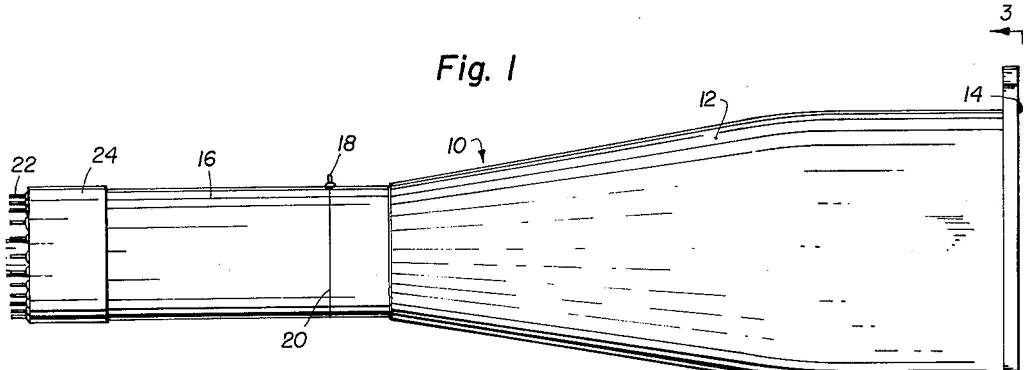
Sept. 21, 1965 W. H. WILBANKS ETAL 3,207,936

ELECTRON BEAM DISPLAY DEVICE

Filed Aug. 21, 1961 2 Sheets-Sheet 1

Fig. 1



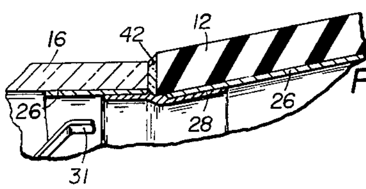


Fig. 5

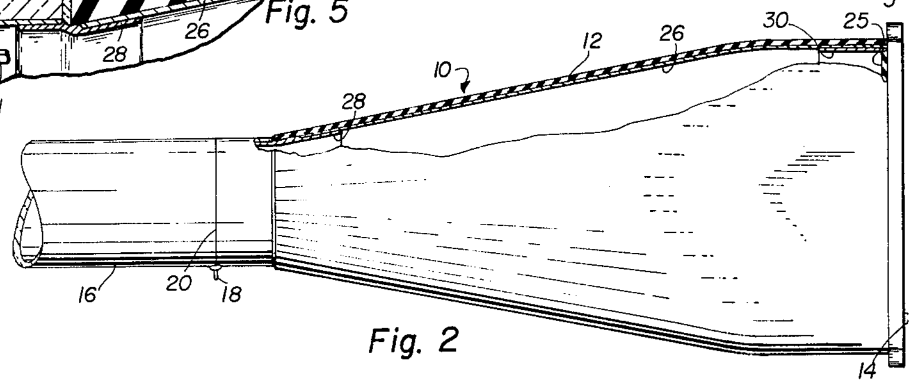


Fig. 2

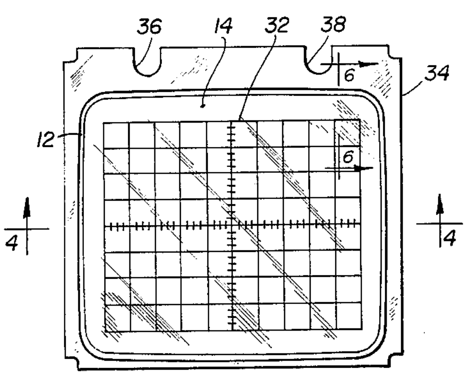


Fig. 3

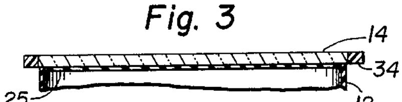


Fig. 4

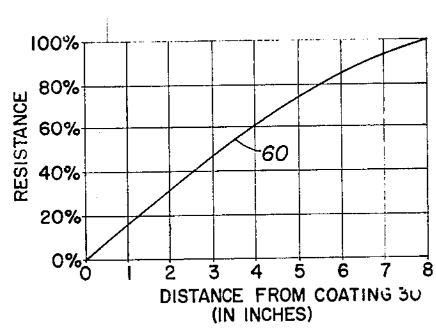


Fig. 12

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ELECTRON BEAM DISPLAY DEVICE

