July 8, 1969 L. J. LEWINSON 3,454,813

MASK-FRAME CAPTIVATOR

Filed Sept. 12, 1968 Sheet 1 of 2

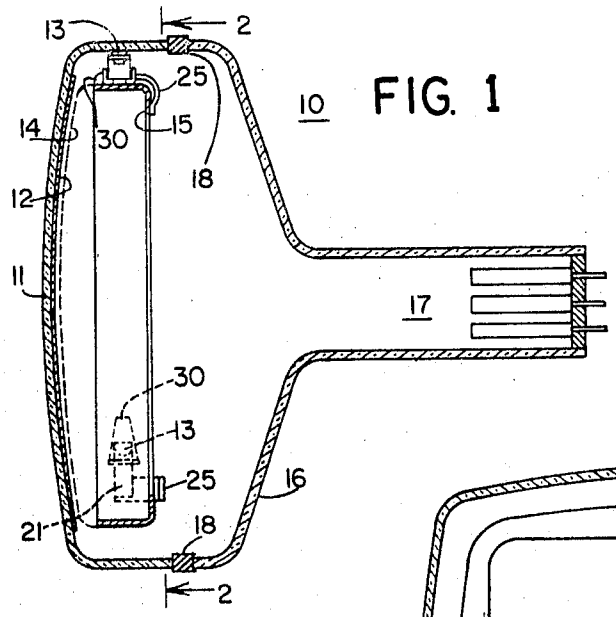


FIG. 1

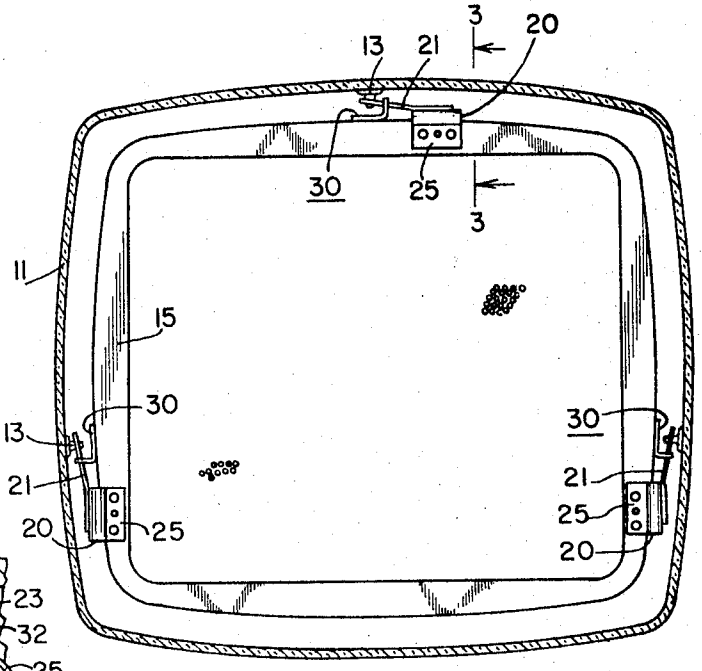
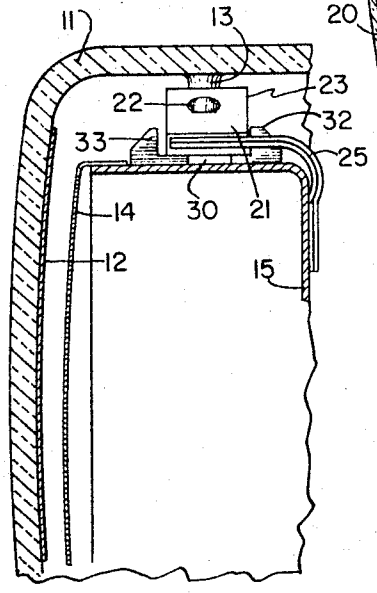


FIG. 2

FIG. 3



INVENTOR
Lothar J. Lewinson
BY Nicholas A. Camasto
ATTY.

