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J. W. SCHWARTZ ET AL
COLOR TUBE MASK MOUNTING INCLUDING MEANS FOR LIMITING
SHIFT OF THE MASK CENTER

3,370,194

Filed May 31, 1966

2 Sheets-Sheet 1

FIG. 3

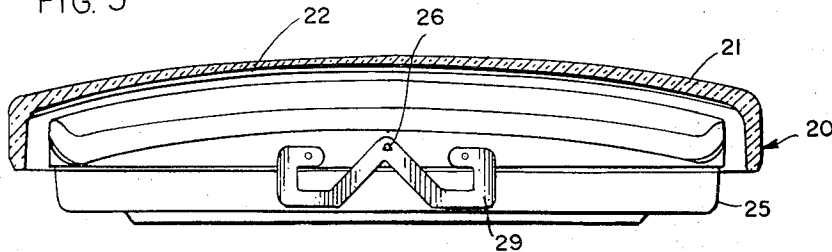


FIG. 2

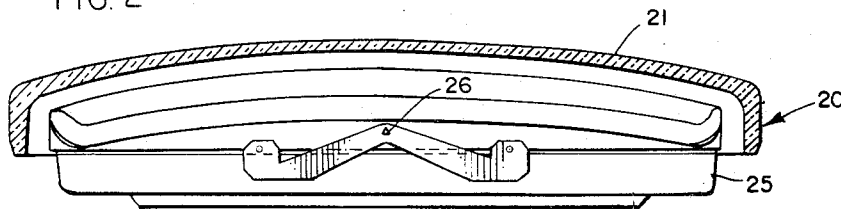


FIG. 1

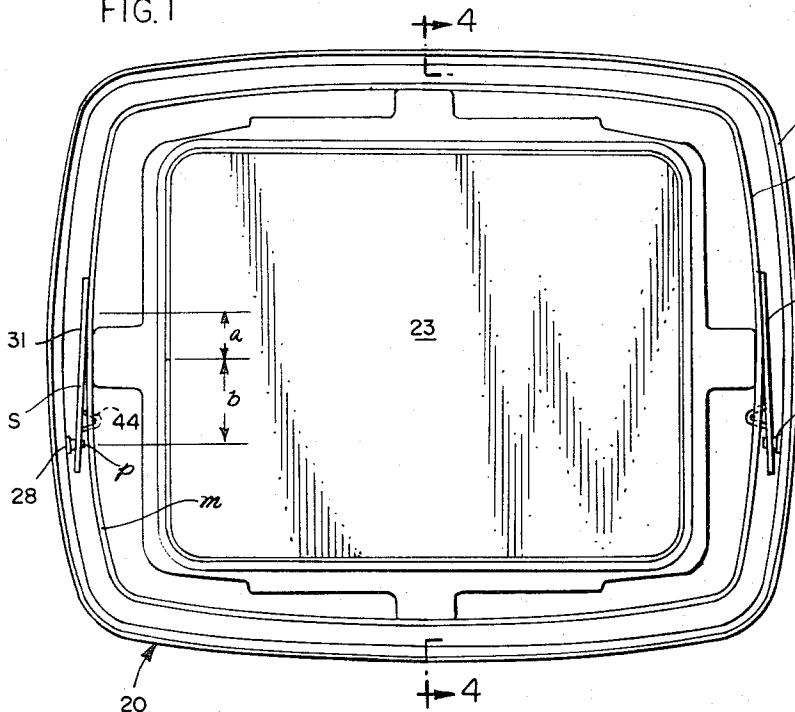
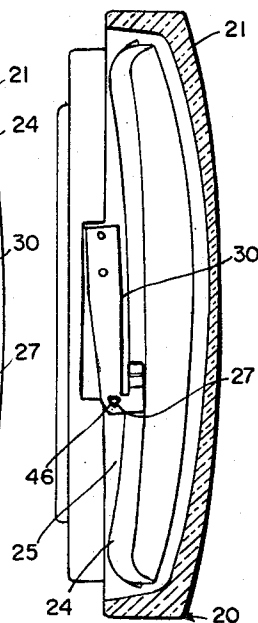


