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3,823,080

PROCESS FOR REMOVING COATING FROM A CATHODE RAY TUBE MASK MEMBER

Kenneth Speigel, Seneca Falls, N.Y., assignor to
GTE Sylvania Incorporated

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3 Claims

ABSTRACT OF THE DISCLOSURE

A process is described for removing the temporary electrophoretically applied aperture-reducing coating from a color cathode ray tube mask member prior to final assemblage of the tube mask-screen assembly. The de-coating process includes immersing the coated aperture mask into an electrolyte solution that is non-corrosive to the mask material per se. An electrode is positioned within the electrolyte solution in a manner to be spatially related to the introduced mask. Opposite polarities of a D.C. potential are thence applied to the mask and electrode to effect a gaseous release at substantially the mask, whereupon, the ensuing bubbling physically removes the coating from the mask as aggregations of solid particulate material thereby restoring the mask apertures to their initial dimensioning.

CROSS-REFERENCE TO RELATED APPLICATION

This application is related to a co-pending application S.N. 310,707, filed Nov. 30, 1972, which is assigned to the assignee of the present invention.

BACKGROUND OF THE INVENTION

This invention relates to the method of fabricating a color cathode ray tube mask-screen assembly and more particularly to a process for removing a temporary coating from the mask prior to final assemblage of the mask-screen assembly.

Color cathode ray tubes, such as those used in television applications, usually have patterned screen structures comprised of repetitive groups of related phosphor materials which are conventionally disposed as bars, stripes or dots depending upon the particular type of color tube construction. For example, in the shadow mask tube, the screen in a defined relationship is a multi-apertured tube of substantially round or discretely elongated dots formed of selected cathodoluminescent phosphors, which, when electron excited, produces additive primary hues to effect the desired color imagery. Spatially associated with the screen in a defined relationship is a multi-apertured shadow mask structure. Each of the apertures therein, being of a substantially round or elongated shaping, is cognitively related to a specific grouping of similarly-shaped phosphor dots in the screen pattern in a manner to enable the selected electron beams traversing the apertures to impinge the proper phosphor areas therebeneath.

Improved brightness and contrast of the color screen image has been achieved by a patterned multiplex screen structure wherein the dot-defining interstitial spacing between adjacent phosphor dots is covered by an opaque light-absorbing material. Specifically, each phosphor dot area is defined by a substantially dark opaque encompassment which collectively comprises a patterned windowed webbing, effecting an array of substantially opaque connected interstices.

A further improvement in tube characteristics is realized from a mask-screen relationship wherein the respective phosphor covered windows of the opaque webbing in the finished multiplex screen are slightly smaller than the

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apertures in the related shadow mask. This aperture-to-window relationship is commonly referenced in the art as a "negative guardband" or as a "window-limited" screen. In this type of color screen construction, when a superimposed phosphor dot is impinged by an aperture-sized electron beam, the excited area completely fills the associated window area with a luminescent hue.

Of the several techniques utilized to achieve a patterned multiplex window-limited color screen structure one advantageous process, which employs a temporarily coated shadow mask member during fabrication of the color screen structure, is disclosed in S.N. 310,707 by Kenneth Speigel, filed Nov. 30, 1972, and assigned to the assignee of this invention. In the aforementioned process, the apertures in the mask are temporarily reduced in size by an electrophoretically applied coating that is absorbent of actinic radiant energy, such being selected from the group consisting essentially of zinc oxide, titanium dioxide, and a mixture of zinc oxide and titanium dioxide. The coated mask is used to photo expose a windowed web defined by opaque interstices on the interior surface of the tube viewing panel; whereupon, the coated mask is again employed to photo expose a superimposed pattern array of phosphor dots to fully cover each of the window areas. After formation of the screen structure, the temporary coating is removed from the mask by the action of a dissolving solution, such as ethanoic acid, with which the mask is de-coated thereby restoring the apertures to their initial dimensioning without harming the underlying mask material per se. In the mask-screen assembly thus fabricated, the mask apertures in the completed tube are of a size larger than the associated phosphor filled window areas of the screen. In solubilizing the zinc oxide coating a solution of water soluble zinc acetate is formed, which, in a production situation, can rapidly accumulate to be an appreciable volume of solution for which adequate disposal is necessary. From both manufacturing and ecological viewpoints, adequate disposal may constitute problems involving additional facilities and expense.

