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(54) Picture display device with a neck portion

(57) The picture display device has a display tube comprising an evacuated envelope (1) comprising a display window (2) with a display screen (3) on its inner side, a conical portion (4) and a neck portion (5). The conical portion is connected to an upstanding wall (15) of the display window. The neck portion accommodates an electron gun (6, 7, 8). The conical portion comprises a glass component. The neck portion comprises a glass component with a composition that is substantially the same as that of the conical portion. Preferably, the neck portion comprises, expressed as a percentage by weight, the following constituents: SiO_2 and Al_2O_3, the sum of the concentrations of SiO_2 and Al_2O_3 being in the range from 50-65 weight%, BaO and/or SrO and/or ZrO_2 the sum of the concentrations of BaO and/or SrO and/or ZrO_2 being in the range from 0.5-10 weight%, and 10-25 weight% PbO.

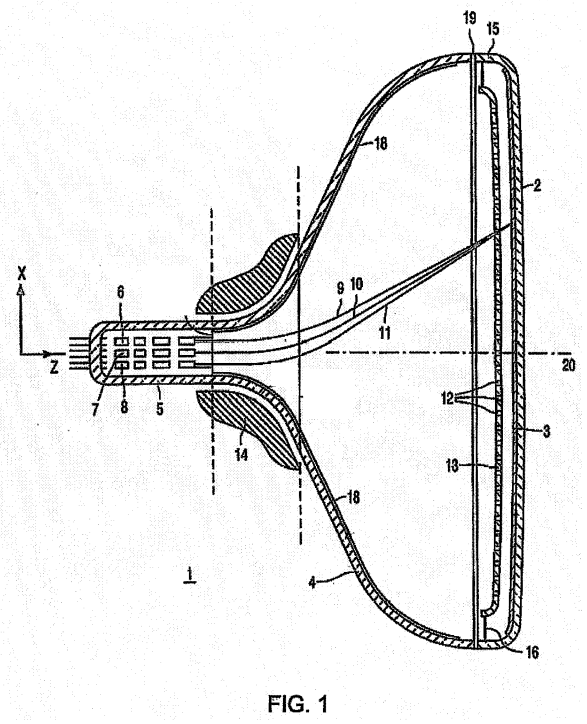

FIG. 1

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Description

FIELD OF THE INVENTION

[0001] The invention relates to a picture display device comprising a display tube having an evacuated envelope with a display window, a conical portion and a neck portion.

[0002] The invention also relates to a neck portion for use in a picture display device.

BACKGROUND OF THE INVENTION

[0003] Picture display devices of the type described in the opening paragraph are used, inter alia, in television apparatuses and computer monitors and are referred to as cathode ray tubes (CRTs).

[0004] A picture display device of the type described in the opening paragraph is known.

[0005] The known picture display device has some drawbacks, notably a relatively high cost price of its neck portion.

SUMMARY OF THE INVENTION

[0006] The invention has for its object to eliminate the above disadvantage wholly or partly. According to the invention, this object is achieved by a picture display device comprising a display tube comprising an evacuated envelope,
the envelope comprising, around a longitudinal axis, a display window with a display screen on its inner side, a conical portion and a neck portion,
the conical portion being connected to an upstanding wall of the display window,
the neck portion accommodating an electron gun,
the display screen comprising a first glass component,
the conical portion comprising a second glass component,
the neck portion comprising a glass component with a composition that is substantially the same as that of the first or the second glass component.

[0007] By manufacturing the neck portion from substantially the same material as the cone portion or from substantially the same material as the display screen, manufacturing of the neck portion is largely simplified thereby obtaining a considerable reduction in the cost price of the neck portion.

[0008] The neck portion is an essential part of a Cathode Ray Tube (CRT). The neck portion provides the location for mounting the electron gun and the gun base, and also the connection for the vacuum pump. The neck portions that are used nowadays, and the neck portions that have been used in the past, all consist of a glass with a relatively high lead oxide content, typically the PbO content is about 30% by weight. The function of the neck portion is to accommodate the position of the electron gun in a CRT and to provide a vacuum tight seal with the conical (or funnel) portion and the gun base (the glass part which contains the pump tube and the electrical connections for the electron gun). Table I gives an overview of the glass compositions that are known to have been used as neck portion glass compositions and also gives a number of characteristic properties.

Table I Composition and properties of known neck glass types.

SiO_2	45-50 weight%
Al_2O_3	1.2-3 weight%
Na_2O	0.5-2.5 weight%
K_2O	9-14 weight%
CaO	0.1-3 weight%
PbO	30-35 weight%
Sb_2O_3	0.1-0.7 weight%
Density	3.3 g/cm3
LE300	9.6-9.9 ppm/K
Tg	460-470°C
Strain point	430-450°C
Anneal point	465-485°C
PHSP	485-490°C
Softening point	645-660°C
Working point	950-960°C
Melting point	1385°C
Tk100	375-385°C

Important for the application as neck portion glass are:

- a sufficiently high X-ray absorption coefficient;
- a sufficiently high electrical resistance (measured as log ρ_{250});
- an expansion coefficient that more or less matches that of (the glass composition of) the conical portion glass and of (the glass composition of) the gun base;
- a viscosity curve which allows processing in an easy way.

[0009] In general, neck portions are quite an expensive type of glass product. Reasons for this relatively high price per kg glass are:

- The production package for this glass type is rather small. This means that the depreciation and capital costs for the furnace and the forming equipment must be covered by a relatively low glass volume.
- The demands on the glass quality are very high. This means that the reject level is typically very high, and

that intensive sorting is necessary to maintain a sufficiently high quality level. Especially bubbles are critical with respect to quality, since they tend to act as disturbances building up high voltage electrical charge.

[0010] It would be desirable to make the neck portions in a more common glass type; this could bring large price advantages. Some reasons for this are:

- The depreciation per product is less for a larger furnace, if it is fully loaded.
- In general, larger furnaces are able to produce a better glass quality, because the ratio refractory surface area to glass melt volume is lower for a larger furnace.
- The energy consumption per kg produced glass of a larger furnace is much lower as that of a smaller furnace.
- Automatic inspection is easier to arrange for a larger production volume.
- For a more common glass type, there will be more suppliers, and more competition, so a better price can be obtained.

[0011] A favorable embodiment of the picture display device according to the invention is characterized in that the composition of the glass component of the neck portion, expressed as a percentage by weight, comprises the following constituents:

SiO_2 and Al_2O_3, the sum of the concentrations of SiO_2 and Al_2O_3 being in the range from 50-65 weight%,
BaO and/or SrO and/or ZrO_2, the sum of the concentrations of BaO and/or SrO and/or ZrO_2 being in the range from 0.5-10 weight%, and
10-25 weight% PbO.

[0012] Lowering of the amount of lead oxide in the glass of the neck portion as compared to known neck glass reduces the X-ray absorption of the glass. However, this effect is to some extent compensated by the presence in the glass of the neck portion according to the invention of BaO and/or SrO and/or ZrO_2 in the concentration range as shown hereinabove. BaO and SrO are introduced in the glass of the neck portion from recycle cullet. SiO_2 and Al_2O_3 more or less have the same function in the neck glass. In addition, Al_2O_3 is included in the glass of the neck portion to reduce crystallization and to enable the use of recycle cullet.

[0013] Preferably, the composition of the glass component of the neck portion comprises the following constituents:

50-60 weight% SiO_2,
0.5-5 weight% Al_2O_3,
0.1-5 weight% BaO,
0.1-5 weight% SrO,
0.05-2 weight% ZrO_2,
10-25 weight% PbO.

[0014] A very favorable embodiment of the picture display device according to the invention is characterized in that the composition of the glass component of the neck portion comprises the following constituents:

52-56 weight% SiO_2,
0.5-3 weight% Al_2O_3,
0.5-4 weight% CaO,
0.1-3 weight% BaO,
0.1-3 weight% SrO,
0.05-1 weight% ZrO_2,
15-20 weight% PbO.

[0015] Na_2O and K_2O can be added to the glass of the neck portion as fluxes and to lower the tendency for crystallization. Na_2O and K_2O also control the thermal expansion coefficient of the glass for matching the thermal expansion coefficient of the gun base and the glass of the cone (or funnel) portion. The ratio Na_2O/K_2O controls the electrical resistivity of the glass and the working range (the difference between working point and softening point) of the glass. CaO and, if desired MgO, are added to control the viscosity curve and to increase the electrical resistivity of the glass. CaO (and MgO) also act as fluxes, at a lower price than Na_2O and K_2O, but added in an amount higher as the mentioned limit, CaO (and MgO) will stimulate crystallization of the glass of the neck portion and lower the working range in such a manner that the forming process by pressing or tube drawing will becomes relatively difficult.

[0016] The invention also relates to a neck portion for use in a picture display device.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] These and other aspects of the invention are apparent from and will be elucidated with reference to the embodiments described hereinafter.

[0018] In the drawings:

Figure 1 is a cross-section of a picture display device comprising a cathode ray tube according to the invention.

[0019] The Figures are purely diagrammatic and not drawn to scale. Notably, some dimensions are shown in a strongly exaggerated form for the sake of clarity. Similar components in the Figures are denoted as much as possible by the same reference numerals.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0020] Figure 1 very schematically shows a cross-sec-

tional view of a picture display device comprising a cathode ray tube (CRT) having a longitudinal axis 20 and an evacuated envelope 1 comprising a display window 2, a conical portion 4 and a neck portion 5. In this embodiment, the neck portion 5 accommodates three electron guns 6, 7 and 8 for generating three electron beams 9, 10 and 11 which are usually co-planar, here the plane of the drawing. A display screen 3 is provided on the inner surface of the display window 2. The display screen 3 comprises a large number of red, green and blue-luminescent phosphor elements. On their way to the display screen 3, the electron beams 9, 10 and 11 are deflected in two mutually perpendicular directions (the so-called field and the so-called line deflection direction) by the deflection unit 14 across the display screen 3 and pass a color selection electrode 13 arranged in front of the display window 2, which electrode usually consists of a thin plate having apertures 12 and is referred to as shadow mask in this case. The color selection electrode 12 is suspended to the inner side of the upstanding wall 15 of the display window 2 with the aid of suspension means 16. The transition between the conical portion 4 and the upstanding wall 15 of the display window 2 is also referred to as the "seal edge" 19 where a (glass) frit is present, which frit serves as a sealing material. The three electron beams 9, 10 and 11 pass the apertures 12 of the color selection electrode 13 at different angles and thus each impinge on phosphor elements of one color only. The inner side of the conical portion 4 is usually coated with a conducting coating 18.

[0021] Tests were conducted wherein a test melt was made; the composition of the glass component corresponding to a composition according to the invention. The glass was used to form neck portions. These neck portions were incorporated into CRT tubes to see how they perform, and what their characteristics with respect to X-ray safety and electrical properties were. Two different types of neck portions were produced: a so-called narrow neck portion and a so-called mini neck portion. The composition and properties of this batch were measured. Results are summarized in Table II. Table II gives an overview of a typical glass composition for a neck portion according to the invention and its most characteristic properties.

Table II Composition and properties of a neck glass according to the invention known neck glass types

SiO_2	54 weight%
Al_2O_3	2 weight%
Na_2O	6.7 weight%
K_2O	7.7 weight%
MgO	1.8 weight%
CaO	2.6 weight%
SrO	2.4 weight%
BaO	2.5 weight%
PbO	19 weight%
Sb_2O_3	0.22 weight%
ZrO_2	0.55 weight%
Density	3.0 g/cm3
LE300	10 ppm/K
Tg	475°C
Strain point	455°C
Anneal point	485°C
PHSP	500°C
Softening point	660°C
Working point	960°C
Melting point	1356°C
Tk100	330°C

[0022] In addition to the above composition, the glass as described in Table II also comprises 0.22 weight% Sb_2O_3 as a refinement glass. In general upto 0.5 wt% of refining agent may be present in the glass. Apart from Sb_2O_3, the glass of the neck portion can also be refined with cerium oxide, chloride, As_2O_3 or sulfate. At present, As_2O_3 is not used anymore for safety and environmental reasons. Avoidance of Sb_2O_3 may become a necessary in the future in view of environmental and/or safety reasons.

[0023] The results of the CRT display devices with the neck glass portion manufactured according the glass with a composition to the invention were positive. The X-ray safety measurements were met and the electrical properties were within the desired specification.

[0024] It should be noted that the above-mentioned embodiments illustrate rather than limit the invention, and that those skilled in the art will be able to design many alternative embodiments without departing from the scope of the appended claims. In the claims, any reference signs placed between parentheses shall not be construed as limiting the claim. Use of the verb "comprise" and its conjugations does not exclude the presence of elements or steps other than those stated in a claim. The article "a" or "an" preceding an element does not exclude the presence of a plurality of such elements. The invention may be implemented by means of hardware comprising several distinct elements, and by means of a suitably programmed computer. In the device claim enumerating several means, several of these means may be embodied by one and the same item of hardware. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a com-

bination of these measures cannot be used to advantage.

Claims

1. A picture display device comprising a display tube comprising an evacuated envelope (1),
the envelope (1) comprising, around a longitudinal axis (20), a display window (2) with a display screen (3) on its inner side, a conical portion (4) and a neck portion (5),
the conical portion (4) being connected to an upstanding wall (15) of the display window (2),
the neck portion (5) accommodating an electron gun (6, 7, 8),
the display screen (3) comprising a first glass component,
the conical portion (4) comprising a second glass component,
the neck portion (5) comprising a glass component with a composition that is substantially the same as that of the first or the second glass component.

2. A picture display device as claimed in claim 1, wherein the composition of the glass component of the neck portion (5) comprises, expressed as a percentage by weight, the following constituents:

SiO_2 and Al_2O_3, the sum of the concentrations of SiO_2 and Al_2O_3 being in the range from 50-65 weight%,
BaO and/or SrO and/or ZrO_2, the sum of the concentrations of BaO and/or SrO and/or ZrO_2 being in the range from 0.5-10 weight%, and
10-25 weight% PbO.

3. A picture display device as claimed in claim 2, wherein the composition of the glass component of the neck portion (5) comprises the following constituents:

50-60 weight% SiO_2,
0.5-5 weight% Al_2O_3,
0.1-5 weight% BaO,
0.1-5 weight% SrO,
0.05-2 weight% ZrO_2,
10-25 weight% PbO.

4. A picture display device as claimed in claim 3, wherein the composition of the glass component of the neck portion (5) comprises the following constituents:

52-56 weight% SiO_2,
0.5-3 weight% Al_2O_3,
0.5-4 weight% CaO,
0.1-3 weight% BaO,
0.1-3 weight% SrO,
0.05-1 weight% ZrO_2,
15-20 weight% PbO.

5. A conical portion (5) for use in a picture display device as claimed in any of the preceding claims.

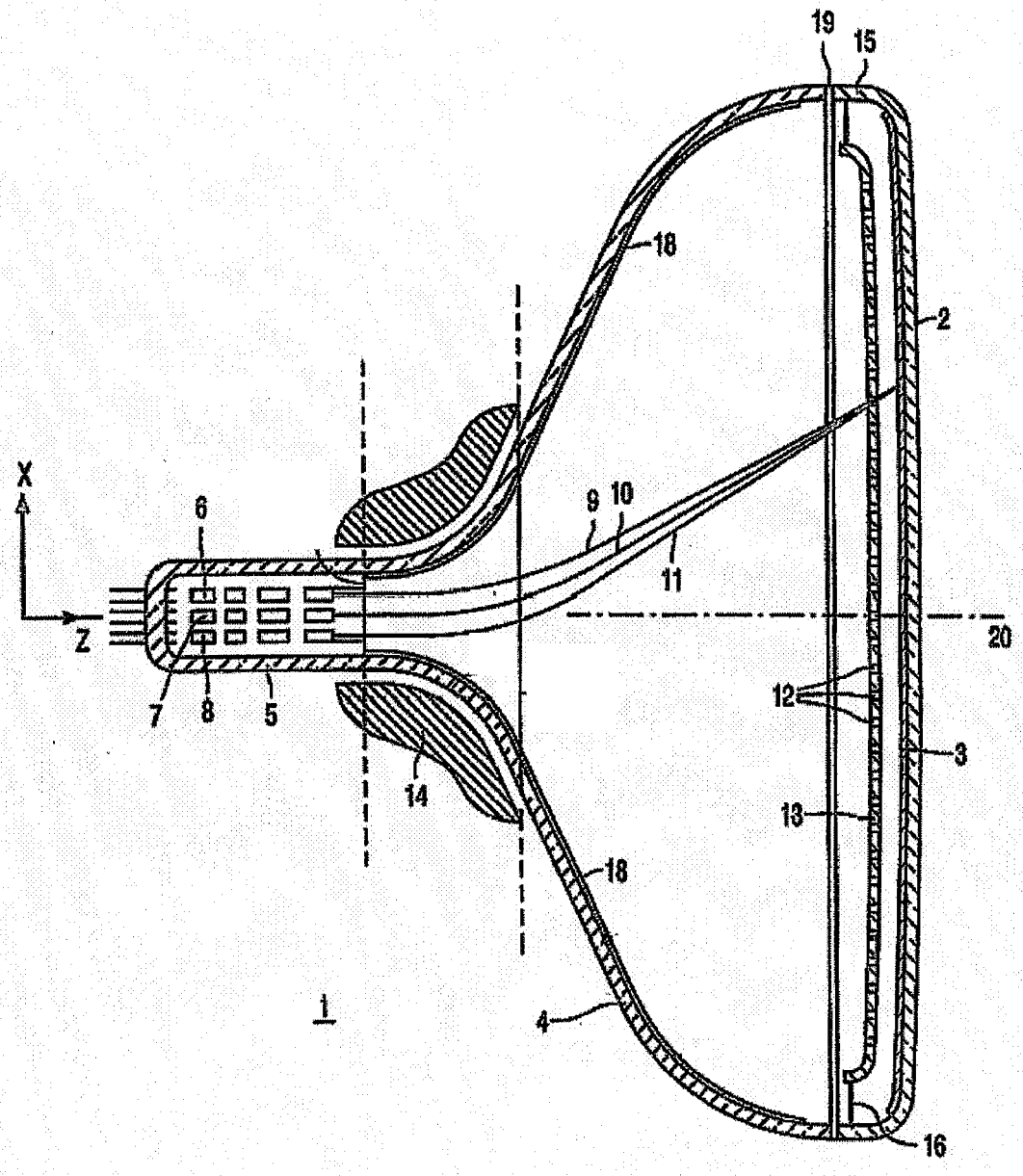

FIG. 1

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EUROPEAN SEARCH REPORT

Application Number
EP 05 10 5019

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Y	EP 1 433 759 A (NIPPON ELECTRIC GLASS COMPANY, LIMITED) 30 June 2004 (2004-06-30) (in comb. with US-2004/0259715) * paragraph [0025] *	3,4	TECHNICAL FIELDS SEARCHED (Int.Cl.7) H01J

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	24 October 2005	Weisser, W

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 05 10 5019

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