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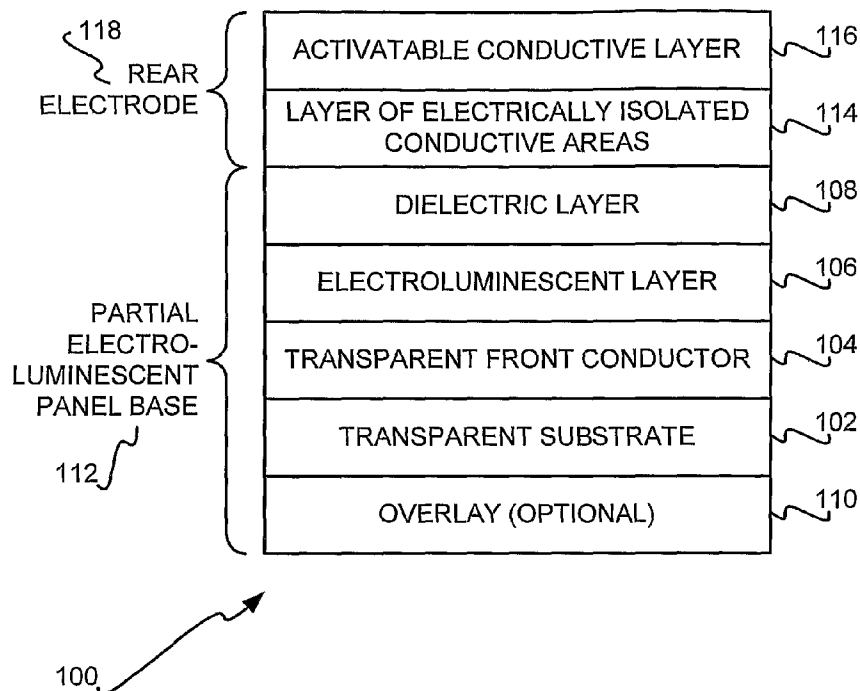
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(54) Title: DEFINING ELECTRODE REGIONS OF ELECTROLUMINESCENT PANEL



(57) Abstract: An electroluminescent panel (110) includes a partial electroluminescent panel base (112), a layer of electrically isolated conductive areas next to the partial electroluminescent panel base (114), and an activatable conductive layer next to the layer of electrically isolated conductive areas (116). The activatable conductive layer is selectively activated to electrically connect selected electrically isolated conductive areas together to define one or more electrically isolated conductive electrode regions.

WO 2007/024385 A1



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- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))

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DEFINING ELECTRODE REGIONS OF ELECTROLUMINESCENT PANEL

BACKGROUND

5 An electroluminescent (EL) panel includes a layer of electroluminescent phosphor powder and a dielectric sandwiched between front and rear electrodes. At least one of these electrodes is transparent. On application of a voltage, the electroluminescent phosphor emits light. One of the electrodes, usually the rear electrode, may be divided into a number of
10 different regions, so that corresponding regions of the EL panel can be selectively and independently lit. Typically, creating the different regions of the rear electrode is accomplished by a screen-printing process. However, the screen-printing process is cost effective only for large production runs. That is, where just a small number of EL panels are desired to be made with
15 particular independently and selectively lit regions, the screen-printing process can be cost prohibitive.

BRIEF DESCRIPTION OF THE DRAWINGS

The drawings referenced herein form a part of the specification. Features shown in the drawing are meant as illustrative of only some
20 embodiments of the invention, and not of all embodiments of the invention.

FIGs. 1 and 2 are diagrams of cross-sectional side views of an electroluminescent (EL) panel, according to an embodiment of the invention.

FIG. 3 is a diagram of a cross-sectional top view of an EL panel, in which a layer of electrically isolated conductive areas is shown, according to
25 an embodiment of the invention.

FIG. 4 is a diagram of a top view of an EL panel, in which an activatable conductive layer is shown, according to an embodiment of the invention.

FIG. 5 is a flowchart of a method for forming an EL panel in which rear electrode regions are defined, according to an embodiment of the invention.

FIG. 6 is a flowchart of a method for use, according to an embodiment of the invention.

DETAILED DESCRIPTION OF THE DRAWINGS

In the following detailed description of exemplary embodiments of the invention, reference is made to the accompanying drawings that form a part thereof, and in which is shown by way of illustration specific exemplary embodiments in which the invention may be practiced. These embodiments are described in sufficient detail to enable those skilled in the art to practice the invention. Other embodiments may be utilized, and logical, mechanical, electrical, electro-optical, software/firmware and other changes may be made without departing from the spirit or scope of the present invention. The following detailed description is, therefore, not to be taken in a limiting sense, and the scope of the present invention is defined only by the appended claims.

FIG. 1 shows a cross-sectional side view of an electroluminescent (EL) panel 100, according to an embodiment of the invention. The EL panel 100 includes a transparent substrate 102, a transparent front conductor 104 situated next to or over the transparent substrate 102, an electroluminescent layer 106 situated next to or over the transparent front conductor, or front electrode, 104, and a dielectric layer 108 situated next to or over the electroluminescent layer 106. The substrate 102, the front conductor 104, the electroluminescent layer 106, and the dielectric layer 108 may together be referred to as a partial EL panel base 112. The EL panel 100 also includes a layer 114 of electrically isolated conductor areas and an activatable conductive layer 116, which together may be referred to as a rear electrode 118, and which are particularly described later in the detailed description. The

EL panel 100 may optionally include an overlay 110, which may be part of the partial EL panel base 112.

The EL panel 100 is depicted in FIG. 1 upside-down to indicate how the various layers and components of the EL panel 100 are typically
5 fabricated. In actual use, the transparent substrate 102 is oriented so that it is positioned towards the front, or top. As a result, light from the electroluminescent layer 106 can emit therethrough, and the dielectric layer 108 is positioned towards the back, or bottom.

The transparent substrate 102 may be polyethylene terephthalate
10 (PET), another type of clear plastic, or another type of transparent substrate material. The substrate 102 is transparent in the sense that it is at least partially or substantially transparent, and/or at least partially or substantially allows light to transmit therethrough. The transparent front conductor, or electrode, 104 may be indium tin oxide (ITO), antimony tin oxide (ATO), or
15 another type of transparent conductive material. The conductor 104 is transparent in the sense that it is at least partially or substantially transparent, and/or at least partially or substantially allows light to transmit therethrough. The conductor 104 is a front conductor because in actual use, the conductor 104 is oriented so that it is positioned towards the front, or top, so that light
20 from the electroluminescent layer 106 can emit therethrough, and the rear conductor or electrode 118 is positioned towards the back, or bottom.

The electroluminescent layer 106 may be an inorganic or organic phosphor. The dielectric layer 108 may be barium titanate powder in a polyurethane binder, or another type of dielectric. The dielectric layer 108,
25 together with the electroluminescent layer 106, the transparent front conductor 104, and the rear conductor or electrode 118 forms a capacitor. Application of a voltage over the dielectric layer 108 energizes the electroluminescent layer 106, which causes light to be emitted from the electroluminescent layer 106. The electroluminescent layer 106 is
30 typically not patterned.

The overlay 110 may be a plastic or another type of overlay, and may have graphics printed thereon, such as for marketing, advertising, and/or

other purposes. Alternatively, the overlay 110 may be an ink-receptive layer that is receptive to artwork or other graphics inkjet-printed thereon. Where the overlay 110 is not present, the artwork or other graphics may be directly inkjet-printed on the transparent substrate 102.

5 FIG. 2 shows another cross-sectional side view of the EL panel 100, according to an embodiment of the invention. In FIG. 2, the rear electrode 118 has been divided into rear electrode regions 118A and 118B, which are electrically isolated conductive regions. Electrical connects 204A and 204B are attached between the rear electrode regions 118A and 118B and a driver
10 202, which includes or is connected to a voltage source, such as a battery or a wall outlet. Another electrical connect 206 is attached between the transparent front conductor 104 and the driver 202.

 Applying a voltage between the rear electrode region 118A and the transparent front conductor 104 energizes the capacitor formed by the region
15 118A, the front conductor 104, the electroluminescent layer 106, and the dielectric layer 108, such that substantially just the portion of the electroluminescent layer 106 correspondingly underneath the rear electrode region 118A emits light. This is accomplished by the driver 202 driving a voltage between the electrical connect 204A and the electrical connect 206.
20 Similarly, applying a voltage between the rear electrode region 118B and the transparent front conductor 104 energizes the capacitor formed by the region 118B, the front conductor 104, the electroluminescent layer 106, and the dielectric layer 108, such that substantially just the portion of the electroluminescent layer 106 correspondingly underneath the rear electrode
25 region 118B emits light. This is accomplished by the driver 202 driving a voltage between the electrical connect 204B and the electrical connect 206.

 Therefore, the rear electrode regions 118A and 118B are defined in accordance with a number, and shape, of regions of the EL panel 100 that are desired to be selectively and independently illuminated. In FIG. 2, there are
30 two such rear electrode regions, for illustrative and descriptive convenience. However, there can be any number of different rear electrode regions in any number of different shapes and sizes. Each of the rear electrode regions

corresponds to a region of the EL panel 100 as a whole that can be selectively and independently illuminated. The manner by which the rear electrode regions are defined is described later in the detailed description.

It is noted that driving a voltage between the electrical connect 204A
5 and the electrical connect 206 is independent of driving a voltage between the electrical connect 204B and the electrical connect 206. Therefore, either a voltage may be driven between the connects 204A and 206, between the connects 204B and 206, or between both the connects 204A and 204B and the connect 206. Thus, either a region of the EL panel 100 corresponding to
10 the rear electrode region 118A can be illuminated, a region of the EL panel 100 corresponding to the rear electrode region 118B can be illuminated, or regions of the EL panel 100 corresponding to both the rear electrode regions 118A and 118B can be illuminated.

The overlay 110 may further be divided into overlay regions 110A and
15 110B corresponding to the rear electrode regions 118A and 118B. Therefore, the overlay 110 may be said to be aligned to the rear electrode 118, so that when the rear electrode region 118A is energized, the overlay region 110A is illuminated, and when the rear electrode region 118B is energized, the overlay region 110B is illuminated. Where the overlay 110 is not present, but where
20 graphics are inkjet-printed directly on the transparent substrate 102, the transparent substrate 102 may alternatively be said to be divided into regions corresponding to the rear electrode regions 118A and 118B.

FIG. 3 shows a cross-sectional top view of the EL panel 100, not including the activatable conductive layer 116, according to an embodiment of
25 the invention. Thus, FIG. 3 depicts a top view of the layer 114 of electrically isolated conductive areas of the EL panel 100. The layer 114 includes electrically isolated conductive areas 302A, 302B, . . . , 302N, collectively referred to as the electrically isolated conductive areas 302. Within the layer 114 itself, each of the conductive areas 302 is electrically isolated from other
30 of the conductive areas 302, and this is why the conductive areas 302 are referred to as the electrically isolated conductive areas 302.

As depicted in FIG. 3, the conductive areas 302 are organized as a grid, are at least substantially uniform in size, are rectangularly shaped, and are at least substantially uniformly spaced apart. However, in other embodiments, the conductive areas 302 may not be organized as a grid, may not be at least substantially uniform in size, may not be rectangularly shaped, and/or may not be at least substantially uniformly spaced apart. The conductive areas 302 may be small, and thus may be measured in densities of areas per inch, or they may be large, and thus may be measured individually in inches. The conductive areas 302 may further be silver conductive areas, copper conductive areas, nickel conductive areas, ultraviolet (UV)-curable conductive areas, and/or photolithographically defined conductive areas.

FIG. 4 shows a top view of the EL panel 100, according to an embodiment of the invention, and thus depicts a top view of the activatable conductive layer 116. The conductive areas 302 of the layer 114 are depicted as dotted lines in FIG. 4 for illustrative and descriptive convenience and clarity. That is, while the activatable conductive layer 116 is typically not transparent, such that the conductive areas 302 of the layer 114 are typically not visible through the activatable conductive layer 116, the conductive areas 302 are shown in FIG. 4 for illustrative and descriptive convenience and clarity.

The activatable conductive layer 116 is initially nonconductive. However, when activated, the activatable conductive layer 116 becomes conductive. More particularly, the activatable conductive layer 116 remains nonconductive at locations thereof that have not been activated, and becomes conductive at locations thereof that have been activated. In one embodiment, the activatable conductive layer 116 is an optical-beam activated conductive layer, such as a laser-activated conductive layer. In such an embodiment, the layer 116 becomes conductive where exposed to an optical beam having a wavelength to which the layer 116 is sensitive, and remains nonconductive where the layer 116 is not exposed to the optical beam.

For instance, such an optically activated conductive layer is described in the previously filed, copending, and coassigned patent application entitled "Conductive Patterning," filed on June 1, 2005, and assigned serial no. 11/142,699. The wavelength of light to which such an optically activated
5 conductive layer is sensitive may be 780 nanometers (nm). The layer 116 may be applied to or over the layer 114 having the conductive areas 302 as a paste, which then hardens into the layer 116. The paste may be a silver paste in one embodiment, and may change color at locations at which it has been activated and thus is conductive.

10 The activatable conductive layer 116 is selectively activated to electrically connect selected areas of the electrically isolated conductive regions 302 of the layer 114 to define the electrically isolated electrode regions 118A and 118B. For instance, the layer 116 is activated at the segmented lines 402A and 402B in FIG. 4 and becomes conductive at the
15 segmented lines 402A and 402B, such that the layer 116 remains nonconductive elsewhere, other than at the segmented lines 402A and 402B. The segmented line 402A electrically connects the conductive regions 302 to the left of the dotted line 404, whereas the segmented line 402B electrically connects the conductive regions 302 to the right of the dotted line 404.
20 However, the conductive regions 302 to the left of the dotted line 404 remain electrically isolated and disconnected from the conductive regions 302 to the right of the dotted line 404.

By electrically connecting together the conductive regions 302 to the left of the dotted line 404, the activatable conductive layer 116 effectively
25 defines the electrode region 118A, and by electrically connecting together the conductive regions 302 to the right of the dotted line 404, the activatable conductive layer 116 effectively defines the electrode region 118B. Because the conductive regions 302 to the left of the dotted line 404 remain electrically isolated from the conductive regions 302 to the right of the dotted line 404, the
30 electrode regions 118A and 118B are themselves electrically isolated from one another. The electrode region 118A encompasses the conductive

regions 302 to the left of the dotted line 404, and the electrode region 118B encompasses the conductive regions 302 to the right of the dotted line 404.

EL panels like the EL panel 100 may be manufactured in large runs, or in bulk, where the activatable conductive layers thereof are not initially
5 activated. To construct a particular EL panel, such as the EL panel 100, having particular electrode regions, such as the electrode regions 118A and 118B, the activatable conductive layer of a given manufactured-in-bulk EL panel is selectively activated to electrically connect selected electrically
10 isolated conductive regions to define desired electrode regions. That is, the EL panels themselves may be fabricated in a mass-produced, cost-effective manner, and can subsequently be customized by defining the desired electrode regions via selectively activating the activatable conductive layer to electrically connect selected electrically isolated conductive regions.
Additionally, customized graphics may be applied to the EL panels via inkjet-
15 printing on the overlays or on the transparent substrates of the panels.

Definition of the electrode regions 118A and 118B is accomplished as has been described in relation to FIG. 4 by activating the activatable
conductive layer 116 to electrically connect the electrically isolated conductive
regions 302 of the layer 114. Just a small portion of the conductive layer 116
20 has to be activated to perform this electrical connection of the conductive regions 302. For instance, in FIG. 4, just two segmented lines 402A and 402B of the layer 116 are activated to electrically connect the regions 302 as desired to form the electrode regions 118A and 118B. The vast majority of the activatable conductive layer 116 remains unactivated and nonconductive
25 in FIG. 4.

Having to activate just a small portion of the conductive layer 116 to define the electrode regions 118A and 118B is advantageous, because activation may be a slow process. Using a laser beam to optically activate an optically activatable conductive layer may particularly be a slow process, for
30 instance. Just a small portion of the conductive layer 116 has to be activated because the activatable conductive layer 116 itself does not solely make up the rear electrode 118, but rather the activatable conductive layer 116

together with the layer 114 of the conductive areas 302 makes up the rear electrode 118.

In other words, if the electrode regions 118A and 118B of the rear electrode 118 were defined just by the activatable conductive layer 116, then
5 nearly all of the conductive layer 116 may have to be activated. However, because the electrode regions 118A and 118B of the rear electrode 118 are defined by the conductive areas 302 of the layer 114 being electrically connected by the activatable conductive layer 116, just a small portion of the conductive layer 116 may have to be activated. Therefore, having the rear
10 electrode 118 made up of the activatable conductive layer 116 and the layer 114 of electrically isolated conductive areas 302 allows for definition of the electrode regions 118A and 118B to occur more quickly when selectively activating the activatable conductive layer 116.

FIG. 5 shows a method 500 of forming the EL panel 100 that has been
15 described, in which the electrode regions 118 are defined, according to an embodiment of the invention. As can be appreciated by those of ordinary skill within the art, the method 500 may include other parts, steps, and/or acts, in addition to and/or in lieu of those depicted in FIG. 5. The EL panel base 112 is first provided (502). As has been described, the EL panel base 112
20 includes the transparent substrate 102, the transparent front conductor or electrode 104, the electroluminescent layer 106, the dielectric layer 108, and optionally the overlay 110.

The layer 114 of the electrically isolated conductive areas 302 is then formed next to or over the EL panel base 112 (504). In one embodiment, the
25 layer 114 may be formed by applying a conductive layer (506), and then photolithographically or otherwise patterning this conductive layer (508) to form the individually electrically isolated conductive areas 302. The activatable conductive layer 116 is formed next to or over the layer 114 (510). For instance, an optical beam-activated conductive paste may be applied to
30 the layer 114, which when hardened forms the layer 116.

Selected areas of the electrically isolated conductive areas 302 are next electrically connected to define the electrode regions 118A and 118B

(512). More particularly, the activatable conductive layer 116 is selectively activated to electrically connect the electrically isolated conductive areas 302 together as desired to define the electrode regions 118A and 118B. For instance, an optical beam, such as a laser, may be selectively emitted on the
5 activatable conductive layer 116 to selectively activate the layer 116 and render it selectively conductive.

Graphics may optionally be inkjet-printed on the EL panel 100 (514), such as on the overlay 110, or directly on the transparent substrate 102. A separate electrical connect is attached for and to each of the electrode
10 regions 118A and 118B, as well as to the transparent front conductor 104 (516). For instance, the electrical connects 204A and 204B are attached to the electrode regions 118A and 118B, respectively, and the electrical connect 206 is attached to the transparent front conductor 104. Finally, the electrical driver 202 is attached to all of the electrical connects 204A, 204B,
15 and 206 (518).

Finally FIG.6 shows a rudimentary method of use 600 for the EL panel 100 that has been formed as has been described, according to an embodiment of the invention. The EL panel 100 is initially provided (602), where the EL panel 100 includes rear electrode regions 118A and 118B
20 encompassing different of the electrically isolated conductive regions 302 as electrically connected via selective activation of the activatable conductive layer 116. The EL panel 100 may further have graphics inkjet-printed thereon, as has been described. Thereafter, the rear electrode regions 118A and 118B are selectively and independently turned on, or energized (604), so
25 that light emits from corresponding regions of the EL panel 100.

It is noted that, although specific embodiments have been illustrated and described herein, it will be appreciated by those of ordinary skill in the art that any arrangement is calculated to achieve the same purpose may be substituted for the specific embodiments shown. As just one example,
30 whereas embodiments of the invention have been substantially described in relation to defining rear electrode regions of an EL panel, other embodiments of the invention may be implemented in relation to defining other electrode

regions, such as front electrode regions. This application is thus intended to cover any adaptations or variations of the present invention. Therefore, it is manifestly intended that this invention be limited only by the claims and equivalents thereof.

We claim:

1. An electroluminescent panel (100) comprising:
 - a partial electroluminescent panel base (112);
 - a layer of electrically isolated conductive areas next to the partial
 - 5 electroluminescent panel base (114); and,
 - an activatable conductive layer next to the layer of electrically isolated conductive areas, the activatable conductive layer selectively activated to electrically connect selected electrically isolated conductive areas together to define one or more electrically isolated conductive electrode regions (116).
- 10 2. The electroluminescent panel of claim 1, wherein each electrically isolated conductive electrode region encompasses a different plurality of the electrically isolated conductive areas.
3. The electroluminescent panel of claim 1, wherein the electrode regions are capable of being independently and selectively powered, such that light emits
- 15 from corresponding regions of the electroluminescent panel.
4. The electroluminescent panel of claim 1, wherein the one or more electrically isolated conductive electrode regions comprise a plurality of electrode regions.
5. The electroluminescent panel of claim 1, wherein the activatable
- 20 conductive layer is nonconductive where unactivated and conductive where activated.
6. The electroluminescent panel of claim 1, wherein the activatable conductive layer comprises an optical beam-activated conductive layer, such that the layer is conductive where exposed to an optical beam having a
- 25 wavelength to which the layer is sensitive.

7. The electroluminescent panel of claim 1, wherein the activatable conductive layer comprises an activatable conductive paste applied next to the layer of electrically isolated conductive areas.

5 8. The electroluminescent panel of claim 1, wherein the layer of electrically isolated conductive areas are at least substantially uniform in size and at least substantially uniformly spaced apart.

9. The electroluminescent panel of claim 1, wherein the layer of electrically isolated conductive areas are organized as a grid.

10 10. The electroluminescent panel of claim 1, wherein the layer of electrically isolated conductive areas is selected from: silver conductive areas, copper conductive areas, nickel conductive areas, ultraviolet (UV)-curable conductive areas, photolithographically defined conductive areas and combinations thereof.

11. The electroluminescent panel of claim 1, wherein the partial
15 electroluminescent panel base comprises:
a transparent substrate (102);
a transparent conductor next to the transparent substrate (104);
an electroluminescent layer next to the transparent conductor (106); and,
a dielectric next to the layer of electrically isolated conductive areas (108).

20 12. The electroluminescent panel of claim 1, wherein the partial electroluminescent panel base further comprises an overlay next to the transparent substrate on which graphics are inkjet-printed (110).

13. The electroluminescent panel of claim 1, wherein graphics are inkjet-printed to the partial electroluminescent panel base.

14. The electroluminescent panel of claim 1, further comprising an electrical connect (204) attached to each electrically isolated conductive electrode region.

15. The electroluminescent panel of claim 1, further comprising an electrical
5 driver (202) electrically coupled to each electrically isolated conductive electrode region.

