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(54) IMPROVEMENTS RELATING TO LUMINESCENT SCREENS

(71) We, PHILIPS ELECTRONIC AND ASSOCIATED INDUSTRIES LIMITED, of Abacus House, 33 Gutter Lane, London, E.C.2, a British Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a method of manufacturing a luminescent screen of a cathode-ray tube for displaying coloured pictures, which screen comprises in discrete areas materials which upon excitation by electrons luminesce in different colours, said areas being separated by areas of a light-absorbing material, the light-absorbing material being first provided on the support of the screen, the materials which upon excitation by electrons luminesce in different colours being then provided successively.

A screen constructed in such manner has the advantage that the tinting of the window glass to prevent the reflection of ambient light, may be omitted or may be less than in a similar tube having a luminescent screen which contains no areas of light-absorbing material which separate the areas of the luminescent materials, since the picture displayed on the screen having the light-absorbing material has more contrast, due to less ambient light being reflected by the screen, than the similar screen containing no areas of light-absorbing material. The observed picture is brighter on account of the reduced or omitted tinting of the window glass.

A method of manufacturing such a screen is known from the United States Patent Specification 3,146,368. The light-absorbing material is applied with the aid of a layer of photo-sensitive lacquer. The layer of the photo-sensitive lacquer is exposed to radiation in the places where the luminescent areas are afterwards present and a lacquer is used having properties such that the exposed parts of the layer are soluble in a solvent in which the non-exposed parts are not soluble. When the light-absorbing material is present in the solution of the photo-sensitive lacquer, it is thus already present in the layer during the exposure; this may give rise to difficulties because the material also has a light-absorbing effect during the exposure so that very long exposure times are necessary. When the light-absorbing material is provided after the exposure of the photo-sensitive lacqer, it is often difficult to obtain a sufficiently dense layer of the light-absorbing material. Moreover, a number of such lacquers have the drawback of being hard to develop because the exposed areas do not dissolve as such but only swell after which the gel-like material has to be removed mechanically, for example, by rubbing.

A method in which the light-absorbing material itself is provided without the aid of a photo-sensitive binder is known from United Kingdom Patent Specification 1,180,195. In this case the support is covered with a layer of a photo-sensitive lacquer which becomes insoluble after exposure. The layer is exposed to radiation in the places where the luminescent areas are afterwards present, and the unexposed areas are then dissolved. On the support, which is partly covered with exposed photo-sensitive lacquer, a dispersion of colloidal graphite in water is provided which after drying adheres both to the uncovered support and to the photo-sensitive lacquer present. The areas of the photo-sensitive lacquer with the graphite particles adhered thereto are then removed by means of a material which chemically attacks the hardened lacquer. The difficulty of said method is that the binder of the colloidal graphite is also attacked which results in an insufficiently dense layer, while in addition the holes which are formed in the layer of colloidal graphite are larger than the areas which correspond to the exposed areas of the photo-sensitive lacquer.

According to the invention, the support is covered with a layer of a photosensitive lacquer which has the property that an unexposed layer has a sticky surface, while this sticky property disappears upon exposure, the layer of the photosensitive lacquer

is exposed in the areas where the luminescent areas are afterwards present, the layer is covered with a powder or suspension of the light-absorbing material which adheres to the unexposed areas, the light-absorbing material is removed by washing the exposed areas and the areas of the differently luminescing materials are provided successively. In this method it is not the solubility or insolubility of areas of the photo-sensitive lacquer that is of importance, but it is the change of the sticky property under the influence of radiation that counts. The sticky property of such materials results in an insufficiently dense layer of the light-absorbing material being obtained. The sticky property disappears upon exposure, but usually the lacquer is also hardened at that region, which means that the lacquer then has the property that the unexposed areas of the layer are soluble in a solvent in which the exposed areas are not soluble. As already stated, this is of no influence on the method described. After removing the light-absorbing material by washing the exposed areas, the areas of the various luminescent materials are provided successively and during these steps the photo-sensitive lacquer by means of which the light-absorbing material has been provided is still present on the support. After providing the luminescent materials. the photo-sensitive lacquer by means of which the light-absorbing material has been provided and the photo-sensitive lacquer(s) by means of which the luminescent materials have been provided, are removed by firing.

As an example of photo-sensitive lacquers which have the property that an unexposed layer has a sticky surface, while said sticky property disappears upon exposure, is mentioned "Cermifax" of Kodak Pathé.

There exist various possibilities for providing the luminescent materials. This may be done by means of a photo-sensitive lacquer which has the property that, as a result of exposure to radiation, the lacquer becomes insoluble in a solvent in which the non-exposed lacquer is soluble. It is also possible to provide the luminescent materials electrophotographically. In this case a conductive layer is provided on the layer of the photo-sensitive lacquer still present and by means of which the light-absorbing material has been provided, and on said layer a photo-conductive layer is provided which is charged by means of a corona discharge. The areas of the photo-conductive layer which correspond to the areas of a given luminescent material are then exposed as a result of which the charge on said areas of the photo-conductive layer flows away. Charged particles of the relevant luminescent material are provided on said areas.

The invention furthermore relates to a cathode-ray tube comprising a luminescent screen manufactured in this manner.

In order that the invention may be readily carried into effect, it will now be described in greater detail with reference to the following Example.

EXAMPLE

On the inside of the screen of a shadow mask tube, a photo-sensitive layer is provided which consists of "Cermifax". After drying the layer which has a sticky surface, the shadow mask is secured in the window and the photo-sensitive layer is exposed three times by means of three different positions of a light source so that the areas of the photosensitive layer which correspond to the areas of the window on which the luminescent areas are afterwards present, are hardened and lose their sticky property. After removing the shadow mask, an aqueous suspension of particles of a light-absorb- material, for example graphite, MnO_2 or Fe_3O_4, is provided on the photo-sensitive layer. These particles adhere to the unexposed parts of the photosensitive layer which still have their sticky property. The liquid is decanted and the surplus particles of the light-absorbing material are removed by washing the exposed particles and the screen is dried. Hereon an aqueous solution of bichromate-activated polyvinyl alcohol which in suspension contains particles of a green luminescent material is provided and dried. The shadow mask is secured in the window and the layer of polyvinyl alcohol is exposed in the areas where the green luminescent material should be present as a result of which the polyvinyl alcohol is hardened. After removing the shadow mask, the unexposed polyvinyl alcohol is removed by washing with water. The blue and red luminescent materials are provided in the same manner. The resulting screen is covered in the usual manner with a thin layer of aluminium after which the screen is fired, "Cermifax" and the polyvinyl alcohol volatilising.

WHAT WE CLAIM IS:—

1. A method of manufacturing a luminescent screen of a cathode-ray tube for displaying coloured pictures, which screen comprises in discrete areas materials which upon excitation by electron luminesce in different colours, said areas being separated by areas of a light-absorbing material, the light-absorbing material being first provided on the support of the screen, the materials which upon excitation by electrons luminesce in different colours being then provided successively, characterized in that the support is covered with a layer of a photo-sensitive lacquer which has the property that an unexposed layer has a sticky

is exposed in the areas where the luminescent areas are afterwards present, the layer is covered with a powder or suspension of the light-absorbing material which adheres to the unexposed areas, the light-absorbing material is removed by washing the exposed areas and the areas of the differently luminescing materials are provided successively. In this method it is not the solubility or insolubility of areas of the photo-sensitive lacquer that is of importance, but it is the change of the sticky property under the influence of radiation that counts. The sticky property of such materials results in an insufficiently dense layer of the light-absorbing material being obtained. The sticky property disappears upon exposure, but usually the lacquer is also hardened at that region, which means that the lacquer then has the property that the unexposed areas of the layer are soluble in a solvent in which the exposed areas are not soluble. As already stated, this is of no influence on the method described. After removing the light-absorbing material by washing the exposed areas, the areas of the various luminescent materials are provided successively and during these steps the photo-sensitive lacquer by means of which the light-absorbing material has been provided is still present on the support. After providing the luminescent materials. the photo-sensitive lacquer by means of which the light-absorbing material has been provided and the photo-sensitive lacquer(s) by means of which the luminescent materials have been provided, are removed by firing.

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surface, while this sticky property disappears upon exposure, the layer of the photo-sensitive lacquer is exposed in the areas where the luminescent areas are present afterwards, the layer is covered with a powder or suspension of the light-absorbing material which adheres to the unexposed areas, the light-absorbing material is removed by washing the exposed areas and the areas of the differently luminescing materials are provided successively.

2. A method of manufacturing a luminescent screen for a colour television tube, substantially as herein described with reference to the specific Example.

3. A luminescent screen manufactured by the method as claimed in Claim 1 or Claim 2.

4. A face-plate bearing a luminescent screen as claimed in Claim 3.

5. A cathode-ray tube including a face-plate as claimed in Claim 4.

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