July 22, 1952 F. C. BREEDEN 2,604,599

CATHODE-RAY TUBE

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FIG. 1

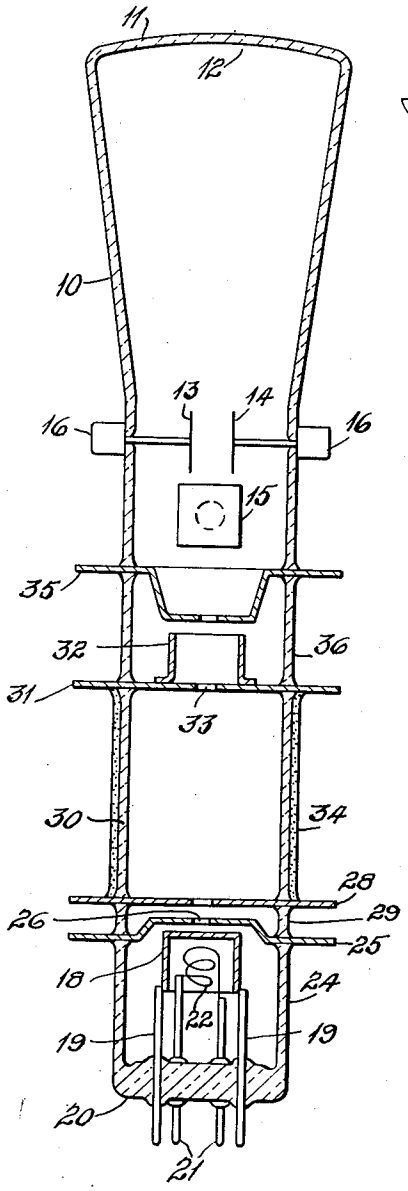
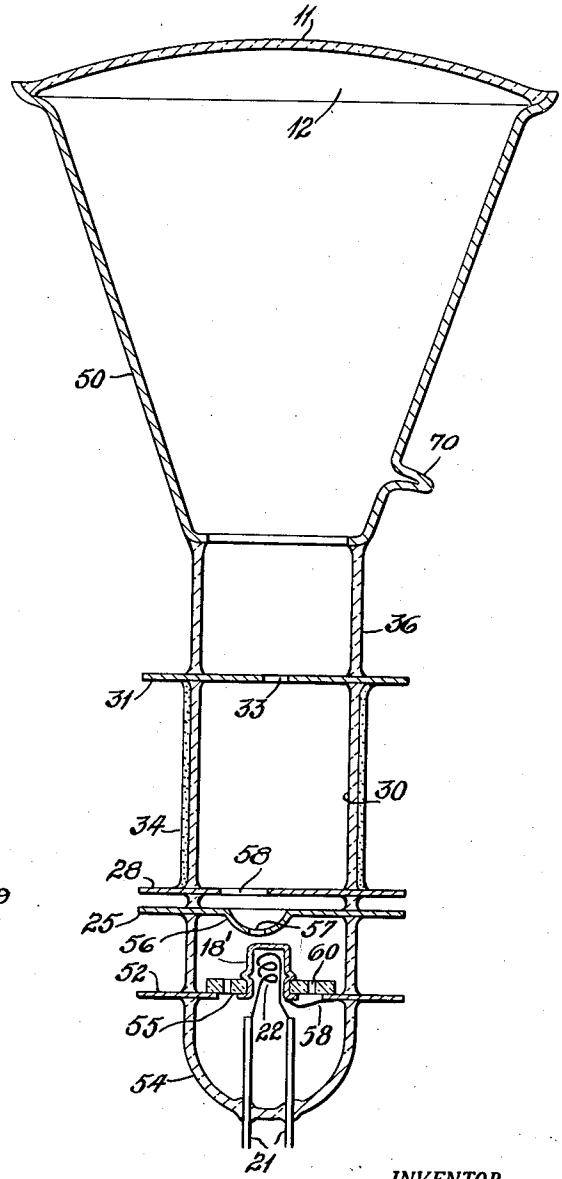


FIG. 2



INVENTOR.
Francis C. Breeden
BY J. Albert Hultquist
ATTORNEY

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CATHODE-RAY TUBE

Francis C. Breeden, Bayside, N. Y., assignor to Sylvania Electric Products Inc., a corporation of Massachusetts

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9 Claims. (Cl. 313—83)

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The present invention relates to electron ray tubes and more particularly to a novel arrangement of the electron source electrode and beam forming electrodes in cathode ray tubes.

