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CATHODE RAY TUBE
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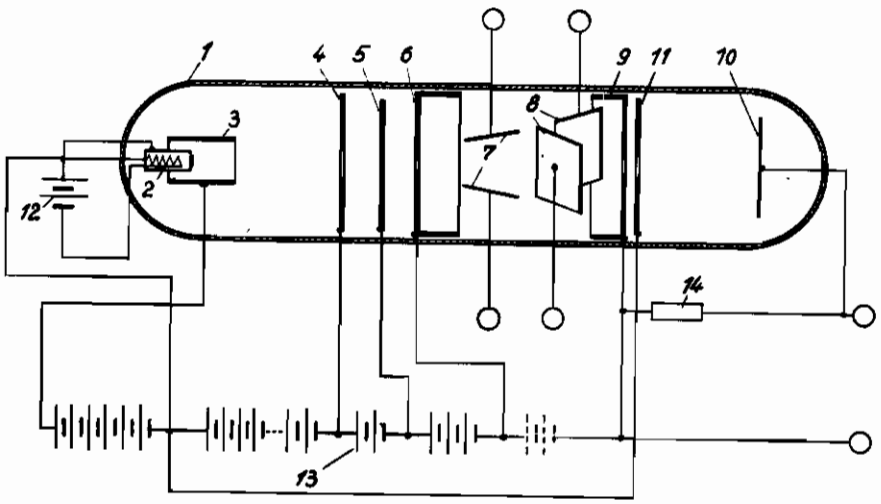

Fig. 1

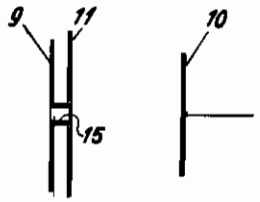

Fig. 2

Fig. 3

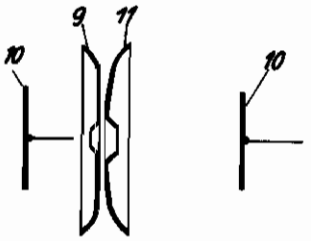

Fig. 4

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ALIEN PROPERTY CUSTODIAN

CATHODE RAY TUBE

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The present invention relates to cathode ray tubes in which means are provided for modulating the intensity of the stream between the cathode and an intercepting electrode (collecting plate) by deflection control with the aid of a cutting-off arrangement. Tubes and systems of this kind can be used as switching devices, so-called cathode ray relays, more particularly electron ray relays, and have been already described in the copending patent applications Ser. No. 96,582 (filed August 18th, 1936) and Ser. No. 112,488 (filed November 24th, 1936).

In employing such tubes one often desires to obtain the highest possible voltage impulses from the device. For this purpose one can connect the one of the taps for the impulses with the collecting plate, the other with the cutting-off diaphragm and insert a resistance between the two electrodes. If the diaphragm is provided with a fixed high potential, for example is connected with the anode of the focussing system or, in a given case, is used itself as an anode, a very high drop of potential occurs at the resistance connected between the diaphragm and the collecting plate. This drop of potential can assume such values that the greater, or at least a considerable part of the electrons which have passed through the diaphragm does not reach the collecting plate but is rejected and returns to the diaphragm. It is evident that by the way the obtainable amount of the voltage impulses is greatly limited.

The difficulty in question can be avoided by giving the collecting plate the highest positive potential which preferably is so much higher than the potential of the diaphragm as is required by the amount of the desired voltage impulse.

The advantage of the just mentioned arrangement, however, is partly compensated by the increased voltage requirement of the device, because voltage supplies must be provided which are able to furnish higher potentials than are required for operating the relay or the tube by itself. Further there is the danger that variations of the potential of the diaphragm cause considerable distortions of the field in front of the diaphragm and that thereby the precise control of the relay is questioned.

It is an object of the present invention to provide arrangements and circuits in and for cathode ray tubes of the above mentioned type which make it possible to avoid the disadvantages of the known arrangements.

According to one feature of the invention, between the diaphragm and the collecting plate there is provided an auxiliary electrode which is so dimensioned, shaped, and biassed, that practically all of the electrons which have passed through the diaphragm reach the collecting plate. The auxiliary electrode prevents that a considerable part of the electrons returns to the diaphragm.

