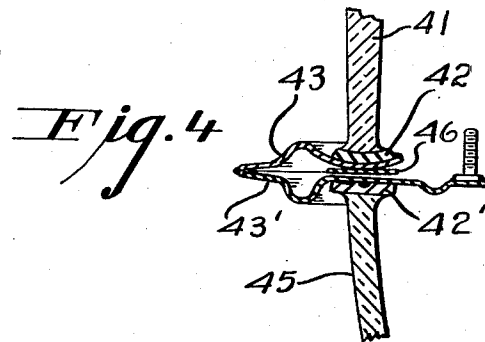
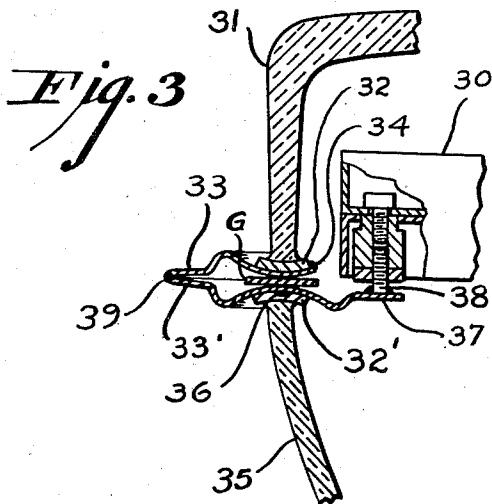
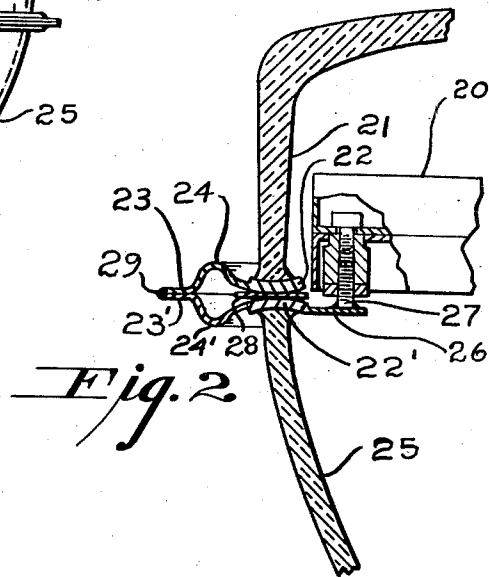
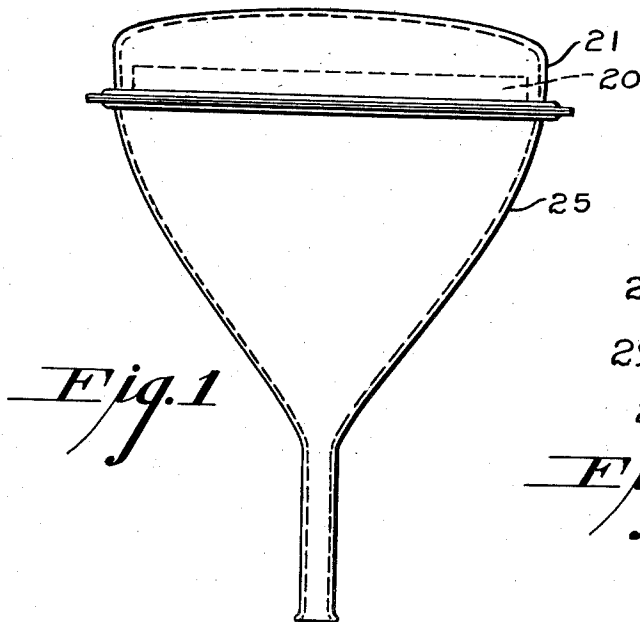


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F. W. MARTIN  
CATHODE-RAY TUBE MANUFACTURE

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1

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## CATHODE-RAY TUBE MANUFACTURE

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17 Claims. (Cl. 220—2.3)

The present invention relates to television picture tubes and is particularly directed to the construction of such a tube of the "all-glass" type suitable for the reproduction of pictures in color.

Television picture reception in color can be obtained through the use of a tube that contains a suitable viewing-screen assembly which may comprise a tri-color phosphor plate and an aperture mask or other grid-like controlling element and which is suitably mounted or otherwise positioned in the panel end of the tube. Since such a viewing-screen assembly is the same or substantially the same as the panel in area, it must be installed before the panel and the funnel are joined together. Because such viewing-screen assembly is relatively sensitive to heat, however, it is necessary that the panel and the funnel be sealed to one another in such a way as to avoid heat damage thereto. This requirement thus renders the conventional manner of sealing the glass panel to the glass funnel of an "all-glass" black-and-white picture tube unsuitable for the production of such a color picture tube since the heat required to effect the seal is sufficient seriously to damage or otherwise to impair the viewing-screen assembly.

As described and claimed in a commonly owned application of Wendell S. Blanding and William W. Shaver, Serial No. 383,804, filed of even date herewith, an "all-glass" type of picture tube can be readily adapted for satisfactory use with such a viewing-screen assembly by sealing the glass panel and the glass funnel to one another through the medium of endless substantially flat metal strip or ring elements whose outer dimensions or diameter is greater than that of the panel and the funnel. Each such endless metal strip or ring element comprises a relatively thick portion and an associated relatively thin portion extending outwardly therefrom with the relatively thick portion substantially conforming in configuration to and following the outline of the sealing surface of the glass panel or the glass funnel and having a width substantially only sufficient to afford a satisfactory surface for butt sealing to the panel or the funnel. The relatively thick portion of one of such elements is butt-sealed to the sealing surface of the glass panel, and the relatively thick portion of the other element is butt-sealed to the sealing surface of the glass funnel. The relatively thin portions of the two elements are in turn joined to each other in sealing relation as by welding preferably at or adjacent to their outer peripheries.

Such endless metal ring element may take various embodiments. For example, it may comprise a metal strip having a flat or planar relatively thick portion and an integral flat or planar relatively thin portion extending outwardly therefrom. Alternatively it may comprise a flat or planar relatively thick metal strip and an associated flat or planar relatively thin metal strip, the latter being joined to the former in sealing relation and extending outwardly therefrom.

As more fully detailed in such Blanding-Shaver ap-

2

plication, the mass of such a thin-thick metal sealing element is so distributed that no undue hoop stress and/or bending stress is created in the glass portion of the glass-to-metal seal. In addition the thick portion of the element provides the rigidity desirable in the glass-to-metal seal area to prevent deformation and pulling away of the metal from the glass. Moreover, because of the thin character of the outwardly extending portion of the elements, the amount of heat required to weld them together is not sufficient to damage the glass-to-metal seals. Such relatively thin portions also possess sufficient resilience so that they can be flexed to the extent necessary in preparation for their welding together.

Unless unusual care is employed or ideal conditions are closely approached in the butt-sealing of such a flat metal strip element to the glass panel or the glass funnel, the element tends to expand and tip at a slight angle, even when shaping of the element to provide an angle between the thick portion and the outwardly extending thin portion as taught by the Blanding-Shaver application is practiced. As pointed out in such application when a tube is evacuated, the resulting compressive load between the element surfaces opposite the butt seals is between their outer margins tending to return the elements to their flatwise position with the accompanying likelihood of introduction of tension at the inner margins of the butt seals.

I have now found that these disadvantages can be avoided by utilizing at least one metal strip or ring element in which the relatively thick portion is arcuately shaped with the sealing surface of the glass panel or the glass funnel advantageously being butt-sealed to the concave surface of such thick portion. With this arrangement, when the tube is evacuated, the compressive load between the strips is confined to the general area midway between the lateral boundaries of the glass-to-metal seal area; and the creation of tensional forces in the inner margins of the glass-to-metal seals is avoided. In addition, the added stiffening of the relatively thick portions of the metal strip elements resulting from their concavo-convex cross-sectional configuration reduces the likelihood of their distortion during the butt-sealing operation with the result that point loading is substantially reduced. Moreover, the concavo-convex cross-sectional configuration increase the rigidity of such a metal strip element so that the total mass of metal can be reduced with a consequent reduction in the hoop stress created in the glass portion of the glass-to-metal seal.

In the accompanying drawing—

Fig. 1 is a side elevation of an "all-glass" type of round television picture tube envelope embodying the glass-to-metal seal of the present invention.

Fig. 2 is an enlarged sectional view of a fragment of the picture tube envelope of Fig. 1 showing one specific form of embodiment of the glass-to-metal seal.

Fig. 3 is a view similar to Fig. 2 illustrating a somewhat modified embodiment of the glass-to-metal seal.

Fig. 4 is a view similar to Fig. 3 showing the use of a concavo-convex metal sealing strip in combination with a flat metal sealing strip.

Referring to the drawing in detail, the picture tube envelope shown in Figs. 1 and 2 embodies a panel portion 21 butt-sealed to the broad concave surface of the thick cross-sectional portion 22 of a metal strip or ring having an integrally adjoining thin cross-sectional portion 23 preferably but not necessarily with a corrugation or rib 24 formed therein paralleling the seal. A similar but oppositely disposed strip or ring comprising corresponding parts 22', 23' and 24' is in a similar fashion butt-sealed to the funnel portion 25 of the tube envelope,

As shown, the thick strip portions 22 and 22' need be only sufficiently wide to provide the necessary surface to effect a satisfactory butt seal. Strip portions 23 and 23' are hermetically joined to one another at or adjacent to their outer boundaries preferably by welding as at 29.

As described and claimed in a commonly owned application of John F. Frazier, S.N. 383,803, filed of even date herewith, strip portion 22' is advantageously provided along its inner margin with an inwardly extending peripheral projection 26 to which are appropriately welded a plurality of spaced threaded studs 27 for supporting a viewing-screen assembly 20. Projection 26 may be of any thickness suitable to provide the desired structural strength and may be welded or otherwise joined to portion 22 as indicated or formed integrally therewith.

Since the surfaces of strip portions 22 and 22' opposite those butt-sealed to the panel and the funnel are convex in transverse cross-section, the panel and the funnel tend to remain in substantial contact with each other during the welding of strip portions 23 and 23' to each other with the load shifted, if at all, only slightly outwardly from the center line of the glass-to-metal seal area. As will be appreciated, such an arrangement has the further advantage that the load is transmitted compressively to the entire cross-section of the glass portion of each glass-to-metal seal. Any point loading that does occur can be further reduced through the use of an annular gasket 28 of a soft metal or other suitable material.

In the embodiment illustrated in Fig. 3 the metal sealing element includes a relatively thick strip 32 which is concavo-convex in transverse cross-section and which is only of sufficient width to provide the surface necessary for the butt seal to the panel portion 31. A companion strip 33 of relatively thin metal and advantageously also in part concavo-convex in transverse cross-section as shown is arranged adjacent the opposite surface of strip 32 and is joined thereto as by welding along or adjacent to their inner margins as at 34. Oppositely disposed corresponding strips 32 and 32' are similarly associated with respect to the funnel portion 35. Preferably point loading is reduced by use of a gasket G, similar to gasket 28 of Fig. 2. As shown strips 32' and 33' are welded to one another preferably along a line outward from their inner margins as at 36. The latter manner of joining the thick and the thin strips may, of course, also be utilized in the panel-sealing element.

As in the case of strip portion 22' shown in Fig. 2, strip 33' desirably has an inwardly extending peripheral projection 37 which at suitably spaced intervals is provided with studs such as 38 for supporting a viewing-screen assembly 30. As in the structure of Fig. 2 the adjoining similar strips 33 and 33' are welded to one another at or adjacent to their outer margins as at 39.

In order to further improve the line of contact between the panel and the funnel and to further reduce point loading, one of the metal sealing elements may be substantially flat as described in the above-identified Blanding-Shaver application. Desirably such substantially flat metal sealing element is butt-sealed to the funnel portion, as indicated in the form of embodiment shown in Fig. 4. In this arrangement the relatively thick strip 42 and the relatively thin strip 43 of the metal sealing element butt-sealed to the panel portion 41 are identical to the corresponding strips 32 and 33 of the metal sealing element butt-sealed to the panel portion 31 shown in Fig. 3; the relatively thick strip 42' and the relatively thin strip 43' of the metal sealing element butt-sealed to the funnel portion 45 differ, however, from the relatively thick strip 32' and the relatively thin strip 33' of the corresponding metal sealing element butt-sealed to the funnel portion 35 in Fig. 3 in that the strips 42' and 43' are formed substantially flat or planar. This arrangement, as will be appreciated, is of particular advantage where there is any variance in the diameters of the respective metal sealing elements since a greater lateral line contact varia-

tion can thereby be tolerated. With this construction, moreover, there is generally no need for the use of a compressible gasket, such as 46, between the panel and the funnel.

Strip portions 22 and 22' and strip portions 23 and 23' may respectively vary considerably in thickness, as may strips 32 and 32' and strips 33 and 33'. In any particular case, however, the optimum or desirable thickness in each strip portion or strip depends in large part on the size of the tube as well as its shape and to some extent on the particular glass and metal utilized. In any event the relatively thin portions or the thin strips should not be so thick as to objectionably increase the hoop stress in the glass portion in the glass-to-metal butt seal or to introduce objectionable stresses into the glass parts when complementary thin strip portions or thin strips are clamped for welding. Moreover, if such thin strip portions or thin strips are too thick, the amount of heat necessary to effect the welding therebetween may be sufficient to require forced cooling of the glass-to-metal seals in order to prevent damage thereto while making the weld.

By way of example an entirely satisfactory "all-glass" type of 15-inch round color television picture tube can be produced in accordance with the present invention by the use of relatively thick strip portions or relatively thick strips ranging from 0.060" to 0.100" in thickness and by the use of relatively thin strip portions or relatively thin strips ranging from 0.020" to 0.030" in thickness. Generally speaking, the relatively thin strip portions or the relatively thin strips should not be much thinner than 0.020" since otherwise excessive warping may occur and the welding of complementary strips together may become objectionably difficult.

It will also be appreciated that, while in the strip assemblies shown, the glass surfaces have been sealed to the thick strips thereof, it is within the concept of the invention to attach the thick strip to the opposite side of the thin strip thus employing the thick strip merely as a stiffening member and to then butt-seal the glass to the thin strip side of the assembly. Furthermore it will be apparent that, as "so-called" thin strips of greater thickness are employed, a corresponding reduction in thickness of the "so-called" thick strips can be tolerated. In other words, as the thickness of the "so-called" thin strip is increased, the thickness of the "so-called" thick strip can be correspondingly reduced in thickness, since when both such strips are sealed to one another, the effectiveness of a thick strip is acquired.

As will be understood, this invention is equally applicable to either circular or non-circular including the so-called rectangular-type picture tubes, the glass-sealing portions of the metal sealing elements being merely conformed to the outline of the glass surfaces to which they are to be butt-sealed.

It should be further understood that, although the shape of the panels illustrated closely follows that embodied in commercial "all-glass" black-and-white picture tubes, the invention is not limited in this respect, since sealing strips embodying the invention can with equal facility be sealed to shallow-walled, concavo-convex, or substantially flat panels such as ordinarily employed in metal-funnel picture tubes. Nor is the invention necessarily limited to picture tubes embodying glass funnels since a panel equipped with a sealing strip embodying the invention may with equal facility be edge-welded to a suitably shaped flange of a metal funnel.

I claim:

1. An article comprising two glass members having endless sealing surfaces facing one another, one of said sealing surfaces being butt-sealed to one of two oppositely disposed broad surfaces of an endless metal strip, the other of said sealing surfaces being butt-sealed to one of two oppositely disposed broad surfaces of another endless metal strip, the broad surfaces of at least one of

5

said metal strips being concavo-convex in transverse cross-section, the two metal strips being joined to each other in sealing relation at their opposite surfaces.

2. An article such as defined by claim 1 wherein the endless sealing surface of the one glass member is sealed to the concave surface of the concavo-convex strip.

3. An article such as defined by claim 1 wherein one of the broad surfaces of the other of said strips is planar.

4. An article such as defined by claim 1 wherein the other of said metal strips is also concavo-convex in transverse cross-section.

5. An article such as defined by claim 4 wherein one glass member is sealed to the concave surface of one of such strips and the other glass member is sealed to the concave surface of the other of such strips.

6. An article comprising two glass members, at least one of which is hollow, such members having endless sealing surfaces facing one another, and an assembly interposed between such sealing surfaces and comprising a pair of endless metal strip elements each such element comprising a relatively thick portion and an associated relatively thin portion extending outwardly therefrom, the relatively thick portion of one of said elements being concavo-convex in transverse cross-section and being butt-sealed to the sealing surface of one of said glass members, the relatively thick portion of the other of said elements being butt-sealed to the sealing surface of the other glass member, the relatively thin portions of the two elements being joined to one another in sealing relation.

7. An article such as defined by claim 6 wherein the relatively thick portion of the other of said elements is also concavo-convex in transverse cross-section.

8. An article such as defined by claim 6 wherein the relatively thick portion of the other of said elements is substantially planar.

9. An article comprising two glass members, at least one of which is hollow such members having endless sealing surfaces facing one another, and an assembly interposed between such sealing surfaces and comprising a pair of endless metal strips, each such strip comprising a relatively thick portion and an integral relatively thin portion extending outwardly therefrom, the relatively thick portion of one of said strips being concavo-convex in transverse cross-section and being butt-sealed to the sealing surface of one of said glass members, the relatively thick portion of the other of said strips being butt-sealed to the sealing surface of the other glass member, the relatively thin portions of the two strips being joined to one another in sealing relation.

10. An article comprising two glass members, at least one of which is hollow such members having endless sealing surfaces facing one another, and an assembly interposed between such sealing surfaces and comprising a pair of endless metal elements, each such element comprising a relatively thick strip and an associated relatively thin strip, the relatively thin strip being joined to the relatively thick strip in sealing relation and extending outwardly therefrom, the relatively thick strip of one of said elements being concavo-convex in transverse cross-section and being butt-sealed to the sealing surface of one of said glass members, the relatively thick strip of the other of said elements being butt-sealed to the sealing surface of the other glass member, the relatively thin strips of the two elements being joined to one another in sealing relation.

11. A television picture tube comprising an envelope, said envelope comprising a glass viewing panel, a glass funnel, said panel and said funnel having endless sealing surfaces facing one another, and an assembly interposed between such sealing surfaces, said assembly comprising a pair of endless metal strip elements, each such element comprising a relatively thick portion and an associated relatively thin portion extending outwardly therefrom, the relatively thick portion of one of said elements being

6

concavo-convex in transverse cross-section and being butt-sealed to the sealing surface of the panel, the relatively thick portion of the other of said elements being butt-sealed to the sealing surface of the funnel, the relatively thin portions of the two elements being joined to one another in sealing relation.

12. A television picture tube comprising an envelope, said envelope comprising a glass viewing panel, a glass funnel, said panel and said funnel having endless sealing surfaces facing one another, and an assembly interposed between such sealing surfaces, said assembly comprising a pair of endless metal strips, each such strip comprising a relatively thick portion and an integral relatively thin portion extending outwardly therefrom, the relatively thick portion of one of said strips being concavo-convex in transverse cross-section and being butt-sealed to the sealing surface of the panel, the relatively thick portion of the other of said strips being butt-sealed to the sealing surface of the funnel, the relatively thin portions of the two strips being joined to one another in sealing relation.

13. A television picture tube comprising an envelope, said envelope comprising a glass viewing panel, a glass funnel, said panel and said funnel having endless sealing surfaces facing one another, and an assembly interposed between such sealing surfaces, said assembly comprising a pair of endless metal elements, each such element comprising a relatively thick strip and an associated relatively thin strip, the relatively thin strip being joined to the relatively thick strip in sealing relation and extending outwardly therefrom, the relatively thick strip of one of said elements being concavo-convex in transverse cross-section and being butt-sealed to the sealing surface of the panel, the relatively thick strip of the other of said elements being butt-sealed to the sealing surface of the funnel, the relatively thin strips of the two elements being joined to one another in sealing relation.

14. An article comprising a glass member having an endless sealing surface and an endless metal strip element, said element comprising a relatively thick portion and an associated relatively thin portion extending laterally therefrom, the relatively thick portion being concavo-convex in transverse cross-section and being butt-sealed to the sealing surface of the glass member, the relatively thin portion being adapted to be joined in sealing relation to another metal member.

15. An article comprising a glass member having an endless sealing surface and an endless metal strip, said strip comprising a relatively thick portion and an integral relatively thin portion extending laterally therefrom, the relatively thick portion being concavo-convex in transverse cross-section and being butt-sealed to the sealing surface of the glass member, the relatively thin portion being adapted to be joined in sealing relation to another metal member.

16. An article comprising a glass member having an endless sealing surface and an endless metal element, said element comprising a relatively thick strip and an associated relatively thin strip, the relatively thin strip being joined to the relatively thick strip in sealing relation and extending outwardly therefrom, the relatively thick strip being concavo-convex in transverse cross-section and being butt-sealed to the sealing surface of the glass member, the relatively thin strip being adapted to be joined in sealing relation to another metal member.

17. An article comprising two glass members, at least one of which is hollow, such members having endless sealing surfaces facing one another, and an assembly interposed between such sealing surfaces and comprising a pair of endless metal elements, each such element comprising two strips that are concavo-convex in transverse cross-section arranged flatwise with respect to one another and joined in sealing relation, one strip extending outwardly from the other, one element being butt-sealed to the sealing surface of one of said glass members and

the other element being butt-sealed to the sealing surface of the other glass member, the outwardly extending strips of the two elements being joined to one another in sealing relation.

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