FIG. 4



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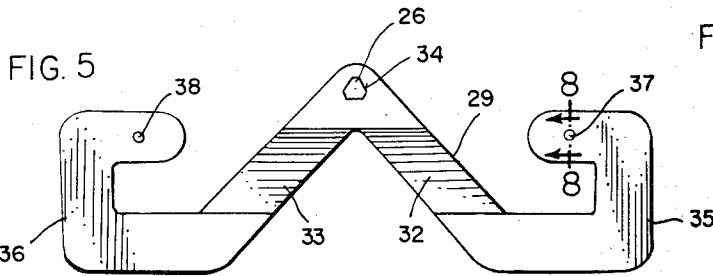
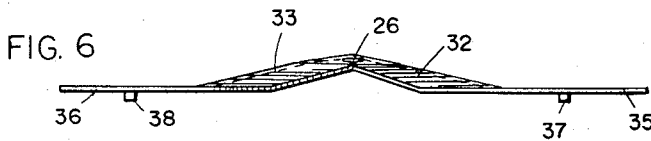
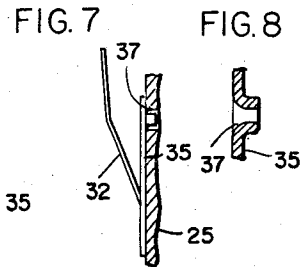
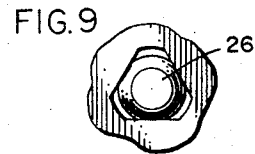
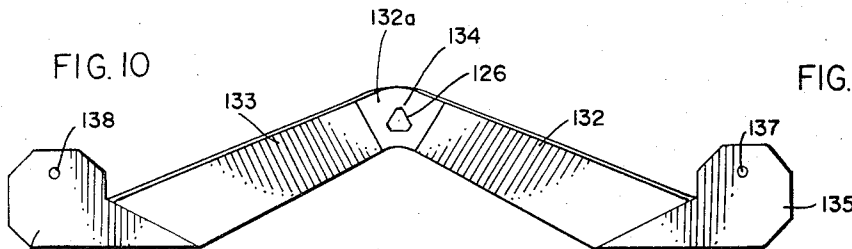
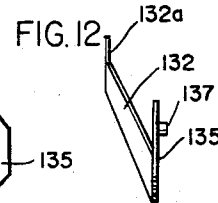
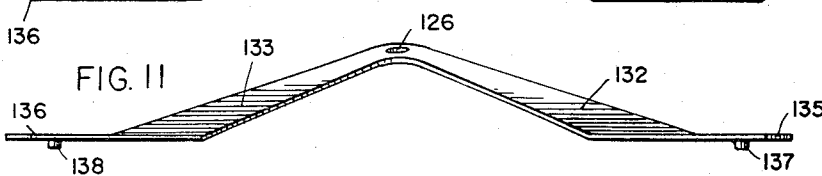
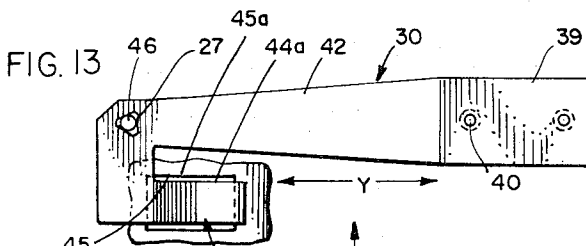
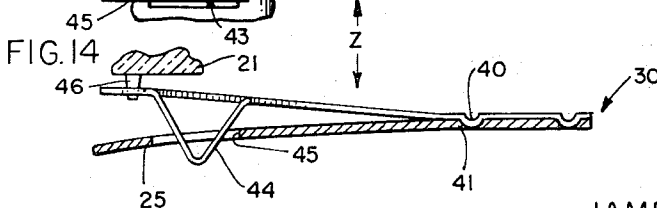
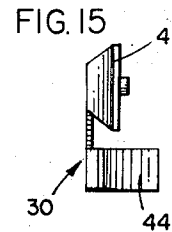


FIG. 8



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3,370,194

COLOR TUBE MASK MOUNTING INCLUDING MEANS FOR LIMITING SHIFT OF THE MASK CENTER

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ABSTRACT OF THE DISCLOSURE

A rectangular shadow mask is mounted within a color television tube adjacent the phosphor screen which defines the viewing area. The mask support includes posts or studs embedded in the flange of the glass faceplate panel in alignment with the sides and top of the mask; and flat metal mounting springs are anchored to the mask and adapted for removable engagement with the posts. The spring associated with the top post includes a unitary metal element having leg portions divergent downwardly from its engagement with the post, and these leg members are symmetrical with respect to the vertical center line of the mask. The leg portions are secured to the mask adjacent their extremities, and the mounting springs are arranged relative to their associated posts to substantially limit shifting of the center of the shadow mask as the mask expands responsive to an impinging electron beam thereby eliminating misregistration of the apertures of the mask with their associated triads of phosphor dots.

This invention relates to a color tube mask mounting and, more particularly, to a mounting arrangement which compensates for dimensional changes due to thermal expansion.

In the operation of a color television tube, a foraminous member designated a "mask" is mounted in juxtaposition to the phosphor screen so as to transmit only that portion of the electron beam from an electron gun that will strike the phosphor material associated with that electron gun. Typically, each opening in the mask transmits electrons from each of three electron guns by parallax toward three separate areas scintillating red, green and blue respectively; thereby achieving a three color display.

When the tube is in use, about 20 watts of energy is absorbed by the mask. This causes expansion in the mask, its frame, and the supporting spring clips, relative to the glass envelope and the phosphor screen. In current practice, the frame is not supported symmetrically with respect to the mask center, subsequently, the center of the screen is moved by thermal influences as much as 0.001". The result is that a beam that is designated to hit a scintillation dot of a certain color (say green), hits and thus illuminates a portion of a phosphor dot of another color (say red) as well, producing a false rendition. In addition to a shift of the center of the screen, there is an expansion at all points of the screen which must be compensated for in order to get the desired operation. Before the second problem can be solved, it is necessary to maintain the center of the screen at a predetermined position, and the provision of means for achieving this constitutes an important object of the invention. Another object of the invention is to provide mask mounting means characterized by improved mechanical shock resistance.

Other objects and advantages of the invention may be seen in the details of operation and construction set down in this specification.

The invention is described in conjunction with the accompanying drawings, in which

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FIG. 1 is an elevational view of the face plate portion of a rectangular color television tube, with the above-mentioned mask mounted in place;

FIG. 2 is a sectional view, taken transversely through the face plate of a television tube and showing means for mounting the top of the mask;

FIG. 3 is a view similar to FIG. 2 but showing an alternative top mounting means;

FIG. 4 is a sectional view taken along the line 4—4 of FIG. 1;

FIG. 5 is an elevational view, on larger scale, of the top mounting means of FIG. 3;

FIG. 6 is a side elevational view of the showing in FIG. 5;

FIG. 7 is an end elevational view of the showing in FIG. 5;

FIG. 8 is a larger scale sectional view taken along the line 8—8 of FIG. 5;

FIG. 9 is a larger scale detail fragmentary showing of the central pivot portion of FIG. 5;

FIG. 10 is a larger scale elevational view of the mounting means seen in FIG. 2;

FIG. 11 is a side elevational view of the showing in FIG. 10;

FIG. 12 is an end elevational view of the showing in FIG. 10;

FIG. 13 is a larger scale elevational view of the side mounting means of FIG. 4;

FIG. 14 is a side elevational view of the clip shown in FIG. 13 and further shown installed on a fragment of the mask which is shown in section; and

FIG. 15 is an end elevational view of the showing in FIG. 13.