The invention will be better understood with the aid of and further features of the invention will be apparent from the following more detailed description and the accompanying drawing of which, in a purely diagrammatic fashion and by way of example:

Fig. 1 illustrates an embodiment of the complete relay and some essential elements of the circuits connected thereto, while

Figs. 2–4 show various embodiments of the arrangement comprising the cut-off diaphragm, the auxiliary electrode, and the collecting plate.

In Fig. 1 the reference numeral 1 designates the tube vessel which contains the incandescent cathode 2 and an electron-optical focussing system consisting, for example, of the Wehnelt cylinder 3 and the electrodes 4, 5, and 6. Element 6 is the main anode above referred to of the focussing system. Moreover, the figure shows two pairs 7 and 8 of deflecting plates mounted within the tube.

It may be noted that for a certain range of applications only means for deflecting the beam in one direction are required.

The tube further contains the cut-off diaphragm 9 and the collecting plate 10. The auxiliary electrode 11, provided according to the invention, is mounted between the electrodes 9 and 10 and preferably in the closest possible vicinity of electrode 9. The auxiliary electrode is also given the form of a diaphragm. The shape of its aperture corresponds to the aperture of the cut-off diaphragm and is homologous to the latter. Preferably the aperture of diaphragm 11 is somewhat larger than the aperture of diaphragm 9 so that the field produced by the auxiliary electrode 11 does not noticeably penetrate into or through the aperture of 9.

The incandescent cathode 2 is heated by means of a current source 12. The potentials required for operating the tube are furnished by the voltage supply 13 which at the same time provides for the biassing potentials of the several tube electrodes. The electrode 10, the variations of potential of which are to be utilised, is connected via a resistance 14 to the diaphragm 9. The voltage impulses preferably are tapped at the dia-

phragm 9 and the plate 10 or at the cathode 2 and the plate 10.

The potential of the auxiliary electrode 11 is so chosen that, if possible, it is lower than the lowest potential which the electrode 10 is desired to assume in operation. In the example illustrated by Fig. 1, the auxiliary electrode is connected to the potential of the cathode, but in a given case it may be suitable to select the potential of the diaphragm 11 higher or lower than the cathode potential.

The electron-optical system is so designed and the potentials of its electrodes are so adjusted that the electron ray is focussed as sharply as possible in the plane of the boundary of the aperture of the diaphragm 9. For example, the focussing system may be so dimensioned as to concentrate the beam in a cross-over point situated in the aperture of the cut-off diaphragm. The potential of the diaphragm 9 is made equal to anode potential and preferably even somewhat higher. This is indicated by the elements shown in dotted lines of battery 13 in Fig. 1.

Of course, the electrostatic electron-optical system shown in the drawing can be replaced by an electromagnetic system or by combined electrostatic and electromagnetic systems. It is also possible to employ a magnetic deflecting system or, when the beam is to be deflected in two directions, combined electrostatic and electromagnetic deflecting means instead of the electrostatic deflecting system of Fig. 1. Also an intensity control grid may be additionally provided in certain cases.

The field produced by the electron-optical focussing system and correspondingly the shape of the electrodes or at least of the apertures of the electrodes of the electron-optical system need not be of rotational symmetry. Instead of spherical electron-optical lenses, for example, electron-optical cylinder lenses can be used and preferably combined with a corresponding form of the emissive surface of the cathode.

In Figs. 2–4 several embodiments of the electrodes 9, 10 and 11 are illustrated.

Fig. 2 shows a diaphragm 9 provided with a tubular abutment 15 which projects into the aperture of the auxiliary electrode 11.

Figs. 3 and 4 show diaphragms and auxiliary electrodes, the rims of which are bent over in order to avoid as far as possible the danger of breakdown between electrodes which have a high potential difference with respect to one another. In such cases the leads to the electrodes preferably are fixed at the inner sides of the bent parts of the diaphragms or at least at the inner sides facing away from one another of the electrodes.

Various shapes depending on the actual requirements can be given to the aperture of the diaphragm 9, for example the electrodes can be made circular, slit-shaped, triangular or of still other form.

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