United States Patent

Bossers

[15] **3,665,569**

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[54] METHOD AND APPARATUS FOR FABRICATING A CATHODE RAY TUBE ENVELOPE HAVING AN ANNULAR SHAPED REAR WINDOW

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[73] Assignee: **Sylvania Electric Products Inc.**

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[52] **U.S. Cl.** **29/25.13,** 29/25.19

[51] **Int. Cl.** **H01j 9/18**

[58] **Field of Search** 29/25.1, 25.11, 25.13, 25.19; 220/2.1

[56] **References Cited**

UNITED STATES PATENTS

2,549,602	4/1951	Hopps	29/25.13 X
3,317,818	5/1967	Hudson	29/25.13 X

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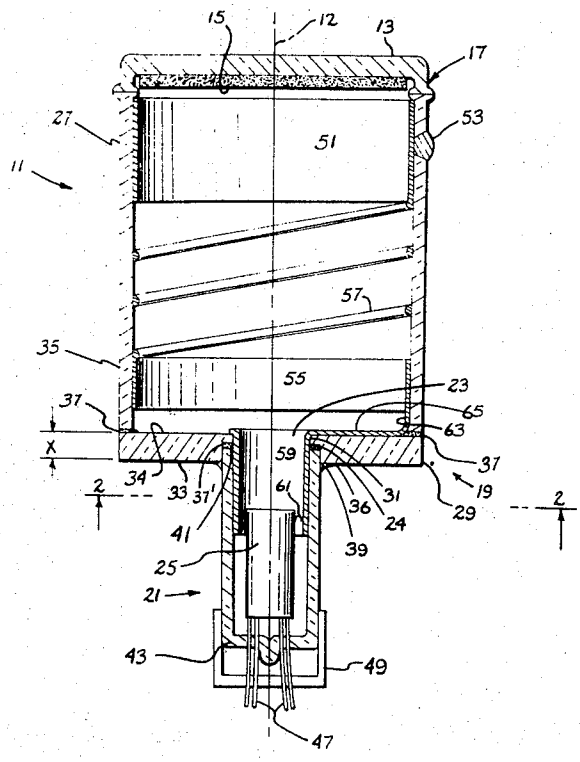
[57] **ABSTRACT**

A method and apparatus for fabricating a rear-window cathode ray tube envelope having a longitudinal axis therethrough. The envelope is formed by hermetically sealing a bulb portion and a tubular neck section to a substantially annular shaped optical access window oriented in substantially symmetrical relationship to the longitudinal axis of the tube to provide a substantially annular viewing area for observing the electron impinged side of the screen.

8 Claims, 4 Drawing Figures



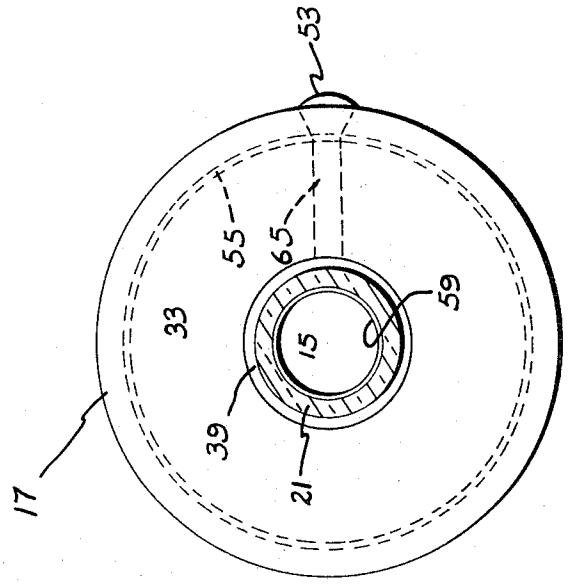


Fig. 2

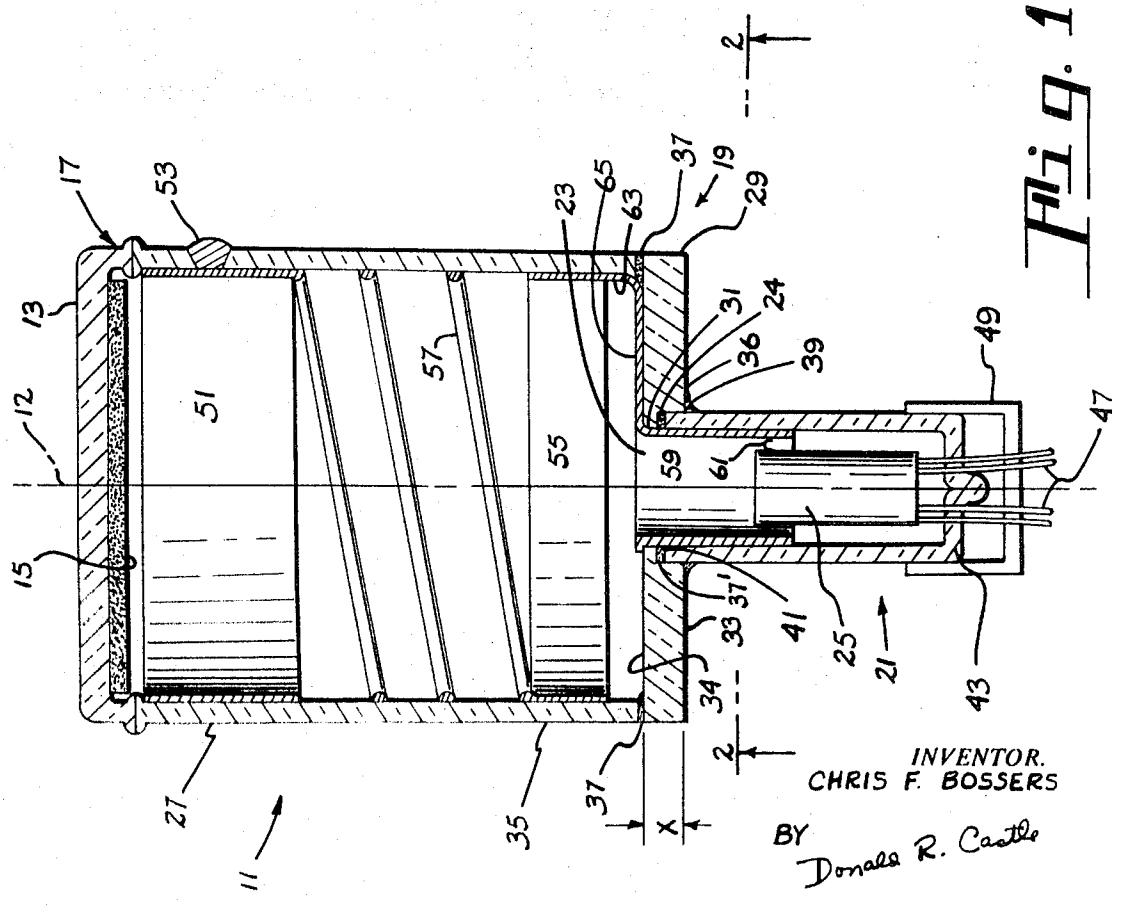


Fig. 1

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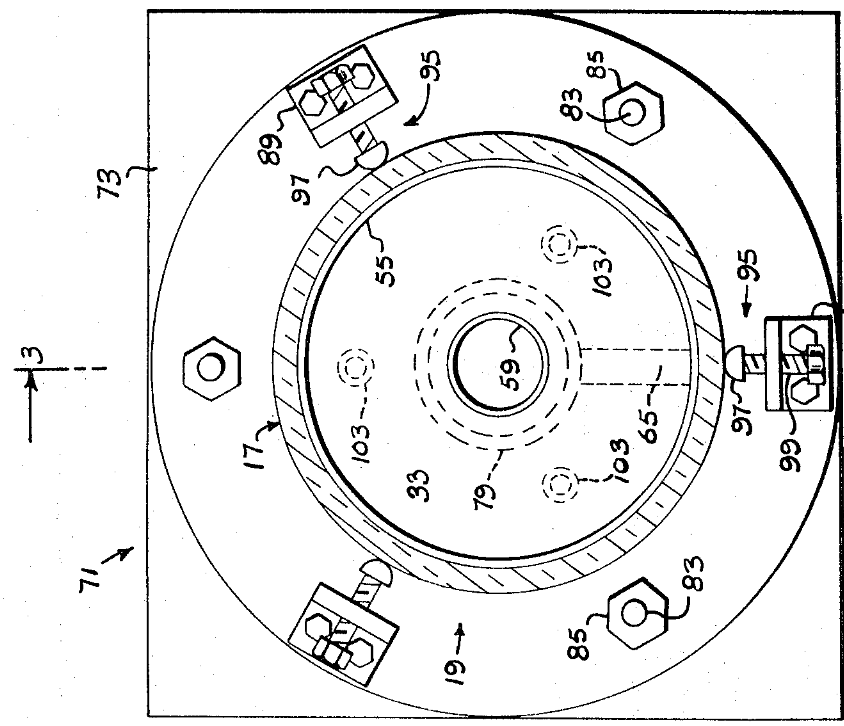
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Fig. 4

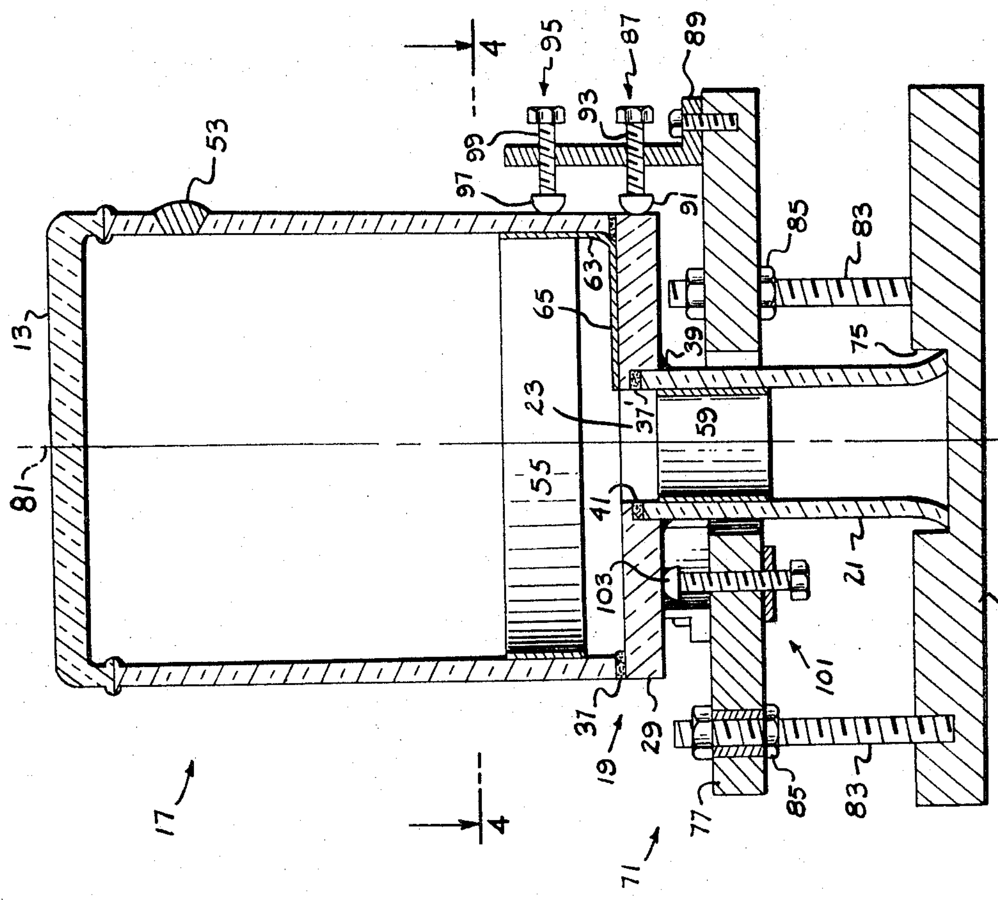
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Fig. 3

METHOD AND APPARATUS FOR FABRICATING A CATHODE RAY TUBE ENVELOPE HAVING AN ANNULAR SHAPED REAR WINDOW

CROSS REFERENCE TO RELATED APPLICATION

This application is a divisional application of Ser. No. 785,647 filed Dec. 20, 1968, now U.S. Pat. No. 3,551,973, which is assigned to the assignee of the present invention.

BACKGROUND OF THE INVENTION

The invention relates to cathode ray tubes and more particularly to a method and apparatus for fabricating an improved rear-window type of cathode ray tube envelope structure. In certain information display systems, rear-window cathode ray tubes are employed to facilitate full presentation and observation of the display. Such tubes not only provide the conventional frontal viewing area but also have one or more portal provisions oriented in the funnel portion of the tube envelope to permit viewing of the rear surface of the screen. Through this type of funnel oriented viewing port, it is possible to observe, photograph, or project a superimposed image on the information displayed on the screen without interferring with the frontal observation thereof. Since a large number of the conventional rear-window tubes are limited to one or two observation ports, a decision must be made whether to observe, record or project information through a respective port or ports as all media cannot be utilized simultaneously at one or two openings. Furthermore, exact positioning of the projection and photographic equipment is determined by the orientation of the respective viewing port or ports. In the conventional rear-ported tubes, the incorporation of a plurality of optical ports into the funnel portion of the envelope becomes a critically exacting and expensive glass working operation.

OBJECTS AND SUMMARY OF THE INVENTION

It is an object of the invention to reduce the aforementioned difficulties and to provide a method and apparatus for fabricating an improved rear-window type of cathode ray tube envelope having an extensive provision for rear view utilization from a number of angles.

The foregoing objects are achieved in one aspect of the invention by the provision of a method and apparatus for fabricating an improved rear-window cathode ray tube envelope wherein the funnel or bulb portion is perimetrically mated and sealed to a substantially transparent annular plate of optical quality. A tubular neck section is hermetically sealed to the substantially centrally oriented aperture in the annular plate. The sealing of the bulb and neck portions to the annular plate are done in a manner to prevent optical distortion of the plate. Thus, there is provided an annular rear-window tube envelope structure which permits simultaneous back-of-the-screen projection, photographing and observation of the information displayed on the cathodoluminescent screen of the tube.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a sectional view illustrating the rear-window cathode ray tube as fabricated by the method and apparatus of the invention;

FIG. 2 is a plan view taken along the line 2—2 of FIG. 1 illustrating the extensive area of the annular rear-window portal;

FIG. 3 is a sectional view showing the apparatus utilized in fabricating the tube envelope; and

FIG. 4 is a plan view taken along the line 4—4 of FIG. 3.

DESCRIPTION OF THE PREFERRED EMBODIMENT

For a better understanding of the present invention, together with other and further objects, advantages and capabilities thereof, reference is made to the following specification and appended claims in connection with the aforedescribed drawings.

With reference to FIG. 1 there is shown a rear-window cathode ray tube 11 as fabricated by the method and apparatus of the invention. The tube, as assembled, has a face panel portion 13 upon which is interiorly disposed a cathodoluminescent screen 15. Integral with the face panel portion is the funnel or bulb portion 17 to which is sealed a substantially transparent annular plate 19 of optical quality. A tubular neck section 21 is sealed to the centrally oriented aperture 23 of the annular plate at a seating provision 24 therein to complete the envelope structure. At least one electron source 25 is mounted in the tubular neck in a manner to beam electrons to the screen to form a cathodoluminescent image therein. The light transmissive plate 19 forms an annular shaped optical window which provides extensive visual access to the rear of the screen.

A round tube is shown and described such as, for example, one having an external envelope diameter within the range of 5 to 6 inches. It is not intended that the size or shape be limiting. In addition, the term "annular" as used herein is intended to include any shape of substantially continuous optical viewing window oriented to surround the axial oriented tubular neck portion of the tube.

In greater detail, with particular reference to FIGS. 1 and 2, the tube 11 has a longitudinal axis 12 extending therethrough from the face to the base portion thereof. The componental parts of the envelope structure have compatible thermal expansion coefficients to insure hermetic jointures therebetween.

The substantially planar face panel portion 13 is of a non-browning type glass having a defined perimetric shape to facilitate a hermetic seal with the compatibly formed first end 27 of the bulb portion 17.

The interior surface of the face panel has a cathodoluminescent screen 15 disposed thereon of phosphor materials chosen to best suit the conditions under which the tube is to be utilized. Usually such phosphor materials are of medium persistence and of a hue and brightness to advantageously present the desired informational display.

A substantially transparent annular planar plate 19, such as of G–12 optical quality glass, is formed to have outer and inner peripheries or boundaries 29 and 31 respectively. These define an annular region 33 therebetween which constitutes an annular shaped planar viewing window that is spacedly related in a substantially symmetrical manner about the longitudinal axis of the tube. The inner periphery 31 defines a substantially centrally oriented opening or aperture 32, while the outer periphery 29 of the annular plate is formed to substantially perimetrically match the second end 35 of the bulb portion. The bulb is hermetically sealed to the plate in a a manner to maintain the optical quality of the viewing window 33. Specifically, the hermetic jointure between the bulb portion 17 and the annular plate 19 is formed of a sandwich-type filling or continuous band of glass solder or devitrifiable frit 37, such as CV–130 obtained from Owens-Illinois Inc., which has a melting temperature much lower than the softening temperatures of the respective compatible glass portions joined together.

A substantially tubular neck section 21 of the tube has a first or forward end 41 and an opposite second or terminal end 43 of which the forward end 41 is formed to substantially match and seat in the seating provision 24 formed in the centrally oriented aperture 32 of the annular plate. The hermetic seal therebetween is formed of a continuous band of glass frit 37′ similar to that utilized in the aforementioned bulb-to-plate seal. The neck-to-plate seal is further strengthened and hermetically insured by an externally applied bead of frit 39. Thus, both perimetrically oriented hermetic seals of the annular plate are accomplished at temperatures that are not detrimental to the optical properties of the annular window member. It is to be noted that the annular optical plate provides a structural foundation for the envelope. It exhibits a sufficient thickness "x" to be free of optical distortion while accommodating the respective weight factors of the associated bulb and neck portions.

One or more electron gun (*s*) is/are positioned within the neck section of the tube in a manner to beam electrons to the screen. As shown, an undetailed source of electrons **25** denotes the presence of one or several guns. In this instance, both focusing and deflection are accomplished by electrostatic means which eliminates the need for externally oriented yoke means.

A stem portion **45**, which supports the source of electrons **25**, is hermetically sealed to the terminal end **43** of the neck section. Electrical connective means **47** extend from the stem through the base **49** to provide external connections for the tube.

The interior surface of the bulb portion **17** has two separated bands of conductive material, such as aquadag, applied thereto. A high voltage band **51** is oriented adjacent the screen area and makes electrical contact with a high voltage anode conductive means or button **53** traversing the wall of the bulb or funnel portion **17** at a region proximal to the face panel. Disposed on the bulb wall near the optical window **33** is a low-voltage conductive band **55** of similar material. The two bands are electrically joined by a conventional accelerating spiral **57** of resistive material. The upper part of the tubular neck section **21** has a neck conductive band **59**, such as aquadag, applied thereto with electrical connection between this band and the electron source **25** effected by conventional resilient connective means **61**.

Operation of the tube is dependent upon electrical connection between the neck conductive band **59** and the low-voltage conductive band **55** on the bulb. Such connection is expeditiously effected by one or more conductive paths **63** extending from the low voltage band to make connection with at least one radial conductive stripe **65** across the annular optical plate **19**.

With reference to FIGS. **3** and **4**, there is illustrated apparatus utilized in the method of fabricating the envelope structure of the aforedescribed rear-window cathode ray tube. The respective figures show the several portions of the envelope positioned in the apparatus for the sealing step of the operation.

In fabricating the tube, the annular optical plate **19** has at least one conductive stripe **65** applied to the interior surface **34** thereof. This electrical conductive material, such as aquadag, is disposed in a substantially radial manner on the plate, extending from the inner periphery **31** to almost the outer periphery **29** thereof.

With the plate on a substantially horizontal plane, a continuous ribbon of devitrifiable glass frit **37** is applied on the interior surface **34** of the annular plate adjacent the outer periphery **29**. The bulb portion **17**, with the low-voltage conductive band **55** thereon, is oriented so that the open end of the bulb is positioned on the peripherally disposed ribbon of frit **37**. The perimeter of the open end of the bulb portion substantially matches the outer periphery **29** of the annular plate. Thus assembled, the frit in the bulb-plate combination is allowed to air dry for approximately an hour at ambient temperature. Usually, the conductive path **63** connecting the conductive stripe **65** on the plate with the low-voltage conductive band **55** on the bulb is consummated at this stage in envelope construction.

A continuous ribbon of devitrifiable glass frit **37'** is applied around the forward open end **41** of the neck section **21** which has a conductive band **59** already disposed on the inner surface of the forward portion thereof. The frit-coated end of the neck section is then seated in the formed aperture of the annular plate. The seating provision **24** therein is formed inwardly from the exterior surface **36** of the plate. A continuous bead of frit **39** is applied around the jointure area between the neck section and the plate aperture to insure the seal and add strength to the jointure.

The fritted envelope is oriented in the fabricating apparatus **71** in a vertical position with the face panel portion **13** uppermost. The terminal end **43** of the neck section is positioned on the base member **73** in an accommodating provision **75** formed therein to support the neck in a vertical position.

Above the base member is a platform **77** which has an aperture **79** therein that is of a diameter greater than the outer diameter of the neck section. The platform aperture provides sufficient space for the neck section to extend therethrough thereby facilitating vertical positioning of the fritted envelope. The platform is spacedly located above and parallel with the base member; the aperture **79** being in coaxial alignment with the neck positioning provision **75** and the axis **81** of the apparatus. The platform is located by platform support member **83** at a horizontal level relative to the forward end **41** of the neck section but spaced below the annular optical plate **19**. As shown, the platform support means are in the form of three spaced apart vertical rods oriented in the base member **73** and having height adjustment provisions **85**. Other support means may be utilized if desired.

Oriented on the top of the platform are a plurality of annular plate alignment means **87**. These are positioned at a horizontal level in equi-spaced relationship with the axis **81** to make contact with the outer periphery **29** of the plate. They are accommodated by brackets **89** affixed to the platform. Each alignment head **91** is of heat resistant material, such as ceramic, and has provisions **93** for horizontal adjustment.

Also oriented atop the platform are a plurality of bulb alignment means **95**. These are positioned in equi-spaced relationship with the axis **81** at a horizontal level to make contact with the perimeter of the bulb portion proximal to the fritted end thereof to provide alignment of the bulb with the plate during the envelope sealing operation. As shown, the bulb alignment means **95** are located on the same bracket **89** as the plate alignment means **87**, but separate brackets can be utilized if desired. The bulb alignment heads **97** are of heat resistant material, such as ceramic, and have horizontal adjustment means **99**. While three of the respective plate and bulb alignment means are shown, more can be utilized if desired.

It will be noted that for the tube size considered, the fritted envelope is positioned in the apparatus in a manner that the envelope structure rests on the neck section. It is desired that upon sealing, the layers of frit should be in the range of 0.015 to 0.030 of an inch to effect the desired jointures. When a larger tube is considered, the weight of the annular plate and bulb portion may be of a value to press too heavily on the neck seal area **37'**. In this case, weight regulative means **101**, accommodated in the platform, are adjustably positioned in a vertical manner so that the several heads **103** of heat resistant material make discrete spaced-apart contact with the exterior surface of the annular plate. This effects the proper spacing relationship between the forward end of the neck section and the seating provision in the plate aperture to provide an adequate and uniform layer of frit **37'** therebetween. Just prior to sealing, the regulative means **101** are slightly relaxed to provide for the flow and set of the frit upon sealing.

The base member **73** and the platform **77** are of heat resistant material, such as for example, Marinite which is manufactured by John-Mansville, New York, N. Y.

With the fritted envelope so positioned within the apparatus, sealing is accomplished by baking the envelope at a temperature within the approximate range of 445–455 degrees centigrade for a time period of approximately 1 hour. This temperature is under the softening point of the respective envelope portions but is higher than the melting point of the respective frit depositions. In this manner, both of the hermetic seals to the annular plate are simultaneously accomplished. Upon devitrification of the frit, the envelope is cooled in a manner to prevent the formation of undesirable strains therein.

After sealing, the envelope is removed from the apparatus and the resistive accelerating spiral **57** is applied by conventional means to the inner surface of the bulb, starting at the low-voltage conductive band **55** and extending toward the high voltage anode button **53**.

Next, the cathodoluminescent screen **15** is suitably formed on the interior surface of the face panel in a conventional manner, such as by the settling technique.

Upon the completion of screening, the high voltage conductive band **51** is applied to the inner surface of the bulb portion proximal to the screen in a manner to make connection with the accelerating spiral **57** and the high voltage button **53**. The envelope is then baked to remove volatile materials.

At least one electron source **25** is positioned within the neck section of the envelope in a manner to make connection with the neck conductive band **59** which is forwardly disposed on the interior surface of the neck section. The electron source is so oriented to beam electrons to the screen.

The tube is thence conventionally processed and sealed by effecting a hermetic closure at substantially the terminal end **43** of the neck section.

Thus, there is fabricated an improved rear-window cathode ray tube **11** which provides an extensive provision for rear-view utilization from a number of angles. The annular window in the envelope adequately and simultaneously accommodates several usages such as photographing and projection in addition to visual observation.

While there have been shown and described what are at present considered the preferred embodiments of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the scope of the invention as defined by the appended claims

What is claimed is:

1. A method of fabricating the envelope of a rear-window cathode ray tube having a bulb portion with an open end and an oppositely disposed face panel, a tubular neck section, and a substantially annular shaped optical plate oriented between said bulb and neck portions in substantially symmetrical relationship about a longitudinal axis of the envelope, said optical plate having interior and exterior surfaces and inner and outer peripheries defining therebetween a substantially annular viewing window for observing the cathodoluminescent screen subsequently formed on the interior surface of said face panel, said neck section having an open forward end diametrically dimensioned to match a seating provision in the centrally oriented aperture defined by the inner periphery of said plate, said method comprising the steps of:

applying a continuous ribbon of glass frit on the interior surface of said annular plate adjacent said outer periphery thereof;

positioning the open end of said bulb portion on said peripherally disposed ribbon of frit, to provide a continuous layer of frit between the edge of said bulb and said plate, said outer periphery of said plate being substantially matched with the perimeter of the open end of said bulb portion;

applying a continuous ribbon of glass frit around the forward open end of said neck section;

seating said frit-coated end of said neck section in the formed aperture of said plate to effect a continuous layer of frit therebetween;

applying a continuous bead of glass frit around the area of jointure between said neck section and the aperture of said plate relative to the exterior surface thereof;

orienting said envelope in a vertical position with said face panel uppermost;

sealing said envelope by baking at a temperature under the softening point of the respective envelope portions but higher than the melting points of the respective frit depositions to effect simultaneous hermetic seals to said annular plate; and

cooling said frit sealed envelope in a manner to prevent the formation of undesirable strains therein.

2. The method of fabricating the envelope of a rear-window cathode ray tube according to claim **1** wherein said respective layers of frit have respective thickness within the range of 0.015 to 0.030 of an inch.

3. The method of fabricating the envelope of a rear-window cathode ray tube according to claim **1** wherein said envelope baking temperature does not substantially exceed 460 degrees centigrade.

4. An apparatus for providing alignment and support during the fabrication of the envelope of a rear-window cathode ray tube having a bulb portion with an open end and an oppositely disposed face panel, a tubular neck section having forward and terminal ends, and a substantially annular shaped optical plate oriented between and frit sealed to said bulb and neck portions in substantially symmetrical relationship about a longitudinal axis of the envelope, said optical plate having interior and exterior surfaces and inner and outer peripheries defining therebetween a substantially annular viewing window for observing the subsequently formed cathodoluminescent screen, said neck section having forward and terminal open ends with the forward end being diametrically dimensioned to match a seating provision in the centrally oriented aperture defined by the inner periphery of said plate, said apparatus having a vertical axis and comprising:

a base member formed to have a neck positioning provision therein for accommodating the terminal end of said neck section to effect vertical orientation thereof;

platform means having an aperture therein of a diameter greater than the diameter of said neck section to facilitate clearance therebetween, said platform being spacedly positioned above and parallel with said base member with said aperture being in coaxial alignment with said neck positioning provision, said platform being oriented relative to the forward end of said neck section at a horizontal level spaced below the annular optical plate when the inner periphery of said plate is positioned for sealing with the forward end of said vertically oriented neck section;

platform support means to effect parallel positioning of said platform in spaced relationship with said base member;

a plurality of plate alignment means oriented on said platform in equi-spaced relationship with said axis and positioned at a horizontal level to make contact with the outer periphery of said plate; and

a plurality of bulb alignment means oriented on said platform in equi-spaced relationship with said axis and positioned at a horizontal level above that of said plate alignment means to make contact with the perimeter of said bulb portion proximal to the open end thereof to provide alignment of said bulb with said plate during the envelope sealing operation.

5. An apparatus utilized in fabricating the envelope of a rear-window cathode ray tube according to claim **4** wherein said base member and said platform are of heat resistant material.

6. An apparatus utilized in fabricating the envelope of a rear-window cathode ray tube according to claim **4** wherein said plate alignment means are at least three in number oriented relative to said axis in a perimetrically spaced-apart relationship.

7. An apparatus utilized in fabricating the envelope of a rear-window cathode ray tube according to claim **4** wherein said bulb alignment means are at least three in number oriented relative to said axis in a perimetrically spaced-apart relationship.

8. An apparatus utilized in fabricating the envelope of a rear-window cathode ray tube according to claim **4** wherein said apparatus has regulative means for providing substantially vertical support to said annular plate by making discrete contact with the exterior surface thereof, said support effecting spacing relationship between the forward end of said neck section and the seating provision in said plate aperture to provide an adequate uniform layer of frit therebetween.

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