Filed Aug. 21, 1961 2 Sheets-Sheet 2

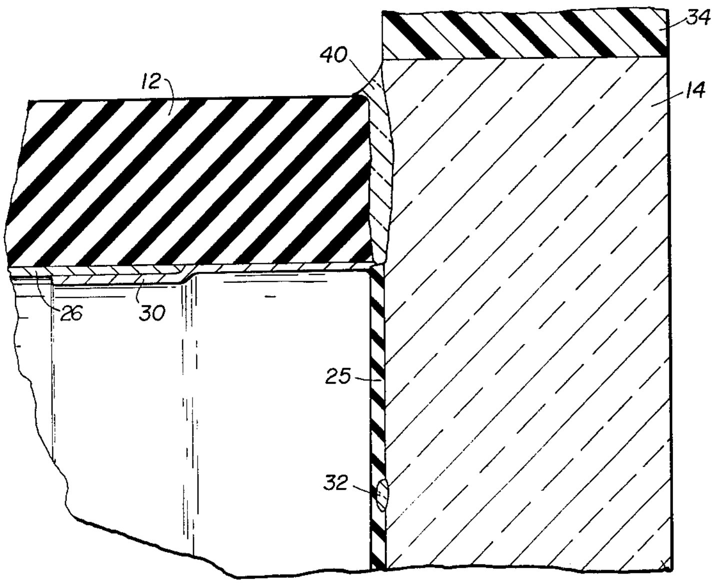

Fig. 6

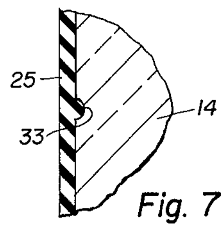

Fig. 7

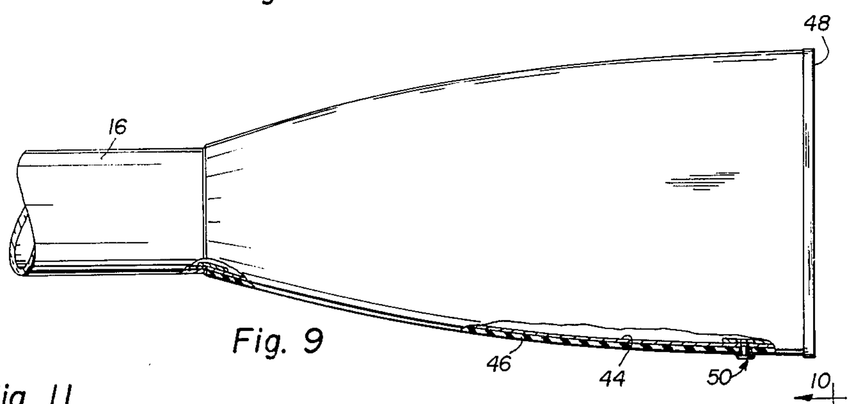

Fig. 9

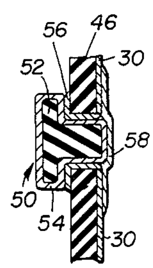

Fig. 11

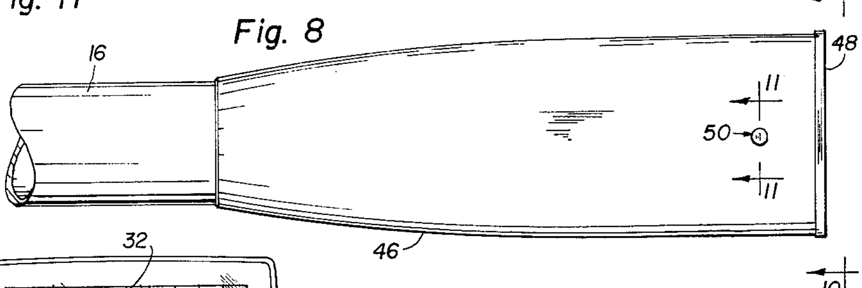

Fig. 8

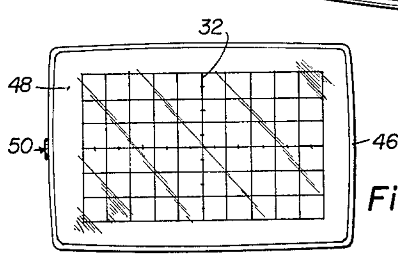

Fig. 10

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ELECTRON BEAM DISPLAY DEVICE

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Filed Aug. 21, 1961, Ser. No. 132,915
16 Claims. (Cl. 313—75)

The subject matter of the present invention relates in general to improvements in electron beam display devices, and specifically includes improved envelope structure for such display devices.

The envelope structure of the present invention is particularly useful in a cathode ray tube type of display device, such as that employed in a cathode ray oscilloscope, so that it will be described in detail with reference thereto.

Briefly the envelope structure of the present invention includes: an envelope having a body portion made of ceramic material with one end of such body portion having a hollow cross-section substantially in the shape of a rectangle, and a face plate portion made of transparent glass in the form of a substantially flat rectangular plate of a shape conforming to that of such one end of such body portion and attached to such one end of such body portion by a seal portion made of a glass frit material having a thermal coefficient of expansion similar to and a softening temperature below that of such ceramic and such transparent glass; a resistance coating of non-carbon refractory material on the inner surface of such ceramic body portion of such envelope, which may have a varying thickness and a graduated resistance per square and be electrically connected to function as a post deflection acceleration anode electrode; and a graticule scale provided on the inner surface of such flat face plate portion of such envelope so that such graticule can be illuminated by light projecting into such face plate portion through the edge surrounding the periphery thereof.

Conventional cathode ray tubes are formed with envelopes made entirely of glass having circular or rectangular face plates supporting the fluorescent screens thereof. These circular face plate cathode ray tubes take up much unnecessary space in a cathode ray oscilloscope because the upper and lower portions of the circular fluorescent screen are seldom if ever used to reproduce the electrical signal wave form under investigation. It is difficult to make a glass envelope with a rectangular shape because the side walls tend to deform inwardly during high temperature evacuation and cracks form at corners having a small radius of curvature, due to stress within the glass. Therefore, when the conventional glass envelopes are shaped to provide a molded rectangular face plate the corners of the rectangular funnel portion must be made of greatly increased thickness for strength which also cuts down on the usable surface area of such face plate. Also, the molded glass face plates of conventional cathode ray tubes are curved rather than flat and as a result require an additional flat, external graticule plate placed in contact with the external surface of the face plate in order to provide an edge-lighted graticule for determining the relative dimensions of the wave form under investigation. This curved face plate and its external graticule result in a distortion of the wave form image and in parallax of the graticule scale image, as viewed by a camera or directly by a human observer.