OBJECTS AND SUMMARY OF THE INVENTION

It is an object of the invention to reduce the aforementioned disadvantages by providing a process for removing the temporary coating from the mask in a sold form that is readily disposable. Another object is to provide a coating removal process wherein the removed coating is not solubilized in the process.

These and other objects and advantages are achieved in one aspect of the invention by the provision of a de-coating process for removing the temporary coating modification from the CRT apertured mask member in a manner not destructive to the mask member per se. Such process includes immersing the mask into an electrolyte solution having an electrode positioned therein in spatial relationship to the introduced mask. Thence forth, opposite polarities of a D.C. potential are applied to the mask and electrode to effect a gaseous release at substantially the mask, whereupon the ensuing bubbling physically removes the coating from the mask as solid particulate material thereby restoring the mask apertures to their initial dimensioning.

DESCRIPTION OF THE PREFERRED EMBODIMENT

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

While the ensuing description is primarily directed to de-coating a coated mask as used in a window-limited

color cathode ray tube shadow mask-screen assembly, the concept of utilizing temporarily modified apertures in a screen forming operation, and the subsequent removal of the temporal coating from the mask, is likewise applicable for tubes employing a focus mask-screen structure.

The present invention provides an advantageous process for de-coating an electrophoretically coated mask whereof the temporary dimensional modification of the apertured pattern member of the shadow mask is utilized in selected steps of the procedure for fabricating the windowed opaque webbing and the associated phosphor elements of a window-limited screen structure. The temporary modification is in the form of a discretely applied coating which is thence removed, by the process of this invention, prior to final positioning of the mask relative to the screen structure during tube fabrication.

A typical shadow mask is usually comprised of a supportive framing portion to which an apertured member is peripherally attached. The apertured member, for example, is formed of a basic steel material having a conventional thickness within the range of 0.005 to 0.007 inch, and is normally domed in a manner related to the interior contour of the tube viewing panel with which it is spatially associated. The mask structure is priorly subjected to a known controlled atmospheric heat treatment to form a dark coating comprising a mixture of iron oxides on both the inner and outer surfaces thereof. It is conventionally desired to retain such dark coating for use in the finished tube to enhance efficiency and uniformity in the radiation of heat in the mask induced by electron bombardment. As a result, the mask operating temperature is lowered and heatup distortion in the mask is noticeably reduced. It has been found that tubes having the dark coated masks can be expeditiously and facily adjusted in operating environments. Therefore, it is important that the temporary mask modification, and the processes for applying and removing the temporal coating, should in no manner affect the beneficial dark iron oxide surface condition on the mask, nor should it in any way permanently alter the initially formed apertures in the mask.

The temporary coated modification of the mask member is, for example, consummated by applying a coating to the apertured member of the mask to effect a pre-determinate reduction in the order of 0.0015 to 0.0025 in the sizes of the initially defined apertures therein. This coating is in the form of at least one uniformly disposed application of a discrete particulate material that is applied, for example, by electrophoretic deposition. The coating material is substantially absorbent and non-reflective of ultraviolet radiant energy in substantially the 340 to 380 nanometer range. This material characteristic is a very important consideration in photo exposing both the basic window pattern and the subsequently disposed pattern of phosphor elements thereover. The UV absorbent material prevents deleterious reflections of the actinic exposure radiation thereby promoting better control of the exposure techniques with marked improvements in size control and definition of the respective resultant patterns. This electrophoretically applied first coating in an opaque minutely particulate UV absorptive material selected from the group consisting essentially of zinc oxide, titanium dioxide, and a mixture of zinc oxide and titanium dioxide.

