United States Patent

Uchida et al.

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[54] METHOD OF MANUFACTURING COLOR PICTURE TUBE

[72] Inventors: **Atsuyoshi Uchida; Yoshihiko Miyata,** both of Mobara, Japan

[73] Assignee: **Hitachi, Ltd.,** Tokyo, Japan

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[30] **Foreign Application Priority Data**

Dec. 24, 1969 Japan.....44/103372

[52] **U.S. Cl.**.....**29/25.17,** 29/25.13

[51] **Int. Cl.**.....**H01j 9/00**

[58] **Field of Search** 29/25.1, 25.11, 25.13, 25.14, 29/25.17, 25.18

[56] **References Cited**

UNITED STATES PATENTS

2,817,276	12/1957	Epstein et al.	29/25.13 X
2,986,080	5/1961	Burdick	29/25.13 X
3,579,768	5/1971	Burdick	29/25.13

Primary Examiner—John F. Campbell
Assistant Examiner—Richard Bernard Lazarus
Attorney—Craig, Antonelli and Hill

[57] **ABSTRACT**

A method of manufacturing color picture tubes, comprising the steps of forming resinous lenses in openings or electron-beam permeating apertures of a color selective electrode of the color picture tube, exposing to light through this color selective electrode a phosphor screen formed on the inner surface of a face plate in a panel portion of said tube, and removing said resin-made lenses after the exposure step.

19 Claims, 6 Drawing Figures

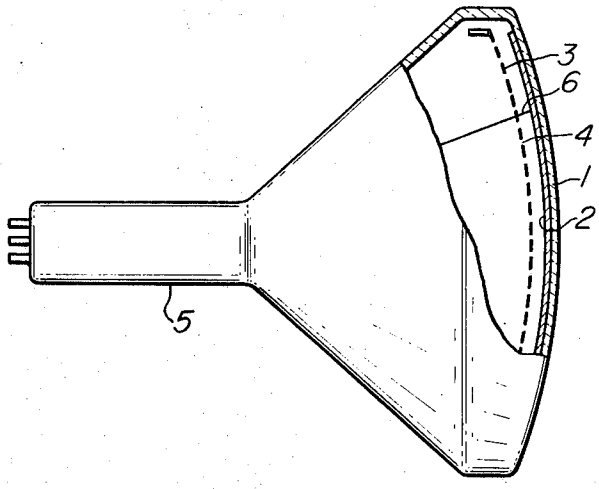


FIG. 1

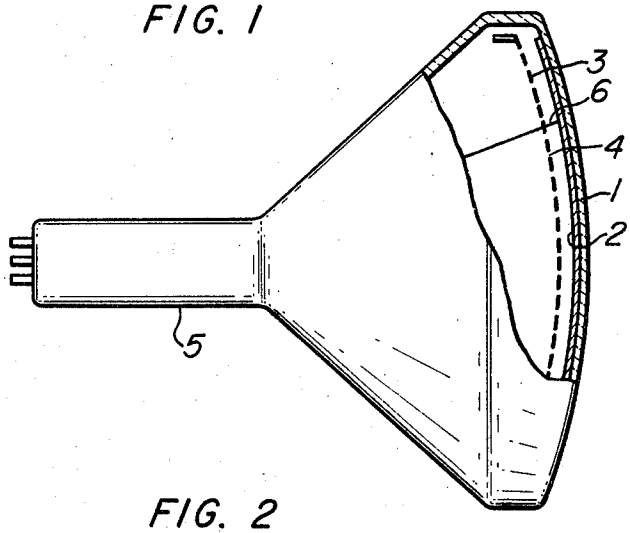


FIG. 3

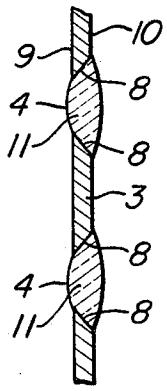


FIG. 2

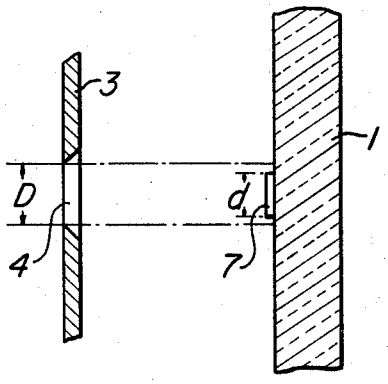


FIG. 4

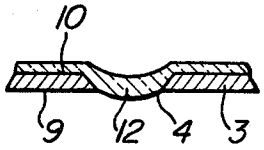


FIG. 5

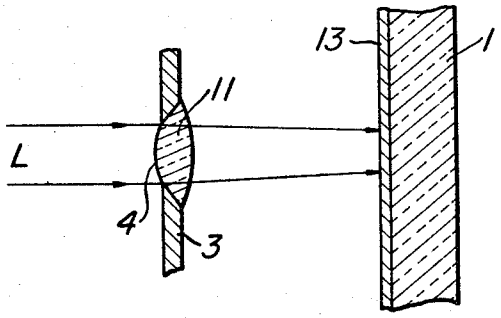
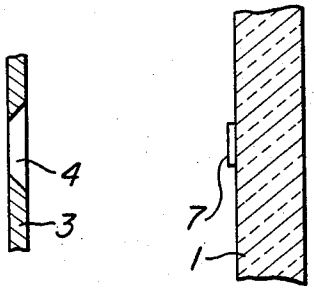


FIG. 6



INVENTORS

ATSUYOSHI UCHIDA
YOSHIHIKO MIYATA

BY Craig, Antonelli, Stewart + Hill

ATTORNEYS

METHOD OF MANUFACTURING COLOR PICTURE TUBE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a method of manufacturing color picture tubes, and more particularly to a novel method of forming a desired pattern of phosphors on a phosphor screen of a color picture tube.

2. Description of the Prior Art

Generally, a color picture tube has on the inner surface of a face plate of a spherical panel, a phosphor screen comprising a number of phosphors among which three phosphors being in charge of red, blue and green, respectively, constitute each set. A color selective electrode is disposed which faces the phosphor screen. In a shadow-mask type color picture tube the phosphors are in the form of dots, while in a chromatron type color picture tube they are in the form of stripes. The color selective electrode is called a "shadow mask" and includes a number of mask apertures in the shadow-mask type, while it has no fixed designation but is termed, e.g., a "grid" and includes a number of slits in the chromatron type. Electron beams from electron guns contained in a neck portion of the picture tube are directed to pass through the mask apertures or the slits and thereafter to be irradiated upon predetermined phosphors.

In color picture tubes of the shadow-mask type or the chromatron type, it is required that the dot or stripe-like phosphors formed on the phosphor screen and the corresponding shadow-mask apertures or grid slits be correctly maintained at predetermined positions relative to each other. Hence, it has heretofore been common practice that the shadow mask or grid inherent in the respective types of color picture tubes are employed in the form to be finally used, in order to carry out the exposure of the phosphor screen thereby to provide the dot or stripe-like phosphors on the phosphor screen.

In accordance with such a method, however, the transmission factor of the shadow mask or the grid can never exceed the ratio between the number of the shadow-mask apertures or grid slits and that of the respectively corresponding phosphor dots or stripes. For example, in a color picture tube with a phosphor screen including three-color dots, the proportion of the shadow-mask apertures should not exceed 33.3 percent. If this value is exceeded, the phosphor dots or stripes formed on the phosphor screen will be overlapped.

Furthermore, as is known, it has been recently suggested that the diameter of the phosphor dot or the width of the phosphor stripe is prescribed to be smaller than the diameter of width of an electron beam to be irradiated upon the phosphor dot or stripe, respectively, whereby the color purity is enhanced.

SUMMARY OF THE INVENTION

An object of this invention is to provide a method of manufacturing color picture tubes, and more specifically a novel method of manufacture of color picture tubes comprising the steps of forming resinous lenses in openings viz. electron-beam permeating apertures of a color selective electrode in the form of a shadow mask or a grid, and carrying out light-exposure of a phosphor screen with this color selective electrode, whereby a desired phosphor pattern is formed.

Another object of this invention is to provide a method of manufacturing a color picture tube which is enhanced in color purity.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a view for explaining a color picture tube, with a part thereof broken away and shown in section;

FIG. 2 is an enlarged view showing the relationship in size between a shadow-mask aperture and a phosphor dot;

FIGS. 3 and 4 are enlarged sectional illustrations of a shadow mask for use in the method of forming phosphor dots in accordance with the invention;

FIG. 5 is an enlarged sectional view for explaining the method of forming phosphor dots in accordance with the invention; and

FIG. 6 is a view showing the relationship between a phosphor dot provided according to the invention and a shadow mask.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

While the following description is specifically made of a shadow-mask type color picture tube, the same principle is also applicable to a chromatron type color picture tube. A detailed explanation of the latter type will be therefore omitted.

FIG. 1 shows those portions of a shadow-mask type color picture tube which are pertinent for giving an explanation of this invention.

As in the previous description, the color picture tube has on the inner surface of a spherical face plate 1 a phosphor screen 2 including a number of phosphor dots (in the case of a chromatron type color picture tube, stripes among which the respective three ones in charge of red, blue and green constitute one set. Facing in parallel to the phosphor screen 2 is a shadow mask 3, which is formed with a number of mask apertures 4. Three electron beams 6 from three electron guns (not shown) contained in a neck portion 5 of the picture tube are arranged to be irradiated upon the respectively predetermined phosphor dots after passing through the mask apertures 4.

FIG. 2 is an enlarged view showing the relationship between the sizes of the shadow-mask aperture and the phosphor dot, in the case of this invention. With the color picture tube according to the invention, the diameter D of each aperture 4 of the shadow mask 3 is set to be larger than that d of each phosphor dot 7 formed on the inner surface of the face panel 1.

Referring now to FIG. 3, there will be described a method of forming lenses in the shadow-mask apertures. A paint to which a resin for the lenses, being a silicone resin, does not adhere is applied onto both surfaces of the shadow mask 3 excepting the inner surface 8 of each mask aperture 4, i.e., the front 9 facing to the electron guns and the back 10 facing to the phosphor screen. Thereafter, the shadow mask applied with the paint is immersed into the lens-forming resin in liquid phase. Solutions suitable for this are transparent resins, such as poly-methyl methacrylate and poly-iso-butyl methacrylate respectively incorporated with a hardener, which are respectively dissolved in a solvent. The shadow mask 3 immersed in such solution is drawn up. Then, since the solution adheres only to the inner surface 8 of the shadow-mask apertures 4, the lens-forming solution is hardened in the mask apertures 4 due to the surface tension thereof into the form of convex lenses 11 which protrude from the front and back sides 9 and 10, respectively. Alternatively, such resin-made lenses may be formed as illustrated in FIG. 4. More specifically, the shadow mask 3 is horizontally kept with the back surface 10 upwards. A resin of, e.g., poly-methyl methacrylate mixed with a hardener is caused to flow on the surface. Then, the resin oozes through each mask aperture 4 under its own weight, thus forming a convex lens 12. In this case, application of, for example, the silicone resin onto the front side 9 of the shadow mask 3 facilitates the formation of the lenses 12. Furthermore, in cases where satisfactory convex lenses are not provided merely with the weight of the resin caused to flow onto the reverse side 10, the shadow mask 3 is rotated about one edge thereof to make the resin sag through the mask apertures 4 due to centrifugal force. Thus, lenses 12 having an appropriate curvature may be formed.

Description will now be made of the method of forming phosphor dots in accordance with the invention. FIG. 5 illustrates the relationship between the shadow mask provided in the apertures with the lenses as has been explained with reference to FIG. 3 or FIG. 4 and a phosphor layer on the inner surface of the face panel 1.

MOre specifically, on the inner surface of the face plate **1**, there is applied the phosphor layer **13**. Under this state, light L is irradiated upon the shadow mask **3** from the left side thereof as viewed in the drawing, i.e., from the electron-gun side. Then, the light L is converged by the lenses **11**, thereby to fall upon circular area portions on the phosphor layer **13** which are each smaller in area than the mask aperture **4**. Thereafter, the other portion of the phosphor layer **13** than the circular portions which have been affected by the rays of light collected by the lenses **11**, is removed by any well-known method. Then, phosphor dots **7** as shown in FIG. **6** are formed. In this manner, the state in FIG. **6** may provide the desired relation in FIG. **2**, that is, each phosphor dot **7** is allowed to be smaller in diameter than the mask aperture **4**.

Removal of the lenses **11** of the shadow mask **3** may be carried out be dissolving them with an appropriate solvent. Alternatively, utilizing the baking treatment in the manufacturing process of the color picture tube, they may be removed by burning.

Although the above explanation has been made of a color picture tube of the shadow-mask type, the invention is applicable to on of the color type as has been previously stated. More specifically, the method described in connection with FIGS. **3** and **4** is applied to a color selective electrode or grid of a chromatron type chromatron picture tube, thereby forming band-like and resin-made convex lenses in its slit-like electron-beam permeating openings. Then, the phosphor layer is exposed to light in the manner stated with reference to FIG. **5**. Thereafter, the resinous lenses are removed. Thus, linear phosphors having a width smaller than that of the slit-like electron-beam permeating openings of the grid are formed on the phosphor screen.

We claim:

1. A method of manufacturing a color picture tube including a glass bulb consisting of a panel portion, a funnel portion and a neck portion, a phosphor screen provided on the inner surface of a face plate of said panel portion, and a color selective electrode placed immediately in front of said phosphor screen in said panel portion, said method comprising the steps of forming resin-made convex lenses in openings of said color selective electrode, exposing said phosphor screen to light through said color selective electrode, and removing said resinous convex lenses after said exposure step.

2. A method of manufacturing the color picture tube according to claim **1**, wherein said removal step for said resinous convex lenses comprises the stage of washing said color selective electrode with a solvent which dissolves a resin for said lenses.

3. A method of manufacturing the color picture tube according to claim **1**, wherein said removal step for said resinous convex lenses comprises the stage of firing them by utilizing the heat from a baking treatment in the manufacturing process of said color picture tube.

4. A method of manufacturing the color picture tube according to claim **1**, wherein said formation step for said resinous convex lenses comprises the stages of applying onto both surfaces of said color selective electrode a paint to which a resin for said lenses does not adhere, thereafter immersing into the lens-forming resin in a liquid phase said color selective electrode applied with said paint, and drawing up said color selective electrode from said liquid lens-forming resin to harden said lens-forming resin stuck to said openings.

5. A method of manufacturing the color picture tube according to claim **4**, wherein said removal step for said resinous convex lenses comprises the stage of washing said color selective electrode with a solvent which dissolves said resin for said lenses.

6. A method of manufacturing the color picture tube according to claim **4**, wherein said removal step for said resinous convex lenses comprises the stage of firing them by utilizing the heat from a baking treatment in the manufacturing process of said color picture tube.

7. A method of manufacturing the color picture tube according to claim **4**, wherein said paint to which said resin for said lenses does not adhere is a silicone resin, while said lens-forming resin in liquid phase is a solution with a member which is selected from the group consisting of poly-methyl methacrylate and poly-iso-butyl methacrylate and which is mixed with a hardener, dissolved in a solvent.

8. A method of manufacturing the color picture tube according to claim **1**, wherein said formation step for said resinous convex lenses comprises the stage of causing a lens-forming resin in liquid phase to flow onto that surface of said color selective electrode which faces to said phosphor screen.

9. A method of manufacturing the color picture tube according to claim **8**, wherein said removal step for said resinous convex lenses comprises the stage of washing said color selective electrode with a solvent which dissolves said resin for said lenses.

10. A method of manufacturing the color picture tube according to claim **8**, wherein said removal step for said resinous convex lenses comprises the stage of firing them utilizing the heat from a baking treatment in the manufacturing process of said color picture tube.

11. A method of manufacturing the color picture tube according to claim **8**, wherein said lens-forming resin in liquid phase is a solution with a member which is selected from the group consisting of poly-methyl methacrylate and poly-iso-butyl methacrylate and which is mixed with a hardener, dissolved in a solvent.

12. A method of manufacturing the color picture tube according to claim **1**, wherein said formation step for said resinous convex lenses comprises the stages of applying a paint to which a resin for said lenses does not adhere, onto that surface of said color selective electrode which faces to the electron guns, and causing the lens-forming resin in liquid phase to flow onto that surface of said color selective electrode which faces to said phosphor screen.

13. A method of manufacturing the color picture tube according to claim **12**, wherein said removal step for said resinous convex lenses comprises the stage of washing said color selective electrode with a solvent which dissolves said resin for said lenses.

14. A method of manufacturing the color picture tube according to claim **12**, wherein said removal step for said resinous convex lenses comprises the stage of firing them by utilizing the heat from a baking treatment in the manufacturing process of said color picture tube.

15. A method of manufacturing the color picture tube according to claim **12**, wherein said paint to which said resin for said lenses does not adhere is a silicone resin, while said lens-forming resin in liquid phase is a solution with a member which is selected from the group consisting of poly-methyl methacrylate and poly-iso-butyl methacrylate and which is mixed with a hardener, dissolved in a solvent.

16. A method of manufacturing the color picture tube according to claim **1**, wherein said formation step for said resinous convex lenses comprises the stages of applying a paint to which a resin for said lenses does not adhere, onto that surface of said color selective electrode which faces to the electron guns, causing the lens-forming resin in liquid phase to flow onto that surface of said color selective electrode which faces to said phosphor screen, and rotating this color selective electrode about one edge thereof.

17. A method of manufacturing the color picture tube according to claim **16**, wherein said removal step for said resinous convex lenses comprises the stage of washing said color selective electrode with a solvent which dissolves said resin for said lenses.

18. A method of manufacturing the color picture tube according to claim **16**, wherein said removal step for said resinous convex lenses comprises the stage of firing them by utilizing the heat from a baking treatment in the manufacturing process of said color picture tube.

19. A method of manufacturing the color picture tube according to claim 16, wherein said paint to which said resin for said lenses does not adhere is a silicone resin, while said lens-forming resin in liquid phase is a solution with a member which is selected from the group consisting of poly-methyl methacrylate and poly-iso-butyl methacrylate and which is mixed with a hardener, dissolved in a solvent.

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