

[54] **FACE PANEL ASSEMBLY FOR COLOR CATHODE-RAY TUBE**

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[51] Int. Cl.....H01j 1/96, H01j 19/50, H01j 29/46

[58] Field of Search.....313/92 B, 85 R

[56] **References Cited**

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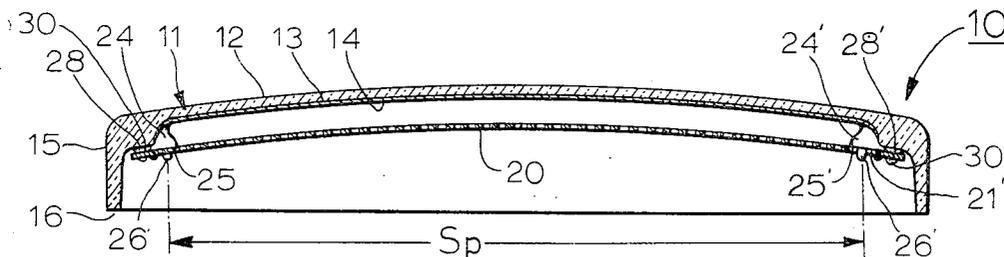
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Attorney—Cornelius J. O'Connor and John J. Pederson

[57] **ABSTRACT**

A face panel assembly for a color picture tube has a face panel formed of a glass having a predetermined coefficient of thermal expansion and a cylindrically shaped target surface that supports a screen. An aperture mask formed of a material having a different coefficient of thermal expansion has a plurality of index stations and a pair of end-mounted strips which are formed of the material having a coefficient of thermal expansion substantially the same as that of the face panel. A plurality of pedestals having upstanding posts are affixed to the face panel and cooperate with the index stations of the mask to support the mask in a predetermined spaced relation to the target surface, to conform the mask to a contour that matches the target surface and to prevent lateral displacement of the mask. Finally, frit means are employed to secure the mask mounting strips to the flange of the face panel.

