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P. T. FARNSWORTH

2,139,814

CATHODE RAY TUBE

Filed Nov. 2, 1936

Fig. 1.

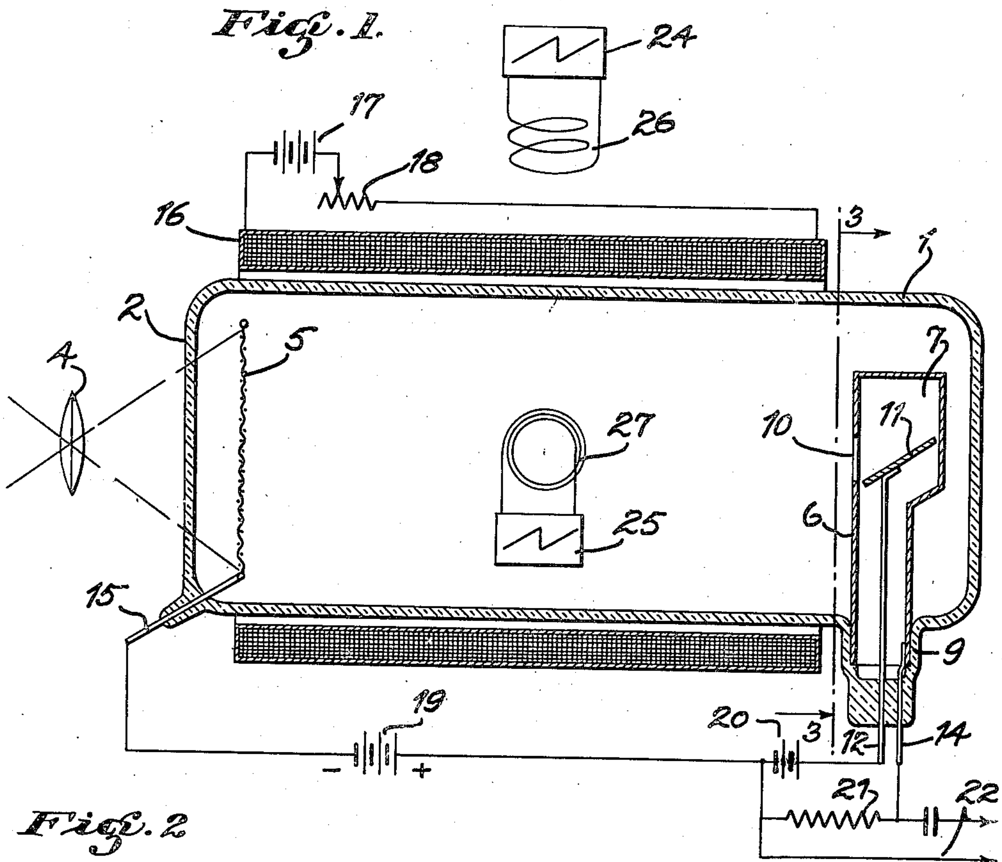


Fig. 2

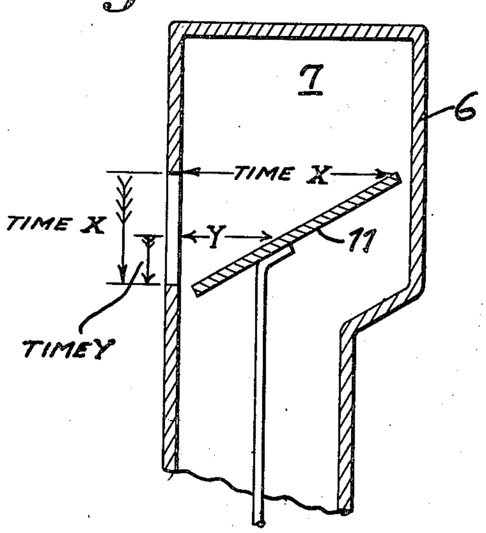
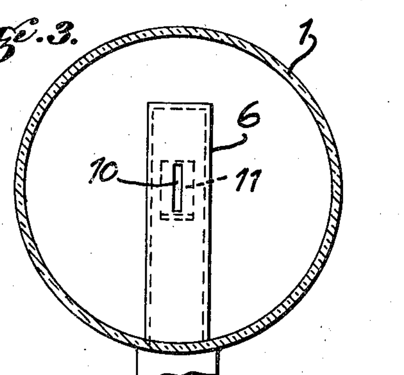


Fig. 3.



