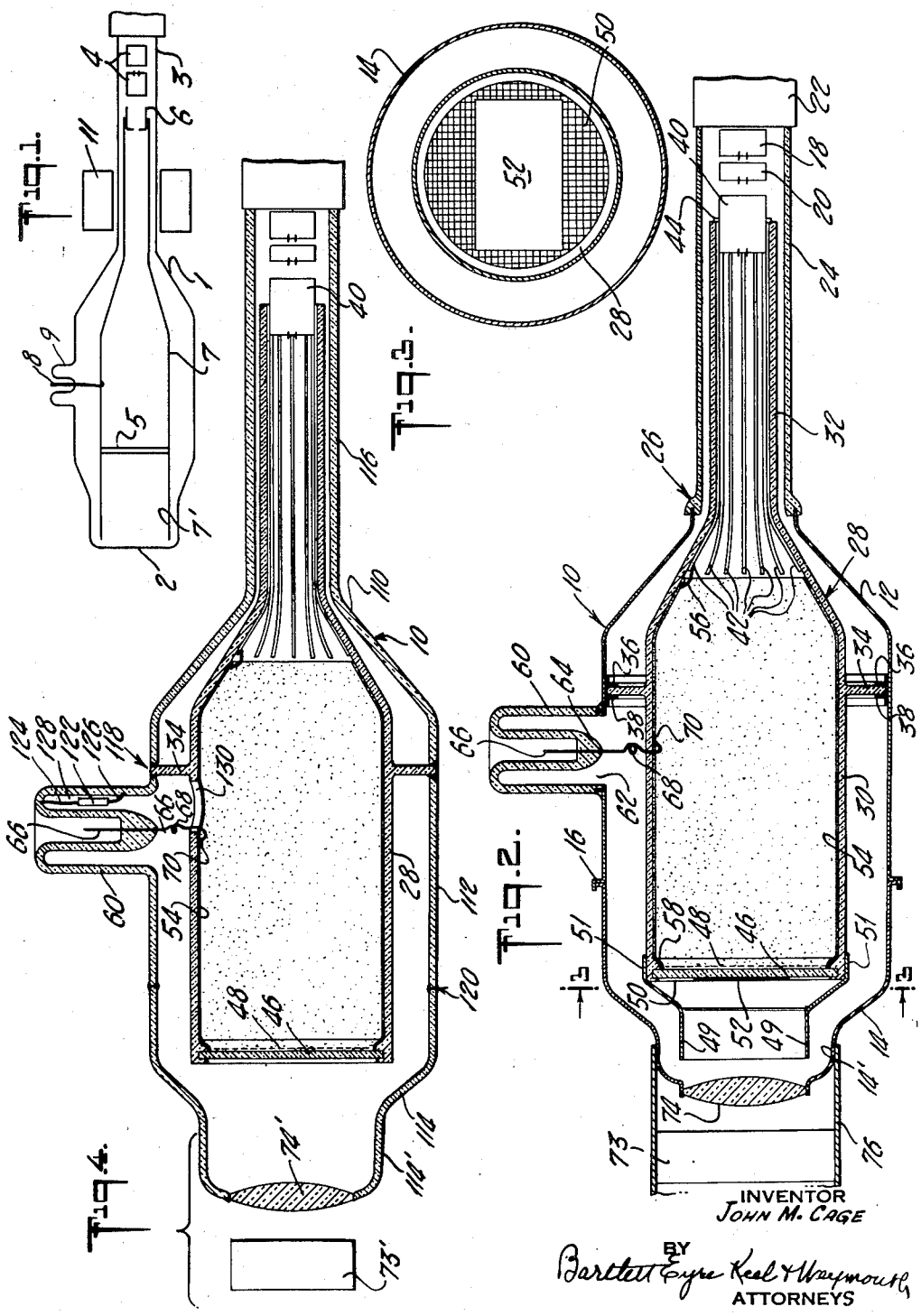
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CATHODE-RAY TUBE

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CATHODE-RAY TUBE

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This invention relates to image reproducing tubes of the cathode ray type that are useful for the reproduction of televised images and for other purposes.

One object of my invention is a new and improved means for shielding the electron beam in cathode ray tubes.

Another object of my invention is a new and improved cathode ray tube wherein the high potential elements are effectively insulated within the tube so that extremely high potentials can be applied without the danger of arc-over either through the glass or through the tube.

Another object of the invention is a new and improved tube of the character set forth wherein the tube wall or envelope can be maintained at a ground or other relatively low potential as compared with the accelerating potential.

Another object of the invention is to provide a relatively small cathode ray tube capable of operating at very high potentials.

Another object of the invention is a new and improved cathode ray tube of the character set forth wherein greatly improved operation and picture brightness is obtained.

Another object is a cathode ray tube wherein contamination of the vacuum is effectively prevented during the operation of the tube.

Another object of the invention is to provide means within the tube to define the picture size and shape that is to be projected.

Still another object of the invention is a new and improved cathode ray tube.

The above and other objects of the invention will become more apparent in the following description and the accompanying drawings.

In the drawings—

Fig. 1 is a diagrammatic view of one embodiment of the invention;

Fig. 2 is a cross-sectional view of another embodiment thereof;

Fig. 3 is a cross-sectional view of the embodiment of Fig. 2 taken along the line 3—3 thereof; and

Fig. 4 is another embodiment of the invention.

In Fig. 1 I have diagrammatically illustrated one form of the invention as applied to a projection type television reproducing tube. The outer envelope 1 of the tube is preferably formed at least in part of metal with a window 2 of glass or other transparent material. At the base or righthand end 3 of the tube is an electron gun 4 of conventional character for generating and controlling the electron beam. The high voltage elements, namely the image screen 5 and the

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second anode 6 are held in spaced relationship within the tube by a member 7 which extends to a point spaced from the window 2 on one end and from the electron gun 4 on the other end. The screen 5 is positioned within and a short distance from the end of the member 7 to provide a light shield part 7' and prevent reflected light from quenching the darker parts of the image formed on the screen 7. For this purpose the inner surface of the shield 7' is preferably of a black mat finish.

The member 7 may be made in whole or in part of a conductive material or may be of a non-conductive material with a partial or complete conductive coating thereon, depending on the particular purpose for which the tube is to be used. The high or accelerating voltage is connected to the member 7 by the conductor 8 centrally disposed in the insulator 9.

By fabricating the outer envelope 1 of metal and providing suitable insulating supports between it and the inner member 7, the envelope can be retained at ground or near ground potential and thereby insure maximum safety for personnel using or servicing the equipment and also prevent external electric fields from affecting the tube operation. Moreover, any harmful rays generated within the tube can be blocked by the metal envelope.

Internal or external deflecting and focusing means may be used for controlling the beam after acceleration thereof, depending on the tube structure. These are usually located after the second anode as, for example, at the place indicated by external coils denoted by the numeral 11. These coils may accomplish the final step of focusing the beam on the screen 7 and constitute the deflecting means for causing the beam to scan the screen in any desired manner.

The embodiment of my invention shown in Fig. 2 of the drawings overcomes certain limitations of conventional structures known to me and includes an outer metal envelope having a tubular glass neck portion extending therefrom to house the gun and focusing electrodes. The tubular neck portion has been formed of glass in order to enable the use of conventional external magnetic focusing and deflecting means of the type shown in Fig. 1 for the control of the electron beam. The tubular neck part of the tube can obviously be fabricated of metal should it be desirable, for example, to use focusing and deflecting means contained wholly within the tube.

More particularly the outer metal envelope 10

is preferably formed in two parts 12 and 14 that may be sweated or otherwise suitably fastened together substantially as indicated at 16. By separating the metallic housing in this way, the assembly as well as the fabrication of the tube components and the metallic shells is greatly simplified as will become apparent.

The electron gun illustrated diagrammatically at 18 and 20 is housed in the neck-like part 24 of the tube and supported by the closed end thereof located within the socket or base of the tube 22. The tubular or neck part 24 is illustrated as being of glass and is sealed in any suitable manner to the metallic shell 12 as shown at 26. It may, however, be desirable in certain instances to fabricate the neck part 24 also of metal, and in that case the neck 24 and the envelope part 12 can be made of one piece.

In cathode ray tubes the electron beam is produced and controlled by the electron gun, whereupon it then is greatly accelerated by the second anode disposed just ahead of the gun and proceeds to the other end of the tube to strike and illuminate a screen. The second anode and screen are therefore maintained at a very high potential which in projection type tubes may be as high as 30,000 or 40,000 volts and even higher. To prevent the accumulation of charges on the envelope walls they are generally coated with aquadag or other similar conductive coating and charged to the same or similar potential as the second anode and screen. With this arrangement it has been found that damaging electrical discharges frequently occur through the glass envelope itself or over the supports holding the second anode and other parts of the electron gun in alinement and for supporting them concentrically inside the cylindrical section 24 of the tube.

This new and improved tube overcomes this difficulty through the use of a new and improved structure adapted to hold the high voltage elements of the tube in spaced relationship to the outer tube envelopes. For this purpose I have provided a unitary structure 28 of glass or other suitable insulating material arranged to hold the high voltage elements above referred to in the desired relationship one to the other and to the electron gun.

More particularly the unitary structure 28 consists of a relatively large cylindrical portion 30 tapered at the rear thereof to form a long, narrow cylindrical part 32 adapted to fit in and be spaced from the neck-like part 24 of the tube. Surrounding the structure 28 is an outwardly extending flange 34 of insulating material such as glass or the like for supporting the structure 28 within the envelope. Although I have illustrated this flange as extending around the larger part 30 of the member 28, it may take the form of a plurality of individual projections arranged in line about the member or staggered over the surface thereof.

In the illustrated embodiment the flange 34 cooperates with a pair of surrounding metallic brackets 36 and 38 sweated or welded to the envelope part 12 to hold the member 28 in proper alinement with the envelope 10. In assembly of the tube, bracket 36 is first positioned in the shell part 12 and suitably fastened thereto. The member 28 is then inserted in the tube part 12 until the flange 34 seats flush on the ring 36, which automatically alines it with the outer envelope parts and the electron gun, whereupon the second ring on bracket 38 can be fastened in place as shown to rigidly hold the member 28 in place.

On the end of the smaller cylindrical part 32 of the member 28 I have secured the second or accelerating anode 40 so that when the member 28 is mounted in the outer envelope it will be properly alined with and spaced from the other gun elements 18 and 20. The anode 40 is held within the tubular part 32 by a plurality of wires or strips 42, each fastened to the anode and extending forward through the tubular part 32. The end part of each wire is bent outwardly to engage the conical part of member 28. A suitable flange or stop 44 may be provided on the anode 40 to limit its forward movement relative to the tubular part 32.

The reproducing screen 46 for interrupting the electron beam is fastened to the large end of the member 28 and has a suitable layer of phosphorous and aluminum on the inner side thereof. On the other or outer side of the screen 48 I have positioned a mask or mat 50 (Figs. 2 and 3) having a rectangular opening 52 therein through which the reproduced image is visible. By employing a mat of this character, the size of the picture can be pre-adjusted to eliminate any edge distortion and produce a well defined projection. Moreover, the screen 48 is flat and with proper control of the scanning means to correct for the lack of screen curvature, a very much improved picture is obtained.

To prevent the accumulation of a charge on the member 28, I prefer to coat the inside of the larger part 30 with a suitable conductive coating 54 of silver or the like extending from the screen 48 to a point spaced from the rods or wires 42 so as to prevent any electrical connection between the forward ends of the wires. One of the wires 42, however, is connected to the coating 54 at 56 and the coating is connected to the screen 48 by a suitable conductive coating or jumper 58. The member 28 instead of being formed of glass having conductive coatings on the inside thereof, may be formed in whole or in part of a suitable conductive material and thereby avoid the necessity of conductive coatings on certain parts thereof.

The high voltage supply for the accelerating anode 40, screen 48 and the conductive coating 54 is brought into the tube through a recessed insulator 60 welded to the edge of an opening 62 in the metallic housing part 12. The insulator 60 is preferably cylindrical in shape and has an inner cylindrical part 64 closed at its bottom end and joined on its upper side to the edge of the outer cylinder. A high voltage conductor 66 extends through the closed end of the inner cylinder 64 and is connected on its inner end to a short pigtail 68 which in turn extends through the member 28 and is connected to the coating 54 at 70.

The metallic end portion 14 of the tube envelope is tapered inwardly toward the left as viewed in Fig. 1 to form a short cylindrical section 14' which terminates in a somewhat smaller opening 72. Within this opening 72 is welded a glass window 74 having a diameter sufficient to permit the entire picture defined by the aperture 52 to be projected onto an external screen. A projection lens 73 is used to focus the reproduced image on the external screen and is slidably mounted within a metallic cylinder 76 arranged to forcibly fit the cylindrical part 14' and be wholly supported thereby. This method of mounting the projection lens insures accurate alinement of the lens within the screen 48 and any movement of

e tube would not cause it to be thrown out of line with its optical system. If desired, the lens supporting cylinder 76 may be sweated or otherwise securely fastened in place on the envelope section 14'.

To prevent reflected light from quenching the image formed on the screen 48, a light shield 49 may be placed in front of the screen and held in position in any suitable manner as by the enlarged cylindrical part 51 engaging the outer surface of the member 28. This shield should preferably have a black mat finish at least on the inside thereof.

Fig. 4 illustrates another embodiment of the invention wherein the outer envelope is formed of glass or other suitable material. The internal structure of the tube is similar to that shown in Fig. 2 and like parts in each figure have been formed and designated by like numerals.

In this embodiment I prefer to form the outer envelope 10 of three individual sections, namely, 110, 112 and 114. The section 110 includes a tapered neck-like part 116 which is similar to the neck-like portion 24 of Fig. 2 and is tapered outwardly toward the left to meet and abut the cylindrical section 112. The inner member 28 supporting the screen 48 in the second anode 40 is positioned in the tube with its flange 34 interposed between the meeting surfaces of the tube envelope parts 110 and 112 as illustrated at 118 and these parts are glass-welded together to form a substantially unitary structure. Upon the welding of the pigtail lead 68, which is fastened to the coating 54 at 70 to the leading in conductor 66, the front section 114 may then be welded in place as indicated at 120. Although I have indicated the front section 114 of the envelope as having a short cylindrical part 114', this part of the tube could obviously be made in any desired manner. This front section of the envelope is closed by a curved window 74' to modify the light passing therethrough, it being understood, however, that this window 74' can be formed as an integral part of the front envelope section 114. The window 74' is particularly useful in projection tubes since it constitutes one of the optical elements of a projection lens, the other elements being indicated diagrammatically at 73'. This structure eliminates one thickness of glass through which the image is to be projected and the attendant light losses.

I have also illustrated in this embodiment of the invention a new and improved getter to inactivate contaminating gases within the tube after it has been evacuated. For this purpose a piece of gettering material 122 is mounted on suitable supporting wires 124 and 126 disposed within the cylindrical opening 128 in the insulator 60. The mounting of the getter in this way will not materially affect the long linkage path obtained by use of the insulating structure 60 and will put the getter in position where it can be easily "fired" by an external source of electro-magnetic energy.

In order to insure the inactivation of all of the residual gases within the tube I provide an opening 130 in the member 28 just below the position of the getter 122 in the high voltage terminal 60. In this way the vapors produced by the getter 122 in firing will not only pervade the space surrounding the member 28 but part of them will be directed into the opening in member 28 to completely and effectively inactivate harmful residual gases. It is apparent that this method of gettering is equally applicable to the tube illustrated in Fig. 2.

The tube structure which I have illustrated in the drawings is particularly useful in high voltage applications where it is desired to project televised images, since all of the high voltage elements are completely and fully insulated from the surrounding envelope. In the embodiment of Fig. 2 the metallic envelope can be grounded so as to prevent the formation of a charge thereon that may endanger persons working on or wiring the equipment, and furthermore, the shell can be made of a metal that will effectively prevent the transmission of the harmful rays that may be generated within the tube by reason of the employment of very high voltages. Moreover, the metal shell will prevent external magnetic fields from affecting the electron beam in any way. Where deflecting means are incorporated wholly within the tube envelope, as previously described, the entire outer envelope can be formed of metal and thereby provide even more effective shielding.

This application is a continuation in part of my copending application for U. S. patent, Serial No. 46,585, filed August 28, 1948, for "Cathode Ray Tube."

I claim:

1. A cathode ray tube comprising an outer envelope having a large cylindrical section closed on one end by a transparent window and a small cylindrical neck-like part extending therefrom, an electron gun in said neck-like part to generate and direct an electron beam along the axis of the envelope, a member within the envelope and in spaced relation to the walls thereof, said member carrying on one end thereof an accelerating anode in alinement with the gun and on its other end a reproducing screen spaced from the window and adapted to interrupt the beam for the formation of images thereon.

2. A cathode ray tube according to claim 1 wherein said outer envelope is formed at least in part of metal.

3. In a cathode ray tube, a high voltage entrance insulator extending from the surface of the tube and having inner and outer walls defining an intermediate opening communicating with the inside of the tube, and gettering means disposed in said opening.

4. A cathode ray tube comprising an outer envelope, a hollow walled insulator extending from the surface of the envelope and having a conductor extending therethrough for the attachment of a high voltage lead-in wire, high voltage elements within the tube including a second anode and screen, a unitary member centrally of the envelope for holding the high voltage elements, gettering means disposed in the insulator for gettering the tube and an opening in said unitary member and in line with the getter to allow vapors produced by the getter when it is fired to pass into said unitary member.

5. A cathode ray tube including an electron gun comprising an outer envelope, a unitary member of smaller diameter than the envelope axially alined therein, an anode on one end of said member in spaced relationship to the electron gun, a screen on the other end of said member, and shielding means on the walls of said member for preventing the accumulation of an electrostatic charge on the walls thereof.

6. A cathode ray tube of the character set forth in claim 5 wherein said unitary member is formed of a conductive material.

7. A cathode ray tube according to claim 5 wherein said shielding means comprises a plural-

ity of individual wires in spaced relationship and extending from the anode to a point between the anode and the screen, and a uniform conductive layer extending from the screen to a point spaced from the ends of said wires.

8. A cathode ray tube comprising an envelope having a transparent window, an electron responsive screen in said envelope and spaced from the window, and a cylindrical member positioned between the screen and the window to prevent direct or reflected light from quenching the darker parts of an image formed on the screen.

9. In a cathode ray tube having a gun structure enclosed within the evacuated tube envelope comprising means for controlling and focusing the beam produced by the gun and a second anode for accelerating the beam including a plurality of individual elongated conductive elements extending from said anode in the direction of movement of the beam, unitary means in said envelope for supporting the second anode and conductive elements and a screen in said tube mounted on the end of said unitary member for the reproduction of images thereon.

10. In a cathode ray tube having an electron gun enclosed within the evacuated tube envelope comprising means for controlling and focusing the beam, a second anode for accelerating the beam including a plurality of individual elongated conductive elements extending from said anode in the direction of movement of the beam, an electron responsive screen in said envelope spaced from the wall thereof, said envelope having a window therein in alinement with said screen and adapted to transmit light patterns produced by said screen, said window being curved to modify the light emitted by the screen and passing through the window.

11. A cathode ray tube having an electron gun enclosed within the evacuated tube envelope comprising means for controlling and focusing the beam, a second anode for accelerating the beam including a plurality of wirelike elements extending from the anode in the direction of movement of the beam, said elements being spaced about the beam and connected one to the other and to the second anode, a screen within said envelope to interrupt the electron beam for the reproduction of images formed thereby, and individual means within the tube for supporting the screen and the second anode including the wirelike elements.

12. In a cathode ray tube according to claim 11 wherein said elements are electrically connected together at the second anode and are spaced substantially uniformly about the beam.

13. The combination with a cathode ray tube as set forth in claim 11 of a window in said tube envelope to transmit light produced by the screen, said window having differentially curved surfaces to modify the light passing therethrough.

14. In an image reproducing tube, an electron gun for producing an electron beam, an anode for accelerating said beam including a plurality of spaced insulated elements extending from the anode in a direction of movement of the beam, said elements surrounding and providing an electrostatic shield for the beam, an electron responsive screen for intercepting the beam, and means for supporting the second anode, the spaced elements and the screen in alinement one with the others and with the electron gun.

15. The combination with an image reproducing tube as set forth in claim 14 of a window in said tube for transmitting the light produced by the screen, said window being curved to provide parts having different thicknesses to modify the image passing therethrough.

16. A cathode ray tube comprising an outer envelope, an electron gun in one end of said envelope and a transparent window in the other end thereof, an internal tubular member within said envelope and extending from the gun to a point spaced from the window, said member being at least in part conductive, a second accelerating anode on the end of said member adjacent the gun and a screen supported within the other end of said member, said screen being spaced a greater distance from the window than the adjacent end of said member.

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REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
1,691,324	Zworykin	Nov. 13, 1928
2,093,238	Ogloblinsky	Sept. 14, 1937
2,119,119	Schoenberg	May 31, 1938
2,197,625	Teves et al.	Apr. 16, 1940
2,224,324	Van Steenis	Dec. 10, 1940
2,229,766	Nicoll et al.	Jan. 28, 1941
2,250,283	Teal	July 22, 1941
2,254,090	Power	Aug. 26, 1941
2,289,906	Epstein	July 14, 1942
2,388,203	Zindel	Oct. 30, 1945
2,407,082	Johnson et al.	Sept. 3, 1946
2,414,881	Law	Jan. 28, 1947
2,438,668	Koch et al.	Mar. 30, 1948
2,440,260	Gall	Apr. 27, 1948
2,452,619	Weimer	Nov. 2, 1948
2,473,320	Wynn et al.	June 14, 1949
2,476,619	Nicoll	July 19, 1949
2,485,561	Burroughs	Oct. 25, 1949
2,546,828	Levy	Mar. 27, 1951