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(54) **METHOD OF MANUFACTURING ORGANIC
ELECTRO LUMINESCENCE PANEL,
MANUFACTURING APPARATUS OF
ORGANIC ELECTRO LUMINESCENCE
PANEL, AND ORGANIC ELECTRO
LUMINESCENCE PANEL**

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(57)

ABSTRACT

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A method of manufacturing an organic electro luminescence panel in which a part or all of an electro luminescence layer formed of a plurality of layers is formed by vapor-deposition using a vapor-deposition mask is provided. The method comprises disposing the vapor-deposition mask on a given position on a vapor-deposited substrate (a glass substrate), and dynamically pressing the vapor-deposited substrate so as to make the vapor-deposition mask closely contact the vapor-deposited substrate.

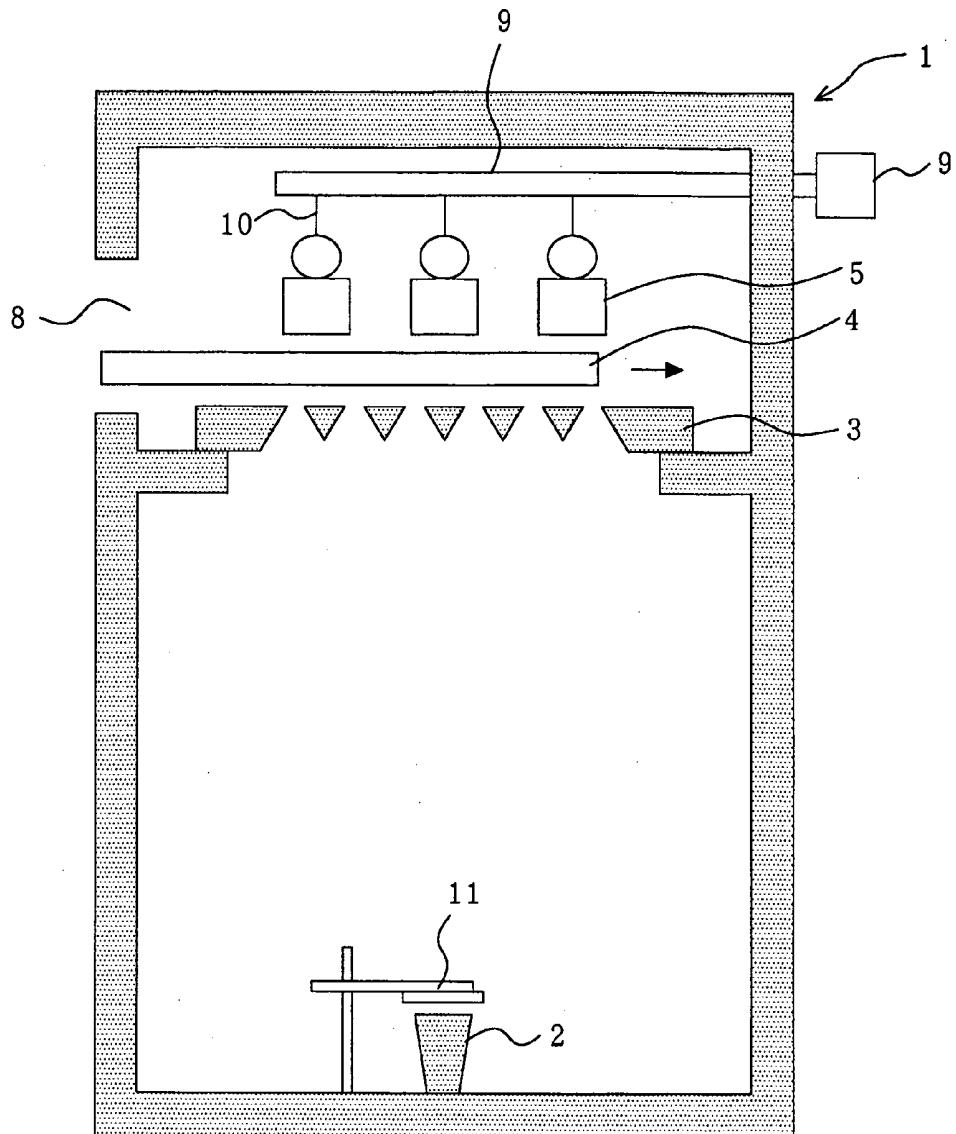
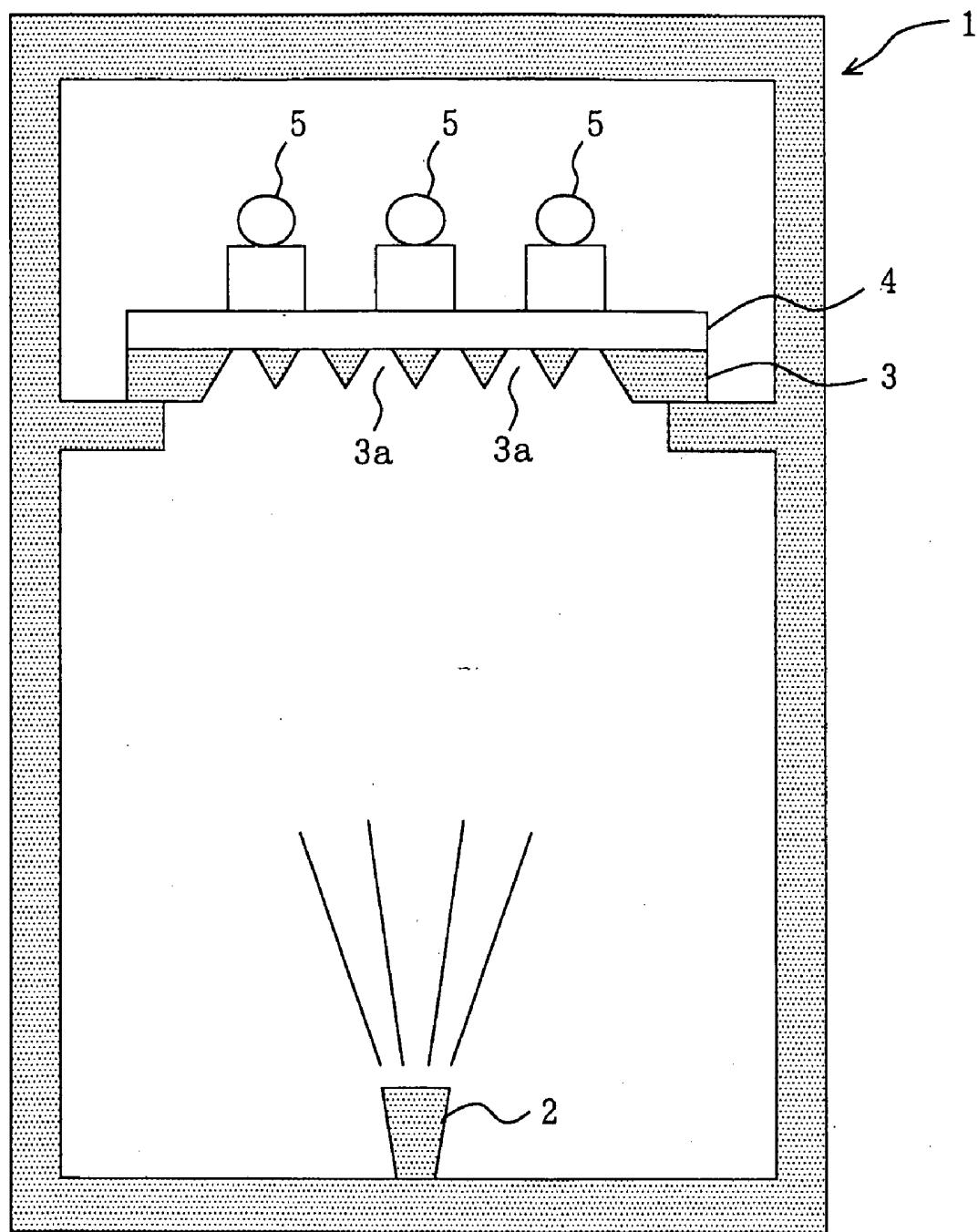
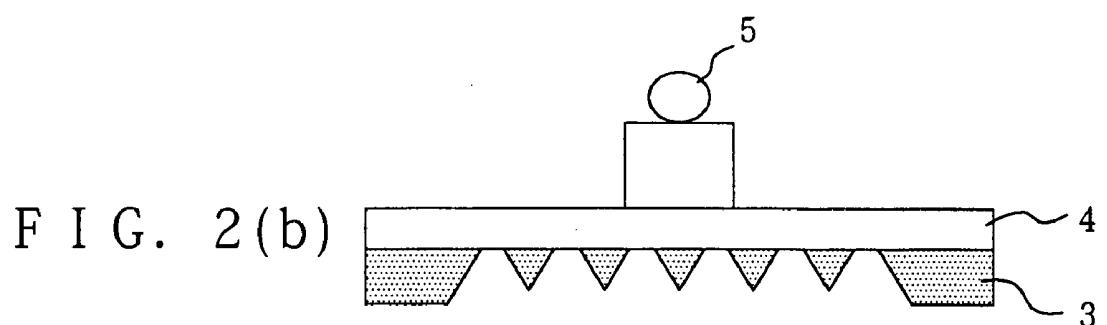
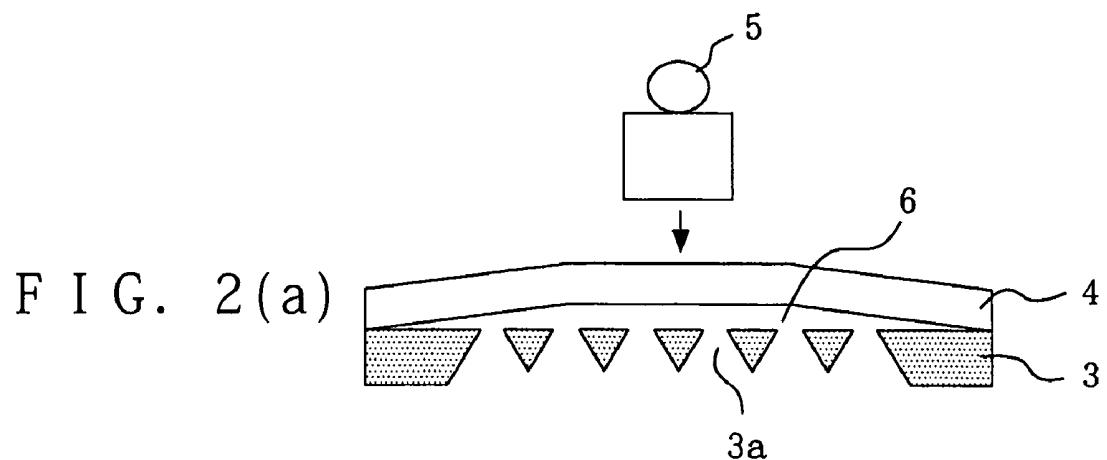


