United States Patent [19]

McKee et al.

[11] **3,772,555**

[45] **Nov. 13, 1973**

[54] **COLOR CATHODE RAY TUBE OF THE SHADOW MASK VARIETY**

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[22] Filed: **Mar. 30, 1972**

[21] Appl. No.: **239,516**

[52] **U.S. Cl.** ..... **313/85 S**

[51] **Int. Cl.** **H01j 29/46**

[58] **Field of Search** ..... 313/85 S

[56] **References Cited**

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3,349,272	10/1967	Bathelt et al.	313/85 S
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Assistant Examiner—James B. Mullins
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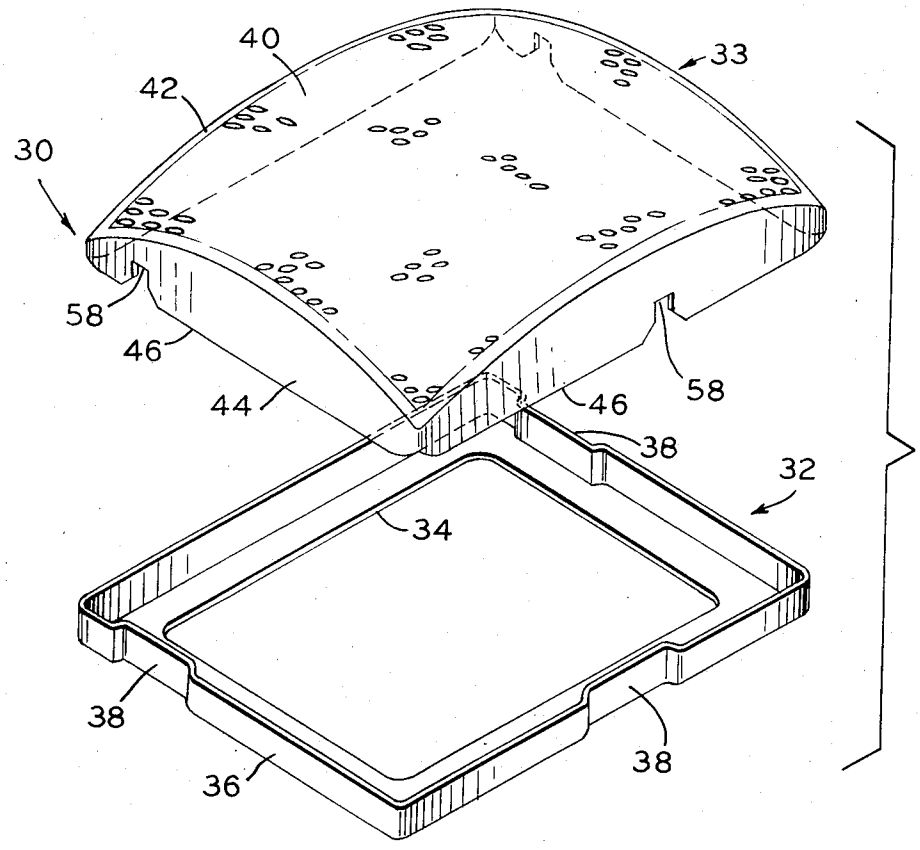
[57] **ABSTRACT**

A shadow mask for a color cathode ray tube has a rectangular, relatively rigid, lightweight frame with an inwardly extending flange having attached thereto a circumferential side wall having a constant height. A foraminated relatively fragile face with a solid skirt portion having a portion thereof formed to provide a rectangular peripheral wall with four sides extending from the face is attached to the frame. Attachment is by means of welds between the peripheral skirt wall and the side wall of the frame. The four sides of the peripheral wall have a planar termination whereby the height of any one of the side walls is continuously variable when measured from adjacent points of the termination to the curved face. This construction provides a shadow mask having increased tolerance to permanent deformation caused by heat generated by impingement of an electron beam in a confined area for extended periods of time.