In addition, conventional cathode ray tubes are provided with a resistance coating of aquadag or other low oxidation temperature carbon material on the interior surface of the body portion of the envelope, which in some instances is connected to function merely as an extension of the second anode in the electron gun and

in other cases as a post acceleration anode to increase the velocity of the electron beam after deflection of such beam by the electrical signal under examination. Heretofore, the post acceleration anode has been provided in the form of either a plurality of spaced, insulated, uniform thickness coating portions with each of such coating portions at different potentials, or a single uniform thickness coating in the shape of a helix, to produce an electrical potential gradient of increasing magnitude from the electron gun to the fluorescent screen of the cathode ray tube. However, these conventional multi-portion and helical resistance coatings do not allow uniform acceleration of the electron beam and do not provide a uniform electric field within a given cross-section of the tube, respectively. Also, the carbon material of such coatings oxidizes if high temperature is used during the "bake out" evacuation process, as is necessary for efficient "out-gassing" to remove absorbed gases in the cathode ray tube.

The above discussed disadvantages of conventional cathode ray tubes are overcome by the envelope structure of the present invention. Thus, the use of an envelope with a ceramic body portion provides the envelope with sufficient strength so that it may be made of a thin, substantially uniform, wall thickness with one end having a hollow cross-section in the shape of a rectangle which may be sealed to a transparent glass face plate in the form of a flat plate of the same configuration as such body cross-section by means of a glass frit seal having a thermal coefficient of expansion substantially the same as, and a softening temperature substantially below, that of such ceramic and transparent glass in order to eliminate the wasted space of conventional glass tubes. The graticule scale may be provided directly on the interior surface of the flat face plate which can be edge-lighted, to eliminate the graticule image parallax and wave shape image distortion of conventional tubes. Also, the post acceleration anode coating may be made of non-carbon refractory material so that high temperature evacuation is possible, and such coating may be formed with a variable thickness which decreases in value from the end of the coating farthest from the face plate toward the end nearest the face plate so that the resistance per square of such coating increases in the same direction. This graduated resistance coating may completely cover the interior surface of the ceramic body portion from one end of such coating to the other end thereof and thereby provides a more uniform electric field within a given cross-section and allows more uniform acceleration of the electron beam.

Therefore, one object of the present invention is to provide an improved electron beam display device employing an envelope portion made of ceramic material.

Another object of the present invention is to provide an improved electron beam display device having an envelope including a body portion of ceramic material with one end having a hollow cross-section in the shape of a right-angle parallelogram, a face plate portion of transparent glass material in the form of a flat plate having the shape of a right-angle parallelogram corresponding to that of such body end cross-section, and a seal portion of a material having a thermal coefficient of expansion similar to, and a softening temperature substantially below, that of such ceramic and such transparent glass attaching such face plate portion to such body portion.

A further object of the invention is to provide an improved cathode ray tube having a graticule scale formed on the inner surface of a substantially flat, transparent glass face plate portion of the envelope of such cathode ray tube upon which the fluorescent screen thereof is supported over such graticule scale, such face plate being adapted to transmit light through the edge surrounding the periphery thereof into such face plate in order to illuminate such graticule.

Another object of the invention is to provide an improved cathode ray tube having an anode coating of electrical resistance material, containing Cr_2O_3, Fe_2O_3, TiO_2 and ceramic material, upon the internal surface of a portion of the envelope of such tube.

Still another object of the present invention is to provide an improved cathode ray tube having an envelope with an electrical resistance coating of non-carbon refractory material upon the interior surface of the funnel-shaped body portion of such envelope so that the thickness of such coating varies with distance from the face plate portion of such envelope by increasing in magnitude from an end nearest to such face plate toward an end farthest from such face plate so that the resistance per square of such coating decreases in the same direction away from such face plate, and such coating is connected to provide an electrical potential gradient so that such coating functions as a post deflection acceleration anode to accelerate the electron beam in such cathode ray tube toward such face plate.

A still further object of the invention is to provide an improved envelope for use in a cathode ray tube including a glass neck portion in the shape of a hollow circular cylinder, a ceramic body portion having one end of a hollow circular cross-section sealed to such stem portion by a glass frit material with a thermal coefficient of expansion substantially the same as, and a softening temperature substantially below, that of such ceramic body and such glass stem and having a second end with a hollow cross-section in the shape of a rectangle, and a face plate portion of transparent glass in the form of a flat plate conforming to the shape of such second end of such body portion and sealed to such second end by a glass frit material having a thermal coefficient of expansion similar to, and a softening temperature substantially below, that of such ceramic body and such glass face plate.

Additional objects and advantages of the present invention will become apparent after referring to the following detailed description of certain preferred embodiments thereof and to the attached drawings of which:

FIG. 1 is a side view of one embodiment of a cathode ray tube made in accordance with the present invention;

FIG. 2 is a partial top view of the cathode ray tube of FIG. 1 with a portion of the envelope broken away;

FIG. 3 is a front view taken along the line **3—3** of FIG. 1;

FIG. 4 is a sectional view taken along the line **4—4** of FIG. 3;

FIG. 5 is a sectional view of part of a glass-to-ceramic seal in the cathode ray tube envelope of FIG. 2;

FIG. 6 is a partial sectional view taken along the line **6—6** of FIG. 3 showing one embodiment of the graticule;

FIG. 7 is a partial view of FIG. 6 showing another embodiment of the graticule;

FIG. 8 is a partial side view of another embodiment of a cathode ray tube made in accordance with the present invention;

FIG. 9 is a top view of the cathode ray tube of FIG. 8 with portions of the envelope broken away;

FIG. 10 is a front view of the cathode ray tube of FIG. 8 taken along the line **10—10**;

FIG. 11 is a partial sectional view taken along the line **11—11** of FIG. 8; and

FIG. 12 is a graph showing the resistance characteristic of the graduated resistance coating used in the cathode ray tube of FIGS. 8 to 11.

One embodiment of the envelope structure of the present invention is shown in FIGS. 1 to 6 which disclose a cathode ray tube having a hollow, evacuated envelope **10** of electrical insulating material including a funnel-shaped body portion **12**, a flat face plate portion **14** and a cylindrical stem portion **16**. The envelope **10** contains a conventional electron gun and conventional electrostatic deflection plates (not shown) inside the stem portion **16** with electrical leads **18** connected to the horizontal and vertical deflection plates extending through a conventional flame seal **20** joining two cylindrical members which form such stem portion. Other electrical leads **22** connected to the electron gun electrodes extend through the end of stem portion **16** remote from body portion **12** so that they are supported in a socket **24** of insulating material mounted on the rear end of envelope **10**. The envelope body portion **12** is made of ceramic insulating material in the shape of a tapered funnel formed of a cone frustrum joined to a rectangular cylinder, and has a smaller end with a hollow circular cross-section attached to the stem portion **16** and a larger end with a hollow rectangular cross-section attached to the face plate **14** supporting fluorescent screen **25** of the cathode ray tube.

A resistance coating **26** of substantially uniform thickness may be provided on the internal surface of envelope body portion **12**, as shown in FIG. 2, which is electrically connected to the second anode in the electron gun to serve as an extension of such anode and provides a substantially uniform electrical field within such body portion **12** for the electron beam of the "mono-acceleration" type cathode ray tube. A pair of thin layers **28** and **30** of silver, or similar conducting material, may be coated over each end of resistance coating **26** for a short distance to define with regularity the outline of the effective anode formed thereby and to provide a good electrical connectio thereto from the second anode through a spring support member **31** as shown in FIG. 5. This uniform resistance coating **26** may be made of conventional low temperature material, such as aquadag or other carbon material, or it may be composed of the non-carbon, refractory material hereafter described with reference to FIGS. 8 to 11.

The face plate **14** may be made of a clear transparent glass material in the form of a substantially flat rectangular plate having a shape, as shown in FIGS. 3 and 4, conforming to that of the larger end of ceramic body portion **12** to which it is attached. A graticule scale **32** may be provided on the inner surface of the face plate **14** by printing lines of glass frit thereon and fusing such frit lines onto the face plate before the layer of phosphor material forming fluorescent screen **25** is applied to such surface over such graticule scale, as shown in FIG. 6. Alternatively, the graticule lines may be chemically etched or mechanically scribed as notches **33** in the surface of the face plate, as shown in FIG. 7, or they may be applied as a paint of light reflecting material. This use of a separate flat face plate **14** enables the phosphor layer **25** and the graticule scale **32** to be applied to such face plate before it is sealed to the envelope body portion **12** so that it can be more easily processed than when a conventional all glass tube is used.

The graticule scale **32** may be "edge-lighted" with a light source positioned adjacent a portion of the edge surrounding the periphery of the face plate **14** so that sufficient light is transmitted through such edge portion into such face plate to illuminate the graticule lines. As shown in FIG. 3, if the light source is located at a position remote from the edge of the face plate **14**, a flange member **34** of clear transparent plastic or similar material in the form of a flat, square plate, may be attached to such face plate edge by a transparent epoxy resin glue or the like so that such flange member functions as a light guide to efficiently transmit light from the light source into the edge of the face plate. This flange member **34** may be provided with two U-shaped notches **36** and **38** in the upper external edge portion thereof to accommodate two light bulbs, and with a conventional coating of light reflecting material (not shown), such as aluminum, silver or white enamel, on the remainder of the external edge of such flange member exclusive of such notches. Also, it may be desirable to provide such a light reflecting coating on the edge of the face plate **14** when flange member **36** is not used.