9 Claims, 7 Drawing Figures



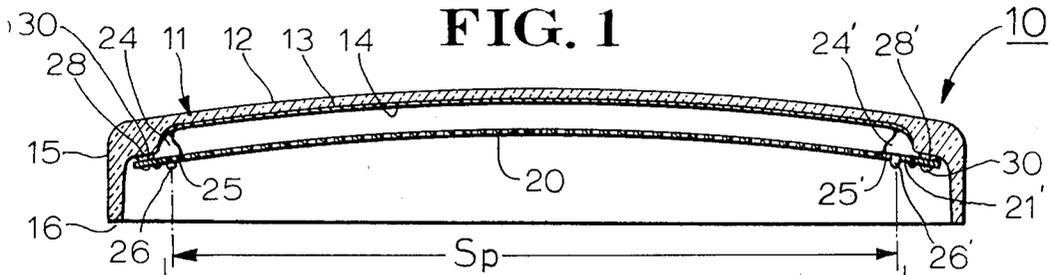


FIG. 1

FIG. 2

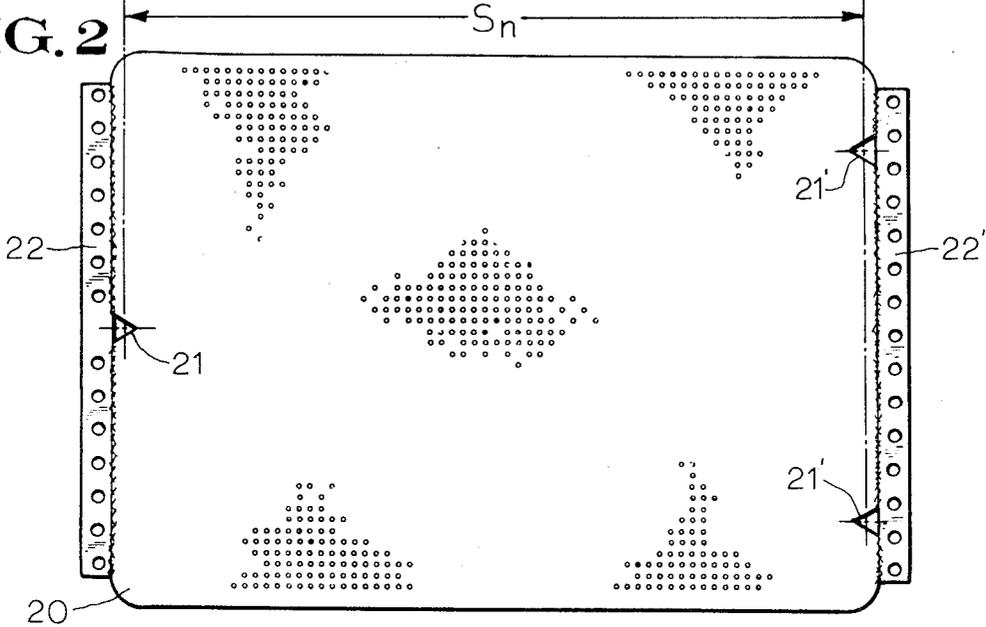


FIG. 3

FIG. 4

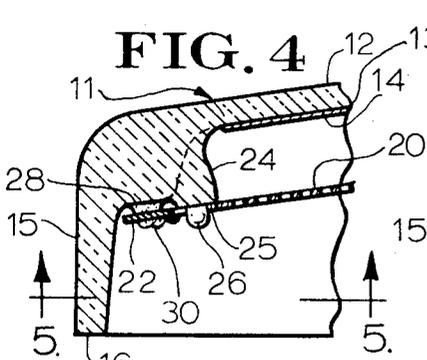


FIG. 5

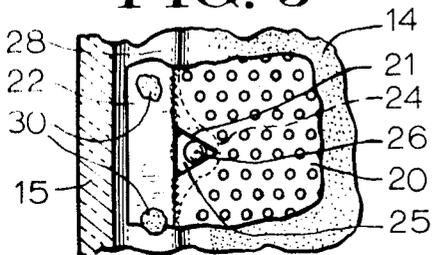


FIG. 6

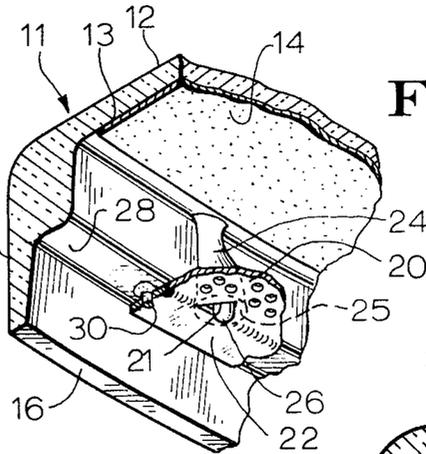
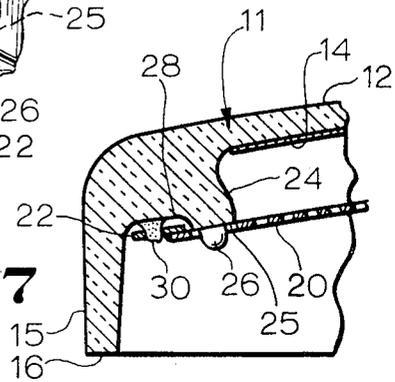


FIG. 7



FACE PANEL ASSEMBLY FOR COLOR CATHODE-RAY TUBE

BACKGROUND OF THE INVENTION

This invention relates in general to color reproducing cathode ray tubes and in particular to a face panel assembly for use therein.

A color tube of the type utilized in present day color television receivers basically comprises a face panel having a screened target surface which is surrounded by a peripheral flange and a mating funnel section which encloses a source of electron beams. The screen comprises an interlaced pattern of different kinds of phosphor materials, a popular and widely employed pattern being one formed of a multitude of phosphor dots arranged in triads, with each triad consisting of a red phosphor, a blue phosphor and a green phosphor. Each of these phosphor dots emits its characteristic hue upon excitation by an assigned one of the electron beams.