July 8, 1969 L. J. LEWINSON 3,454,813

MASK-FRAME CAPTIVATOR

Filed Sept. 12, 1968 Sheet 2 of 2

FIG. 5

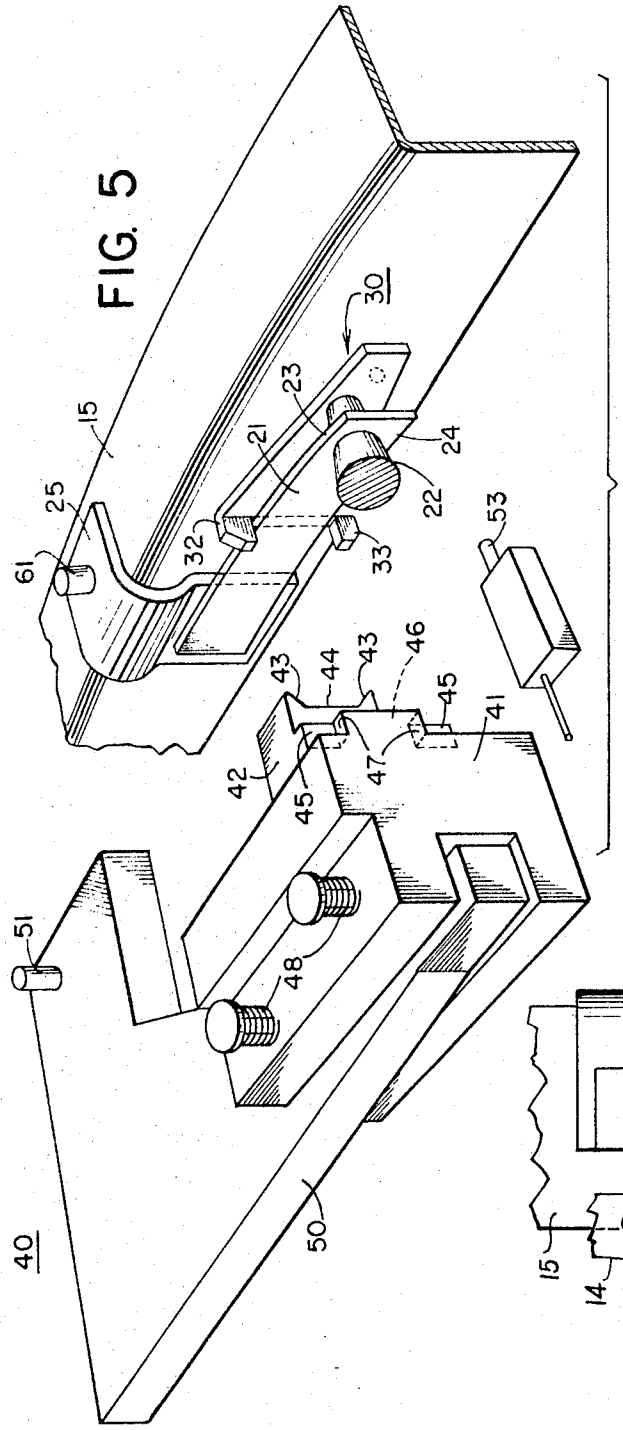
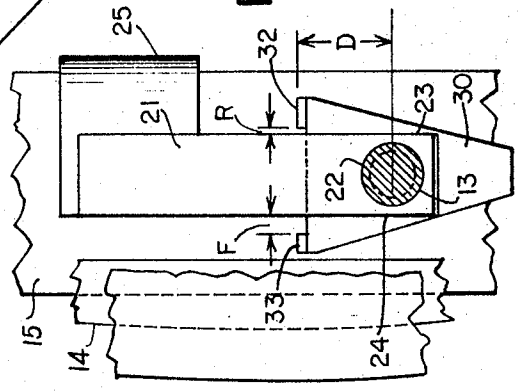


FIG. 4



INVENTOR
Lothar J. Lewinson

BY Nicholas A Camasta

ATTY.

United States Patent Office

3,454,813

Patented July 8, 1969

3,454,813

MASK-FRAME CAPTIVATOR

Lothar J. Lewinson, Oak Park, Ill., assignor to Admiral Corporation, Chicago, Ill., a corporation of Delaware

Filed Sept. 12, 1968, Ser. No. 759,298
Int. Cl. H01j 1/96
U.S. Cl. 313—284 7 Claims

ABSTRACT OF THE DISCLOSURE

A thermally compensated color television picture tube has its mask-supporting frame connected to its leaf type mounting springs by bimetallic thermal expansion brackets. Captivators are mounted on the frame in accurate spaced relation to each spring for confining movements thereof within their elastic limits, yet allowing full expansion bracket deflection during high temperature processing without spring-captivator interference.

This invention relates to color television picture tubes of the type having an aperture mask through which beams of electrons pass before striking the phosphor screen on the inner surface of a glass panel, and bimetallic expansion brackets which maintain alignment between the mask and the panel over the operating temperature range of the picture tube. In particular, this invention provides captivating means for constraining a plurality of leaf springs, secured between the expansion brackets and the glass panel, within their elastic limits in the event the picture tube is subjected to mechanical shock.

In picture tubes of the type described, three mounting studs are triangularly disposed about the perimeter of the glass panel. A metal frame supporting a multi-apertured shadow mask is releasably secured to the panel by three apertured leaf springs which cooperate with the appropriate mounting studs. A mosaic of red, blue and green color phosphors is deposited on the interior of the glass panel in accordance with conventional "lighthouse" techniques, using the detachable mask for exposing appropriate portions of the panel to sensitizing light rays.

A tri-gun electron source is mounted in a delta configuration in the neck of a tapered glass envelope which is frit sealed to the glass panel. The electron guns are mechanically prealigned with respect to the shadow mask such that electrons passing through the apertures impinge only corresponding color phosphors. For example, electrons emanating from the first gun strike only the red phosphors, electrons from the second gun strike only the blue phosphors, etc.

As is well-known, most of the electrons in the electron beam are intercepted by the shadow mask and fail to reach the phosphor screen. Since the kinetic energy of these electrons is transformed into heat, the shadow mask undergoes considerable thermal expansion. Upon expansion, alignment between the electron beams and the corresponding color phosphors is upset and, as a result, electrons emanating from the first gun may, for example, partially excite the blue or the green phosphors causing substantial color impurities.

Numerous methods have been suggested for compensating for the thermal expansion of the shadow mask. One structure incorporates three substantially L shaped bimetallic expansion brackets which are secured between the frame and corresponding leaf springs. As the temperature of the mask-frame assembly increases due to electron bombardment, the expansion brackets undergo corrective flexures moving the mask-frame assembly closer to the glass panel. Such movement maintains registration between the electrons passing through the shadow mask and the corresponding color phosphors, thereby helping

to assure chromatic purity over the operating temperature range of the picture tube. For a complete description of a system of this type, see the copending application of Cowles et al., Ser. No. 742,651, filed July 5, 1968.

During shipping and handling, both before and after installation in a receiver, picture tubes are often subjected to severe mechanical shock causing the spring-mounted frame assembly to move with respect to the glass panel. With the implementation of the relatively flexible expansion brackets described above, this movement tends to be exaggerated. The frame, being relatively heavy, exerts large forces on the springs, often inducing permanent deformations therein. These deformations may prevent the frame assembly from returning to its original position, thereby upsetting mask-panel alignment and causing substantial color impurities.

This invention provides captivating means which constrane the leaf springs within their elastic limits, while permitting unimpeded movement of the mask-frame assembly over the entire range of temperatures encountered during picture tube operation and fabrication. For example, during manufacture, when the glass envelope is frit sealed to the glass panel, temperatures approach 450° C., and for reasons previously discussed, the bimetallic expansion brackets flex considerably and move the mask-frame assembly substantially. The captivators do not interfere with this "normal" movement, thus precluding the possibility of inducing stresses in the frame, springs or bimetallic brackets during processing.

