July 28, 1959 J. P. FIORE 2,897,392

COLOR TELEVISION TUBE MASK AND FRAME ASSEMBLY

Filed Feb. 9, 1956 2 Sheets-Sheet 1

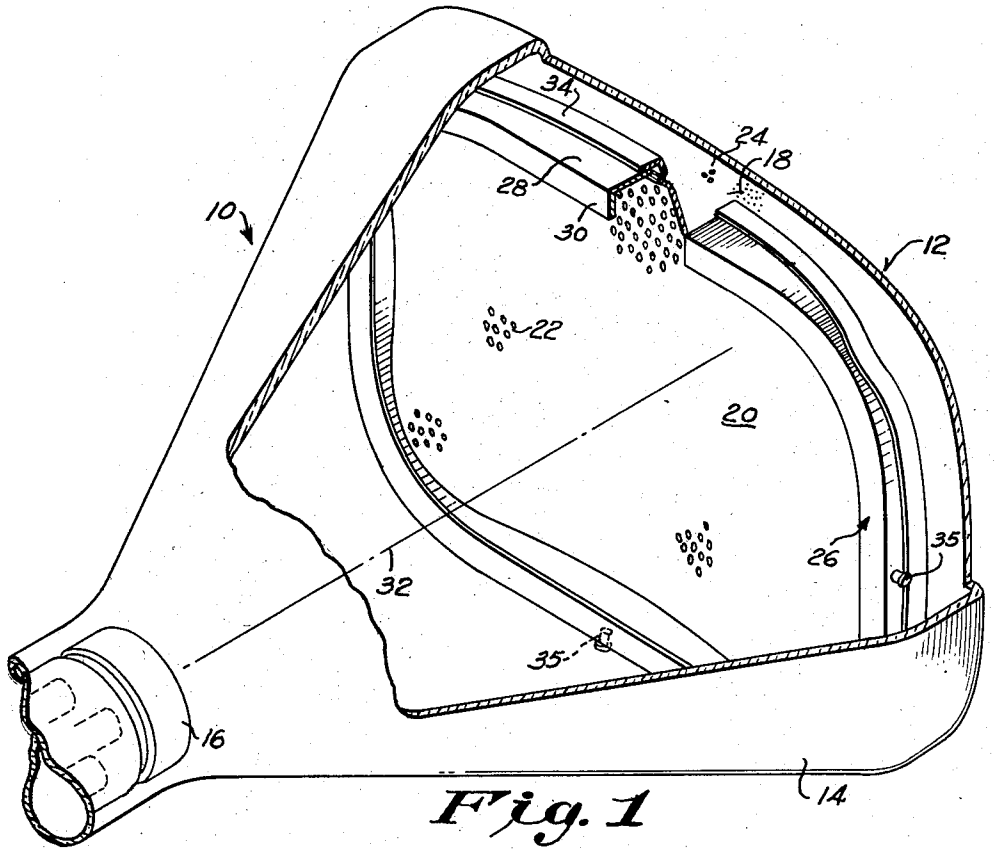


Fig. 1

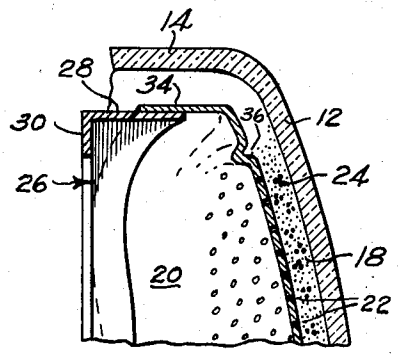


Fig. 2

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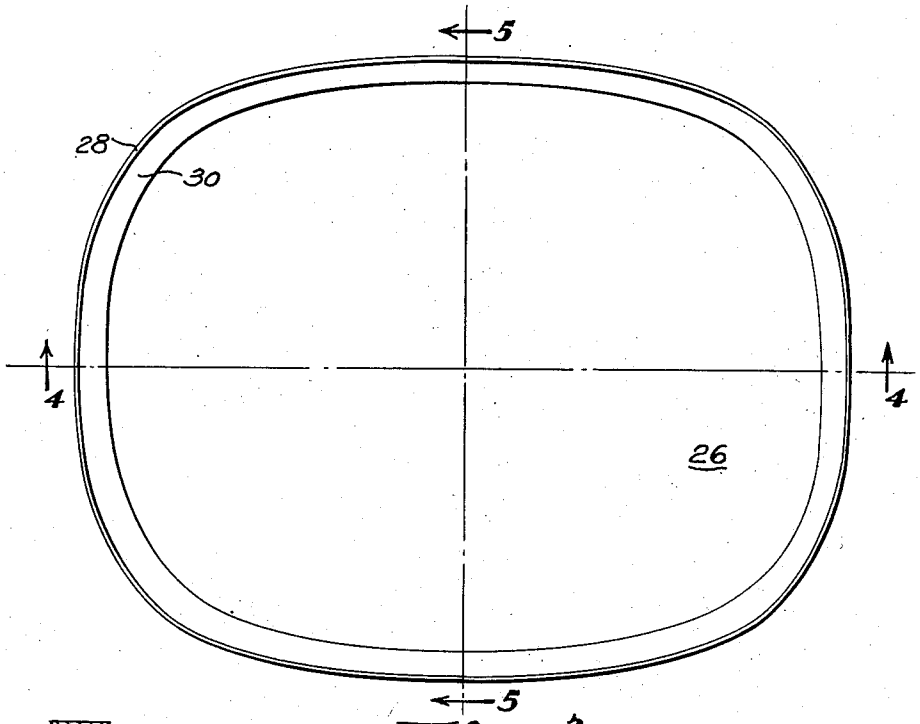


Fig. 3

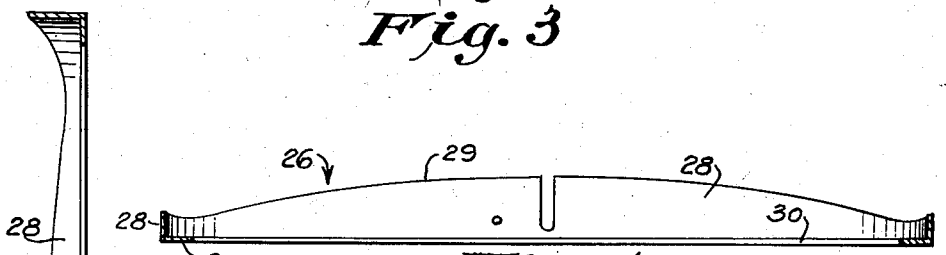


Fig. 4

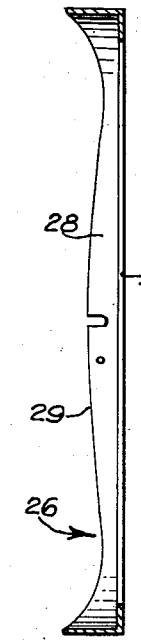


Fig. 5

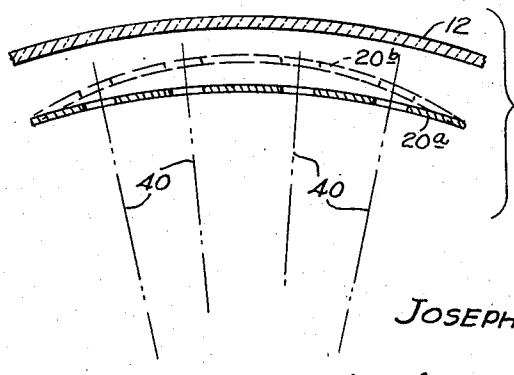


Fig. 6

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COLOR TELEVISION TUBE MASK AND FRAME ASSEMBLY

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Application February 9, 1956, Serial No. 564,434

2 Claims. (Cl. 313—92)

This invention pertains to picture tubes of the type used in television receivers, and more particularly to improvements in the structure of cathode-ray picture tubes used in color television receivers.

In color picture tubes of the kind with which the invention is concerned, it is common to provide an evacuated envelope of glass or metal, having an enlarged end carrying a faceplate, and at its opposite end provided with an electrode arrangement forming one or more electron guns for projecting a stream or streams of electrons in the direction of the faceplate. As in the case of a black-and-white picture tube, the energy of the electrons approaching the faceplate is converted into light by a suitable phosphor, which may be coated on the inside surface of the faceplate, or in some cases carried by a separate structure disposed within the envelope and exposed to view through the faceplate. The color tube, in one practical form of embodiment, utilizes a phosphor layer which is differentiated from point to point in that different adjacent elemental areas of the phosphor material produce light of different colors. A mask, formed usually of very thin metal capable of interrupting the electron stream, is disposed adjacent the phosphor layer on the gun side, and this mask is perforated with a large number of small and closely spaced apertures geometrically related to the elemental phosphor areas producing the different colors of light. The geometrical relationship is such that by controlling the beam position or direction phosphor areas of definite color-producing quality can be selectively energized to provide a visible picture corresponding faithfully to the composition of the original scene.