3 Claims, 5 Drawing Figures



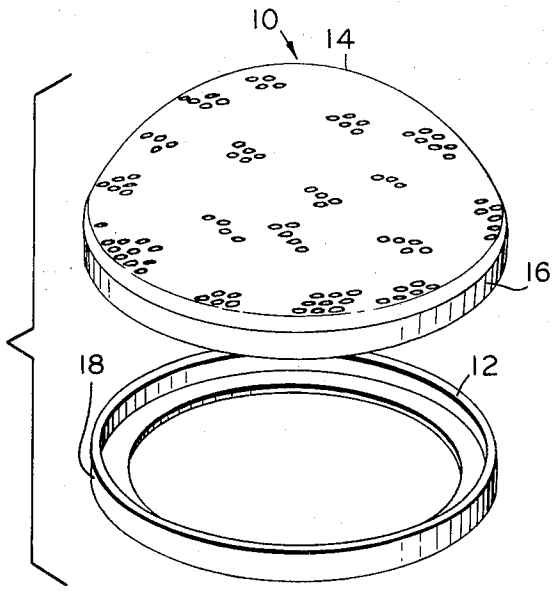
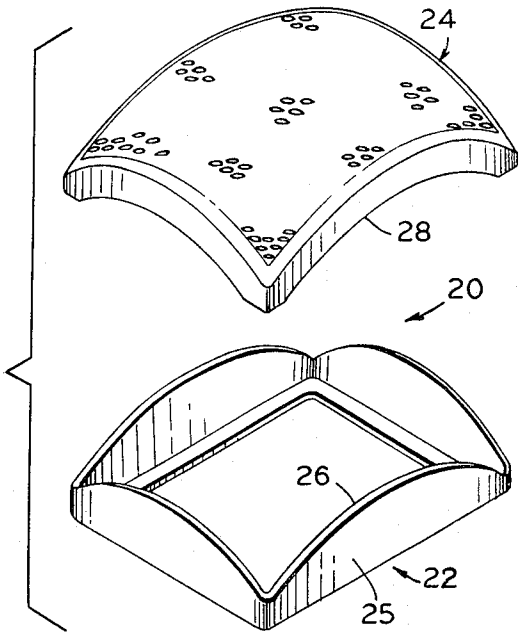


Fig. 1
PRIOR ART

Fig. 2
PRIOR ART



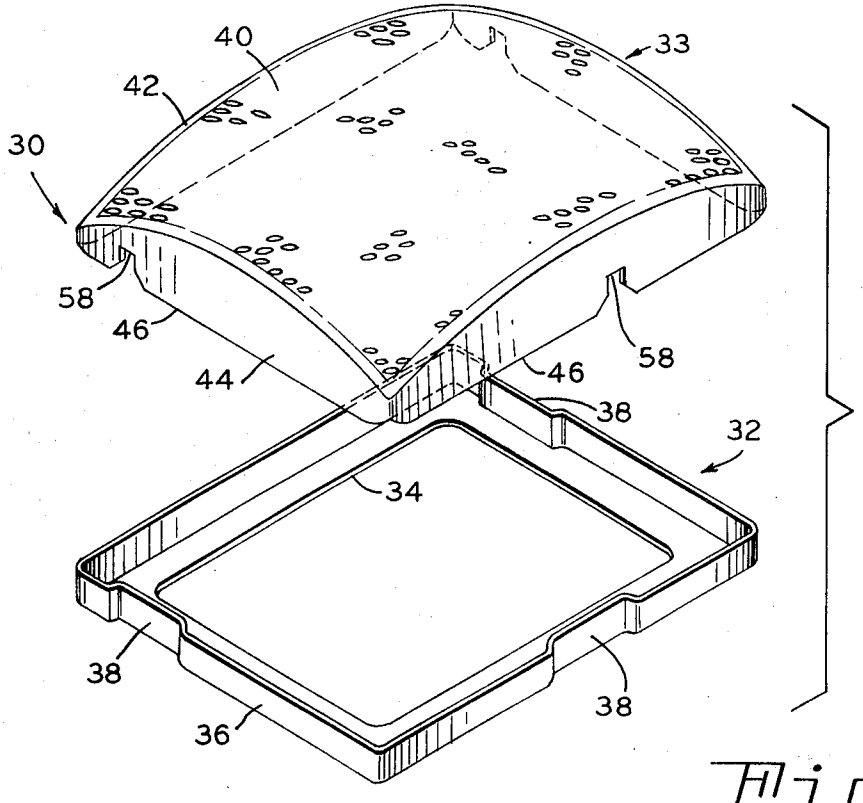


Fig. 3

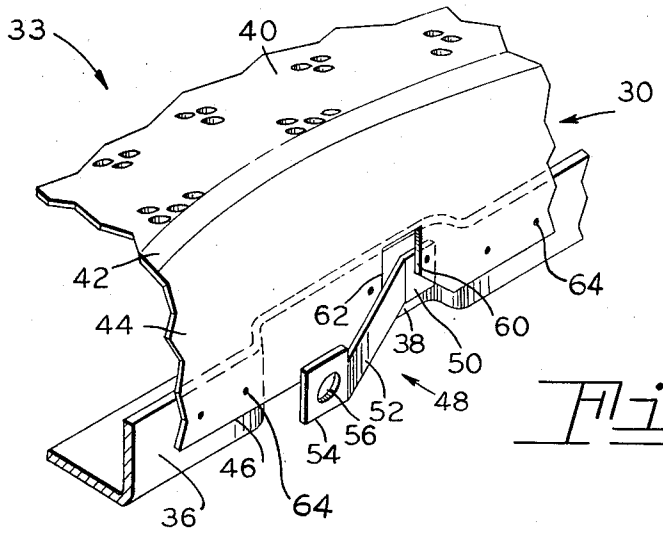

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Fig. 4

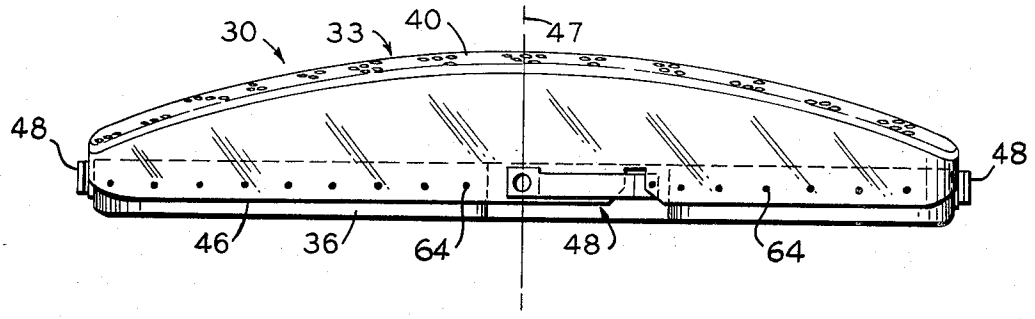
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Fig. 5

COLOR CATHODE RAY TUBE OF THE SHADOW MASK VARIETY

BACKGROUND OF THE INVENTION

This invention relates to color cathode ray tubes of the shadow mask variety and more specifically to a rectangular shadow mask for use in such tubes. Color tubes of the type delineated above are in common usage and generally comprise a faceplate portion of glass having a patterned phosphor screen thereon and a plurality of electron guns for emitting streams of electrons which impinge on the patterned phosphors to cause selective color illumination. To aid in color selection and to define the beams a shadow mask is positioned between the phosphor screen and the electron guns. This mask comprises a foraminated portion whose apertures are specifically aligned with the patterned phosphors on the screen. Such construction is well known. It has long been a desire to provide a frameless mask in this type of tube. Such a proposal was described in U.S. Pat. No. 2,690,518 and much later in U.S. Pat. No. 3,479,546. Both of these patents related to shadow masks which did not utilize a frame. However, neither of these various embodiments has ever been practically successful. Nevertheless, disadvantages continue to exist when a relatively heavy frame is utilized to support the very fragile foraminous mask. These disadvantages are that the heavy frame, of course, adds considerable weight to the tube and further acts as a heat sink during fabrication of the tube and during operation thereof. More particularly, one of the disadvantages of the heavy frame occurs during required drop testing of finished color television receivers. When such receivers are drop tested it has been found that a mask with a heavy frame is liable to pitch forward with such velocity that the welds which affix the supporting springs to the frame are broken. Furthermore, when such receivers pass the drop tests, problems occur during operation of the tube if, for example, a peculiar pattern is generated on the tube which requires that the full energy of all three electron beams be directed at a selected or confined area of the mask for extended periods of time. When this occurs, the fragile mask is very apt to buckle and become permanently distorted. This is due, primarily, to the difference in thermal expansion between the mask area and the heavy frame. It has been proposed that the frameless mask type of construction would avoid this problem; however, as has been stated above, such frameless masks inherently have other problems such as lack of sufficient rigidity and difficulty in manufacture.