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UNITED STATES PATENT OFFICE

2,139,814

CATHODE RAY TUBE

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Application November 2, 1936, Serial No. 108,722

2 Claims. (Cl. 250—150)

My invention relates to electron image dissectors, and more particularly to a target assembly for such dissectors wherein aperture effect is substantially eliminated.

My invention also has particular application to the type of image dissector described and claimed in my patent, No. 1,773,980, issued August 26, 1930. In my prior patent mentioned above, I described and claimed a type of image dissector tube wherein a photoelectric cathode is positioned within an envelope in such a manner as to receive thereon an optical image. Electrons are emitted from the photoelectric cathode and are passed along the tube, meanwhile maintaining their spatial relationship as emitted, and the cross-section of the electron beam thus produced will show electron densities corresponding to the illumination of the elementary area of the photoelectric cathode from which the electrons were emitted. I term the cross-section of such a beam an electron image. I then scan this beam across an aperture in an anode, and collect the electrons passing through the aperture. Inasmuch as the electrons emitted from elementary areas of the photoelectric cathode will be finally collected after having passed through the aperture, these electrons may be used to initiate a television signal, or a signal which represents the dissection of an image with respect to time.

The present invention relates to a particular type of aperture combined with a particular type of collecting electrode, the combination being utilized to minimize aperture effect.

Aperture effect is well known in the art and may be explained simply by saying that certain frequencies having a wave length or harmonics thereof which approach the physical dimensions of the aperture are not satisfactorily differentiated by the aperture, and it is, particularly in television, desirable to eliminate aperture effect. Furthermore, when an electron beam is scanned across an aperture, it is obvious that even though a square-fronted wave be swept across an aperture the waveform passing through the aperture will never be the same as that in front of the aperture, because of the time factor involved in traversing the aperture. In other words, if, in an anode assembly having an aperture therein with a collecting plate behind it, an electron beam is swept across the aperture, and this beam has variations in intensity therein, it is obvious that the time for the electrons to pass from the plane of the aperture to the collecting plate will not be the same as the time required for a definite point in the beam to pass across the extent of the aperture, and this is particularly true when the variations of intensity within the beam are of heterogeneous frequencies.

Aperture effect can be substantially eliminated by causing all the electrons in an elemental area to be collected upon a collector simultaneously instead of being incrementally collected, as occurs when the collecting plate is parallel to the plane of the aperture.

It is therefore the main object of my invention to provide an image dissector tube operating on the principles of my prior patent wherein aperture effect is substantially eliminated, and it is another object of my invention to provide a combination of aperture and collector in an image dissector tube of the type described in my patent, which will allow the electrons of each elemental area to arrive simultaneously upon the collector.

My invention possesses numerous other objects and features of advantage, some of which, together with the foregoing, will be set forth in the following description of specific apparatus embodying and utilizing my novel method. It is therefore to be understood that my method is applicable to other apparatus, and that I do not limit myself, in any way, to the apparatus of the present application, as I may adopt various other apparatus embodiments, utilizing the method, within the scope of the appended claims.

Referring directly to the drawing which illustrates one form of my improved collecting device:

Figure 1 is a longitudinal sectional view of an idealized image dissector tube, wherein an electron image is formed and dissected in accordance with my present invention.

Figure 2 is an enlarged sectional view of the aperture and collecting plate utilized in the device of Figure 1.

Figure 3 is a view partly in section and partly in elevation, taken as indicated by line 3—3 in Figure 1.

The broad aspect of my invention may be more fully understood by detailed reference to the drawing, wherein an envelope 1, preferably cylindrical and elongated, is provided with a transparent window 2 at one end thereof through which an optical image may be projected by lens system 4 on a photoelectric cathode 5. At the opposite end of the tube I position an accelerating anode 6 in the form of a cylinder having an enlarged end 7, this cylinder being supported by the inside walls of an arm 9.

In anode 6, facing the cathode and lying in the axis of the envelope, I provide an elongated aperture 10. Back of this aperture, and within the accelerating anode 6, I position an inclined collecting anode 11, the inclination taking place across the long dimension of the aperture. The collecting anode is supported on lead 12 passing through the end of arm 9, and an additional lead 14 also passes therethrough to provide connection to accelerating anode 6. The photoelectric cathode 5 is also provided with an exterior lead.