The flat glass face plate **14** may be attached to the rectangular end of ceramic body portion **12** by means of a vacuum tight seal **40** surrounding fluorescent screen **25** to form the butt joint shown in FIG. 6. This seal **40** may be made of a glass frit having a thermal coefficient of expansion approximately the same as that of the ceramic in body portion **12** and the glass in face plate **14** and a softening or sealing temperature substantially below that of such ceramic and such glass. Another glass frit seal **42**, similar to seal **40**, may be provided to form the butt joint between the circular end of ceramic body portion **12** and glass stem portion **16** of the envelope, as shown in FIG. 5, since the glass material of such stem portion may be the same as that of the face plate **14**. Any suitable glass and ceramic system may be used having the above discussed characteristics. For example, the body portion **12** may be made of forsterite ceramic having a composition by weight of approximately:

	Percent
MgO	28
Talc	60
Kaolin	12
	100

The face plate portion **14** and the stem portion **16** may be made of soda lime glass or common lead glass commercially available from Corning Glass Works as Corning No. 0080 and No. 0120, respectively. This soda lime glass has a composition by weight of approximately:

	Percent
SiO_2	73.6
Na_2O	16.0
K_2O	.6
CaO	5.2
MgO	3.6
Al_2O_3	1.0
	100.0

The glass frit of seals **40** and **42** may be made of a devitrifiable glass, such as the lead-zinc-borate type glass disclosed in U.S. Patent No. 2,889,952, issued to S. A. Claypoole on June 9, 1959, having a thermal coefficient of expansion similar to that of the forsterite ceramic of approximately 93×10^{-7} per ° C. within the temperature range of 25 to 450° C. and a low softening temperature on the order of 420 to 450° C. One such devitrifiable glass is commercially available from Corning Glass Works as "Pyroceram Cement" No. 7572 and may be applied as seals **40** and **42** in the manner disclosed in the above patent.

It should be noted that this devitrified glass is often referred to as a "glass-ceramic" because it possesses similar characteristics to both of these classes of materials. However, the term "glass frit" is defined herein as including such a devitrified glass throughout the present application. Also, the term "ceramic material" is hereby defined as distinguishing from "glass" in that the former is a crystalline material while the latter is a supercooled liquid, noncrystalline material.

Another embodiment of a cathode ray tube made in accordance with the present invention is shown in FIGS. 8 to 11. This "post acceleration" type of cathode ray tube is similar to that shown in FIGS. 1 to 6 except the uniform resistance coating **26** is replaced by a graduated resistance coating **44** of varying thickness on the inner surface of a funnel-shaped envelope body portions **46** having a different configuration than body portion **12**, including parabolic curved side walls. Also, a different shaped face plate **48** without the flange member light guide **34**, is provided of rectangular configuration but with a smaller height dimension so that the graticule scale **32** is 6 cm. by 10 cm., rather than 8 cm. by 10 cm. as shown in FIG. 3.

The graduated resistance coating **44** varies in thickness by decreasing in magnitude from a maximum at the end thereof adjacent the stem portion **16** to a minimum at the end adjacent the face plate **48** which results in the resistance per square of such coating increasing in the same direction from a minimum near stem portion **16** to a maximum near face plate **48**. The end of this graduated resistance coating **44** adjacent stem portion **16** of the envelope, is connected to the second anode of the electron gun in the same manner as uniform resistance coating **26** by means of the spring member **31** and conductive coating **28** shown in FIG. 5, while the other end of such graduated resistance coating adjacent face plate **48** is connected to a source of greater positive D.C. voltage than such second anode by means of an electrical connector **50** extending through a hole in envelope body portion **46**. Therefore, an electrical potential gradient is established along the surface of graduated resistance coating **44** so that such resistance coating functions as a post deflection acceleration anode which increases the velocity of the electron beam after its deflection by the electrical signals applied to the electrostatic deflection plates, so that such electron beam increases in velocity after deflection as it travels along such resistance coating toward face plate **48** and produces a higher intensity light image on fluorescent screen **25** without decreasing the deflection sensitivity of the tube.

As shown in FIG. 11, the electrical connector **50** may be in the form of a solid plug **52** made of ceramic material similar to that of envelope portion **46** and having a coating **54** of electrically conducting material, such as silver, on the external surface thereof. This coated plug may be inserted into a hole made in envelope portion **46** adjacent conductive coating **30** and secured to such body portion by a vacuum tight seal **56** in the form of a glass frit, which may have a composition similar to that of the material used in seals **40** and **42** of this post acceleration cathode ray tube, or it may be made of a different material suitable for the metal to ceramic seal. An additional silver coating **58** may be applied over the end of plug **52** after it is attached to the envelope portion **46** making contact between conductive coating **54** and conductive coating **30** to prevent the glass frit **56** from insulating coating **54** from coating **30**.

A different ceramic and glass system may be used to make the post acceleration cathode ray tube of FIGS. 8 to 11. For example, the body portion **46** of the envelope may be made of an alumina ceramic having a composition by weight of approximately:

	Percent
Al_2O_3	85
Talc	4
Ball clay	7
Nepheline syenite	4
	100

The stem portion **16** and the face plate portion **48** of the envelope may be formed of a zirconium silicate glass such as that commercially available from Corning Glass Works under Corning No. 7280 having a composition by weight of approximately:

	Percent
SiO_2	70
ZrO_2	17
Na_2O, K_2O	13
	100

The seals **40** and **42** may be made of a glass frit having a thermal coefficient of expansion of approximately 75×10^{-7} cm./cm. per ° C. in the temperature range of 25 to 700° C. and a softening temperature substantially below that of the above zirconium silicate glass. One such glass frit is a devitrifiable glass commercially available from Corning Glass Works as "Pyroceram Cement"

No. 7541. However, another glass frit has been discovered which has been found to be suitable and is believed to be heretofore unknown, having a composition by weight of approximately:

	Percent
PbO	48
Al_2O_3	3
SiO_2	28
B_2O_3	7
ZnO	14
	100

This new undevitrifiable glass has a sealing temperature on the order of 760 to 788° C. and a thermal coefficient of expansion of approximately 65×10^{-7} cm./cm. per ° C. at 25 to 450° C. temperature.

For proper operation as a post acceleration anode the graduated resistance coating **44** should have a resistance characteristic similar to that of the theoretical ideal curve **60** in FIG. 12. This curve is a plot of percent of the total resistance of coating **44** verses the distance in inches from its face plate end measured from coating **30**. Note that in the region of 0 to 1 inch there is a resistance change of about 17% while in the region of 7 to 8 inches there is a resistance change of only about 7%. Therefore, the theoretical ideal resistance per square of coating **44** decreases from a maximum value near face plate **48** to a minimum value near stem portion **16**. Since thickness varies inversely with resistance, the theoretical ideal thickness of coating **44** increases from a minimum value near face plate **48** to a maximum value near stem portion **16**. It should be noted that curve **60** merely represents the theoretical ideal characteristic of graduated resistance coating **44** and that operable coatings may have actual characteristic curves which deviate by several percent above or below such ideal curve. Also, the *total* resistance of resistance coating **44** may be anywhere between 100 and 2000 megohms for operable tubes and this total resistance is represented on the graph by the 100% resistance point.

This graduated resistance coating **44** may be formed of conventional materials, such as aquadag or other carbon materials. However, it has been found that such carbon coatings are damaged by the high temperature used in the out-gassing process so that they are unsuitable when extremely high temperatures are used, as is necessary for efficient removal of the absorbed gases. Therefore, the material of graduated resistance coating **44** or uniform resistance coating **26**, should be a non-carbon, refractory material which does not oxidize or melt at extremely high temperatures. Such a material believed to be heretofore unknown has been discovered. This new resistance material has composition by weight of approximately:

	Percent
Cr_2O_3	2.6
Fe_2O_3	35.0
TiO_2	2.4
Feldspar	17.3
Ball clay	13.2
Flint	14.3
Whiting (prepared $CaCo_3$)	15.2
	100.0

It should be noted that this new resistance coating may be considered basically a mixture of two different materials which are (1) a conducting material formed by the first three compounds listed—totalling 40% and (2) a ceramic material consisting of the last four compounds listed—totalling 60%. This resistance film may be applied by any conventional spraying method and then heated to fuse it to the envelope wall.

Various details of the above described preferred embodiments of the present invention may be varied without departing from the spirit of the invention. Thus, the stem portion **16** may be formed integrally with the body portions **12** and **46** so that it too can be made of ceramic material. The face plate end of such envelope body portion may be made of any desirable configuration to provide a hollow cross-section of any convenient shape including a right-angle parallelogram in the form of a square or rectangle, and the face plates attached thereto may likewise be formed of any convenient shape. The light guide flange **34** may be formed integrally with the face plate so that it too is made of glass, or it can be eliminated entirely. The butt joints formed by seals **40** and **42** may be of a different type, for example, seal **42** may be in the form of a slip joint. Therefore, the scope of the present invention should be determined only by the following claims.

We claim:

1. An electron beam display device, comprising:
an envelope having a hollow body portion made of ceramic material, a face plate portion made of transparent glass in the form of a substantially flat plate shaped to conform to one end of said body portion, and a seal portion attaching said face plate portion to said one end of said body portion with said seal portion being made of fused glass material different from said transparent glass but having a thermal coefficient of expansion similar to that of said ceramic and said transparent glass;
a fluorescent screen including a layer of phosphor material supported on the flat inner surface of said glass face plate portion inside said envelope;
a source of electrons positioned within said envelope at one end thereof remote from said face plate;
means to accelerate said electrons and to focus said electrons into an electron beam; and
means to deflect said electron beam in response to an electrical signal before said beam strikes said fluorescent screen on said face plate.

2. An electron beam display device, comprising:
an envelope having a body portion made of ceramic material in the shape of a hollow funnel with the larger end of said body portion being of a substantially right-angle parallelogram configuration, a face plate portion made of transparent glass in the form of a substantially flat plate shaped to conform to said larger end of said body portion, and a seal portion attaching said face plate portion to said larger end of said body portion with said seal portion being made of a fused glass frit material different from that of said transparent glass but having a thermal coefficient of expansion similar to that of said ceramic and said transparent glass;
a fluorescent screen including a layer of phosphor material supported on the flat inner surface of said glass face plate portion inside said envelope;
a source of electrons supported within said envelope at the end thereof remote from said face plate;
means to accelerate said electrons and to focus said electrons into an electron beam; and
means to deflect said electron beam in response to an electrical signal before said beam strikes said fluorescent screen.

3. An electron beam display device, comprising:
an envelope having a body portion made of ceramic material with one end of said body portion being of a substantially rectangular hollow cross-section, and a face plate portion made of transparent glass in the form of a flat plate of a shape substantially conforming to that of said cross-section and attached to said one end of said body portion by a seal portion made of a fused glass frit material having thermal coefficient of expansion similar to, and a softening temperature below, that of said ceramic and said transparent glass;

a fluorescent screen including a layer of phosphor material on the flat inner surface of said glass face plate portion inside said envelope;

a coating of electrical resistance material on the inner surface of said ceramic body portion of said envelope, having a variable thickness which increases in value from the end nearest to said face plate toward the end farthest from said face plate so that the resistance per square of said coating decreases in the same direction, and connected to function as a post deflection acceleration anode by providing an electrical potential gradient of increasing magnitude for the electron beam in said display device as it approaches said face plate;

a source of electrons supported within said envelope at the end thereof remote from said face plate;

means to accelerate said electrons and to focus said electrons into an electron beam; and

means to deflect said electron beam in response to an electrical signal before said beam passes through said post acceleration anode and strikes said fluorescent screen.

