Aug. 18, 1970 D. J. RIGDON 3,524,973

SHADOW MASK SUPPORTING STRUCTURE HAVING THERMAL EXPANSION CORRECTION MEANS

Filed Aug. 13, 1968 2 Sheets-Sheet 1

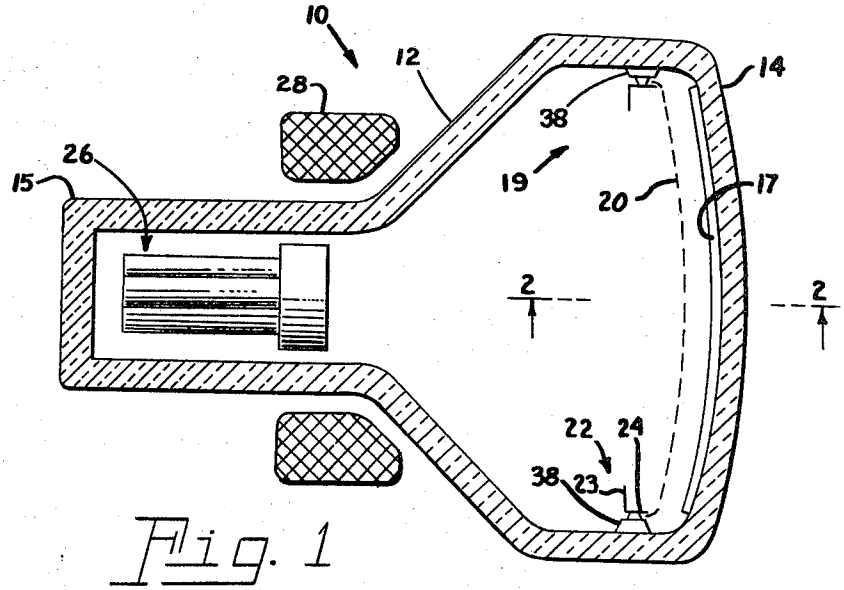

Fig. 1

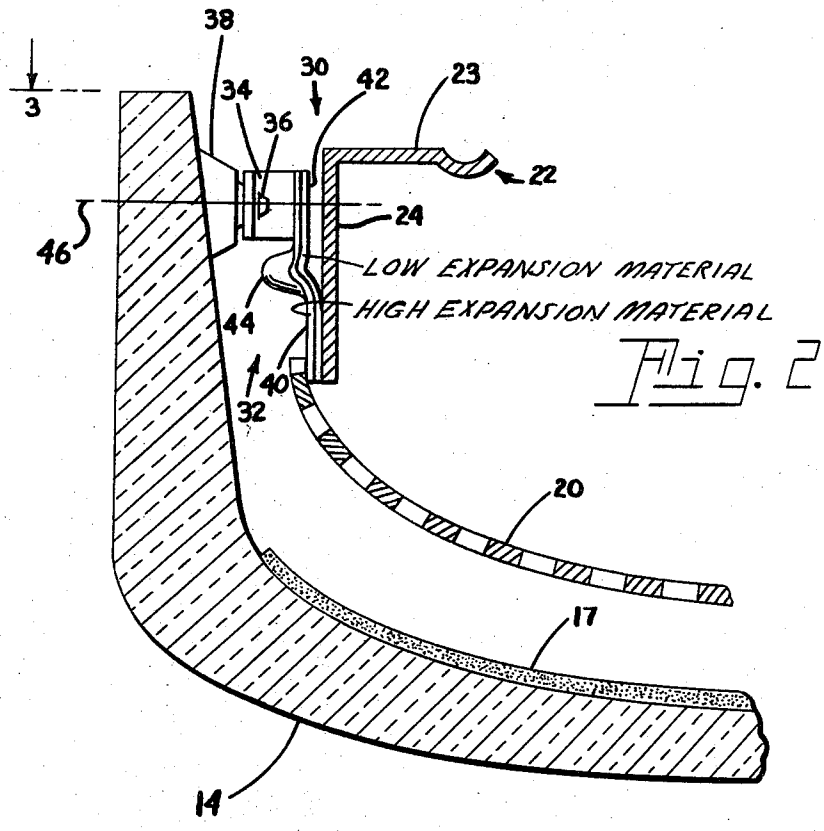

Fig. 2

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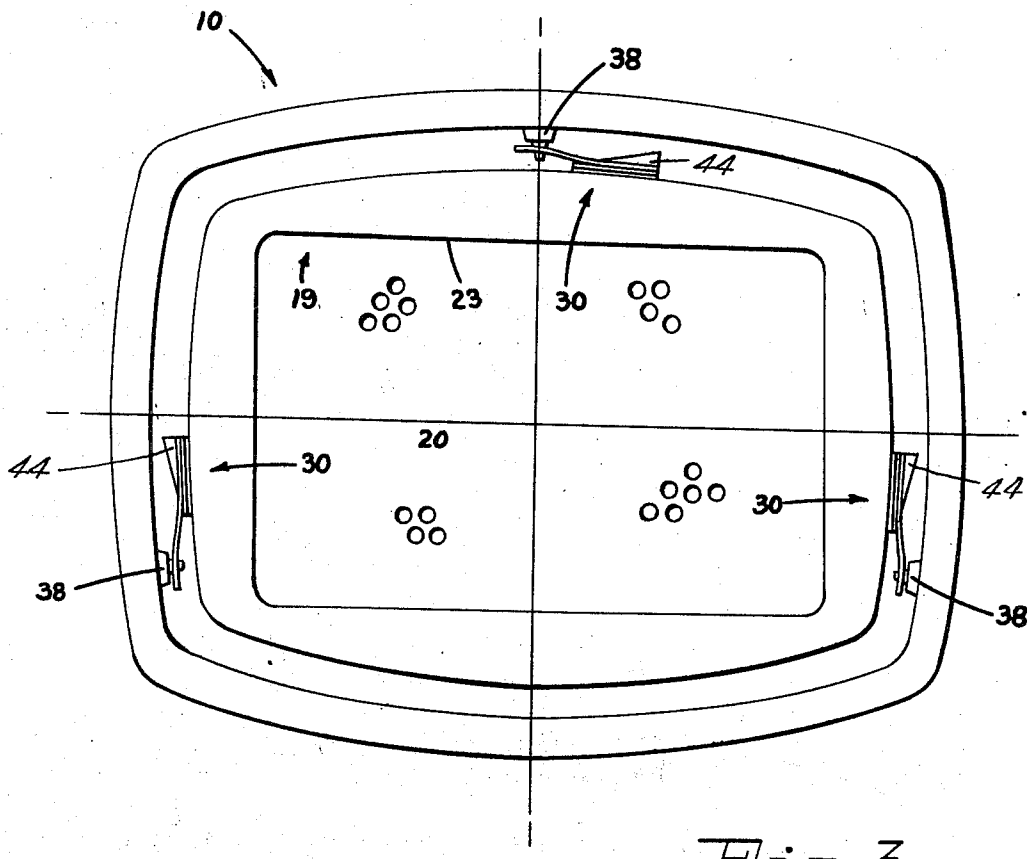

Fig. 3

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United States Patent Office 3,524,973 Patented Aug. 18, 1970

3,524,973

SHADOW MASK SUPPORTING STRUCTURE HAVING THERMAL EXPANSION CORRECTION MEANS

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Filed Aug. 13, 1968, Ser. No. 752,279
Int. Cl. H01j 19/46, 29/46
U.S. Cl. 313—85 3 Claims

ABSTRACT OF THE DISCLOSURE

Deleterious thermal expansion in the shadow mask of a color cathode ray tube is translated into advantageous, alignment maintaining movement toward the screen of the mask through utilization of an intermediate spring mounting member formed by a bi-metallic material provided with a movement amplifying, contracting hinge. The movement is derived from the shape of the hinge, the direction from which the free end of the spring projects therefrom, the lever arm effect of the spring, and by mounting the base of the spring on the plane of the supporting studs.

BACKGROUND OF THE INVENTION

This invention relates to color cathode ray tubes of the shadow mask variety and more particularly to a supporting means for mounting the shadow mask within the tube. An exemplary tube of this type may be found described in U.S. Pat. No. 2,986,080. It has been conventional practice in the color cathode ray tube industry to support the foraminous shadow mask of the tube from a relatively rigid frame structure and to support this assembly within the tube by means of cooperation between releasable leaf springs attached to the frame and studs formed on an inside wall of the tube.

To prevent overscanning of the screen by the electron beams with subsequent color impurities caused by stray electrons, a haze shield has generally been formed about the upper edge of the frame. This haze shield or flange projects inwardly toward the center of the tube a prescribed distance and prevents the electron beams from impinging upon the inner wall of the frame and thus substantially reduces the aforementioned color impurities. Flanges of the type described above are preferably planar and an exemplary type may be found described in U.S. Pat. No. 3,345,530.

One of the current and most persistent problems in color tubes of this type has been a loss of color purity during operation of the tube caused by the expansion of the mask-frame assembly from the heating effect of the scanning electron beam. This expansion leads to misalignment between the discrete phosphor elements on the tube face, the apertures in the mask, and the electron beam.

