(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 283 920 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
**19.10.2022 Bulletin 2022/42**

(21) Application number: **15889381.8**

(22) Date of filing: **17.04.2015**

(51) International Patent Classification (IPC):
***G02F 1/1335*** *(2006.01)*

(52) Cooperative Patent Classification (CPC):
**G02F 1/133602; G02F 1/133514; G02F 1/133555;**
G02F 1/133521; G02F 1/133626; G02F 2201/52

(86) International application number:
**PCT/US2015/026300**

(87) International publication number:
**WO 2016/167788 (20.10.2016 Gazette 2016/42)**

# (54) TRANSFLECTIVE LIQUID CRYSTAL DISPLAY

TRANSFLEKTIVE FLÜSSIGKRISTALLANZEIGE

DISPOSITIF D'AFFICHAGE À CRISTAUX LIQUIDES TRANSFLECTIF

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**

(43) Date of publication of application:
**21.02.2018 Bulletin 2018/08**

(73) Proprietor: **Amel Technology, LLC**
**Fairhaven, MA 02719 (US)**

(72) Inventor: **NEVEUX, Nathanael**
**East Providence, RI 02914 (US)**

(74) Representative: **Engstle, Verena et al**
**Meissner Bolte**
**Patentanwälte Rechtsanwälte**
**Partnerschaft mbB**
**Bankgasse 3**
**90402 Nürnberg (DE)**

(56) References cited:
**JP-A- 2003 302 516**
**JP-A- 2008 268 738**
**US-A1- 2006 197 896**
**US-A1- 2007 063 945**
**US-A1- 2007 063 945**
**US-A1- 2008 174 716**
**US-A1- 2011 148 832**
**US-A1- 2012 127 140**
**US-A1- 2013 235 559**
**US-B1- 6 774 963**
**US-B2- 7 760 297**



EP 3 283 920 B1

## Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

**[0001]** The present invention relates to I transflective liquid crystal display (hereinafter "LCD") panels.

2. Description of Related Art

**[0002]** In a transflective LCD panel, ambient light may be reflected off a mirror and its color may be produced in the reflective portion of a sub-pixel contained within a pixel in the panel's pixel array. In contrast, light produced from within the panel may be transmitted through a filter and its color may be produced in the transmissive portion of the same sub-pixel. Typically, the color produced by the reflective portion of the sub-pixel may be a de-saturated color, while the color produced by the transmissive portion of the sub-pixel may be a fully saturated color. In low ambient light conditions, the produced color may be a color with good optical properties. In bright ambient light conditions, however, the de-saturated color from the reflective portion of the sub-pixel dominates and, thereby, diminishes the optical properties of the produced color.

**[0003]** In U.S. Patent No. 7,636,076, an additional color-less sub-pixel, referred to as sub-pixel M, is used to increase the optical properties of the produced color in bright ambient light conditions. In U.S. Patent No. 7,760,297, an additional sub-pixel is also used to increase the optical properties of the produced color in bright ambient light conditions. Here, the additional sub-pixel has a color filter that complements the primary color filters. For example, the additional sub-pixel may have a cyan color filter.

**[0004]** US6774963 B1 discloses a transflective LCD device with dichroic RGB color filters. A first color filter transmits red light while reflecting cyan light, a second color filter transmits magenta light while reflecting green light, and third color filter transmits blue light while reflecting yellow light. In the transmissive mode, only the pixels to which a voltage is applied transmit light, for instance the red pixel transmits red light. In reflection mode, the red pixel, to which a voltage is applied blocks light since the light passes twice through the LC layer, and the green and blue pixels not having a voltage applied, reflect yellow and magenta which together is perceived as red light.

**[0005]** US 2007/063945 A1 discloses a transflective LCD with ambient light sensor to control the input signal to a fourth sub-pixel dependent on the ambient light conditions.

**[0006]** JP 2003 302516 A, US 2006/197896 A1 and JP 2008 268738 A each disclose transflective display devices with a color filter including an array of sub-pixels containing both RGB color filter elements and CMY color filter elements.

**[0007]** JP 2003 302516 A discloses a transflective display device wherein one pixel has three sub-pixels respectively displaying the color of Magenta, Yellow, and Cyan in the reflective mode, and respectively displaying the color of Red, Green, and Blue in the transmissive mode. However, the filters of JP 2003 302516 A are not dichroic filters but the effect is achieved by different areas in each pixel occupied by two or only one absorbing color filter element.

**[0008]** US 2006/197896 A1 on the other hand discloses a transflective display device wherein one pixel has three sub-pixels each having a reflective region and a transmissive region, wherein a first sub-pixel includes yellow and magenta color filter portions and is arranged to display the color red in both the reflective region and the transmissive region, and wherein a second sub-pixel includes magenta and cyan color filter portions and is arranged to display the color blue in both the reflective region and the transmissive region, and wherein a third sub-pixel includes cyan and yellow color filter portions and is arranged to display the color green in both the reflective region and the transmissive region. In other words, US2006/197896 A1 discloses an array of color filter elements containing both RGB color filter elements and CMY color filter elements arranged to transmit and reflect the same set of colors, namely RGB. But the color filter elements of US2006/197896 A1 are not of dichroic nature.

**[0009]** Finally, JP 2008 268738 A discloses a transflective display with RGBYCM-sub-pixel elements, wherein the RGB sub-pixels have reflective regions of thinner color filter widths and transmissive regions of larger color filter widths, while the YCM sub-pixels are purely transmissive and have the same color filter widths as the transmissive regions of the RGB-sub-pixels. In the backlit transmissive mode, the display of JP 2008 268738 A displays RGBYCM-colors in each pixel, whereas in the reflective mode using ambient illumination, the display of JP 2008 268738 A displays RGB-colors in each pixel. The color filter elements of JP 2008 268738 A are however also not of dichroic nature.

BRIEF SUMMARY OF THE INVENTION

**[0010]** The invention is set out in the appended set of claims.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

**[0011]** The foregoing features of the invention will be more readily understood by reference to the following detailed description, taken with reference to the accompanying drawings, in which:

Figure 1 is a schematic representation of a transflective LCD panel, in accordance with an embodiment of the invention.

Figure 2a is a schematic representation of a transflective LCD, in accordance with an embodiment of the invention, in transmissive light mode.

Figure 2b is a schematic representation of a transflective LCD, in accordance with an embodiment of the invention, in reflective light mode.

Figure 3 is a schematic representation of a transflective LCD, in accordance with an embodiment of the invention, in transmissive and reflective light mode.

Figure 4 is a schematic representation of a pixel array, in accordance with an embodiment of the invention, of a transflective LCD.

Figure 5 is a schematic representation of a first embodiment for the pixel array of the transflective LCD shown in Figure 4.

Figure 6 is a schematic representation of a second embodiment for the pixel array of the transflective LCD shown in Figure 4.

Figure 7a is a perspective view of a pixel array, in accordance with an embodiment of the invention, in transmissive light mode.

Figure 7b is a perspective view of a pixel array, in accordance with an embodiment of the invention, in reflective light mode.

## DETAILED DESCRIPTION OF THE INVENTION

**[0012]** Fig. 1 is a schematic representation of a transflective LCD panel, in accordance with an embodiment of the invention. In panel 100, processing unit 102 controls graphic-processing unit 104, and processing unit 102, in conjunction with ambient light sensor 106, controls backlight 108. In operation, ambient light sensor 106 monitors the level of ambient light entering panel 100. When the level of ambient light brightens to a particular level, as discussed in more detail below, ambient light sensor 106 signals processing unit 102 to turn off backlight 108. In this light mode, color substrates 110a and 110b act as mirrors and reflect the ambient light. When the level of ambient light dims to a particular level, as discussed in more detail below, ambient light sensor 106 signals processing unit 102 to turn on backlight 108. In this light mode, color substrates 110a and 110b act as filters and transmit the light emitted from backlight 108.

**[0013]** In an alternative embodiment, processing unit 102 may signal graphic-processing unit 104 and graphic-processing unit 104 may control backlight 108. Or, in another alternative embodiment, ambient light sensor 106 may send its signal to graphic-processing unit 104 (rather than processing unit 102) and graphic-processing unit 104 may control backlight 108.

**[0014]** As a person of ordinary skill in art understands, processing unit 102 may be a central processing unit ("CPU"), a sub-processing unit, or a co-processing unit.

**[0015]** In all light modes, the light passes through liquid crystal layer 112, which is composed of numerous liquid crystals (not shown), and through diffusion substrate 114. The liquid crystals control the intensity, that is, the brightness, of the reflected or transmitted light.

**[0016]** The transflective LCD panel described in Fig. 1 further comprises a pixel array. As shown in Fig. 4, which is a schematic representation of a pixel array in accordance with an embodiment of the invention, the pixel array (denoted as 418) contains numerous pixels (denoted as 416), and each pixel contains numerous sub-pixels (denoted as 410). The color substrates (for example, 110a and 110b) are arrayed in correspondence to the array of sub-pixels. In other words, each sub-pixel reflects the reflective color of its color substrate and transmits the transmissive color of its color substrate.

**[0017]** As shown in Figs. 2a and 2b, which are schematic representations of a transflective LCD in accordance with an embodiment of the invention, the transmissive color of color substrate 210a (denoted as TC) is different than the reflective color of color substrate 210a (denoted as RC). Similarly, the transmissive color of color substrate 210b is different than the reflective color of color substrate 210b. For example, color substrate 210a may transmit red light, but reflect cyan light. In contrast, color substrate 210b may transmit cyan light, but reflect red light. In industry parlance, this type of color substrate may be referred to as a dichroic filter, dichroic mirror, dichroic filter/mirror, or an interference filter.

**[0018]** The color substrates may be composed of a thin, transparent spacer-such as glass (for example, borofloat glass) or thermoplastic elastomers (such as polycarbonate)-that has been coated on at least one side. As understood by a person of ordinary skill in the art, the spacer is coated with multiple thin layers of metal oxides-such as chromium, silicon, titanium, magnesium, aluminum, zirconium, etc. Typically, the coating is applied to the spacer in a vacuum chamber under high temperature. In an alternate example not falling under the appended claims, the color substrates may also be composed of glass that is dyed or lacquered, gelatin that is dyed or lacquered, synthetic polymers that are dyed or lacquered, or any material that is created or transformed to meet the required optic properties in which either the transmissive color of the material may be selected or the reflective color of the material may be selected.

**[0019]** For the transflective LCD panel described herein, the optic properties might include color substrates in which the transmissive color is the complement of the reflective color. For example, a color substrate that transmits red might reflect cyan, a color substrate that transmits magenta might reflect green, a color substrate that transmits blue might reflect yellow, etc.

**[0020]** As shown in Fig. 3, which is a schematic representation of a transflective LCD in accordance with an embodiment of the invention, as the level of ambient light approaches the level of light emitted from backlight 308, panel 300 is operating in both transmissive and reflective light mode. This transflective light mode stems from the optic properties of color substrates 310a and 310b. Unlike most conventional transflective LCD panels, which have sub-pixels with transmissive and reflective regions,

color substrates 310a and 310b do not have transmissive and reflective regions. Rather, under certain lighting conditions, color substrates 310a and 310b may be acting as a filter (transmissive light mode) and a mirror (reflective light mode) at the same, or substantially the same, moment in time and from the same, or substantially the same, place on the substrate.

**[0021]** In the transflective LCD panel described herein, this transflective light mode is foremost when the level of the ambient light is the same as, or substantially the same as, the level of the light emitted from the backlight. As understood by a person of ordinary skill in the art, the interaction occurring between the transmitted light and the reflected light at this point in time changes the saturation and/or the wavelength of the displayed colors. For example, when the transmitted light is the complement of the reflected light, the displayed colors will become less saturated-that is, approach gray-scale-or, when the reflected light exceeds the transmitted lights, the display colors will be inverted.

**[0022]** As discussed above in regard to Fig. 1, ambient light sensor 106 monitors the level of ambient light and, via processing unit 102 and/or graphic-processing unit 104, controls backlight 108. The type of control may range from two-state control to variable-state control. In two-state control, backlight 108 has two states-on and off. In contrast, in variable-state control, backlight 108 may have two states-on and partial on-or may have three states-on, partial on, and off.

**[0023]** In two-state control, when backlight 108 is on (that is, emitting light), the processed signal from ambient light sensor 106 turns backlight 108 off, and when backlight 108 is off, the processed signal from ambient light sensor 106 turns backlight 108 on. Depending on the device in which panel 100 is installed, as well as the device's usage and/or application, ambient light sensor 106 may send its signal when the level of ambient light is the same as, or within some percent of, the level of light emitted from backlight 108. For example, if backlight 108 has a lux level of 100, then ambient light sensor 106 may send its signal when the lux level of ambient light is 100, when the lux level is 80 (that is, 80% of the lux level of backlight 108), or when the lux level is 120 (that is, 120% of the lux level of backlight 108).

**[0024]** When panel 100 is displaying reflective light (that is, backlight 108 is off), ambient light sensor may send its signal to turn on backlight 108 when the level of ambient light is the same as, or within some percent of, the "rated" level of light emitted from backlight 108 (that is, the level of light when backlight 108 is turned on). For example, if backlight 108 has a lux level of 100 (when turned on), then ambient light sensor 106 may send its signal when the lux level of ambient light is 100, when the lux level is 80 (that is, 80% of the lux level of backlight 108), or when the lux level is 120 (that is, 120% of the lux level of backlight 108).

**[0025]** In variable-state control, the level of light emitted from backlight 108 varies in accordance with the LCD panel settings, which may be set by the manufacturer and/or by the user. These LCD panel settings may include, for example, the auto-brightness setting and the brightness level setting. In turn, ambient light sensor 106 uses this "calculated" level of light emitted from backlight 108 to control backlight 108. In a manner similar to two-state control, ambient light sensor 106 may send its signal when the level of ambient light is the same as, or within some percent of, the "calculated" level of light emitted from backlight 108.

**[0026]** In an alternate embodiment, the light reflectance level of panel 100 may be used in the calculations for controlling backlight 108. For example, in either two-state control or variable-state control, the light reflectance level may modify the level of ambient light at which ambient light sensor 106 sends its signal for controlling backlight 108.

**[0027]** In either two-state control or variable-state control, the process of controlling backlight 108 may be performed by processing unit 102 or graphic-processing unit 104. In an alternate embodiment of the invention, the process may be performed by ambient light sensor 106. As noted above, processing unit 102 may be a central processing unit ("CPU"), a sub-processing unit, or a co-processing unit.

**[0028]** As discussed above in regard to Figs. 1 and 4, the transflective LCD panel described herein comprises a pixel array. As shown in Fig. 5, which is a schematic representation of an embodiment for the pixel array, the pixel array (denoted by 518) contains numerous pixels (denoted by 516), each of which contains an array of six sub-pixels (denoted by 510) aligned in three columns and two rows. The corresponding color substrates for the sub-pixels are the primary colors (red, green, blue) and the secondary colors (cyan, magenta, yellow). In this embodiment for pixel 516, the primary color sub-pixels form the top row of the sub-pixel array, and the secondary color sub-pixels form the bottom row of the sub-pixel array. In an alternate embodiment for the pixel 516, the secondary color sub-pixels form the top row of the sub-pixel array, and the primary color sub-pixels form the bottom row of the sub-pixel array.

**[0029]** In Fig. 6, which is a schematic representation of an alternate embodiment for the pixel array, the pixel array (denoted by 618) contains numerous pixels (denoted by 616a and 616b), each of which contains an array of six sub-pixels (denoted by 610) aligned in three columns and two rows. In pixel 616a, the top row of the sub-pixel array is formed by two primary color sub-pixels bordering one secondary color sub-pixel, and the bottom row of the sub-pixel array is formed by two secondary color sub-pixels bordering one primary color sub-pixel. In contrast, in pixel 616b, the top row of the sub-pixel array is formed by two secondary color sub-pixels bordering one primary color sub-pixel, and the bottom row of the sub-pixel array is formed by two primary color sub-pixels bordering one secondary color sub-pixel. In this embodiment for pixel array 618, pixel 616a forms the

odd-numbered columns of pixel array 618, and pixel 616b forms the even-numbered columns of pixel array 618. In an alternate embodiment for pixel array 618, pixel 616a forms the odd-numbered columns of pixel array 618, and pixel 616b forms the even-numbered columns of pixel array 618.

**[0030]** Fig. 7a shows a perspective view of the pixel array described in Fig. 6 in transmissive light mode. In this embodiment, backlight 708 is on, that is, it is emitting light, and the transmitted color is generated from primary color sub-pixels 710a, 710c and 710e (which transmit red, blue and green, respectively). In a further embodiment, secondary color sub-pixels 710b, 710d and 710f (which transmit magenta, cyan and yellow, respectively) also may be used and, thereby, produce brighter, more saturated colors.

**[0031]** Fig. 7b shows a perspective view of the pixel array described in Fig. 6 in reflective light mode. In this embodiment, backlight 708 is off, that is, it is not emitting light, and the reflected color is generated from secondary color sub-pixels 710b, 710d and 710f (which reflect green, red and blue, respectively). In a further embodiment, primary color sub-pixels 710a, 710c and 710e (which reflect cyan, magenta and yellow, respectively) also may be used and, thereby, produce brighter, more saturated colors.

**[0032]** The pixel arrays described herein may need to be controlled via a six-color signal (rather than the standard three-color signal). As understood by a person of ordinary skill in the art, the standard three-color signal output by a graphic-processing unit may be readily converted into the six-color signal, or the graphic-processing unit may be readily converted to output the six-color signal.

**[0033]** Although various exemplary embodiments of the invention have been disclosed, it should be apparent to those skilled in the art that various changes and modifications can be made which will achieve some of the advantages of the invention without departing from the scope of the invention defined by the appended claims

## Claims

1. A transflective liquid crystal display panel (100), the display panel (100) operable in a transmissive mode, a reflective mode and a transflective mode and comprising:

   a backlight (108, 208, 308, 708) configured to be switched off when the display panel is operated in the reflective mode and configured to be switched on when the display panel is operated in the transmissive or transflective mode;
   a sensor (106) configured to measure a level of ambient light entering the display panel, wherein the backlight is controlled to be switched off to operate the display panel in the reflective mode if the measured level of ambient light equals a predetermined light emission level of the switched-on backlight, or is within a predetermined percentage range thereof;
   an array (418, 518, 618) of transflective pixels (416, 516, 616) each including an array of six transflective sub-pixels (410, 510, 610, 710a-f) aligned in two rows and three columns;
   a color filter substrate with an array of dichroic color filter elements (110a, 110b, 210a, 210b, 310a, 310b) aligned corresponding to the array of sub-pixels, each of the dichroic color filter elements being configured to transmit a transmissive color and to reflect a reflective color, the reflective color being the complement of the transmissive color, wherein the six dichroic color filter elements associated with each pixel include a pair of red-reflecting and cyan-reflecting dichroic color filter elements arranged in a first one of the three columns, a pair of green-reflecting and magenta-reflecting dichroic color filter elements arranged in a second one of the three columns, and a pair of blue-reflecting and yellow-reflecting dichroic color filter elements arranged in a third one of the three columns, so that, in each column, the color of light transmitted by one of its dichroic color filter elements is complementary to the color of light transmitted by the other one of its dichroic color filter elements, and so that the color of light reflected by said one of its dichroic color filter elements is complementary to the color of light reflected by the other one of its dichroic color filter elements, the color filter substrate thereby transmitting light of transmissive colors when the display panel is operated in the transmissive or transflective mode, and, from substantially the same area in the color filter substrate, reflecting light of the same reflective colors when the display panel is operated in the reflective mode.

2. The display panel according to claim 1, wherein at least one of the three columns, the top row is either a cyan-reflecting, magenta-reflecting or yellow-reflecting dichroic color filter element and the corresponding bottom row is its paired red-reflecting, green-reflecting or blue-reflecting color filter element.

3. The display panel according to claim 1, wherein the red-reflecting color filter element is in the top row and the cyan-reflecting dichroic color filter element is in the bottom row of the first one of the three columns, the green-reflecting color filter element is in the top row and the magenta-reflecting color filter element is in the bottom row of the second one of the three columns, and the blue-reflecting color filter element is in the top row and the yellow-reflecting color filter

element is in the bottom row of the third one of the three columns.

4. The display panel according to claim 1, wherein at least one of the three columns, the top row is either a red-reflecting, green-reflecting, blue-reflecting, cyan-reflecting, magenta-reflecting or yellow-reflecting dichroic color filter element and the corresponding bottom row is its paired cyan-reflecting, magenta-reflecting, yellow-reflecting, red-reflecting, green-reflecting or blue-reflecting color filter element.

**Patentansprüche**

1. Transflektive Flüssigkristallanzeigetafel (100), wobei die Anzeigetafel (100) in einem Transmissionsmodus, einem Reflexionsmodus und einem Transflektionsmodus betrieben werden kann und Folgendes umfasst:

   eine Hintergrundbeleuchtung (108, 208, 308, 708), die so konfiguriert ist, dass sie ausgeschaltet wird, wenn die Anzeigetafel im Reflexionsmodus betrieben wird, und so konfiguriert ist, dass sie eingeschaltet wird, wenn die Anzeigetafel im Transmissions- oder Transflektionsodus betrieben wird;
   einen Sensor (106), der so konfiguriert ist, dass er einen Pegel des in die Anzeigetafel einfallenden Umgebungslichts misst, wobei die Hintergrundbeleuchtung so gesteuert wird, dass sie ausgeschaltet wird, um das Anzeigefeld im Reflexionsmodus zu betreiben, wenn der gemessene Pegel des Umgebungslichts einem vorbestimmten Lichtemissionspegel der eingeschalteten Hintergrundbeleuchtung entspricht oder innerhalb eines vorbestimmten Prozentbereichs davon liegt;
   ein Array (418, 518, 618) von transflektiven Pixeln (416, 516, 616), die jeweils ein Array von sechs transflektiven Subpixeln (410, 510, 610, 710a-f) enthalten, die in zwei Reihen und drei Spalten angeordnet sind;
   ein Farbfiltersubstrat mit einer Anordnung von dichroitischen Farbfilterelementen (110a, 110b, 210a, 210b, 310a, 310b), die entsprechend der Anordnung von Subpixeln angeordnet sind, wobei jedes der dichroitischen Farbfilterelemente so konfiguriert ist, dass es eine transmissive Farbe durchlässt und eine reflektierende Farbe reflektiert, wobei die reflektierende Farbe das Komplement der transmissiven Farbe ist, wobei die sechs dichroitischen Farbfilterelemente, die jedem Pixel zugeordnet sind, ein Paar von rot-reflektierenden und cyan-reflektierenden dichroitischen Farbfilterelementen, die in einer ersten der drei Spalten angeordnet sind, ein Paar von grün-reflektierenden und magenta-reflektierenden dichroitischen Farbfilterelementen, die in einer zweiten der drei Spalten angeordnet sind, und ein Paar von blau-reflektierenden und gelb-reflektierenden dichroitischen Farbfilterelementen, die in einer dritten der drei Spalten angeordnet sind, umfassen, so dass in jeder Spalte die Farbe des von einem seiner dichroitischen Farbfilterelemente durchgelassenen Lichts komplementär zu der Farbe des von dem anderen seiner dichroitischen Farbfilterelemente durchgelassenen Lichts ist, und so dass die Farbe des von dem einen seiner dichroitischen Farbfilterelemente reflektierten Lichts komplementär zu der Farbe des von dem anderen seiner dichroitischen Farbfilterelemente reflektierten Lichts ist, das Farbfiltersubstrat dadurch Licht in durchlässigen Farben durchlässt, wenn die Anzeigetafel im Transmissions- oder Transflektionsmodus betrieben wird, und von im Wesentlichen demselben Bereich in dem Farbfiltersubstrat Licht in denselben reflektierenden Farben reflektiert, wenn die Anzeigetafel im Reflexionsmodus betrieben wird.

2. Anzeigetafel nach Anspruch 1, wobei in mindestens eine der drei Spalten, die obere Reihe entweder ein cyan-reflektierendes, magenta-reflektierendes oder gelb-reflektierendes dichroitisches Farbfilterelement ist und die entsprechende untere Reihe ihr gepaartes rot-reflektierendes, grün-reflektierendes oder blau-reflektierendes Farbfilterelement ist.

3. Anzeigetafel nach Anspruch 1, wobei das rot-reflektierende Farbfilterelement in der oberen Reihe und das cyan-reflektierende dichroitische Farbfilterelement in der unteren Reihe der ersten der drei Spalten ist, das grün-reflektierende Farbfilterelement in der oberen Reihe und das magentareflektierende Farbfilterelement in der unteren Reihe der zweiten der drei Spalten ist, und das blau-reflektierende Farbfilterelement in der oberen Reihe und das gelb-reflektierende Farbfilterelement in der unteren Reihe der dritten der drei Spalten ist.

4. Anzeigetafel nach Anspruch 1, wobei in mindestens einer der drei Spalten die obere Reihe entweder ein rot-reflektierendes, grün-reflektierendes, blau-reflektierendes, cyan-reflektierendes, magenta-reflektierendes oder gelb-reflektierendes dichroitisches Farbfilterelement ist und die entsprechende untere Reihe sein gepaartes cyan-reflektierendes, magenta-reflektierendes, gelb-reflektierendes, rot-reflektierendes, grün-reflektierendes oder blau-reflektierendes Farbfilterelement ist.

## Revendications

1. Un panneau d'affichage à cristaux liquides transflectif (100), le panneau d'affichage (100) pouvant fonctionner dans un mode transmissif, un mode réflectif et un mode transflectif et comprenant:

   un rétroéclairage (108, 208, 308, 708) configuré pour être éteint lorsque le panneau d'affichage fonctionne dans le mode réfléchissant et configuré pour être allumé lorsque le panneau d'affichage fonctionne dans le mode transmissif ou transflectif;
   un capteur (106) configuré pour mesurer un niveau de lumière ambiante entrant dans le panneau d'affichage, dans lequel le rétroéclairage est commandé pour être éteint afin de faire fonctionner le panneau d'affichage dans le mode réfléchissant si le niveau mesuré de lumière ambiante est égal à un niveau d'émission de lumière prédéterminé du rétroéclairage allumé, ou est dans une plage de pourcentage prédéterminée de celui-ci;
   un réseau (418, 518, 618) de pixels transflectifs (416, 516, 616) comprenant chacun un réseau de six sous-pixels transflectifs (410, 510, 610, 710a-f) alignés en deux rangées et trois colonnes ;
   un substrat de filtre coloré avec un réseau d'éléments de filtre coloré dichroïque (110a, 110b, 210a, 210b, 310a, 310b) alignés en correspondance avec le réseau de sous-pixels, chacun des éléments de filtre coloré dichroïque étant configuré pour transmettre une couleur transmissive et pour réfléchir une couleur réfléchissante, la couleur réfléchissante étant le complément de la couleur transmissive, dans lequel les six éléments de filtre de couleur dichroïque associés à chaque pixel comprennent une paire d'éléments de filtre de couleur dichroïque réfléchissant le rouge et réfléchissant le cyan disposés dans une première des trois colonnes, une paire d'éléments de filtre de couleur dichroïque réfléchissant le vert et réfléchissant le magenta disposés dans une deuxième des trois colonnes, et une paire d'éléments de filtre de couleur dichroïque réfléchissant le bleu et réfléchissant le jaune disposés dans une troisième des trois colonnes, de sorte que, dans chaque colonne, la couleur de la lumière transmise par l'un de ses éléments de filtre coloré dichroïque est complémentaire de la couleur de la lumière transmise par l'autre de ses éléments de filtre coloré dichroïque, et de sorte que la couleur de la lumière réfléchie par ledit un de ses éléments de filtre coloré dichroïque est complémentaire de la couleur de la lumière réfléchie par l'autre de ses éléments de filtre coloré dichroïque, le substrat de filtre coloré transmettant ainsi la lumière des couleurs de transmission lorsque le panneau d'affichage fonctionne dans le mode de transmission ou de transflexion, et, à partir de sensiblement la même zone dans le substrat de filtre coloré, réfléchissant la lumière des mêmes couleurs de réflexion lorsque le panneau d'affichage fonctionne dans le mode de réflexion.

2. Panneau d'affichage selon la revendication 1, dans lequel au moins une des trois colonnes, la rangée supérieure est soit un élément de filtre de couleur dichroïque réfléchissant le cyan, réfléchissant le magenta ou réfléchissant le jaune et la rangée inférieure correspondante est son élément de filtre de couleur apparié réfléchissant le rouge, réfléchissant le vert ou réfléchissant le bleu.

3. Panneau d'affichage selon la revendication 1, dans lequel l'élément de filtre de couleur réfléchissant le rouge est dans la rangée supérieure et l'élément de filtre de couleur dichroïque réfléchissant le cyan est dans la rangée inférieure de la première des trois colonnes, l'élément de filtre de couleur réfléchissant le vert est dans la rangée supérieure et l'élément de filtre de couleur réfléchissant le magenta est dans la rangée inférieure de la deuxième des trois colonnes, et l'élément de filtre de couleur réfléchissant le bleu est dans la rangée supérieure et l'élément de filtre de couleur réfléchissant le jaune est dans la rangée inférieure de la troisième des trois colonnes.

4. Panneau d'affichage selon la revendication 1, dans lequel au moins une des trois colonnes, la rangée supérieure est soit un élément de filtre de couleur dichroïque que réfléchissant le rouge, réfléchissant le vert, réfléchissant le bleu, réfléchissant le cyan, réfléchissant le magenta ou réfléchissant le jaune et la rangée inférieure correspondante est son élément de filtre de couleur apparié réfléchissant le cyan, réfléchissant le magenta, réfléchissant le jaune, réfléchissant le rouge, réfléchissant le vert ou réfléchissant le bleu.

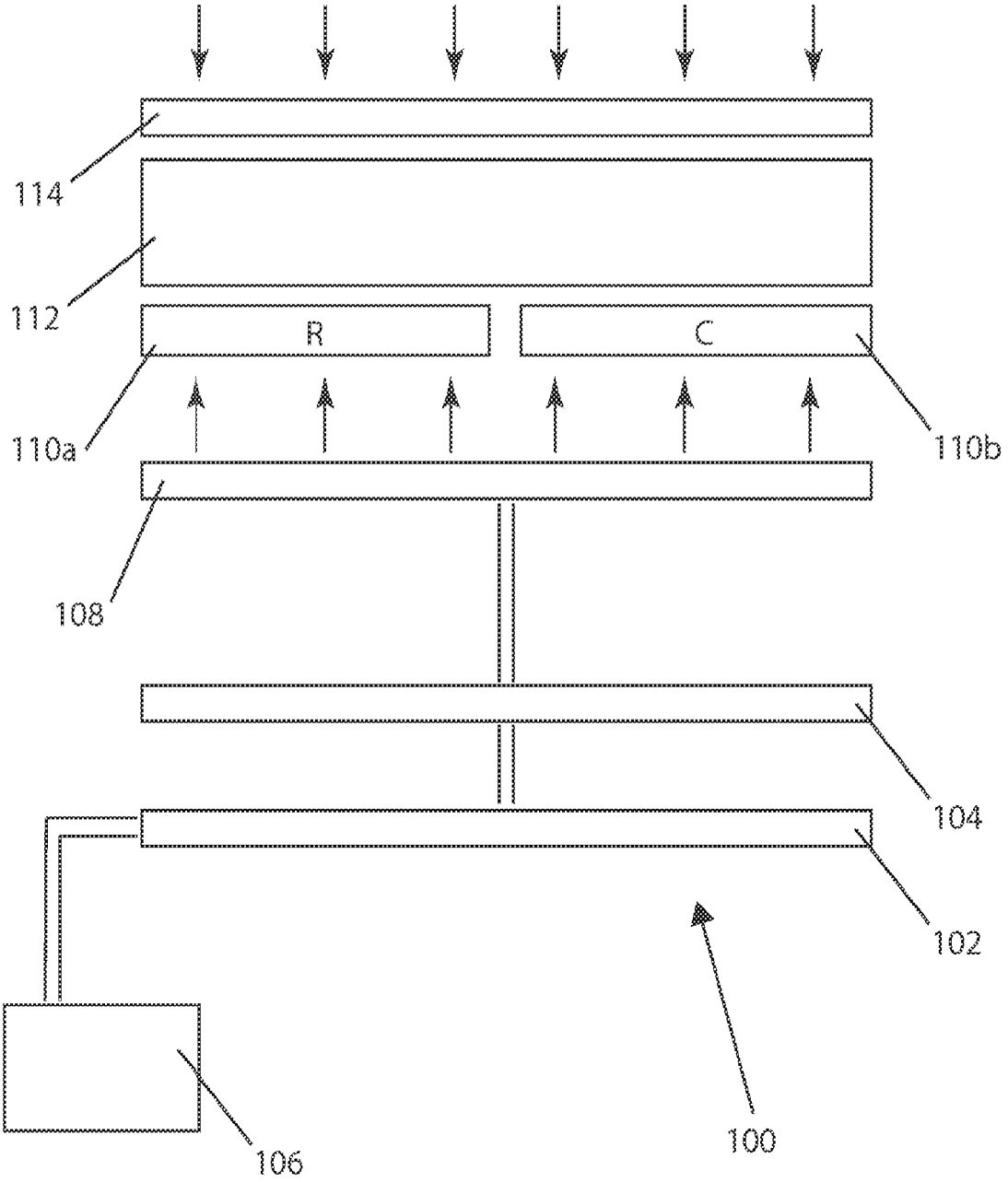


FIG. 1

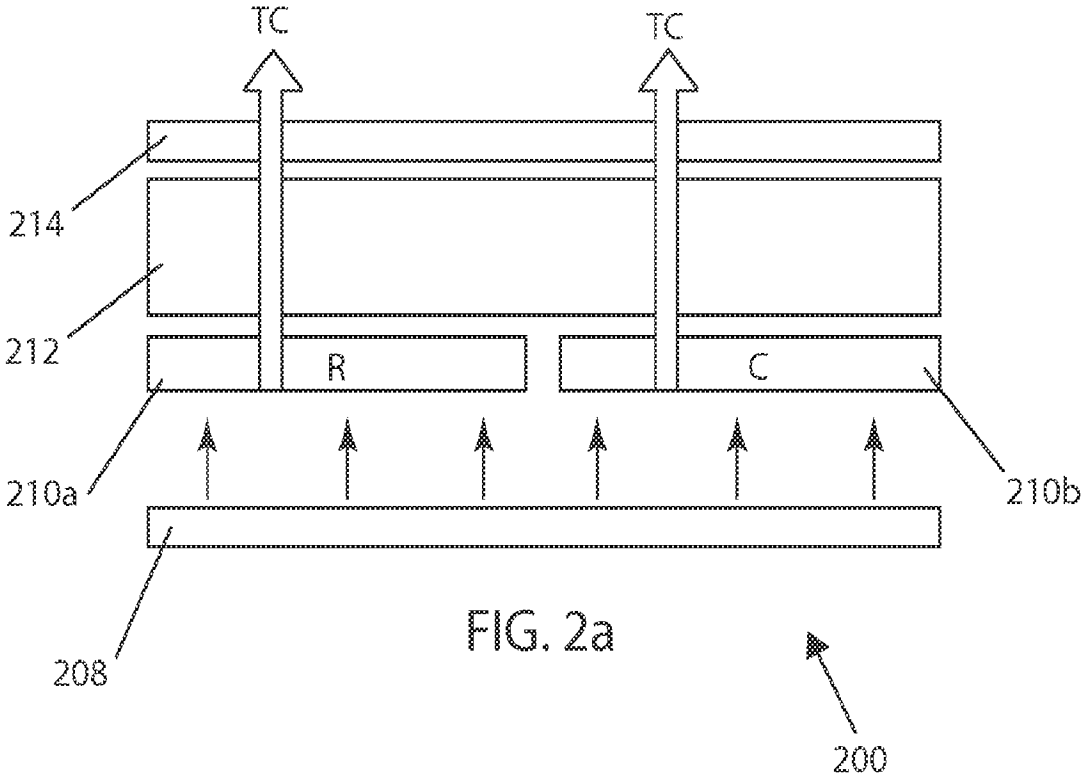
TC
TC
214
212
R
C
210a
210b
208
200

FIG. 2a

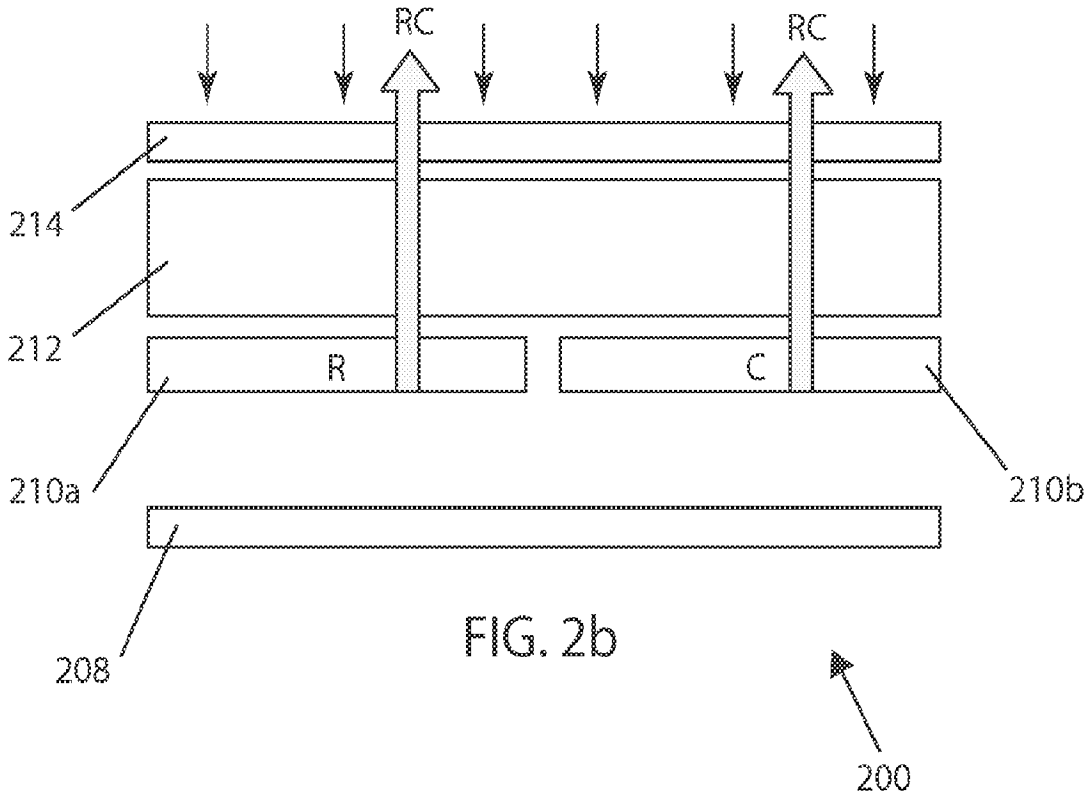
RC
RC
214
212
R
C
210a
210b
208
200

FIG. 2b

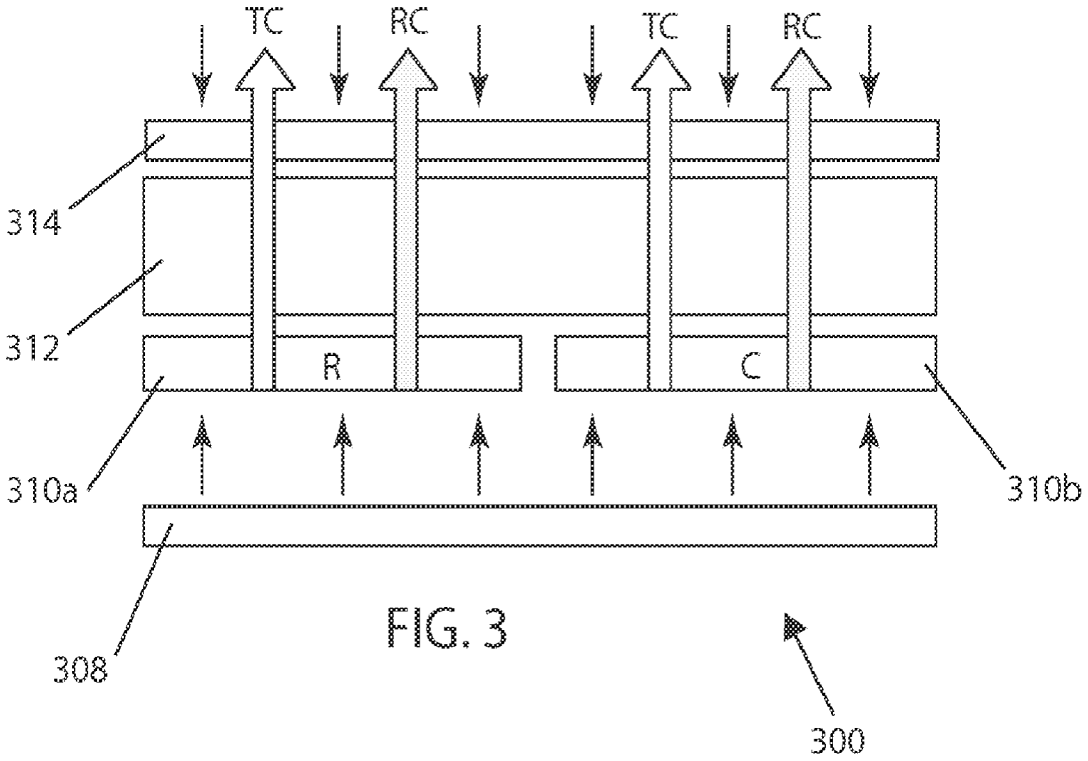


FIG. 3

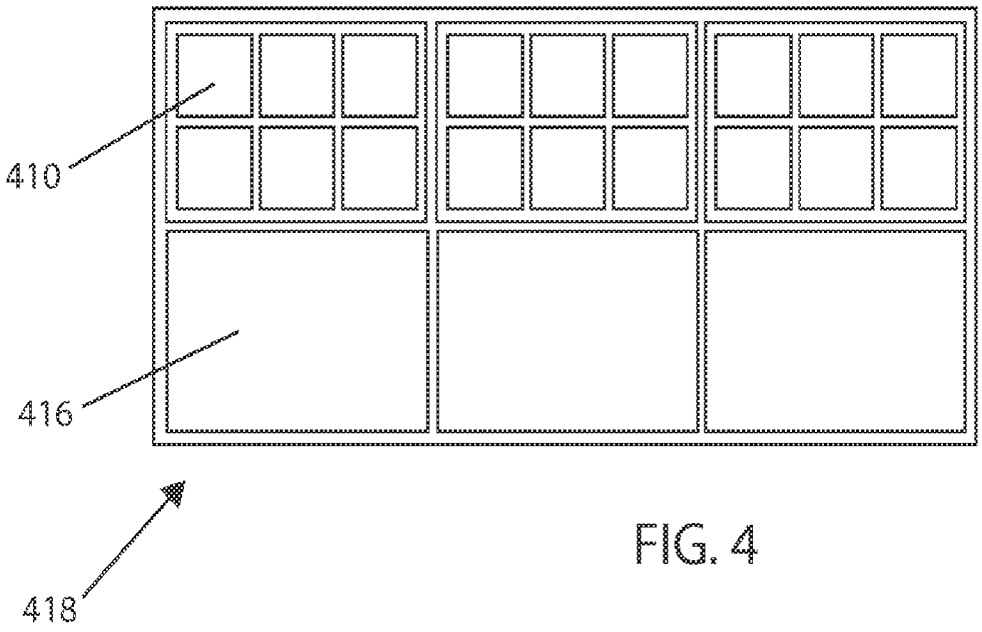


FIG. 4

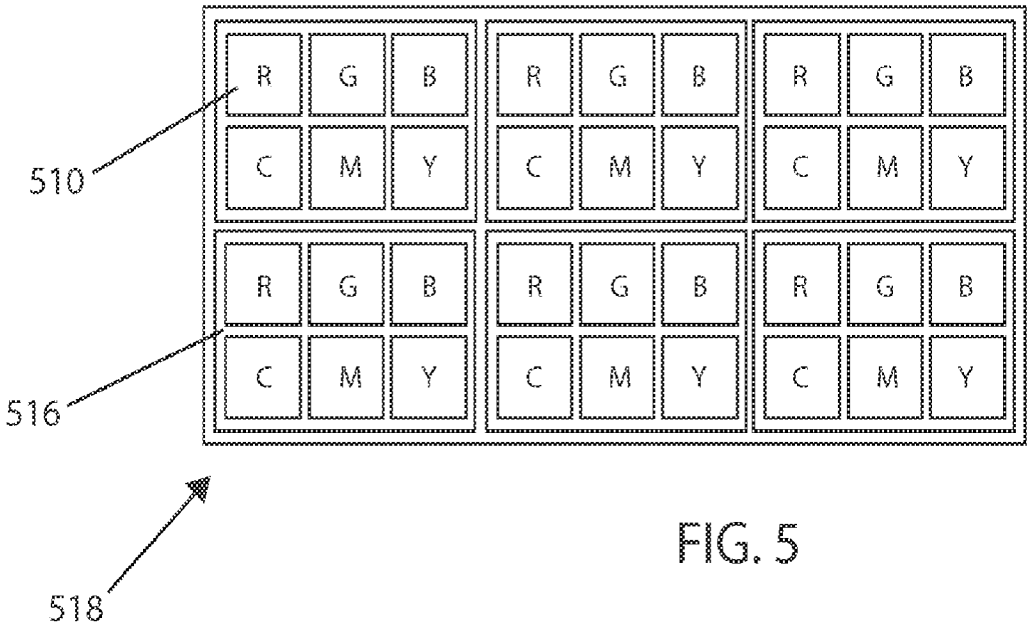


FIG. 5

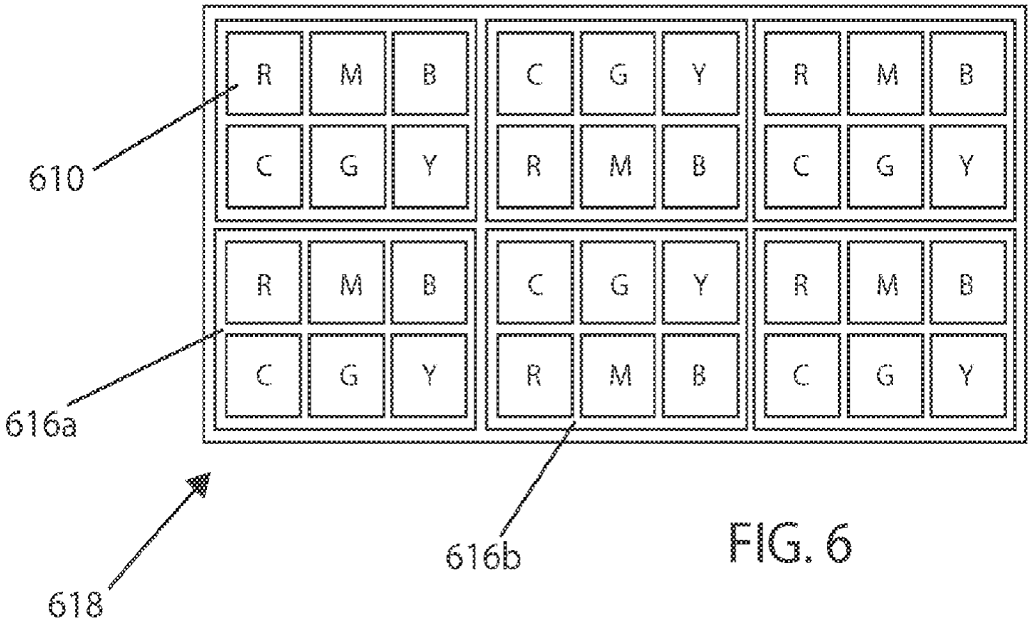


FIG. 6

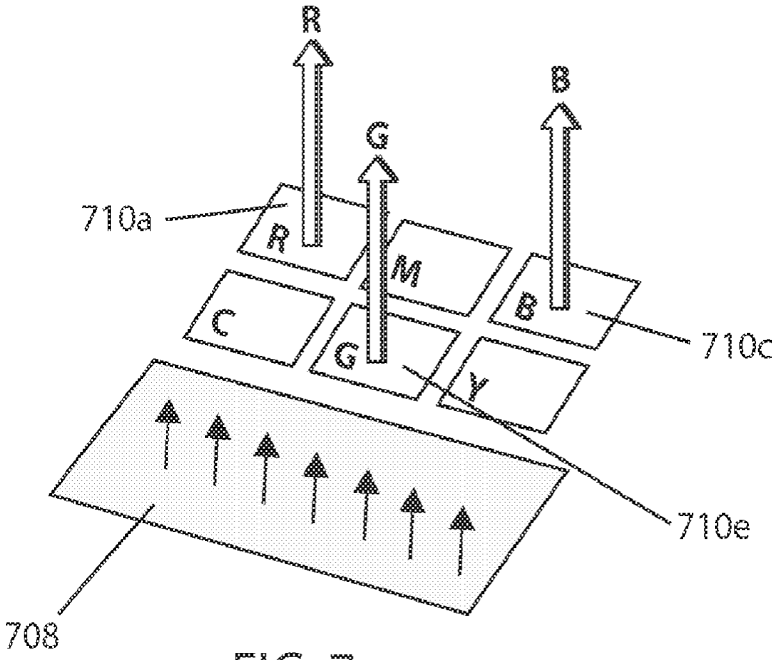


FIG. 7a

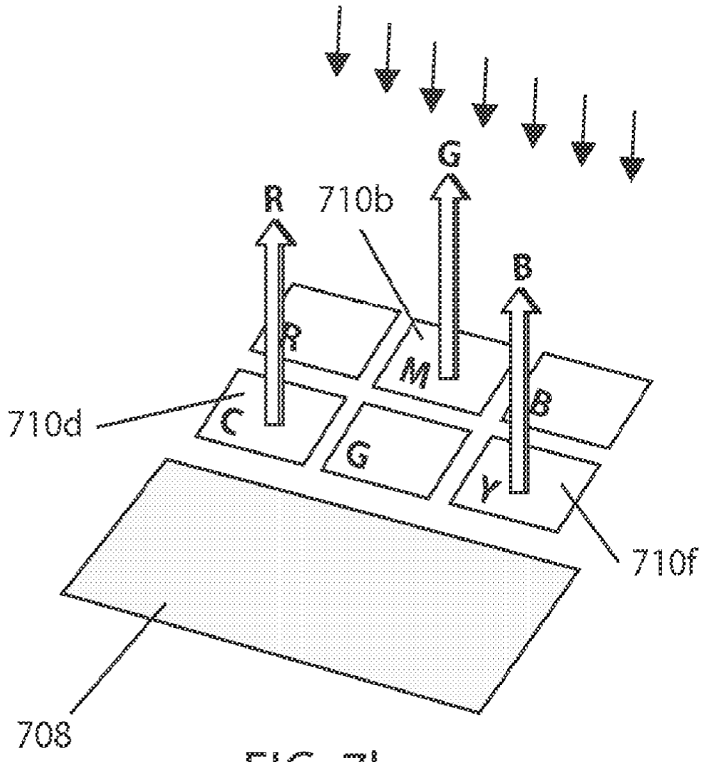


FIG. 7b

## REFERENCES CITED IN THE DESCRIPTION

*This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.*

### Patent documents cited in the description


- US 7636076 B **[0003]**
- US 7760297 B **[0003]**
- US 6774963 B1 **[0004]**
- US 2007063945 A1 **[0005]**
- JP 2003302516 A **[0006] [0007]**
- US 2006197896 A1 **[0006] [0008]**
- JP 2008268738 A **[0006] [0009]**