4. An electron beam display device, comprising:

an envelope having a body portion made of ceramic material with one end of said body portion being of a substantially rectangular configuration, and a face plate portion made of transparent glass in the shape of a substantially flat rectangular plate attached to said rectangular end of said body portion by a seal portion made of a fused glass frit material having a thermal coefficient of expansion similar to, and a softening temperature below, that of said ceramic and said transparent glass;

a graticule scale formed by a plurality of straight lines intersecting at right angles on the inner surface of said face plate portion inside said envelope;

a fluorescent screen including a layer of phosphor material on the inner surface of said face plate over said graticule scale;

means for projecting light into said face plate portion through the edge surrounding the periphery thereof in order to illuminate said graticule scale, including a plastic flange member attached at its inner edge to said edge of said face plate so that said flange member may function as a light guide to transmit light from an external source into said face plate;

a source of electrons supported within said envelope at the end thereof remote from said face plate;

means to accelerate said electrons and to focus said electrons into an electron beam; and

means to deflect said electron beam in response to an electrical signal before said beam strikes said fluorescent screen.

5. An electron beam display device, comprising:

an envelope having a hollow body portion made of ceramic material with one end formed as a rectangular cylinder joined to the other end of said body portion formed in the shape of the frustrum of a cone, a tubular stem portion made of glass in the shape of a circular cylinder attached to said other end of said body portion by a first seal of fused glass material different from the stem glass but having a thermal coefficient of expansion similar to that of said ceramic and said stem glass, and a face plate portion made of transparent glass in the form of a substantially flat plate shaped to conform to said one end of said body portion and attached to said one end of said body portion by a second seal made of fused glass material different from the face plate but having a thermal coefficient of expansion similar to that of said ceramic and said face plate glass;

a fluorescent screen including a layer of phosphor material supported on the flat inner surface of said glass face plate portion inside said envelope;

a source of electrons positioned within said envelope at one end thereof remote from said face plate;

means to accelerate said electrons and to focus said electrons into an electron beam; and

means to deflect said electron beam in response to an electrical signal before said beam strikes said fluorescent screen on said face plate.

6. An electron beam display device, comprising:

an envelope having a body portion made of ceramic material with one end of said body portion being of a substantially rectangular hollow cross-section, and a face plate portion made of transparent glass in the form of a flat plate of a shape substantially conforming to that of said cross-section and attached to said one end of said body portion by a seal portion made of a fused glass frit material having thermal coefficient of expansion similar to, and a softening temperature below, that of said ceramic and said transparent glass;

a fluorescent screen including a layer of phosphor material on the flat inner surface of said glass face plate portion inside said envelope;

a coating of electrical resistance material on the inner surface of said ceramic body portion of said envelope, having a variable thickness which increases in value from the end nearest to said face plate toward the end farthest from said face plate so that the resistance per square of said coating decreases in the same direction, and connected to function as a post deflection acceleration anode by providing an electrical potential gradient of increasing magnitude for the electron beam in said display device as it approaches said face plate;

means to connect said resistance coating as a post acceleration anode to a source of electrical potential, including a conducting layer of electrically conducting material of uniform thickness on said envelope body portion over said end of said resistance coating nearest said face plate, and a plug of ceramic material provided with a coating of conducting material, sealed in a hole through said envelope body portion at a position adjacent said conducting layer so that the conducting coating on said plug makes electrical contact with said conducting layer;

a source of electrons supported within said envelope at the end thereof remote from said face plate;

means to accelerate said electrons and to focus said electrons into an electron beam; and

means to deflect said electron beam in response to an electrical signal before said beam passes through said post acceleration anode and strikes said fluorescent screen.

7. An electron beam display device, comprising:

an envelope having a body portion made of ceramic material with one end of said body portion being of a substantially rectangular hollow cross-section, and a face plate portion made of transparent glass in the form of a flat plate of a shape substantially conforming to that of said cross-section and attached to said one end of said body portion by a seal portion made of a fused glass frit material having thermal coefficient of expansion similar to, and a softening temperature below, that of said ceramic and said transparent glass;

a fluorescent screen including a layer of phosphor material on the flat inner surface of said glass face plate portion inside said envelope;

a coating of electrical resistance material containing Fe_2O_3, TiO_2, Cr_2O_3 and a ceramic material, on the inner surface of said ceramic body portion of said envelope, having a variable thickness which increases in value from the end nearest to said face plate toward the end farthest from said face plate so that the resistance per square of said coating decreases in the same direction, and connected to function as a post deflection acceleration anode by providing an electrical potential gradient of increasing magnitude for the electron beam in said display device as it approaches said face plate;

a source of electrons supported within said envelope at the end thereof remote from said face plate;

means to accelerate said electrons and to focus said electrons into an electron beam; and

means to deflect said electron beam in response to an electrical signal before said beam passes through said post acceleration anode and strikes said fluorescent screen.

8. An envelope for use in an electron beam display device, comprising:

a body portion made of ceramic material and having one end of a hollow cross-section substantially in the shape of a right-angle parallelogram;

a face plate portion made of transparent glass material in the form of a thin, flat plate having sides substantially corresponding in shape to said one end of said body portion with a graticule formed on the surface of one of said sides; and

a seal portion made of a fused glass material different from said transparent glass but having a thermal coefficient of expansion similar to that of said transparent glass and said ceramic, attaching said face plate portion to said body portion so that said graticule is positioned on the interior surface of said envelope.

9. An envelope for use in a cathode ray tube, comprising:

a body portion made of ceramic material in the shape of a funnel and having its larger end of a substantially rectangular cross-section;

a face plate portion made of transparent glass material in the shape of a substantially flat rectangular plate with a graticule formed on the surface of one side thereof;

a seal portion of fused glass frit material different from said transparent glass but having a thermal coefficient of expansion similar to that of said ceramic and said transparent glass, said seal portion attaching said face plate portion to said larger end of said body portion so that said graticule is positioned on the interior surface of said envelope; and

means for projecting light into said face plate portion through the edge surrounding the periphery thereof in order to illuminate said graticule.

10. An envelope for use in a cathode ray tube, comprising:

a body portion made of ceramic material and having one end of a substantially rectangular hollow cross-section;

a face plate portion made of transparent glass material in the shape of a substantially flat rectangular plate with a graticule formed by fused glass lines coated on the surface of one side thereof;

a seal portion made of a fused glass frit material having a thermal coefficient of expansion similar to, and a softening temperature below, that of said transparent glass and said ceramic, said seal portion attaching said face plate portion to said one end of said body portion so that said graticule is positioned on the interior surface of said envelope; and

means for projecting light into said face plate portion through the edge surrounding the periphery thereof in order to illuminate said graticule.

11. An envelope for use in a cathode ray tube, comprising:

a body portion made of ceramic material and having one end of a substantially rectangular hollow cross-section;

a face plate portion made of transparent glass material in the shape of a substantially flat rectangular plate with a graticule formed by notches in the surface of one side thereof;

a seal portion formed by a fused glass frit material different from said transparent glass, attaching said face plate portion to said body portion so that said graticule is positioned on the interior surface of said envelope; and

means for projecting light into said face plate portion through the edge surrounding the periphery thereof in order to illuminate said graticule.

12. An envelope for use in a cathode ray tube, comprising:

a body portion made of ceramic material in the shape of a funnel and having its larger end of a substantially rectangular cross-section;

a face plate portion made of transparent glass material in the shape of a substantially flat rectangular plate with a graticule formed on the surface of one side thereof;

a seal portion of fused glass frit material having a thermal coefficient of expansion similar to, and a sealing temperature substantially below, that of said ceramic and said transparent glass, attaching said face plate portion to said larger end of said body portion so that said graticule is positioned on the interior surface of said envelope; and

means for projecting light into said face plate portion through the edge surrounding the periphery thereof in order to illuminate said graticule including a transparent plastic flange member attached at its inner edge to said edge of said face plate so that said flange member may function as a light guide to transmit light from a remote external light source into said face plate.

13. An envelope for use in an electron beam display device, comprising:

a body portion made of ceramic material and having one end of a hollow cross-section substantially in the shape of a right-angle parallelogram;

a face plate portion made of transparent glass material in the form of a thin, flat plate having sides substantially corresponding in shape to said one end of said body portion with a graticule formed on the surface of one of said sides; and

a seal portion made of a fused glass material containing PbO, Al_2O_3, SiO_2, B_2O_3 and ZnO, having a termal coefficient of expansion similar to, and a sealing temperature substantially below, that of said transparent glass and said ceramic, attaching said face plate portion to said body portion so that said graticule is positioned on the interior surface of said envelope.

14. An envelope for use in an electron beam display device, comprising:

a body portion made of ceramic material and having one end of a hollow cross-section substantially in the shape of a right-angle parallelogram;

a face plate portion made of transparent glass material in the form of a thin, flat plate having sides substantially corresponding in shape to said one end of said body portion;

a first seal portion made of a fused glass frit different from said transparent glass but having a termal coefficient of expansion similar to that of said transparent glass and said ceramic, said first seal portion attaching said face plate portion to said body portion so that said graticule is positioned on the interior surface of said envelope;

a tubular stem portion of glass; and

a second seal portion similar to said first seal portion attaching said stem portion to the other end of said body portion.

15. An anode for uniformerly accelerating electrons as they travel along the surface of said anode spaced therefrom, comprising:

a support member of electrical insulating material; and a graduated resistance coating of electrical conducting material on said support member with the thickness of said coating varying from a maximum at one end thereof to a minimum at the other end thereof so that the electrical resistance per square of said coating increases from a minimum value at said one end to a maximum value at said other end.

16. An anode for uniformrly accelerating electrons as they travel along the surface of said anode space therefrom, comprising:

a support member of electrical insulating material; and

a graduated resistance coating of electrical conducting material containing a mixture of Fe_2O_3, Cr_2O_3, TiO_2 and ceramic material on said support member with the thickness of said coating varying from a maximum at one end thereof to a minimum at the other end thereof so that the electrical resistance per square of said coating increases from a minimum value at said one end to a maximum value at said other end.

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