April 24, 1956 K. A. HOAGLAND 2,743,391

CATHODE RAY TUBE

Filed Nov. 2, 1951

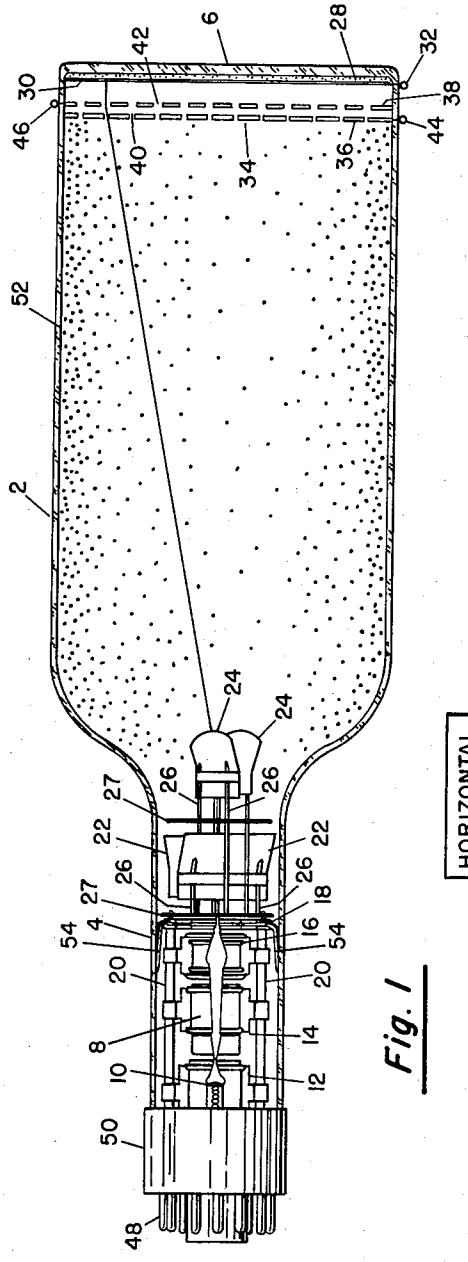


Fig. 1

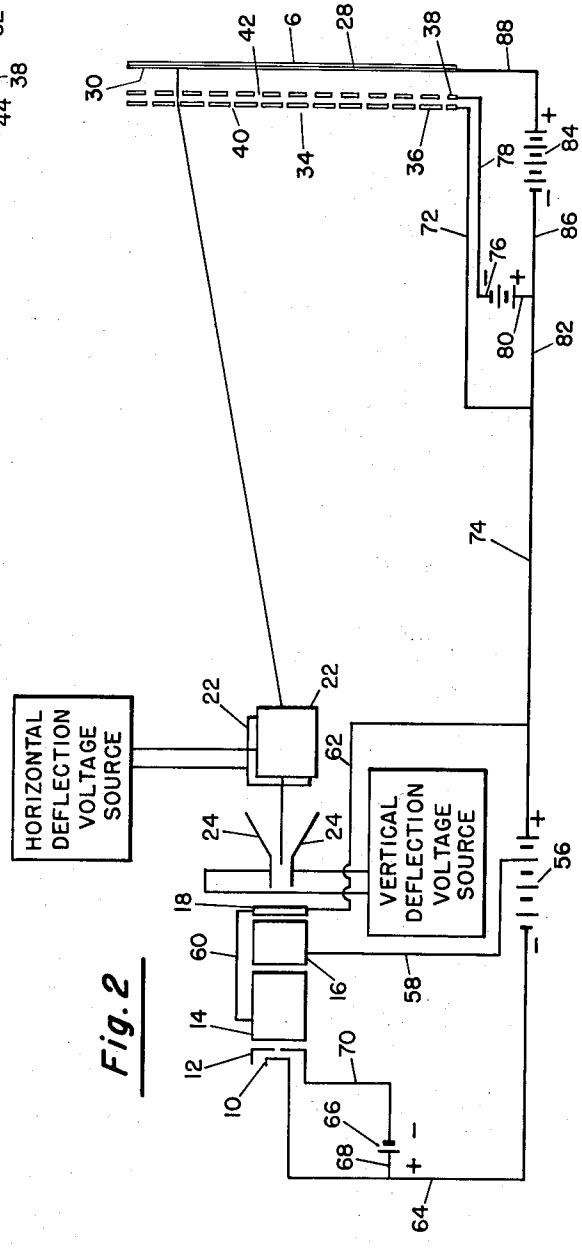


Fig. 2

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United States Patent Office 2,743,391 Patented Apr. 24, 1956

2,743,391

CATHODE RAY TUBE

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Application November 2, 1951, Serial No. 254,575

9 Claims. (Cl. 315—17)

The present invention relates to cathode ray tubes and particularly to improvements in cathode ray tubes of the post deflection acceleration type.