FIG. 1





6 GAP

FIG. 3

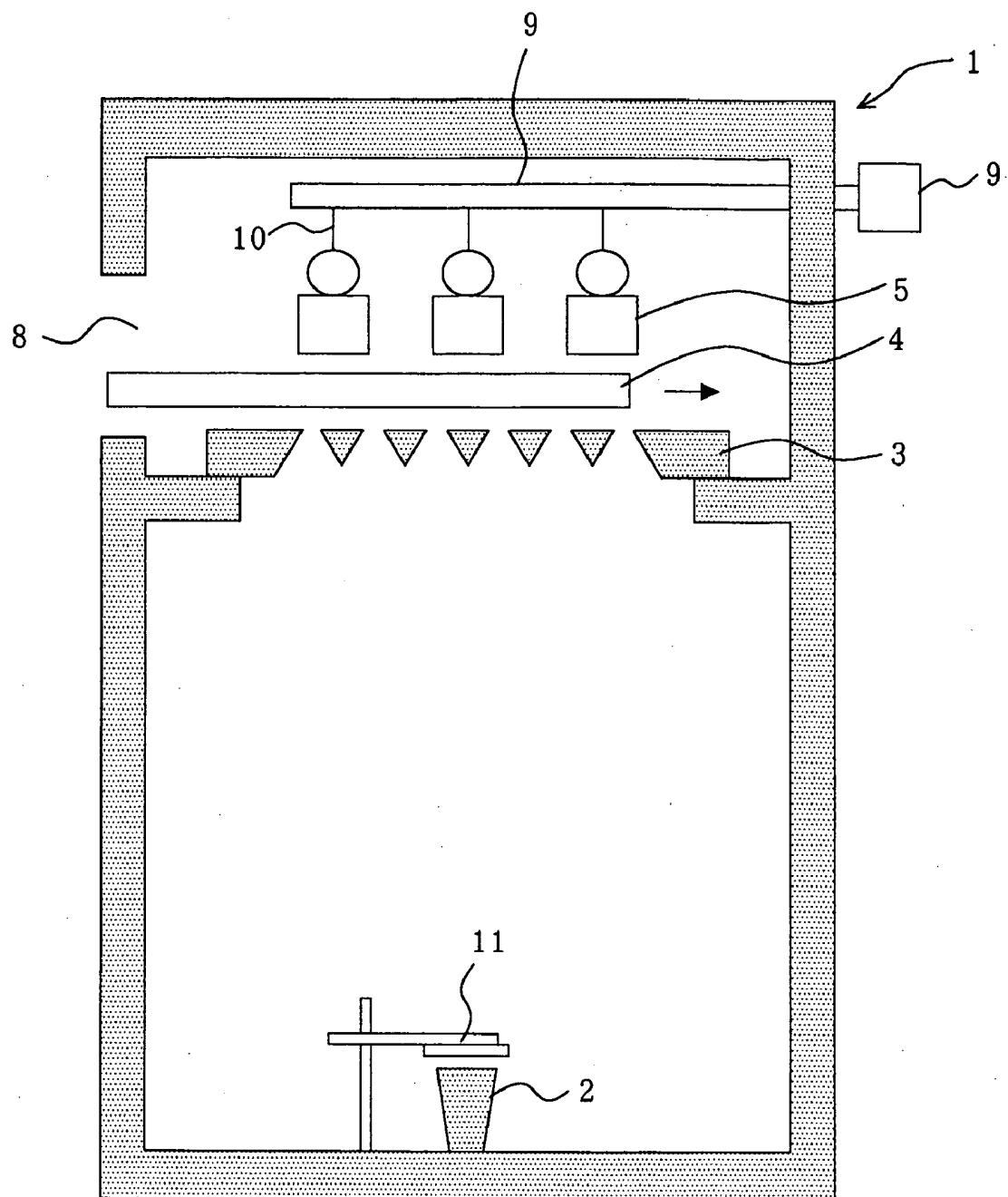


FIG. 4

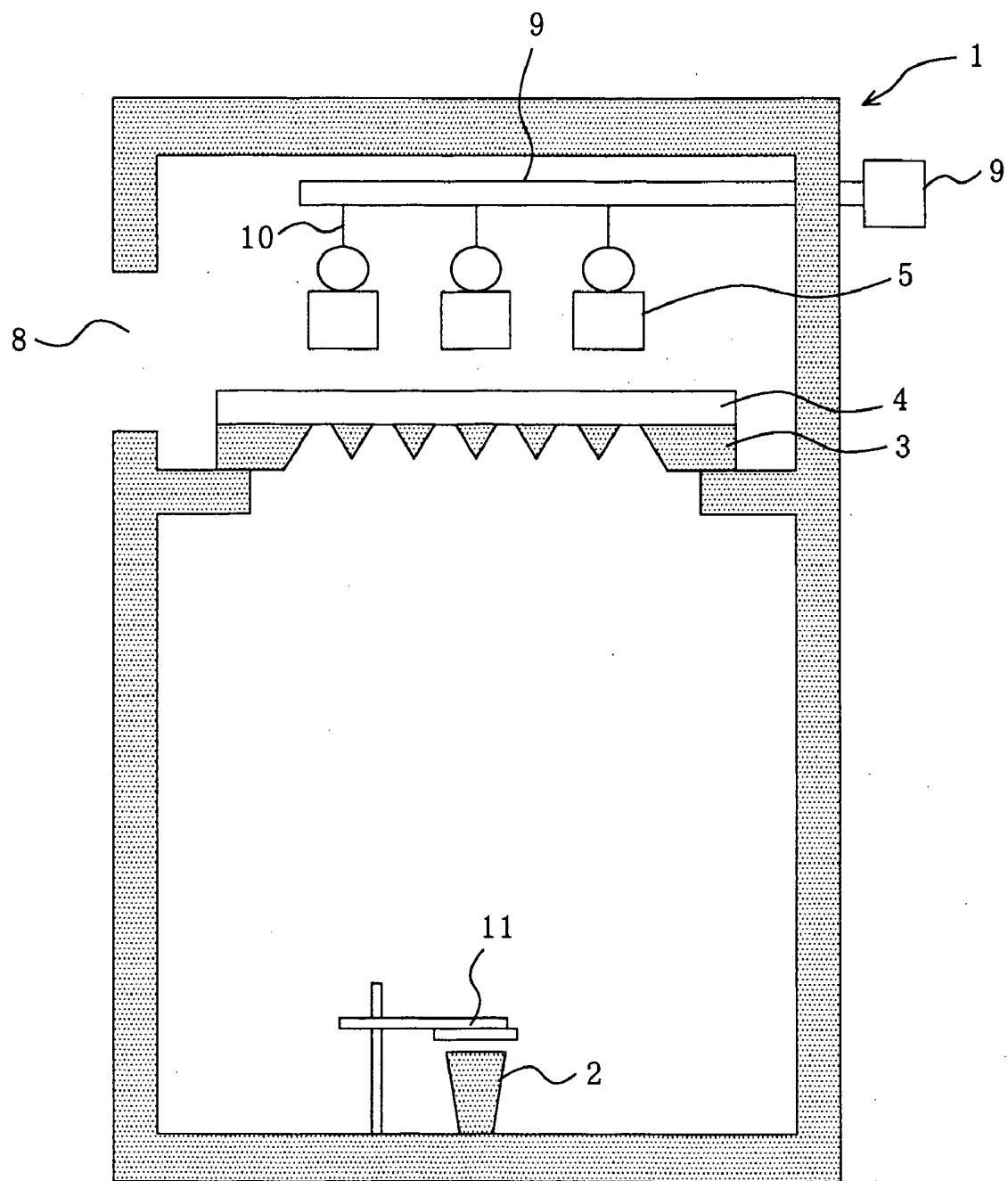


FIG. 5

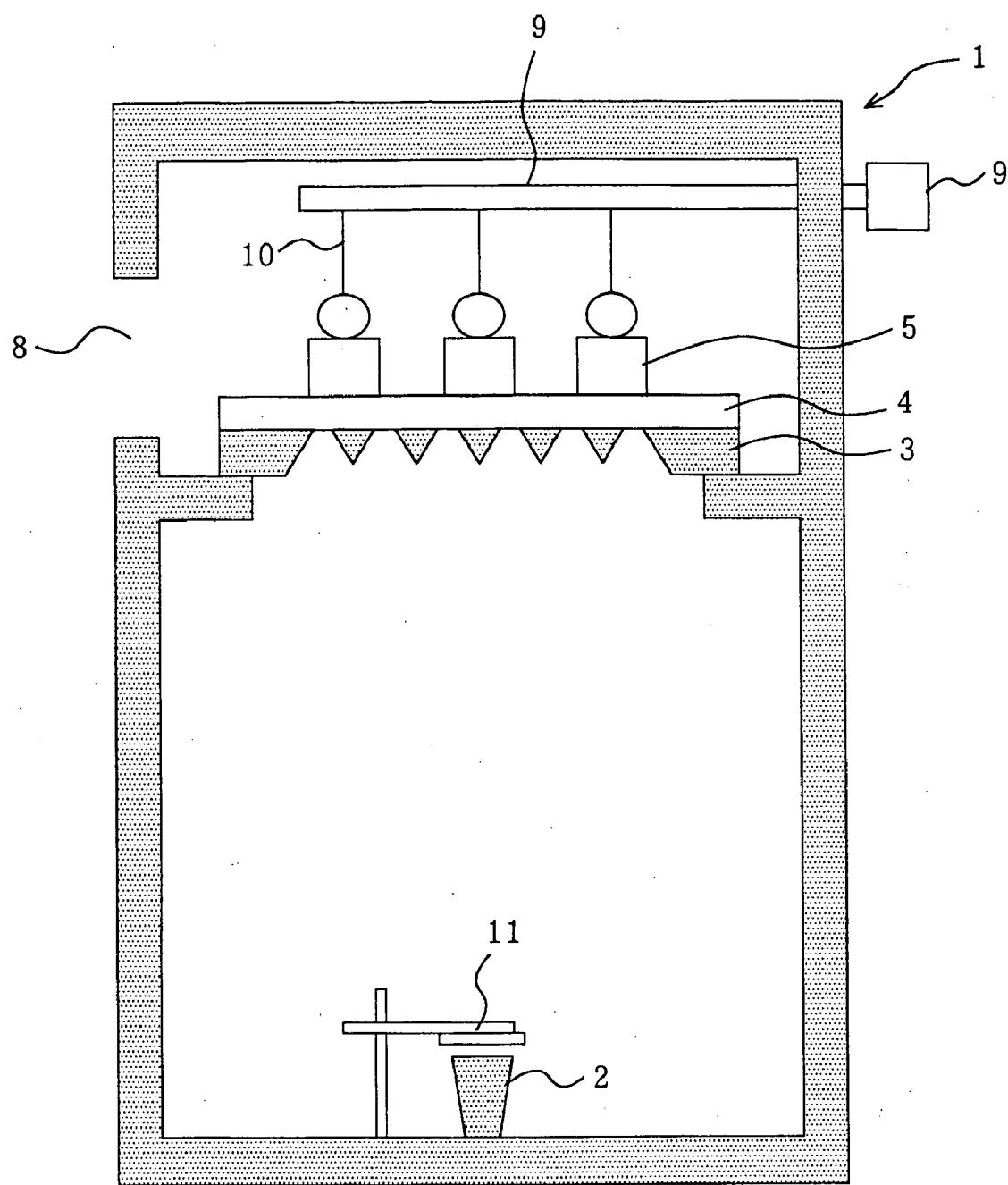


FIG. 6

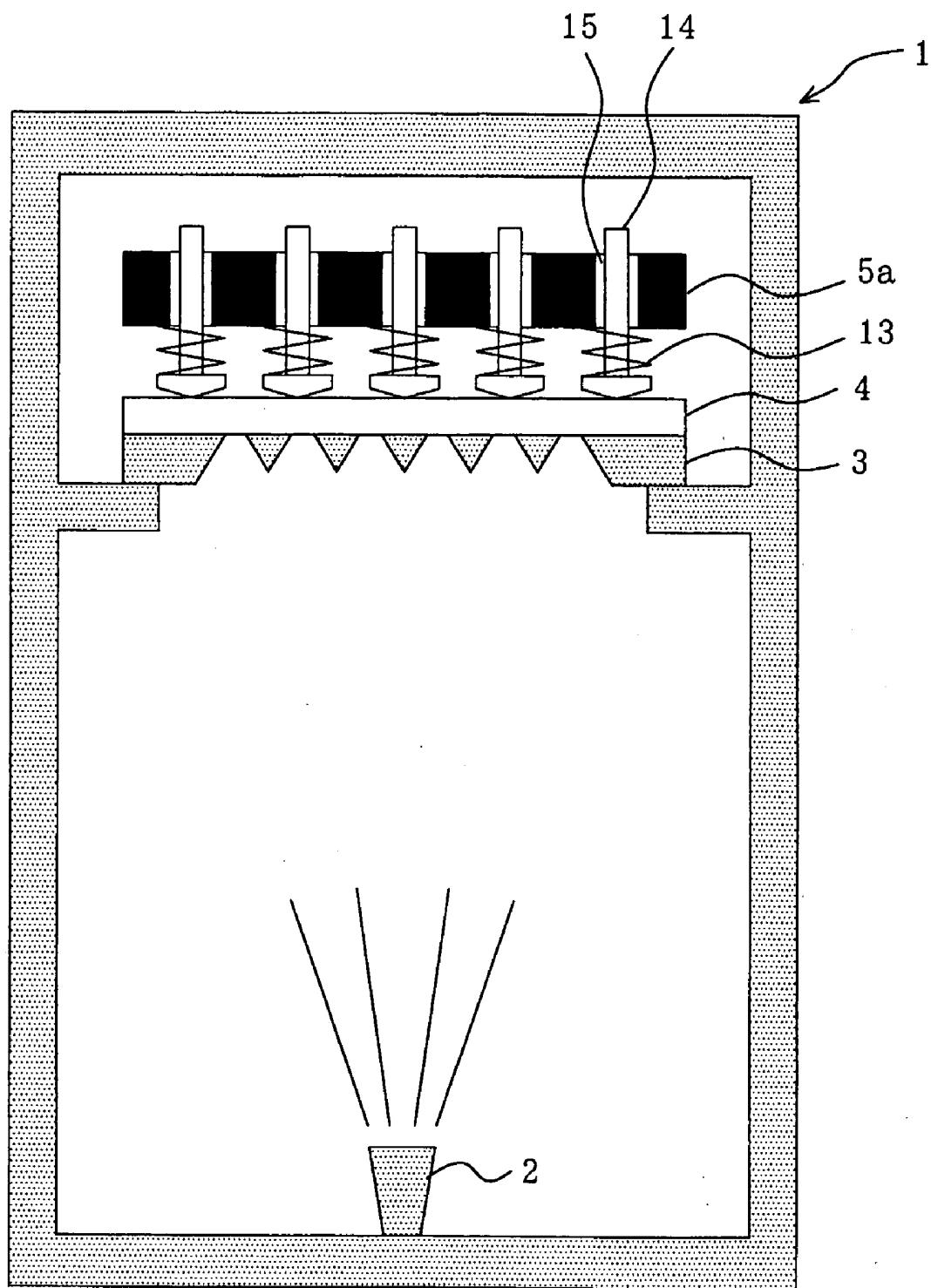
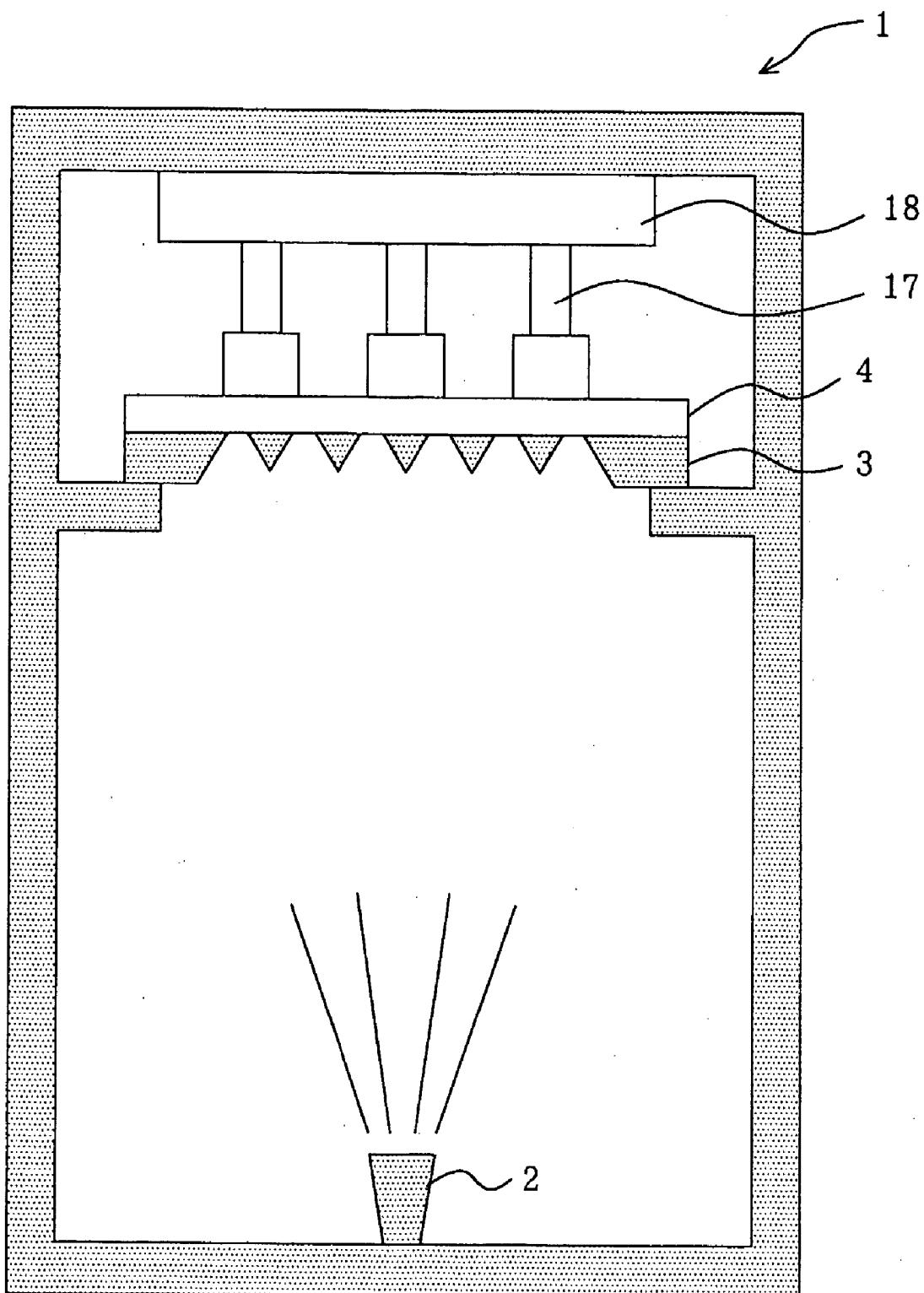
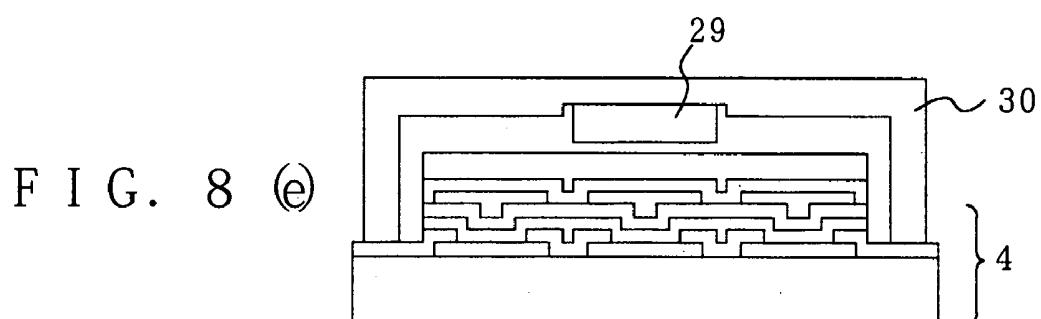
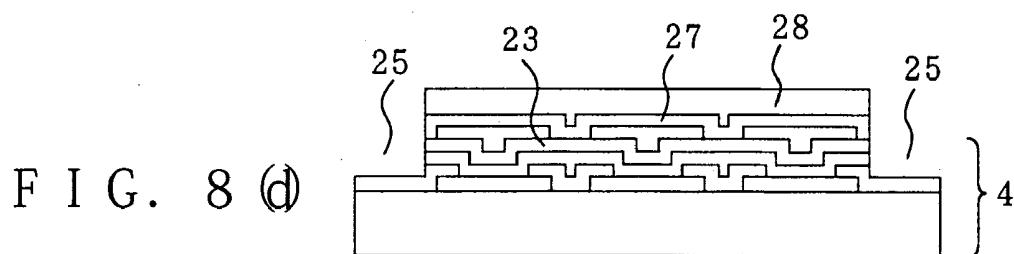
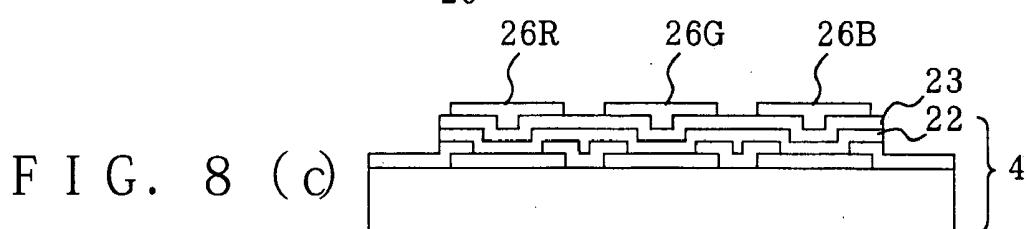
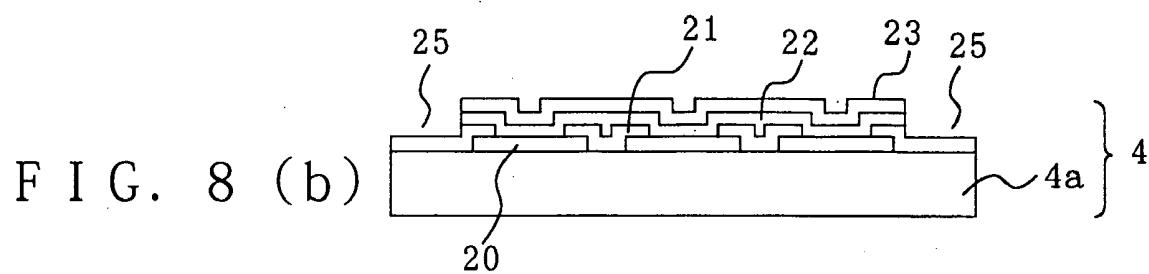
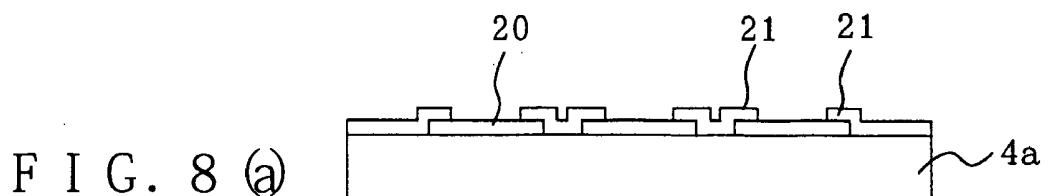


FIG. 7





**METHOD OF MANUFACTURING ORGANIC
ELECTRO LUMINESCENCE PANEL,
MANUFACTURING APPARATUS OF ORGANIC
ELECTRO LUMINESCENCE PANEL, AND
ORGANIC ELECTRO LUMINESCENCE PANEL**

RELATED APPLICATIONS

[0001] This application claims priority to Japanese Patent Application No. 2003-397125 filed Nov. 27, 2003 which is hereby expressly incorporated by reference herein in its entirety.

BACKGROUND

[0002] 1. Filed of the Invention

[0003] The present invention relates to a method of manufacturing an organic electro luminescence (hereinafter, referred to as organic EL) panel, a manufacturing apparatus of an organic EL panel, and an organic EL panel, and particularly to a method of manufacturing an organic EL panel that can form an organic EL layer with high accuracy, a manufacturing apparatus of an organic EL panel for implementing this manufacturing method, and an organic EL panel manufactured with this manufacturing apparatus.

[0004] 2. Related Art

[0005] In a conventional manufacturing method of a full-color organic EL display panel, when vapor-depositing light-emitting layers of red, green and blue, three vacuum chambers for vapor-depositing materials corresponding to each color are prepared, and thus a full-color organic EL display panel is manufactured inside these vacuum chambers by using a metal mask whose area is larger and thickness is thinner than those of the organic EL display panel.

[0006] Also, in some conventional manufacturing methods of an electro luminescence display, a vapor-deposition mask for vapor-depositing light-emitting layers and so forth is formed of a single crystal silicon wafer. The vapor-deposition mask composed of a single crystal silicon wafer is formed by using semiconductor manufacturing techniques such as photolithography and dry etching, and therefore is processed with high accuracy. In addition, a vapor-deposition mask composed of a single crystal silicon wafer has substantially the same thermal expansion coefficient as that of a glass substrate, which is a vapor-deposited substrate. Therefore, no offset of the depositing positions of light-emitting elements and so forth due to thermal expansion when depositing is caused (for example, refer to Japanese Unexamined Patent Publication No. 2001-185350 (Page 2, FIG. 1)).

[0007] Also, in a conventional manufacturing method of an organic EL display panel, when depositing light-emitting layers and so forth, a magnetic material mask or a metal mask is used as a vapor-deposition mask, and then spacers and the vapor-deposition mask are attracted by a substrate holder including a magnet. Thereby, the vapor-deposition mask is aligned with a vapor-deposited substrate with the spacers therebetween.

[0008] In a conventional manufacturing method of a full-color organic EL display panel, when manufacturing a full-color organic EL display panel with a large panel size,

a metal mask that is correspondingly large needs to be used. However, there is a problem in that it is very difficult to manufacture a thin metal mask having a large area.

[0009] Moreover, a metal mask has an extremely large thermal expansion coefficient compared to a glass substrate, which is a vapor-deposited substrate. Accordingly, there is a problem in that the metal mask expands because of radiant heat when vapor-depositing so that the depositing positions of light-emitting layers and so forth become offset. Particularly, when a large-scale panel of 20-inches or more is fabricated, the offset of depositing positions become cumulatively large, and therefore the problem is serious.

[0010] In a conventional manufacturing method of an electro luminescence display device, no offset between the positions of a vapor-deposition mask composed of single crystal silicon and a glass substrate, which is a vapor-deposited substrate, due to thermal expansion is caused. However, since single crystal silicon is nonmagnetic, there is a problem in that it is impossible to attract the vapor-deposition mask with a magnet from the backside of the glass substrate so as to make the vapor-deposition mask be in close contact with the vapor-deposited substrate, like the manufacturing method of an organic EL display panel of Japanese Unexamined Patent Publication No. 2001-273976. Accordingly, there is a problem in that a gap is generated between the glass substrate and the vapor-deposition mask when depositing, and therefore the vapor-deposited material enters the gap, so that the accuracy of the deposition pattern is lowered.

[0011] Also, in a conventional manufacturing method of an organic EL display panel, a magnetic material mask or a metal mask is used as a vapor-deposition mask, and spacers and the vapor-deposition mask are attracted with a magnet from the backside of a glass substrate, which is a vapor-deposited substrate. However, if the vapor-deposition mask is closely contacted with the vapor-deposited substrate with a strong magnet without providing spacers, the vapor-deposition mask is attached to the vapor-deposited substrate so that they can not be separated from each other easily. Meanwhile, if a magnet is weak, a gap is generated between the vapor-deposition mask and the vapor-deposited substrate, and therefore the deposited particles enter the gap, so that the accuracy of deposition pattern is lowered.

