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## METHOD OF MANUFACTURE OF CATHODE RAY TUBES

Harry R. Colgate, Redondo Beach, Calif., assignor to Philco Corporation, Philadelphia, Pa., a corporation of Pennsylvania

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This invention relates to the manufacture of cathode ray tubes involving deposition of discrete elements on interior surfaces. For example, the invention is applicable to the manufacture of cathode ray tubes having index elements which, in response to electron beam impingement, produce an index signal (e.g. by light emission or secondary electron emission) indicative of the rate of beam traversal of the screen and of the position of the beam at any instant.

While not limited thereto, the invention is particularly applicable and will be described with reference to the manufacture of color image-producing cathode ray tubes for use in color television receivers wherein an index signal is utilized to coordinate the instantaneous beam modulation, and the instantaneous beam position to insure proper color rendition, and it is very important that the index elements be accurately located. In a preferred form of such a cathode ray tube, the screen has phosphor stripes extending transversely to the direction of line scanning and arranged in successive triplets, the stripes of each triplet being successively emissive of light of different primary colors (e.g. red, green and blue) in response to electron beam impingement during each line scan of the screen, and the screen also has index stripes associated with the color triplets. In order to increase the light output from the screen and thus increase the brightness of the reproduced image, an electron-permeable light-reflecting film, preferably composed of aluminum, is provided behind the colored light-emissive elements and this film serves additionally as a support for the index elements which are applied to its rear surface. Cathode ray tubes of the stated character are now well known.

Experience has shown that the best method of applying the colored light-emissive elements and the index elements is the photographic method which involves, for each set of elements, application of a photosensitive layer (i.e. a photographic emulsion), selective light exposure through a suitable mask of those areas of said layer where the elements are to be provided, and removal of the unexposed portions of said layer. The light exposed portions are rendered insoluble, and it is a simple matter to remove the unexposed portions simply by washing them away with water in which the unexposed emulsion is soluble. In the manufacture of a color image-producing cathode ray tube, the three sets of colored light-emissive elements are first applied in succession, then the aluminum film is applied, and finally the index elements are applied.

Exemplary embodiments of the photographic method are described in a copending application of J. W. Tiley, Serial No. 248,356, filed September 26, 1951, and a copending application of M. Sadowsky and S. L. Parsons, Serial No. 408,219, filed February 4, 1954.

In cathode ray tubes employing a light-reflecting film, such as the aforementioned aluminum film, it is generally desirable to have this film extend beyond the screen

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area onto at least a portion of the wall of the bell portion of the tube envelope, particularly where the index signal is to be produced by light emission of the index elements. The present practice is to have the light-reflecting film extend over substantially the entire wall of the bell portion as this enhances the production of the index signal. Moreover, it is also desirable to provide index elements not only on the screen area but also on the wall area adjacent thereto so that the index signal will be generated throughout the entire trace of the electron beam. The present practice, as described on pages 1115 to 1119 of the Proceedings of the I.R.E. for September 1956, is to form the envelope unit comprising the face plate and the bell portion, and then carry out the aforementioned process using back projection of light. However, the provision of index elements on the wall area gave rise to a problem in that light directed to the wall area for location of index elements thereon tends to be reflected by the aluminum film to portions of the screen area where index elements are not desired, with resulting degradation of the index pattern.

One object of the present invention is to provide a simple and inexpensive solution of this problem.

Another object of this invention is to provide a method which is applicable in any instance where it is desired to apply discrete elements to the screen and wall areas of the light-reflecting film by the photographic method.

In accordance with this invention, the aforementioned undesired reflection of light in the practice of the photographic method is prevented by applying to the light-reflecting film a material which is non-reflective of the light to which the photosensitive layer next to be applied is sensitive. Thus the method according to this invention includes not only the steps previously followed but also an intermediate step following the application of the light-reflecting film and prior to the application of the photosensitive layer for the deposition of the elements, e.g. index elements, which are applied to the screen and wall areas.

The invention may be fully understood from the following detailed description with reference to the accompanying drawing wherein the single figure is a sectional view taken horizontally through the axis of a color image-producing cathode ray tube manufactured in accordance with the present invention. It will be understood that it is impossible to illustrate on true scale the multitudinous extremely fine elements as they exist in the physical structure, and therefore the illustration is intended only to be generally representative of the structure.

Referring more particularly to the drawing, the envelope unit shown comprises the face plate 10 and the bell portion 11. In the photographic process as presently practiced, a light pattern of each set of elements to be deposited is projected from the rear through the bell portion. For simplicity of illustration, the light pattern in each instance may be regarded as emanating from a point 12, although it will be understood that in actual practice light projection apparatus including a mask is used to produce each light pattern, as described in the aforementioned Proceedings of the I.R.E. As hereinbefore stated, the colored light-emissive elements 13 are first applied to the face plate 10, and the light-reflecting film 14, preferably composed of aluminum, is then applied. In the illustration this film is shown extending over the wall area adjacent to the screen area, and in some instances it may be desired to have the film extend over substantially the entire wall area of the bell portion 11, which in fact is the present practice.

In accordance with the present invention, the next step in the overall process is the application to the light-re-

reflecting film 14 of a coating 15 of material which is non-reflective of light of a particular color to which the photosensitive layer next to be applied is sensitive. This coating can be applied as a liquid in any suitable manner as by painting, and it need only be a thin coating which covers the film 14. Preferably, the material 15 is a red dye which is non-reflective of blue light to which the usual photographic emulsion is sensitive. If desired, the dye can be added to the lacquer which is commonly applied to the aluminum film as a protective film. The coating 15 extends over the screen area and the adjacent wall area. Any suitable material may be used for the coating 15 which can be later baked out without leaving a residue. For example, the oil dyes which are used to color gasoline and leave no residue when baked out can be used for the coating 15.

Following the application of the coating 15, the photosensitive layer 16 is applied and those areas thereof where the index elements are to be provided are selectively exposed to light, after which the unexposed portions of layer 16 are removed as by washing them away with water in which the unexposed emulsion is soluble, leaving the index elements 17.

Prior to this invention, in the absence of the coating 15, a problem was presented with respect to the provision of index elements on the wall area adjacent to the screen area. Consider, for example, the light ray 18 impinging on the photosensitive layer 16 to provide index element 17a. In the absence of the coating 15, all of the light of this ray would be reflected by the reflecting film 14, as indicated by the dotted line 19, and the result would be that portions of the layer 16 where no index elements are desired would be rendered insoluble, thus degrading the index pattern. However, with the coating 15 present, the light to which the layer 16 is sensitive is not reflected by the film 14. Thus this invention provides a very simple solution to the problem.

The final step in the process is the removal of the coating 15 by baking. The usual baking operation, to which cathode ray tubes are commonly subjected, will serve to remove the coating 15 without leaving a residue.

From the foregoing description it will be seen that the present invention has provided a very simple solution to a real problem. Moreover, the invention is applicable in any instance where it is desired to apply elements to the screen and adjacent wall area of a cathode ray tube. It will be understood, therefore, that no limitation of the invention is intended herein except as defined by the appended claims.

I claim:

1. In the manufacture of cathode ray tubes wherein it is desired to provide for light reflection and also to provide elements on the screen and on the wall area adjacent thereto, the method which includes the steps of applying a light-reflecting film to the screen area and also at least to the adjacent wall area, applying to the light-reflecting film a material which is non-reflective of light of a particular color, applying over said material a photosensitive layer which is sensitive to light of said particular color, selectively exposing to light those areas of said layer where said elements are to be provided, and removing said material and the unexposed areas of said layer.

2. In the manufacture of cathode ray tubes wherein it is desired to provide for light reflection and also to provide elements on the screen and on the wall area adjacent thereto, the method which includes the steps of applying a light-reflecting film to the screen area and also at least to the adjacent wall area, applying to the light-reflecting film a material which is non-reflective of light of a particular color and which can be removed later by

baking, applying over said material a soluble photosensitive layer which is rendered insoluble by light of said particular color, selectively exposing to light those areas of said layer where said elements are to be provided, dissolving the unexposed areas of said layer, and removing said material by baking.

3. In the manufacture of cathode ray tubes wherein it is desired to provide for light reflection and also to provide elements on the screen and on the wall area adjacent thereto, the method which includes the steps of applying a light-reflecting film to the screen area and also at least to the adjacent wall area, applying to the light-reflecting film a red dye which is non-reflective of blue light and which can be removed later by baking, applying over said dye a soluble photosensitive layer which is rendered insoluble by blue light, selectively exposing to light those areas of said layer where said elements are to be provided, dissolving the unexposed areas of said layer, and removing said dye by baking.

4. In the manufacture of color image-producing cathode ray tubes of the index type wherein it is desired to provide for light reflection and also to provide index elements on the screen and on the wall area adjacent thereto, the method which includes the steps of applying to the screen elements emissive of light of different colors when impinged by an electron beam, applying a light-reflecting film to the screen area containing said elements and also at least to the adjacent wall area, applying to the light-reflecting film a material which is non-reflective of light of a particular color, applying over said material a photosensitive layer which is sensitive to light of said particular color, selectively exposing to light those areas of said layer where the index elements are to be provided, and removing said material and the unexposed areas of said layer.

5. In the manufacture of color image-producing cathode ray tubes of the index type wherein it is desired to provide for light reflection and also to provide index elements on the screen and on the wall area adjacent thereto, the method which includes the steps of applying to the screen elements emissive of light of different colors when impinged by an electron beam, applying a light-reflecting film to the screen area containing said elements and also at least to the adjacent wall area, applying to the light-reflecting film a material which is non-reflective of light of a particular color and which can be removed later by baking, applying over said material a soluble photosensitive layer which is rendered insoluble by light of said particular color, selectively exposing to light those areas of said layer where the index elements are to be provided, dissolving the unexposed areas of said layer, and removing said material by baking.

6. In the manufacture of color image-producing cathode ray tubes of the index type wherein it is desired to provide for light reflection and also to provide index elements on the screen and on the wall area adjacent thereto, the method which includes the steps of applying to the screen elements emissive of light of different colors when impinged by an electron beam, applying a light-reflecting film to the screen area containing said elements and also at least to the adjacent wall area, applying to the light-reflecting film a red dye which is non-reflective of blue light and which can be removed later by baking, applying over said dye a soluble photosensitive layer which is rendered insoluble by blue light, selectively exposing to light those areas of said layer where the index elements are to be provided, dissolving the unexposed areas of said layer, and removing said dye by baking.

No references cited.