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[54] **INTEGRATED SHADOW MASK STRUCTURE**
2 Claims, 4 Drawing Figs.

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313/292
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S, 92 B

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ABSTRACT: The shadow mask of a color cathode-ray tube is constructed of a single piece of metal formed to have a color-selection portion with a field of apertures and also to have a circumscribing mounting frame contiguous to the color-selection portion. A stiffening rib is pressed into the mounting frame to add mechanical strength and the mounting springs further contribute to strengthening the structure. Each spring extends from a baseplate which bridges the stiffening rib of the frame and is welded to the frame on opposite sides of the stiffening rib.

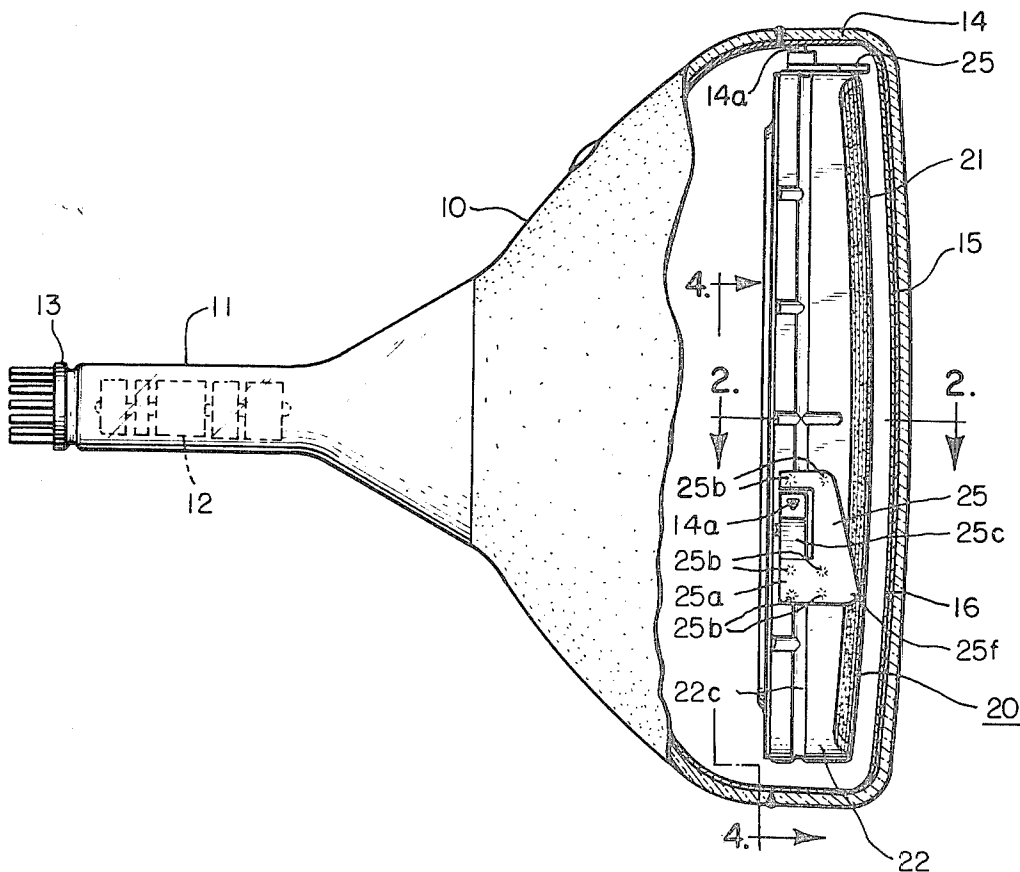


FIG. 1

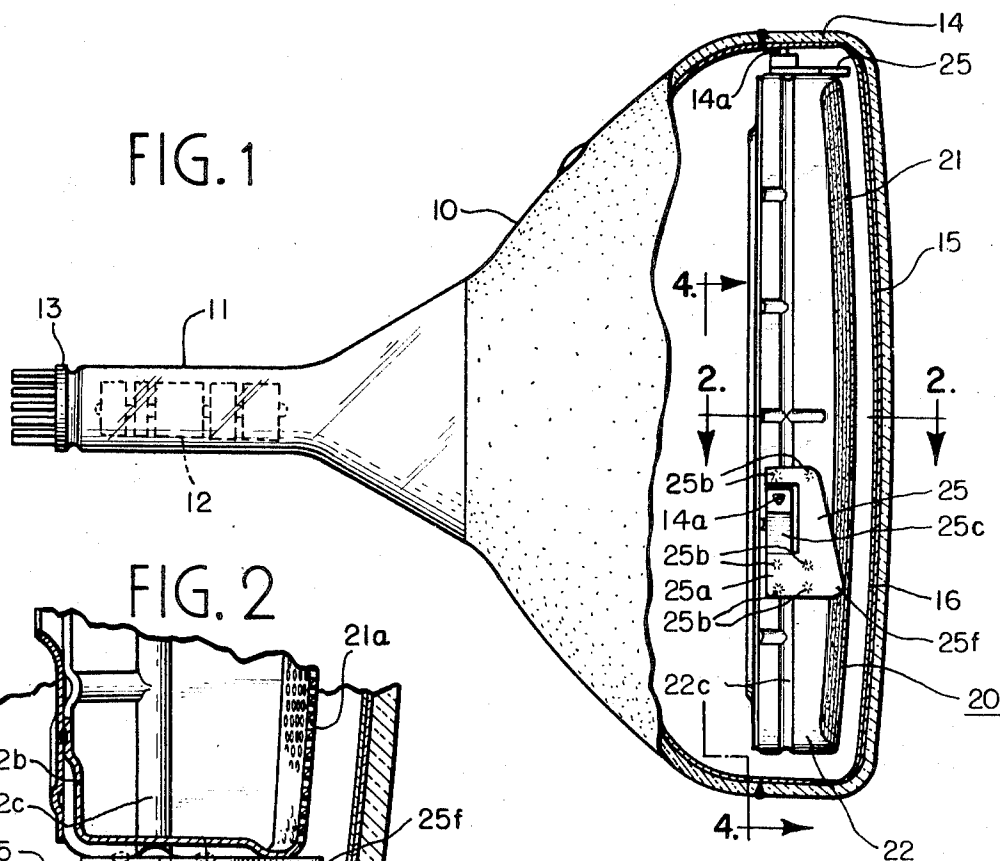


FIG. 2

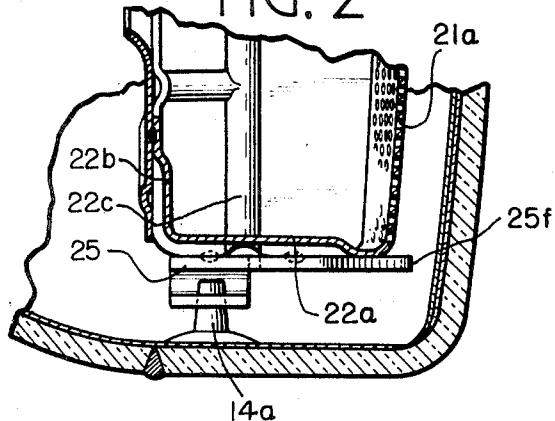


FIG. 4

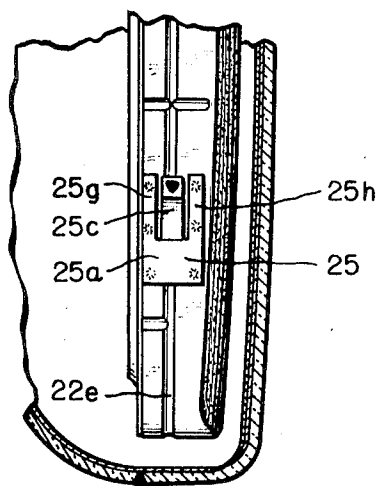
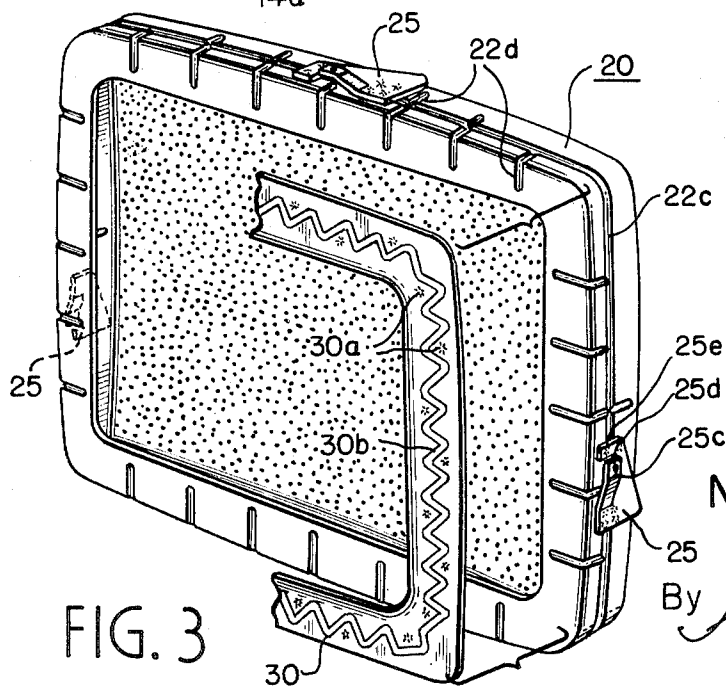


FIG. 3

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INTEGRATED SHADOW MASK STRUCTURE

BACKGROUND OF THE INVENTION

The present invention is addressed to the color-selection electrode characteristically included in a tri-color cathode-ray tube. The specifics of the color-selection electrode are dictated in some measure by the nature of the tri-color screen. For example, if the screen has an interlaced pattern of stripes of the three different phosphors usually employed in an additive color system, the color-selection electrode is of the grille type having linear slots or electron transparent portions for obtaining color selection. On the other hand, where the phosphor