Cathode ray tubes in which electron acceleration is obtained after deflection have the desirable characteristic of a high degree of deflection sensitivity at substantially lower deflection control voltages. Heretofore, this desirable characteristic has been obtained in cathode ray tubes by providing either an electrically conductive ring or a plurality of electrically conductive rings spaced between the deflection means and the screen of the tube. Such rings have commonly been referred to as intensifier rings and where a single ring has been utilized, the tube is generally operated with the ring at a voltage substantially higher than the anode voltage to obtain the desired electron acceleration. Where a series of spaced rings have been utilized, the tube is generally operated with each of the rings at voltages substantially higher than the anode voltage and at successively increased voltage as the rings approach the screen.

Tubes of these types have not been entirely satisfactory, however, because of the electron lens effect caused by the rings and the consequent distortion of the beam along paths angularly displaced from the central axis of the tubes.

Accordingly, it is an object of the present invention to provide an improved cathode ray tube of the post deflection acceleration type.

It is another object of the present invention to provide an improved cathode ray tube of the post deflection acceleration type in which post deflection beam distortion is substantially eliminated.

It is still another object of the present invention to provide an improved cathode ray of the post deflection acceleration type in which the electron lens effect is substantially eliminated between the deflection means and the screen of the tube.

These and other desirable objects are attained in accordance with the present invention by providing a cathode ray tube in which acceleration of the electrons is obtained after deflection thereof by an electron acceleration region in the tube formed by spaced electrically conductive elements positioned transversely of the tube and adjacent the screen.

For a better understanding of the invention, reference may be had to the following description along with the drawing in which Figure 1 is a longitudinal cross-sectional view with parts broken away of a cathode ray tube embodying the present invention and Figure 2 is a diagrammatic illustration of the tube with a schematic illustration of circuit relationship of the elements of the tube.

Referring now to the drawing and particularly to Figure 1, there is illustrated a cathode ray tube embodying the present invention and comprising a substantially tubular container 2 which is generally made of glass but may be made of other suitable materials. One end of

the container is reduced to provide a neck portion 4 and the other end of the container is provided with a face plate 6. Supported within the neck portion 4 is an electron gun 8 such as are commonly used in cathode ray tubes and comprising a cathode 10, a grid 12, a first accelerating electrode 14, a focussing electrode 16 sometimes referred to as a first anode, and a second accelerating electrode 18 also known in the art as a second anode. Each of the aforementioned elements are supported in axial alignment in a unitary assembly within the neck portion by a pair of insulating rods 20. A pair of horizontal deflection plates 22 and a pair of vertical deflection plates 24 are secured in spaced relationship on opposite sides of the longitudinal axis of the electron gun and are respectively positioned parallel with the perpendicular cross-sectional axes of the electron gun, and at one end thereof. The deflection plates are secured to supporting wires 26 which, in turn, are supported by a pair of insulating discs 27, one of which is attached to the ends of the insulating rods 20, as shown.

While I have illustrated and described a cathode ray tube structure especially adapted to utilize electrostatic means such as deflection plates for horizontal and vertical deflection of the electron beam, it will be obvious that deflection of the beam may be obtained by well-known means other than deflection plates, such as an electromagnetic yoke which is supported externally of the neck of the tube.

The face 6 of the cathode ray tube 2 is provided on its inner surface with a fluorescent coating 28 and an electrically conductive screen or coating 30. The coating 30, as shown, is formed on the surface of the fluorescent coating 28 and is accordingly provided with electron permeable characteristics. In this connection, it should be understood that a transparent metallic electrically conductive screen interposed between the face of the tube and the fluorescent coating would be equally as effective for the purposes of this invention as screen 30. An electrically conductive lead 32 provides an external connection for the screen 30.

Spaced from the screen 30 is a grid assembly 34 comprising spaced grids 36 and 38. Grids 36 and 38 are electrically conductive discs supported transversely of the tube and are provided respectively with a plurality of equally spaced small apertures 40 and 42 throughout the entire cross-section thereof. The discs 36 and 38 are positioned in the tube with the apertures 40 and 42 in alignment along axes parallel to the central axis of the tube and discs and apertures 42 are formed with a cross-sectional diameter substantially larger than that of apertures 40 to avoid the interception of electrons which have passed through the apertures 40 of disc 36. External terminals 44 and 46 passing through the tube wall provide means for electrical connections with the discs 36 and 38. Likewise prongs 48 in the base 50 provide electrical connections with the cathode 10, grid 12, focussing electrode 16 and deflection plates 22 and 24. An electrical conductive coating 52 on the inner surface of the tube which is in circuit conducting relationship with disc 36 and the spring fingers of a support member 54 connected to the electrodes 18 and 14 in a manner to be described hereinafter in connection with Figure 2 of the drawing provides means for connecting these electrodes with an external source of potential.