Several methods have been proposed for compensating for this thermal expansion of the shadow mask by causing the mask to move axially toward the screen as it expands outwardly, to maintain the desired alignment of the mask apertures and elemental screen areas. One such prior art proposal suggested movably mounting the mask within the envelope by means of three carriages attached to the periphery of the mask and sliding on inclined tracks mounted on the envelope. Another proposal suggested the use of a multiplicity of flexible hinges connecting the masking member with the supporting frame,

or a pivot bell crank having arms slidably engaging the mask. While all of these approaches were theoretically possible, none of them were very successful as a practical matter.

A still further innovation in the frame support system to correct for impurity color problems caused by the thermal expansion of the mask-frame assembly has been proposed in U.S. Pat. No. 3,330,980.

This innovation provides for an intermediate mounting member between the frame and the supporting spring which comprises a bi-metallic element having upper and lower portions connected by an expansion loop. The lower portion is affixed to the frame and the upper portion has one end of a leaf spring attached thereto in such a manner that the free end of the leaf spring engages a mating tapered stud which projects inwardly from an upstanding wall of the face plate. In designs of this type the expanding hinge or loop projects inwardly toward the center of the tube and thus some modification of the frame to accent this projecting article is necessary. One of the suggested modification involved curving the haze shield and frame to substantially conform to the curvature of the face plate of the tube. The modification thus left the center areas of the edges of the frame lower than the ends and provided the necessary space for the expanding loop; however, this modification was not completely successful because it destroyed some of the efficiency of the haze shield.

OBJECTS AND SUMMARY OF THE INVENTION

Therefore, it is an object of this invention to enhance color television tube operation.

It is another object of the invention to obviate the difficulties inherent in the above-cited prior art structure.

It is yet another object of the invention to provide within the color television tube a temperature compensating means which requires no modification to the frame or the planar haze shield.

These objects are accomplished in one aspect of the invention by providing means for removably mounting the shadow mask which comprises a base plate of bi-metallic sheet metal having upper and lower mounting sections connected by a contracting, movement amplifying hinge of triangular configuration. The lower section of the bi-metal sheet is fixedly attached to the shadow-mask electrode and the upper section has fixedly mounted thereon a projecting, elongated leaf spring having an aperture in the free end thereof, formed to cooperate for engaging purposes with a projecting stud on the interior wall of the face plate. The base plate is mounted so that the wide end of the triangular hinge is more remote from the stud than the narrow end. The hinge is formed so that the outermost material has a co-efficient of thermal expansion greater than that of the inside layer and, thus, when heated during operation of the tube, the hinge contracts and forces the mask substantially axially downward toward the screen and thus substantially maintains the desired beam alignment.

This modification allows the loop to extend outwardly away from the shadow-mask frame and thus it may be utilized with shadow-mask electrodes of the type having a planar haze shield.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a sectional view of a typical color tube of the shadow mask variety;

FIG. 2 is a sectional view taken along the line 2—2 of FIG. 1 and illustrating an embodiment of the invention; and

FIG. 3 is a sectional plan view taken along the line 3—3 of FIG. 2 showing one form of mounting arrangement.

DESCRIPTION OF THE PREFERRED EMBODIMENT

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

Referring now to FIG. 1 there is shown diagrammatically a typical color cathode ray tube **10** comprising a substantially infundibular portion **12**, face plate portion **14**, and a neck portion **15**. The interior surface of face plate **14** has formed thereon a mosaic cathodoluminescent screen **17**, which may be of conventional design. A shadow-mask assembly **19** comprised of a foraminous portion **20** and a frame **22** having an inwardly extending, planar haze shield or flange **23** at the upper surface thereof and a peripheral wall **24** projecting therefrom is positioned adjacent to the screen. An electron source **26**, which is diagrammatically shown and which typically is a package of three electron guns, is positioned within the neck **15** of the tube. Positioned adjacent the jointure of infundibular portion **12** and neck **15** is a deflection yoke **28** for causing the electron beams to scan the face of the tube in a particular manner, all as is well understood in the art.

Referring now to FIG. 2 there is shown a temperature compensating, shadow mask supporting system **30**, comprised of an intermediate bi-metallic mounting member **32** and an elongated leaf spring **34**. The free end of the spring **34** is provided with an aperture **36** which cooperates for mounting purposes with a stud **38** formed on an upstanding wall of face plate **14**. The spring mounting system for this type of tube is necessary because of the photographic system employed to deposit the elemental phosphor areas on the face of the tube. Each of the separate color light emitting phosphors is applied individually and the shadow mask is used as the negative for forming these areas; thus, after each exposure of a single phosphor color the mask must be removed so that the screen may be properly developed. For more specific information in regard to screen forming techniques utilized with this type of tube, reference is hereby made to U.S. Pat. No. 3,025,161 which fully describes at least one method for so forming the screen.