In prior art tubes using a separate planar screen support, and in tubes of circular cross section with the screen deposited upon the faceplate, the mask referred to above has been supported from the side walls of the picture tube envelope by an intermediate frame, to which the mask is bolted, welded or otherwise secured. In other spherical-screen circular-cross section tubes, the frame has been omitted entirely. The constructional details of these arrangements have given rise to considerable distortion in the shape of the mask itself, especially having regard to the fact that it is desirable that it be made of extremely thin sheet metal. The constructional difficulties are aggravated when the screen is deposited on a faceplate which is of rectangular or rounded-rectangular shape, and additionally has spherical curvature. In the latter case, and to provide the largest picture area possible considering the size of the faceplate, it is necessary that the mask also be of rectangular or rounded-rectangular shape, and that it be "dished" or deformed to a spherical surface so that it is approximately the same distance from the phosphor at all points of the display.

Since the fidelity with which the finished picture tube reproduces the original scene, both as to optical imagery and color, depends in an important way upon the maintenance of an accurate position-relationship between the

mask and the phosphor, the mounting for the mask must be extremely rigid and free from deviations from the specified shape and position thereof. Inasmuch as the projection of a rectangle upon a spherical surface yields a figure having no straight boundaries, the fabrication of a suitable support frame having the necessary shape would be extremely difficult and costly to carry out. It has therefore been proposed to utilize a support frame of simpler configuration, for example one of rectangular shape, and to connect the margin of a dished rectangular mask thereto at only a few points spaced about the margin of the mask. Such a proposal produces a structure in which the position of the mask is subject to accidental alteration both during fabrication and actual use of the picture tube, and this proposal is therefore not a complete solution of the problem.

According to the present invention, the support frame for the mask is formed as a ring of the desired shape (rectangular, rounded-rectangular or the like) and of L-shaped cross-section at all points about the periphery of the opening which is to be covered by the mask. Such a support frame can readily be formed of sheet metal by drawing or bending, or it can be made from a strip of L-shaped cross-section bent to the desired shape of the support frame. This "frame" is essentially a flanged ring, the ring itself forming the base of the L and lying in a plane perpendicular to the axis of symmetry of the picture tube, and the flange forming the upright leg of the L and extending from the outer edge of the ring toward the phosphor screen and hence lying on the side of the ring away from the gun. With this arrangement, it is now possible for the ring portion to lie in a single plane, the height of the flange (which will be measured in the direction parallel to the tube axis) being varied from point to point so as to define a curve approximating the intersection of the rectangle or rounded-rectangle perimeter of the display area with the spherical surface of the mask. By this means, the invention permits a construction requiring no compound curves, and permitting the attachment of the mask to the support frame at all points, or at as many points as desired, by simple spot welding or equivalent fastening, while the frame and mask are positioned in a suitable jig.

The invention also comprehends the provision in the mask itself of a stress-relieving deformation in the nature of a gutter extending just within the marginal edge of the mask and encircling the usable area thereof. With this refinement, it has been found that manufacture can readily be accomplished because the edges of the delicate mask are not subjected to substantial deformation during the assembly process.

It is accordingly a primary object of the invention to provide an improved mask and support frame structure for color kinescope tubes. More specifically it is an object of the invention to provide a support arrangement for masks having spherical curvature and non-circular outlines, by which the mask may be rigidly supported throughout its periphery upon a frame of simple shape which can be manufactured easily and at low cost.

A further object of the invention is to provide a structure of the above type in which the delicate mask is cushioned against permanent deformation arising either from the stresses of manufacture or from mishandling thereafter.

The preferred arrangement and manner of producing the invention will best be understood by referring now to the following detailed specification of a preferred embodiment thereof, taken in connection with the appended drawings, in which:

Figure 1 is a perspective view, partly broken away and partly in section, of a cathode-ray picture tube incorporating the invention.

