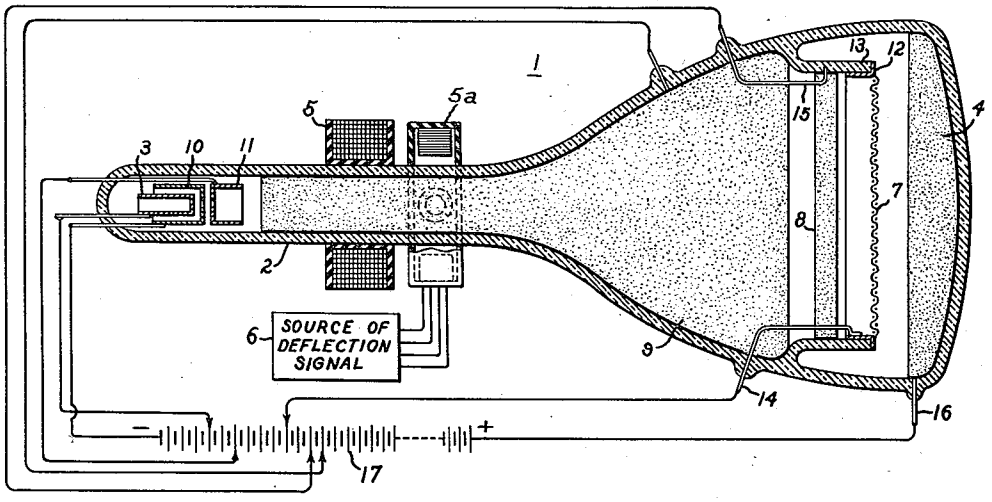
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CATHODE RAY TYPE OF ELECTRON DISCHARGE DEVICE

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CATHODE-RAY TYPE OF ELECTRON DISCHARGE DEVICE

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This invention relates to electron discharge devices of the type in which electrons are caused to produce images on luminescent screens and, in particular, relates to cathode ray electron discharge devices of the kind used for purposes of projection of pictures in television receivers or for producing oscillograms.

It is known that in order to obtain a sufficiently intense indication on the screen of a cathode ray electron discharge device it is necessary to impart high velocities to the electron beam which produces light on the screen. However, increasing the velocity of the electron beam by increasing the anode voltages which accelerate the beam gives rise to certain problems. If conventional beam deflection circuits are employed, the electron discharge device has low deflection sensitivity; that is, since the electrons in the beam are moving faster, it takes a larger force to produce the same absolute deflection that would be produced with a lower velocity electron beam. In addition, a special design is required for the electron gun when high potentials are used on the various anodes. In a magnetic deflection cathode ray electron discharge device insulation of the second anode coating in the device from the deflection coil may present a serious problem when high potentials are used on the second anode.

Heretofore it has been proposed to interpose a shielding grid of the kind shown in U. S. Patent 1,810,018 between the luminescent screen of the cathode ray type of electron discharge device and the remainder of the electrode structure of the device. With this innovation it is possible to utilize a conventional deflection circuit in the electron gun portion of the device while at the same time achieve the advantages of a high velocity beam. It will be noted that with this arrangement the screen is operated at a much higher potential than the shielding grid. A cathode ray type of electron discharge device of the kind just described with a shielding grid has the disadvantage that the screen of the tube is subject to background illumination for reasons to be hereinafter described. It is to the solution of this problem of background illumination that the present invention is particularly addressed.

Accordingly, it is an object of my invention to provide means in cathode ray type of electron discharge apparatus whereby the advantages of a high velocity beam may be combined with the advantages of high sensitivity deflection circuits without the serious limitations of devices combining these features.

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It is another object of my invention to provide a cathode ray tube in which the advantages of high deflection sensitivity and high intensity illumination are present without the serious disadvantage of background illumination.

It is a further object of my invention to provide improvements in cathode ray electron discharge apparatus.

The features of the invention desired to be protected are set forth in the appended claims. The invention itself, together with further objects and advantages thereof, may best be understood by reference to the following specification taken in connection with the accompanying drawing in which is shown a cathode ray type of electron discharge device, in section, connected in a manner to carry out the objects of my invention.

Briefly stated, the objects of the invention are achieved in one exemplary embodiment by providing a collector electrode or means behind the grid of the cathode ray type of electron discharge device and operated at a slightly higher potential than the shielding grid to collect the stray electrons which produce the background illumination of the luminescent screen.

Referring now to the single figure of the drawing, there is shown a cathode ray type of electron discharge device 1 having an hermetically sealed envelope 2. At one end of the envelope is located a cathode 3 supplying electrons for the device 1. At the other end of the device 1 is located a luminescent screen 4 which is subject to the bombardment of the electrons from the cathode 3. Intermediate the cathode 3 and the screen 4 are located various electrodes entirely conventional in the art for the purpose of forming and focussing the electron beam. Coil 5a functions to deflect the beam in accordance with external signals applied by a source 6. A shielding grid electrode 7 is located a short distance from the screen 4 which is operated at a much higher potential than the grid 7 so that in effect the cathode ray device to the left of the grid 7 operates substantially as a conventional low voltage cathode ray device. It will be appreciated that electrons from the cathode 3 will be easily deflected by the deflection means 6 because they are of low velocity, and upon passing through the grid 7 the electrons will be considerably accelerated and consequently will strike the screen 4 of the tube with high energy thereby producing large amounts of light from the luminescent coating making up the screen 4. It is readily appreciated that by the provision of the grid 7 the advantages of a

high deflection sensitivity device with a device that has high luminosity characteristics is achieved.

It will be noted that not all of the electrons will pass through the grid structure to the screen. Some of the electrons will impinge on the wire mesh forming the grid 7 with the consequent liberation of secondary electrons. When the electrons reflected and liberated from the shielding grid 7 pass in the vicinity of the open spaces of the shielding grid electrode 7, they will be attracted through and strike the screen 4 thereby producing background illumination on the screen. It will be appreciated that this background illumination is of a shape corresponding to the shape of the grid. Background illumination may be eliminated by eliminating the electron cloud formed behind the grid. I have provided in one embodiment a collector electrode 8 for this purpose. The collector electrode 8 is operated at a potential slightly higher than the potential of the grid electrode 7. Preferably the second anode 9 is operated at a potential slightly higher than collector electrode 8 to insure substantially complete collection of all stray electrons. It will be readily appreciated that the second anode 9 may be utilized as a collector electrode as well. When the second anode 9 is used as a collector it would be necessary to operate the second anode 9 at a potential slightly higher than the shielding grid electrode 7. A separate collector electrode may be thus eliminated. The collector electrode 8 and the second anode 9 may be connected together and operated at the same potential slightly higher than the grid electrode 7.

Referring now to the particularities of construction of the cathode ray devices of my invention, there is shown in the drawing a conventional electron gun for the device comprising a cathode 3, an intensity control electrode 10, and a first anode electrode 11. The deflection coil 5*a*, entirely conventional, functions to deflect the electron beam from the electron gun in response to a deflection signal. It is understood of course that the electron gun may be focussed magnetically or electrostatically and likewise that the beam deflection may be accomplished either by electromagnetic or electrostatic means. In the figure coil 5 functions to focus the electron beam. The second anode 9 comprises a thin conductive coating extending into the neck of the device 1 as shown. This conductive coating is usually an aquadag coating, although of course other suitable materials may be employed. The grid 7 of the device 1 is attached to a metal ring 12 suitably fastened to one end of the glass cylinder 13. The other end of the glass cylinder 13 is connected to the body of the glass envelope 2. The attachment of the insulating cylinder 13 to the body of the envelope 2 at a location removed from the screen 4 reduces the surface voltage gradient between grid 7 and screen 4 thereby eliminating the danger of electrical breakdown between these high voltage electrodes. On the inside surface of the glass cylinder 13, and a short distance behind the grid 7 is located a conductive strip which may be formed of aquadag or any other suitable material. Conductors 14 and 15 permit the application of external potentials to the grid 7 and electrode 8, respectively.

The grid 7 is made of a fine mesh of wires, for instance, a tungsten ring strung with .001 of an inch tungsten wire wound 330 turns per inch would be suitable. In the preceding example the grid then would comprise a series of .001 of an inch parallel tungsten wires with approximately .002 of an inch spacing between wires. Also finely electroplated nickel meshes would be suitable as shielding grids.

The screen 4 located on the face of the device 1 comprises any suitable luminescent material adapted to be excited by an electron beam. The screen 4 may be formed on a conducting transparent glass base. Also, a conductive aluminum film could be applied over the phosphor of the screen by the usual techniques. This latter arrangement has the known advantage of higher light output because of light reflection from the aluminum film. The aluminum film also has the advantage that it helps to prevent any loose particles of phosphor from coming off and getting on the grid 7. A conductive connection 16 is made through the glass envelope so that the screen may be externally energized by suitable potentials.

Referring now to the operation of one of the above described embodiments of my invention, the cathode 3 is connected to one end of a suitable source 17 of unidirectional potential. The screen 16 is connected to the high potential end of the unidirectional source. The second anode 9 is connected to a potential point intermediate the potential applied between the cathode and the screen anode 14. The collector electrode 8 is connected to a potential point on the unidirectional source 17 which is slightly higher than the grid 7 but slightly less positive or the same potential as the second anode 9. Electrodes 10 and 11 are connected to suitable potential points on the unidirectional source 17. If the beam current is to be modulated the control grid 10 must of course be connected to a modulating potential source. The deflection coils 5*a* are connected to a source of deflection signal 6. With the second anode operating at a potential of about 10,000 volts, with the screen 4 operating at a potential of about 45,000 volts, with the shielding grid 7 operating at a potential anywhere in the range of 90–300 volts lower than the second anode 9 and collector electrode 8, very satisfactory operation of the device was obtained. Background illumination was virtually eliminated.