The liquid vehicle of the suspension is comprised, for example, of a C₁-C₂ monohydric alcohol, such as methanol and/or ethanol, combined with a C₃-C₅ monohydric alcohol, such as a propyl, butyl or amyl alcohol or mixtures of the same. A small amount of aluminum nitrate is included to promote electrical conductivity. The suspended solids are preferably of sub-micron size particles having a mean particle size within the range of approximately 0.10 to 0.20 microns. The upper limit of particle size should not exceed substantially 5.0 microns.

The application of the temporary modification coating to the domed and formed apertured pattern position of the complete shadow mask structure is effected by an electrophoretic coating procedure prior to fabrication of the screen structure. The shadow mask is invertedly positioned in a manner that only the domed apertured portion thereof is immersed in the aforescribed electrophoretic coating suspension. A foraminous electrode, positioned in the coating suspension, is shaped to a contour compatible to that of the domed aperture portion of the mask to which it is spacedly related when the mask is immersed in the coating suspension. The functioning area of the suspension electrode at least equals the area of the related aperture portion of the mask, and the openings in the electrode facilitate movement of the coating suspension which is desirably agitated to promote homogeneity during application. Separate electrical connections from a D.C. electrical supply are connected through appropriate switching means to both the mask and the suspension oriented electrode to effect electrically induced coating deposition on the apertured portion of the mask. For example, when the coating suspension electrode is made the anode and the mask and the cathode, cataphoretic deposition of the suspension solids is consummated on the mask.

The D.C. coating potential may be in the order of 100 to 200 volts to establish a coating application current of a sufficiency, such as two amperes between the mask (cathode) and the coating suspension electrode (anode), the voltage being dependent upon the inter-electrode anode-to-cathode spacing therebetween. An electrical potential activation period of from one to two minutes effects a cataphoretic deposition of from 1.0 to 1.5 mils of particulate material, such as zinc oxide, on the pattern portion of the mask which temporarily modifies or reduces the size of the apertures therein.

After the coating has been applied, the temporarily modified mask is utilized in fabricating the windowed interstitial webbing of the color screen structure by known photo exposure techniques. An example of one web-forming procedure is disclosed in S.N. 41,535 by R. L. Bergamo et al., filed May 28, 1970, and assigned to the assignee of this invention and now abandoned. The coated mask is then utilized in forming the phosphor screen pattern wherein the areas of the comprising phosphor components, such as the red, blue and green cathodoluminescent elements, are disposed over the window areas of the interstitial webbing by one of several conventional phosphor deposition procedures.

Upon completion of the formation of the screen structure, the temporary coating modification is removed from the mask by the process of the invention. The mask member is immersed into an electrolyte solution that is non-corrosive to the steel mask material per se or to the beneficial oxide surface condition thereof. Positioned within the electrolyte solution is an electrode structure having openings therein and a functional expanse at least equaling the apertured area of the mask, to which it is spatially related when the mask is immersed in the electrolyte. The open-structure electrode is a foraminous, mesh or lattice electrically conductive member formed to effect the necessary functional expanse. The actual surface area of the electrode is less than the surface area of the mask to reduce the electrical current requirements for the process. Electrical connections are made to a D.C. power source in a manner to apply opposed polarities to the mask members and the electrode respectively to effect a gaseous release at substantially the mask, a reaction which is thought to be gasification of the electrolyte. The resultant bubbling action loosens the coating from the base material thereby producing physical de-coating of the mask.

In greater detail, the apertured mask member, which has a temporary UV absorbent coating modification of zinc oxide, titanium dioxide, or a mixture of zinc oxide and titanium dioxide thereon, is immersed in an electro-

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lyte solution in the form of a 3 to 6 percent ethanoic acid (acetic acid) concentration in water. The electrophoretically disposed coating, being substantially a porous deposition, permits penetration of the electrolyte thereinto. Positioned within the electrolyte solution, which is preferably agitated during the process, is an open-structured electrode member spacedly oriented relative to the walls and bottom of the electrolyte container to facilitate movement of the electrolyte solution through the electrode. Thus, the electrode is predeterminedly spatially related to the mask member, when such is immersed into the solution, the spacing therebetween being in the order of 0.250 to 1.000 inch.