Further, the captivators are accurately positioned on the frame with respect to the corresponding leaf springs, such that, as explained later, proper separation between the spring and the captivator is assured, notwithstanding dimensional variations in the springs. Accordingly, three captivators, each comprising a base plate having a pair of tabs extending perpendicularly therefrom, are located on the mask-supporting frame of the picture tube such that the corresponding leaf springs are properly constrained between the captivator tabs. This arrangement allows great flexibility in placement of the captivators and facilitates the practice of the spring location techniques set out in the above mentioned copending application.

Thus, the primary object of this invention is to provide an improved color television picture tube.

Another object of this invention is to provide improved means for constaining the leaf springs in a color television picture tube within their elastic limits, in the event the tube is subjected to mechanical shock.

A further object of this invention is to provide, in a color tube with a thermally compensated mask-frame assembly, captivating means permitting free movement thereof during tube operation and fabrication, while constraining the leaf springs within their elastic limits in the event of mechanical shock.

A feature of this invention resides in means for accurately locating and securing the captivator to the mask-supporting frame of a color television picture tube with respect to the position of the corresponding leaf springs, notwithstanding dimensional variations in the springs.

Other objects, features and advantages of this invention will be seen upon reading the following specification in conjunction with the drawings in which:

FIG. 1 is a sectional view of a color television picture tube incorporating the invention;

FIG. 2 is a sectional view taken along line 2—2 of the color television picture tube shown in FIG. 1;

FIG. 3 is an enlarged view of the upper portion of the color television picture tube of FIG. 2 showing the elements of the invention;

FIG. 4 is a view of the structures of FIG. 2 taken along the line 4—4 showing the relative location of the elements of the invention; and

FIG. 5 is a perspective view of mounting and welding apparatus for accurately locating and securing the captivator to the mask-supporting frame of the color television picture tube in accordance with the invention.

Referring now to FIG. 1, a color television picture tube **10** includes a glass panel **11** having a spherical contour on which a mosaic **12** of red, blue and green color phosphors is deposited. Three mounting studs **13** (best seen in FIG. 2) are accurately embedded or otherwise permanently secured to the inside perimeter of glass panel **11**. A shadow mask **14**, secured to a relatively heavy frame **15**, has a spherical contour similar in shape to glass panel **11**. Frame **15** has an L shaped cross section and, as explained in the description of FIG. 2, is releasably secured to the glass panel at mounting studs **13**.

A glass funnel **16**, including a neck portion having three electron guns **17** mounted therein, is secured to glass panel **11** by a conventional circumferential glass to glass frit seal **18**. Electron guns **17** are mechanically prealigned such that electrons emanating therefrom strike corresponding ones of the different color phosphors forming mosaic **12**. Color selection is performed by the well-known masking effect of shadow mask **14**.

In FIG. 2, three mounting assemblies **20**, each comprising a leaf spring **21** fastened at one end to an L shaped thermal expansion bracket **25** are shown. These assemblies are preferably fabricated and located in accordance with the teachings of the above mentioned copending application. Three captivators **30** each comprise a base plate **31** having a pair of tabs **32** and **33** (best seen in FIG. 3) extending perpendicularly therefrom. As explained below, captivators **30** are accurately secured to frame **15** such that spring **21** properly extends between tabs **32** and **33**.

In FIG. 3, leaf spring **21** includes a front edge **24**, a rear edge **23** and a stud engaging aperture **22**. Captivator **30** is secured to frame **15** such that tabs **32** and **33** straddle edges **23** and **24** of the spring. The various elements are secured to each other by welding. For example, bimetallic expansion bracket **25** is secured to frame **15** by spot welding, as is spring **21** and bimetallic bracket **25**. For details regarding the arrangement and order of assembly of these parts, reference is again made to the above mentioned copending application of Cowles et al.

In FIG. 4, the location of the various parts with reference to mounting stud **13** (shown in section) is clearly depicted. The distance D is that between the center of mounting stud **13** (also aperture **22** of the leaf spring) and the tab edge of captivator **30**. This distance is critical since, during movement of frame **15** and its attached parts (bracket **25** and captivator **30**), spring **21** pivots about mounting stud **13**. The actual distance any point on the spring moves is a function of its distance from the pivot point, namely the center of stud **13**.