Advantages in the use of cathode ray tubes of the type described above are that the conventional low voltage electron gun and electrostatic or magnetic deflection system of low power can be used. A further advantage is that no extra insulation in the neck of the cathode ray devices is required for high voltage operation. Furthermore, neither the beam focus nor deflection are affected by the potential of the fluorescent screen; consequently, a high voltage source of relatively low power capabilities can be used for the application of potentials to the luminescent screen.

While I have shown and described particular embodiments of my invention, it will be obvious to those skilled in the art that various changes and modifications may be made without departing from my invention in its broad aspects and I, therefore, aim in the appended claims to cover all such changes and modifications as fall within the true scope of my invention.

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

1. Cathode ray electron discharge apparatus, comprising a cathode ray type of electron discharge device having a cathode, a luminescent screen anode, a second anode located between said cathode and said screen anode, an electrode mounted between said second anode and said

screen anode adjacent to said screen anode, means for maintaining said electrode at a slightly lower potential than said second anode and means for maintaining said screen anode at a considerably higher potential than said second anode.

2. The apparatus of claim 1 in which said electrode comprises a fine mesh wire screen located substantially parallel to the face of the cathode ray electron discharge device.

3. The apparatus of claim 2 in which said second anode comprises a conductive ring located on the inside surface of the envelope of said electron discharge device.

4. Cathode ray electron discharge apparatus, comprising a cathode ray type of electron discharge device having a cathode, a luminescent screen anode, a second anode located between said cathode and said screen anode, said second anode comprising a conductive coating on the inside surface of the envelope of said cathode ray electron discharge device, an electrode mounted between said second anode and said screen anode and adjacent to said screen anode, a second electrode located between said first electrode and said second anode, means for maintaining said first electrode at a slightly lower potential than said second anode and said second electrode, and means for maintaining said second anode at a slightly higher potential with respect to said second electrode, and means for maintaining said screen anode at a considerably higher potential than said first electrode.

5. The apparatus of claim 4 in which said first and second electrodes are located on a cylindrical insulating member attached to the envelope of said electron discharge device at a location substantially removed from said screen anode, said first electrode comprising a wire mesh attached to the free end of said cylindrical member and located substantially parallel with respect to said screen anode, said second electrode comprising a conductive ring on the inside surface of said insulating member.

6. The apparatus of claim 5 in which means are provided for maintaining said second anode and said second electrode at substantially the same potential.

7. Cathode ray electron discharge apparatus, comprising a cathode ray electron discharge device having a cathode, a luminescent screen anode, a second anode located between said cathode and said screen anode, said second anode comprising a conductive coating on the inside surface of the envelope of said cathode ray electron discharge device, an electrode mounted between said second anode and said screen anode and adjacent to said screen anode on a cylindrical insulating member attached to the envelope of said electron discharge device at a location substantially removed from said screen anode, said electrode comprising a wire mesh attached to the free end of said cylindrical member and located substantially parallel with respect to said screen anode,

means for maintaining said first electrode at a slightly lower potential than said second anode, and means for maintaining said screen anode at a considerably higher potential than said first electrode.

8. Electron discharge apparatus comprising a cathode ray type of electron discharge device having an electron gun, a luminescent screen, electron beam deflecting means, a first electrode mounted near said screen, a second electrode mounted adjacent to said first electrode on the gun side of said first electrode, means for maintaining said second electrode at a slightly higher positive potential than said first electrode, means for maintaining said screen anode at a considerably higher potential than said first electrode, whereby high intensity illumination free of background illumination is produced on said screen while at the same time high deflection sensitivity is obtained.

9. Electron discharge apparatus comprising a cathode ray type of electron discharge device having an electron gun for developing a cathode ray beam, a luminescent screen adapted to be excited by said cathode ray beam, electron beam deflecting means in operative association with said cathode ray beam for deflecting said cathode ray beam, an electrode mounted near said screen, said electrode comprising a wire mesh located substantially parallel with respect to said screen, another electrode mounted adjacent to said first electrode on the gun side of said first electrode comprising a conductive coating on the inside surface of the envelope of said discharge device, energizing means for energizing said electron gun and said electrodes so that the deflection sensitivity of said cathode ray beam is high, energizing means for energizing said luminescent screen so that high intensity lumination is produced by the impingement of said electron beam on said screen, said second electrode adapted to be energized with a slightly higher positive potential than said first electrode while said screen is adapted to be energized by a substantially higher potential than said first electrode.

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REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
1,810,018	Howes	June 16, 1931
1,955,899	Zworykin	Apr. 24, 1934
2,077,270	Schlesinger	Apr. 13, 1937
2,239,769	Batchelor	Apr. 29, 1941
2,289,906	Epstein	July 14, 1942
2,315,367	Epstein	Mar. 30, 1943
2,461,515	Bronwell	Feb. 15, 1949
2,483,457	Feldt et al.	Oct. 4, 1949
2,518,200	Sziklai et al.	Aug. 8, 1950
2,543,477	Sziklai et al.	Feb. 27, 1951