materials are arrayed in dot triads disposed over the screen area of the tube, which is the more conventional form of image reproducer currently in commercial use, the color-selection electrode or shadow mask has a field of circular apertures corresponding in configuration to the pattern of triads on the screen with one mask aperture provided for each such triad. The invention has application to either structure but is especially attractive in improving the aperture mask type of color-selection electrode and will be described in that connection.

The shadow mask structure of the prior art has two principal components that are generally formed separately and subsequently integrated, as by welding, to constitute an assembly for mounting within the color picture tube. One of these components is the aperture mask which is formed of light weight stock of cold rolled steel or the like and in which a pattern of apertures is provided by etching. This is an attractive method of fabrication for the reason that it makes possible the desired close control of the aperture system and also facilitates grading the apertures, when desired, from the center radially outwardly of the mask structure. Generally, etching is accomplished while the material is in sheet form after which it is drape pressed to have a dome or spherical type of configuration. The other component may be likened to a picture frame which is dimensioned and configured to circumscribe the pattern of apertures in the mask and also to fit telescopically with the mask so that these components may be united by spot welding their overlapping peripheral portions. It is common practice to construct the frame from stock that is L-shaped in cross section and is heavy in comparison with the stock used in preparing the mask. This contributes desired mechanical strength to the structure which is necessary because the mask assembly is used in screening the tube into which it is to be installed and, in the screening process, the mask assembly is repeatedly inserted and removed from the cap or faceplate section of the tube. Unless it has adequate strength, there is a very definite danger of damage in the removal and insertion of the mask assembly during screening.

One particular disadvantage inherent in the prior structure is its response to heating in the operation of the tube. The tube usually has three electron beams that are scanned across the mask assembly and that assembly intercepts a significant portion of the scanning beams, sufficient that the structure experiences an appreciable increase in temperature. Because of the difference in mass represented by the mask and its supporting frame, they respond differently to the increase in temperature as the tube attains stable operating conditions. In particular, they expand at different rates and in different amounts all of which leads to a misregistration of the beams with the assigned dots of the phosphor triads constituting the screen of the tube. This has become such a problem that various thermal compensation schemes have been proposed to minimize the possibility of misregistration as the tube is brought to operating temperature. The schemes of compensation are frequently expensive and difficult with which to deal. Therefore, it is most desirable to provide a structure that avoids the necessity of thermal compensation. Such a result may be obtained with an integral mask-frame structure by which is meant a structure in which the mask and its supporting frame are formed of a single unitary piece of material.

Structures of this type have been proposed heretofore but have exhibited insufficient mechanical strength for use in production.

Accordingly, it is an object of the invention to improve the structure of an integrated mask or color-selection electrode for a color cathode-ray tube.

It is a specific object of the invention to provide an integrated form of shadow mask which has improved mechanical strength, sufficient to meet the requirements of mass production.

It is a further object of the invention to arrange an integrated mask structure such that it is less susceptible to damage when used in the screening of the color cathode-ray tube in which it is to be installed.

SUMMARY OF THE INVENTION

An integrated shadow mask structure for a color cathode-ray tube has a color-selection portion including a plurality of apertures and a circumscribing frame or L-shaped cross section extending from the color-selection portion and formed therewith from a unitary sheet of material. A stiffening rib is pressed into that part of the frame which is contiguous to the color-selection portion and, in accordance with the invention, an improved arrangement is provided for releasably attaching that structure to mounting studs that project inwardly from the envelope of the tube. The arrangement comprises a plurality of at least three mounting springs secured to the two sides and at least to the top or the bottom of that part of the frame which extends generally parallel to the tube axis. Each of the mounting springs has a base plate positioned to bridge the stiffening rib of the frame and mechanically secured thereto on opposite sides of the stiffening rib. A leaf spring extends from and out of the plane of the baseplate and has an aperture in its free end dimensioned to releasably receive one of the tube mounting studs.

BRIEF DESCRIPTION OF THE DRAWING

The features of the present invention which are believed to be novel are set forth with particularity in the appended claims. The invention, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawing, in the several figures of which like reference numerals identify like elements, and in which:

FIG. 1 is a side elevational view, partly in cross section, of a color cathode-ray tube having an integrated shadow mask structure including the improvement of the invention;

FIG. 2 is a fragmentary sectional view taken along section line 2-2 of FIG. 1;

FIG. 3 is an exploded view showing the mask structure and its electron shield;

while FIG. 4 is a fragmentary cross sectional view representing a modified form of mounting arrangement for the integrated shadow mask.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now more particularly to FIG. 1, the color tube there represented has an envelope comprised of a funnel shaped or conical section 10 terminating at its small end in a neck section 11 which accommodates a cluster 12 of electron guns various of the electrodes and heaters of which connect with pins provided in the customary base 13. The gun mount 12 is conventional and constitutes no part of the present invention. Usually, it is a delta arrangement of three electron guns each of which produces a beam of electrons for scanning the screen area of the tube.

At its opposite end, envelope section 10 is sealed to a cap or faceplate section 14 and, for that to be possible, they must be alike in dimension and configuration. Neither the size nor the shape is of particular consequence and while round color tubes have been used, for the most part, a rectangular form of tube is employed today and it will be assumed that the tube

represented in FIG. 1 is of that type. The inside surface of envelope section 14 is provided with a screen 15, generally in a mosaic or interlaced pattern of deposits of different phosphor materials. Let it be assumed for convenience of description that the screen has a multiplicity of dot triads each including a dot of green, a dot of red and a dot of blue phosphor. The screen is backed by a layer 16 of a conductive material such as aluminum of a thickness that it is readily penetrated by the electrons of a scanning beam and yet serves as a reflector to improve light output on the screen. All of the matters discussed thus far are conventional and well understood in the art, requiring no further elaboration.

Positioned between screen 15 and gun mount 12, but in close spaced relation to the screen, is an integral shadow mask structure 20 which has a color-selection portion 21 and a circumscribing frame 22 of L-shaped cross section. As more clearly apparent in the fragmentary showing of FIG. 2, the frame has one part 22a which extends substantially parallel to the longitudinal axis of the tube and a second part 22b disposed in essentially perpendicular relation to the horizontal axis of the tube and approximately parallel to the color-selection portion 21 and screen 15. It is also apparent in FIG. 2 that the color-selection portion 21 has a plurality of apertures 21a; they are arranged in a generally rectangularly shaped field since it is assumed that the tube under consideration is of the rectangular type. The apertured portion 21 and the frame 22 are formed from a unitary sheet of material, usually cold rolled steel, with frame portion 22a contiguous to and extending from the apertured mask 21.

In fabricating the mask structure, while the starting material is in sheet form, the field of apertures 21a is etched in known fashion and this is followed by a series of forming steps in which mask 21 attains its domed configuration and in which frame portions 22a and 22b are formed and shaped. As a part of this process a stiffening rib 22c is pressed into frame part 22a to add mechanical strength. As indicated in FIG. 3, rib 22c is pressed into the four sides of frame 22 as a continuous rib. Additional but transversely disposed gussets or ribs 22d may also be pressed into frame parts 22a and 22b in the manner indicated in FIG. 3 further to add mechanical strength.

The integrated mask structure is removably supported within envelope section 14 of the tube by mounting studs 14a which project inwardly of the tube envelope. There are three or four such studs depending upon whether a three or four point suspension is desired for mask structure 20. They are positioned generally at the sides of the envelope and at the top as well as the bottom for a four point suspension but usually only at the top of the envelope for a three point suspension which is the case under consideration. Although the tube would therefore have three such studs, only two are shown in FIG. 1.

In accordance with the invention, there is an improved arrangement provided for releasably attaching the integrated mask structure to mounting studs 14a. This arrangement comprises a plurality of mounting springs 25, corresponding in number to the mounting studs extending from the tube envelope and, for the case under consideration, totaling 3. Usually, the mounting springs secured to the side of mask structure 20 are identical and the same type of structure may be employed at the top even though some picture tubes use a slightly modified mounting spring at the top of the frame. For convenience, it will be assumed that all three are identical in structure. As shown in FIG. 3, one is positioned centrally of the top of mask structure 20 while the other two are secured at corresponding points on the sides of that structure but below the central plane thereof. FIG. 3 represents all three mounting springs as facing in the same direction although the springs which are secured to the sides may be differently arranged, specifically both may face upwardly or downwardly.

Each mounting spring has a base plate 25a which is much smaller in its major dimension than the side or portion of mask structure 20 to which it is attached. The baseplate is dimen-

sioned and positioned to bridge stiffening rib 22c and is mechanically secured to frame 22 by welding on opposite sides of rib 22c. The weld points, for example, may be as indicated at 25b in FIG. 1. In addition to the baseplate, each mounting device has a leaf spring 25c which extends from, and out of, the plane of baseplate 25a and has at its free end, as shown in FIG. 3, an aperture 25d that is dimensioned to releasably receive an assigned one of mounting studs 14a. For added strength, it is desirable that plate 25a be longer than spring 25c and be mechanically secured to the frame, not only on both sides of rib 22c by also on both sides of the plane of attachment of leaf spring 25c to the baseplate. One way in which this may be done, for example, is to provide the baseplate with an L-shaped portion 25e, shown in FIGS. 1 and 3, extending beyond the projection of the free end of leaf spring 25c and likewise extending across rib 22c and welded to the frame on opposite sides of that rib. It is preferred in forming this mounting structure, to strike leaf spring 25c out of the baseplate and to provide mounting aperture 25d and the desired configuration of the leaf spring by further die pressing and stamping operations.

The curvature of mask 21 is very similar to that of the faceplate of the tube so that the mask may be thought to have a substantially uniform spacing from screen 15 when the mask is properly positioned within envelope section 14. Obviously, errors in inserting the mask structure may cause damage particularly if the mask is inserted too far and strikes against the inner wall surfaces of the tube envelope or strikes against any of the mounting studs. This possibility of damage may be minimized by providing another extension 25f on baseplate 25a which extends in the direction of and beyond the immediately contiguous part of mask 21a. Portion 25f may then serve as a stop or bumper to prevent undesirably bringing mask 21 into contact with the tube envelope or mounting studs.

It is current practice to secure an electron shield to the mask assembly, and such a shield 30 is fixed to frame part 22b as indicated in FIG. 3. It is a frame of the same configuration as the field of apertures in mask portion 21 and is superposed over frame part 22b, being secured thereto by a zigzag pattern of welds 30a. If desired, the electron shield may also have a stiffening rib 30b, likewise of zigzag configuration, to add to the strength of the final structure.

In the modified form of mounting structure of FIG. 4, baseplate 25a has extensions 25g and 25h which are essentially parallel to leaf spring 25c and of essentially the same length. They overlie on opposite sides of rib 22c and are welded thereto.

The integral mask structure 20 functions in conventional fashion in permitting each beam issued from gun mount 12 to impact only the dots of phosphor material to which that beam has been assigned, that is to say, one beam impinges only the dots of red phosphor, the second impacts only the dots of green, while the third impacts the dots of blue phosphor. There is nothing unusual or different in this function of color selection of the described structure over and above structures of the prior art. There is, however, a distinct difference in their makeup in that the described arrangement is an integrated structure in which mask 21 and frame 22 are formed from a single unitary piece of metal. Tubes constructed with this mask structure exhibit an unexpected stability and so improve the registration of the electron beams with the assigned phosphor dots of the screen as the tube is brought to its operating temperature that errors of misregistration are minimized. Use of the integrated mask structure to date indicates that there is no need whatever for thermal stabilization proposed for prior structures in which the frame is a massive component compared to the mask. Another attractive attribute of the described structure is its markedly reduced weight.

In one form of the device successfully used in a 23-inch rectangular color cathode-ray tube, the mask structure was formed of a sheet of cold rolled steel of 0.006 inches

thickness. The mounting structures 25 were formed of 0.025 inches Unitemp A-286 cold rolled steel, reduced 35 percent prior to heat treating. The hardness after heat treating was measured at 40.6 to 44.6 on the Rockwell "C" scale. If desired, full hard, stainless steel 304 can be used instead of cold rolled steel for the mounting structures 25.

While particular embodiments of the invention have been shown and described, it will be obvious to those skilled in the art that changes and modifications may be made without departing from the invention in its broader aspects, and, therefore, the aim in the appended claims is to cover all such changes and modifications as fall within the true spirit and scope of the invention.

I claim:

1. In a color cathode-ray tube, a shadow mask structure having a color-selection portion including a plurality of apertures and a circumscribing frame of L-shaped cross section extending from said color-selection portion and formed therewith from a unitary sheet of material and having a stiffening rib pressed into that part of said frame which is contiguous to said color-selection portion, an improved electron shield and mounting arrangement for releasably attaching the shadow mask structure to mounting studs projecting inwardly from the envelope of the tube which arrangement comprises:
a plurality of at least three mounting springs secured to the two sides and to at least the top or bottom of said part of said frame, each of said mounting springs having a baseplate bridging said rib and mechanically secured to said part of said L-shaped frame on opposite sides of said rib and further having a leaf spring extending from and

out of the plane of said baseplate and having an aperture in the free end thereof dimensioned to releasably receive one of said mounting studs;

and a frame of the same configuration as the field of apertures in said color-selection portion, having a reinforcing rib of zigzag configuration pressed therein, and superposed over the part of said L-shaped frame that is substantially parallel to said color-selection portion.

2. In a color cathode-ray tube, a shadow mask structure having a color-selection portion including a plurality of apertures and a circumscribing frame of L-shaped cross section extending from said color-selection portion, an improved arrangement for releasably attaching the shadow mask structure to mounting studs projecting inwardly from the envelope of the tube which arrangement comprises:

a plurality of at least three mounting springs secured to the two sides and to at least the top or bottom of said frame, each of said mounting springs: (a) having a baseplate mechanically secured to an assigned part of said frame; (b) having an elongated leaf spring disposed generally parallel to the part of said frame to which its baseplate is secured and extending from and out of the plane of said baseplate with an aperture in the free end thereof dimensioned to releasably receive an assigned one of said mounting studs; and (c) further having a bumper portion disposed transversely of the part of said frame to which its baseplate is secured and extending in the direction of and beyond the immediately contiguous part of said color-selection portion.

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