For a better understanding of the operation of the cathode ray tube of the present invention, reference may be had to Figure 2 of the drawing. In this figure, 56 illustrates a source of accelerating potential for the electron gun 8. Focussing electrode 16 of the electron gun 8 is connected by lead wire 58 to source 56 at an intermediate potential terminal of the source while electrodes

14 and 18 are connected together by lead wire 60 and to the high potential terminal of the source by lead wire 62. The aforementioned potentials are with reference to the electrical potential of the cathode 10 which is connected by lead wire 64 to the negative terminal of the source 56. In order to obtain control of the current in the electron beam of the gun 8, an auxiliary source of potential 66 is provided and has its positive terminal connected to source 56 through lead wires 68 and 64 and its negative terminal connected to the control grid 12 by lead wire 70.

At the end of the tube opposite the gun 8 the apertured screen 36 is connected through terminal 44 and lead wires 72 and 74 to the high potential terminal of the source 56 and through the conductive coating 52, in contact therewith it is connected with the electrode 18 in a manner which has been described hereinabove. As the electrodes 14 and 18 are operated at the same potential, they are connected together within the tube by a lead wire 60. With this arrangement there is provided within the tube, an extended space from electrode 18 to the screen 36 which operates throughout the length therebetween at a uniform potential determined by the high potential terminal of the source 56.

The terminal 46 of apertured screen 38 is connected to the negative terminal of an auxiliary source of potential 76 by lead wire 78. In this connection, the polarity of the source 76 is arranged so that the electrical potential of screen 38 is negative with respect to the screen 36. The positive terminal of auxiliary source 76 is, in turn, connected to the positive terminal of source 56 through the lead wires 80, 82, and 74. Also, the positive terminal of the auxiliary source 76 is connected to the negative terminal of a source of potential 84 through lead wires 80 and 86.

To provide a source of potential for acceleration of the electrons in the beam after passing through the apertures 40 and 42, a source of high potential 84 has its positive terminal connected through lead wire 88 to the terminal 32 of the electron permeable screen 30. The negative terminal of the source 84 is, in turn, connected by lead wires 86 and 80 to the positive terminal of the auxiliary source 76 and by lead wires 86, 82 and 74 to the positive terminal of the source 56. With this arrangement, there is provided a high potential accelerating field between the grid structure 34 and screen 30 which is parallel to the axis of the longitudinal tube.

With the tube connected for operation as described, the electron gun 8 provides a focussed electron beam of small cross-section with the velocity of the electrons in the beam adjacent the gun determined by the potential of the source 56. To obtain a relatively high degree of sensitivity for the deflection means including deflection plates 22 and 24, the velocity of the electron beam is preferred to be relatively low as the electrons enter the space between the deflection plates. Accordingly, the potential source 56 which determines the velocity of the electrons in the electron beam in the space between the deflection plates is relatively low, being substantially 500 to 1000 volts. In conventional cathode ray tube structures, such a voltage would be so low as to limit the image intensity on the screen scanned by such a beam, and would not be satisfactory. However, this undesirable characteristic is overcome in the tube of the present invention, while retaining a high degree of deflection sensitvity control by applying a substantially higher potential source, such a source 84, to the screen 30. In this connection, we have found that a potential as high as insulation limits, permits may be used. However, satisfactory results are obtained with a potential source 84 of substantially 20,000 volts.

With the impingement of the electrons of the electron beam on the grid 36, particularly at the edge of the apertures 40, there is an emission of secondary electrons, the direction and velocity of which do not correspond with the direction and velocity of the primary electrons in the electron beam which pass through the apertures 40. These secondary electrons, if permitted to accelerate toward the screen 30, adversely affect the resolution of the image on the screen. Accordingly, to substantially eliminate this condition, the screen 38 is operated at a potential which is negative with respect to the potential of screen 36. With a negative potential applied to screen 38 substantially all of the secondary electrons are repelled and they are prevented from entering the acceleration space between screen 36 and screen 30. A potential source 70 of 100 volts has been found to be entirely satisfactory to apply to screen 38 for repelling the secondary electrons.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. An electron discharge device comprising an envelope having a neck portion and a target face, a fluorescent screen on said face, an electron gun positioned in said neck portion for directing a stream of electrons against said screen, a pair of grids positioned in said envelope between said gun and said screen and substantially parallel to said screen, and an electrically conductive screen positioned in said envelope adjacent said fluorescent screen, said grids and electrically conductive screen having means for attachment to a source of electrical potential to make the grid nearer said conductive screen negative with respect to the other grid of said pair, and an electron accelerating force between said grids and said conductive screen.

2. An electron discharge device comprising an envelope having a neck portion and a target face, a fluorescent screen on said face, an electron gun positioned in said neck portion for directing a stream of electrons against said screen, a pair of spaced grids positioned in said envelope between said gun and said screen and substantially parallel to said screen, and an electrically conductive screen positioned in said envelope adjacent said fluorescent screen, said grids and electrically conductive screen having means for attachment to a source of electrical potential to make the grid nearer said conductive screen negative with respect to the other grid of said pair, and an electron accelerating force between said grids and said conductive screen.

3. An electron discharge device comprising an envelope having a neck portion and a target face, a fluorescent screen on said target face, an electron beam forming device positioned in said neck portion, said device comprising a cathode, grid, first accelerating electrode, focussing electrode and second accelerating electrode, a pair of grids positioned in said envelope between said device and said screen and substantially parallel to said screen, means connecting said first and second accelerating electrodes to the grid adjacent said device, means for connecting the grid adjacent said device to a source of electrical potential to provide a space therebetween of uniform potential, means for connecting the other grid to a source of electrical potential to make said other grid negative with respect to said first-named grid, and an electrically conducting screen positioned in said envelope adjacent said fluorescent screen, said conducting screen having means for attachment to a source of electrical potential for providing an electron accelerating force between said grids and said conducting screen.

4. An electron discharge device comprising an envelope having a target face, a fluorescent screen on said face, an electron gun positioned in said envelope for directing a stream of electrons toward said screen, a plurality of grids positioned in said envelope between said gun and said screen and substantially parallel to said screen, an electrically conductive screen positioned in said envelope adjacent said fluorescent screen, means for connecting said grids to potential to make one of said grids nearer said conductive screen negative with respect to one of said grids nearer said electron gun, and means

connecting potential to said electrically conductive screen and to one of said grids to provide an electron accelerating force therebetween.

5. An electron discharge device comprising an envelope having a fluorescent screen, an electrically conductive surface adjacent said fluorescent screen, an electron gun for generating and directing electrons toward said screen, a first grid positioned between said gun and said screen and having electron-permeable openings therein, and a second grid adapted to operate at a potential lower than the potential of said first grid and positioned between said first grid and said screen, with electron-permeable openings therein in alignment with the path of said electrons to permit said electrons to pass therethrough and to prevent said electrons from striking the conductive portions thereof said first and said second grids being substantially parallel to said conductive screen.

6. An electron discharge device comprising an envelope having a target face, a fluorescent screen on said face, an electrically conductive screen positioned in said envelope adjacent said fluorescent screen, an electron gun positioned in said envelope for directing a stream of electrons toward said fluorescent screen, a pair of grids positioned in said envelope between said electrically conductive screen and said gun and substantially parallel to said conductive screen, a source of potential, means connecting said source of potential to said grids to cause the grid nearer said screen to be negative with respect to the other of said pair of grids, and means connecting said source of potential to said electrically conductive screen and the grid nearest thereto to cause an electron accelerating force therebetween.

7. An electron discharge device comprising an envelope having a target face, a fluorescent screen on said face, an electrically conductive screen positioned in said envelope adjacent said fluorescent screen, an electron gun positioned in said envelope for directing a stream of electrons toward said fluorescent screen, a pair of grids positioned in said envelope between said electrically conductive screen and said gun and substantially parallel to said conductive screen, a source of potential having an intermediate terminal and a second terminal less than approximately 100 volts negative with respect to said intermediate terminal and a third terminal positive

with respect to said intermediate terminal by approximately 20,000 volts, means connecting said intermediate terminal the grid nearest said gun and connecting said second terminal to the other grid and means connecting said third terminal to said electrically conductive screen to cause said electrically conductive screen to be positive with respect to the grid adjacent thereto.

8. An electron discharge device comprising an envelope having a target face, a fluorescent screen on said face, an electrically conductive screen positioned in said envelope adjacent said fluorescent screen, an electron gun positioned in said envelope for directing a stream of electrons toward said fluorescent screen, a first and a second perforated grid plate positioned in order in said envelope between said gun and conductive screen and transversely of the longitudinal axis of said envelope and substantially parallel to each other and to said conductive screen, said plates having their perforations in electron path alignment with the electron path to substantially prevent electrons from striking said second grid after passing through the perforations in said first grid, a source of potential, means connecting said source of potential to said first and second grids to cause said first grid to be positive with respect to said second grid and means connecting said source of potential to said electrically conductive screen and to said second grid to cause said electrically conductive screen to be positive with respect to said second grid.

9. The apparatus of claim 8, in which the perforations in said second grid plate are larger than the perforations in said first grid plate.

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