June 12, 1951 O. H. SCHADE 2,556,824

CATHODE-RAY TUBE

Filed March 28, 1946 2 Sheets-Sheet 1

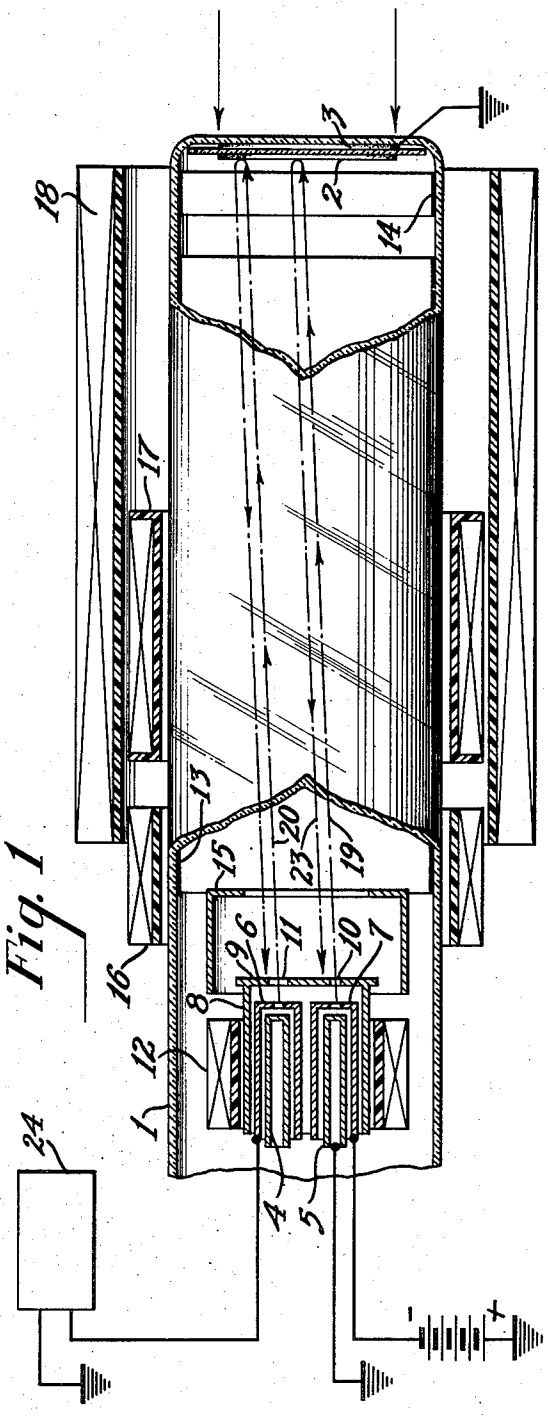


Fig. 1

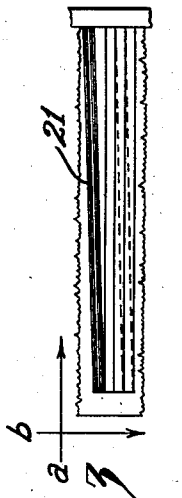


Fig. 3

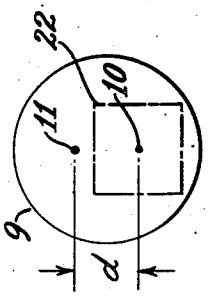


Fig. 2

