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[54] **EXPOSURE APPARATUS FOR FORMING FLUORESCENT SCREENS OF COLOUR PICTURE TUBES**

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Apr. 6, 1973 Japan 48-38715

[52] **U.S. Cl.** **354/1**
[51] **Int. Cl.** **G03b 27/00**
[58] **Field of Search** 354/1

[56] **References Cited**
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Primary Examiner—Richard M. Sheer
Attorney, Agent, or Firm—Charles E. Pfund, Esq.

[57] **ABSTRACT**

In exposure apparatus for forming a fluorescent screen of a colour picture tube provided with a slot type colour selection electrode of the type wherein a photosenstiive film coated on the inner surface of the panel of the tube is exposed by the light emitted by exposure light source and transmitting through a correction lens and the slot of the colour selection electrode, there is provided driving device for moving the exposure light source along a straight line extending in the longitudinal direction of the slot of the colour selection electrode and for oscillating the correction lens about the center thereof so as to move the exposure light in the longitudinal direction of the slot.

9 Claims, 4 Drawing Figures

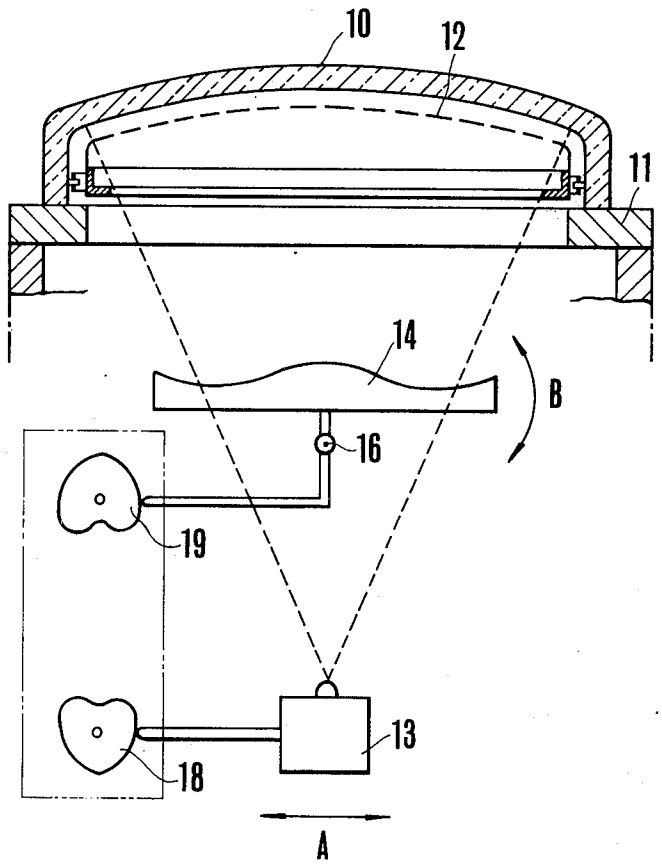


FIG. 1

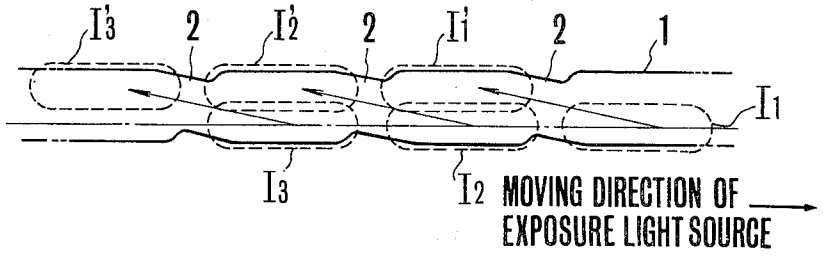

I'3
2
I'2
2
I'1
2
1
I1
I3
I2
MOVING DIRECTION OF
EXPOSURE LIGHT SOURCE

FIG. 2

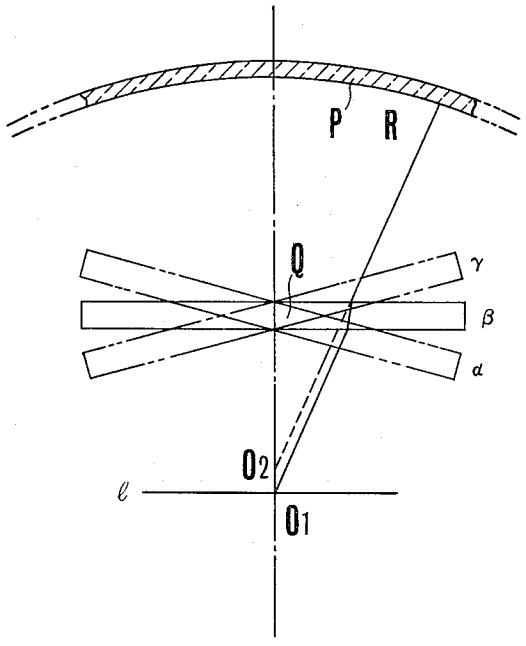

P
R
Q
γ
β
α
O2
ℓ
O1

FIG. 3

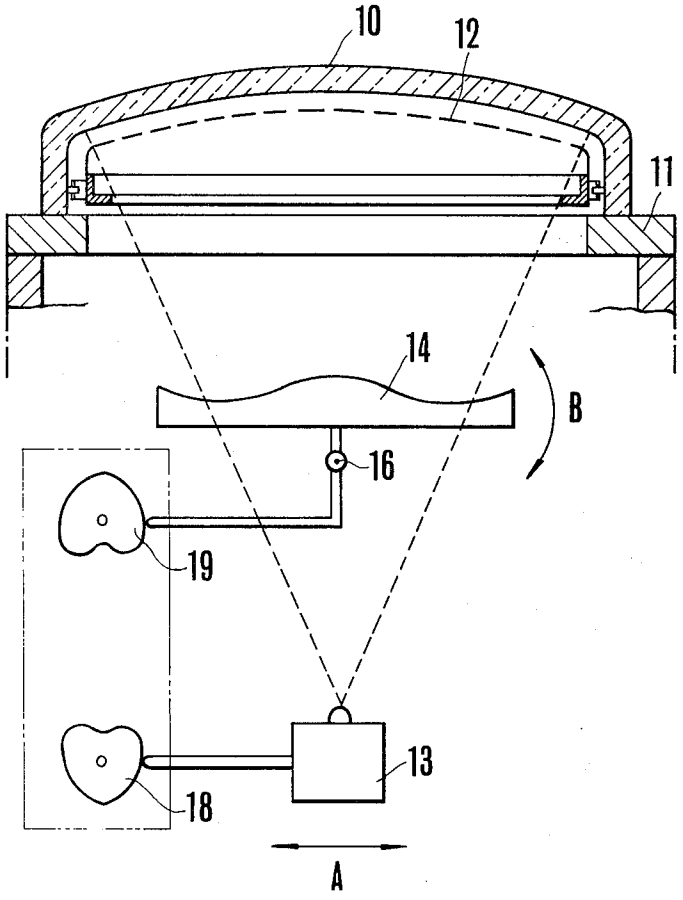
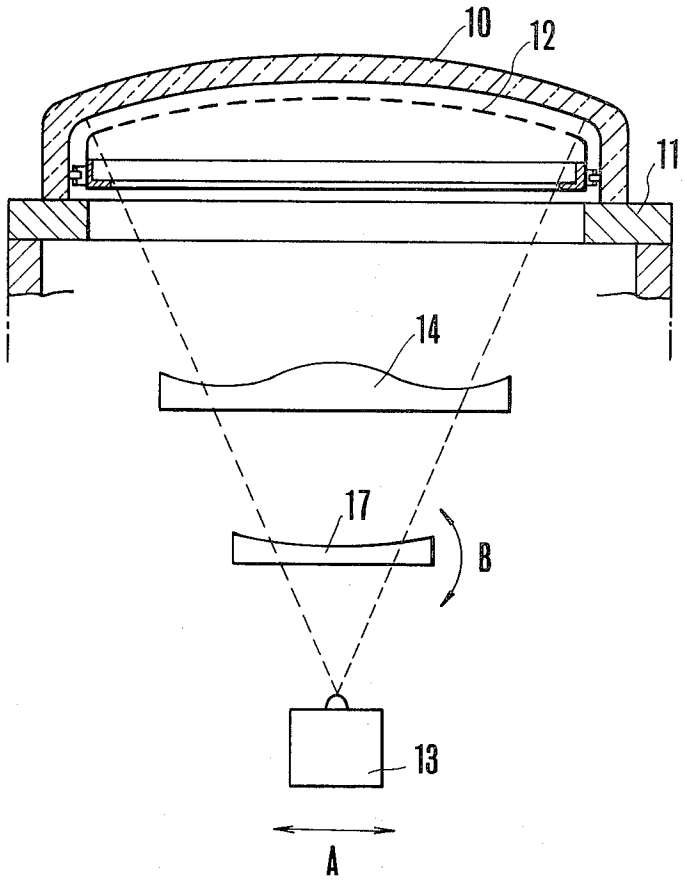