An object of the present invention is the provision of a novel type of cathode ray tube structure.

Another object of the present invention is the provision of a cathode ray tube structure in which the electron beam forming electrodes are of more simplified construction than heretofore known.

A further object of the present invention is the provision of a cathode ray tube as aforesaid in which the beam forming and beam producing electrodes are more rigidly held in position than heretofore.

Still a further object of the present invention is the provision of a cathode ray tube which is more easily constructed than heretofore known types of cathode ray tubes.

Still another object of the present invention is the provision of a cathode ray tube structure, large portions of which may be prefabricated before assembling into a completed cathode ray tube.

Yet another object of the present invention is the adaptation of disc electrode sealing techniques to cathode ray tube construction.

The attainment of these objects in accordance with principles of the present invention result in a cathode ray tube which is particularly usable for television purposes and which requires a smaller focusing coil and a smaller deflection coil than previously known and as a result less horizontal deflection power is used. In accordance with one aspect of the present invention, the electron stream producing and beam forming electrodes of a cathode ray tube are each held by a number of flat metal plates or disc electrodes which are separated by appropriate lengths of coaxially aligned pieces of glass tubing. A glass-to-metal seal is provided at the junction between each disc electrode and each of the pieces of the glass tubing. Where it is desired that a pair of adjacent disc electrodes be connected by a metallic or conducting cylindrical electrode portion, it is contemplated that this structure be provided by conductively coating the intervening section of glass tubing either on its interior or exterior. The neck structure of the tube as thus provided is subsequently sealed onto a glass bulb portion which, in the case of an electrostatic deflection type of

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tube may have suitable electrostatic deflecting electrodes mounted therein.

If desired, the neck portion as above described may be welded or fused to the smaller end of a metal cone which carries on its larger end a glass screen bearing the fluorescent material. The focusing and deflection of the cathode ray beam in such an arrangement is usually accomplished electromagnetically in which case the electromagnetic focusing and deflecting coils may be placed about the glass neck portion between the final disc electrode and the metal cone. If a metal cone form of construction is used, it is considered preferable that the tube during the exhaust processes be exhausted through a tubulation in the metal cone since the largest volume of the tube then will be most closely adjacent to the exhaust apparatus and a better evacuated tube will thus be produced.

It will be apparent that the electrode construction of a cathode ray tube constructed according to the present invention may be readily and accurately assembled by using the metal-to-glass sealing techniques disclosed in prior application, Serial No. 612,029 filed August 22, 1945, now Patent #2,575,448 by Paul Haas, assignor to the assignee of the present application.

The present invention will be more fully understood by reference to the following detailed description which is accompanied by a drawing in which Fig. 1 illustrates in longitudinal cross section the application of the present invention to a electrostatic deflection type of cathode ray tube while Fig. 2 illustrates a modification of the present invention as applied to a electromagnetic deflection type of cathode ray tube having a metal cone.

Referring now to Fig. 1, there is shown, in this figure, in longitudinal cross section, a glass cathode ray tube having a bulb portion 10, having an end wall 11 coated on its interior with a fluorescent material as indicated by reference number 12. By appropriate proportioning the transverse dimensions of the end wall bearing the fluorescent screen may be made as large as desired. Only a small screen diameter is shown in the present figure for the purposes of illustrating the principles of the present invention. The bulb portion 10 is necked down somewhat at its lower open end and in this portion of the bulb are provided a pair of plates 13, 14 for electrostatically deflecting the beam in one direction and another pair of plates, one of which is indi-

cated at 15, lying in planes perpendicular to the planes in which plates 13 and 14 lie, for deflecting the electron beam in directions normal to the direction of deflection caused by plates 13 and 14. As indicated with reference to deflecting plates 13 and 14, the deflecting plates may be held in position by the leads sealed through the glass and terminating in connection caps such as that indicated as 16. Below the portion where the electrostatic deflecting means are provided is an extending neck portion which carries a number of apertured electrodes for electrostatically focusing the stream of electrons generated by cathode 18 into a fine beam of electrons and for varying the intensity of the beam in accordance with the purpose for which the tube is employed. In the modification shown in Fig. 1 cathode 18 is supported by a number of lead-in electrodes 19 passing through a glass header 20. Additional lead-in electrodes 21 are provided for connecting a source of power to the heater element 22, within the cathode 18, by means of which the cathode 18 is heated to an extent sufficient for it to emit a stream of electrons. Hermetically sealed to header 20 is a first short length of glass tubing 24 which surrounds the cathode 18. At the upper end of the glass tubing section 24 is provided a first disc electrode 25 having a central aperture 26 therein. This electrode is normally supplied with a predetermined potential, negative with respect to cathode 18, for controlling the intensity of the stream of electrons passing through aperture 26. An annular ring seal is provided between the upper end of the glass tubing section 24 and the disc electrode 25. Immediately above the disc electrode 25 is a second disc electrode 28 separated therefrom by a short length of glass tubing 29, ring metal-to-glass seals being formed between each end of tube section 29 and disc electrodes 25 and 28. Above disc electrode 28 is another section of glass tubing 30, followed by a further disc electrode 31 carrying a short conductive cylinder 32 on its upper surface concentrically arranged with respect to the aperture 33 in disc 31. The glass tubing section 30 is preferably coated either on its inner or outer surfaces with a conductive material 34 which is in electrical contact with both disc electrode 28 and disc electrode 31. The complete conductive assembly 28, 34, 31, 32 forms a cylindrical anode structure to which a high positive potential is preferably applied. Above disc electrode 31 and in spaced alignment therewith is a final disc electrode 35. A short length of glass tubing 36 is concentrically arranged with respect to tubing 30 and sealed with a ring metal-to-glass seal to both electrodes 31 and 35. Disc electrode 35 is then sealed to the neck of bulb 10 by a ring metal-to-glass seal. Final electrode 35, serves as a final anode for producing the final focusing and beam intensifying action on the electron beam before it reaches the zone where it is controlled by the vertical and horizontal deflecting plates in the neck of bulb 10.

It will be understood that electrodes 25, 28, 31 and 35 together with the interposed pieces of glass tubing 29, 30 and 36 and the glass tubing section 24 which carries the cathode assembly may readily be assembled in a jig which holds the pieces in accurate alignment while heat is applied to the disc electrodes and to the adjacent ends of the glass tubing section for simultaneously forming all of the ring metal-to-glass seal at the same time. After all portions of the neck structure are sealed together and sealed to the neck of the bulb 10 the cathode ray tube is ready for the conventional exhaust processes which may be accomplished by connecting an exhaust tubulation, not shown, to an exhaust pump. The exhaust tubulation may pass through the header 20 or through the glass wall at some other convenient point. After the predetermined vacuum is obtained within the space enclosed by the glass walls of the tube the tube may be sealed off and applied to its final use.

The form of the invention shown in Fig. 2 is similar to that described above with reference to Fig. 1 and, in general, the same reference numerals are applied to corresponding portions of the tube structures. It will, however, be noted that in the form shown in Fig. 2, a metal cone 50 is provided between the neck portion and the end wall 11 bearing the fluorescent screen 12. Also, since the tube shown in this figure is designed for electromagnetic focusing and deflection there are no deflection plates shown nor is as complicated an electron beam forming apparatus required as in the case of Fig. 1. Thus, there is no final anode such as that shown at 35 in Fig. 1 required. However, the metal cone 50 in Fig. 2 may constitute the final accelerating electrode. Also, in the modification shown in Fig. 2 the cathode 18' is carried by a metal disc 52 passing through the walls of the glass tubing section at the lower end of the tube instead of utilizing a cylindrical glass tube section 24 and a glass header such as is shown in Fig. 1. In Fig. 2 the lower end wall of the cathode ray tube is provided by a dome shaped glass section 54 having a pair of leads 21 passing through for connection to the cathode heater 22. Since it is desirable to minimize the heat loss in cathode 18' as much as possible, it is preferred to interpose a ceramic washer 55 between the metal disc 52 and cathode 18'. Disc electrode 52 may be riveted or otherwise secured to washer 55 as may also cathode 18'. Alternatively cathode 18' may be spun into the central aperture of washer 55. It is of course necessary to provide electrical conductivity between cathode 18' and electrode 52 as by means of a thin metal strap 58. Disc electrode 52 or ceramic washer 55 is provided with through aperture 60 to assure that the volume within the dome shaped member 54 is adequately exhausted. Also, since the tube shown in Fig. 2 is designed for electromagnetic deflection there is provided an arrangement for eliminating ions from the electron beam. This is accomplished by providing grid electrode 25 with a depressed portion or cup 56 and an aperture 57 in the middle of the cup. The axis of the cupped portion and the axis of the aperture 57 are both offset in the same direction from the central axis of the tube. The first disc electrode 28, forming a part of the anode, also has an aperture 58 offset from the central axis of the tube in the same direction as the offset of the cup portion 56 and aperture 57 of the grid 25. The resulting electric field between electrodes 25 and 28 and the offset apertures causes the electron stream from cathode 18 to be deflected in a direction which tends to cross the axis of the tube. Then appropriately placed magnetic poles surrounding the anode 34 may be caused to bend the electron stream back so that it passes through the central aperture 33 and electrode 31 so that it will eventually strike the fluorescent screen 12 and be scanned over the surface thereof. The ions in the beam, however, being heavier than the electrons are not deflected as far by the magnetic

deflecting beams as the electrons and are consequently collected by the electrode **31**. In the form of the invention shown in Fig. 2 I prefer to exhaust the tube through a metal tubulation **70** in the side of the metal cone **50**. Since the exhaust tubulation **70** directly connects with the largest interior volume of the tube, the air within the tube may be much more readily exhausted than would be the case if the exhaust took place through a tubulation connected to the smaller end of the tube whereby all the gases within the large volume enclosed by cone **50** would have to pass through all of the small apertures **33**, **58**, **57** and **55** on their way out of the tube.

Also, the metal seal off tubulation **70** forms a convenient point for connection of a source of potential for positively biasing the cone **50** to the extent desired for accelerating the electron stream after deflection and before it strikes the fluorescent screen **12**. While I have particularly shown and described several embodiments of the present invention, it should be distinctly understood that my invention is not limited thereto but that modifications within the scope of the invention may be made.

What I claim is:

1. A cathode ray tube having an envelope with an enlarged body portion and a substantially cylindrical neck portion and a number of electron beam producing and focusing electrodes in the form of discs passing through and supported by said cylindrical neck portion, said electrodes being hermetically sealed to the glass, a pair of adjacent ones of said electrodes being connected together by a conductive coating on the surface of the interposed portion of said cylindrical neck portion, said tube having an exhaust tubulation in the body portion.

2. A cathode ray tube having an envelope with a substantially cylindrical neck portion and a number of electron beam producing and focusing electrodes in the form of discs passing through and supported by said cylindrical neck portion, said electrodes being hermetically sealed to the glass, a pair of adjacent ones of said electrodes being connected together by a conductive coating on the surface on the interposed portion of said cylindrical neck portion.

3. A cathode ray tube having a substantially cylindrical glass neck portion including a number of coaxially arranged sections of glass tubing, adjacent ends of each of said sections of glass tubing being separated by and sealed to disc electrodes, said discs being of greater diameter than the tubing to provide exterior connection surfaces and each having an opening within said neck portion, an end one of said sections of glass tubing having a header sealed to its open end, said header carrying a number of lead in electrodes sealed therethrough, a pair of adjacent ones of said disc electrodes being connected together by a conductive coating on a surface of the interposed section of glass tubing.

4. A cathode ray tube having an electron gun structure including a number of spaced substantially flat disc electrodes, and interposed coaxially arranged sections of glass tubing, adjacent ends of said sections of glass tubing being hermetically sealed to said disc electrodes, one of said discs carrying a cup shaped cathode having electron emissive material on its end, the connection between said cathode and one disc being so arranged that heat conduction through said disc is minimized.

5. A cathode ray tube having an electron gun structure including a number of spaced substantially flat disc electrodes, and interposed coaxially arranged sections of glass tubing, adjacent ends of said sections of glass tubing being hermetically sealed to said disc electrodes, an end one of said electrodes being arranged to carry a cup shaped cathode having an electron emissive material on the outside surface of the bottom of said cup.

6. A cathode ray tube having an electron gun structure including a number of spaced substantially flat disc electrodes, and interposed coaxially arranged sections of glass tubing, adjacent ends of said sections of glass tubing being hermetically sealed to said disc electrodes, a pair of adjacent ones of said disc electrodes being connected together by a conductive coating on a surface of the interposed section of glass tubing, an end one of said electrodes being arranged to carry a cup shaped cathode having an electron emissive material on the outside surface of the bottom of said cup, a heater element within said cup and connection leads from said heater.

7. A cathode ray tube having an electron gun structure including a number of spaced substantially flat disc electrodes, and interposed coaxially arranged sections of glass tubing, adjacent ends of said sections of glass tubing being hermetically sealed to said disc electrodes, an end of said electrodes being arranged to carry a cup shaped cathode having an electron emissive material on the bottom of said cup, a heater element within said cup and connection leads from said heater, the one of said glass tubing sections beyond said end electrode being hermetically sealed at its free end and said connection leads passing through said free end.

8. A cathode ray tube having an electron gun structure including a number of spaced substantially flat disc electrodes and coaxially arranged sections of glass tubing interposed between said disc electrodes, adjacent ends of said sections being hermetically sealed to said disc electrodes, an end one of said electrodes being arranged to carry a cup shaped cathode; others of said electrodes serving as control grid and anode members, said other electrodes having through apertures within the area surrounded by the seals to said class tubing sections, a pair of adjacent ones of said disc electrodes being connected together by a conductive coating on a surface of the interposed section of glass tubing.

9. A cathode ray tube having an electron gun structure including a number of spaced substantially flat disc electrodes and coaxially arranged sections of glass tubing interposed between said disc electrodes, adjacent ends of said sections being hermetically sealed to said disc electrodes, an end one of said electrodes being arranged to carry a cup shaped cathode; others of said electrodes serving as control grid and anode members, said other electrodes having through apertures within the area surrounded by the seals to said glass tubing sections, a pair of adjacent ones of said disc electrodes being connected together by a conductive coating on a surface of the interposed section of glass tubing, the apertures through said control grid electrode and first anode electrode being offset to one side of the axis of said structure whereby the electron beam from said cathode is skewed with respect to said axis.

FRANCIS C. BREEDEN.

(References on following page)

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
2,075,141	Schlesinger	Mar. 30, 1937
2,215,155	Kallmann et al.	Sept. 17, 1940
2,254,090	Power	Aug. 26, 1941
2,303,166	Laico	Nov. 24, 1942
2,308,800	Anderson	Jan. 19, 1943
2,336,774	Brackney et al.	Dec. 14, 1943
2,343,457	Herzog	Mar. 7, 1944
2,343,630	Atwood	Mar. 7, 1944

Number	Name	Date
2,400,753	Haeff	May 21, 1946
2,416,566	Beggs	Feb. 25, 1947
2,421,767	Varian	June 10, 1947
2,443,916	Kelar	June 22, 1948
2,472,766	Woodbridge	June 7, 1949
2,501,882	Trump et al.	Mar. 28, 1950
2,521,426	Trump et al.	Sept. 5, 1950

FOREIGN PATENTS

Number	Country	Date
566,542	Great Britain	June 3, 1945
602,804	Great Britain	June 3, 1948