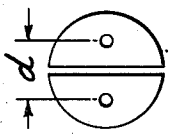


Fig. 6

INVENTOR.
Otto H. Schade
BY
William A. Zalesak
ATTORNEY

June 12, 1951 O. H. SCHADE 2,556,824

CATHODE-RAY TUBE

Filed March 28, 1946 2 Sheets-Sheet 2

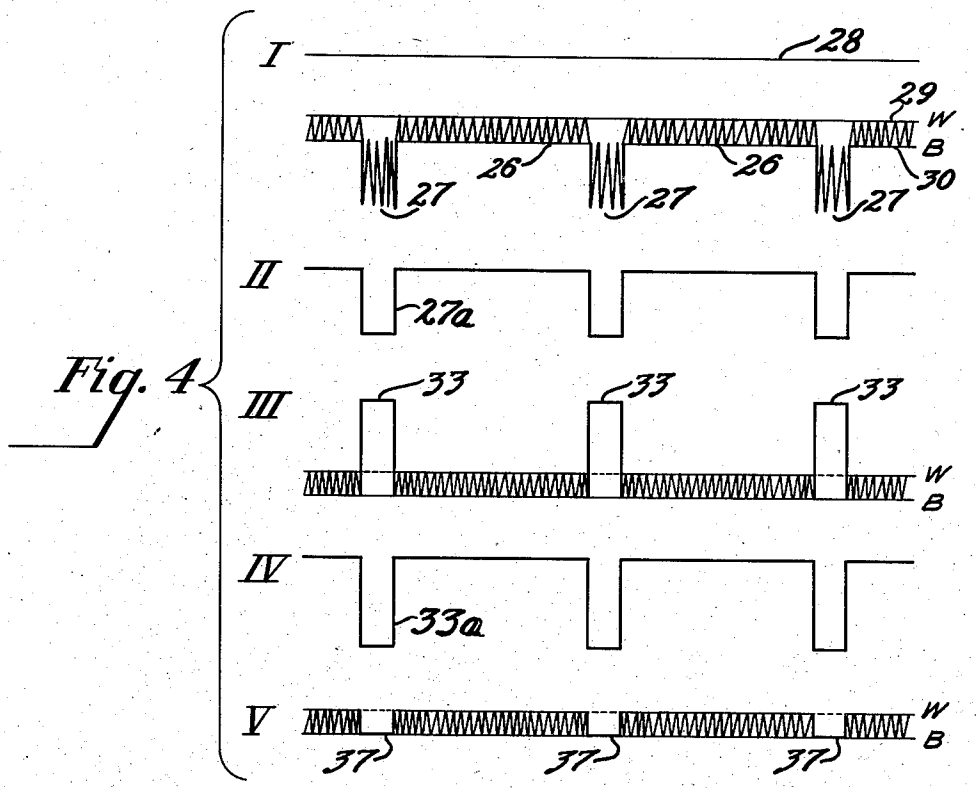
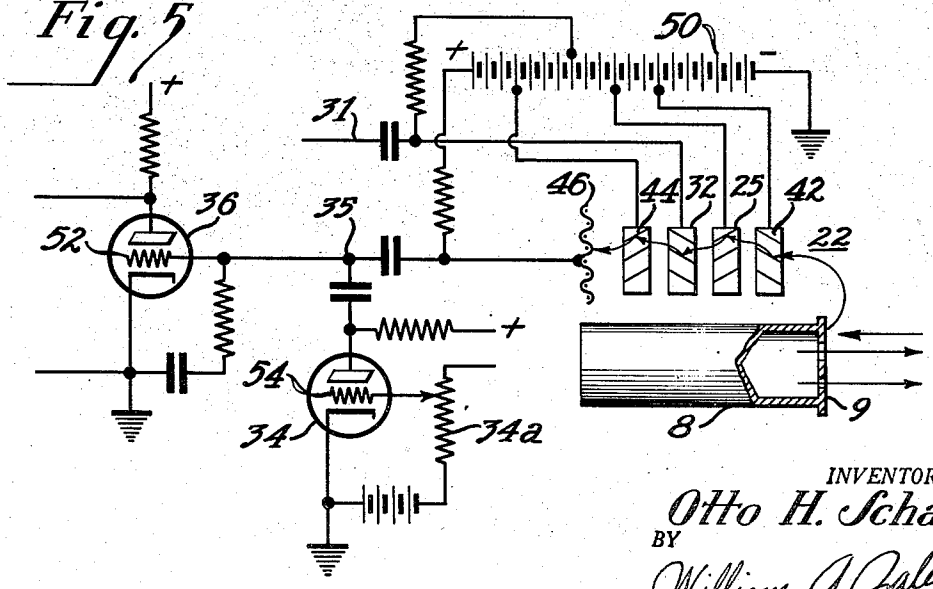