The mask member and electrolyte electrode are individually connected, through a suitable switching arrangement, to the opposite polarities of a D.C. voltage supply. The most efficient de-coating appears to result when the mask is made the anode. The ensuing evolution of gas from the electrolyte is manifest at substantially the anode by a bubbling action which is thought to be primarily liberated oxygen. This anode-related gaseous movement physically removes the electrophoretically disposed coating from the steel base material thereby restoring the mask apertures to their initial dimensioning. Additionally, the oxidation on the mask surface is beneficially retained.

It has been found desirable to avoid the use of large power supplies. Therefore, as previously mentioned, the active cathode electrode surface area is reduced in relation to the mask area to effect a de-coating current in the order of 1 to 5 amperes. The de-coating potential is within the range of substantially 30 to 100 volts. The period of voltage application is for a duration of substantially 20 to 40 seconds. Accordingly, an adequate production procedure, is for example, a potential of substantially 50 volts for an application period of approximately 30 seconds.

The de-coating process is advantageous in that the coating material is removed as aggregations of particulate solids which upon settling are readily separable from the electrolyte. Being particulate solid material it is easily handled and is in a form adaptable for purification and re-use. Furthermore, the de-coating process of the invention is in no manner harmful to the mask material.

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 the method for fabricating the mask-screen assembly of a color cathode ray tube employing an apertured metallic mask member whereof the apertured portion has been electrophoretically coated with a substan-

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tially porous deposition of a fine particulate material to temporarily reduce the initial aperture dimensions during screen structure formation, a process for removing the temporary mask coating prior to final assemblage of the mask-screen assembly, said coating removal process being non-destructive to the mask member per se and comprising:

immersing the coated apertured mask into an electrolyte in the form of an ethanoic acid-water solution non-corrosive to the mask material, the apertured portion of said mask being positioned in said electrolyte in spaced relationship to an electrode spatially positioned in a predetermined manner adjacent thereto and having openings therein to facilitate movement of the electrolyte to the coated mask, said electrode having a contour related to the apertured area of said mask and an expanse at least equalling that of the adjacent coated mask area but having a surface area less than the surface area of said mask;

agitating said electrolyte during operation of the process to provide movement of the electrolyte through the openings in said discretely shaped electrode; and applying opposed polarities of a D.C. potential to said mask and said electrolyte electrode to effect a gaseous release to physically de-coat said mask as aggregations of particulate solids which settle and are readily separable from said electrolyte, the application of said de-coating potential being of a time-duration sufficient to separate said coating from said mask member thereby restoring the mask apertures to their initial dimensioning.

2. The process for removing the temporary electrophoretically disposed mask coating according to Claim 1 wherein said coating is a UV absorbent material selected from the group consisting essentially of zinc oxide, titanium dioxide and a mixture of zinc oxide and titanium dioxide, and wherein said electrolyte is in the form of a substantially 3 to 6 percent ethanoic acid-water solution.

3. The process for removing the temporary electrophoretically disposed mask coating according to Claim 2 wherein the applied de-coating potential is within the range of substantially 30 to 100 volts, the current being in the order of 1 to 5 amperes, and wherein the power application is for a duration of substantially 20 to 40 seconds.

References Cited

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THOMAS M. TUFARIELLO, Primary Examiner

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,823,080 Dated July 9, 1974
Inventor(s) Kenneth Speigel

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

Column 1, line 47 - delete "in a defined relationship is a multi-apertured tube" and insert
-- pattern is conventionally comprised of a multitude --

Column 3, line 61 - delete "in" and insert -- is --

Signed and sealed this 29th day of October 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents