United States Patent

Miyata

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[54] **METHOD OF MANUFACTURING COLOR PICTURE TUBES**

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

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** **29/25.18,** 29/25.11, 29/25.14

[51] **Int. Cl.**.....**H01j 9/16,** H01j 9/44

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

[56] **References Cited**

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3,631,576 1/1972 Law.....29/25.13

Primary Examiner—John F. Campbell

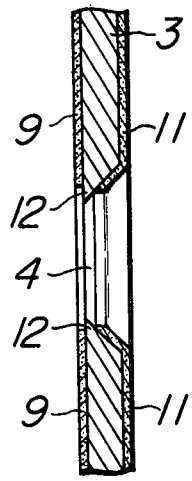
Assistant Examiner—Richard Bernard Lazarus

Attorney—Craig, Antonelli, Stewart & Hill

[57] **ABSTRACT**

A method of manufacturing color picture tubes comprising the steps of forming openings or beam-permeating apertures in a color selective electrode with smaller dimensions than the ones finally required in the completed tube, exposing a phosphor screen on the inner surface of a face plate of a panel portion to light through said color selective electrode, thereafter coating an anti-etching protective film with the necessary portions uncovered by the inversion development process, and expanding said openings to said predetermined dimensions by etching.

4 Claims, 10 Drawing Figures



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SHEET 1 OF 2

FIG. 1

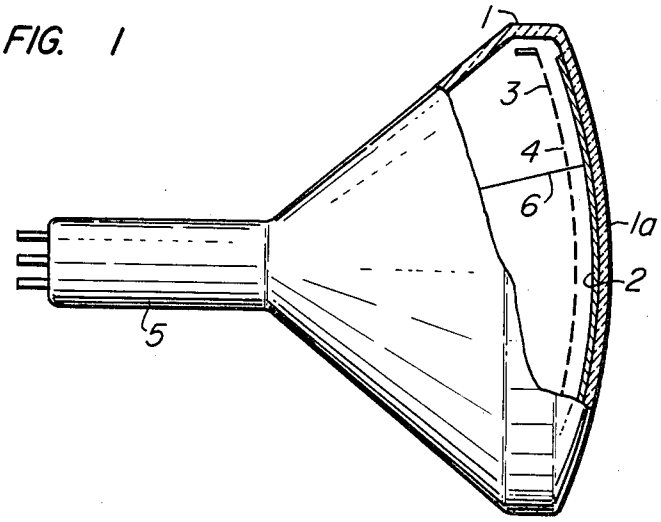


FIG. 2

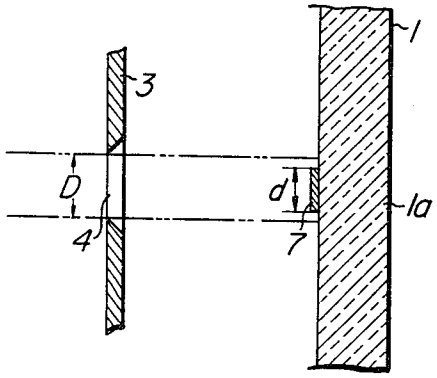


FIG. 3

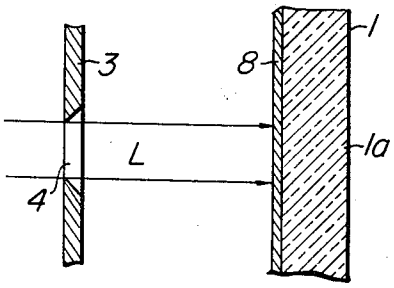
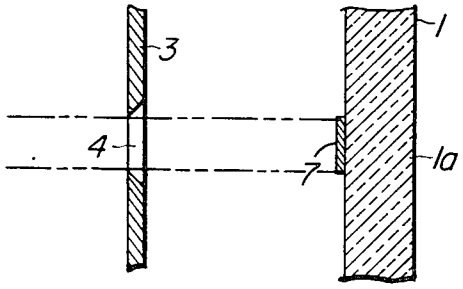


FIG. 4



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FIG. 5A

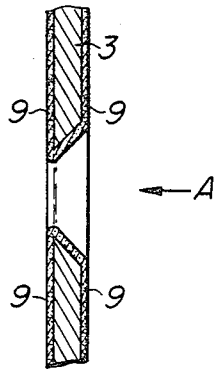


FIG. 5B

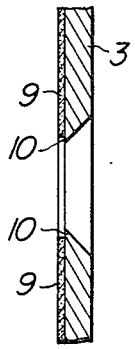


FIG. 5C

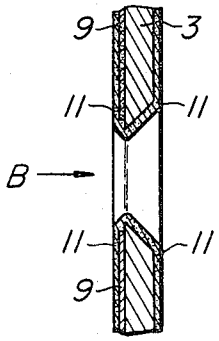


FIG. 5D

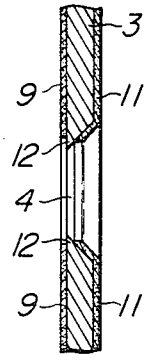


FIG. 5E

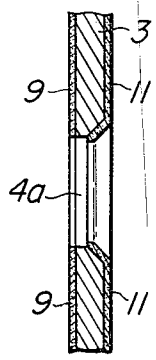
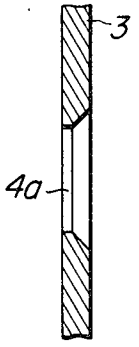


FIG. 5F



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METHOD OF MANUFACTURING COLOR PICTURE TUBES

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 triads of phosphors among which three phosphors providing red, blue, and green illumination respectively, constitute each triad. A color selective electrode is disposed in the tube facing 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 in a mask-type tube is called a "shadow mask" and includes a number of mask apertures, while the chromatron-type tube has no fixed designation but is termed, e.g., a "grid" which includes a number of slits. 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 are 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 are correctly maintained at predetermined positions relative to each other. Hence, it has heretofore been common practice that the shadow mask or grid conventionally used in the respective types of color picture tubes are initially make 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 a triad of 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 overlap.

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

SUMMARY OF THE INVENTION

It is an object of the invention to provide a method of manufacturing color picture tubes, and more specifically, a novel method of manufacturing color picture tubes in which the openings or beam-permeating apertures of a color selective electrode, such as a shadow mask and a grid, are first formed with smaller dimensions than the predetermined ones finally required in the completed tube, and a phosphor screen is exposed to light using this color selective electrode, whereby a desired pattern of phosphors is formed.

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

According to this invention, the above objects are accomplished in such a way that in order to provide dot or stripe-like phosphors on a phosphor screen of a color picture tube, the phosphor screen is exposed to light using a color selective electrode which has openings formed in smaller dimensions than predetermined ones as are finally required, an anti-etching protective film is thereafter coated with the necessary parts uncovered by the inversion development process, and the openings are then expanded to the predetermined dimensions by etching.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a sectional view, partly broken away, illustrating basic components of a color picture tube.

FIG. 2 is an enlarged view showing the relationship between the sizes of a shadow-mask aperture and a phosphor dot.

FIGS. 3 and 4 are enlarged views of relevant portions, of the picture tube, illustrating the step of forming phosphor dots from a phosphor layer.

FIGS. 5A through 5F are views illustrating the steps of the etching of a shadow-mask.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the accompanying drawings, an embodiment of the invention will be described. While in the following embodiment a specific reference will be made to a shadow-mask type color picture tube, the invention may be applied, in principle, similarly to a chromatron type color picture tube. Therefore, a detailed explanation of the latter type will be omitted.

FIG. 1 shows those portions of a shadow-mask type color picture tube which are necessary for an explanation of this invention. As previously stated, such a color picture tube includes on the inner surface of a face plate **1***a* of a spherical panel **1** a phosphor screen **2** comprising a number of dots among which a triad of three phosphor dots (stripes in the case of a chromatron type color picture tube) provide the red, blue and green colors, respectively, and constitute each set of phosphors. A shadow-mask **3** is provided which faces the phosphor screen **2** in parallel thereto, and which has a number of mask apertures **4**. Three electron beams **6** emanating from three electron guns (not shown) which are contained in a neck portion **5** of the picture tube, are directed to pass through each of the mask apertures **4** to be thereafter irradiated upon the respective predetermined phosphor dots.

FIG. 2 is an enlarged view which represents the relation between the sizes of a shadow-mask aperture and the phosphor dot. In the color picture tube according to the invention, the diameter D of each mask aperture **4** of the shadow mask **3** is made larger than the diameter d of each phosphor dot **7** formed on the inner surface of the face plate **1***a*.

FIGS. 3 and 4 are views for explaining the step of forming the phosphor dot 7. Referring to FIG. 3, a phosphor layer 8 is first applied uniformly onto the inner surface of the face plate 1*a*. The shadow mask 3 is attached at a predetermined position inside the panel 1 with respect to the phosphor layer 8 provided on the inner surface of the face plate 1*a*. When, under this condition, light rays are directed from the left side of the shadow mask 3 as viewed on the drawing, that is, from the electron-gun side, then the light rays L passing through the mask aperture 4 will selectively irradiate the phosphor layer 8 so that the irradiated part is caused to sense the light. The region having thus sensed the light has an area equal to or slightly larger than that of the mask aperture 4. The remaining region of the phosphor layer 8 which has not sensed the light, is removed by any known process. Thus, the phosphor dot 7 as shown in FIG. 4 is formed on the inner surface of the face plate 1*a*. This step is carried out for the phosphor dots for each color of red, blue, and green.

On the other hand, the shadow mask 3 which has been attached at the predetermined position inside the panel 1 during exposing of the phosphor layer 8 to light, is detached after the exposure and is subjected to such processes as will be described hereinbelow with reference to FIG. 5. As shown in FIG. 5A, the shadow mask 3 is first coated over its entire surface with an anti-etching protective film 9 which contains a sensitizer having the property of retaining portions which are not exposed to light and dissolving those portions which are subjected to exposure, upon development. Parallel rays are irradiated from the front of the shadow mask 3, that is, in the direction of the arrow A. Thereafter, the protective film 9 is subjected to development, thereby to remove portions excepting for those on the back of the shadow mask 3 as is illustrated in FIG. 5B. Although peripheral edges 10 of the mask apertures at the back of the shadow mask 3 are not directly exposed to light irradiation, they also sense the light through the phenomenon of the diffraction of light. Therefore, the peripheral edges 10 are also uncovered as depicted.

Subsequently, as shown in FIG. 5C, the entire surface of the shadow mask 3 is again covered with an anti-etching protective film 11 containing a sensitizer similar to the above-mentioned one. Parallel rays are then directed from the rear of the shadow mask 3, i.e., in the direction of the arrow B. Thereafter, development is carried out in the same manner as in the previous case. Then, knife-edge-like peripheral edges 12 of the mask aperture 4 are uncovered, while the entire periphery except for the edges remains covered with the protective films 9 and 11, as shown in FIG. 5D. In the next step, the shadow mask thus processed is immersed into an etchant which corrodes the material thereof, whereby the knife-edge-like peripheral edges 12 of the mask aperture 4 are corroded as depicted in FIG. 5E. Finally, the protective coverings 9 11 are removed from both surfaces of the shadow mask 3. Then, as shown in FIG. 5F, a mask aperture 4*a* is formed which has a diameter larger than that of the mask aperture 4 during the exposure of the phosphor layer 8. The fact that the mask aperture 4*a* after the treatment is larger in diameter than the mask aperture 4 during the exposure of the phosphor layer 8 results, as will be clearly understood from the above description, from the steps of uncovering the peripheral edges 12 of the mask aperture 4 by utilizing the inversion development process twice and of removing the uncovered peripheral edges 12 by etching. The final mask-aperture 4*a* is thus made larger in diameter than the phosphor dot 7.

The shadow-mask processed by the foregoing steps so as to have an aperture diameter larger than that during exposure, is attached at a predetermined position inside the panel 1 which is provided on the inner surface of the face plate 1*a* in registration with the desired phosphor dots 7. Thereafter, the color picture tube is finished by any known manufacturing steps.

While the above embodiment uses the inversion development process twice when etching the peripheral edges of the mask apertures, the shadow mask may also be etched only with a one-side protective film (for example, one as shown in FIG. 5B) and in accordance with a single inversion development, thereby to dissolve the peripheral edges. In addition, it is a matter of course that during the etching treatment of the shadow-mask, a mask frame supporting it and the leaf springs holding it inside the panel (neither being shown) and others are preferably covered with the protective coating.

While the embodiment of the invention has been explained for the shadow-mask type color picture tube, it may obviously be applied to a color picture tube of the chromatron type as has been referred to in the foregoing. More specifically, a color selective electrode or grid wires of the chromatron type color picture tube are prepared in larger dimensions than predetermined ones. Then the exposure of the phosphor screen is performed, whereupon the anti-etching protective films 9 and 11 as stated above are formed on the wires. After further steps which are quite the same as those in the previous case, a color picture tube with a desired, stripe-like phosphor pattern formed on the phosphor screen may be obtained.

I claim:

1. In a method of manufacturing a color picture tube which comprises a glass bulb including 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 provided immediately in front of said phosphor screen within said glass bulb, the improvement comprising the steps of coating a substrate with a light responsive phosphor to form a phosphor screen, forming openings in a metal plate to be used as said color selective electrode with smaller dimensions than the openings finally required in the completed tube, exposing said phosphor screen to light solely through the openings in said color selective electrode, developing said phosphor screen and expanding the size of said openings in said plate to form said color selective electrode having proper dimensions for use in the completed tube.

2. A method of manufacturing the color picture tube according to claim 1 wherein the step of expanding said openings to said predetermined dimensions comprises the steps of forming an anti-etching protective film on said color selective electrode with at least those portions desired for the expansion to said predetermined dimensions uncovered, and etching said uncovered portion for removal.

3. A method of manufacturing the color picture tube according to claim **2** wherein the step of forming said anti-etching protective film with said uncovered portions comprises the steps of coating said anti-etching protective film over the entire surface of said color selective electrode, and subjecting said shadow mask to the inversion development twice.

4. A method of manufacturing the color picture tube according claim **2** wherein the step of forming said anti-etching protective film with said uncovered portions comprises the steps of coating said anti-etching protective film over the entire surface of said color selective electrode, and subjecting said shadow mask to inversion development once.

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