Fig. 4

Fig. 5



INVENTOR.
Otto H. Schade
BY
William A. Galesak
ATTORNEY

Patented June 12, 1951

2,556,824

UNITED STATES PATENT OFFICE

2,556,824

CATHODE-RAY TUBE

Otto H. Schade, West Caldwell, N. J., assignor to Radio Corporation of America, a corporation of Delaware

Application March 28, 1946, Serial No. 657,702

7 Claims. (Cl. 315—12)

1

This invention relates to cathode ray beam pick-up tubes and more particularly to an arrangement for obtaining complete discharge of the target after the signal has been utilized.

In cathode ray beam pick-up tubes in which the beam is decelerated substantially to zero velocity at the target and deposits electrons in proportion to the charge image, the discharge is not always complete. Low light charges are therefore built up exponentially during successive scansions to a higher value at which charge and discharge are equal. This time lag reduces the sharpness of moving objects. The residual charges, as well as interline charges remaining with interlaced scanning, will cause color carry-over in color television, unless removed by a discharge process.

In an attempt to produce a complete discharge of the target after each line scansion, the beam has heretofore been shifted to previously scanned line areas during line retrace without shutting it off; but with an increase of intensity of about fifteen times that of the normal strength during line trace. This has been somewhat successful, but it is difficult to operate an electron gun having a small aperture, such as 2 mils, with such a high density beam current and, further, this procedure requires special deflecting means for the heavy discharge beam.

It is an object of this invention to provide for the full discharge of a cathode ray beam target without utilizing the normal beam aperture during line retrace.

Another object is to provide for the full discharge of the image through use of a separate beam controlled by the normal deflecting coils.

Other objects of the invention will appear in the following description, reference being had to the drawing, in which:

Fig. 1 is an illustration of a cathode ray tube embodying the invention.

Fig. 2 is an end view of the gun, illustrating the relative position of the two beam apertures in relation to the area scanned thereon by the return beam.

Fig. 3 diagrammatically illustrates a portion of the target, showing the discharge area of the heavy beam trailing the line-scansion of the normal beam.

Fig. 4 contains a series of graphs illustrating the principle of the invention.

Fig. 5 is a circuit diagram illustrating one way for eliminating the undesired pulse produced by the clean-up beam.

2

Fig. 6 shows a modification of the control electrode.

Referring to the drawing, the evacuated envelope 1 of glass contains a target of transparent mica having on one side a mosaic 2 capable of emitting photo-electrons under the action of the light rays focused thereon from the object to be televised. These pass through a transparent metallic grounded coating 3 called the signal plate. At the opposite end of the tube is located the gun of normal construction except that it projects two beams instead of one through the use of two cathodes 4, 5, two grids 6, 7 and an anode 8 having an end 9 with the usual small aperture 10 and a larger aperture 11, shown as dots in Fig. 2. The anode end 9 may act as the first dynode of a multiplier, such as disclosed in the application of Paul K. Weimer, filed September 16, 1944, Serial No. 554,494, now U. S. Patent 2,443,941, issued January 6, 1948. The other stages of the multiplier are indicated diagrammatically at 42, 25, 32 and 44.

The envelope 1 also contains the usual elements of an orthicon tube, such as wall coating electrode 13, decelerating ring electrode 14 and a so-called persuader ring electrode 15 adjacent the end of the gun. Outside the envelope are located the axially adjustable compensating coil 16, the usual vertical and horizontal deflecting coil unit 17 and the magnetic focusing coil 18. The functions of these elements are similar to those described in the said Weimer application and need not be further referred to.

The beam aperture 10 may be of small diameter, say in the neighborhood of 2 mils, to produce a beam 19 of sufficient intensity for video line scansion. The aperture 11 may be sufficiently larger than aperture 10 to furnish a beam 20 of suitable intensity and diameter to wipe out the residual charges in one or more scansions across the target during line retrace time of the beam 19. The direction of line and frame scansion is indicated by the arrows *a* and *b* in Fig. 3.

