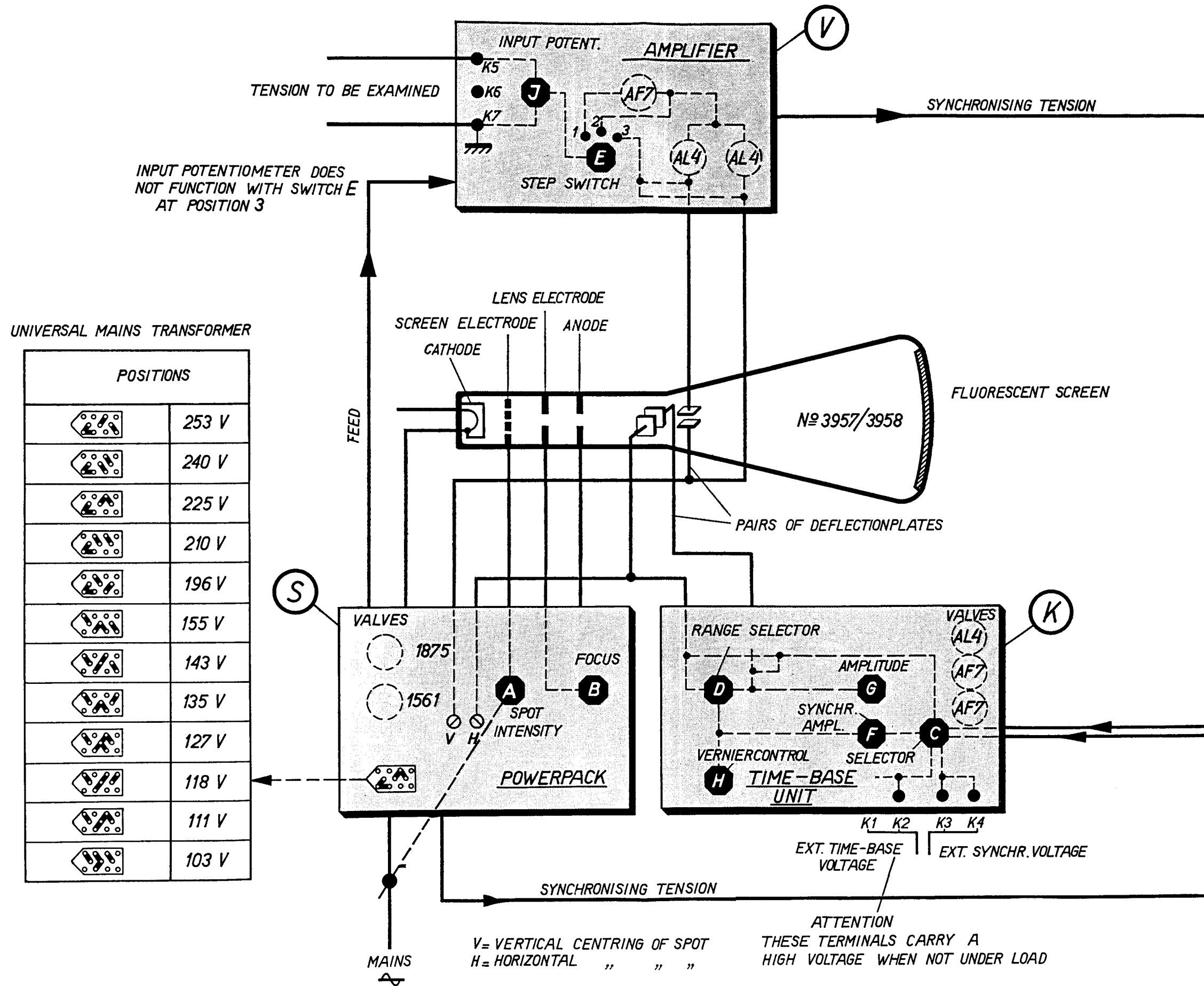


Fig. 1