The distance F is that between front edge **24** of spring **21** and tab **33**. The distance R is that between rear edge **23** of spring **21** and tab **32**. These distances must be selected precisely and must be greater than the normal movement attributable to the deflection of expansion bracket **25** during tube processing, and less than that which will produce injurious torsional forces on the bracket and spring in the event of mechanical shock. In practice, the distance F is much greater than R since tube processing and operating temperature changes cause frame movement toward the phosphor screen (to the left in FIG. 4). Thus distances F and R are selected to allow complete freedom of movement of the mounting springs under all operating and processing temperatures to preclude the development of injurious stresses which would adversely affect mask-screen registration. Ideally, in normal usage, captivator tabs **32** and **33** should never contact spring edges **23** and **24**. The captivator's sole purpose is to prevent damage in the event of abnormal conditions occurring, such as dropping or violent jarring of the tube or complete television receiver.

In FIG. 5, there is shown a mounting apparatus **40**, comprising an adjustable locating assembly **41**, resiliently secured by a pair of spring loaded studs **48**, to a rigid arm **50**, for accurately and automatically positioning and mounting the captivator. Arm **50** is pivotably mounted to a pin **51**, and spring loaded studs **48** allow only vertical movement of assembly **41** with respect to arm **50**. Adjustable locating assembly **41** includes a guide piece **42** having a pair of ram surfaces **43** terminating in a seating surface **44**, and a pair of abutting surfaces **45**. Locating assembly **41** further includes locating means **46** having two perpendicular spaced tab engaging surfaces **47**, the distance between surfaces **47** being very slightly smaller than the distance between tabs **32** and **33** of capitvator **30**.

The above structure is mounted on a welding fixture (not shown) having three locating pins **61** (only one of which is shown), accurately positioned with respect to pivot pin **51**. The three locating pins **61** extend through corresponding locating holes in frame **15** and expansion brackets **25** as fully explained in the above mentioned copending application of Cowles et al. In accordance with said application, a fixed coordinate distance is maintained between each spring aperture **22** and corresponding locating pin **61** once brackets **25** are secured to frame **15**.

In operation, mounting apparatus **40** swivels about pin **51** until leaf spring **21** cooperates with one of the ramp surfaces **43**. Locating assembly **41** vertically adjusts as the engaged ramp surface **43** is guided by the engaged edge of leaf spring **21**, assuring mating engagement between seating surface **44** and the flat surface of the leaf spring regardless of variations in the positioning of the leaf spring. During this operation, surface **44** depresses the leaf spring somewhat.

Captivator **30** is then positioned between the side of frame **15** and the undersurface of spring **21** with tabs **32** and **33** straddling tab engaging surfaces **47** and moved until the tabs engage abutting surfaces **45**. The captivator may be temporarily held in this position by any of a number of well-known means, for example, by tiny magnets embedded in surfaces **45**. The attainment of distances F and R between the captivator tabs **33** and **32** and the respective edges **24** and **23** of leaf spring **21** may be automatically assured by fabricating locating assembly **41** with the proper vertical displacement between the edges of seating surface **44** and tab engaging surfaces **47**.

Welding electrodes **53** are then moved, by means not shown, into engagement with the captivator to secure it to the frame. As should be obvious, the distance D may be predetermined by the placement of abutting surfaces **45**, once the relative positioning between locating pin **61** and pivot **51** is fixed.

In the event the completed picture tube is subjected to severe mechanical shock, the mask-frame assembly tends to move along the transverse axis of the tube. Before excessive deformation of the springs or bimetallic brackets occur, however, the springs engage the captivator tabs, thus restraining further movement. When the mask-frame assembly undergoes movement in response to the thermal expansion of the bimetallic brackets, whether in actual operation or in processing of the tube, the mask-frame assembly is not restrained since the distances F and R provide sufficient clearance between the captivator tabs and corresponding leaf springs. As a result, free movement of the mask-frame assembly is assured over the operating and processing temperatures experienced by the picture tube while protection from mechanical shock is provided.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A color television picture tube comprising: a glass panel; a plurality of mounting studs disposed about the interior of said panel; a heavy, rigid frame; a plurality of thermal expansion members secured to said frame;

a corresponding plurality of leaf springs secured to said expansion members and cooperating with said mounting studs for releasably maintaining said frame a fixed distance from said panel; and a plurality of captivating members, accurately positioned on said frame with respect to said leaf springs, confining said leaf springs to flexures within their elastic limits in the event said picture tube is subjected to mechanical shock.

2. A color television picture tube comprising: a glass panel; a plurality of mounting studs disposed about the interior of said panel; a heavy, rigid frame; a plurality of thermal expansion brackets, undergoing flexures in response to variations in temperature, secured to said frame; a corresponding plurality of leaf springs, each having a first end fastened to respective ones of said expansion brackets, and a second end, including an aperture, cooperating with respective ones of said mounting studs; said studs, springs and brackets maintaining said frame is registration with said glass panel; and captivating members secured to said frame and accurately spaced with respect to said leaf springs to allow free movement between said frame and said studs over the normal range of temperatures encountered, but restraining said leaf springs to movements within their elastic limits in the event of mechanical shock.

3. A color television picture tube as set forth in claim 2, wherein each captivating member comprises a base plate including a first tab and a second tab extending substantially perpendicular to one end thereof; said captivating members being positioned on said frame such that said tabs straddle corresponding ones of said leaf springs.

4. A color television picture tube as set forth in claim 3, wherein, during tube processing, said thermal expansion brackets are subjected to a maximum temperature and experience maximum flexures, moving said frame a corresponding maximum distance with respect to said glass panel; and wherein said leaf springs each include a first edge; said first tabs of corresponding ones of said captivating members being spaced from said first edges a first distance great enough to allow said frame to freely move said maximum distance, but small enough to engage and restrain said first edges in the event of excessive mechanical shock.

5. A color television picture tube as set forth in claim 4, wherein each of said leaf springs includes a second edge; said second tabs of corresponding ones of said captivating members being spaced from said second edges by an amount less than said first distance.

6. A color television picture tube as set forth in claim 4, wherein the spacing between any selected one of said mounting studs and an imaginary line joining the tabs of its corresponding captivating member defines a second distance; and wherein the spacing between said one mounting stud and the point of attachment of its corresponding leaf spring and expansion bracket defines a third distance; the ratio of said first distance to said second distance being slightly greater than the ratio of said maximum distance to said third distance.

7. In combination: a glass panel; a plurality of mounting studs disposed about the interior of said panel; a heavy, rigid frame; a plurality of thermal expansion brackets, undergoing flexures in response to temperature variations, secured to said frame; a corresponding plurality of flat leaf springs each having a first end fastened to said expansion brackets, and a second end forming an aperture for releasable engagement with respective ones of said mounting studs; said mounting studs, flat leaf springs and expansion brackets cooperating to maintain said frame in registration with said glass panel; said expansion brackets, being subjected to high temperatures during tube fabrication and moving said frame a maximum distance toward said glass panel; and a plurality of captivating members, each comprising a flat plate having a pair of tabs extending substantially perpendicular to said plate; said captivating members being secured to said frame with said tabs straddling respective ones of said flat leaf springs; first ones of said tabs being spaced from first respective edges of said springs a first distance great enough to allow uninhibited movement of said frame toward said glass panel over said maximum distance; second ones of said tabs being spaced from second respective edges of said springs a second distance which is less than said first distance; said first and said second distances defining the maximum movement of said springs under mechanical shock conditions to prevent deformation thereof.

References Cited

UNITED STATES PATENTS

2,727,172	12/1955	Mark et al.	313—85
2,824,989	2/1958	Christofferson	313—85
3,370,194	2/1968	Schwartz et al.	313—92

JAMES W. LAWRENCE, *Primary Examiner.*

V. LAFRANCHI, *Assistant Examiner.*

U.S. Cl. X.R.

313—85, 292