The larger aperture 11 is placed a distance *d*, such as ten lines, from the smaller aperture 10 so that its wipe-off trace 21 (Fig. 3) will trail a suitable distance behind the lines not yet scanned by beam 19, which distance should take it outside the area 22 scanned on the first dynode 9 by the signal beam 23 returning from the target. This will prevent its image from being passed through the multiplier stages. The secondaries liberated under bombardment of the first dynode 9 of the multiplier are drawn into

the remaining stages 42, 25, 32 and 44, as explained in more detail later herein.

The grid 6 for beam 20 will be controlled by any known type of pulse generator, indicated by block diagram 24, so that it is keyed off while the beam 19 is scanning a line and keyed on while that beam is on line retrace. It will be apparent that the heavy beam 20 will produce an undesired video signal during the retrace time of the small beam 19. This can be eliminated in various ways in the amplifiers to which the multiplier output is connected, but I have shown in Figures 1 and 5 a preferred way of doing this. Figures 1 and 5 disclose a circuit means for providing a signal pulse to eliminate the undesired video signal produced by the retrace beam 20. The multiplier stages 42, 25, 32, and 44 are shown as connected, respectively, to points of different potential of an energy source, such as a battery 50. This provides an increasing positive potential on each successive stage. Collector 46, of the multiplier section 22, is the most positive of the multiplier parts and collects the amplified signal electrons after they have passed through the several stages. These signal electrons produce a pulse which provides a voltage change on grid 52 of an amplifier triode 36. The current through the triode amplifier is thus modulated by the grid 52 and may be further amplified to provide the video output signal of the system. At terminal 35 in the circuit joining collector 46 to amplifier grid 52, there is connected a triode 34, whose grid is connected to an adjustable grid circuit resister 34A, which in turn is connected to a pulse generator (not shown).

The video pulses produced by beam 20 during retrace are eliminated by reducing the voltage between any two of the multiplier stages, for example, the third and fourth, or 25 and 32 respectively. Graph I of Fig. 4 illustrates the output electron current, say of the third stage 25. The video signal of the beam 19 on line trace is shown at 26 and the undesired output of beam 20 is indicated at 27. Line 28 is zero current value and represents super white. Lines 29 and 30 represent normal white and black, respectively. During line retrace a negative voltage pulse is introduced at 31 by well-known generating means, such as a pulse generator indicated at 40. The voltage pulse is indicated by graph II at 27A and is of such value that it reduces the voltage on the fourth multiplier stage 32 to the voltage of the third stage 25, or below it. Thus, during line retrace no electrons are drawn into the fourth stage and this eliminates the undesired current produced during line retrace by beam 20, as indicated by graph III. However, the absence of electron current at 33 of this graph represents undesirable super white instead of the desired black. Therefore, I introduce into the multiplier output by means of tube 34 at point 35 (Figure 5) a pulse that is equal and opposite to the multiplied value of pulses 33. This is represented by graph IV, showing pulses 33A equal and opposite to pulses 33. The pulse in the adjustable grid circuit resistor 34a would, of course, be the reverse of graph IV. Thus, the video input to the amplifiers, represented for simplification by a single triode 36, would have the form shown by graph V, with the desired picture black value during line retrace.

It will be obvious that multiple grid tubes may be used in place of the triodes 34, 36. It will also be clear that the target of the tube in Fig. 1 may be of the two-sided type, as in the image orthicon, on which charges are produced by secondary electrons released by bombarding photo-electrons, as shown in said Weimer application.

The paths of beams 19 and 20 are controlled by the same deflection unit and the aperture of beam 20 may be made as large as required for complete discharge, so the prior art complications previously referred to are avoided.

The two beams may be produced in other ways than that disclosed. For example, one cathode would suffice. The grids then would consist of two semi-circular discs, one with the small aperture and the other with the large aperture, as shown in Fig. 6. Also, two entirely separate guns may be used. The action in these cases would be exactly the same as that described.

Various other modifications may be used without departing from the spirit of the invention.