Returning now to the support means per se, the bi-metallic mounting member **32** is composed of a lower section **40** and an upper section **42** connected by a contracting, movement amplifying hinge **44** of triangular configuration (see FIG. 3). As stated above, structure **32** and, consequently, hinge **44** are formed so that the material having the highest thermal co-efficient of expansion is on the outside of the hinge. Suitable materials for bi-metal plate **32** may comprise, for example, an inner layer of Invar (36% Ni, 64% Fe) which, at the temperatures encountered at the mask area, has a nearly zero thermal co-efficient, and the other layer may be of a material having the composition, 22% Ni, 3% Cr, and 75% Fe. A suitable thickness for the material is in the neighborhood of .030" to .060".

As may be seen clearly in FIG. 2, the lower section **40** of bi-metal **32** is fixedly positioned to a wall **24** of frame **22**, as by welding. The upper section **42** is spaced away from wall **24** a distance sufficient to allow for downward movement of the device during operation without frictional engagement with the wall. The end of spring **34** which is spaced from aperture **36** is fixedly positioned on upper section **42**, as by welding. The spring **34** is attached in such a manner so that the apertured end projects from the end of bi-metal **32** containing the narrow end of triangular hinge **44**. Thus the wide end of hinge **44** is more remote from stud **38** than the narrow end.

It will also be seen from FIG. 2 that the longitudinal center of spring **34** lies substantially on a plane transverse of the tube and passing through the studs **38**, indicated in the drawing as **46**, and the hinge **44** is positioned below the plane **46**. This arrangement provides the maximum in stability for the mask-frame assembly.

The amplifying factor in the contracting hinge **44** stems from its triangular configuration, when viewed in plan, as may be seen in FIG. 3. This substantially triangular configuration, together with the direction from which the spring **34** projects therefrom, in operation, causes two temperature compensating actions of system **30**, which are additive, to give the desired mask motion toward the screen. The first action is a pivoting motion; as hinge **44** closes, because of the heat developed in the operating tube, pressure is exerted upon the spring causing it to pivot in such a fashion as to push against the fixed stud **38** causing the mask-frame assembly **19** to move toward the face panel. The second action of system **30** occurs as it continues to heat up and continued contraction causes a rolling motion of the upper section **42** toward wall **24** of frame **22**. This rolling motion of upper section **42** changes the angle of the section with respect to the frame wall. As this angle changes an arc is subtended by the offset spring aperture forcing the mask assembly even further toward the face plate. The magnitude of the subtended arc is dependent on the spacing between the pivoting plane of the upper section **42** and the plane of contact between the spring and the stud **38**.

In FIG. 3 there is shown a plan view of a complete mounting system for the shadow mask-frame assembly **19** which comprises three studs and three associated support systems **30**. While the embodiment shown utilizes a three-point suspension system, it is to be understood that the concept of invention defined herein is equally applicable to a four-point suspension system utilized by some tube manufacturers.

Thus, there has been provided by this invention a new and novel shadow mask supporting system which substantially translates deleterious heat caused expansion of the shadow mask electrode into downward movement thereof, thereby substantially maintaining the desired alignment within the tube and having the added advantage that it permits utilization of the desirable planar haze shield feature.

While there has been shown and described what is at present considered the preferred embodiment of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the scope of the invention as defined by the appended claims.

What is claimed is:

1. In a cathode ray tube comprising an envelope having a face plate at one end thereof and an electron source at another end thereof, and an apertured mask electrode adjacent said face plate, a plurality of support means for removably mounting said electrode, each of said support means comprising: a base plate of bi-metallic sheet metal comprised of contiguous layers, a first of said layers having a relatively high coefficient of expansion and the second of said layers having a relatively low coefficient of expansion, and having upper and lower mounting sections connected by a contracting, movement amplifying hinge of triangular configuration, said high expansion material being on the outside of said hinge, said lower one of said mounting sections being closer to said face plate than said upper section and being attached to said mask electrode; and an elongated leaf spring having one end connected to said envelope and another end attached to said upper one of said mounting sections; said base plate being mounted so that the wide end of said triangular hinge is more remote from said one end of said spring connected to said envelope than the narrow end thereof.

2. The invention of claim 1 wherein said springs are connected to said envelope by means of an aperture in said springs and cooperating tapered studs fixed in the upstanding wall of said face plate, said studs being positioned on a transverse plane around said tube and all being equal distance from said face plate, said hinges being positioned below said transverse plane and thus closer to said face plate than said studs.

3. The invention of claim 1 wherein said contracting hinges are substantially laterally U-shaped.

References Cited

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JAMES W. LAWRENCE, Primary Examiner

V. LAFRANCHI, Assistant Examiner

U.S. Cl. X.R.

313—284, 292

PO-1050
(5/69)

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,524,973 Dated August 18, 1970

Inventor(s) David J. Rigdon

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, line 20 of the patent "accent" should read - - accept - - .

SIGNED AND SEALED
NOV 3 1970

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents