

[54] **METHOD OF MANUFACTURING COLOUR SELECTION ELECTRODES FOR USE IN COLOUR PICTURE TUBES**

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

[58] Field of Search..... 29/25.14, 25.17, 25.18;
313/85 S; 96/36.1

[56] **References Cited**

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[57]

ABSTRACT

A colour selection electrode having a plurality of parallel stripe shaped perforations which are divided into a plurality of slit-shaped sections by means of transverse bridges used in a colour picture tube provided with a fluorescent screen having a plurality of stripe shaped phosphors is manufactured by preparing a first pattern member formed with a plurality of parallel stripe shaped light transmitting portions extending in a first direction, the width of the light transmitting portions gradually decreasing from the center toward the opposite ends, a second pattern member formed with a plurality of parallel stripe shaped light transmitting portions extending in a second direction which is different from the first direction, and a third pattern member formed with a plurality of parallel light intercepting portions extending in a third direction which is different from the first and second directions. The second and third pattern members are combined to form a fourth pattern member having a plurality of discontinuous light intercepting portions. Then the first and fourth pattern members are combined to prepare a reference pattern member having a plurality of parallel stripe shaped light transmitting portions which are divided into a plurality of slit shaped sections by means of staggered light intercepting bridges. The colour selection electrode is prepared by using the reference pattern member.

5 Claims, 8 Drawing Figures

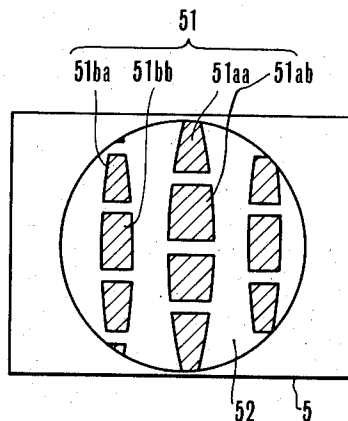


FIG. 1A

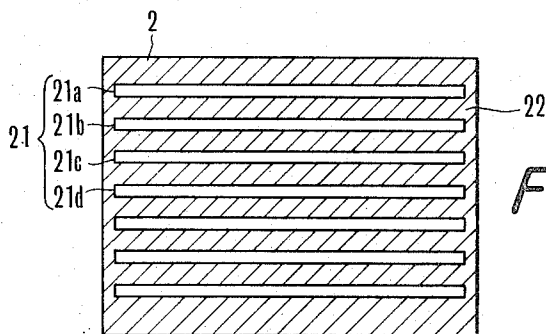
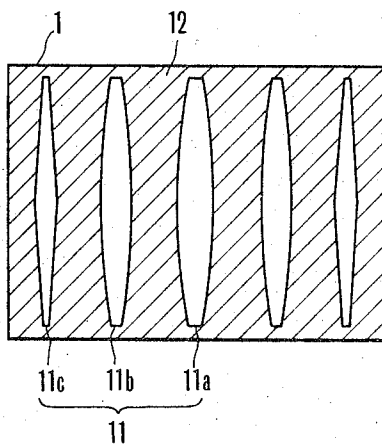
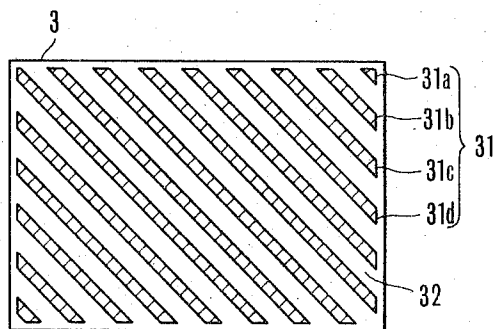


FIG. 1B

FIG. 1C



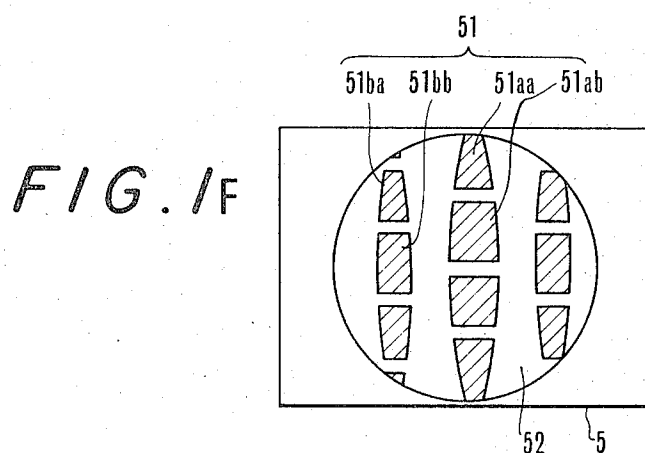
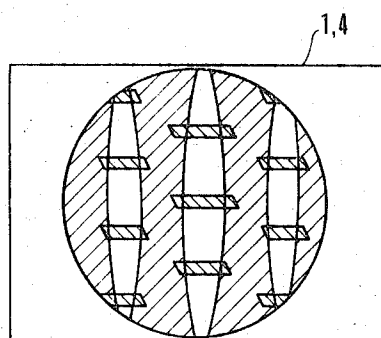
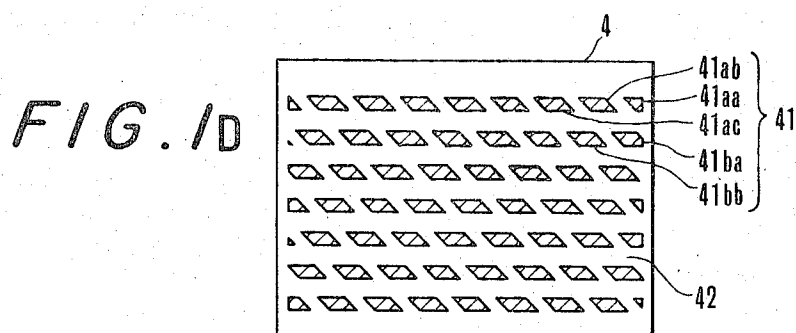


FIG. 1G

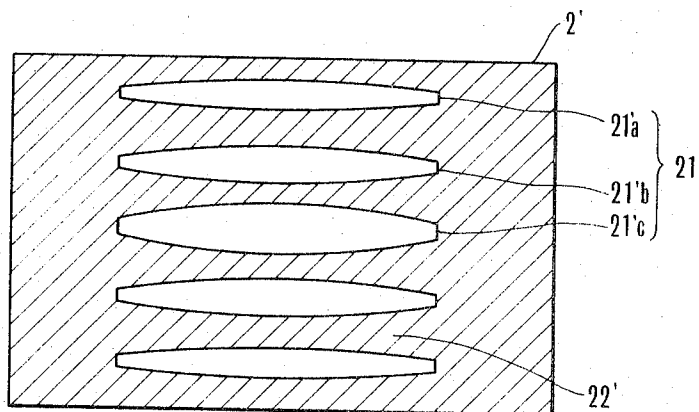
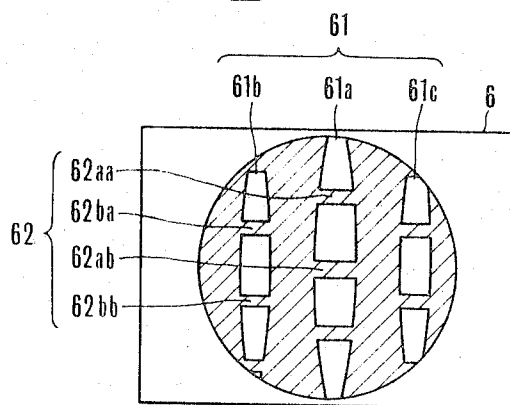


FIG. 2



METHOD OF MANUFACTURING COLOUR SELECTION ELECTRODES FOR USE IN COLOUR PICTURE TUBES

BACKGROUND OF THE INVENTION

This invention relates to a method of manufacturing a colour selection electrode provided with a plurality of stripe shaped perforations utilized in a colour picture tube including a fluorescent screen having a plurality of stripe shaped phosphors for three colours.

With a widespread use of colour television receivers in recent years, various types of colour picture tubes have been developed including those having fluorescent screens provided with striped shaped three colour phosphors described above. Since this type of the colour picture tube does not require any adjustment of the focusing of the electron beam in the vertical direction, it is possible to product pictures of high colour purities with a simpler electronic circuit than the colour picture tube utilizing a dot type shadow mask.

However, since the colour selection electrode for use in this type of the colour picture tube is provided with a plurality of stripe shaped perforations which extend substantially the entire vertical width of the colour selection electrode, its mechanical strength is small so that the colour selection electrode vibrates when it is subjected to mechanical vibrations or a large voice raised by a speaker incorporated in a colour television receiver during the use thereof thereby causing colour shading.

According to one approach to this problem, fine steel wires are provided with a proper spacing across the stripe shaped perforations to reinforce the colour selection electrode. However as it is necessary to secure the steel wires, as by spot welding, to the colour selection electrode, the colour selection electrode is deformed so that this solution can not be applied to a spherical colour selection electrode.

According to another solution the stripe shaped perforation are divided into a plurality of slit shaped sections by providing spaced apart bridges which traverse the perforations. However, when the bridges of the parallel stripe shaped perforations are aligned in one direction, for example in the direction of horizontal scanning, the stripe shaped phosphors formed on the fluorescent screen formed by using such a colour selection electrode with stripe shaped perforations which are divided into a plurality of slit shaped sections includes gaps corresponding to the bridges. For this reason, the reproduced picture contains horizontal stripes, thus impairing the quality thereof.

To solve this difficulty it has been proposed to stagger in the vertical direction the bridges of adjacent slit shaped perforations. Usually, such a colour selection electrode is prepared by coating liquid photosensitive material onto a substrate of a soft steel sheet, for example, exposing to light the liquid photosensitive material through a glass plate formed with a pattern of the divided slit shaped perforations, developing the exposed photosensitive material, and then etching the substrate. The glass plate formed with the desired pattern of the divided slit shaped perforations is prepared by depicting an enlarged pattern of one section of the divided slit, forming a pattern of the divided slit shaped perforations by sequentially moving the enlarged pattern as in the known method of preparing a photomask utilized

to fabricate integrated circuits, and then reducing the size of the pattern of the divided slit shaped perforations. With this method, however, as the desired pattern of the divided slit shaped perforations is formed by sequentially moving the pattern of a single section, the pitch of the completed sections is not uniform with the result that the reproduced picture is not uniform. If the pitch of the sections deviates two microns from the desired pitch, an uneven picture would result.

Furthermore, in order to increase the brightness of the reproduced picture, the colour selection electrode is generally required to have a high rate of light transmission when it is used to expose the photosensitive substance coated on the fluorescent screen. In other words, the colour selection electrode is required to have perforations of a large total area. On the other hand, in order to improve the colour purity, the size of the perforations should be such that the electron beam may not impinge upon the portions of the fluorescent screen not coated with the phosphors. In other words, the size of the perforations should be limited to satisfy these contradictory requirements. A colour selection electrode with graded perforations has been used wherein the light transmission is made high at the central area and is gradually decreased toward the peripheral portion of the colour selection electrode.

However, when a colour selection electrode is formed with such graded stripe shaped perforations each divided into a plurality of slit shaped sections by means of a number of bridges which are staggered in the vertical direction, for example, the area of the stripe shaped perforations will be gradually decreased from the central area towards the peripheral portion whereas the width of the bridges will be increased toward the peripheral portion which results in a uneven picture.

To obviate this difficulty, it has been proposed to vary the width of the divided slit shaped perforations to maintain the width of respective bridges at a constant value. With this construction, since the width of the adjacent perforations is different, it is difficult to obtain pictures of excellent quality.

SUMMARY OF THE INVENTION

Accordingly, it is an object of this invention to provide an improved method of manufacturing a colour selection electrode for use in a colour picture tube utilizing a fluorescent screen provided with a plurality of parallel stripe shaped phosphors capable of producing pictures of excellent quality free from colour shading and having a high colour purity.

Another object of this invention is to provide a colour selection electrode which can resist against mechanical shocks and is suitable for use in a colour picture tube provided with a fluorescent screen formed with stripe shaped phosphors.

According to this invention there is provided a method of manufacturing a colour selection having a plurality of stripe shaped perforations and used in a colour picture tube provided with a fluorescent screen having a plurality of stripe shaped phosphors, the method comprising the steps of preparing a first pattern member formed with a plurality of parallel stripe shaped light transmitting portions extending in a first direction, the width of the light transmitting portions gradually decreasing from the center toward the opposite ends, a second pattern member formed with a plu-

ality of parallel stripe shaped light transmitting portions extending in a second direction which is different from the first direction, and a third pattern member formed with a plurality of parallel light intercepting portions extending in a third direction which is different from the first and second directions; preparing a fourth pattern member formed with a plurality of discontinuous light intercepting portions which are formed by using a combination of the second and third pattern members; combining the first and fourth pattern members for preparing a reference pattern member formed with a plurality of parallel stripe shaped light transmitting portions which are divided into a plurality of slit shaped section by means of a plurality of light intercepting bridges; and forming said colour selection electrode provided with a plurality of parallel stripe shaped perforations by using the reference pattern member, the width of each stripe shaped perforation gradually decreasing from the center toward the opposite ends, each stripe shaped perforation being divided into a plurality of slit shaped sections by means of transverse bridges, the bridges in adjacent perforations being staggered in the direction thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings:

FIGS. 1A through 1F show pattern members utilized in the successive steps of manufacturing a colour selection electrode according to the method of this invention;

FIG. 1G shows a modification of the pattern member shown in FIG. 1B, and

FIG. 2 shows a plan view of a completed colour selection electrode.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the accompanying drawings, the patterns shown therein are simplified and exaggerated for the sake of understanding and the opaque portions are shown with shadings. First, three pattern members 1, 2 and 3 as shown in FIGS. 1A, 1B, and 1C are prepared. More particularly, the pattern member 1 is provided with a plurality of parallel vertical stripe shaped light transmitting or transparent portions 11 (11a, 11b . . .) which are graded from the center toward the periphery and a light intercepting or opaque portion 12. Thus, for example, the width of light transmitting portion 11a is the largest at the center and decreases toward its upper and lower ends. Moreover, the width of light transmitting portion 11a is larger than that of the other light transmitting portion 11b and 11c at any level.

The pattern member 2 is formed with a plurality of parallel stripe shaped light transmitting portions 21 (21a, 21b . . .) which extend in a direction perpendicular to the light transmitting portions 11 of pattern member 1, and a light intercepting portion 22 surrounding light transmitting portions 21.

As shown in FIG. 1c, the pattern member 3 is formed with a plurality of parallel stripe shaped light intercepting portions 31 (31a, 31b . . .) which extend in a direction different from those of the light transmitting portions 11 and 21 of pattern members 1 and 2, that is in a direction of 45°, and a light transmitting portion 32 surrounding the light intercepting portions 31.

Then a transparent substrate coated with photosensitive material is exposed to light transmitting through an assembly formed by superposing pattern member 2 upon pattern member 3, and the exposed photosensitive material is developed to obtain a pattern member 4 as shown in FIG. 1D. This pattern member 4 comprises a plurality of diamond shaped light intercepting portions 41 (41aa, 41ab . . . , 41ba, 41bb . . .) which are formed by the superposition of the horizontal light transmitting portions 21 of the pattern member 2 and the oblique light intercepting portions 31 of the pattern member 3, and a light transmitting portion 42 surrounding the diamond shaped light intercepting portions 41.

Then, pattern members 1 and 4 are superposed each other as shown in FIG. 1E and by exposing photosensitive material coated on a transparent substrate to the light transmitting through this assembly and then developing the exposed photosensitive material, a reference pattern member 5 having a desired pattern as shown in FIG. 1F can be obtained. Portions 51 (51aa, 51ab . . . , 51ba, 51bb . . .) of the reference pattern member 5 comprise light intercepting portions while the remaining portion 52 comprises a light transmitting portion. It should be understood that FIGS. 1E and 1F are shown exaggerated.

FIG. 2 shows a colour selection electrode 6 prepared by projecting light through the reference pattern member 5 upon a substrate coated with photosensitive material, developing the exposed photosensitive material and then etching. The shaded portion shows a light intercepting portion. The width of the slit shaped perforations 61 (61a, 61b, 61c) is graded, that is gradually decreases from the center toward the upper and lower ends. The perforations are divided into a plurality of sections by transverse bridges 62 (62aa, 62ab, . . . 62ba, 62bb . . .) which are spaced by a suitable distance, and are staggered in the vertical direction. The width of respective bridges 62 is constant throughout the effective area of the colour selection electrode 6.

In one example, a colour selection electrode 6 was formed with a plurality of stripe shaped perforations at a pitch of 0.6mm. The width of the bridges was 0.05mm and the spacing between the bridges was 1 mm. The width of the perforation was 0.14mm at the center and 0.123mm at a position 100mm remote from the center. The bridges were staggered in the vertical direction. To prepare this colour selection electrode, the stripe shaped light transmitting portions 11 of the pattern member shown in FIG. 1A had a pitch of 0.6mm and a width of 0.05mm at the center by taking into consideration the effect of side etching. Of course, the width of these light transmitting portions was decreased from the center toward the opposite ends. For example, the width of the perforation at a position 100mm remote from the center was made to be 0.033mm.

The pattern member 2 shown in FIG. 1B was formed with a plurality of parallel stripe shaped light transmitting portions 21 having a width of 0.14mm which was determined by taking into consideration the effect of side etching. The pitch of the stripe shaped light transmitting portions 21 was made to be 0.5mm which is equal to one half of the spacing (1mm) between the bridges to be formed across the eight transmitting portions 11 of the pattern member 1.

The pattern member 3 shown in FIG. 1c was formed with a plurality of stripe shaped light intercepting por-

tions 31 at a pitch of 0.78mm. The width of respective light intercepting portions was 0.39mm and these portions were inclined at an angle of 45° with respect to the light transmitting portions of the pattern members 1 and 2.

It was found that, in the colour selection electrode 6 prepared by using these pattern members, it was possible to limit the errors in the pitch and the bridge spacing to be less than two microns.

FIG. 1G shows a modification of the pattern member 2 shown in FIG. 1B. In the pattern member 2' shown in FIG. 1G, the width of the stripe shaped light transmitting portions 21' (21'a, 21'b . . .) is graded, that is the width is the largest at the center and gradually decreases toward opposite ends. In the colour selection electrode prepared by using this pattern member 2', the width of the bridges are also graded so that it is possible to produce better pictures.

As above described, according to the method of this invention it is possible to manufacture at a low cost and with a mass production scale, a colour selection electrode which is used in a colour picture tube to form an excellent fluorescent screen having a plurality of stripe shaped phosphors of three colours capable of producing uniform pictures of high colour purity.

We claim:

1. A method of manufacturing a colour selection electrode having a plurality of stripe shaped perforations and used in a colour picture tube provided with a fluorescent screen having a plurality of stripe shaped phosphors, said method comprising the steps of preparing a first pattern member formed with a plurality of parallel stripe shaped light transmitting portions extending in a first direction, the width of said light transmitting portions gradually decreasing from the center toward the opposite ends, a second pattern member formed with a plurality of parallel stripe shaped light transmitting portions extending in a second direction which is different from said first direction, and a third pattern member formed with a plurality of parallel light intercepting portions extending in a third direction

which is different from said first and second directions; preparing a fourth pattern member formed with a plurality of discontinuous light intercepting portions which are formed by using a combination of said second and third pattern members; combining said first and fourth pattern members for preparing a reference pattern member formed with a plurality of parallel stripe shaped light transmitting portions which are divided into a plurality of slit shaped sections by means of a plurality of staggered light intercepting bridges; and forming said colour selection electrode provided with a plurality of parallel stripe shaped perforations by using said reference pattern member, the width of each stripe shaped perforation gradually decreasing from the center toward the opposite ends, each stripe shaped perforation being divided into a plurality of slit shaped sections by means of transverse bridges, the bridges in adjacent perforations being staggered in the direction thereof.

2. The method according to claim 1 wherein the stripe shaped light transmitting portions of said first pattern member and the stripe shaped light transmitting portions of said second pattern member intersect with each other at right angles.

3. The method according to claim 1 wherein the light intercepting portions of said third pattern member and the stripe shaped light transmitting portions of said second pattern member intersect with each other at an angle of 45°.

4. The method according to claim 1 wherein the discontinuous light intercepting portions of said fourth pattern member are disposed in a plurality of parallel rows, and each of said discontinuous light intercepting portions has a shape of a diamond.

5. The method according to claim 1 wherein the width of each of said parallel striped shaped light transmitting portions of said second pattern member decreases gradually from the center toward the opposite ends.

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