

PATENT SPECIFICATION

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(54) PHOSPHOR SCREEN EXPOSURE APPARATUS

(71) We, HITACHI, LTD., a Corporation organized under the laws of Japan, of 5-1, 1-chome, Marunouchi, Chiyoda-ku, Tokyo, Japan 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 present invention relates to an exposure apparatus which is used during the formation of the phosphor screen of a color picture tube.
 Generally, to form the phosphor screen of a color picture tube, a phosphor screen exposure apparatus is used and the inside surface of the panel coated with a slurry of phosphor material or the phosphor screen is exposed to the light from a light source through a shadow mask, thus forming tri-color phosphor dots or phosphor stripes corresponding to the mask holes in the shadow mask on the phosphor screen. The size of the thus formed phosphor dots or stripes constitutes an important factor which determines the picture quality such as the color phase irregularity of the color picture tube. For this reason, the phosphor dots or stripes must be formed so that the resulting dots or stripes always have a predetermined size and, this size is affected greatly in particular by the amount of light to which the slurry of phosphor material is exposed during the above-mentioned manufacturing process. Thus, exposure apparatus has heretofore been used, widely which incorporates a light quantity control unit so that the luminance at the position of its one or plurality of light receiving elements is detected and the detector output signal is maintained at a predetermined value thus maintaining the brightness of the light source at a constant value.

A disadvantage of the conventional light quantity control units of this type is that since the light receiving element is disposed

between the light source and the panel, the light receiving element is subjected to the intense heat radiation and ultraviolet rays from the light source with the resulting rise in its temperature, thus causing variation in the detector output signal or deterioration in the material of the light receiving element and thereby making it difficult to control the brightness of the light source with a high degree of accuracy.

It is an object of this invention to provide an exposure apparatus including an improved light quantity control unit in which the temperature of its light receiver does not rise, nor the light receiver is attacked by ultra-violet rays and which is capable of controlling the light quantity with a high degree of accuracy.

According to the invention there is provided a phosphor screen exposure apparatus for color picture tubes, the apparatus comprising illumination means within means for supporting a color picture tube face panel for, in use of the apparatus, exposure of a slurry coated on an inner surface of the panel to light directed from the illumination means through a shadow mask disposed near said inner surface of the panel, the illumination means comprising a lamp housing and a light receiving system fitted in said lamp housing, said lamp housing comprising a light source, a housing body portion holding said light source in place and having a space therein serving as a cooling water container for cooling said light source, a transparent upper plate for transmitting light emanating from said light source toward the shadow mask and making said housing body portion watertight, and an opening into which said light receiving system is fitted, and said light receiving system comprising a light receiver for receiving light emanating from said light source and generating, in response thereto a control signal which, in use, controls the

brightness of said light source, a light receiver holder holding said light receiver in a predetermined position of said light receiving system, said light receiver holder being disposed in said opening of said lamp housing, and a transparent, water-sealing plate sealing water and transmitting part of the light emanating from said light source toward the light receiver, said light receiver extending into a recess in said light receiver holder.

The invention will be further apparent from the following detailed description given by way of example with reference to the accompanying drawings, in which:

Fig. 1 is a sectional view showing the principal parts of an embodiment of an exposure apparatus according to the invention.

Fig. 2 is an enlarged detailed view of the lamp housing and light receiving section in the exposure apparatus shown in Fig. 1.

Fig. 3 is a sectional view taken along the line A-A' of Fig. 2.

As shown in Fig. 1, the exposure apparatus according to the illustrated embodiment comprises as illumination means a lamp housing 2 including a light source 1 consisting of a very high pressure mercury lamp, a luminance correcting filter 3 for correcting the distribution of the luminance on the phosphor screen, a correction lens 4 for aligning the locus of the beam of light emitted from the light source 1 with the actual path of the electron beam, and a light receiving system 9 fitted in the lamp housing 2 and including a light receiver 8, and cooling water pipes 10. A further housing with a plate 7 is provided as means for holding in place a panel 6 having the inside surface thereof coated with a slurry of phosphor material (not shown) and also having a shadow mask 5 disposed inside.

Figs. 2 and 3 are enlarged views of the structure in which the light receiving system 9 is fitted in the lamp housing 2 of Fig. 1. As shown in the Figures, the lamp housing 2 includes the mercury lamp light source 1, a housing body portion 11 for holding the mercury lamp in place and also serving as a cooling water container, an arc length base plate 12 which acts as a shield to determine the effective length of the light source, and a transparent upper quartz plate 13 for transmitting light and also making the interior of the housing watertight.

The housing body 11 further includes an opening 14 into which the light receiving system 9 is fitted.

As shown in Figs. 2 and 3, the light receiving system 9 comprises, in addition to the light receiver 8, a quartz plate 16 for water seal, a pinhole plate 17 for reducing the light from the light source, a glass plate 18 for obstructing the transmission

of ultraviolet rays having wavelengths of about 3,000Å or less, a glass diffusion plate 19 for diffusing the light transmitted through the pinhole, a heat radiation absorbing filter 20 for absorbing the heat radiation from the light source, a spectral filter 21 for transmitting only those specific wavelengths ranging from 3,500 to 4,000Å and a light receiver holder 22 for holding these elements. The light receiving system 9 is fitted in the opening 14.

During the time that the above-mentioned exposure apparatus is operated, the running water introduced through the cooling water pipe 10 of the lamp housing cools the mercury lamp 1 as well as the entire lamp housing 2. Consequently, the light receiving system 9 is also cooled. Further, the light receiver 8 of the light receiving system 9 is not heated greatly by the heat radiation, since it is subjected only to the light transmitted through the pinhole plate 17. Thus, the temperature of the light receiver 8 does not rise and consequently the brightness of the light source 1 can be controlled with improved accuracy. Also, since the incident light on the light receiver 8 is that which was passed through the pinhole plate 17, the filter 18 for absorbing the undesired ultraviolet rays and the spectral filter 21, there is no possibility of the light receiver 8 being exposed to the undesired ultraviolet rays with the result that the light receiver 8 is not adversely affected under the effect of ultraviolet rays and thus it has a long-time service durability.

Further, to prevent bubbles in the cooling water from staying in the space between the light receiver 8 and the light source 1, i.e., a space 23 shown in Fig. 3 and affecting the light input to the light receiver 8, bubble inhibiting water channels 24 and 24' are provided in addition to a mercury lamp cooling water channel 25 thus ensuring improved results.

WHAT WE CLAIM IS:

1. A phosphor screen exposure apparatus for color picture tubes, the apparatus comprising illumination means within means for supporting a color picture tube face panel for, in use of the apparatus, exposure of a slurry coated on an inner surface of the panel to light directed from the illumination means through a shadow mask disposed near said inner surface of the panel, the illumination means comprising a lamp housing and a light receiving system fitted in said lamp housing, said lamp housing comprising a light source, a housing body portion holding said light source in place and having a space therein serving as a cooling water container for cooling said light source, a transparent upper plate for transmitting light emanating from said light source toward the shadow mask and mak-

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brightness of said light source, a light receiver holder holding said light receiver in a predetermined position of said light receiving system, said light receiver holder being disposed in said opening of said lamp housing, and a transparent, water-sealing plate sealing water and transmitting part of the light emanating from said light source toward the light receiver, said light receiver extending into a recess in said light receiver holder.

The invention will be further apparent from the following detailed description given by way of example with reference to the accompanying drawings, in which:

Fig. 1 is a sectional view showing the principal parts of an embodiment of an exposure apparatus according to the invention.

Fig. 2 is an enlarged detailed view of the lamp housing and light receiving section in the exposure apparatus shown in Fig. 1.

Fig. 3 is a sectional view taken along the line A-A' of Fig. 2.

As shown in Fig. 1, the exposure apparatus according to the illustrated embodiment comprises as illumination means a lamp housing 2 including a light source 1 consisting of a very high pressure mercury lamp, a luminance correcting filter 3 for correcting the distribution of the luminance on the phosphor screen, a correction lens 4 for aligning the locus of the beam of light emitted from the light source 1 with the actual path of the electron beam, and a light receiving system 9 fitted in the lamp housing 2 and including a light receiver 8, and cooling water pipes 10. A further housing with a plate 7 is provided as means for holding in place a panel 6 having the inside surface thereof coated with a slurry of phosphor material (not shown) and also having a shadow mask 5 disposed inside.

Figs. 2 and 3 are enlarged views of the structure in which the light receiving system 9 is fitted in the lamp housing 2 of Fig. 1. As shown in the Figures, the lamp housing 2 includes the mercury lamp light source 1, a housing body portion 11 for holding the mercury lamp in place and also serving as a cooling water container, an arc length base plate 12 which acts as a shield to determine the effective length of the light source, and a transparent upper quartz plate 13 for transmitting light and also making the interior of the housing watertight.

The housing body 11 further includes an opening 14 into which the light receiving system 9 is fitted.

As shown in Figs. 2 and 3, the light receiving system 9 comprises, in addition to the light receiver 8, a quartz plate 16 for water seal, a pinhole plate 17 for reducing the light from the light source, a glass plate 18 for obstructing the transmission

of ultraviolet rays having wavelengths of about 3,000Å or less, a glass diffusion plate 19 for diffusing the light transmitted through the pinhole, a heat radiation absorbing filter 20 for absorbing the heat radiation from the light source, a spectral filter 21 for transmitting only those specific wavelengths ranging from 3,500 to 4,000Å and a light receiver holder 22 for holding these elements. The light receiving system 9 is fitted in the opening 14.

During the time that the above-mentioned exposure apparatus is operated, the running water introduced through the cooling water pipe 10 of the lamp housing cools the mercury lamp 1 as well as the entire lamp housing 2. Consequently, the light receiving system 9 is also cooled. Further, the light receiver 8 of the light receiving system 9 is not heated greatly by the heat radiation, since it is subjected only to the light transmitted through the pinhole plate 17. Thus, the temperature of the light receiver 8 does not rise and consequently the brightness of the light source 1 can be controlled with improved accuracy. Also, since the incident light on the light receiver 8 is that which was passed through the pinhole plate 17, the filter 18 for absorbing the undesired ultraviolet rays and the spectral filter 21, there is no possibility of the light receiver 8 being exposed to the undesired ultraviolet rays with the result that the light receiver 8 is not adversely affected under the effect of ultraviolet rays and thus it has a long-time service durability.

Further, to prevent bubbles in the cooling water from staying in the space between the light receiver 8 and the light source 1, i.e., a space 23 shown in Fig. 3 and affecting the light input to the light receiver 8, bubble inhibiting water channels 24 and 24' are provided in addition to a mercury lamp cooling water channel 25 thus ensuring improved results.

WHAT WE CLAIM IS:

1. A phosphor screen exposure apparatus for color picture tubes, the apparatus comprising illumination means within means for supporting a color picture tube face panel for, in use of the apparatus, exposure of a slurry coated on an inner surface of the panel to light directed from the illumination means through a shadow mask disposed near said inner surface of the panel, the illumination means comprising a lamp housing and a light receiving system fitted in said lamp housing, said lamp housing comprising a light source, a housing body portion holding said light source in place and having a space therein serving as a cooling water container for cooling said light source, a transparent upper plate for transmitting light emanating from said light source toward the shadow mask and mak-



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ing said housing body portion watertight, and an opening in which said light receiving system is fitted; and said light receiving system comprising a light receiver for receiving light emanating from said light source and generating, in response thereto, a control signal which, in use, controls the brightness of said light source, a light receiver holder holding said light receiver in a predetermined position of said light receiving system, said light receiver holder being disposed in said opening of said lamp housing, and a transparent, water-sealing plate sealing water and transmitting part of the light emanating from said light source toward the light receiver, said light receiver extending into a recess in said light receiver holder.

2. A phosphor screen exposure apparatus as claimed in claim 1, wherein water channel means are provided for preventing the retention of bubbles in front of the light receiving system.

3. A phosphor screen exposure apparatus as claimed in claim 1 or 2, wherein said light receiving system further comprises a pinhole plate for passing a part of the light from said light source and a spectral filter selecting and transmitting light hav-

ing wavelengths of 3500-4000Å, between said transparent, water-sealing plate and said light receiver.

4. A phosphor screen exposure apparatus as claimed in claim 1 or 2, wherein said light receiving system further comprises, disposed between the transparent water sealing plate and the light receiver, a pinhole plate for reducing the quantity of light which otherwise would be transmitted from said light source to the light receiver, a glass plate for removing ultraviolet rays from such a transmitted light, a glass diffusion plate for diffusing light passed by the pinhole, a heat ray absorbing filter absorbing heat radiation from the light source, and a spectral filter for transmitting only specific wavelengths.

5. A phosphor screen exposure apparatus constructed and arranged to operate substantially as hereinbefore described, with reference to and as shown by the accompanying drawings.

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