

PATENT SPECIFICATION

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DRAWINGS ATTACHED

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(54) CATHODE RAY TUBE SCREEN

(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 comprising 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 materials which, upon excitation by electrons, luminesce in different colours being first provided on the window of the tube by means of a photo-sensitive binder, the light-absorbing material being provided afterwards.

A screen constructed in this manner provides the advantage that with the same contrast the tinting of the window glass may be omitted or be at least smaller. As a result of this the observed brightness of the picture is greater.

United States patent specification 3,365,292 describes a method of manufacturing such a screen. After the various luminescent materials have been provided on the window by means of a photosensitive binder, they are provided with a filter layer. The window which is provided with areas of the various luminescent materials is then covered with a photo-sensitive binder. The photosensitive binder is soluble in a solvent but after exposure to a certain radiation which is not passed by the filter layer, the binder becomes insoluble in the relevant solvent. The layer of binder comprises a material which does not or only slightly absorbs the relevant radiation and which can be converted into a dark light-absorbing material. After drying the layer of binder it is exposed to the relevant radiation through the window. Since the filter layer is

present on the areas which are covered with areas of the various luminescent materials, the layer of binder does not adhere to those areas of the window. The binder is hardened over all the areas where it is in contact with the window. After dissolving the non-hardened binder, the material present in the hardened layer of binder is converted into a dark light-absorbing material by heating. The difficulty of this method is that a large number of operations are necessary.

United States patent specification 3,475,169 describes a method of manufacturing a luminescent screen of a cathode-ray tube for displaying coloured pictures which comprises in discrete areas substances which upon excitation by electrons luminesce in different colours, these areas being separated by areas of a light-absorbing material. In this method the areas of the various luminescent materials and of the light-absorbing material are provided electrophotographically, in which for the formation of the charge image for the light-absorbing material, irradiation with light is necessary to produce a pattern which can be developed. This patent specification also describes a method in which the areas of the various luminescent materials are provided electrophotographically but in which a binder is added to the luminescent materials which is modified in a further manufacturing step so that in the subsequent charging for the light-absorbing material it will not absorb any charge. In all these methods the whole window is provided with a conductive layer and a photoconductive layer.

The present invention provides a method of manufacturing a luminescent screen of a cathode-ray tube for displaying coloured pictures comprising 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 materials which, upon excitation by electrons, luminesce in different colours being first provided on the window of the tube by

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means of a photo-sensitive binder, the light-absorbing material being provided afterwards, characterized in that on the window provided with the discrete areas of the various luminescent materials a conductive layer is provided by rinsing with a solution comprising not more than 10% by weight of an electrically conductive material in a suitable solvent, said conductive layer being formed only in the spaces between the areas of the luminescent materials, a dielectric layer being then provided by rinsing with a solution comprising not more than 10% by weight of an electrically insulating material in a suitable solvent, said dielectric layer after drying being charged by means of a corona discharge, the light-absorbing material being provided on said charged dielectric layer by electrostatic deposition from a suspension in an apolar solvent. In this method the light-absorbing material is provided on parts of the window which are still uncovered after providing the luminescent materials. By limiting the maximum strength of the solution used to form the conductive layer to 10% by weight, and since the pattern of the luminescent areas is discontinuous, a conductive layer is only formed in the intermediate spaces between the luminescent areas. Similarly the formation of a continuous dielectric layer is prevented by the pattern of the luminescent areas so that the dielectric layer is only present on the conductive layer. After drying the dielectric layer should preferably have a thickness of less than 10 μm , in particular from 1—5 μm . During charging, the dielectric layer is charged to a high charge density as a result of its large capacity. Owing to the absence of a capacititive layer structure there is no charge on the luminescent areas. The formed charge image in the intermediate areas is developed by electrostatic deposition from a suspension of a black pigment which is suspended in an apolar solvent. An apolar solvent must be used in order that the charge image should not be discharged by contact with the solvent. According to this method which includes three treatments with liquids but which are not accompanied by irradiation, the intermediate areas between luminescent areas can be covered with a light-absorbing material consisting of a black pigment without a disturbing deposition of the black pigment on the luminescent areas.