I claim:

1. An electron discharge device comprising, an electron gun structure for forming two electron beams along respective paths, a target electrode positioned transversely to said beam paths, means for scanning said electron beams over a surface of said target electrode, and a pulse generator circuit including said electron gun structure for keying one of said beams on only during retrace time of said other beam.

2. An electron discharge device comprising, an electron gun structure for forming two electron beams along respective paths, a target electrode positioned transversely to said beam paths, means for scanning said electron beams over a surface of said target electrode, said electron gun structure including a control grid surrounding the path of one of said electron beams, and a pulse generator circuit including said control grid for keying on said one electrode beam only during retrace time of said other beam.

3. A television signal transmitting device comprising an envelope, an electron gun structure for forming two electron beams along two respective paths within said envelope, a target electrode positioned within said envelope transversely to said beam paths and including an insulator sheet adapted to have a charge distribution formed thereon, means for producing line scansion of said electron beams over a surface of said insulator sheet, a collector electrode within said envelope for receiving electrons from said insulator surface, said electron gun structure including a control electrode surrounding the path of one of said electron beams, and a pulse generator circuit including said control electrode for keying on said one electron beam only during retrace time of said other beam.

4. A television signal transmitting device comprising an envelope, an electron gun structure for forming two electron beams along two respective paths within said envelope, a target electrode positioned within said envelope transversely to said beam paths and including an insulator sheet adapted to have a charge distribution formed thereon, means for producing line scansion of said electron beams over a surface of said insulator sheet, an electron multiplying means including a plurality of dynode electrodes for receiving reflected beam electrons from said insulator target surface, said electron gun structure including a control electrode surrounding the path of one of said electron beams, and a pulse generator circuit including said control electrode for keying on said one electron beam only during retrace time of said other beam, and a circuit means including two of said dynode electrodes and a second pulse generator for main-

taining said two dynode electrodes at the same potential only during said retrace time of said other beam.

5. A television signal transmitting device comprising an envelope, an electron gun including an electron source and electrode structure for forming two electron beams along respective paths within said envelope, a target electrode positioned within said envelope transversely to said beam paths and including an insulator sheet, a conductive layer on one face of said sheet and a photosensitive layer on the other face of said sheet, circuit means connected to said conductive target layer for maintaining said conductive layer and said electron source at a common potential during operation, means for producing line scansion of said electron beams over a surface of said photosensitive layer, an electron multiplying means including a plurality of dynode electrodes for receiving reflected beam electrons from said photosensitive target layer, said electron gun structure including a control electrode surrounding the path of one of said electron beams, and a pulse generator circuit including said control electrode for keying on said one electron beam only during retrace time of said other beam, and a circuit means including two of said dynode electrodes and a second pulse generator for maintaining said two dynode electrodes at the same potential only during said retrace time of said other beam.

6. The method of operating an electron tube having a photosensitive film coating one face of an insulator sheet, said method comprising the steps of producing a charge distribution on said photosensitive film, line scanning an electron beam over the surface of said photosensitive film to discharge said charge distribution, scanning said photosensitive film with a second beam only during retrace time of said first beam to completely discharge said photosensitive film.

7. The method of operating an electron tube having a photosensitive film coating one face of an insulator sheet, said method comprising the steps of producing a charge distribution on said photosensitive film, line scanning an electron beam over the surface of said photosensitive film to discharge said charge distribution, scanning said photosensitive film with a second beam only during retrace time of said first beam to completely discharge said photosensitive film, reducing said electron beams to substantially zero velocity adjacent said target surface whereby the electrons of said beams not discharging said target are reflected, collecting the reflected electrons of said beams by a multiplier section having a plurality of dynode electrodes, maintaining an adjacent pair of said dynode electrodes at a common potential only during retrace time of said first beam.

OTTO H. SCHADE.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,227,484	Bouwers	Jan. 7, 1941
2,260,911	Knick et al.	Oct. 28, 1941
2,276,359	Von Ardenne	Mar. 17, 1942
2,335,983	Wilson	Dec. 7, 1943
2,345,282	Morton	Mar. 28, 1944