1/3

FIG 1

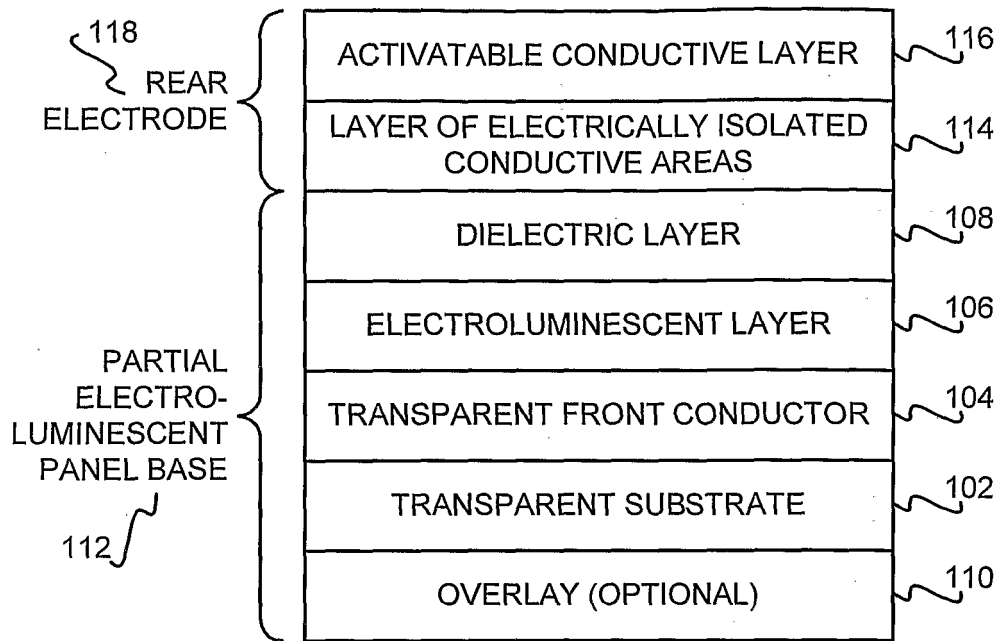
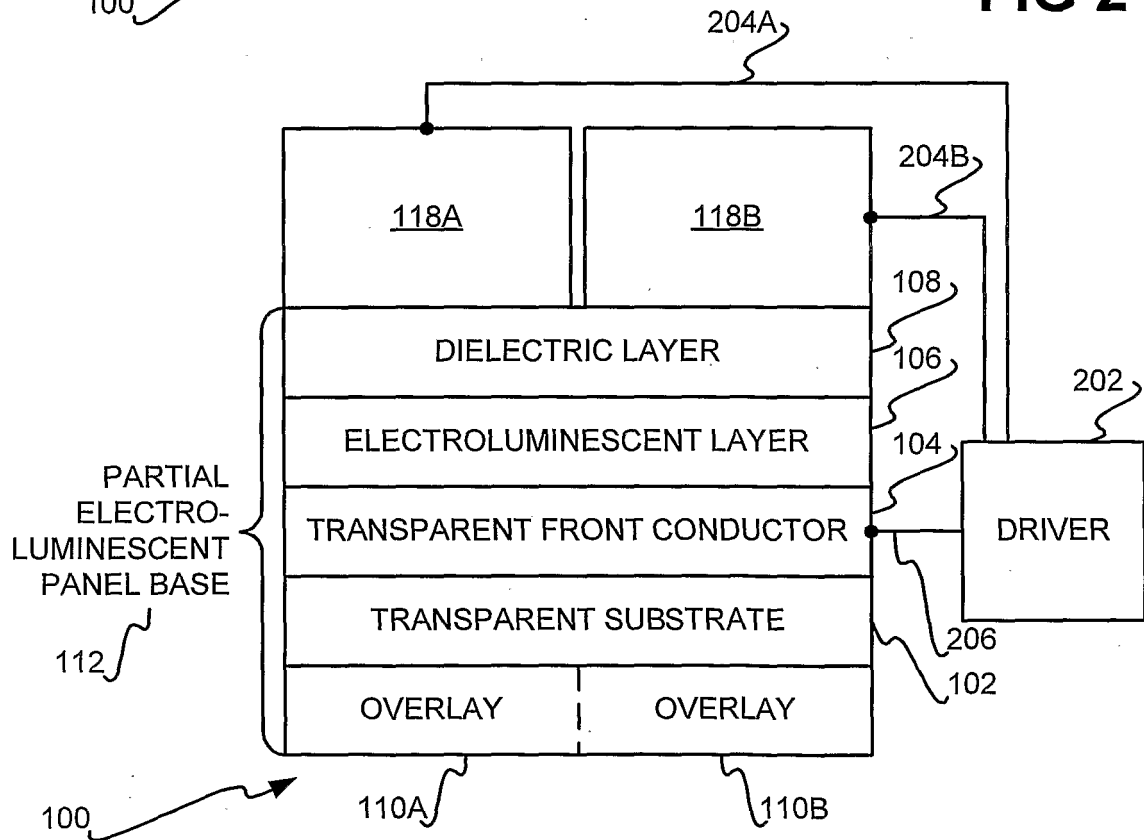


FIG 2



2/3

FIG 3

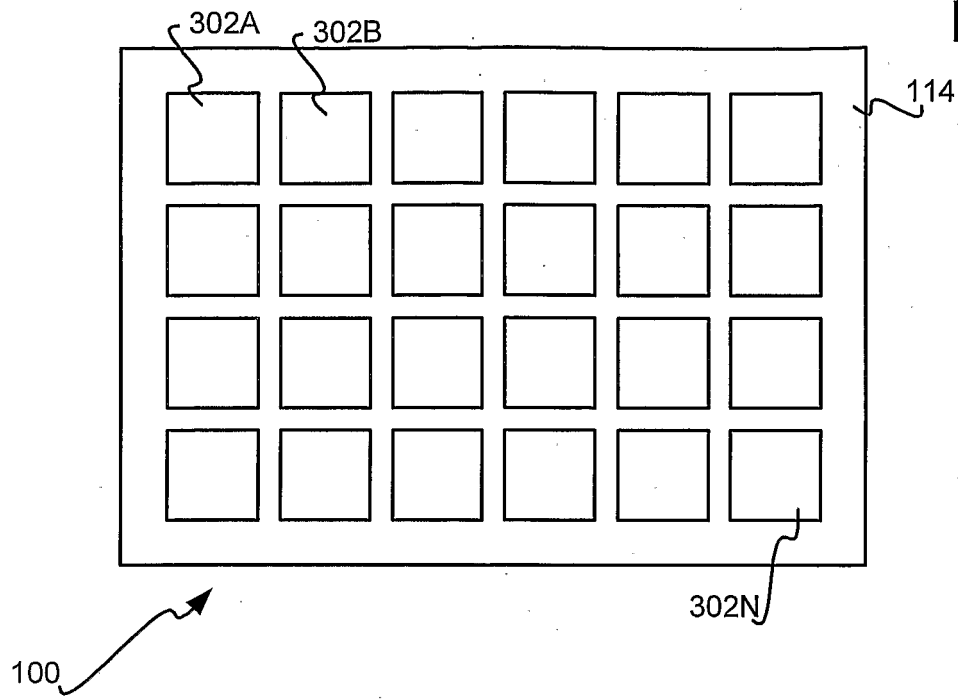
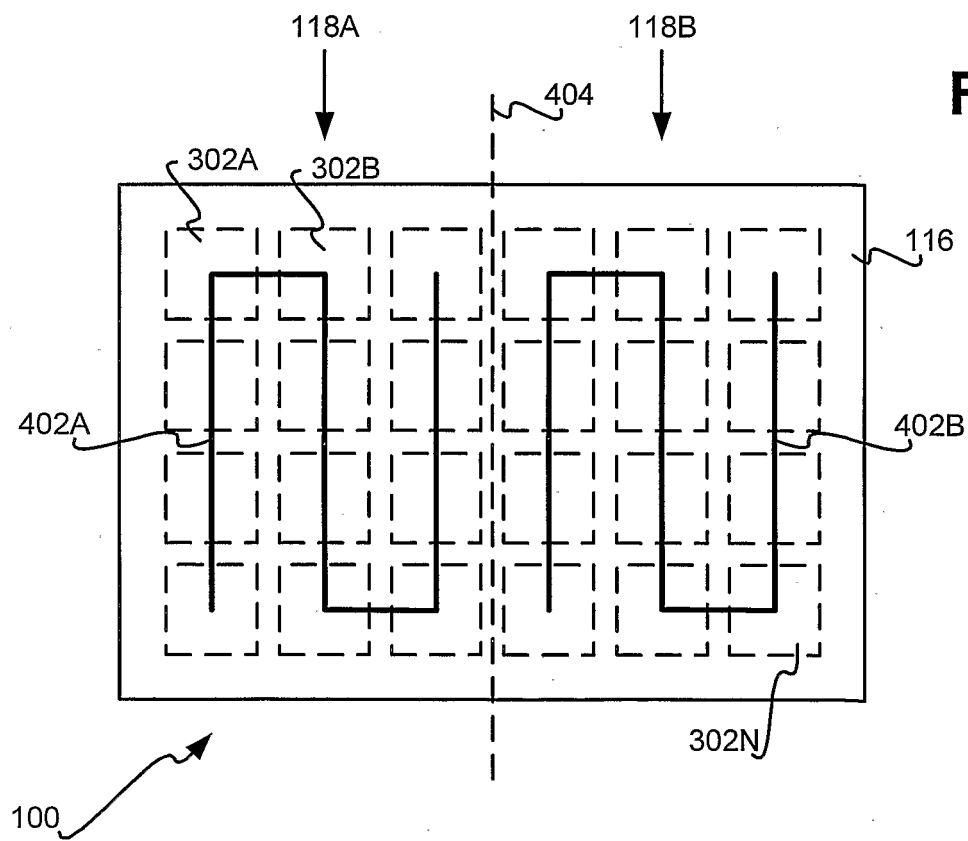
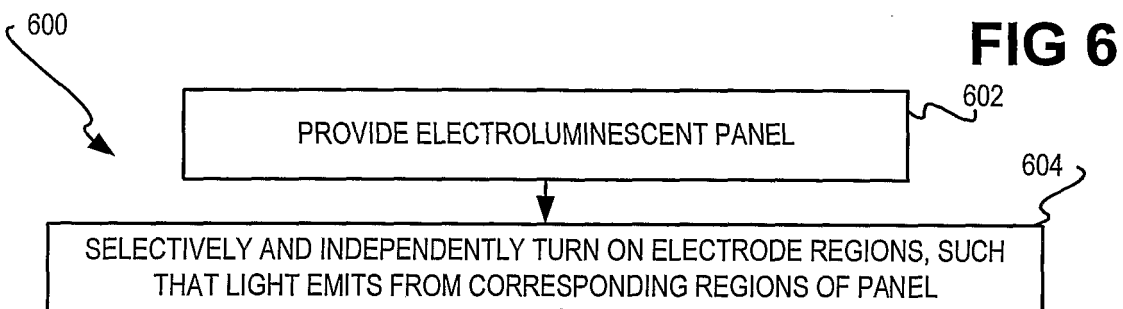
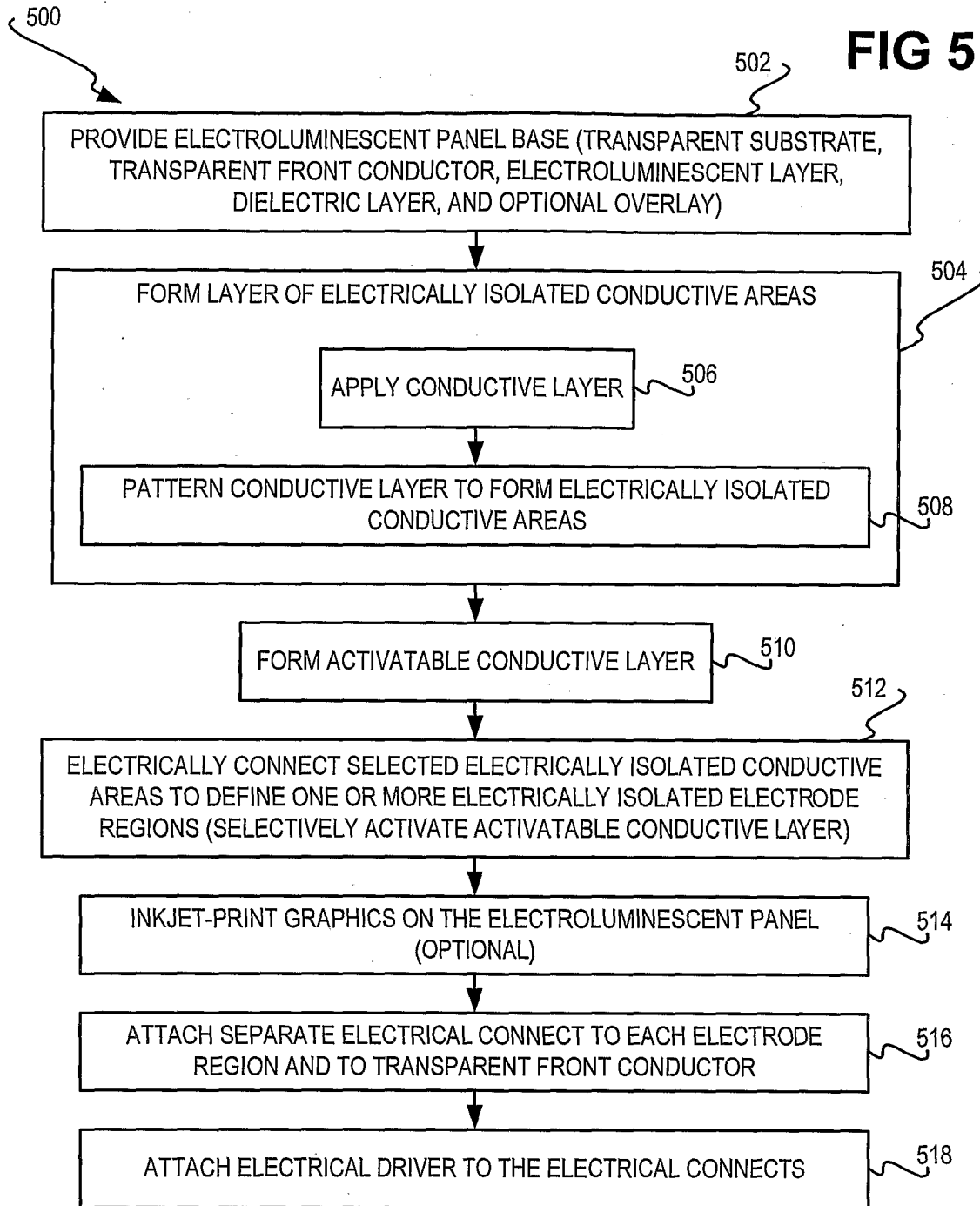


FIG 4



3/3



INTERNATIONAL SEARCH REPORT

International application No

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A. CLASSIFICATION OF SUBJECT MATTER

INV. H05B33/26

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H05B H05K H01L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

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A	US 5 821 691 A (RICHIE BENJAMIN L [US] ET AL) 13 October 1998 (1998-10-13) abstract figures 1,4 column 3, lines 8-39 column 4, line 27 - column 5, line 30	1-15
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INTERNATIONAL SEARCH REPORT

International application No
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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专利名称(译)	定义电致发光面板的电极区域		
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摘要(译)

电致发光面板 (110) 包括部分电致发光面板基座 (112) , 靠近部分电致发光面板基座 (114) 的电隔离导电区域层 , 以及紧邻电隔离导电区域层 (116) 的可激活导电层 (116) 。) 。选择性地激活可激活导电层以将选定的电隔离导电区域电连接在一起以限定一个或多个电隔离导电电极区域。