OBJECTS AND SUMMARY OF THE INVENTION

Therefore, it is an object of this invention to obviate the disadvantages of the prior art.

It is yet another object of the invention to provide a framed shadow mask which does not have the disadvantages of the prior art.

It is yet another object of the invention to provide a shadow mask that is economical to manufacture.

It is still another object of the invention to specifically provide a shadow mask that has increased tolerance to permanent deformation caused by heat generated by impingement of an electron beam in a confined area thereof for extended periods of time.

These objects are accomplished in one aspect of the invention by the provision of a shadow mask which has a relatively rigid light weight frame of substantially rectangular configuration and which is formed to provide an inwardly extending flange having an attached side wall thereabout, which side wall has a constant height. At least three areas of indentation can be formed in the side wall, one each being formed in the short sides and one in the long side of the frame. Support springs of known design and configuration are attached to the frame within the provided indentations. A relatively fragile, curved, foraminated face is provided which has a solid or imperforate skirt surrounding the face. A portion of the skirt is formed to provide a rectangular peripheral upstanding wall having four sides extending from the face and joined at the corners thereof. The four sides of the upstanding wall have a planar termination whereby the height of any one of the side walls is continuously variable when measured from adjacent points of the termination to the curved face. The peripheral wall of this foraminated face fits over the outside of the frame side wall and is attached thereto by a plurality of welds.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an exploded perspective view of a prior type color cathode ray tube;

FIG. 2 is an exploded perspective view of a later type of prior art shadow mask;

FIG. 3 is an exploded perspective view of a shadow mask incorporating the improvements of this invention;

FIG. 4 is a perspective detail of a spring mounting arrangement; and

FIG. 5 is an elevational view of an assembled mask and frame of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

For a better understanding of the present invention, together with other and further objects, capabilities and advantages thereof, reference is made to the following disclosure and appended claims in conjunction with the above-described drawings.

Referring now to the drawings with greater particularity, there is shown in FIG. 1 a shadow mask **10** comprising a circular frame **12** and a foraminated face **14.** The face **14** has a peripheral circumferential wall **16** having a constant height which engages an upstanding wall **18** on the frame **12.** This circular structure was the basic tube for many years until replaced by the rectangular variety now in use.

An early variety of rectangular shadow mask **20** is shown in FIG. **2.** Until the present invention, this construction was standard throughout the industry. Herein, the mask **20** comprises a rectangular frame **22** and a foraminated face **24.** The frame in this instance has upstanding walls **25,** the terminal portions **26** of which are curved to conform to the configuration of foraminated face **24.** The face **24** has an upstanding wall **28** which, again, is of constant height. In assembly the face **24** and side walls **28** are fitted over the side walls **25** of frame **22** and are affixed thereto as by a plurality of welds. It will be seen in this structure, as in the structure of FIG. **1,** that effectively the side walls of the frame act as the side walls of the face portion. That is, they provide a very rigid structure with the face portion being restricted in its ability to expand or contract because of the severe attachment of the peripheral wall of the face with the side walls of the frame. It is this restriction of

movement which led to the buckling problems of the prior art structures.

Referring now to FIG. 3, it will be seen therein how the disadvantages of the prior art are obviated. There is here provided a shadow mask 30 having a frame 32, of substantially rectangular configuration, which is relatively rigid yet of light weight and a foraminated face 33. The frame 32 has an inwardly projecting flange 34 which has attached thereto a circumferential side wall 36 having a constant height. Elongated indentations 38 are provided in the side wall, generally three in number, with two being oppositely positioned in the short sides of the frame and one in the long side. Support springs for releasably holding the mask within the tube are affixed in these areas as will be explained hereinafter.

The foraminated face 33 is relatively fragile and is formed with a curved surface 40 surrounded by a solid skirt 42. A portion of skirt 42 is formed to provide a rectangular, peripheral, upstanding wall 44 having four sides extending from the face 33 and joined at the corners thereof. The four sides of the wall 44 have a planar termination 46 remote from the foraminated face 33. This construction provides for walls whose height is continuously variable when measured from adjacent points of the termination 46 to the curved face 33. Since the face is symmetrically curved about a centerline 47 (see FIG. 5) it is obvious that the height variation discussed above occurs when both measuring points are on the same side of the centerline.

Before assembling the foraminated face 33 to frame 32, a plurality of leaf springs 48 are attached to the side wall 36 of frame 32 within indentations 38, as by welding. These indentations 38 have a depth substantially corresponding to the thickness of the springs; however, this relationship is exaggerated in FIG. 4 for clarity. The springs 48 have a flat area 50 which is in contact with the frame and have an outwardly angled area 52 which extends away from the frame. The distal ends 54 of springs 48 are provided with apertures 56 as is conventional in the art.

The sides 44 of face 33 fit over the side wall 36 of frame 32 and are provided with slots 58 to encompass the attached portions of springs 48. Thus, the slots have an overlying edge 60 which lies on top of attached flat area 50 and an underlying edge 62 which lies under the angled area 52. The edges of the slots 58 can be provided with an angled entry to facilitate assembly. A detail of the spring-mask assembly can be seen in FIG. 4.

The attachment of sides 44 to side 36 of frame 32 is accomplished by a plurality of welds 64 substantially equally spaced about the periphery of the mask. Further, the welds 64 are substantially the height above the flange 34 of frame 32, a definite advantage in manufacture.

If necessary, the two edges of slots 58 can be welded also. In such an instance, edge 60 is usually welded to flat area 50 of spring 48 and edge 62 is welded directly to frame wall 36. Further, it may be necessary that the latter two welds not be aligned with welds 64.

It will be seen from the above that a shadow mask constructed in accordance with the teachings contained herein provides definite advantages over the prior art structures.

The foraminated face with the planar termination of its side walls is stronger and easier to handle in assembly than its predecessor, which, before attachment to a frame, could only support itself on four corners (See FIG. 2). The novel frame provides sufficient rigidity yet is much lighter in weight than those of the prior art.

Primarily, however, is the operational improvement derived from the constant height of the frame wall and the variable height of the face wall. The greater flexibility of this construction provides for freer expansion and contraction of the mask not only in operation but also during processing and reduces the buckling problem to the point where it is practically nonexistant.

While there has been shown what is at present considered to be the preferred embodiment of the invention, it will be apparant to those of ordinary skill in the art that various changes can be made therein without departing from the scope of the invention as defined by the appended claims.

What is claimed is:

1. A shadow mask for a color cathode ray tube, said shadow mask having increased tolerance to permanent deformation caused by heat generated by impingement of an electron beam in a confined area for extended period of time, and comprising: a relatively rigid light weight frame of substantially rectangular configuration being formed to provide an inwardly extending flange having an attached side wall thereabout having a constant height; at least three areas of indentations formed in said side wall, one each being formed in the short sides and one in the long side of said frame; and a relatively fragile portion having a curved foraminated face and a solid skirt surrounding said face, a portion of said skirt being formed to provide a rectangular, peripheral, upstanding wall having four sides extending from said face and joined at the corners thereof, said four sides of said wall having a planar termination whereby the height of any one of said side walls is continuously variable when measured from adjacent points of said termination to said curved face, said peripheral wall of said foraminated face fitting over the outside of said frame side wall and being attached thereto by a plurality of welds spaced thereabout; each of said indentations having a leaf spring attached thereto, said springs having a flat area in contact with said indentations and having outwardly angled areas, said peripheral upstanding wall having slots in at least three of said sides corresponding to said indentations and said slots being positioned so that one edge of each of said slots lies on said flat area of said spring and the other edge of said slots lies between said springs and said indentations.

2. The shadow mask of claim 1 wherein said edge of said slot lying on said spring is welded thereto and said edge of said slot lying between said spring and said indentation is welded to said frame.

3. The shadow mask of claim 2 wherein the remainder of the welds attaching said peripheral wall of said foraminated face to said frame are substantially equidistantly spaced from the jointure of said frame side wall and said frame flange.

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