United States Patent

Nakamura et al.

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[54] **SHADOW MASK SUPPORT MECHANISM FOR A COLOR TELEVISION IMAGE TUBE**

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[51] **Int. Cl.**.....**H01j 29/06,** H01j 31/20

[58] **Field of Search**.....313/85 S, 269

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[57] **ABSTRACT**

A shadow mask support means including three leaf springs for supporting a rectangular shadow mask on a face panel at three sides of a frame of the mask, said three leaf springs having a predetermined relationship with respect to the spring constant and deflection so that, even when the image tube is subjected to a shock load or the shadow mask in thermally expanded, the change in the relative position of the shadow mask and the face panel is minimized.

1 Claim, 5 Drawing Figures

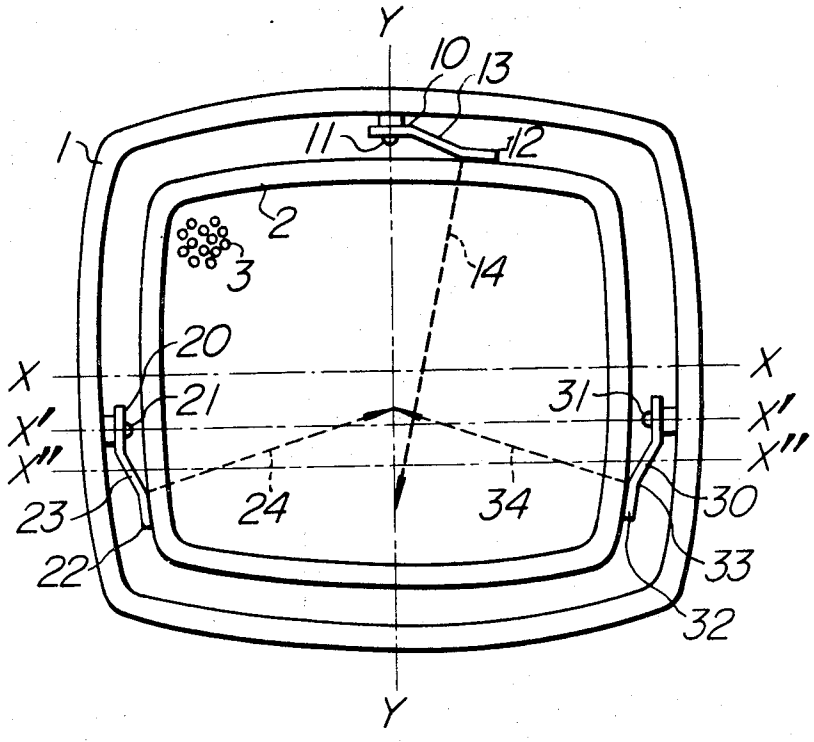


FIG. 1

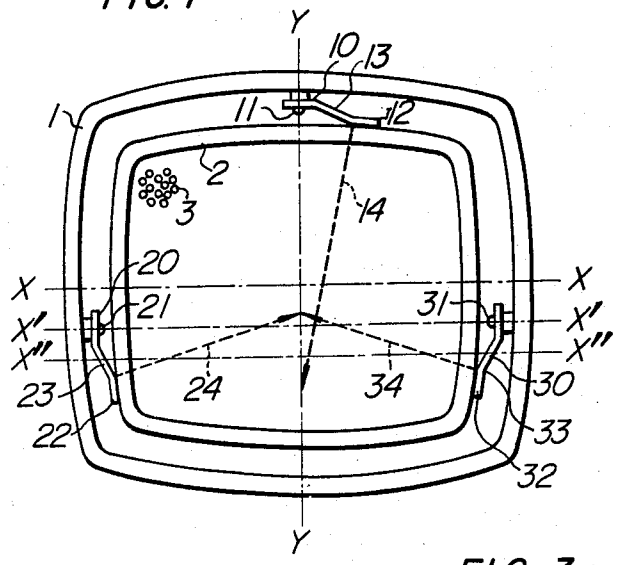


FIG. 2

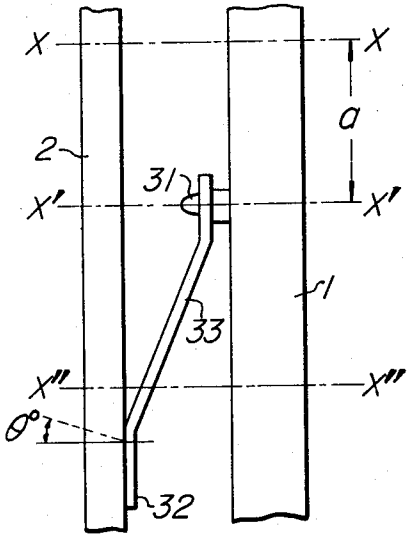


FIG. 3a

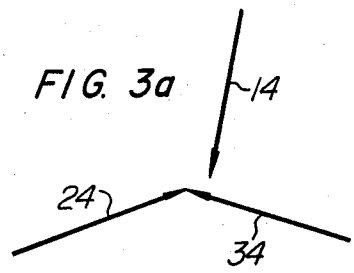


FIG. 3b

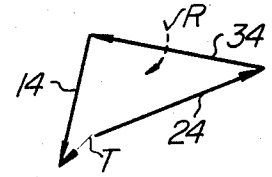
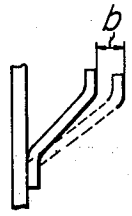


FIG. 4



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SHADOW MASK SUPPORT MECHANISM FOR A COLOR TELEVISION IMAGE TUBE

The present invention relates to a mechanism for stably supporting a rectangular shadow mask of a color television image tube on a face panel at three points.

In a color television image tube, three shadow leaf springs are normally used for resiliently supporting a rectangular shadow mask on a face mask. Each of the leaf springs comprises a pin projecting from the inner surface of the side wall of the face panel, and a leaf spring having one end engaging said pin and the other end secured to the outer surface of the side wall of the mask frame. Three such leaf springs are disposed with suitable spacings in a space between said frame and said face panel. The spacings of the leaf springs have a great influence on the supporting characteristics of said mask on said face panel, and in some instances the leaf springs cannot withstand the shock load applied from outside. Further, in some cases, the center of the shadow mask is displaced or the mask is rotated about a point at or near the center thereof when it is thermally expanded.

Therefore, an object of the present invention is to minimize the relative displacement between a face panel and a rectangular shadow mask supported thereon at three points even when the image tube is subjected to a mechanical shock load or when the shadow mask is thermally expanded.

The mask support mechanism of the present invention will now be described with reference to a preferred embodiment shown by way of example in the accompanying drawings;

FIG. **1** is a plan view of a mask support mechanism embodying the present invention;

FIG. **2** is a detailed view of a portion of the mechanism shown in FIG. **1**;

FIGS. **3***a* and **3***b* respectively show vector diagrams representing the relative relationship among three spring forces of the leaf springs;

FIG. **4** is a diagrammatical view showing the spring deflection in the leaf spring.

Referring to FIG. **1**, a rectangular face panel **1** is combined with a first leaf spring **10** which is attached to the upper side thereof and which has a pin **11** located on the vertical center line Y—Y of the face panel. A leaf spring **12** engaging the pin **11** at its one end has a spring portion **13** extending from the vertical center line Y—Y toward the right as seen in FIG. **1** and secured at the other end to the outer surface of the side wall of a frame **2** provided in a rectangular shadow mask **3**. Therefore, the spring in the first leaf spring acts along a line **14** which intersects the vertical center line Y—Y. On the left and right sides of the panel, there are disposed a second and a third leaf springs **20** and **30** respectively which have pins **21** and **31** respectively located on the same horizontal line X'—X'. Springs **22** and **32** which respectively engage with said pins **21** and **31** at respective one of their ends have spring portions **23** and **33** respectively which extend toward the bottom side of the face panel **1** and are secured to the frame **2** at their distal ends. The spring **22** of the second leaf spring **20** acts along a line **24** which intersects a line **34**, along which the third leaf spring **30** acts, at a point on the vertical center line Y—Y. In FIG. **1**, the reference X—X shows a horizontal center line of the face panel **1**.

According to the above described three point support mechanism, the distance by which the horizontal line X'—X' is offset from the horizontal center line toward the lower side of the face panel has an important effect on the shock absorbing characteristics of the mechanism. In the past, it has been believed that an excellent characteristics will be obtained for withstanding a shock load acting along the image tube axis or a shock load which will be applied on the tube when it is dropped, if said distance is selected to one-fourth of the vertical side length of the frame **2**.

However, according to the inventors, it has been found that, when the spring portions **23** and **33** of the second and the third leaf springs **20** and **30** are arranged so as to intersect a horizontal line X''—X''' which is located below the horizontal

center line X—X and spaced therefrom by a distance equal to one-fourth the vertical side length of the frame, the most excellent shock absorbing characteristics can be obtained.

Further, in addition to the above described locations of the three leaf springs **10**, **20** and **30**, the direction and the amount of the spring forces acting along the lines **14**, **24** and **34** are also important. Assuming that identical leaf springs are used in the mask support mechanism and the spring of each leaf springs develops a spring force of F kg, the spring forces can be represented as in FIG. **3***a*. These forces will produce a resultant force shown by the reference T and a resultant moment shown by R in FIG. **3***b*, both the resultant force and moment being applied to the shadow mask **3**. These forces will cause a temporary or permanent deviation of the location of the mask **3** when the temperature of the mask **3** is increased, with the result that the color purity of the image tube will be adversely affected.

The present invention aims at eliminating said undesirable deviation of the mask location, while at the same time, obtaining a sufficient shock absorbing effect.

When the second and the third leaf springs **20** and **30** having springs of F kg are arranged with the angle θ in FIG. **2** selected to a nominal value of 7°14' and the spring force of the first leaf springs **10** is determined to about 0.25 F kg which is equal to 2 $F \cdot \sin 7°14'$, the spring forces of the three leaf springs are substantially balanced and the resultant force T and the moment R can be reduced to a minimum value. The spring of the first leaf springs **10** may be designed to have a spring force of 0.25 F kg by reducing the spring constant (In an elastic system obeying the Hooke law, the magnitude of the applied force F, and the elongation x are related by $F=kx$, where the constant k is called the spring constant; i.e. spring constant = force/deflection = force/elongation). This design may be effective to minimize said deviation of the thermally expanded mask. However, if the spring constant of the first leaf springs **10** is reduced by for example simply reducing the cross-section of the spring, the supporter will become too weak to withstand a shock load which may be applied to the tube when it is dropped. The present invention has been accomplished by noting the fact that the spring force is the product of the spring constant and the deflection and is characterized by the fact that both the spring constant and the deflection are changed to obtain a spring force of 0.25 F.

In FIG. **2**, the distance a between the horizontal center line X—X and the horizontal line X'—X' may be 54 mm for a 20 inch size rectangular image tube. In this case, in order to make the first leaf springs **10** withstandable to the shock load in the direction of the tube axis, its spring constant must be about 60 percent of those of the second and the third leaf springs **20** and **30**. Further, for image tubes of average size including those of 22 inch size, the spring constant of the first leaf springs may be selected to 50 to 60 percent of those of the second and the third leaf springs.

In the mask support mechanism in accordance with the present invention, the spring constant of the first leaf springs **10** is selected to be 50 to 60 percent of those of the second and the third leaf springs **20** and **30** and, at the same time, the deflection of the spring, that is, the distance b shown in FIG. **4** in the first leaf springs **10** is reduced as compared with those of the other leaf springs **20** and **30** so that the effective spring force of the first leaf springs **10** is reduced substantially to 0.25 F kg. The spring deflection in the first leaf springs may be about 0.42 to 0.5 of those in the second and the third leaf springs and, by this arrangement, both the thermal characteristics and the shock absorbing characteristics of the mechanism for mounting the shadow mask on the face panel are highly improved.

What is claimed is:

1. A mask support mechanism for a color television image tube including a rectangular shadow mask supported on a rectangular face panel, said mechanism comprising a first leaf spring, one distal end of said spring engaging a pin provided on the upper side of said rectangular face panel and providing a

spring portion extending from a vertical center line toward one side only of said panel and secured at the other end to the outer surface of the side wall of a frame provided in said rectangular shadow mask, and a second and a third substantially identical leaf springs having ends engaging pins provided on the left and right sides of said panel, and each other end of said first, second and third springs being secured to the outer surface of the side wall of a frame provided in a rectangular shadow mask, a horizontal line connecting the spring portions of said second and third leaf springs being spaced from the horizontal center line of said face panel by a distance equal to one-fourth the shorter side length of the shadow mask frame, said shadow mask being resiliently supported at the inner side of said panel, the spring constant of said first leaf spring being selected to be 50 to 60 percent of those of the second and the third leaf springs and the spring deflection of the first leaf spring being determined to be small as compared with those of said second and third leaf springs, so that in the case of thermal expansion of the shadow mask the resultant force of the spring forces of said first, second and third leaf springs is substantially reduced.

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