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(19)

(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 displacing 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 provided by means of a 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 lacquer, 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 parts 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 parts are then dissolved. On the supported, 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 photo-sensitive lacquer and 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 corresponds to the exposed areas of the photo-sensitive lacquer.

According to the invention, the support is covered with a layer of a photo-sensitive lacquer which under the influence of radiation from a first wavelength range becomes

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insoluble in a first solvent in which the unexposed lacquer is soluble, in which layer a filtering material is present which passes radiation from the first wavelength range but does not pass radiation from a second wavelength range and which is not soluble in the first solvent but is soluble in a second solvent, said layer is exposed to radiation from the first wavelength range in the places where the luminescent areas are afterwards present, the unexposed parts of the lacquer layer together with the filtering material present therein are removed by washing with the first solvent, the partly covered support is covered with a layer of a photo-sensitive lacquer which under the influence of radiation from the second wavelength range becomes insoluble in a third solvent in which the unexposed lacquer is soluble, in which layer the light-absorbing material is present, said layer is exposed, through the support, to radiation from the second wavelength range, the unexposed parts of the lacquer layer together with the light-absorbing material present therein are removed by washing with the third solvent, the filtering material still present is removed by washing with the second solvent and the areas of the differently luminescent substances are successively provided. During the provision of the various luminescent substances, parts of the photosensitive lacquer by means of which the filtering material has been provided and parts of the photo-sensitive lacquer by means of which the light-absorbing material has been provided, are still present on the support. After providing the luminescent materials, the photo-sensitive lacquer by means of which the filtering material has been provided, the photo-sensitive layer 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.

There are 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 furthermore 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 parts 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 particles flows away. Charged particles of the relevant luminescent material are provided on said parts.

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, an embodiment will now be described in greater detail with reference to the following Example.

EXAMPLE

On the inside of the screen an aqueous solution of polyvinyl alcohol activated with bichromate is provided which in suspension contains pigment particles of an azo dye, for example "Grasolecht Gelb" marketed by Geigy Co. Ltd). This material poorly passes radiation of approximately 3650 Å, but properly passes radiation from 4000 Å on. Furthermore, the particles are non-water-soluble but are water-soluble in a water-miscible organic solvent, for example ethanol or acetone. After drying the layer, the shadow mask is secured in the window and the polyvinyl alcohol layer is exposed three times by means of three different positions of a light source which *inter alia* has a spectral emission in the region from 3650 to 4500 Å. The parts of the layer of polyvinyl alcohol in which the pigment particles are suspended and which correspond to the parts of the window on which the luminescent areas are present afterwards, are hardened. After removing the shadow mask, the unexposed parts of the photo-sensitive layer with the pigment particles suspended therein are removed by washing with water. On the inside of the screen which is partly covered with hardened polyvinyl alcohol dots in which the pigment particles are present, an aqueous solution of bichromate-activated polyvinyl alcohol is provided which contains graphite particles in suspension. After drying the layer it is exposed through the window by means of a light source which transmits only radiation of approximately 3650 Å. In this manner, only those parts of the polyvinyl alcohol layer containing the graphite particles are hardened which are present between the already hardened polyvinyl alcohol dots in which the pigment particles are present. The unexposed parts of the layer together with the graphite particles present therein are collectively removed by washing. In this case the third solvent is the same as the first solvent, namely water, because the photo-sensitive layer which is used for the filtering material and the photo-sensitive lacquer which is used for the graphite layeris polyvinyl alcohol in both cases. The window is now fully covered with hardened polyvinyl alcohol in which pigment particles are present in the parts which correspond to the parts of the window on which the luminescent materials are afterwards present, while in the remaining parts graphite is present. The pigment particles are now removed by dissolving in a water-miscible organic solvent, for example ethanol or acetone. The window is then fully covered with

hardened polyvinyl alcohol in which graphite is present in the parts situated between the parts of the window on which the luminescent materials are afterwards present. 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 through the shadow mask in the places 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, the polyvinyl alcohol still present, which has been used during providing the pigment particles, the graphite and the luminescent materials, 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 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, characterized in that the support is covered with a layer of a photo-sensitive lacquer which under the influence of radiation from a first wavelength range becomes insoluble in a first solvent in which the unexposed lacquer is soluble, in which layer a filtering material is present which passes radiation from the first wavelength range but does not pass radiation from a second wavelength range and which is not soluble in the first solvent but is soluble in a second solvent, said layer is exposed to radiation from the first wavelength range in the places where the luminescent areas are afterwards present, the unexposed parts of the lacquer layer together with the filtering material present therein are removed by washing with first solvent, the partly covered support is covered with a layer of a photo-sensitive lacquer which under the influence of radiation from the second wavelength range becomes insoluble in a third solvent in which the unexposed lacquer is soluble, in which layer the light-absorbing material is present, said layer is exposed, through the support, to radiation from the second wavelength range, the unexposed parts of the lacquer layer together with the light-absorbing material present therein are removed by washing with the third solvent, the filtering material still present is removed by washing with the second solvent 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 Example.

3. A luminescent screen manufactured by a 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.

C. A. CLARK,
Chartered Patent Agent,
Century House,
Shaftesbury Avenue,
London, W.C.2.
Agent for the Applicants.

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