Interposed between the screen and the source of electron beams is a color selection electrode, generally in the form of a metal mask having an array of apertures, and oriented relative to the screen so that each aperture is in registration with an assigned dot triad. In this fashion the mask exerts a control effect to the end that the electron beams impinge only upon their assigned phosphor dots. However, achieving proper beam landing, or color selection, is not easily realized since it requires that the mask be precisely aligned with and spaced from the phosphor pattern. Moreover, the problem is compounded by the configuration adopted by the mask. More particularly, the practice today is to form the mask as a section of a sphere after the apertures are developed which operation tends to distort the aperture pattern. Thereafter, during operation of the tube, the mask is subjected to thermal expansion which causes the apertures in the mask to change location as the mask material expands. This thermal expansion causes the mask to be displaced outward, i.e. toward the screen. Displacement of the mask at any point, can be tolerated if the direction of displacement is along the beam path.

In general, the prior art practice is to affix the aforementioned spherical type mask to a heavy gauge steel frame which serves to impart rigidity to the mask as well as to provide means for mounting it. The face panel is provided with studs that project inwardly from the flange to releasably receive mounting springs which are attached to the mask frame. This construction is utilized in order that the mask may be installed and removed from the face panel, as required, to carry out the process steps through which the screen phosphors are deposited. At the completion of the screening process, the mask is reinserted in the face panel and that assembly is then united with the funnel section. The remaining steps in fabricating the tube, i.e., bake-out, exhaust and sealing, etc., are then undertaken.

The aforementioned frame, however, aggravates the mask aperture-phosphor dot registration. Specifically, the frame suffers thermal expansion but, the most significant aspect of this expansion is that it displaces the critical edge apertures of the mask essentially in a lateral direction, i.e., in a direction normal to the axis of the tube thus introducing an intolerable misregistration. As noted, displacement of the mask along the beam path can be tolerated; therefore the art resolves

the lateral displacement error by resort to a temperature compensating structure that includes bi-metal springs for coupling the mask frame to the panel studs. In operation this compensating structure physically shifts the frame and mask forward in order to offset at least part of the lateral displacement of the mask apertures.

In the prior art practice, adverted to above, the aperture mask employed for screening a particular face panel must be mated to that specific face panel in order to insure proper registration between the phosphor triads and the mask apertures. Obviously, significant economies could be achieved if interchangeable aperture masks were employed in fabricating the screen. For example, if a series of aperture masks were formed from a master mask, then interchangeability of that series of masks would be realized to the extent that any of those masks could be utilized with a phosphor screen developed from a mask derived from the aforesaid master.

The concept of interchangeable masks finds particular application in a color cathode ray tube utilizing that type of screen which has come to be known as a "black-surround" screen. This designation describes a screen in which light-absorbing material, in the form of a black pigment, surrounds the elemental phosphor dots. A color tube having phosphor dot triads distributed over the screen with a black material surrounding each dot, is described and claimed in U.S. Pat. No. 3,146,368 which issued Aug. 25, 1964 in the name of Joseph P. Fiore et al. This patent is assigned to the assignee of the present invention.

The advantage of an interchangeable mask for a black-surround picture tube resides in the fact that the more desirable approach to black-surround requires that the apertures in the mask be larger than the phosphor dots. This feature is practically realized by employing a mask having apertures of a predetermined size for the screening process and thereafter enlarging the apertures of that mask by a process commonly designated re-etching. The advantage of interchangeable masks is now manifest in that a mask related to the aforementioned master, and having apertures of said predetermined size, can be employed for screening the target surface of the face panel. Thereafter, upon completion of the screening process, a different mask having an aperture pattern developed from the same master, but have apertures larger than the screening mask apertures, is then mounted in the panel to complete the panel assembly.

It is therefore a general object of the invention to provide an improved face panel assembly for a color reproducing cathode ray tube.

It is a specific object of the invention to provide a face panel assembly featuring the concept of an interchangeable aperture mask;

It is another object of the invention to provide a face panel assembly which is particularly amenable to black-surround type color picture tubes;

It is also an object of the invention to provide a face panel assembly that dispenses with the conventional mask support frame.