FIG. 4



EXPOSURE APPARATUS FOR FORMING FLUORESCENT SCREENS OF COLOUR PICTURE TUBES

BACKGROUND OF THE INVENTION

This invention relates to exposure apparatus utilized to form a fluorescent screen of a colour picture tube, and more particularly to exposure apparatus for forming stripe shaped phosphor films.

In order to form continuous stripe shaped phosphor films of the fluorescent screen of a colour picture tube utilizing a slot type colour selection electrode it has been the practice to use exposure apparatus including an exposure light source movable along a straight line in a phase containing an axis extending in the longitudinal direction of the slot of the colour selection electrode. However, as the surfaces of the fluorescent screen and the colour selection electrode are generally curved or spherical, when the fluorescent screen is formed by utilizing the exposure apparatus of the type described above phosphor films of wavy configuration will be formed at the corners of the fluorescent screen. This is caused because at the corners, the longitudinal axes of respective slots of the colour selection electrode and the direction of movement of the exposure light source are not contained in a group of parallel planes. In other words, although the plane of movement of the exposure light source and the spherical surface of the colour selection electrode are included in a group of substantially parallel planes at the central portion and the peripheral portion of the colour selection electrode excepting the corners thereof, at the corners the plane of movement of the exposure light source and the spherical surface of the colour selection electrode are not included in the same group of parallel planes owing to the curvature at the corners so that when the exposure apparatus is moved along a straight line, the image of the slot will have a component of movement in the direction of the width thereof whereby wavy phosphor films are formed.

When an electron beam impinges upon a fluorescent screen formed in this manner, there is a drawback of forming colour mismatch. More particularly, since the image of the slot formed on the fluorescent screen by the electron beam extends along the longitudinal direction of the slot the electron beam could not arrive at the portions of the phosphor films displaced in the direction of width of the slot.

In order to obviate this difficulty, it is ideal to construct the exposure apparatus to be movable in three directions which are perpendicular with each other so that the exposure light is moved in the longitudinal direction of the slot. Such construction, however, is extremely complicated and expensive and is not suitable for practical use.

SUMMARY OF THE INVENTION

Accordingly, it is an object of this invention to provide improved exposure apparatus capable of forming a fluorescent screen with stripe shaped phosphor films that do not cause any colour mismatch.

Another object of this invention is to provide improved exposure apparatus of simple construction capable of forming stripe shaped phosphor films not including wavy configuration.

According to this invention, these and further objects can be accomplished by providing an improved exposure apparatus for forming a fluorescent screen of a colour picture tube of the type comprising means for supporting a panel of the colour picture tube, the panel being coated with a photosensitive film on the inner surface thereof, and the panel being provided with a slot type colour selection electrode on the inner side thereof, an exposure light source adapted to direct exposure light to the inner surface of the panel and positioned a predetermined distance spaced apart from the inner surface and an optically transparent body interposed between the exposure light source and the colour selection electrode for diffracting the exposure light, characterized in that there is provided driving means for moving linearly the exposure light source in a plane containing an axis extending in the longitudinal direction of the slot of the colour selection electrode and for inclining the optically transparent body with respect to the plane.

With this arrangement, even when the exposure light source is moved along a straight line in a plane the imaginary image of the exposure light source is formed at a position remote from said plane whereby it is possible to position an apparent vector of the threedimensional movement of the exposure light source and the spherical surface of the colour selection electrode provided with slots at substantially the same group of planes.

Actually the optically transparent body comprises a correction lens or a combination of a connection lens and an additional lens. In the latter case the correction lens is held stationary and the additional lens is oscillated in the vertical direction about the center thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

Further objects and advantages of the invention can be more fully understood from the following detailed description taken in conjunction with the accompanying drawings in which:

FIG. 1 is a diagram showing a stripe shaped phosphor film formed by a prior art exposure apparatus at the corners of fluorescent screen;

FIG. 2 is a diagram useful to explain the theory of operation of the exposure apparatus embodying the invention;

FIG. 3 is a diagrammatic sectional view of the novel exposure apparatus embodying the invention; and

FIG. 4 is a view similar to FIG. 3 and showing a modified embodiment of this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

As diagrammatically shown in FIG. 1, a phosphor film 1 formed by a conventional exposure apparatus includes wavy portions 2 at the corners of a fluorescent screen. It is assumed that the phosphor film shown in FIG. 1 is located at the left upper corner of the fluorescent screen. The dotted line blocks show the images of the slots of a slot type colour selection electrode projected on the fluorescent screen. As the exposure light source is moved to the right, images I_1, I_2 and I_3 move to the positions I_1', I_1' and I_3' as shown by arrows. Thus, at the corners, since the longitudinal axes of respective slots of the colour selection electrode and the direction of movement of the exposure light source are not included in the same group of parallel planes, when the exposure light source is moved linearly the images of the slots will have components of movements in the di-

rection of the width. As a result, waves 2 are formed in the fluorescent film 1 thus causing colour mismatch.

The principle of the operation of the novel exposure apparatus will now be described with reference to FIG. 2, in which 0_1 shows a point source to exposure light which is moved along a straight line 1. Between the light source O_1 and a photosensitive film P is positioned a flat plate lens Q which is supported to be rotatable about a center. When the flat plate lens Q is positioned at a position β, the light emitted from the point light source O_1 is diffracted by the lens to reach a point R on the photosensitive film P. When the light source O_1 is seen from the point R, the imaginary image of the light source will be seen at point O_2. Consequently, as the lens Q is rotated successively to points α, β and γ, even though the exposure light source O_1 is moved along a straight line in a plane it is possible to select the position of the imaginary image of the light source to be in a free space independent of the plane. Consequently, by successively setting the position of the exposure light source and the angle of rotation of the flat plate lens Q it is possible to position the apparent vector of the movement of the exposure source and the slots of the colour selection electrode on substantially the same group of the planes. Taking a corner of the colour selection electrode on a three-dimensioned spherical surface as an example, by a suitable combination of the linear movement of the exposure light source on a plane and the rotary movement of the lens Q it is possible to attain the same result as if the exposure light source were moved in the longitudinal direction of the slot at the corner, thereby eliminating any component of movement in the transverse direction of the slot. Consequently, it is possible to form linear stripe shaped phosphor films not only at the central portion but also at the portion corresponding to the corner of the colour selection electrode.

One preferred embodiment of the novel exposure apparatus will now be described in detail with reference to FIG. 3. In FIG. 3, the face plate 10 of a colour picture tube is formed with a photosensitive film, not shown, on the inner surface thereof, and is mounted on a pedestal 11 of the exposure apparatus. Also, a slot type colour selection electrode 12 is mounted on the inner surface of the face plate 10, and an exposure light source 13 is located at a point a predetermined distance from the inner surface of the face plate to project exposure light upon the photosensitive film. A correction lens 14 of the well known construction is disposed between the exposure light source 13 and the colour selection electrode 12. The exposure light source 13 is reciprocated by a driving device 15 shown diagrammatically in a group of planes parallel to a plane containing an axis extending in the longitudinal direction of the slots at the central portion of the colour selection electrode 12, as shown by an arrow A. At the same time, the driving device 15 causes the correction lens 14 to oscillate about a pivot 16 as shown by an arrow B. The exposure light source 13 and the correction lens 14 are interlocked with a predetermined timed relationship such that the light beam emanated from the exposure light source 13 is diffracted by the correction lens 14 and can reach the photosensitive film on the face plate while moving only in the longitudinal direction of the slot of the colour selection electrode. In other words, the direction of the correction lens is varied so that the light beam transmits through a suitable portion of the correction lens for assuring proper values of the angle of diffraction and direction of the light beam. This can be attained by varying the size, contour and positional relationship of two heart shaped cams 18 and 19 of the driving device 15. Accordingly, the exposure apparatus shown in FIG. 3 can provide the same effect as if the light source were moved in the longitudinal direction of a slot at the corner of the colour selection electrode on a spherical surface.

In a modified embodiment shown in FIG. 4, the correction lens 14 is held stationary but an additional lens 17 located between it and the light source 13 is oscillated in the direction of arrow B by a suitable driving means, not shown. It will be clear that this modification can also provide the same advantageous function as that shown in FIG. 3.

Although in the foregoing embodiments, optically transparent bodies, that is the correction lens 14 and the additional lens 17 were oscillated in a plane including a straight line along which the exposure light source is reciprocated so long as these bodies are caused to tilt such that the exposure light that transmits through these bodies is moved substantially in the longitudinal direction of the slot of the colour selection electrode, the optically transparent bodies may be tilted in any direction.

As described hereinabove, since the exposure light source is moved linearly it is possible to simplify the construction. Further, since the correction lens or second lens is inclined or oscillated it is not necessary to use a lens of special contour.

Thus, the invention provides effective exposure apparatus capable of forming wave free stripe shaped phosphor films extending in the direction of the slots of the colour selection electrode.

What is claimed is:

1. In exposure apparatus for forming a fluorescent screen of a colour picture tube of the type comprising means for supporting a panel of said colour picture tube, said panel being coated with a photosensitive film on the inner surface thereof, and said panel being provided with a slot type colour selection electrode on the inside thereof, an exposure light source adapted to direct exposure light to the inner surface of said panel and positioned a predetermined distance spaced apart from said inner surface, and an optically transparent body interposed between said exposure light source and said colour selection electrode for diffracting said exposure light, the improvement which comprises driving means for linearly moving said exposure light source in a plane containing an axis extending in the longitudinal direction of the slots of said colour selection electrode and for simultaneously oscillating said optically transparent body with respect to said plane.

2. The exposure apparatus according to claim 1 wherein the linear movement of said exposure light source and the oscillating movement of said optically transparent body are timed such that the exposure light transmitted through said optically transparent body is moved substantially in the longitudinal direction of the slot of said colour selection electrode.

3. The exposure apparatus according to claim 1 wherein said optically transparent body is oscillated in the vertical direction about the center thereof.

4. The exposure apparatus according to claim 3 wherein said optically transparent body is oscillated in

a plane containing a straight line along which said exposure light source is reciprocated.

5. The exposure apparatus according to claim 1 wherein said optically transparent body comprises a correction lens.

6. The exposure apparatus according to claim 1 wherein said optically transparent body comprises a correction lens and an additional lens, and wherein said correction lens is held stationary and said additional lens is oscillated.

7. The exposure apparatus according to claim 6 wherein said additional lens is oscillated in a vertical plane about the center of said additional lens.

8. The exposure apparatus according to claim 7 wherein said vertical plane contains a straight line along which said exposure light source is reciprocated.

9. The exposure apparatus according to claim 1 wherein said driving means comprises first and second heart shaped rotary cams adapted to drive said exposure light source and said optically transparent body respectively, the size, contour and positional relationship of said first and second cams being selected such that the light beam emanated from said exposure light source is diffracted by said optically transparent body and is then caused to reach said photosensitive film in the longitudinal direction of the slot of said colour selection electrode while said exposure light source is moved linearly.

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UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 3,900,854

DATED : August 19, 1975

INVENTOR(S) : Kuniharu Osakabe and Fumiaki Yonai

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

[57] ABSTRACT, line 4, "senstiive" should be -- sensitive --.

Column 2, line 61, "I_1', I_1' and I_3'" should read -- I_1', I_2' and I_3' --.

Signed and Sealed this

thirteenth Day of *April 1976*

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks

UNITED STATES PATENT AND TRADEMARK OFFICE

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