

PATENT SPECIFICATION

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(54) COLOUR SIGNAL GENERATING APPARATUS

(71) We, EASTMAN KODAK COMPANY, a Company organized under the Laws of the State of New Jersey, United States of America of 343 State Street, Rochester, New York 14650, United States of America, 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 the separation of light from an image into its colour components for the generation of signals representative of the intensity of each colour component.

The translation of colour light images, either real or recorded, as on motion picture film, into electrical signals suitable for measurement purposes or for the display of the colour light images has long been practised through the use of optical-to-electrical signal transducer apparatus such as photomultiplier tubes and/or photosensitive semiconductor apparatus.

Recognizing that the colour of an object may be recreated by a mixture of red, green and blue light, it has been a common practice in the transmitting of colour images as electrical signals to separate the colour light image into the red, green and blue colour components of the image and to translate the intensity of each of the separated colour components into an intensity electrical signal. A display of the colour image of the object may then be recreated at a remote location by the translation of the respective electrical signals into their respective colour components and the combination of the colour components as a colour image.

In accordance with the present invention there is provided colour signal generating

apparatus comprising light-projecting means for projecting light on to separating means having arcuate reflective surfaces which separate the incident light and direct it along a plurality of distinct paths in each of which paths is a light and arranged to generate a signal representative of the intensity of that predetermined colour in the light.

In the accompanying drawings:—

Fig. 1 is a schematic illustration of one form of the present invention showing the arrangement of the separating means with respect to the photosensitive devices;

Fig. 2 is a frontal view of the reflecting surfaces of the separating means shown in Fig. 1;

Fig. 3 is a schematic illustration of a second form of the present invention showing the arrangement of the separating means with respect to the photosensitive devices; and

Fig. 4 is a frontal view of the reflecting surfaces of the separating means shown in Fig. 3.

Referring to Fig. 1 of the drawings. A light image results from the illumination of an information storage medium such as a motion picture film 10 by a white light source 12 and a focusing lens 14. The white light passing through a frame of the motion picture film 10 is modulated by the colour content of the image on the frame. A lens 16 is provided to direct the resulting modulated light so that it falls upon a separating means which comprises a reflecting device 20 in a plane 18.

The reflecting device 20 is operative to separate the incident light into three parts and to direct the three parts in the paths indicated by the numerals 22, 24 and 26 respectively upon three respective filtered photosensitive devices.

[Price 25p]

The filtered photosensitive devices are provided with filters 28, 30 and 32, each selected to transmit a predetermined range of wavelengths of light corresponding to a respective primary colour. The predetermined primary colour transmitted by filters 28, 30 and 32 may, for example, be generally described as green, red and blue, respectively. The light transmitted by each of the filters 28, 30 and 32 is imaged by a respective lens 34, 36 and 38 on to photosensitive devices 40, 42 and 44, respectively. The filtered light striking the surface of the photosensitive devices 40, 42 and 44 is translated thereby into electrical signals, the magnitude of which are dependent upon the quantity of filtered light striking the three respective photosensitive devices. The electrical signals may thereafter be modified and otherwise made suitable for communication to further apparatus where they may be used for colour correction during reproduction of the frame of the motion picture film 10, or may be otherwise employed. Further description of such apparatus is deemed unnecessary.

The reflective device 20 consists of three arcuate reflective surfaces 46, 48 and 50 having separate focal points disposed with respect to each other and the plane 18 to separate the unfocussed incident light into three unfocused part beams and to direct the separated part beams in the aforementioned light paths 22, 24 and 26.

Referring now to Fig. 2, there is shown a frontal view of the reflecting device 20 and the three arcuate reflective surfaces 46, 48 and 50. The dotted line 52 represents the area of the reflective device 20 upon which the unfocused incident light, as modulated by the colour content of the film frame is directed by lens 16. The arcuate reflective surfaces 46, 48 and 50 may be mirror surfaces that roughly approximate rectangles which correspond to the shape of the photosensitive surfaces of the photosensitive devices 40, 42 and 44. The relative areas of the three sections 46, 48 and 50 may be adjusted to compensate for the spectral sensitivity of the photosensitive devices 40, 42 and 44. For example, the arcuate mirror section 48 has the largest surface area, and it may correspond to the red sensitive photosensitive device 42 which is usually least sensitive of the three photosensitive devices.

Referring now to Fig. 3 of the drawings. Illumination of a point 60 on an information storage medium such as a frame of motion picture film 62 is effected by light 64 generated by a flying spot scanner tube 66 and focused upon the point 60 by a lens assembly 68. The white light 64 is sharply focused by the lens assembly 68 on the point 60 of the motion picture film frame 62 and, on transmission, is modulated by the colour

content of the point 60 in the motion picture film frame. The light 64 radiated from the faceplate of the flying spot scanner tube 66 scans in the well-known television raster pattern sequentially to illuminate each point in the film frame 62. A lens 70 forms an image of the exit pupil of the lens assembly 68 and directs the light therefrom transmitted by the point 60 (where the light is modulated by the colour content of the point 60) to a separating means in a plane 72 so as to illuminate the whole of the separating means regardless of the scanning position of point 60 in the frame 62.

The separating means comprises a reflecting device 74 which is operative to separate the light incident thereon into three part beams and to direct the three part beams in the paths indicated by the numerals 76, 78 and 80 on to three respective filtered photosensitive devices.

The filtered photosensitive devices are provided with filters 82, 84 and 86, each selected to transmit a predetermined range of wavelengths of light corresponding to a respective primary colour. The predetermined primary colour transmitted by each of the filters 82, 84 and 86 may for example be generally described as green, red and blue, respectively. The light transmitted by each of the filters 82, 84 and 86 is imaged by a respective condenser lens 88, 90 and 92 on to photosensitive devices 94, 96 and 98, respectively. The filtered light striking surface of the photosensitive devices 94, 96 and 98 is translated thereby into electrical signals, the magnitude of which are dependent upon the intensity of filtered light striking the three respective photosensitive devices. The electrical signals may thereafter be modified and otherwise made suitable for communication to further apparatus for the reproduction of the image in the frame of the motion picture film 62, or otherwise employed, and further description of such apparatus is deemed unnecessary.

The reflective device 74 consists of three arcuate reflective surfaces 100, 102 and 104 each having separate focal points disposed with respect to each other and the plane 72 to separate the unfocused incident light into three part beams and to reflect the separated part beams in the aforementioned light paths 76, 78 and 80.

The part beams reflected by the surfaces 100, 102 and 104 of the reflective device 74 in the paths 76, 78 and 80, respectively are focused on the condenser lens 88, 90 and 92 which cooperate with the respective reflective surfaces 100, 102 and 104 to image the corresponding portion of the exit pupil of the lens assembly 68 upon the photosensitive surfaces of the photosensitive devices 94, 96 and 98. Therefore, regardless of the position of the scanned point 60, the three part

bears are always focused upon the entire area of the photosensitive surfaces of the photosensitive devices 94, 96 and 98.

Referring now to Fig. 4, there is shown a frontal view of the reflecting device 74 and the three arcuate reflective surfaces 100, 102 and 104. The enlarged image of the exit pupil of the lens assembly 68, modulated on passage through the image frame and formed on the reflective device 74 by the lens 70 fills the circular area of the reflective device 74. The arcuate reflective surfaces 100, 102 and 104 may be mirror surfaces and may correspond to the shape of the photosensitive surfaces of the photosensitive devices 94, 96 and 98. The relative areas of the three surfaces 100, 102 and 104 may be adjusted to compensate for the spectral sensitivity of the photosensitive devices 94, 96 and 98. For example the arcuate mirror surface 102 has the largest surface area, and it may correspond to the red sensitive photosensitive device 96 which is usually least sensitive to the three photosensitive devices.

Since the purpose of the reflective devices 20 and 74 is respectively to separate the unfocused incident light into three part beams and to direct the part beams along separate paths, the mirror surfaces of the arcuate sections 46, 48 and 50, and 100, 102 and 104 need not be of high optical quality.

From the description of the two forms of the present invention set forth above, it is apparent that the invention may be practised in many alternative ways. For example, the signal generating apparatus could be employed in conjunction with a camera system for determining the colour composition of a naturally or artificially illuminated scene. Also, the filters and the photosensitive devices may have any required spectral absorption.

Further, the reflective devices 20 and 74 may each consist of a half-silvered ground glass mirror that both transmits and reflects the illuminated image.

WHAT WE CLAIM IS:—

1. Colour signal generating apparatus comprising light-projecting means for projecting light on to separating means having arcuate reflective surfaces which separate the incident light and direct it along a plurality of distinct paths in each of which paths is a light responsive means responsive to a predetermined colour of light and arranged to generate a signal representative of the intensity of that predetermined colour in the light.

2. An apparatus according to claim 1 further comprising means for illuminating a film frame, the light projecting means being arranged to receive the light passing through the film frame.

3. An apparatus according to Claim 1 or 2 wherein each light responsive means comprises a photocell located in the respective distinct path and a colour filter disposed in the same respective path between the separating means and the photocell.

4. An apparatus according to Claim 3 wherein the plurality of distinct paths comprise three separate paths and the colour filters comprise red, blue and green primary colour transmitting filters respectively.

5. An apparatus according to claim 2, or claim 3 or claim 4 as appendant to claim 2 wherein the illuminating means comprises a white light source and a focusing lens.

6. An apparatus according to claim 2, or claim 3 or claim 4 as appendant to claim 2 wherein the illuminating means comprises a flying spot scanner tube and a lens assembly.

7. Colour signal generating apparatus according to Claim 1 constructed substantially as hereinbefore described with reference to, and as shown in, Figs. 1 and 2 or Figs. 3 and 4 of the accompanying drawings.

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Referring now to Fig. 4, there is shown a frontal view of the reflecting device 74 and the three arcuate reflective surfaces 100, 102 and 104. The enlarged image of the exit pupil of the lens assembly 68, modulated on passage through the image frame and formed on the reflective device 74 by the lens 70 fills the circular area of the reflective device 74. The arcuate reflective surfaces 100, 102 and 104 may be mirror surfaces and may correspond to the shape of the photosensitive surfaces of the photosensitive devices 94, 96 and 98. The relative areas of the three surfaces 100, 102 and 104 may be adjusted to compensate for the spectral sensitivity of the photosensitive devices 94, 96 and 98. For example the arcuate mirror surface 102 has the largest surface area, and it may correspond to the red sensitive photosensitive device 96 which is usually least sensitive to the three photosensitive devices.

Since the purpose of the reflective devices 20 and 74 is respectively to separate the unfocused incident light into three part beams and to direct the part beams along separate paths, the mirror surfaces of the arcuate sections 46, 48 and 50, and 100, 102 and 104 need not be of high optical quality.

From the description of the two forms of the present invention set forth above, it is apparent that the invention may be practised in many alternative ways. For example, the signal generating apparatus could be employed in conjunction with a camera system for determining the colour composition of a naturally or artificially illuminated scene. Also, the filters and the photosensitive devices may have any required spectral absorption.

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2. An apparatus according to claim 1 further comprising means for illuminating a film frame, the light projecting means being arranged to receive the light passing through the film frame.

3. An apparatus according to Claim 1 or 2 wherein each light responsive means comprises a photocell located in the respective distinct path and a colour filter disposed in the same respective path between the separating means and the photocell.

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5. An apparatus according to claim 2, or claim 3 or claim 4 as appendant to claim 2 wherein the illuminating means comprises a white light source and a focusing lens.

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