It is a further and specific object of the invention to provide an aperture mask-face panel construction which eliminates mask temperature compensating structure.

It is still another object of the invention to provide a face panel assembly which eliminates the shortcomings of spherical type aperture mask assemblies.

SUMMARY OF THE INVENTION

A face panel assembly for use in a color reproducing cathode ray tube comprises a face panel formed of a material having a predetermined coefficient of thermal expansion and having a curved target surface for supporting a cathodoluminescent screen. A color selection electrode, formed of a material having a predetermined different coefficient of thermal expansion, has a plurality of index stations. A pair of mounting strips, formed of a material having a coefficient of thermal expansion substantially the same as that of the face panel, are individually affixed to opposite ends of the color selection electrode. Mounting means are affixed to the face panel and cooperate with the index stations to support the color selection electrode in a predetermined spaced relation to the target surface to conform that electrode to a contour that substantially matches that of the target surface and to prevent lateral displacement of the electrode. Finally, means are provided for fixedly securing the mounting strips to selected inner surfaces of said face panel.

BRIEF DESCRIPTION OF THE DRAWING

The features of the present invention which are believed to be novel are set forth with particularity in the appended claims. The invention, together with further objects and advantages thereof, may best be understood by reference to the following description taken in conjunction with the accompanying drawing, in the several figures of which like reference numerals identify like elements and in which:

FIG. 1 is a cross-sectional view of a face panel assembly constructed in accordance with the invention;

FIG. 2 is a plan view of the aperture mask employed in the face panel assembly of FIG. 1;

FIG. 3 is an edge view of the mask shown in FIG. 2;

FIG. 4 is an enlarged detail of the left-hand side of the mask assembly of FIG. 1;

FIG. 5 is a cross-sectional view taken along lines 5—5 of FIG. 4;

FIG. 6 is a fragmentary prospective view of an arrangement for mounting the aperture mask in the face panel; and

FIG. 7 is a detail illustrating an alternative construction for securing the mask to its mounting strips.

Referring now more particularly to FIG. 1, the panel assembly 10 there illustrated comprises a face panel 11 formed of a hard glass having a predetermined coefficient of thermal expansion. Normally, glass of the type employed in cathode ray tube face panels has a coefficient of expansion approximating 100×10^{-7} in/in/C°. Panel 11 comprises an outer viewing surface 12 and a parallel inner target surface area 13 both of which are contoured to approximate a section of a cylinder. The target area 13 supports a cathodoluminescent screen 14 formed of an interlaced pattern of red, green and blue phosphor dots arranged in a plurality of color triads. The phosphor dots are separated from one another by deposits of light-absorbing pigment, in the manner described in the aforementioned Fiore et al patent.

Screen 14 is preferably processed by a mask created from a master; in this fashion any mask related to that master will, when subsequently inserted in place of the

screening mask, have its apertures in proper registration with the previously applied dot triads. The viewing and target surfaces of panel 11 are circumscribed by a flange 15, the periphery of which is provided with a flat sealing land 16 to augment a subsequent fusion to a funnel portion (not shown) to form a cathode ray tube envelope.

A color selection electrode in the form of a rectangular aperture mask 20 is preferably formed, for reasons of economy, of cold rolled steel and nominally has a coefficient of thermal expansion different from that of the face panel, specifically 130×10^{-7} in/in/C°. Mask 20 is provided with a plurality of index stations in the form of V-notches 21, 21'. Aperture mask 20, including its indexing notches, are desirably created from the same master that fathered the screening mask. However, if the screen for which mask 20 is to serve as a color selection electrode is of the black-surround variety, then the etching process for mask 20 would be prolonged a period sufficient to enlarge its apertures to a dimension larger than those of the screening mask. As shown in FIG. 2, three indexing notches are employed, notch 21 being located on one of the short sides of the mask while two notches 21' are disposed on the opposite side. As will be shown, these notches serve to properly align the apertures in the mask with the dot triads of screen 14. It should be noted that the actual configuration of the apertures is of no consequence insofar as the subject invention is concerned; that is, resort may be had to circular, hexagonal, rectangular, etc., shaped apertures for the mask.

