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

(11) EP 1 168 448 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
11.01.2017 Bulletin 2017/02

(51) Int Cl.:
H01L 27/32 $^{(2006.01)}$ ***H01L 51/52*** $^{(2006.01)}$

(21) Application number: **01305299.8**

(22) Date of filing: **19.06.2001**

(54) **Full color organic EL display panel**

Vollfarbene organische elektrolumineszente Anzeigetafel

Panneau d'affichage électroluminescent organique en couleur

(84) Designated Contracting States:
DE FR GB NL

(30) Priority: **19.06.2000 KR 2000033628**
19.09.2000 KR 2000054990
24.10.2000 KR 2000062655

(43) Date of publication of application:
02.01.2002 Bulletin 2002/01

(60) Divisional application:
10186664.8 / 2 264 768

(73) Proprietor: **LG Electronics, Inc.**
Seoul (KR)

(72) Inventors:
- **Kim, Chang Nam**
Seoul (KR)
- **Kim, Jung Bae**
Seoul (KR)
- **Kim, Hak Su**
Seoul (KR)
- **Kim, Myung Seop**
Kwachon-shi,
Kyonggi-do (KR)

(74) Representative: **Boult Wade Tennant**
Verulam Gardens
70 Gray's Inn Road
London WC1X 8BT (GB)

(56) References cited:
EP-A2- 0 158 366 WO-A1-00/05703

- **PATENT ABSTRACTS OF JAPAN vol. 2000, no. 06, 22 September 2000 (2000-09-22) -& JP 2000 091069 A (PIONEER ELECTRONIC CORP), 31 March 2000 (2000-03-31) -& US 6 297 589 B1 (MIYAGUCHI SATOSHI ET AL) 2 October 2001 (2001-10-02)**
- **PATENT ABSTRACTS OF JAPAN vol. 1998, no. 06, 30 April 1998 (1998-04-30) -& JP 10 039791 A (MITSUBISHI ELECTRIC CORP; IDEMITSU KOSAN CO LTD), 13 February 1998 (1998-02-13)**
- **PATENT ABSTRACTS OF JAPAN vol. 2000, no. 06, 22 September 2000 (2000-09-22) & JP 2000 091083 A (SONY CORP), 31 March 2000 (2000-03-31)**
- **PATENT ABSTRACTS OF JAPAN vol. 2000, no. 11, 3 January 2001 (2001-01-03) & JP 2000 235891 A (TORAY IND INC), 29 August 2000 (2000-08-29)**

Printed by Jouve, 75001 PARIS (FR)

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a full color flat display panel by using an organic electro-luminescent (EL) device.

2. Description of the Related Art

[0002] Lately, the flat display industry has been remarkably developed. In particular, an organic EL array is gradually gaining interest as an image source in a direct display or a virtual display since the organic EL array can generate a relatively large amount of light and a display adopting the organic EL array can be used under various surrounding conditions.

[0003] In other words, the organic EL array can emit light in a sufficient amount so as to be used as the display under the various surrounding conditions ranging from those with no or little amount of light to those with sufficient amount of light.

[0004] Also, the organic EL array can be manufactured at a low price, and variously applied from a very small size of under 1 inch up to a considerably large size of tens of inches (1 inch=2.54 cm).

[0005] Further, the organic EL array provides a very wide range of view angle.

[0006] An example of the organic EL array as a small sized article is applied to portable electronic articles such as a pager, a cellular phone and a portable phone.

[0007] Such an organic EL device is comprised of a first electrode layer, an electron transporting layer, a light emitting layer, a hole transporting layer and a second electrode layer.

[0008] Here, light can be emitted in one or both directions of an electrode, and the most efficient EL device has one transparent electrode layer in a light emitting side.

[0009] Also, one of the most widely used transparent electrodes is made of an indium-tin oxide(ITO), which is deposited on a transparent substrate such as a glass panel.

[0010] However, the major problem of the organic EL device is the connection capacitance, which includes the capacitance within the device composed of the material and the electrode and the capacitance from column and line electrodes in an array structure.

[0011] In other words, since the EL device is driven by a current unlike - a liquid crystal display(LCD) which is driven by a voltage, an initially supplied current is used for charging the connection capacitance when the organic EL device is driven in the array structure.

[0012] Therefore, if the connection capacitance increases as the array increases or the device is enlarged, a larger amount of current should be supplied for the initial charge.

[0013] Also, the resistance of an anode line and a cathode line in the array structure gives a very important influence not only to response features of the device but also to the whole power.

[0014] In other words, a time for charging the capacitance or an RC time is influenced not only from the size of the capacitance but also to the resistance connected to the capacitance so that the response speed of the device is considerably influenced also as the resistance size of anode and cathode lines increases.

[0015] Further, the transparent electrode layer is made of a high resistive material thereby increasing such a problem.

[0016] Therefore, the connection capacitance and the electrode layer having high resistance of the organic EL device hinder producing the EL device in a large array structure.

[0017] In order to reduce such an influence, the anode and cathode lines can be made of a metal excellent in conductivity and low in resistance to reduce the line resistance in the anode and cathode lines thereby improving the response features of the device and simultaneously to reduce the voltage loss in the line resistance thereby lowering a drive voltage and reducing power consumption.

[0018] However, in a delta shaped array structure, such line resistance can be a more serious obstacle due to the fine cathode line. In other words, in a full color device structure, the voltage and current ratio among R, G and B pixels is 3:6:1 for expressing a white light. Therefore, the G(Green) pixel requires a smaller amount of voltage and current than the B(Blue) pixel in expressing the same value of luminance.

[0019] FIG. 1 shows a structure of RGB stripe-type pixels, and the current and voltage features in a, a' and a" positions of an A material which composes one of the RGB pixels and b, b' and b" positions of another B material which composes another one of the RGB pixels.

[0020] As can be seen in FIG. 1, the RGB pixels have their own physical properties different from one another so that the current-voltage features may be different in this case.

[0021] Referring to FIG. 1, the current-voltage features of the B material is better than those of the A material.

[0022] As an example, the A material can be regarded as the R(Red) pixel, and the B material can be regarded as the G or B pixel.

[0023] This can be varied according to the properties of materials, in which the A material can be regarded as having the poorest properties.

[0024] Also, referring the current-voltage features of each material, if the device has an array structure, there is a difference in the voltage-current features as in a, a' and a' and a" even in the same material due to the effect of line resistance observed along the anode line and along the cathode line.

[0025] The properties of the material like this increase the voltage applied to the line resistance of the anode and the cathode such as b, b' and b" and a, a' and a" to cause the increase of the drive voltage.

[0026] In particular, in the case of the A material (for the R pixels for example) which is poor in the current-voltage features, a higher current is required to obtain the white light thereby causing a voltage drop due to line resistance to be more serious.

[0027] Here, if the RGB pixels do not have their own power, the driver power should be determined according to a material having the poorest current-voltage features so that the drive voltage in another material having better current-voltage features is elevated thereby incurring overall power loss.

[0028] In driving the circuit in practice, the drive voltage is determined according to the pixel having the highest voltage. If the G light emitting pixels are assumed to have the luminance v. current features at least two times better than the R pixels, the drive voltage should be determined by the R pixel so that the drive voltage of the R pixels increases in respect to the G pixels thereby incurring power loss.

[0029] As a method of solving this case, the drive voltage is determined different for each of the RGB pixels to reduce power consumption.

[0030] However, when each of the RGB pixels is applied with a different voltage from one another, a reverse voltage should be applied to prevent crosstalk according to the features of the organic EL device. Here, the reverse voltage should be applied so that a positive voltage applied to the device does not exceed the threshold voltage.

[0031] Therefore, since the reverse voltage is applied according to the drive voltage of the R light emitting pixels if the R light emitting pixels have the highest drive voltage, the higher reverse voltage should be applied as the drive voltage of the R light emitting pixels is stepped up. So, many problems are caused in using the reverse voltage.

[0032] Meanwhile, FIG. 2A is a sectional view of the full color organic EL display device driven by the driving circuit of FIG. 1.

[0033] In manufacturing the organic EL display device, a shadow mask is used to form the RGB light emitting pixels having the optimal luminous efficiency as shown in FIG. 2A.

[0034] Also, the shadow mask as above is also used in a line method as shown in FIG. 2B, and in a method of arranging the pixels into a delta shape as shown in FIG. 2C.

[0035] In other words, as shown in FIG. 2A, anode lines 2-2 (only one is shown) are formed on a glass 1, and partitions 7 are formed before forming cathode lines in the organic EL display device. Then, red, green and blue emitting material layers 8-1, 8-2 and 8-3 are formed by using a shadow mask 9 followed by forming cathodes 10 for forming cathode lines in the front surface.

[0036] However, a cell array structure of the full color organic EL device of the related art described hereinbefore has the following problems:

In arranging the pixels according to the line method or the delta shape, the RGB light emitting pixels are sized almost the same so that the R pixel relatively poor in luminance and luminous efficiency is not properly expressed thereby degrading the texture.

[0037] Also, the opening ratio is lowered and ITO lines for connecting the light emitting pixels are thinned and elongated to increase resistance so that the uniformity across the screen is degraded and the drive voltage is elevated.

[0038] JP2000-91069 describes an organic electroluminescent full color display panel and method of manufacturing the same. The display has transparent and metallic electrode lines. JP10-39791 describes an organic electroluminescent display device capable of maintaining luminance balance of red, blue and green without deterioration over time. WO00/05703 describes a display device having a combination of flat sources of coloured light. JP 2000-091083 describes an organic EL display formed by laminating a stripe positive electrode wiring part, an organic layer having at least a layer made of an organic light emitting material, and a negative electrode on a transparent board to form plural organic EL elements. EP 0158366 describes a color liquid crystal apparatus in which picture element electrodes are provided and picture elements are arranged in a delta pattern.

SUMMARY OF THE INVENTION

[0039] The present invention provides a full color electroluminescent display panel, as set out in claim 1.

[0040] Embodiments of the present invention seek to address the foregoing problems of the related art.

[0041] It would be desirable to provide a full color organic EL display panel and a manufacturing method thereof, in which, for the compensation of the low luminance of red, a red light emitting area is enlarged to upgrade the texture and elevate the opening ratio for increasing the efficiency of the device.

[0042] It would also be desirable to provide a full color EL display panel and a manufacturing method in which a shadow mask for depositing red, green and blue organic EL layers can be used in common.

[0043] It would also be desirable to provide a full color EL display panel and a manufacturing method in which auxiliary electrodes are provided in a certain area of anode lines to reduce resistance thereby increasing the uniformity across a screen and lowering the drive voltage of the device.

[0044] It would also be desirable to provide a driving circuit of an organic EL device which can minimize the driving power of the organic EL device while improving response features of the organic EL device driven by using a current source.

[0045] It would also be desirable to provide a driving circuit of an organic EL device having an RGB array structure which rapidly controls the response features of the organic EL device by reducing effects of the line resistance in anode lines and cathode lines, adjusts the area ratio of the organic EL device to make the drive voltage of each of the RGB pixels similar to one another, and reduces the drive voltage to minimize power loss when constant current is applied to the organic EL device for realizing a white light.

[0046] There is provided a full color organic EL display panel comprising: first, second and third pixels; a plurality of transparent first electrodes; and a plurality of second electrodes perpendicularly intersecting the first electrodes; wherein each of the first, second and third light emitting pixels is arranged in each of intersecting positions of the first and second electrodes; wherein each of the first, second and third light emitting pixels has the area different from one another according to luminous efficiency.

[0047] The full color organic EL display panel further comprises auxiliary electrodes arranged at least around the first, second and third light emitting pixels and in portions of the first electrodes.

[0048] The full color organic EL display panel further comprises partitions arranged among the second electrodes for electrically insulating the second electrodes.

[0049] The first electrodes have zigzag-shaped structures having partitions inclined at a certain angle for connecting between each of the first light emitting pixels and each of the second light emitting pixels, and stripe shaped structures for connecting between each of the third light emitting pixels.

[0050] The partitions are arranged so as not to overlap with corner portions of the third light emitting pixels.

[0051] Also, the third light emitting pixels have the area larger than that of the first and second light emitting pixels.

[0052] Preferably, the first, second and third light emitting pixels have quadrangular structures which are the same or different from one another.

[0053] Also preferably, the second electrodes are made of metal.

[0054] There is provided a method of manufacturing a full color organic El display panel which includes first, second and third pixels, a plurality of first electrodes, and a plurality of second electrodes perpendicularly intersecting the first electrodes, in which each of the first, second and third light emitting pixels is arranged in each of intersecting positions of the first and second electrodes, the method, not forming part of the invention, comprising the following steps of: (a) forming the first electrodes on a substrate, wherein the first electrodes include stripe-shaped structures for connecting between each of the third light emitting pixels, and zigzag-shaped structures having partitions inclined at a certain angle for connecting between each of the first light emitting pixels and each of the second light emitting pixels; (b) forming insulation partitions in areas excepting the light emitting pixels perpendicular to the first electrodes to insulate the first, second and third light emitting pixels; (c) forming organic EL layers on the first, second and third light emitting pixels for emitting lights corresponding to the light emitting pixels respectively; and (d) depositing an electrode material on the whole surface including the organic EL layers to form a plurality of second electrodes.

[0055] The light emitting pixels are composed into an array structure in which red, green and blue pixels have different areas according to luminous efficiency so that the luminous efficiency of the red pixel relatively poor in luminance and luminance efficiency can be enhanced.

BRIEF DESCRIPTION OF THE DRAWINGS

[0056] The above and other objects, features and other advantages of the present invention will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which

FIG. 1 shows a driving circuit of a device having a stripe-type array structure of the related art and the current v. voltage features of the circuit according to light emitting position.

FIG. 2A is a sectional view of a full color organic EL display device;

FIG. 2B is a plan view for showing a structure of an organic display device by using a line method of the related art;

FIG. 2C is a plan view for showing a structure of an organic display device by using a method of arranging pixels into a delta shape of the related art;

FIG. 3A to FIG. 3K are plan views for showing a process of manufacturing a full color EL display device according to the present invention;

FIG. 4 is a magnification of FIG. 3B;

FIG. 5 is a plan view for showing a shadow mask according to the present invention;

FIG. 6A and FIG. 6B are plan views for showing a completed full color organic EL display device according to the present invention;

FIG. 7 is a plan view for showing a connection structure of anode lines for connecting between light emitting pixels;

FIG. 8A to FIG. 8L are a plan view for showing a process for manufacturing a full color organic EL display device according to a first example outside the scope of the invention;

FIG. 9 shows a shadow mask according to the first example outside the scope of the invention;

FIG. 10 shows a driving circuit of an RGB device having an array structure according to a second example outside the scope of the invention;

FIG. 11 shows a driving circuit for reducing a voltage applied to the line resistance of cathodes in the structure of FIG. 10;

FIG. 12 shows a driving circuit for reducing power consumption by reducing a voltage applied to the line resistance of cathodes in the structure of FIG. 10; and FIG. 13 shows alternative arrangement of the driving circuit shown in FIG. 12.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0057] Preferred embodiments of a full color organic EL display panel will be described in reference to the appended drawings as follows:

The full color organic EL display panel and a manufacturing method thereof will be described as divided in the present invention and first example, and a driving circuit for the organic EL display device will be described in the second example.

Present Invention

[0058] FIG. 3A to FIG. 3K are plan views for showing a process of manufacturing a full color EL display device according to the present invention.

[0059] As shown in FIG. 3A, a pattern of anode lines 102-2 is formed on a glass 101 by using ITO or other transparent electrodes. Here, light emitting pixels 102-1 are formed into the shape of a polygon with at least three angles, and have the area for emitting a red light larger than that for emitting blue and green lights. Half of the area of the light emitting pixels 102-1 is arranged for red, and the other area is arranged for blue and green. Another pattern of anode lines is also formed under light emitting pixels 102-1.

[0060] Then, as shown in FIG. 3B, auxiliary electrodes 105 are formed in anode lines 102-2 which connect the light emitting pixels 102-1, in order to reduce the resistance of the anode lines 102-2. When the auxiliary electrodes 104 are provided around the light emitting pixels 102-1 also, the resistance can be further reduced than provided only in the anode lines 102-2.

[0061] FIG. 4 is a partial magnification of FIG. 3B, in which it can be seen that the auxiliary electrodes 104 and 105 are formed both around the light emitting pixels 102-1 and in the anode lines 102-2 for connecting the light emitting pixels 102-1. Here, a material used for the auxiliary electrodes 104 and 105 includes a metal such as Cr, Al, Cu, W, Au, Ni, Ag and the like which has relatively smaller resistance than ITO.

[0062] Then, an insulating layer 106 is formed as shown in FIG. 3C. Here, the insulating layer 106 is made of an organic or inorganic insulator. The inorganic insulator includes oxide, nitride. Also, those spinably molten to solvents are available also. Polymers are preferred for the organic substance, and photo-resist, polyimide and polyolenfin are more preferred.

[0063] Then, as shown in FIG. 3D, partitions 107 are formed for the insulation among cathodes which will be formed later.

[0064] In sequence, as shown in FIG. 3E, red, green and blue common organic EL layers or common organic EL layers 108 are deposited at a single time by using a blank mask capable of performing deposition on the whole light emitting area.

[0065] Then, a shadow mask 109 shown in FIG. 5 is used to deposit red light emitting material layers 108-1 which are organic EL layers for emitting the red lights as shown in FIG. 3F and FIG. 3G. Also, in the same manner as in the red light emitting material layers, the shadow mask 109 is used to deposit green and blue light emitting material layers 108-2 and 108-3 for generating green and blue lights shown in FIG. 3H and FIG.

[0066] Here, instead of depositing the common organic EL layers 108 in the whole light emitting area, the common organic EL layers 108 can be formed in each of the RGB pixels by using the single shadow mask 109 shown in FIG. 5 while moving the same.

[0067] Then, as shown in FIG. 3J a metal layer for forming the cathode 110 is formed by using a Mg-Ag alloy, Al or other conductive materials.

[0068] Then, as shown in FIG. 3K, a protective layer such as an oxygen absorbing layer, a moisture absorbing layer and a moisture proof layer is formed, and encapsulation is performed by using encapsulating materials 111 and encapsulating plates 112 to complete the device.

[0069] FIG. 6A and FIG. 6B are plan views for showing the completed device.

[0070] Positions for the deposition of red, green and blue can be located to have a triangular structure and a reverse triangular structure as shown in FIG. 6A and FIG. 6B.

[0071] Here, in the formation of red, green and blue by using the single shadow mask 109, the red light emitting pixels 102-1 are halved by using the insulating layer 106.

[0072] When a red-dedicated shadow mask 109 is used, the light emitting pixels are formed without being halved as shown in FIG. 6B.

[0073] FIG. 7 is a magnification of the anode lines 102-2 for connecting between the green light emitting pixels 102-1 and the blue light emitting pixels 102-1, and the light emitting pixels 102-1 of the anode lines 102-2 for connecting between the red light emitting pixels 102-1 for showing the minimization of the area of the light emitting pixels 102-1.

[0074] Basically, the anode lines 102-2 for connecting between each of the green light emitting pixels 102-1 and each of the blue light emitting pixels 102-1 should be formed on a straight line A, formed as inclined as in B in portions where two anode lines 102-2 overlap with each other, and formed as inclined as in C also in corners of the red light emitting pixels 102-1 formed beside the two anode lines 102-2. Thus, the size of the red light emitting pixels 102-1 can be maximized.

First Example

[0075] FIG. 8A to FIG. 8L are a plan view for showing a process for manufacturing a full color organic EL display device according to a first example outside the scope of the invention.

[0076] First, as shown in FIG. 8A, patterns of anode lines 202-1 and 202-2 are formed on a glass 201 with ITO or other transparent electrodes. The anode lines 202-1 and 202-2 are patterned into the above shape so that each unit of light emitting pixels 202-3 is divided along diagonal directions into four sub-pixels 202-4 shaped as a triangle with smooth corners. The unit light emitting pixel 202-3 comprised of the sub-pixels 202-4 is provided with light emitting material layers for emitting red, green and blue lights.

[0077] In the sub-pixels 202-4 structured as above, a pair of sub-pixels opposed in the diagonal direction applied with red light emitting material layers which will emit low red lights with relatively low luminous efficiency, and another pair of sub-pixels are applied with blue and green light emitting material layers to emit blue and green lights.

[0078] Then, as shown in FIG. 8B, auxiliary electrodes 205 are formed to reduce the resistance of the anode lines 202-2 at portions connecting the light emitting pixel.

[0079] In sequence, as shown in FIG. 8C, when edge portions of each of the light emitting pixels are provided with auxiliary electrodes 204 also, the resistance can be further reduced compared to when the auxiliary electrodes are provided only in the anode lines 202-2 for connecting between each of the light emitting pixels.

[0080] Materials available for the auxiliary electrodes 204 and 205 include metals such as Cr, Al, Cu, W, Au, Ni, Ag and the like which have relatively small resistance than ITO.

[0081] As shown in FIG. 8D, an insulating layer 206 is formed to cover anode taps - 203-1.

[0082] The insulating layer 206 can be halved by using the red light emitting sub-pixels.

[0083] The insulating layer is formed around the light emitting pixels including the anode taps 203-1 where light is not emitted. The insulating layer 206 is made of an organic or inorganic insulator. The inorganic insulator includes oxide, nitride. Also, those spinably molten to solvents are available also. Polymers are preferred for the organic substance, and photo-resist, polyimide and polyolenfin are more preferred.

[0084] Then, as shown in FIG. 8E, insulating partitions 207 are formed for the insulation among cathodes which will be formed later.

[0085] Next, as shown in FIG. 8F, red, green and blue common organic EL layers or common organic EL layers 208 are deposited at a single time by using a blank mask capable of performing deposition on the whole light emitting area.

[0086] Then, a shadow mask 209 shown in FIG. 9 is used to deposit red light emitting material layers 208-1 which are organic EL layers for emitting the red lights as shown in FIG. 8G and FIG. 8H. In forming light emitting pixels arranged in the upper part as shown in FIG. 8H, the shadow mask 209 is rotated 180°. Alternatively, a shadow mask having triangular holes formed in the upper and lower parts can be used also.

[0087] Then, in the same manner as in the red light emitting material layers, the shadow mask 209 is used to deposit green and blue light emitting material layers 208-2 and 208-3 for generating green and blue lights shown in FIG. 8I and FIG. 8J. Each of the light emitting material layers 208-2 and 208-3 is formed in each of the green and blue sub-pixels by rotating the shadow mask 209 or using another mask.

[0088] Here, instead of depositing the common organic EL layers 208 in the whole light emitting area, the common organic EL layers 208 can be formed in each of the RGB sub-pixels by using the single shadow mask 209 shown in FIG. 9.

[0089] Then, as shown in FIG. 8K, a metal layer for forming the cathode lines 210 is formed by using a Mg-Ag alloy, Al or other conductive materials.

[0090] Then, as shown in FIG. 8L, a protective layer such as an oxygen absorbing layer, a moisture absorbing layer and a moisture proof cover is formed, and encapsulation is performed by using encapsulating materials 211 and encapsulating plates 212 to complete the device.

<u>Second Example</u>

[0091] FIG. 10 shows a driving circuit for an organic EL device having an array structure according to a second example outside the scope of the invention.

[0092] Referring to FIG. 10, the driving circuit is comprised of an anode circuit 301 for applying a certain drive voltage to each of light emitting RGB pixels, a cathode circuit 302 for outputting scan signals to the cathode lines with both ends of cathode lines being connected in a circuit, and a display unit 303 for being displayed by data signals and the scan signals through the adjustment of the area ratio of each of the RGB light emitting pixels and the width of the anode lines according to the features of a drive voltage applied to each of the light emitting RGB pixels.

[0093] Hereinafter, the current driven organic EL device as shown in FIG. 10 will be compared with the EL device of the related art as shown in FIG. 1.

[0094] If the different value of drive voltage is outputted from the anode circuit 10 for each of the RGB pixels as in the circuit of the related art in FIG. 1, power consumption can be reduced a little since it should be considered only about power consumption according to the supply voltage of each of the RGB pixels.

[0095] In this case, however, when the reverse voltage is applied for preventing - crosstalk which can occur due to the properties of the organic EL device, the reverse voltage should be based upon the A material with the highest drive voltage so that the voltage applied to the A material in the array structure may not exceed threshold voltage. Thus, as a problem, the higher the drive voltage of the A material, the higher reverse voltage is required.

[0096] Therefore, the circuit as shown in FIG. 10, can adjust the area ratio of each of the RGB light emitting pixels and the width of the anode lines for emitting a white light under each of the drive voltages which are as similar as possible so that the overall maximum drive voltage can be lowered to reduce power consumption and the reverse voltage for preventing crosstalk can be lowered also.

[0097] To be more specific, if the A material requires the highest voltage for emitting the white light, the area of the A light emitting pixels is enlarged to lower the drive voltage of the A material thereby reducing the overall drive voltage.

[0098] Also, as the area is increased and thus the line width of the A material is increased at the cathode side, the line resistance is reduced and thus the voltage applied to the anode line resistance is reduced also.

[0099] Meanwhile, other materials have better current v. voltage features than the A material and thus require less amount of current for emitting the white light so, the area can be reduced and the voltage loss in line resistance can be reduced.

[0100] The area ratio of each of the RGB light emitting pixels and the width of the anode lines are adjusted like this, the line resistance and the drive voltage may be reduced.

[0101] FIG. 11 shows a driving circuit for reducing the voltage applied to the line resistance of the cathodes in the structure of FIG. 10.

[0102] Referring to FIG. 11, the driving circuit is comprised of an anode circuit 401 - for outputting a different drive voltage for each of the RGB pixels so as to correspond to the drive voltage varying according to the line resistance and the material features of the anode lines and the cathode lines, a cathode circuit 402 having both ends of the cathode lines being connected for outputting the same signals to the both ends, and a display unit 403 composed of the RGB light emitting pixels with a certain size ratio and the anode lines and being displayed by applied data and scan signals.

[0103] Hereinafter, the current driven organic EL device as shown in FIG. 11 will be compared with the EL device of the related art as shown in FIG. 1.

[0104] According to the array structure of the related art shown in FIG. 1, the current of each of the RGB pixels, which flows through the anodes of the light emitting pixels, flows through the cathodes incurring voltage step-up due to the line resistance of cathodes.

[0105] When the light emitting pixels need larger amount of current to obtain higher luminance, the magnitude of voltage applied to the cathode line resistance will increase more.

[0106] Here, if one cathode line is connected with the cathode circuit 20 at only one terminal, one cathode line adjacently connected with the cathode circuit 20 and another cathode line remotely connected with the cathode circuit 20 have line resistance different from each other.

[0107] In other words, the line resistance applied to portions of the RGB light emitting pixels remote from the cathode circuit 20 is enlarged.

[0108] In order to solve such problems, one end of each of the cathode lines is bound with the other end in driving the circuit, the voltage applied to the cathode line resistance can be halved.

[0109] In other words, the voltage is the highest in the center of each of the cathode - lines and lowers as approaches the both ends thereof. So, comparing with the circuit as shown in FIG. 1 where the current flows from one end of each of the cathode lines to the other end thereof, the voltage applied to the line resistance of the cathode lines shown in FIG. 11 can be halved if the same current flows through the cathode lines in FIG. 11 and those in FIG. 1.

[0110] FIG. 12 shows a driving circuit in which both ends of each of cathode lines are bound as in FIG. 11 to prevent the voltage step-up shown in the structure of FIG. 10. The circuit is comprised of an anode circuit 501 for outputting a different drive voltage for each of the RGB pixels so as to correspond to the drive voltage varying according to the line resistance and the material features of the anode lines and the cathode lines, a cathode circuit 502 for outputting scan signals to the cathode lines with both ends connected in a circuit, and a display unit 503 for being displayed by data signals and the scan signals through the adjustment of the area ratio of each of the RGB light emitting pixels and the width of the anode lines according to the features of a drive voltage applied to each of the light emitting RGB pixels.

[0111] FIG. 13 shows a driving circuit according to another arrangement. The driving circuit is comprised of an anode circuit 601 for outputting a different drive voltage for each of the RGB pixels so as to correspond to the drive voltage varying according to the line resistance and the material features of the anode lines and the cathode lines, cathode circuits 602 and 602' arranged at both ends of cathode lines for outputting scan signals to the both ends of the cathode lines, and a display unit 603 for being displayed by data signals and the scan signals through the adjustment of the area ratio of each of the RGB light emitting pixels and the width of the anode lines according to the features of a drive voltage applied to each of the light emitting RGB pixels.

[0112] Considering the difference between FIG. 13 and FIG. 12, the both ends of the cathode lines are bound in applying the scan signals to the both ends of the cathode lines in FIG. 12, and the two cathode circuits are provided to apply the scan signals to the both ends of the cathode lines thereby preventing the voltage step-up due to the current in the cathode lines in FIG. 13.

[0113] Since specific features of FIG. 12 and FIG. 13 can be understood through the description of FIG. 10 and FIG. 11, the specific description thereof will be omitted.

[0114] Meanwhile, the driving circuits of the organic EL device shown in FIG. 10 to FIG. 13 can be adopted to all types of display devices which are powered with electricity.

[0115] As described hereinbefore, the full color organic EL display device, the manufacturing method thereof, and the driving circuit of the organic EL display device have the following effects:

First, in manufacturing the full color organic EL device, in order to compensate the disadvantage of the red light emitting pixels with the relatively lower luminous efficiency, the red light emitting pixels are sized larger than the green light emitting pixels and the blue light emitting pixels to enhance the luminous efficiency of the red light emitting pixels. Thus, the texture and the opening ratio can be enhanced to raise the efficiency of the device.

Second, the single shadow mask can be used in depositing the RGB organic EL layers.

Third, the auxiliary electrodes with low resistance are provided in certain portions of the anode stripes to reduce resistance so that the uniformity across the screen can be enhanced and the drive voltage of the device can be reduced.

Fourth, the influence from the line resistance in the anode lines and the cathode lines is reduced when a constant current is introduced into the device structured of the RGB array in order to realize the white light as full color. Thus, the voltage loss on the line resistance is prevented and the area ratio of the device is adjusted to make each of the RGB pixels for generating the white light have the similar value of drive voltage thereby minimizing power loss.

[0116] Throughout the foregoing description, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope - of the invention. Therefore, the technical scope of the invention is not restricted to the description of the foregoing embodiments but will be defined by those disclosed in the accompanying claims.

Claims

1. A full color organic EL display panel comprising:

first, second and third light emitting pixels (102-1) wherein each of the light emitting pixels comprise a light emitting material (108); and the first, second and third light emitting pixels (102-1) comprise blue, green and red light emitting pixels, respectively;
a plurality of transparent anode electrodes (102-2) and
a plurality of cathode electrodes (110) perpendicularly intersecting said anode electrodes; and auxiliary electrodes (104) formed on the anode electrodes at portions connecting the light emitting pixels thereby forming an anode-auxiliary electrode combination having a lower resistivity than the anode electrode alone,
wherein each of said first, second and third light emitting pixels is arranged in each of intersecting positions of said anode electrodes and cathode electrodes; and
characterised in that
said third light emitting pixels have the area larger than that of said first and second light emitting pixels to compensate for differences in luminous efficiency,
the auxiliary electrodes (104) are arranged at least around said first, second and third light emitting pixels, in portions of said anode electrodes,
the anode electrode (102-2) includes indium tin oxide (ITO) and the auxiliary electrode (104) includes Ag, and
wherein said anode electrodes for connecting between each of said first light emitting pixels and for connecting between each of said second light emitting pixels have zigzag-shaped structures having partitions inclined at a certain angle wherein said partitions are arranged so as not to overlap with corner portions of said third light emitting pixels, and the anode electrodes for connecting between each of said third light emitting pixels have stripe shaped structures.

2. A full color organic EL display panel according to claim 1, wherein said first, second and third light emitting pixels have quadrangular structures which are the same or different from one another.

3. A full color organic EL display panel according to claim 1, wherein said first, second and third light emitting pixels are arranged into a delta structure.

4. A full color organic EL display panel according to claim 1, wherein said cathode electrodes (110) are made of metal.

Patentansprüche

1. Vollfarbenes, organisches EL-Anzeigefeld, umfassend:

erste, zweite und dritte lichtemittierende Pixel (102-1), wobei jedes der lichtemittierenden Pixel ein lichtemittierendes Material (108) umfasst; und die ersten, zweiten bzw. dritten lichtemittierenden Pixel (102-1) blaue, grüne bzw. rote lichtemittierende Pixel umfassen;
eine Mehrzahl von transparenten Anodenelektroden (102-2) und
eine Mehrzahl von Kathodenelektroden (110), welche die Anodenelektroden rechtwinklig schneiden; und
Hilfselektroden (104), welche an den Anodenelektroden an Teilbereichen ausgebildet sind,

welche die lichtemittierenden Pixel verbinden und damit eine Anoden-Hilfselektroden-Kombination mit einem niedrigeren spezifischen Widerstand als die Anodenelektrode allein ausbilden,
wobei jedes der ersten, zweiten und dritten lichtemittierenden Pixel in jeder der Schnittpositionen der Anodenelektroden und Kathodenelektroden angeordnet sind; und
dadurch gekennzeichnet, dass
der Bereich der dritten lichtemittierenden Pixel größer ist als der der ersten und zweiten lichtemittierenden Pixel, um Unterschiede des Lichtwirkungsgrades zu kompensieren,
die Hilfselektroden (104) wenigstens um die ersten, zweiten und dritten lichtemittierenden Pixel herum in Teilbereichen der Anodenelektroden angeordnet sind,
die Anodenelektrode (102-2) Indiumzinnoxid (ITO - indium tin oxide) umfasst und die Hilfselektrode (104) Ag umfasst, und
wobei die Anodenelektroden, um jedes der ersten lichtemittierenden Pixel miteinander zu verbinden und um jedes der zweiten lichtemittierenden Pixel miteinander zu verbinden, zickzackförmige Strukturen aufweisen, welche unter einem bestimmten Winkel geneigte Partitionen aufweisen, wobei die Partitionen derart angeordnet sind, dass sie Eckteilbereiche der dritten lichtemittierenden Pixel nicht überlappen, und die Anodenelektroden, um jedes der dritten lichtemittierenden Pixel miteinander zu verbinden, streifenförmige Strukturen aufweisen.

2. Vollfarbenes, organisches EL-Anzeigefeld nach Anspruch 1, wobei die ersten, zweiten und dritten lichtemittierenden Pixel gleiche oder sich voneinander unterscheidende viereckige Strukturen aufweisen.

3. Vollfarbenes, organisches EL-Anzeigefeld nach Anspruch 1, wobei die ersten, zweiten und dritten lichtemittierenden Pixel in einer Delta-Struktur angeordnet sind.

4. Vollfarbenes, organisches EL-Anzeigefeld nach Anspruch 1, wobei die Kathodenelektroden (110) aus Metall hergestellt sind.

Revendications

1. Panneau d'affichage électroluminescent (EL) organique en couleurs comprenant :

des premiers, deuxièmes et troisièmes pixels électroluminescents (102-1) où chacun des pixels électroluminescents comprend un matériau électroluminescent (108) ; et les premiers, deuxièmes et troisièmes pixels électroluminescents (102-1) comprennent des pixels électroluminescents bleus, verts et rouges, respectivement ;
une pluralité d'électrodes d'anode transparentes (102-2) et
une pluralité d'électrodes de cathode (110) coupant perpendiculairement lesdites électrodes d'anode ; et
des électrodes auxiliaires (104) formées sur les électrodes d'anode au niveau de parties reliant les pixels électroluminescents formant ainsi une combinaison d'électrodes auxiliaire-d'anode ayant une résistivité inférieure à celle de l'électrode d'anode seule,
dans lequel chacun desdits premiers, deuxièmes et troisièmes pixels électroluminescents est agencé dans chacune des positions d'intersection desdites électrodes d'anode et électrodes de cathode ; et
caractérisé en ce que
lesdits troisièmes pixels électroluminescents ont une surface plus grande que celle desdits premiers et deuxièmes pixels électroluminescents pour compenser les différences d'efficacité lumineuse,
les électrodes auxiliaires (104) sont agencées au moins autour desdits premiers, deuxièmes et troisièmes pixels électroluminescents, dans des parties desdites électrodes d'anode,
l'électrode d'anode (102-2) comporte de l'oxyde d'indium-étain (ITO) et l'électrode auxiliaire (104) comporte de l'Ag, et
dans lequel lesdites électrodes d'anode pour la liaison entre chacun desdits premiers pixels électroluminescents et pour la liaison entre chacun desdits deuxièmes pixels électroluminescents ont des structures en zigzag ayant des cloisons inclinées à un certain angle où lesdites cloisons sont agencées de manière à ne pas se chevaucher avec des parties de coin desdits troisièmes pixels électroluminescents, et les électrodes d'anode pour la liaison entre chacun desdits troisièmes pixels électroluminescents ont des structures en forme de bande.

2. Panneau d'affichage électroluminescent (EL) organique en couleurs selon la revendication 1, dans lequel lesdits premiers, deuxièmes et troisièmes pixels électroluminescents ont des structures quadrangulaires qui sont identiques ou différentes les unes des autres.

3. Panneau d'affichage électroluminescent (EL) organique en couleurs selon la revendication 1, dans lequel lesdits premiers, deuxièmes et troisièmes pixels électroluminescents sont agencés en une structure en delta.

4. Panneau d'affichage électroluminescent (EL) organique en couleurs selon la revendication 1, dans lequel lesdites électrodes de cathode (110) sont réalisées en métal.

FIG. 1
Related Art

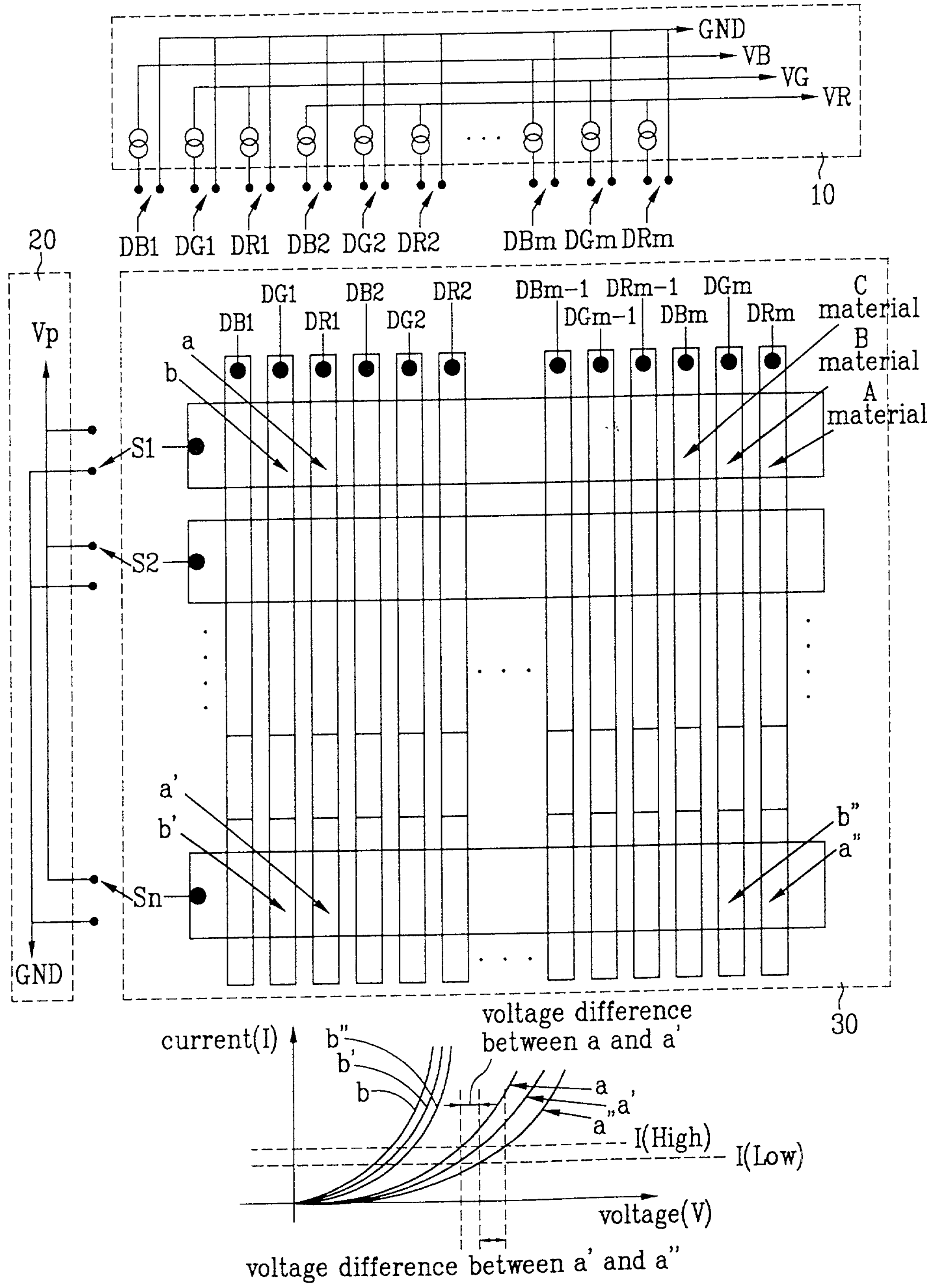


FIG. 2A
Related Art

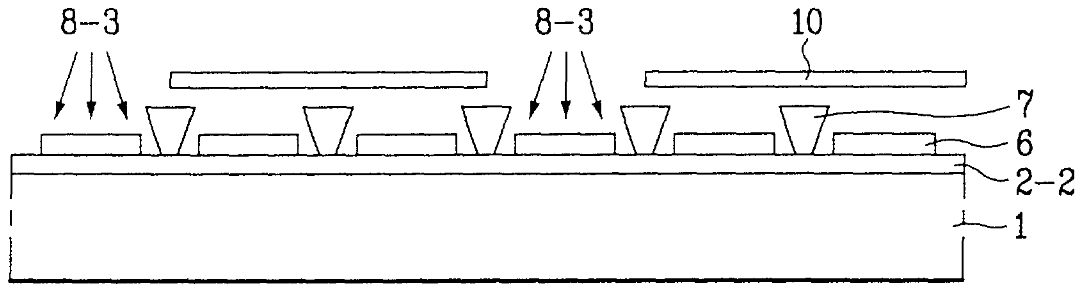


FIG. 2B
Related Art

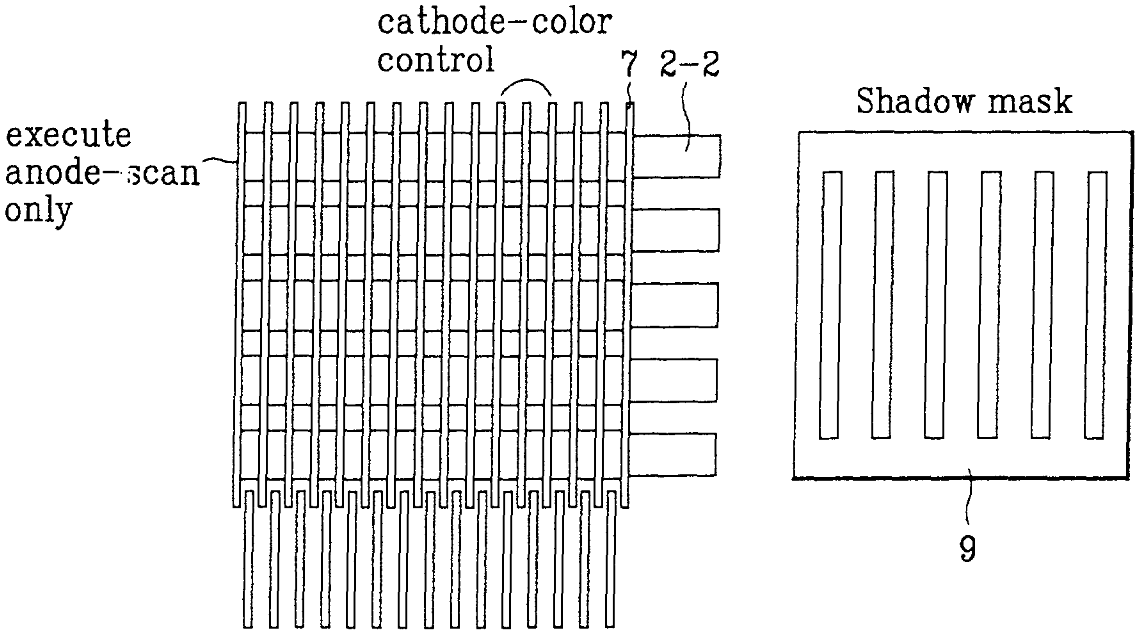


FIG. 2C
Related Art

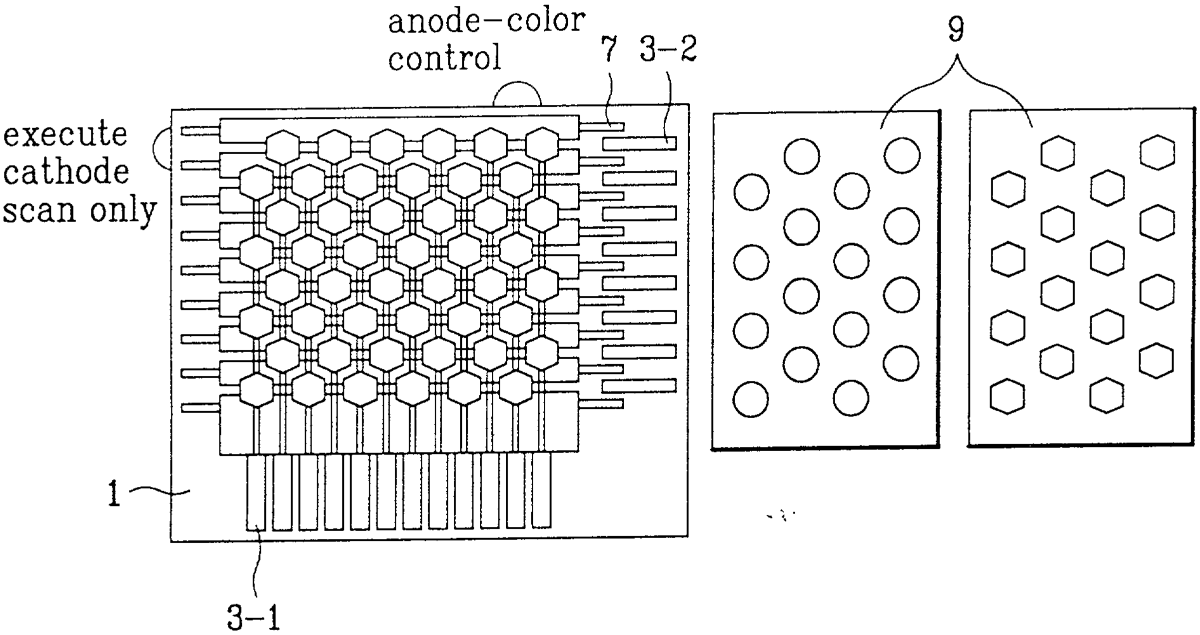


FIG. 3A

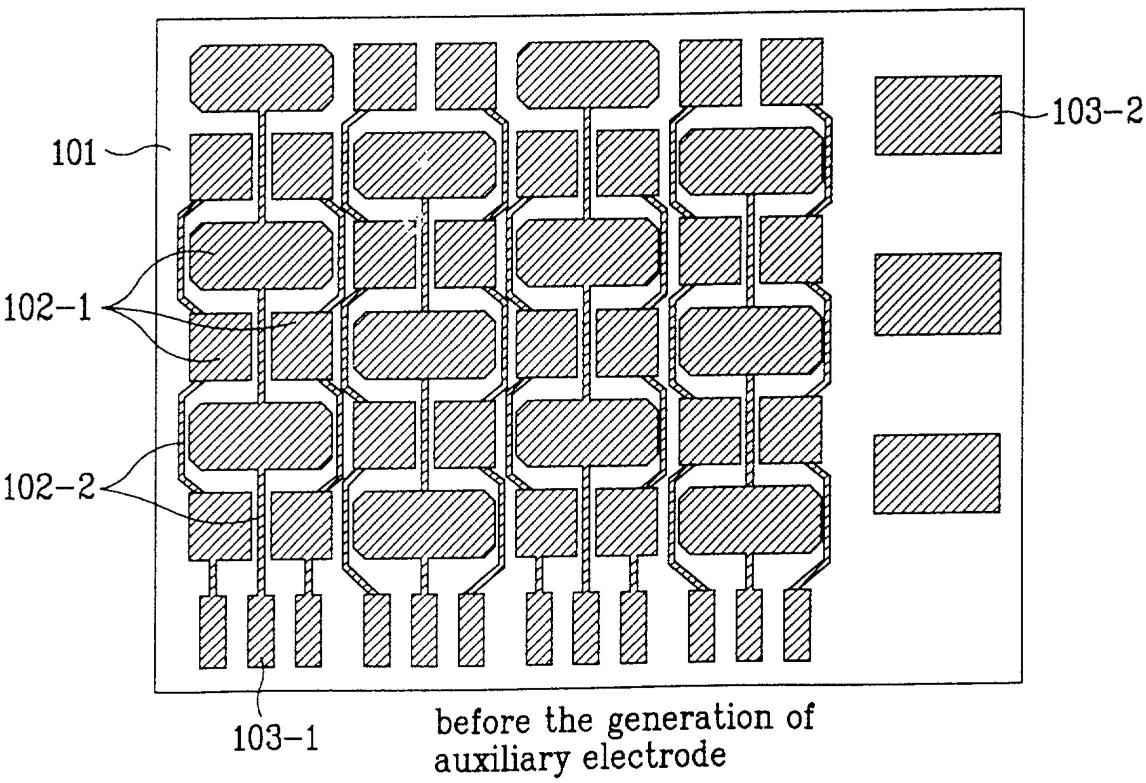


FIG. 3B

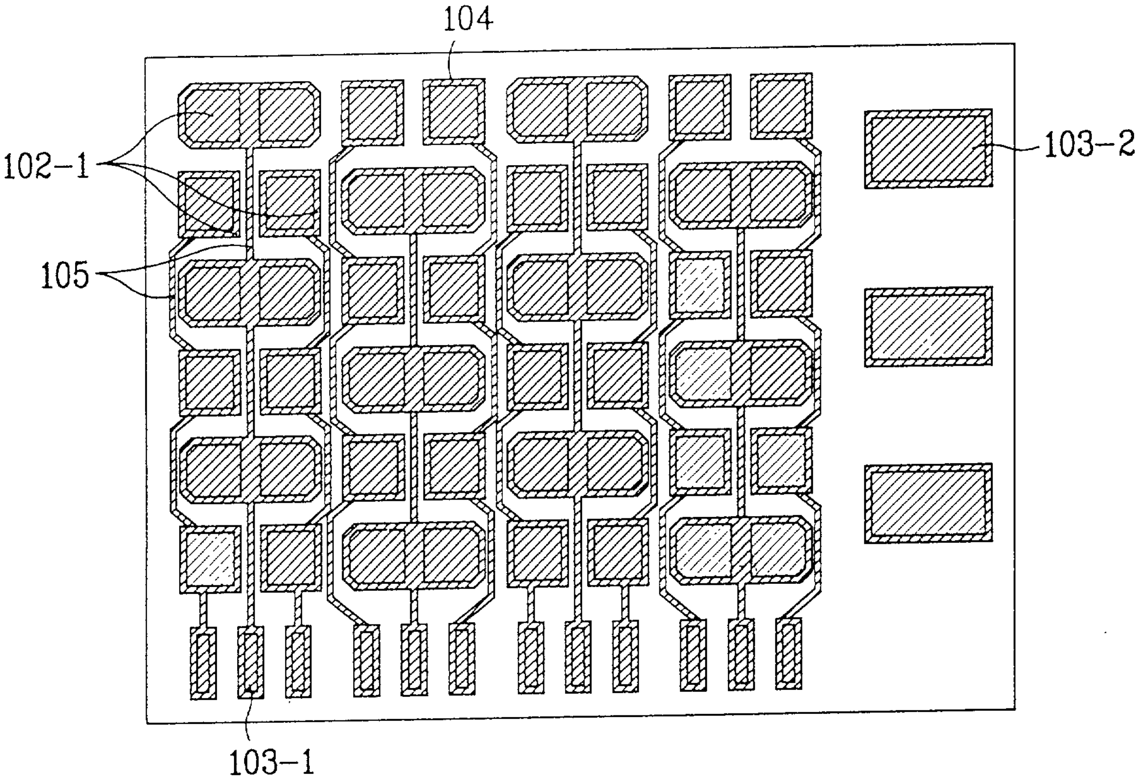


FIG. 3C

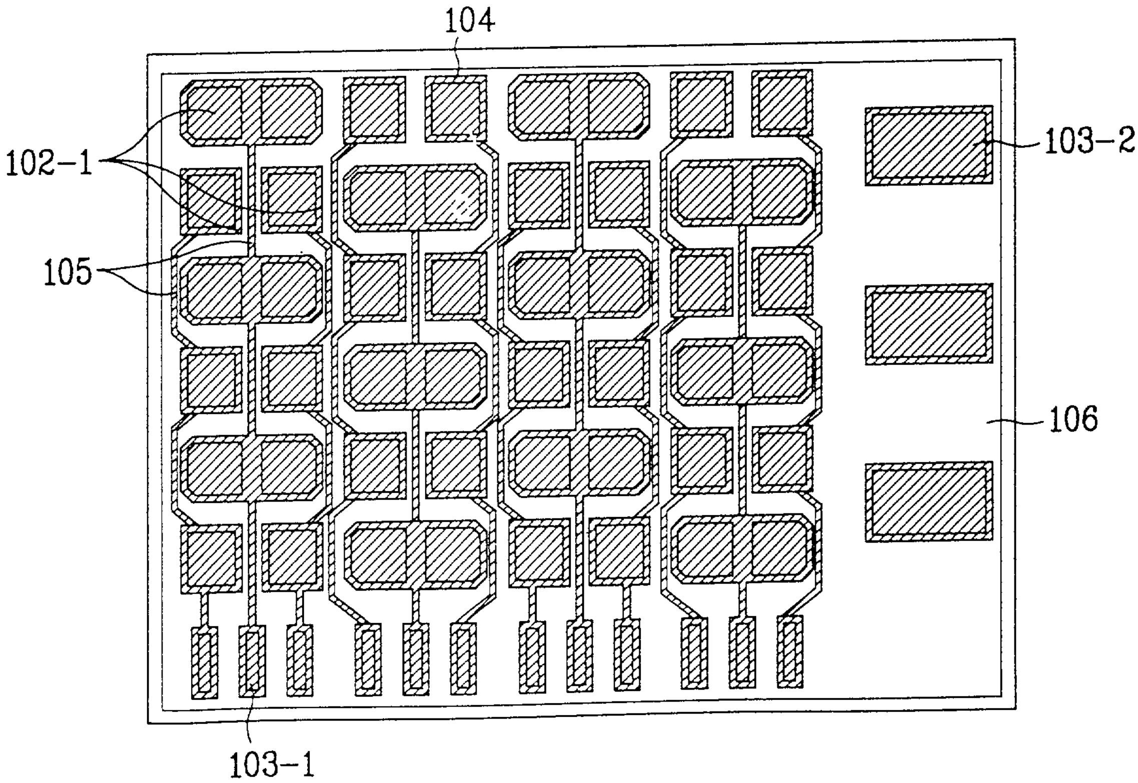


FIG. 3D

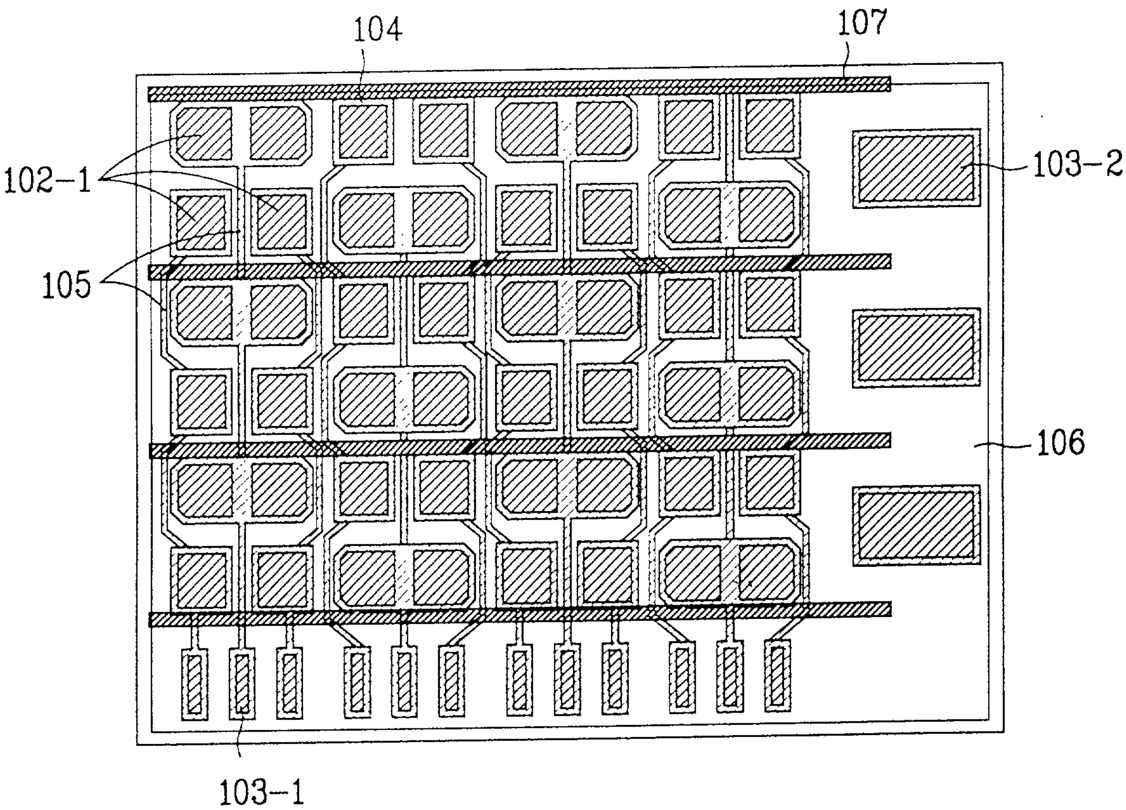

104
107
102-1
103-2
105
106
103-1

FIG. 3E

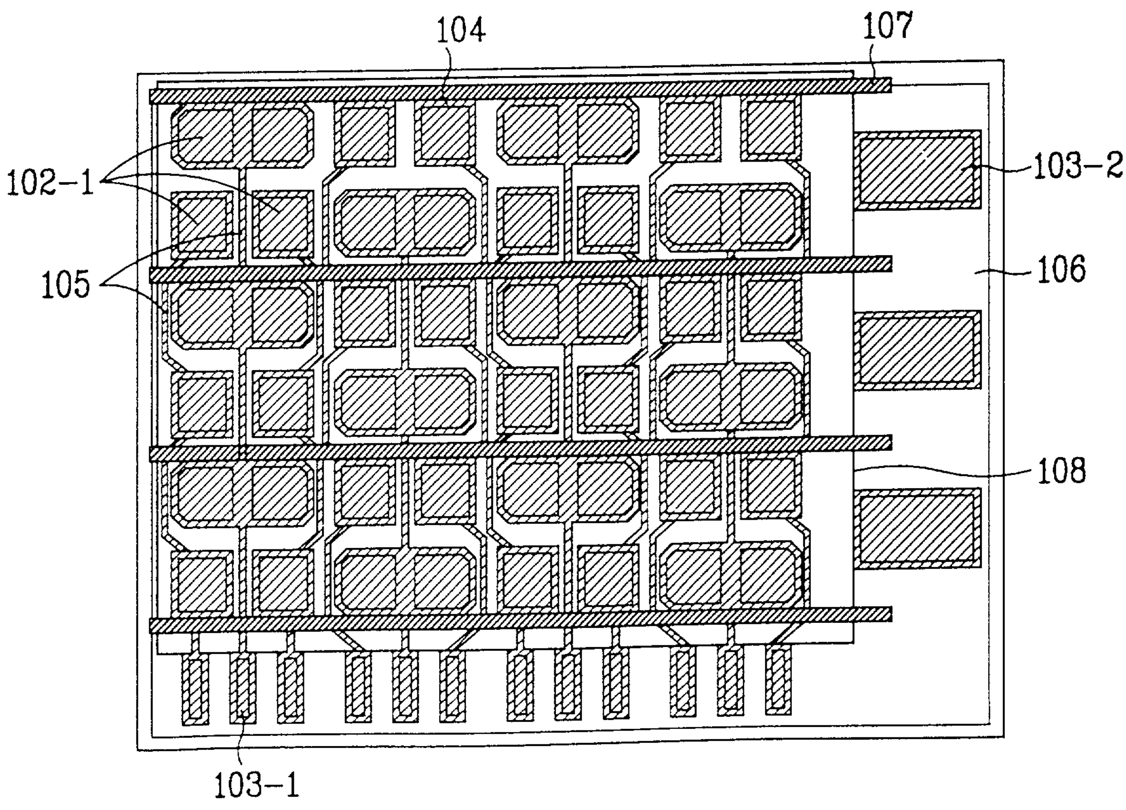

104
107
102-1
103-2
105
106
108
103-1

FIG. 3F

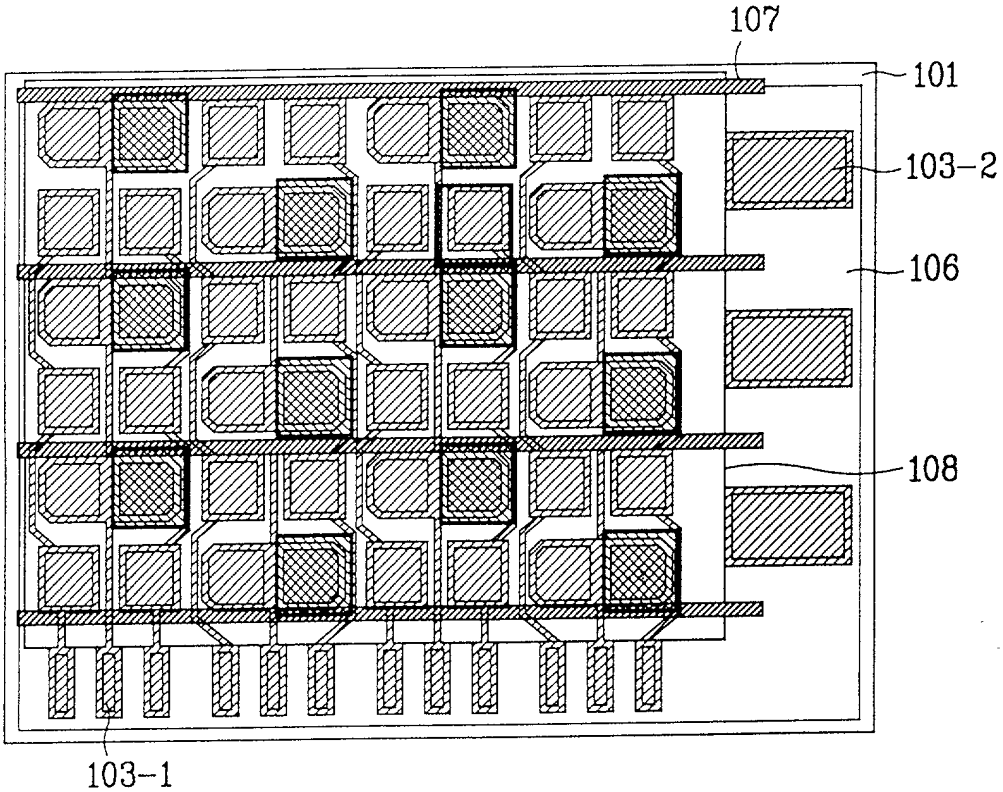


FIG. 3G

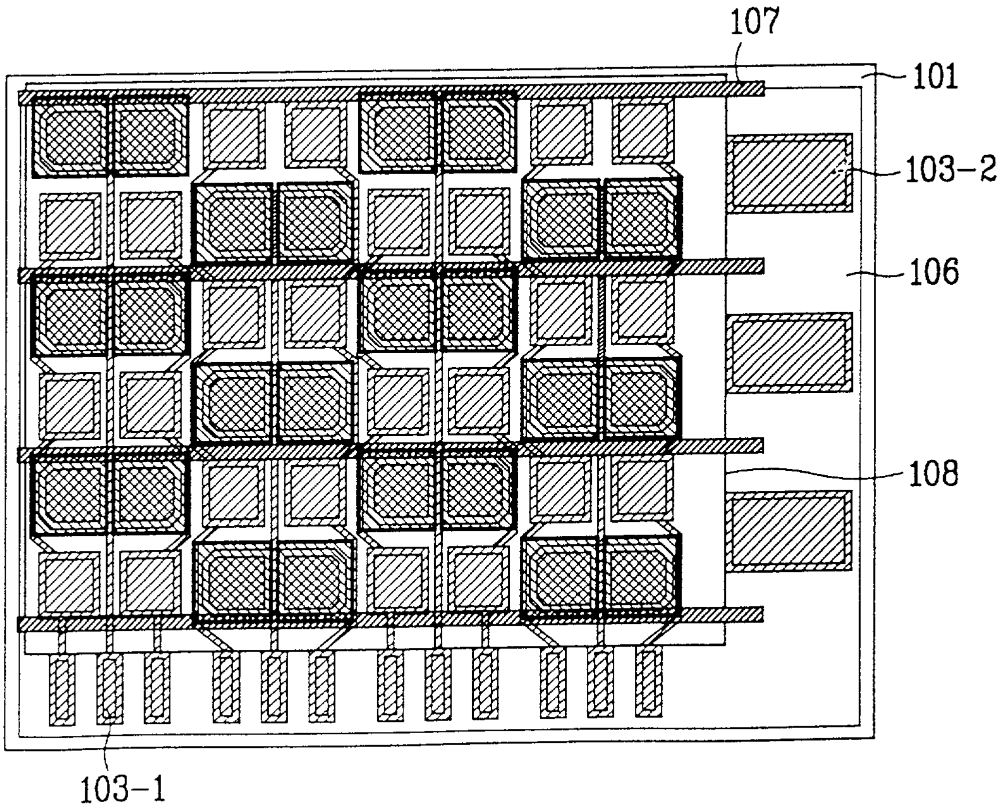


FIG. 3H

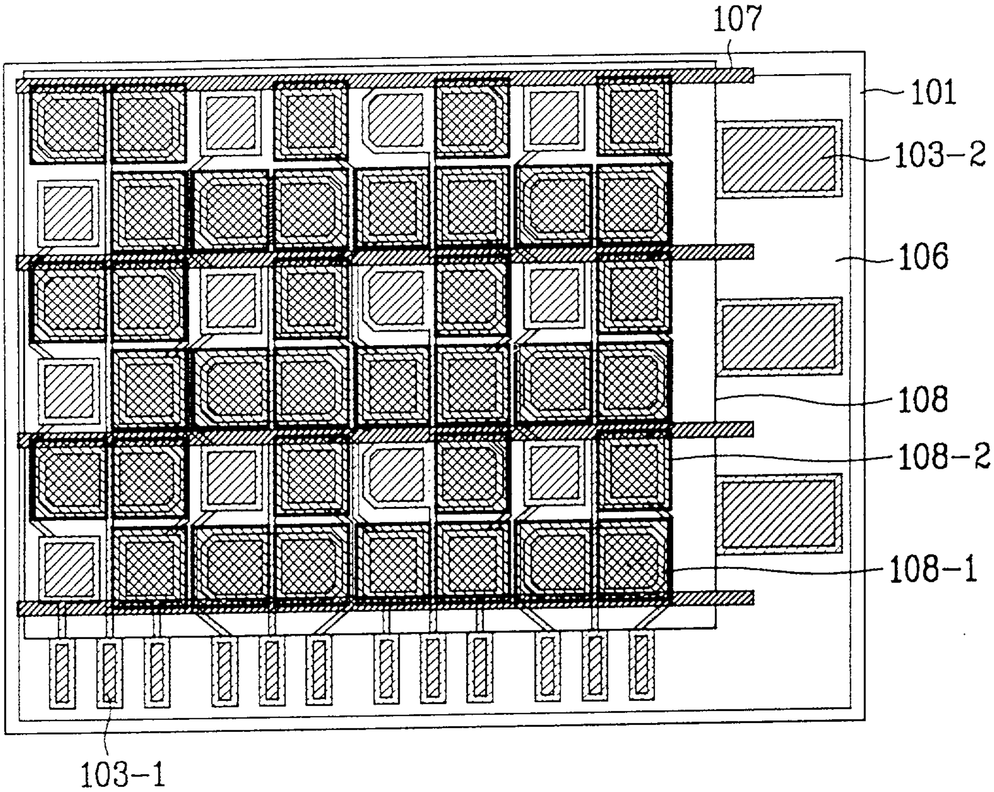

107
101
103-2
106
108
108-2
108-1
103-1

FIG. 3I

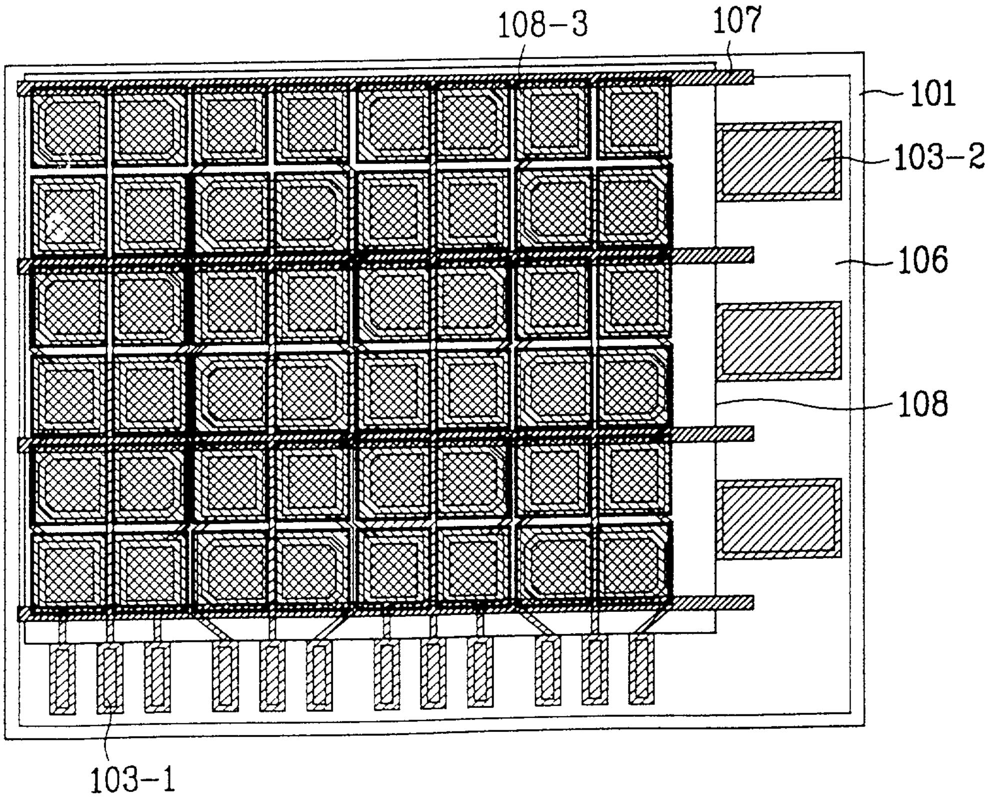

108-3
107
101
103-2
106
108
103-1

FIG. 3J

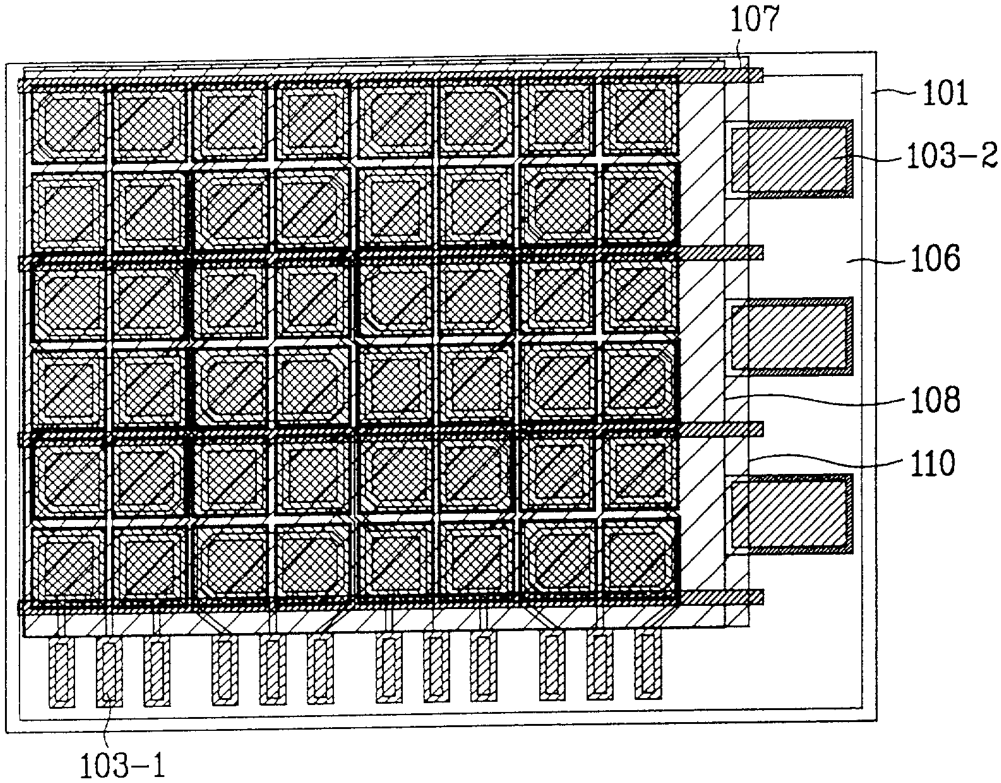


FIG. 3K

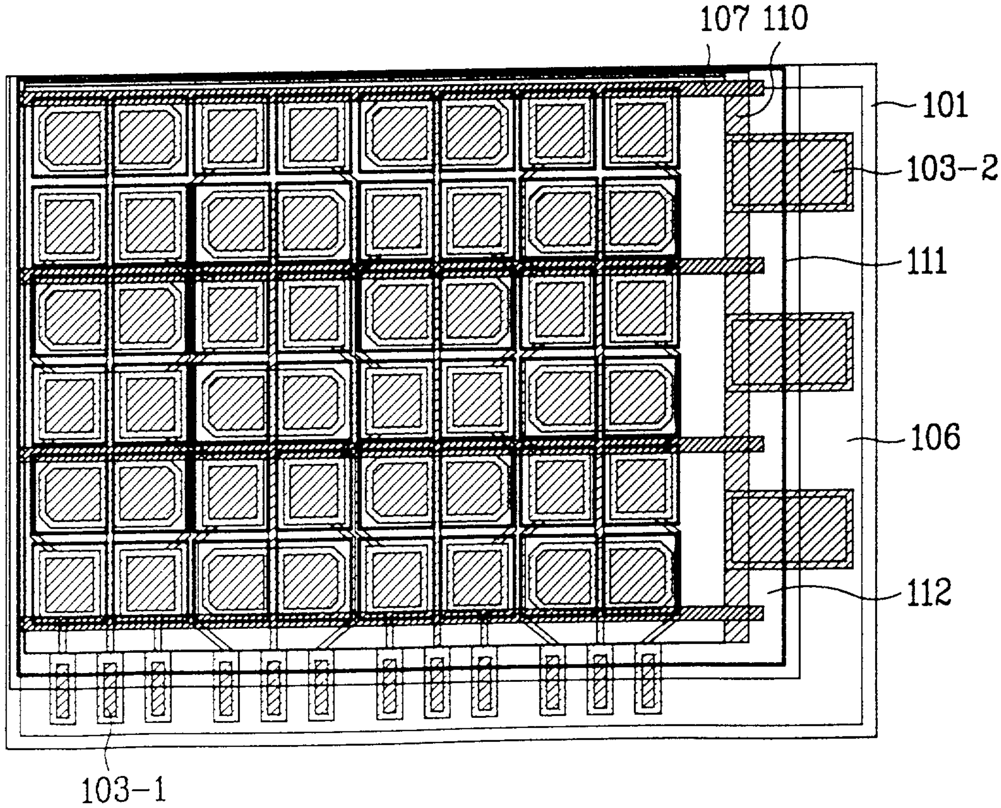
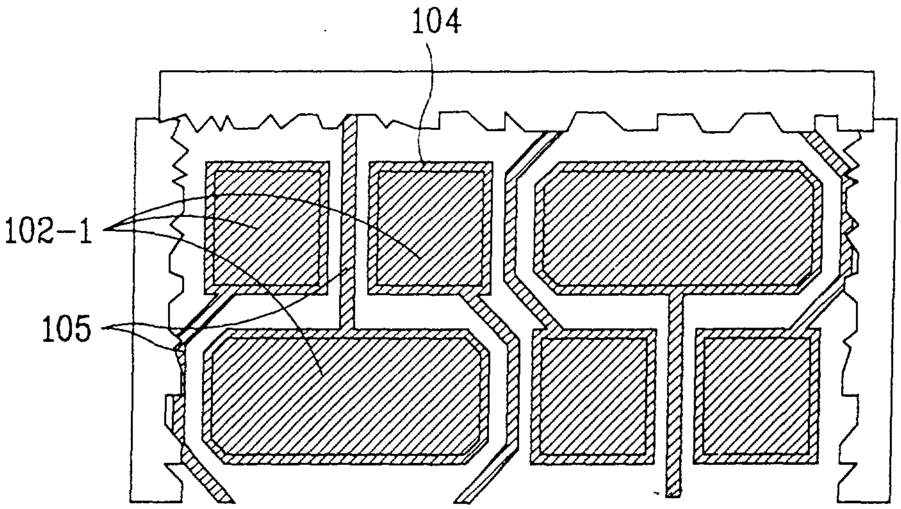


FIG. 4



after the generation of auxiliary electrode

FIG. 5

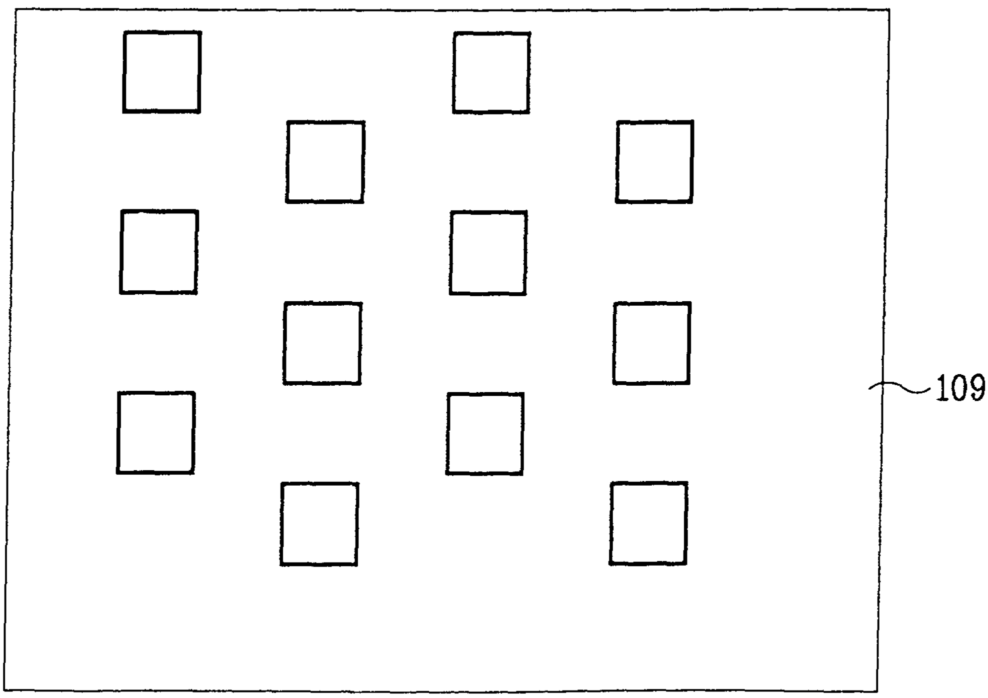


FIG. 6A

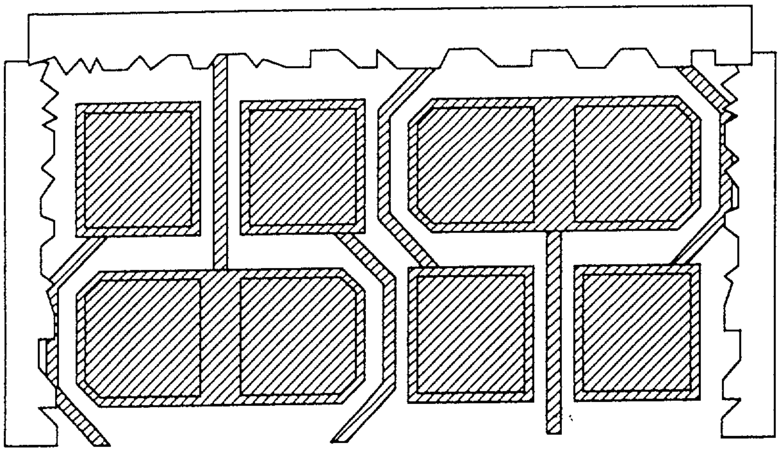


FIG. 6B

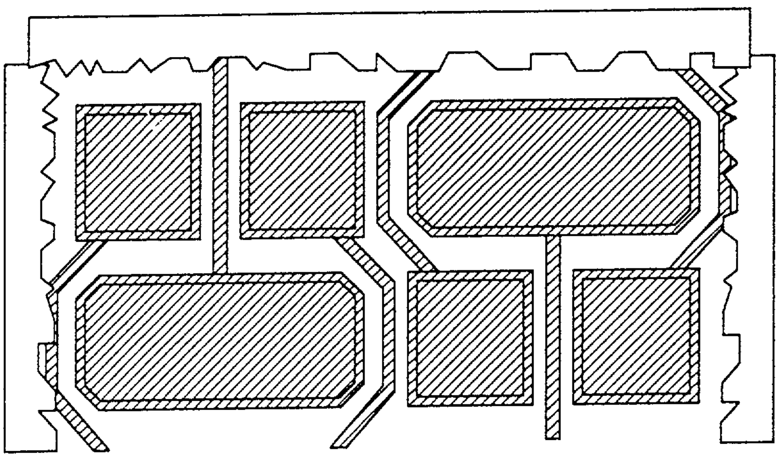


FIG. 7

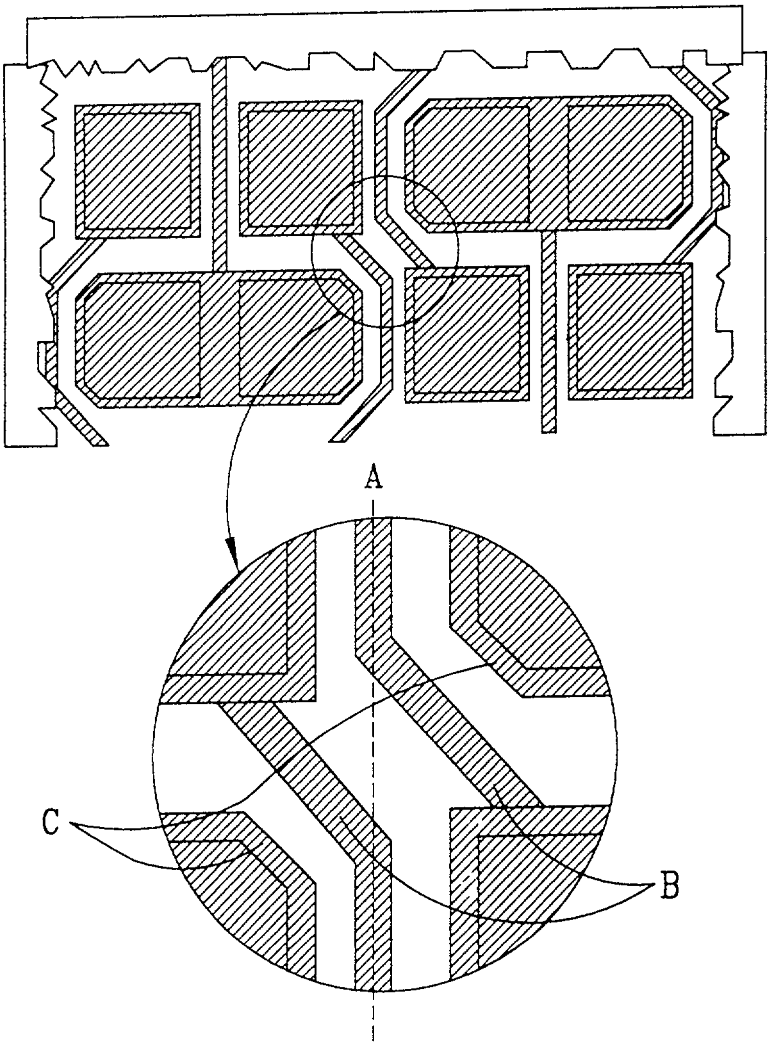


FIG. 8A

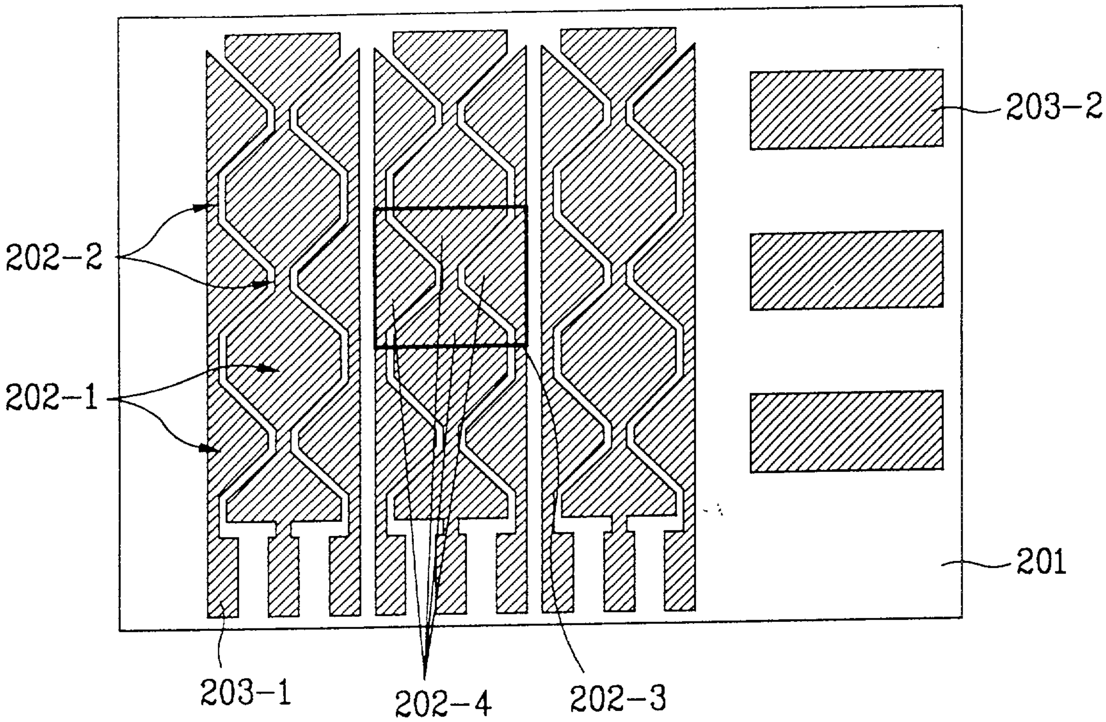


FIG. 8B

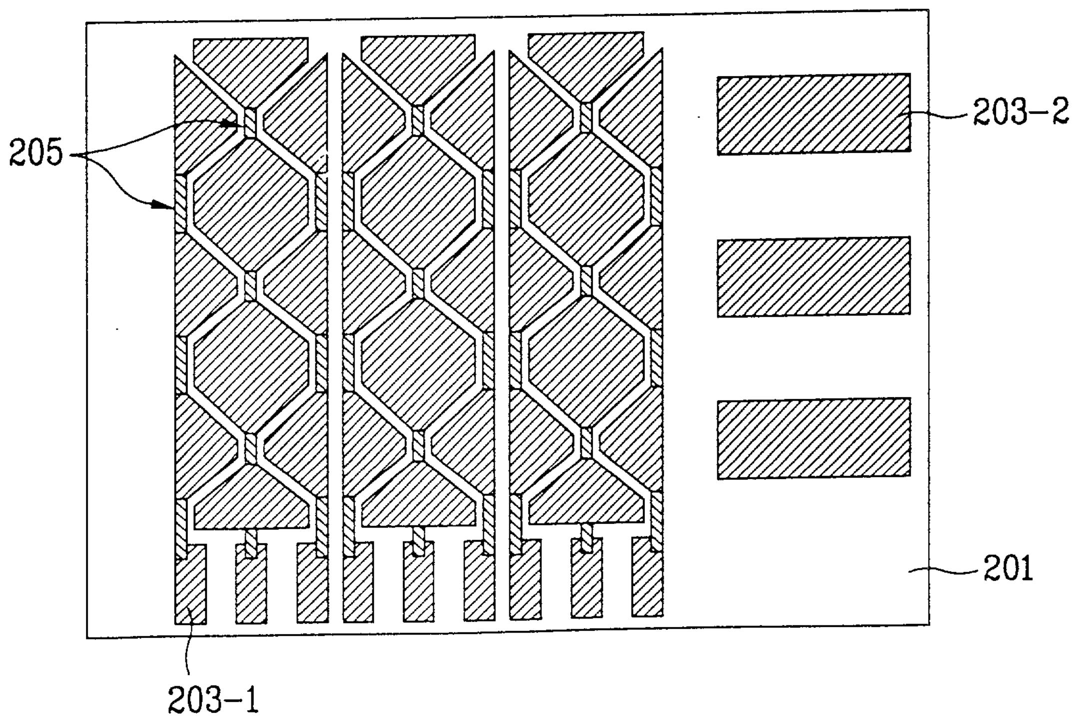


FIG. 8C

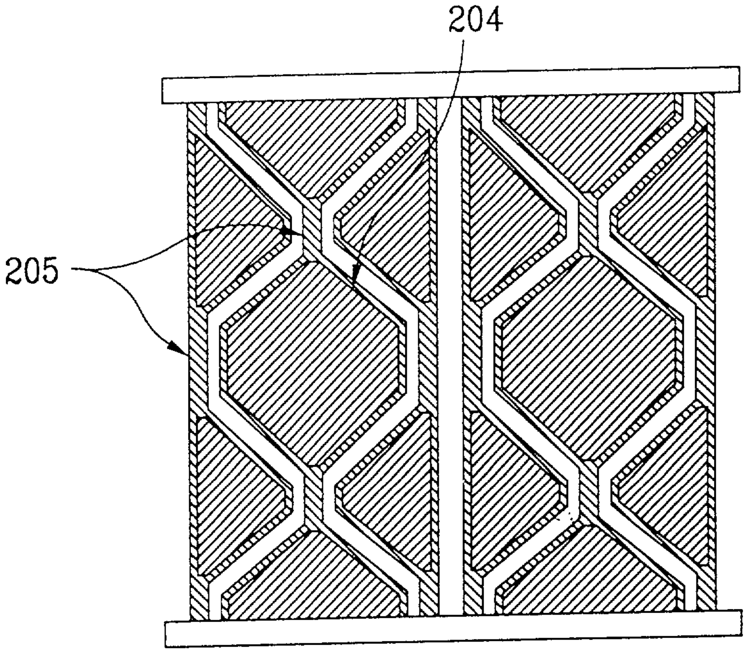


FIG. 8D

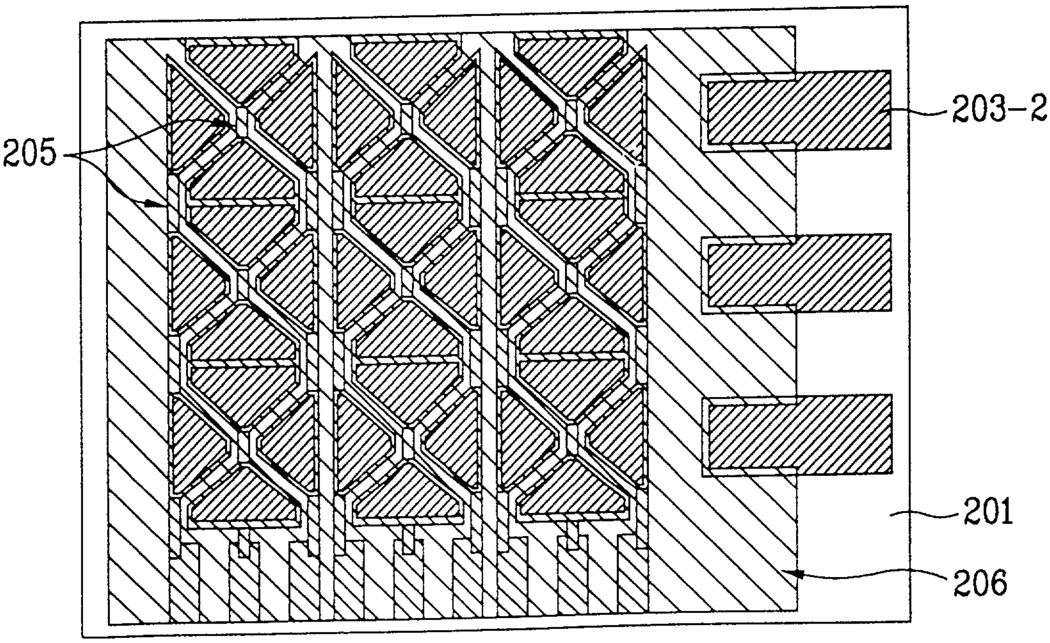


FIG. 8E

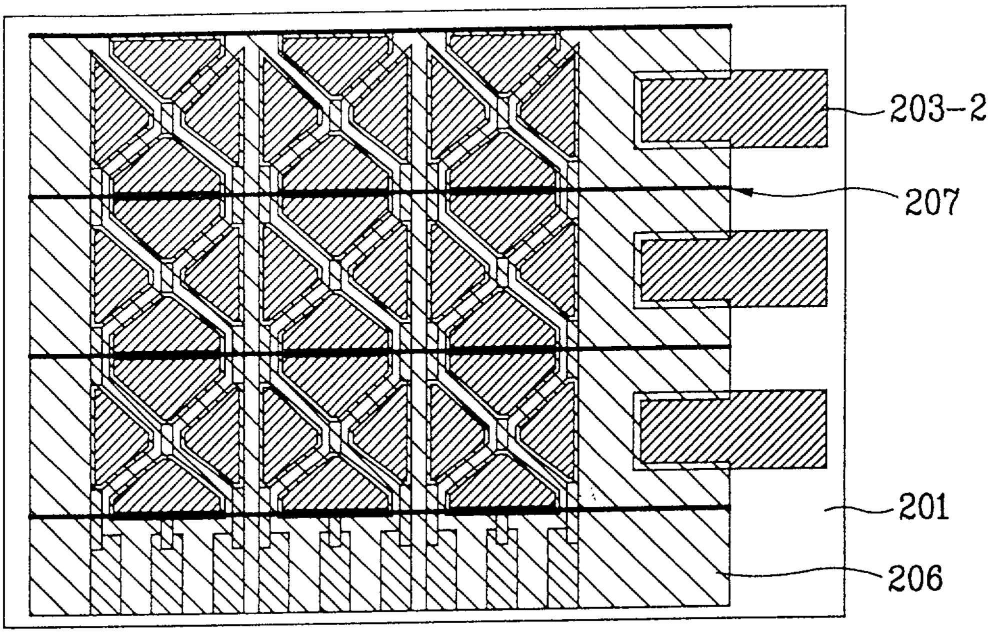


FIG. 8F

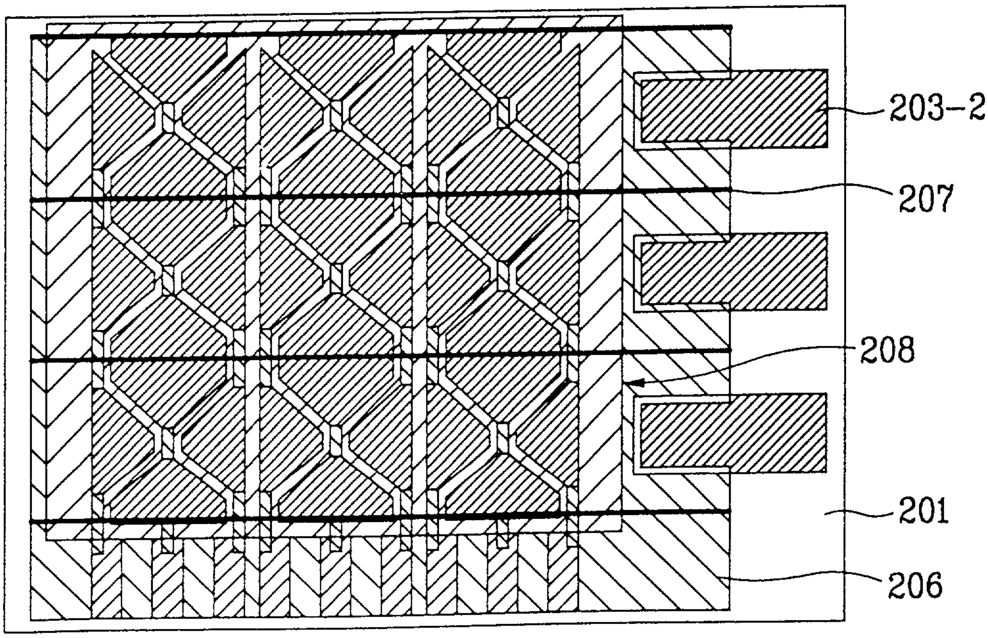


FIG. 8G

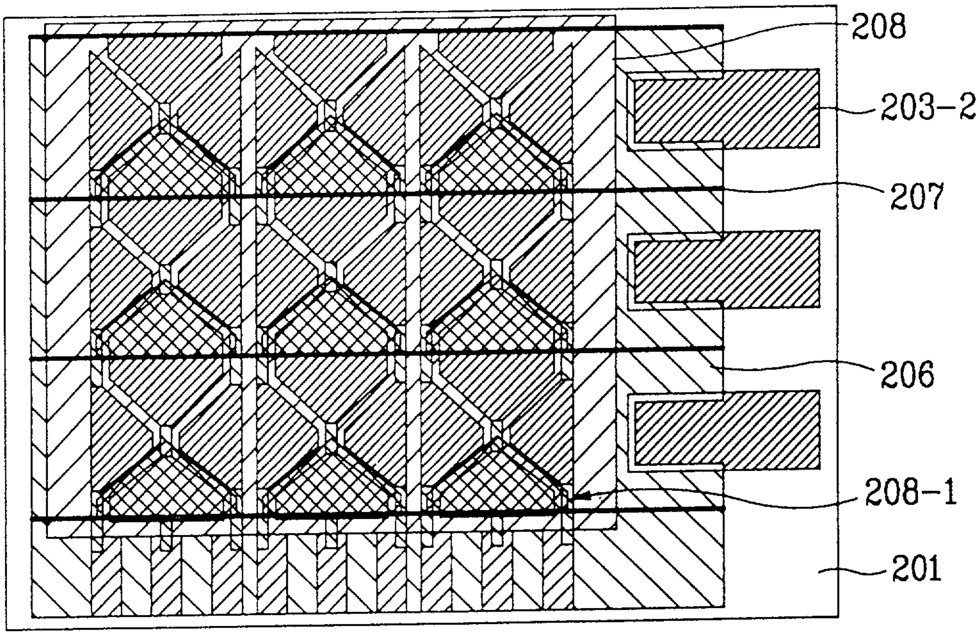


FIG. 8H

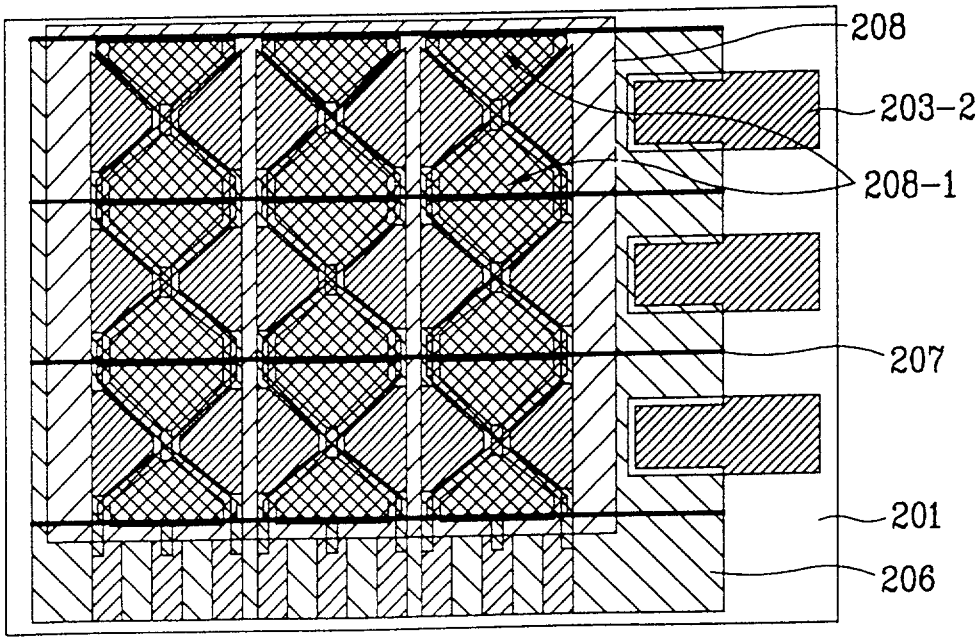


FIG. 8I

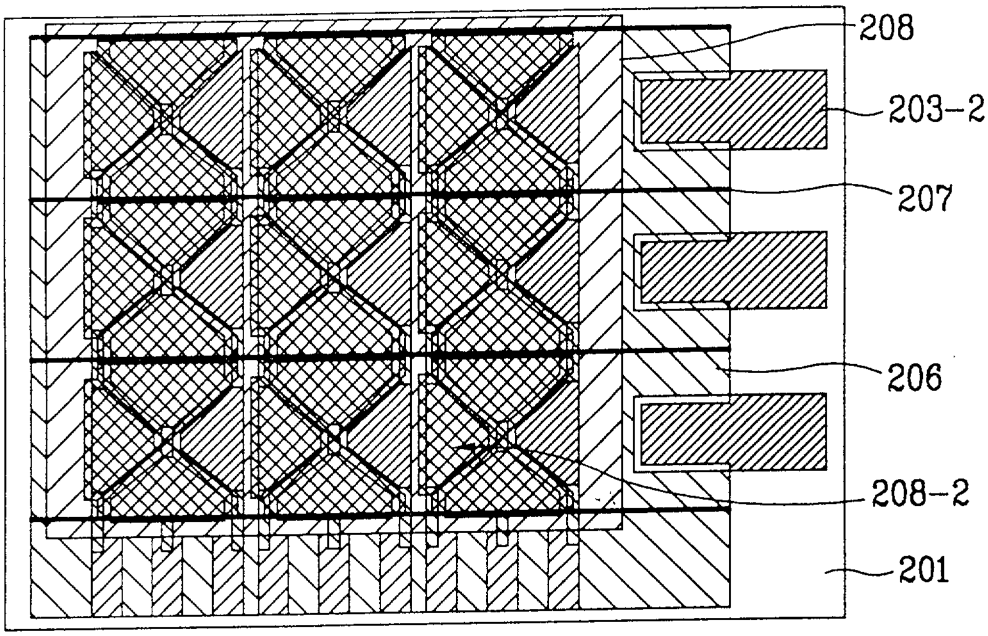


FIG. 8J

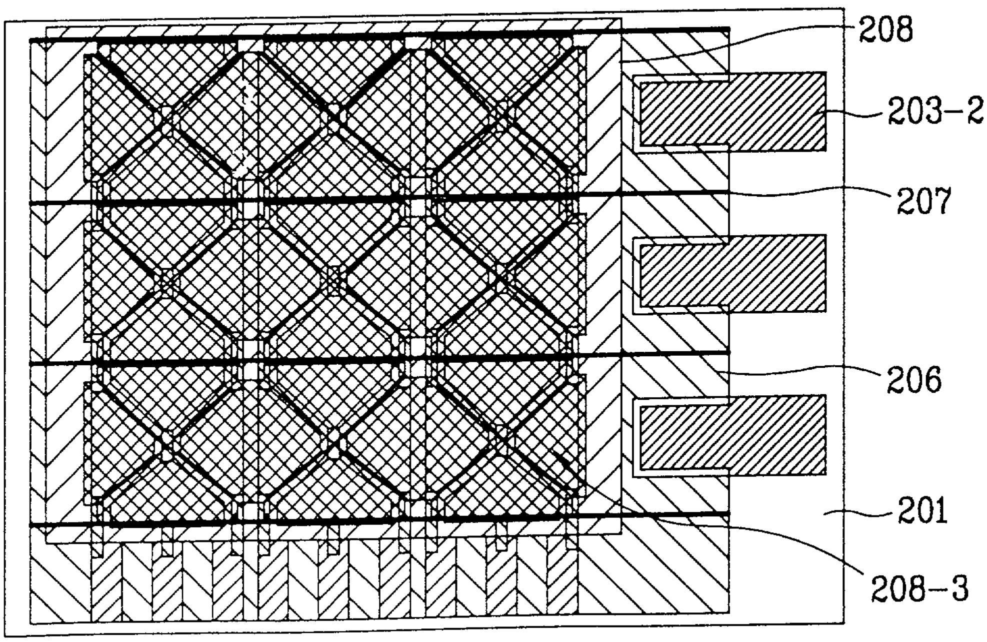


FIG. 8K

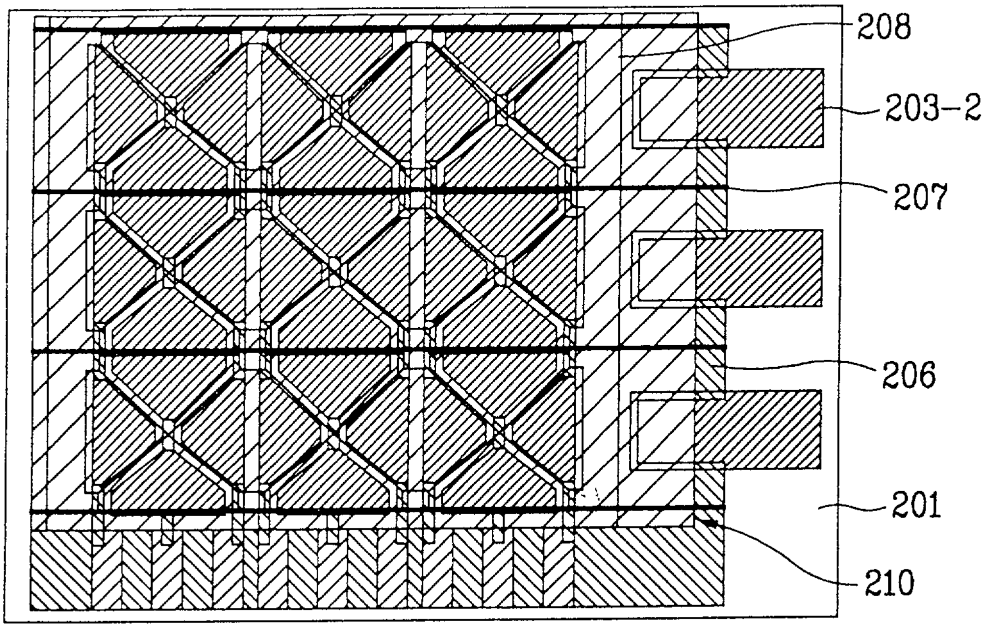


FIG. 8L

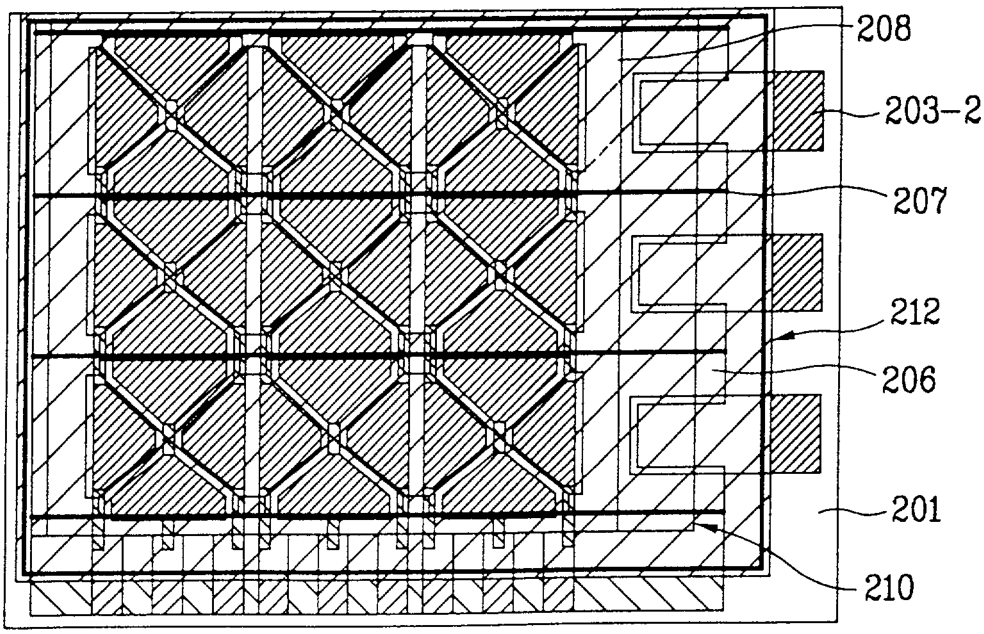


FIG. 9

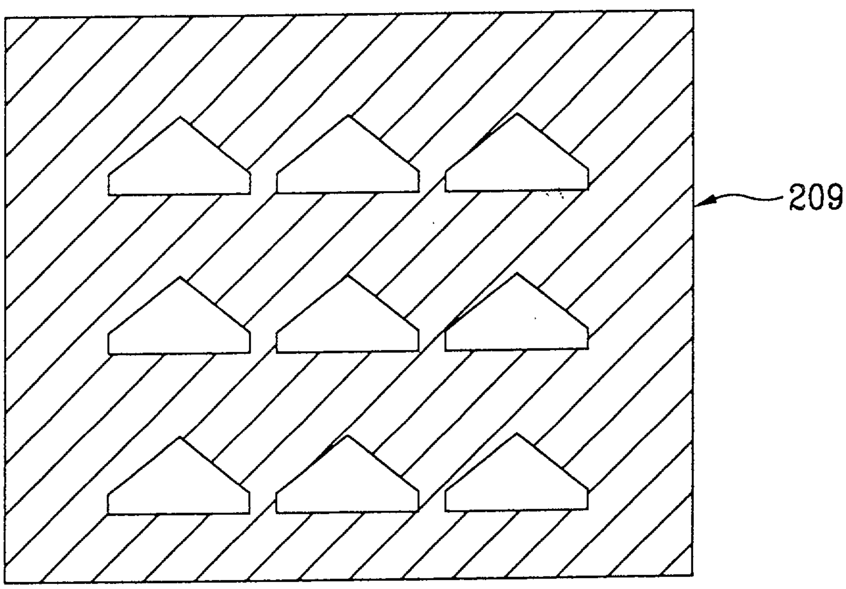


FIG. 10

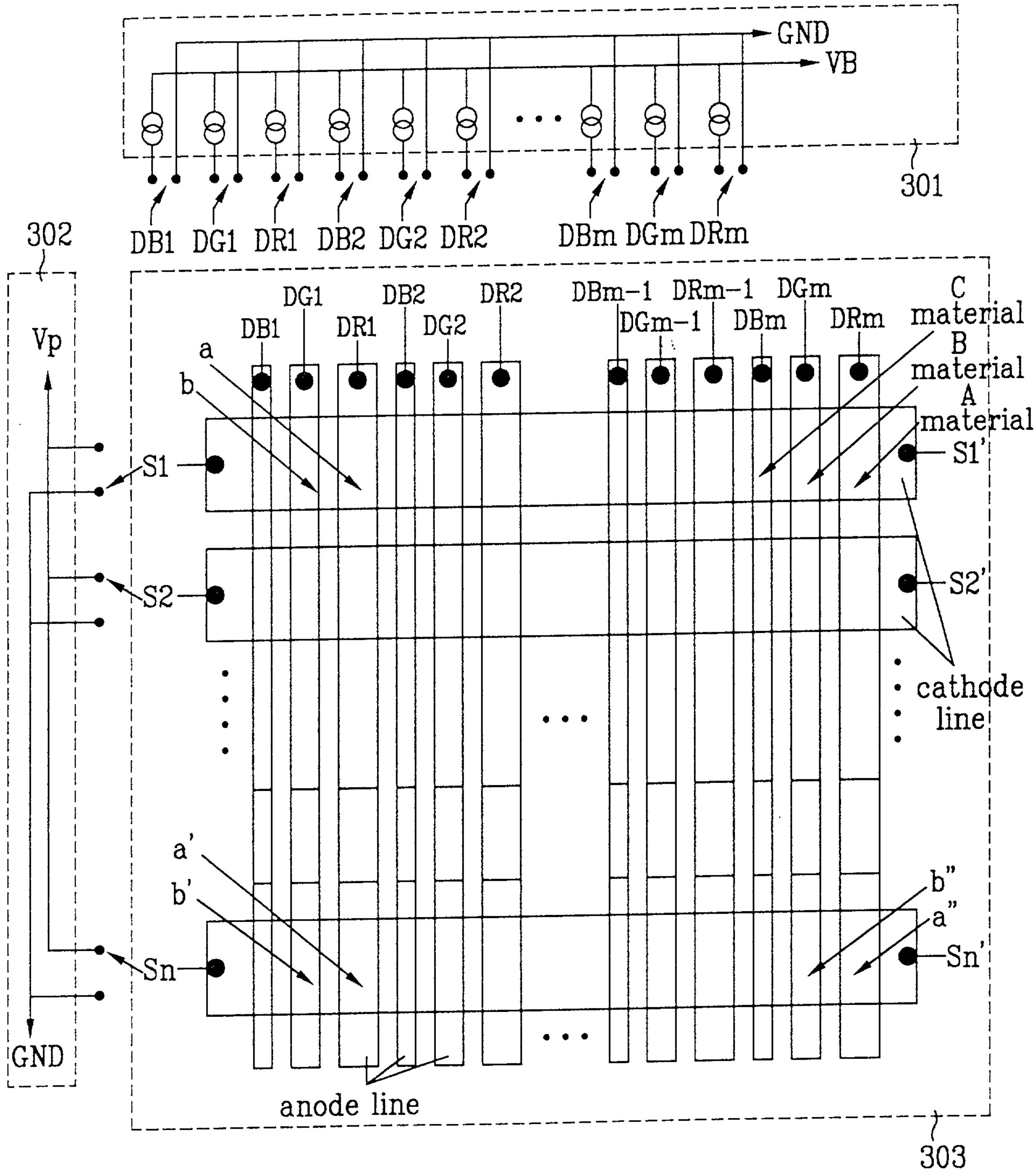

GND
VB
301
DB1 DG1 DR1 DB2 DG2 DR2
DBm DGm DRm
302
Vp
S1
S2
Sn
GND
DG1
DB2
DR2
DBm-1
DRm-1
DGm
DB1
DR1
DG2
DGm-1
DBm
DRm
C material
B material
A material
a
b
S1'
S2'
cathode line
a'
b'
b"
a"
Sn'
anode line
303

FIG. 11

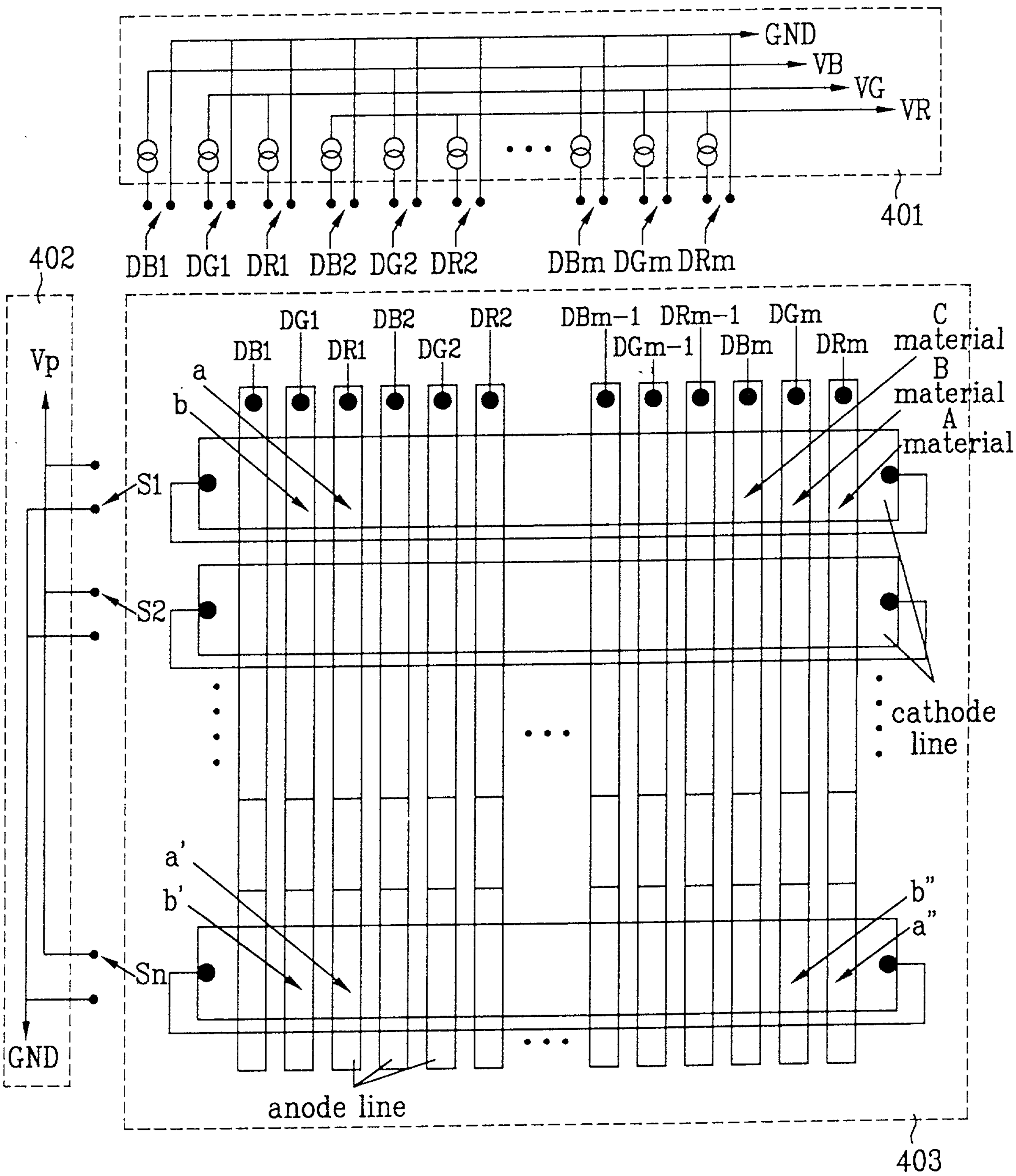
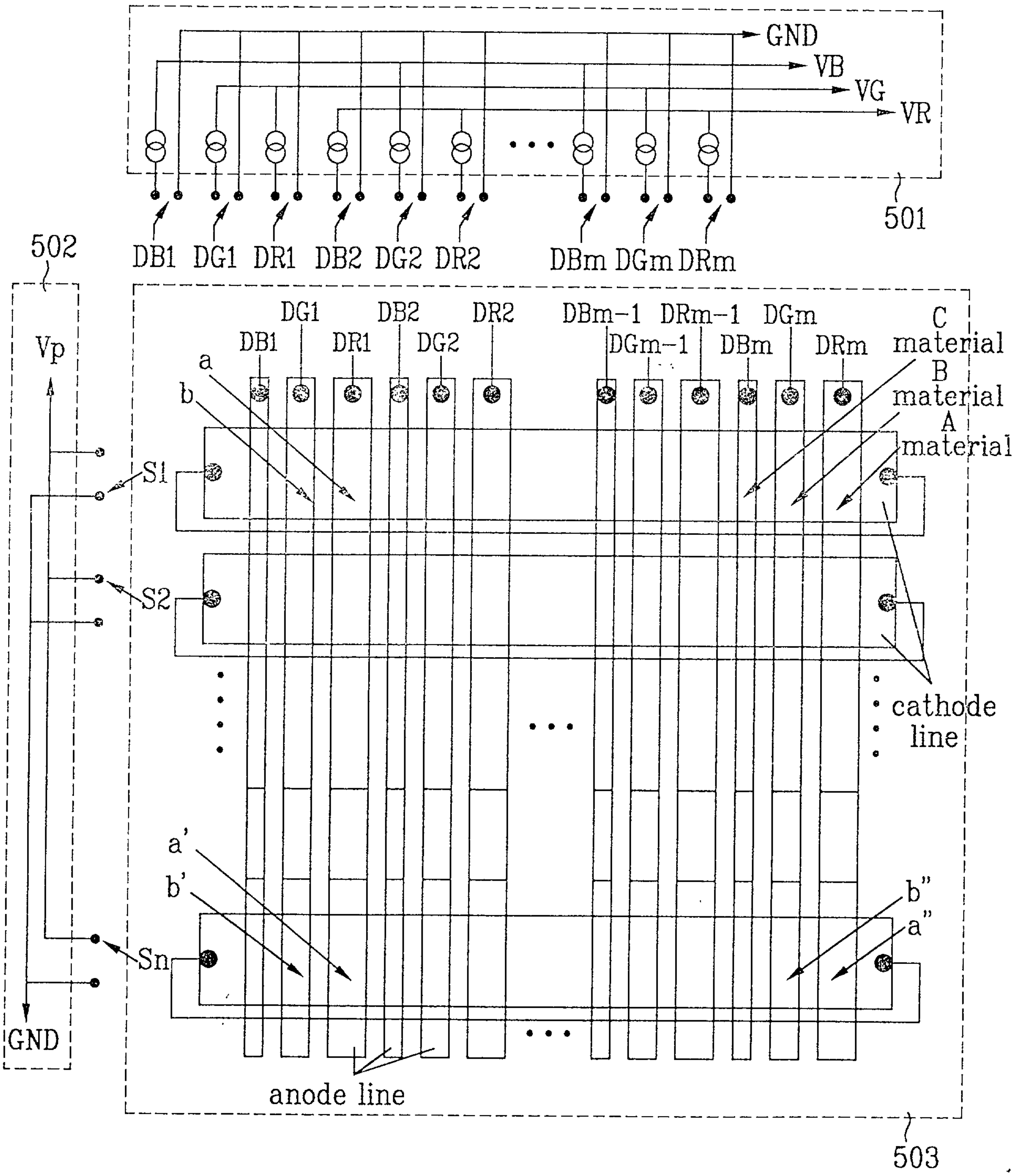
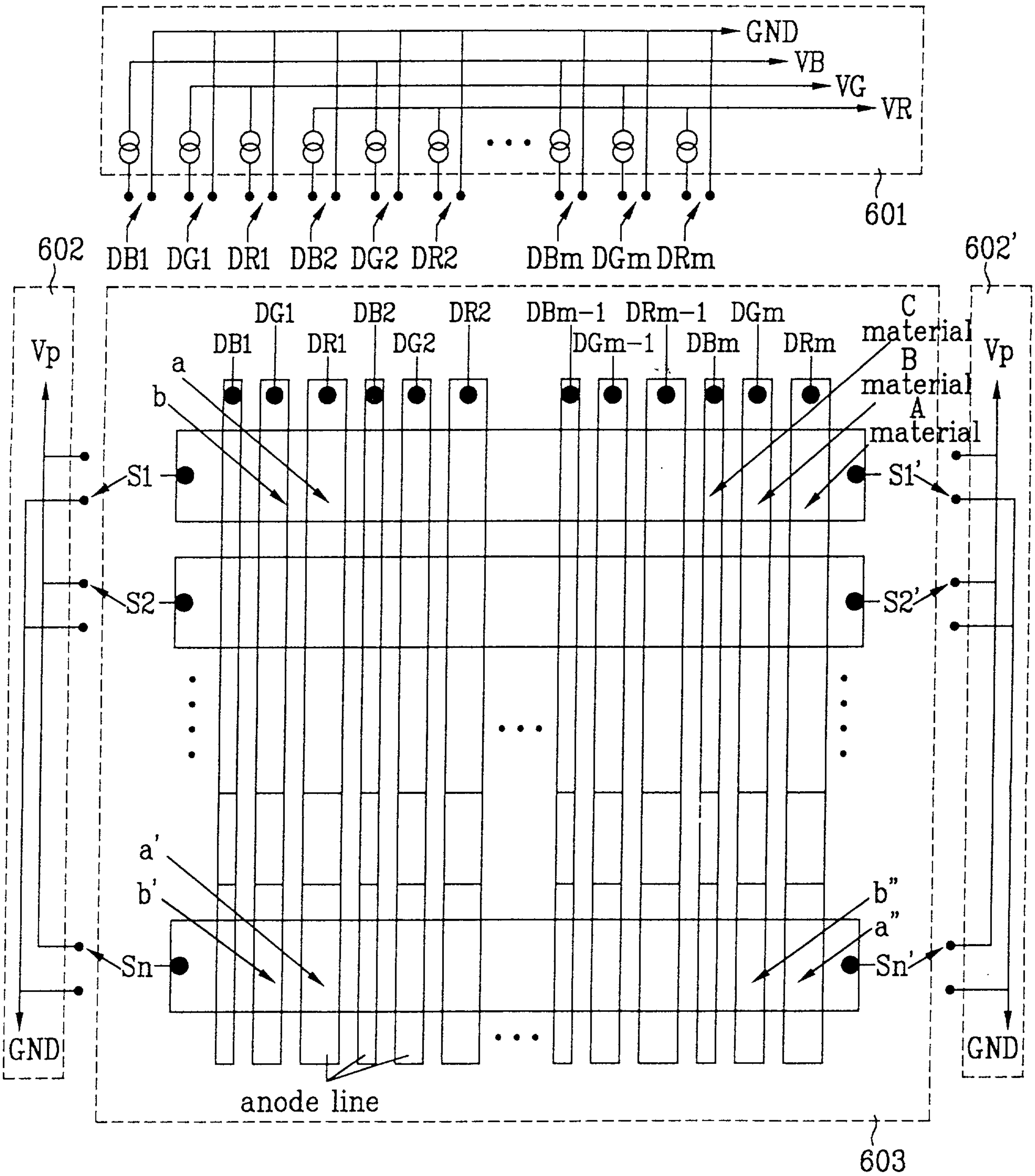

GND
VB
VG
VR
401
402
DB1 DG1 DR1 DB2 DG2 DR2
DBm DGm DRm
Vp
DG1
DB2
DR2
DBm−1
DRm−1
DGm
DB1
DR1
DG2
DGm−1
DBm
DRm
C material
B material
A material
a
b
S1
S2
Sn
cathode line
a'
b'
b"
a"
GND
anode line
403

FIG. 12



GND
VB
VG
VR
501
DB1 DG1 DR1 DB2 DG2 DR2 DBm DGm DRm
502
Vp
S1
S2
Sn
GND
DG1
DB2
DR2
DBm-1
DRm-1
DGm
DB1
DR1
DG2
DGm-1
DBm
DRm
C material
B material
A material
a
b
a'
b'
b"
a"
cathode line
anode line
503

FIG. 13


GND
VB
VG
VR
601
602
DB1 DG1 DR1 DB2 DG2 DR2 DBm DGm DRm
602'
DG1 DB2 DR2 DBm-1 DRm-1 DGm
DB1 DR1 DG2 DGm-1 DBm DRm
C material
B material
A material
Vp
a
b
S1
S1'
S2
S2'
a'
b'
b"
a"
Sn
Sn'
GND
anode line
603

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

- JP 2000091069 A **[0038]**
- JP 10039791 A **[0038]**
- WO 0005703 A **[0038]**
- JP 2000 A **[0038]**
- JP 091083 A **[0038]**
- EP 0158366 A **[0038]**

patsnap

专利名称(译)	全彩有机EL显示屏		
公开(公告)号	EP1168448B1	公开(公告)日	2017-01-11
申请号	EP2001305299	申请日	2001-06-19
申请(专利权)人(译)	LG电子株式会社.		
当前申请(专利权)人(译)	LG电子公司.		
[标]发明人	KIM CHANG NAM KIM JUNG BAE KIM HAK SU KIM MYUNG SEOP		
发明人	KIM, CHANG NAM KIM, JUNG BAE KIM, HAK SU KIM, MYUNG SEOP		
IPC分类号	H01L27/32 H01L51/52		
CPC分类号	G09G3/3216 G09G2300/0426 H01L27/3216 H01L27/3218 H01L27/3281 H01L27/329 H01L51/5209 H01L51/5212		
代理机构(译)	博尔特WADE TENNANT		
优先权	1020000033628 2000-06-19 KR 1020000054990 2000-09-19 KR 1020000062655 2000-10-24 KR		
其他公开文献	EP1168448A3 EP1168448A2		
外部链接	Espacenet		

摘要(译)

本发明公开了一种采用有机电致发光（EL）器件的全彩色平板显示器面板及其制造方法，有机EL器件的驱动电路，特别是包括第一，第二和第三像素，多个第一像素电极和与第一电极垂直相交的多个第二电极，其中第一，第二和第三发光像素中的每一个布置在第一和第二电极的每个交叉位置。发光像素根据发光效率布置成具有不同的面积，使得效率相对较差的红色发光区域的尺寸大于蓝色或绿色发光区域，从而制造有效的全色有机EL显示面板。而且，当将恒定电流引入到由RGB阵列构成的器件中时，阳极线和阴极线中的线电阻的影响减小，以便将白光实现为全色。因此，防止了线电阻上的电压损失，并且调节器件的面积比以使得用于产生白光的每个RGB像素具有相似的驱动电压值，从而使功率损耗最小化。<IMAGE> <IMAGE>

FIG. 1
Related Art