The tube may be hooked up for operation by surrounding the envelope with a focusing coil 16, current being passed therethrough from a focusing coil source 17 under the control of a resistor 18. The cathode 5 is attached to the negative end of an accelerating source 19, the positive end of which passes to lead 12 and thence to collecting anode 11 through signal source 20. An output resistor 21 joins the negative end of signal source 20 with accelerating anode 6 through accelerating anode lead 14, and output leads 22 are taken from each end of the output resistor 21.

In operation, an optical image is thrown upon photoelectric cathode 5, which is preferably in the form of a mesh screen. Electrons are emitted from each elementary area of this cathode in accordance with the intensity of light falling thereon. These electrons are drawn through the apertures in the screen and are accelerated toward accelerating anode 6 by the potential thereon, but are maintained in electron image array by the action of focusing coil 16 which maintains a strong longitudinal magnetic field within the tube, and the current through this coil is adjusted so that the electrons to be collected will focus substantially in the plane of aperture 10. Thus, at any instant, electrons from only one elementary area of cathode 5 will enter aperture 10 to fall upon collecting anode 11. The electron stream is then moved past aperture 10 in two directions, preferably at right angles to each other, by the magnetic fields produced by high-frequency oscillator 24 and low-frequency oscillator 25, feeding high and low frequency magnetic deflecting coils 26 and 27, respectively.

It will be noticed that the deflecting coils are so arranged that the electron stream will be passed across aperture 10, so that the path having the highest speed of travel will be parallel to the long dimension of aperture 10, and the low speed deflection will be at right angles to this dimension.

Referring directly to Figure 2, it will be seen that if the length of the aperture be so arranged that each image point passes across the aperture in time X, and the distance from the far end of collecting anode 11 to the edge of the aperture first met by the moving beam is such that an electron traveling from this edge to the collecting plate will also be time X, the collecting plate thereafter slanting toward the opposite end of the aperture, then, under these conditions, substantially all electrons in each elemental area will arrive on the collecting plate 11 simultaneously, thus giving rise to a signal pulse of high amplitude and one which has a substantially square wave front.

It is not possible herein to give exact figures for the relationship of the aperture length to collecting anode angle because of the fact that there are many variants in the operation of the tube. For example, time X changes with the rate of scansion, and therefore the distance between the far edge of the collecting anode and the aperture edge will change for different scanning rates.

Theoretical perfection is, of course, predicated upon the fact that electrons will maintain parallel paths between the aperture and the collecting anode. The actual results obtained, however, fall slightly below that of the theoretical maximum because the electrons will not hold completely to their parallel paths there, and then again, the electrons from the outer edges of cathode 5 will enter the aperture at a slight angle. The latter effect may be minimized by lengthening the tube, thus decreasing the angle between the outer portions of cathode 5 and the final collecting point. The former effect may be minimized as well by allowing the focusing fiields and the scanning fields to operate on the electrons during their passage from the aperture to the collecting plate, all of which expedients will be immediately obvious to those skilled in the art. However, even when such expedients are not used, and even when the exact theoretical angles are not obtained, I have found that practically any substantial inclination of the collecting electrode greatly minimizes the aperture effect, and I therefore do not wish to be limited to an exact approximation of the time of aperture traversal to the time of electron travel between aperture and collecting plate.

I claim:

1. In a cathode ray tube having an envelope containing means for producing an electron stream having varying electron densities in elementary cross-sectional areas thereof, means for collecting electrons in said areas comprising an electrode having an elongated aperture therein, means for moving said beam across said aperture in a path parallel to a long dimension of said aperture, and a collecting electrode positioned back of said aperture and substantially inclined to said dimension and said path.

2. In a cathode ray tube having an envelope containing means for producing an electron stream having varying electron densities in elementary cross-sectional areas thereof, means for collecting electrons in said areas comprising an electrode having an elongated aperture therein, means for moving said beam across said aperture in a path parallel to a long dimension of said aperture, and a collecting electrode positioned back of said aperture and substantially inclined to said dimension and said path, said collecting electrode being at its maximum distance from said aperture at the edge of the aperture first traversed by said beam.

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