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

In order that the invention may readily be carried into effect, it will now be described in greater detail, by way of example, with reference to the accompanying drawing, the sole Figure of which shows a part of a window of a tube during manufacture. The inside of the window of a shadow-mask tube

is provided with green, blue and red luminescent phosphor dots. The whole area of the window is covered with a suspension of one of these luminescent materials in a polyvinyl alcohol solution to which ammonium dichromate has been added. After the layer has been dried, it is exposed to ultraviolet radiations through the shadow mask, the swelling power of the layer in the exposed places is reduced and the unexposed material is then washed away. The three sets of luminescent patterns are prepared by this method. A conductive layer is first provided on the window comprising the luminescent areas, which layer is formed only in the intermediate areas between the luminescent areas. This is achieved by rinsing with dilute solutions of ionogenic materials in polar and non-polar solvents, possibly with the addition of wetting agents. The conductive layer which in a subsequent manufacturing step serves as an opposite electrode should have only a minimum conductivity because only very small currents must flow through the conductive layer. For example, 0.5 to 3% solutions of potassium silicate in water or a mixture of polyvinyl alcohol and glycerine in water are successfully used. Other substances for manufacturing said conductive layer used by those skilled in the art may be used. On said conductive layer a dielectric layer of approximately 1—5 μm thickness is provided. For that purpose the inside of the window is treated, for example, with a 1—5% solution of polyvinyl carbazol in 5 parts of chlorobenzene and 1 part of dichloromethane. A variety of organic film-forming polymers having good dielectric properties may be used instead of polyvinyl carbazol. In the places of the luminescent dots the formation of a coherent layer is again strongly impeded. The layer is then dried. The Figure shows the resulting structure. Luminescent areas 2 are present on a window 1. The intermediate areas on the window 1 are provided with a conductive layer 3 on which a dielectric layer 4 is present. The picture screen is now exposed to a positive or negative corona discharge. One or several needle-shaped tips or thin wires are connected to a high-voltage source of 6—30 kV direct voltage and guided over the earthed layer 3 at a distance of a few centimetres. The dielectric layer 4 in the intermediate areas between the luminescent areas 2 is charged to a high charge density as a result of its large capacity and the counter charges are present on the conductive layer 3. No charge occurs on the luminescent areas owing to the absence of the necessary capacity. This charge image in the intermediate spaces is now pigmented by means of an electrostatic deposition from a suspension of a black pigmentation and an apolar solvent. Any black, finely divided dye may be used as the black pigment. A suitable suspension of a positively

charged pigment for the black matrix is as follows:

- 5 30 g black pigment "Bayer 7454 Ca"
 5 g polymethacrylate "SV 46" Röhm
 und Haas
 0.01 g Ca-diisopropyl salicylate
 0.01 g Ca-dodecyl sulfosuccinate.

10 Other black pigments, for example, soot may be used in a similar manner. By using other ionogenic materials in the suspension, negative charges of the pigments can also easily be provided for the case in which a positive charge of the dielectric layer is to be used.

15 **WHAT WE CLAIM IS:—**

1. A method of manufacturing a luminescent screen of a cathode-ray tube for displaying coloured pictures comprising 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 materials which, upon excitation by electrons, luminesce in different colours being first provided on the window of the tube by means of a photosensitive binder, the light-absorbing material being provided afterwards, characterized in that on the window provided with the discrete areas

of the various luminescent materials a conductive layer is provided by rinsing with a solution comprising not more 10% by weight of an electrically conductive material in a suitable solvent, said conductive layer being formed only in the spaces between the areas of the luminescent materials, a dielectric layer being then provided by rinsing with a solution comprising not more than 10% by weight of an electrically insulating material in a suitable solvent, said dielectric layer, after drying, being charged by means of a corona discharge, the light-absorbing material being provided on said charged dielectric layer by electrostatic deposition from a suspension in an apolar solvent.

2. A method of manufacturing a luminescent screen of a colour television display tube, substantially as herein described with reference to the accompanying drawing.

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

4. A cathode-ray tube comprising a luminescent screen as claimed in Claim 3.

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