A pair of elongated perforated mounting strips 22, 22' formed of a material having substantially the same coefficient of thermal expansion as that of the face panel, for example titanium modified No. 430 stainless steel, 108×10^{-7} in/in/C° or No. 446 stainless steel, 104×10^{-7} in/in/C°, are individually affixed to the same sides of mask 20 as the indexing notches. These strips may be affixed to the mask by butt welding, see FIGS. 3 and 4 or, if desired, by an overlapping welded joint, FIG. 7. As will be shown, the particular manner in which the strips are attached to the mask is of no concern since it only affects the elevation of the surfaces to which the strips are ultimately secured.

Integrally formed from a wall of panel 11 are a plurality of pedestals 24, 24' having respective precisely ground flat mounting surfaces 25, 25' for supporting those portions of mask 20 immediately adjacent notches 21, 21'. Extending from surfaces 25, 25' are respective indexing posts 26, 26', which are received by notches 21, 21'. Each of posts 26, 26' effects a two-point engagement with its assigned notch, see FIG. 5, to re-establish the proper orientation of the mask apertures relative to their assigned dot triads in screen 14. This alignment obtains by virtue of the fact that mask 20 is related to the same master as the screening mask employed for processing screen 14 and, since the screening mask was originally aligned with the target area 13 of the panel by posts 26, 26', mask 20 will assume the same position as that mask. Disposed along the inside walls of the side flange portions of the face panel, and at a level spaced from pedestal surfaces 25, 25', are a pair of lands 28, 28' which, in a manner detailed below, serve to secure mask mounting strips 22, 22' to panel 11.

The lateral spacing S_p between posts 26, 26', see FIG. 1, is less than the lateral spacing S_n between notches

21, 21', see FIG. 2, so that the posts, in conjunction with the notches serve to conform the mask to a contour that substantially matches the contour of target surface 13 of the face panel. In this fashion posts 26, 26' in cooperation with notches 21, 21' conform the mask essentially into a section of a cylinder. In this regard it is noted that, by resort to a rectangular cylindrical mask for the subject face panel assembly, stress and deformation of the mask material, which is inherent during the drawing process in a spherically formed mask, is avoided. It is also to be noted that the relative spacings between the posts and the notches serve to securely retain the screening mask in position during the screening process while still facilitating removal and re-insertion of that mask.

Turning now to pedestals 24, 24', it is the function of the surfaces 25, 25' to offer three points of support for the aperture mask. As best seen in FIG. 4 when the left-hand portion of mask 20 is seated upon pedestal surface 25, strip 22 overlies the depressed surface 28 so that spacing of the mask relative to the screen is entirely relegated to the three pedestal surfaces 25, 25'. Surfaces 25, 25' are accurately machined so that they lie in a common curvilinear plane parallel to screen 14. In this manner they insure that the proper spacing between the mask and the screen is established. Accordingly, with posts 26, 26' cooperating with notches 21, 21' the apertures of the mask are correctly aligned relative to their assigned triads, while the mask itself is correctly spaced, relative to the target surface, by pedestal surfaces 25, 25'.

The mask is now fixedly secured to the flange of the face panel by applying a frit compound 30 to the perforations in strips 16. The frit of course, is selected to have a coefficient of thermal expansion substantially the same as the panel and/or the stainless steel mounting strips 22, 22'. In this fashion when the frit sets-up, that is when it is heated to anchor the strips to the panel, there will be no danger of a fracture developing in the frit or the glass panel since the strips, the panel and the frit will expand, and contract, at the same rate. The frit can be applied as individual droplets to the perforations in the strips or as a continuous bead across the perforations. In either case, the frit material passes through the perforations to come in direct contact with surfaces 28, 28' located along the side walls of the panel flange.

Since the phosphor screen has previously been applied to the target surface panel, the panel assembly is now ready for joining to the funnel portion of the envelope. This, of course, is a well known step in the process of picture tube fabrication and merely entails the application of frit material to the sealing land 16 of the face panel and to the sealing land on the funnel. The face panel and funnel are then mated and passed through a bake-out oven which seals the face panel to the funnel and at the same time secures mask mounting strips 22, 22' to surfaces 28, 28' along the flange of the face panel. In this regard it is significant to note that the edges of the mask are now firmly anchored to the face panel and therefore lateral displacement of the mask is prevented, insuring good edge registry. Since the mask is now limited essentially to a displacement along the beam path, when subjected to thermal expansion, the registration between the mask apertures and their assigned dot triads is substantially preserved.

The described face panel assembly not only disposes with the heavy frame structure characteristic of prior art practice, but also eliminates the frame temperature compensating springs. Further, since mounting strips 22, 22' actually anchor the sides of the mask, lateral displacement of the mask is precluded and aperture-triad registration is maintained. Moreover, since screening and aperture masks are formed from a master any aperture mask fathered by that master can be used in any face panel in which the phosphor screen was developed from a mask derived from the master. Accordingly, interchangeability of aperture masks is also achieved. It is also significant that resort to an essentially cylindrically contoured face plate and mask in the subject assembly precludes the problems inherent in a mask formed as a section of a sphere.

Finally, use of the described face panel assembly finds particular application in black-surround type color picture tubes since re-etching is eliminated. This is facilitated by virtue of the fact that, since the aperture mask and the screening mask are derived from the same master, it is only necessary to enlarge the apertures in the former, at the time of its fabrication, to obtain a mask having the desired aperture dimension for insertion in the screened panel.

While particular embodiments of the invention have been shown and described, modifications may be made, and it is intended in the appended claims to cover all such modifications as may fall within the true spirit and scope of the invention.

I claim:

1. A face panel assembly for use in a color reproducing cathode ray tube comprising:
 - a face panel formed of a material having a predetermined coefficient of thermal expansion and having a curved target surface for supporting a cathodoluminescent screen;
 - a color selection electrode formed of a material having a predetermined different coefficient of thermal expansion and having a plurality of index stations;
 - a plurality of mounting strips formed of a material having a coefficient of thermal expansion substantially the same as that of said face panel and individually affixed to opposite ends of said electrode; mounting means affixed to said face panel and cooperating with said index stations for supporting said electrode in a predetermined spaced relation to said target surface, for conforming said electrode to a contour that substantially matches that of said target surface and for preventing lateral displacement of said electrode;
 - and means for fixedly securing said mounting strips to said face panel.
2. A face panel assembly as set forth in claim 1 in which said color selection electrode has at least three index stations.
3. A face panel assembly as set forth in claim 1 in which said color selection electrode comprises an apertured rectangular member.
4. A face panel assembly as set forth in claim 1 in which said face panel material has a coefficient of thermal expansion approximating 100×10^{-7} in/in/C°; said color selection electrode has a coefficient of thermal expansion approximating 130×10^{-7} in/in/C°;

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and said mounting strips have a coefficient of thermal expansion approximating 108×10^{-7} in/in/C°.

5. A face panel assembly as set forth in claim 1 in which said mounting strips comprise a pair of elongated members formed of a material having a coefficient of thermal expansion approximating 104×10^{-7} in/in/C°.

6. A face panel assembly as set forth in claim 3 in which said mounting strips are affixed to the oppositely disposed short sides of said rectangular color selection electrode.

7. A face panel assembly as set forth in claim 1 in which said panel includes a peripheral flange portion that circumscribes said target surface and said mounting means for supporting said color selection electrode are integrally formed from said flange portion.

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8. A face panel assembly as set forth in claim 1 in which said curved target surface of said face panel approximates a section of the cylinder.

9. A face panel assembly as set forth in claim 7 in which said flange portion includes surfaces disposed along oppositely disposed inside walls thereof for cooperating with said mounting strips,

said mounting strips are provided with a series of perforations

and said means for securing said mounting strips includes applications of frit material upon said perforations for bonding said mounting strips to said inside surfaces of said face panel.

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