In the illustration given, the numeral 20 designates generally a rectangular color television tube which, for purposes of clarity, is shown only in the extreme forward end thereof, i.e., the face plate 21. Provided on the interior front face of the face plate 21 is the usual phosphor screen 22 (designated only in FIG. 3) which is made up of a plurality of phosphor dots scintillating in red, blue and green colors respectively, so arranged that each one of the dots, representing red, blue and green fields can be energized by the first, second and third guns, respectively, which—due to this reason—hereafter will be called red, blue and green guns. The beams emanate from an electron gun (not shown) in conventional fashion.

The numeral 23 designates generally the previously referred-to mask, and the mask 23 includes a frame 24 providing a perimetric lip 25. The screen itself is perforated at positions correlated to the location of the phosphor dots in the screen 22.

The interior of the face plate 21 is equipped with a top pivot 26 aligned with the vertical center lines of the screen and the mask 23. Side pivots as at 27 and 28 are also provided. These being post-like elements are partially embedded with the face plate 21 and project inwardly therefrom. For mounting the mask on the pivots 26—28, three spring clips or elements are provided as at 29 relative to the top pivot 26, and 30 and 31 relative to the side pivots 27 and 28, respectively. The use of these suitable spring clips or brackets (as at 29—31) achieves the stabilization of the center of the mask 23.

Mathematical analysis

To arrive at the value of parameters needed to minimize vertical shift of the mask centerline upon increase in temperature, the following mathematical analysis can be employed. In the drawing, a represents the vertical distance from the connection of the spring clip s of the mask m to the horizontal centerline of the mask, while b represents the vertical distance between the mask horizontal

centerline and the connection of the spring clip *s* with the pivot *p*. $\Delta(a+b)$ expansion of the spring has to be equal to the expansion of the portion of the mask between its horizontal centerline and the welding point of the spring as marked by the distance *a*, because having the fixed point at stud *p*, the expansion of the spring $\Delta a + \Delta b$ and that of the portion *a* of mask work in opposite directions.

Therefore, if we wish to keep the horizontal centerline of the mask in place (in spite of the increasing temperature) we have to fulfill the following equation.

$$(a+b)c_s\Delta t_s = ac_m\Delta t_m \quad (1)$$

where:

c_m is the expansion coefficient of the mask,
 Δt_m is the temperature increase of the mask, or rather, that of its frame,
 Δt_s is the average temperature increase (along its length) of the spring and is a proportional function of Δt_m , as can be expressed by the following formula:

$$\Delta t_s = k\Delta t_m \quad (2)$$

Analytical calculations and experiments show that *K* approximately equals 0.5.

Therefore, we can rewrite Equation 1 as follows:

$$(a+b)c_s k\Delta t_m = ac_m\Delta t_m \quad (3)$$

or

$$(a+b)c_s k\Delta t_m - ac_m\Delta t_m = 0 \quad (4)$$

since Δt_m in general $\neq 0$, (4) simplifies to:

$$(a+b)c_s k - ac_m = 0 \quad (5)$$

Because *b* is defined by the previous design based on considerations related to spring design requirements, and c_m is defined by the material characteristics of the mask presently used (for cold rolled steel: $c_m = 12 \times 10^{-6} \text{ } ^\circ \text{C.}$), the distance *a* is properly related to the thermal expansion coefficient of the spring as expressed by the following formulas:

$$ac_s k + bc_s k - ac_m = 0 \quad (6)$$

$$a(c_m - c_s k) = bc_s k \quad (7)$$

$$a = \frac{bc_s k}{c_m - c_s k} \quad (8)$$

If we can find a material with properties that are otherwise suitable to make a spring for such a purpose (low residual magnetism [coercive force], high enough yield strength, that preferably cannot be annealed at 830° F. Lehr temperature) yet, with a thermal expansion coefficient c_s that is virtually zero, Equation 8 could be further simplified as follows:

$$a = 0 \quad (9)$$

Using 36% Ni alloy steel (Invar, Nilvar, etc.) that exhibits a thermal expansion coefficient about 10% of that of the mask Equation 8 can be further developed to this form:

$$a = \frac{bk}{\frac{c_m}{c_s} - k} \quad (10)$$

$$a = \frac{b \cdot 0.5}{10 - 0.5} = \frac{1}{19} b = 0.052b \quad (11)$$

Horizontal shift of the mask may be avoided by making use of a symmetrical spring clip 29. The clip 29, as seen in FIG. 5, includes a unitary member having leg portions 32 and 33 downwardly divergent in proceeding away from the opening 34 adapted to receive the pivot 26 which is essentially triangular in cross section. The legs 32 and 33 adjacent their extremities, i.e., remote from the pivot opening 34, are equipped with integral hook parts as at 35 and 36. The hook parts 35 and 36 are held in proper orientation by extensions or lugs 37 and 38, and the assembly is secured by spot welding to the peri-

metric lip 25 of the mask 23. Consideration of FIGS. 6 and 7 reveals that the divergent leg portions 32 and 33 are angularly related to the frame lip 25 which includes the hook portions 37 and 38. Thus, there is provided an advantageous deflection of the spring clip 29 when the opening 34 is mounted on the pivot 26. A spring clip of this type not only avoids asymmetrical horizontal shift of the mask, but also assures greatly increased mechanical strength assuring freedom from damage when the tube is subjected to strong impact.

An alternative form of the top securing means can be seen in FIG. 2 and FIGS. 10-12. As compared with the showing in FIG. 5, the showing in FIG. 10 reveals that the hook-like portions 135 and 136 are somewhat foreshortened. Again, there is a central pivot as at 26 which receives the generally triangular-shaped opening 134. As before, diverging leg portions 132 and 133 are angularly related to both the planar portions at 132a (circumscribing the opening 134) and the planar portions at the extremities as at 135 and 136 (surrounding the spot weld openings 137 and 138).

A side clip is seen in FIGS. 13-15 and the unitary element generally designated 30 therein is seen to be generally J-shaped. The element 30 includes several integral portions which can be appreciated readily from a comparison of FIGS. 13 and 14. At the upper righthand portion of FIG. 13, there is provided a base portion 39 for securing the element 30 to the flange 25 of the mask frame 24. For this purpose, the base portion 39 is dimpled as at 40 (see FIG. 14) and the dimples extend into openings 41 in the flange 25 and are weldably secured thereto.

The numeral 42 designates the spring portion of the element 30 and the numeral 43 generally designates the tab portion thereof. Further, the tab portion 43 includes as an integral part a hair pin configuration 44 (developed by partially folding tab portion 43 on itself) so as to engage a slot 45 in the flange 25 (see FIGS. 1 and 14). Also seen in FIG. 13 is an aperture 46 which permits engagement of the element 30 with the post 27 associated therewith.

While the spring element 30 is firmly welded to the mask flange 25, any force parallel to the axis of the picture tube (such as kinetic forces resulting from dropping the tube generally along its axis) would act on the spring element 30 as on a cantilever beam, with the lever arm *a* plus *b*. However, with the presence of the tab portion 43, this disadvantageous loading is avoided—the hair pin configuration 44 cooperating with the preferably rectangular opening 45 to provide an additional support when required.

This additional support is provided by the engagement of the sides 44a of the hair pin configuration 44 with the sides 45a of the opening 45 (see FIG. 13), so that movement of the element 30 in the axial direction is limited while the spring element 30 is free to move in the other two mutually-perpendicular directions—to compensate for expansion as in direction *Y* (FIG. 13) and for disengagement, direction *Z* (FIG. 14).

The tab portion 43 is advantageous in providing an easily finger manipulatable part for installing the mask within the picture tube. It will be appreciated that there is only slight clearance between the flange 25 and the interior of the tube face plate 21 so that installation is ordinarily awkward, and, furthermore, delicate. Through the provision of the tab portion 43, a substantial manufacturing handicap is overcome while further providing a distinct operational advantage. Optimally, as pointed out previously, the unitary element 30 constituting a side spring is constructed of a material having minimal coefficient of thermal expansion, such as Invar.

It will be appreciated that the arrangement of elements 29, 30 and 31 provides a non-rotative mounting of the face mask 23. The symmetrical arrangement of the top spring clip 29, i.e., about the vertical axis of the tube, and the fact that the side clips 30 and 31 both extend down-

wardly, being anchored to the mask at their upper portions, insures that any tendency of the mask to rotate will be resisted in addition to compensation for thermal expansion.

While in the foregoing specification, a detailed description of the invention has been set down for the purpose of explanation, many variations in the details herein given may be made by those skilled in the art without departing from the spirit and scope of the invention.

We claim:

1. In a color television tube having a glass envelope equipped with a phosphor screen and confining a generally rectangular mask in juxtaposition to said screen, a mask support assembly comprising post means in said envelope in alignment with the sides and top of said mask, and spring means anchored to said mask in removable engagement with said post means, the spring means associated with said top post means including a unitary metal element having leg portions divergent downwardly from said pivot means and generally symmetrical about the mask vertical center line, said leg portions being secured to said mask adjacent their extremities, said spring means further arranged and constructed relative to said post means to substantially limit shifting of the mask center upon thermal expansion of said mask.

2. The structure of claim 1 in which said leg portions adjacent their extremities each have an integral hook part secured to said mask whereby the divergent leg portions are adapted to lie in a plane angularly related to the plane of said integral hook parts.

3. In a color television tube having a glass envelope having a generally rectangular front face adapted to be normally positioned in a generally vertical plane, said face on the interior thereof being equipped with a phosphor screen, a generally rectangular mask mounted within said envelope in juxtaposition to said screen and having a generally horizontal top and generally vertical sides, an improved mask supporting assembly comprising post means in said envelope, spring means on said mask releasably interconnecting said envelope post means with said mask top and being contoured to be generally symmetrical about the vertical centerline of said mask to substantially limit horizontal shift of the mask center upon thermal expansion of said mask, right and left post means in the right and left sides of said envelope, right and left spring means on said mask releasably connecting said mask sides to said envelope right and left post means, said right and left spring means being constructed and arranged so that the expression:

$$ac_s k + bc_s k - ac_m$$

is substantially zero, wherein:

b is the vertical distance between the right or left post means and the mask horizontal centerline under conditions unproductive of thermal expansion of said mask,

a is the vertical distance between the right or left post means and the associated spring means connection to the mask,

k is a constant relating the temperature differential of the mask to the temperature differential of the spring means, and

c_s and c_m are, respectively, the coefficients of thermal expansion of the spring and mask.

4. The structure of claim 3 in which said right and left spring means are secured to said mask at about the horizontal centerline of said mask, said right and left pivot means being positioned on said envelope below said mask horizontal centerline, said spring means being constructed of material having a minimal coefficient of thermal expansion.

5. The structure of claim 3 in which the material of said right and left spring means and said vertical distance a are correlated to develop a zero value of said expression.

6. The structure of claim 3 in which said right and left spring means each include a tab portion operative to facilitate installation of said mask within said envelope.

7. The structure of claim 6 in which said mask is equipped with tab portion engaging means for limiting the deflection of said right and left spring means in response to shock.

8. The structure of claim 7 in which each of said right and left spring means includes a generally J-shaped element, said element engaging said mask adjacent the extremities of said J-shaped element and releasably engaging said envelope intermediate the ends of said element.

9. The structure of claim 3 in which said right and left spring means are constructed of a nickel steel alloy having a minimal coefficient of thermal expansion.

References Cited

UNITED STATES PATENTS

2,795,718 6/1957 Van Hekken et al. 313—85
3,317,770 5/1967 Merchant 313—85 X

JAMES W. LAWRENCE, *Primary Examiner*.

V. LAFRANCHI, *Assistant Examiner*.