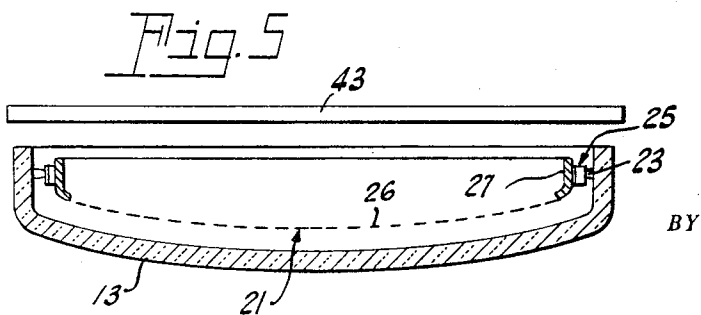
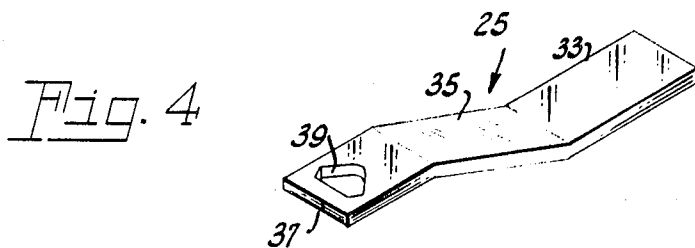
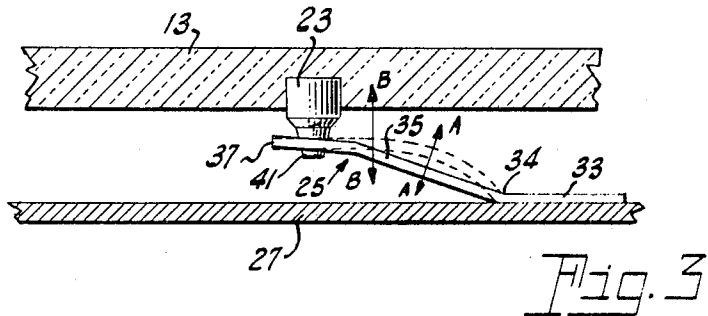
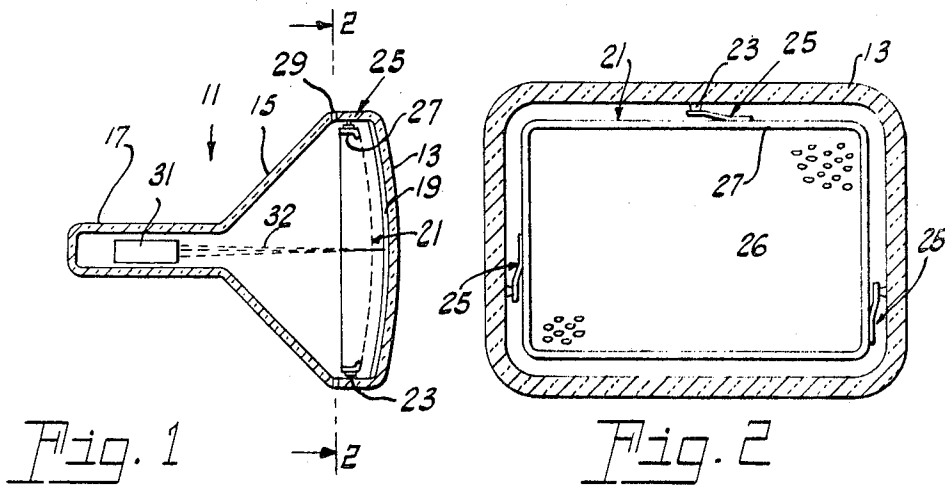


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PROCESS FOR IMPROVING MASK-SCREEN REGISTRATION
IN CATHODE RAY TUBES
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PROCESS FOR IMPROVING MASK-SCREEN REGISTRATION IN CATHODE RAY TUBES

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2 Claims

ABSTRACT OF THE DISCLOSURE

A process for providing improved mask-screen registration in a shadow-mask cathode ray tube by effecting a partial reduction of the residual stress in the resilient mask support means relative to the panel. Such is accomplished prior to screen formation by baking the panel with the mask positioned therein at a temperature sufficient to resolve the force vectors of the mask-to-panel support means to provide a consistency of mask orientation whereby the mask-screen registration utilized during screen fabrication is maintained in the finished tube.

This invention relates to the enhancement of color purity in color cathode ray tubes and more particularly to the process for improving registration between the patterned screen and a compatible structure having openings therein positioned adjacently thereto.

Of the conventional cathode ray tubes employed as image reproduction devices in color television applications, many incorporate a patterned color screen in spaced combination with a compatible grid or structure having openings or apertures therein through which electron beams reach the screen. In this specification, the term "mask" will be used generically to denote open structures such as grids, apertured shadow-masks and similar constructions. In tubes utilizing such mask type structures, the screen is generally disposed on the inner surface of the tube face panel in the form of a pattern composed of multitudinous dot, bar, or stripe formations of electron responsive green, blue, and red fluorescent phosphor materials. The respective fluorescent groupings constituting the patterned screen are formed in accordance with the number of electron guns to be utilized in the particular tube in conjunctions with the respective mask employed.

Because of the large number of fluorescent material groups needed to produce a pattern sufficient to provide a high resolution picture, the process of forming the fluorescent pattern must be one which is capable of accurately forming discrete configurations to realize an imagery of desired color purity. By way of example, one of the conventional screen forming processes utilizes a photoprinting technique wherein the inner surface of the viewing panel, having a coating of a light sensitive substance and a desired electron responsive phosphor disposed thereon, is exposed to light beams from a specific point source which are directed to pass through the openings in an adjacently oriented mask and impinge on the screen coating therebeneath. Subsequent development of the screen area produces a first screen pattern in the form of a discretely spaced array of electron responsive phosphor areas capable of specific color fluorescence. This process is sequentially repeated to dispose the remaining specific phosphor patterns comprising the formation of the tri-color screen. In exposing each of the above mentioned specific color patterns, the point source of light is usually appropriately offset relative to the mask to provide proper displacement of each pattern in forming the repetitive plurality of color groupings in the formed screen.

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By way of example, when the mask structure is of the foraminous shadow-mask type, the resultant screen on the inner surface of the glass face panel is comprised of numerous triads of tangentially oriented green, blue, and red phosphor dots. Since these dots are photodisposed, in the aforementioned manner, by light beamed through the foraminous mask, they are desirably in registry or alignment with the apertures of the shadow-mask when subjected to subsequent electron beam bombardment.

Misregistry of the screen dots with the respective apertures in the shadow-mask has been a long standing problem in the art of color cathode ray tube fabrication. This problem has been influenced by an accumulation of variable factors including inefficiencies in the electron gun structure such as inaccurate positioning of componential parts and misalignment of the guns, deformation of the shadow-mask and erratic positioning thereof, irregularities in screen deposition dimensional changes in the face panel and defects in the convergence structure of the tube. A certain amount of misregistry in the finished tube can be overcome by using auxiliary electrostatic or magnetic field producing devices employed internally or externally of the tube.

With the advancement and refinement of the art and the resultant increased efficiencies of tube fabrication techniques, the aggravating effects of the before-noted factors have been greatly diminished. It is then that the contributing effects of other factors become apparent. For example, there was evidence that the screen dot-mask aperture alignment was deleteriously affected by the temperature encountered during the processing operation of frit sealing the screened face panel to the tube envelope portion. It was found that the sealing process produced a permanent nonuniform transverse dimensional change in the glass face panel supporting the screen dots. This produced a degree of dot-aperture misregistry in the finished tube by allowing the electron beams to impinge portions of the color dots adjacent to the primary target dots or the interstitial spacing therebetween. Heat treating the glass face panel prior to screen deposition thereon bettered screen-mask registry, but still greater insurance of registry was needed to provide an improved display having the color purity desired.

Accordingly, it is an object of the invention to reduce the aforementioned disadvantages and to provide an improved color cathode ray tube having greater color purity.

Another object of this invention is to improve, in the finished tube, the registry of the openings in the mask with the corresponding phosphor pattern disposed on the inner surface of the glass face panel.

An additional object is the provision of a method of producing an improved screen-mask relationship in finished electronic image reproduction devices.

The foregoing objects are achieved in one aspect of the invention by utilizing a process for at least partially relieving stresses in a resiliently supported color cathode ray tube foraminous mask assembly prior to screen formation on the related screen panel and the subsequent sealing thereof to an envelope portion. The process comprises orienting the mask assembly with the resilient supports stressed in a manner effecting mask positioning as subsequently utilized in the finished tube, and baking the resiliently supported mask assembly at a temperature-time relationship at least substantially equalling the temperature-time relationships encountered during the subsequent screen formation and sealing operations. Thus, there is established, prior to screen formation, a mask-panel relationship as it is substantially existent in the finished tube.

For a better understanding of the present invention, together with other and further objects, advantages and capabilities thereof, reference is made to the following

specification and appended claims in connection with the accompanying drawings in which:

FIGURE 1 is a sectional view of a cathode ray tube showing the orientation of the processed mask-screen panel structure;

FIGURE 2 is a plan view looking into the open side of the mask-panel structure taken along the line 2—2 of FIGURE 1;

FIGURE 3 is an enlargement of the resilient mask support means;

FIGURE 4 is a perspective illustration of the mask spring support means; and

FIGURE 5 is a cross-sectional view of the mask-panel structure showing a processing shield position relative thereto.

With reference to the drawings, FIGURE 1 shows one embodiment wherein the process of the invention is utilized, i.e., a plural beam shadow-mask type of cathode ray tube.

The envelope 11 comprises a face panel portion 13, a funnel portion 15, and a neck portion 17. A patterned cathodoluminescent screen 19 is disposed on the inner surface of face panel 13 and a foraminous shadow-mask structure 21 is oriented in spaced adjacency thereto. Embedded in the inner wall of the panel portion 13 are a plurality of mask positioning means in the form of positioning studs 23 each of which cooperates with a compatible spring support means 25 attached to the frame portion 27 of the mask structure 21, the spring support means being extended in a stressed manner to make pressured contact with the positioning stud. The face portion 13 with the mask 21 positioned therein is hermetically bonded to the funnel portion of the envelope at a seal 29. Located within the neck portion 17 of the envelope are plural electron beam generating means 31 which project discrete electron beams 32 through the apertures in the mask to impinge the patterned cathodoluminescent screen 19.

When the mask foraminous portion 26 is capped on and welded to the heavier gauge frame portion 27, stresses are induced in the foraminous portion in the peripheral area adjacent the frame. Such stresses are evidenced by slight localized doming and are substantially relieved by subsequent heat treating of the mask structure.

It has been discovered that marked improvement in mask-screen registration is achieved by discretely heat treating the assembled mask-panel combination prior to the formation of the screen on the panel and the subsequent heat sealing thereof to the envelope funnel portion. In addition, it has been found that baking the mask-panel combination, at a temperature-time relationship which is at least substantially equal to the temperature-time relationships encountered during the subsequent screen formation and envelope sealing operations, provides conjunctive stress relief of the mask structure and resilient spring supports that is not realized by baking the several components separately. The relief of residual stresses initially retained in the components of the combined assembly results in inter-related dimensional finalizations that are substantially consistent within a repetition of the temperature-time relationship involved. Discovery was made that, in addition to a finalization of the lateral dimensions of the glass panel and relief of stresses in the mask structure, a beneficial stress relief is produced in the resilient mask supports.

As shown in FIGURES 2, 3, and 5 the rectangular mask structure 21 of the embodiment is resiliently supported and oriented within the panel 13 by the aforementioned spring supports 25 and positioning studs 23. In greater detail, with particular reference to FIGURE 3 the spring support 25, is for example, of 302SS tempered material shaped to comprise a base portion 33, a shank portion 35, and a head portion 37 formed with an aperture 39 therein. In this instance, the aperture 39 is substantially triangular in shape having wall portions to pro-

vide three-point contact with the projecting thimble portion 41 of positioning stud 23. The base portion 33 is affixed to the mask frame 27, as by welding with the shank portion 35 making a juncture therewith through a moment of bend 34. The solid outline of the spring portion 35 indicates the shank portion stressed by initial positioning of the mask within the panel. Very little flexure is noted in the shank portion, the force vector between the mask frame and panel being substantially diagonal as indicated by the arrow A—A. Upon baking the mask-panel combination, the residual stresses within substantially the shank portion are partially reduced. The resultant flexure after heat treating is shown in phantom with the resultant force vector being substantially as shown by arrow B—B. It will be noted that the three-point contact between the spring aperture 39 and the stud thimble 41 is improved and thereby effects more positive support. When the mask is necessarily removed and re-positioned several times during the screen forming process, the spring supports, having been partially stress relieved in positional orientation as in the tube, maintain an accurate consistency of support which follows through to the finished tube.

In a preferred embodiment of accomplishing the baking process of the invention, a controlled heat enclosure such as a conveyORIZED air-atmospherelehr is utilized to effect the desired baking of the assembled mask-panel combination. A lehr of this type has means for predeterminedly controlling the temperature of the respective pre-heat, high temperature and cooling zones through which the conveyor belt moves at a specifically controlled rate of travel. The mask-panel assemblies are positioned on individual supporting racks in spaced relationship on the moving lehr belt. A non-oxidizing shield means 43, such as a stainless steel plate, is positioned in spaced adjacency to the open side of the mask-panel assembly to provide a partial closure therefore to prevent the formation of heavy oxidation of the metallic parts of the mask structure during the baking procedure. It is evident, that if so desired, a second mask-panel assembly can be utilized to function as a shield instead of the metal plate. In which case, the two assemblies would be positioned with their open sides in spaced adjacency. Thus, the shielded assemblies are sequentially conveyed through the pre-heat, high temperature and cooling zones in accordance with the time-temperature schedule to effect the desired conjunctive relief of stresses within the assembly combination. Of course, if the baking is accomplished in a controlled atmosphere, the shielding can be eliminated.

It has been found that, under certain frit material conditions, temperatures up to about 470 degrees C. can be utilized for the sealing operation wherein the panel is joined to the funnel portion of the tube envelope. When such conditions are considered the temperature of mask-panel baking should substantially approximate that of sealing or be of a temperature-time relationship at least equivalent thereto; as for example, a temperature not exceeding substantially 470 degrees C. for a time span of at least one hour duration. If desired, the mask-panel combination baked at about 470 degrees C. can be utilized in a lower temperature frit sealing operation.

After cooling, a plurally patterned dotted screen is suitably formed on the interior surface of the panel in alignment with an adjacently positioned foraminous mask as by the photo-deposition technique already described in this specification.

The screened panel with the mask temporarily removed is conventionally processed by the addition of lacquering and aluminizing to provide improved reflective means, and by a subsequent heating treatment wherein the screened panel is subjected to a temperature level of about 410 degrees C. for a time period of approximately forty-five minutes to remove the volatile chemicals therefrom. Since this chemical-removal-heating is of a lower temperature than the previous mask-panel baking, the stabilized stress relief in the assembly combination is substantially retained. Thence, the panel with the mask repositioned

therein in registry with the screen is sealed to the envelope-funnel portion by a lehr technique, wherein the envelope-funnel-panel structure (with the mask therein) is subjected to a temperature-time relationship such as a temperature level of about 450 degrees C. for a time span of approximately one hour. The next sequential fabrication step involves the sealing of electron beam generating means within the neck portion of the envelope. Final vacuum processing with related heating and tip-off sealing provides a completed tube having optimum registration of the patterned screen with the apertured mask that is in keeping with the initial alignment.

Thus, the occurrence of misregistration of the mask and screen during tube sealing and processing is substantially reduced by the heat relief of residual stresses in the mask structure and resilient supports while the supports are stressed in a manner to effect mask positioning as subsequently utilized in the finished tube. Use of the process of this invention insures optimum registration of the mask and screen in the finished tube which results in noticeable enhancement of color purity of the display.

While there have been shown and described what are at present considered the preferred embodiments 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. A process for improving mask-screen registration in a shadow-mask cathode ray tube, said process being consummated prior to the formation of said screen on a related panel and the subsequent heat sealing thereof to an envelope funnel portion, the panel of said tube having a plurality of spaced apart inwardly protruding studs partially embedded in the wall portion thereof whereupon the mask assembly frame is fully supported by a plurality of longitudinal resilient supports of tempered metallic material each having base, shank, and head portions whereof the base portion is bonded to said frame, said process involving an initial temperature treatment to produce partial stress relief of said resilient supports in relationship to said panel and comprising the steps of:
orienting said mask assembly on said supporting studs within said panel by stressing substantially the shank

portion of each of said resilient supports to provide a substantially diagonal force vector between said mask frame and said panel wall;
initially baking said panel with said mask positioned and fully supported therein by support means finally fixed to the panel at a temperature sufficient to provide a partial reduction of the residual stress within substantially said shank portion of each of said resilient supports to effect a resultant supporting force vector therein that is substantially normal to said frame and said panel wall, said initial baking temperature not exceeding that required for said heat sealing; and
removing said mask from said panel and repositioning the same therein for the number of times required to accomplish screen formation, said resilient supports having been partially stress relieved by said initial baking in positional orientation in a manner to effect an accurate consistency of mask orientation whereby the mask-screen registration utilized during screen fabrication is maintained in the finished tube.
2. The process according to claim 1 wherein said baking temperature is substantially within the range of 450 to 470 degrees centigrade for a time span of at least one hour duration to modify the force vector within each of said supports.

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