Figure 2 is a detailed fragmentary section view of the mask assembly of the invention.

Figure 3 is a plan view of the mask support of the invention.

Figure 4 is a section taken on line 4—4 of Figure 3.

Figure 5 is a section taken on line 5—5 of Figure 3.

Figure 6 is a schematic diagram illustrating the effect of thermal expansion upon the electron-optical system of the invention.

In Figure 1 the cathode-ray picture tube indicated generally by numeral **10** includes a transparent faceplate **12**, having a shallow dished or spherical curvature, an envelope **14** and an electron gun and beam-deflection structure **16**. While the gun **16** is shown as a three-gun assembly, it is to be understood that the masking assembly of the present invention may equally well be utilized in a cathode-ray tube employing but one gun or some other desired number. Inside the envelope **14** and on the inner surface of faceplate **12** is a luminescent screen **18** which may be composed of three different color-emitting phosphors arranged in a manner well known in the color tube art. In one form of color screen, for example, the total screen area comprises a plurality of clusters of elemental target areas; each of these clusters includes a dot or elemental area of each of the three color phosphors used. Thus as each target cluster is bombarded by electrons, light is emitted in the three colors corresponding to the phosphors used, usually red, green and blue.

In order that the picture presented by the entire screen shall correspond element for element with the color of the scene which it is desired to present, each of the phosphor dots of each target cluster of the screen must be selectively energized to produce a brilliance in the particular color of that dot representative of the corresponding elemental area of the desired scene. One common way in which such selective energization of the elemental phosphor areas is accomplished is to provide three electron guns so positioned within the picture tube that electrons from a given gun always impinge upon a phosphor dot of the same color, even when the beams formed by the guns are subjected to vertical and horizontal displacement voltages. In this manner each of the three guns corresponds to a given color, and the intensity of the beam formed by each determines the brilliance of that color as viewed at the screen. Circuitry for control of the guns in accordance with televised signals is conventional or well known, and forms no part of the present invention.

A parallax barrier or mask is usually employed as the color-selection element of the color picture tube. For each target cluster of the screen, there is a corresponding aperture in the mask, and the beams from the three guns are positioned so as to converge at the mask and to diverge slightly beyond the mask before striking the screen. With each aperture in line with the virtual source of each beam and with the corresponding phosphor dot, the mask serves to shield each of the phosphor dots of each elemental area from the electrons of the two beams which are or may be aimed at the other two dots of that area.

Such a mask is shown at **20** in Figure 1 in close proximity to the screen **18**. As stated generally in the preceding paragraphs, the apertures **22** in mask **20** correspond positionally and in number to the target clusters **24** of the screen **18** (see Figure 2). An annular mask support **26** having mutually orthogonal webs or legs **28** and **30** serves to support mask **20**. As may be seen, the mask-supporting member **28** is in the nature of a flange whose width dimension is generally parallel to the optical axis **32** of the tube **10**, and member **30** is provided to add mechanical strength. In order that the mask **20** may be supported by the flange member **28**, the mask is supplied with a continuous uninterrupted peripheral flange **34** which is in continuous engagement with member **28** and which may be spot-welded thereto. Support **26** is, in turn, secured to envelope **14** by any suitable means, support pins **35** being shown as exemplary of such means.

Where the luminescent screen of a picture tube is supported on a planar substrate, or where the screen is spherical but employed in a tube of circular cross-section, the periphery of the screen normally lies in a single plane. With such configurations, the mask used in conjunction with the screen also has an planar periphery and as a result presents no difficult mechanical problems with regard to mounting upon a support.

A problem of primary concern in the present invention, however, is the provision of a masking element in a cathode-ray picture tube in which the periphery of the luminescent screen, and hence of the masking element therefor, does not lie in a single plane. Such a condition obtains, for example, when a spherical screen (generally supported upon the internal surface of a spherical faceplate) is used in a picture tube the cross-section of which is square or rectangular. The mask **20** of Figure 1 is such a mask. The problem presented is to find means adequately to support a mask of this nature while maintaining mechanical trueness of the mask under the variations in temperature which occur when the mask is subjected to electron bombardment.

As may be seen in Figures 3 through 5, taken in conjunction with Figure 1, the mask support **26** of the present invention has a mask-supporting flange member **28** the width of which varies in a manner complementary to the variation of the position of the peripheral edge of the mask **20** with respect to a plane perpendicular to the optical axis **32**. Thus, in the example being described, all points of the forward edge **29** of member **28** lie on a common sphere which is concentric with the spherical faceplate **12**. With the mask **20** and its flange **34** of uniform width mounted as shown in Figure 1 upon support **26**, the assembly has adequate mechanical strength as well as a symmetrical distribution of mass.

As may be seen in Figures 1 and 2, the mask **20** preferably has a peripheral corrugation **36** near its margin and extending about the entire periphery just within the intersection line between flange **34** and the domed major portion of the mask **20**, which aids in the mounting of the mask upon the support **26**. In the mounting operation it is sometimes necessary to bend flange **34** slightly in order to fit it over the supporting member **28**. Corrugation **36** permits this bending to be accomplished without concomitant permanent deformation of the central portion of the mask **20**. When the mask is properly located upon the support **26**, it may be secured by spot welding, for example. Thus the mask **20** is securely held to support **26** continuously around the periphery of the mask. Consequently, when mask **20** becomes heated during operation of picture tube **10**, peripheral expansion of the mask is effectively minimized; instead, the mask expands toward faceplate **12**.

Figure 6 illustrates, in schematic form, the effect of the thermal expansion of mask **20** upon the electron-optical system of tube **10**. The mask is shown in two positions; unheated at **20***a* and at normal operation temperature at **20***b*. The trajectories of one of the electron beams from gun structure **16** are indicated by dash lines **40**. Because the mask cannot expand peripherally to any great extent, thermal expansion of the mask from position **20***a* to position **20***b* results primarily in an increase in the curvature of the mask, bringing it closer to faceplate **12** but leaving apertures **22** in the same relative alignment with beam trajectories **40** as in position **20***a*. Consequently, thermal expansion of the mask does not adversely affect operation of the picture tube.

It will be seen from the above description that the mask and mask support structure described can readily be fabricated at low cost and with high precision, because all of the elements having curvature are of the type in which the curvature is formed in effect in a single plane. Thus, the mask support frame constituted by legs **28** and **30** can

be a conventional stamping with the profiled forward edge thereof formed by conventional trimming operations. Alternatively, and for mass production, the blank from which this support is to be drawn or stamped can have the profile applied while the material is in flat form, followed by formation of the depending ring **30** in the usual way. Also, the support frame can readily be formed from angle stock having the proper cross-section and flange profile, by bending the stock into the proper frame profile and securing the free ends to one another as by butt welding or the like.

The complementary curvature on the rearward edge of the flange **34** of mask **20**, produced as a result of the intersection of a sphere and rectangle, can be formed while the material is in the flat, as by a blanking operation, and before the flange portion **34** is formed over to the position shown in the drawings. The perforations in mask **20** are usually produced by an etching process, but may be provided in any other way, as to which techniques the prior art affords many examples.

While the invention has been described in connection with the support of a mask having a purely optical mask function, the geometrical and manufacturing problems solved by the invention are equally applicable where the mask itself forms an active electrode in the tube system. Basically, the problem is directed to the solution of the support of a mask in such a manner that it is at all points equidistant from the phosphor screen, and where the screen and mask have curved major boundary surfaces and non-circular peripheral profiles. Thus, it is immaterial whether the tube envelope construction be entirely of glass, or a composite of glass and metal or other materials.

While a particular embodiment of the present invention has been shown and described, it is apparent that various changes and modifications may be made, and it is therefore contemplated in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

I claim:

1. In a color television image-reproducer having an envelope of substantially rectangular cross-section, a spherically curved luminescent screen, a spherically curved parallax mask spaced from said screen, and means including at least one electron gun for projecting through said mask a plurality of electron beam components along paths approaching said screen at different angles of incidence to selectively impinge respective different groups of elemental areas thereof: a generally rectangular-shaped mask supporting frame having a peripherally continuous substantially L-shaped cross-section and symmetrically disposed about the central axis of said envelope, said frame having a ring portion extending transversely with respect to said axis and a flange portion substantially parallel to said axis extending from said ring portion toward said screen, the leading edge of said flange portion having a contour substantially corresponding to the intersection with said envelope of a spherical surface substantially parallel to said screen, and said mask being in full peripheral contact with said leading edge and affixed to said flange portion.

2. Apparatus in accordance with claim 1, in which said mask is provided with an annular bead near its periphery.

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