[0012] Moreover, even when spacers are provided, a problem may occur in that the spacers are attached to the vapor-deposited substrate or the like. Also, there is a problem in that the handling of the spacers and the deposition process are complicated, and thus increase cost.

[0013] The present invention is intended to provide a method of manufacturing an organic EL panel by which highly accurate electro luminescence layers can be formed and in which the attachment and removal between a vapor-deposition mask and a vapor-deposited substrate are easy, a manufacturing apparatus of an organic EL panel with a simple structure for implementing the manufacturing method, and an organic EL panel manufactured with the manufacturing apparatus.

SUMMARY

[0014] A method of manufacturing an organic electro luminescence panel according to the present invention is a

method of manufacturing an organic electro luminescence panel in which a part or all of an electro luminescence layer formed of a plurality of layers is formed by vapor-deposition using a vapor-deposition mask. The method comprises: disposing the vapor-deposition mask on a given position on a vapor-deposited substrate when vapor-depositing; and pressing the vapor-deposited substrate dynamically so as to make the vapor-deposition mask closely contact the vapor-deposited substrate.

[0015] Since a vapor-deposition mask closely contacts a vapor-deposited substrate by pressing the vapor-deposited substrate dynamically, a gap is not generated between the vapor-deposition mask and the vapor-deposited substrate when vapor-depositing so that the accuracy of vapor-deposition pattern can be enhanced.

[0016] In addition, since the vapor-deposited substrate is classical-dynamically pressed without using magnetic force and electric force so as to be contacted with the vapor-deposition mask closely, the vapor-deposition mask does not attach to the vapor-deposited substrate and they may be readily separated from each other.

[0017] In the method of manufacturing an organic electro luminescence panel according to the present invention, one weight or a plurality of weights may be used as means for dynamically pressing.

[0018] If one weight or a plurality of weights is used as a means for dynamically pressing, a vapor-deposition mask closely contacts a vapor-deposited substrate easily, and furthermore highly accurate electro luminescence layers can be formed with a simple manufacturing apparatus.

[0019] Moreover, if a plurality of weights whose size is smaller than that of the vapor-deposited substrate, even when there are variations in the flatness of the vapor-deposited substrate, the vapor-deposition mask closely contacts the vapor-deposited substrate easily.

[0020] In the method of manufacturing an organic electro luminescence panel according to the present invention, the means for dynamically pressing may include one elastic body or a plurality of elastic bodies, and presses the vapor-deposited substrate via the elastic body.

[0021] The one elastic body or a plurality of elastic bodies press the vapor-deposited substrate elastically with the elastic body. Therefore, the vapor-deposited substrate can be prevented from being damaged. In addition, even when there are variations in the flatness of the vapor-deposited substrate, the vapor-deposition mask closely contacts the vapor-deposited substrate accurately.

[0022] In the method of manufacturing an organic electro luminescence panel according to the present invention, a plunger pin may be attached to the elastic body, the plunger pin being brought into contact with the vapor-deposited substrate so as to press the vapor-deposited substrate.

[0023] Since a plunger pin is attached to the elastic body, even when there are variations in the flatness of the vapor-deposited substrate, the vapor-deposition mask closely contacts the vapor-deposited substrate accurately.

[0024] If a plunger pin that moves only along a specific direction (vertical direction and so forth) is contacted with

the vapor-deposited substrate so as to press it, for example, given positions of the vapor-deposited substrate can be pressed accurately.

[0025] In the method of manufacturing an organic electro luminescence panel according to the present invention, the vapor-deposition mask is composed of single crystal silicon for which given processing is carried out.

[0026] As above, since the vapor-deposited substrate is classical-dynamically pressed without using magnetic force and electric force so as to be contacted with the vapor-deposition mask closely, the vapor-deposition mask composed of single crystal silicon, which is not a metal or magnetic material, can be used. In addition, if the vapor-deposition mask is formed by photolithography, dry etching and so forth, a highly accurate vapor-deposition mask can be manufactured, so that a highly accurate deposition pattern can be formed.

[0027] A manufacturing apparatus of an organic electro luminescence panel according to the present invention comprises the means for dynamically pressing for implementing any of the above methods of manufacturing an organic electro luminescence panel.

[0028] Since the manufacturing apparatus includes the means for classical-dynamically pressing that does not use magnetic force and electric force, and press the vapor-deposited substrate with the means for pressing so as to make the vapor-deposition mask contact the vapor-deposited substrate closely. Accordingly, the accuracy of vapor-deposition pattern can be enhanced, and the vapor-deposition mask does not attach to the vapor-deposited substrate and they may be readily separated from each other.

[0029] The means for dynamically pressing is not limited to the above weights but may be a body that can be directly attached to the manufacturing apparatus.

[0030] An organic electro luminescence panel according to the present invention is manufactured with the above manufacturing apparatus of an organic electro luminescence panel.

[0031] The organic electro luminescence panel is manufactured with a manufacturing apparatus including the above means for dynamically pressing, and therefore has a highly accurate vapor-deposition pattern of electro luminescence layers and has less defects and damage.

BRIEF DESCRIPTION OF THE DRAWINGS

[0032] FIG. 1 is a conceptual diagram showing a manufacturing method and a manufacturing apparatus of an organic EL panel according to a first embodiment.

[0033] FIGS. 2A-B are conceptual diagrams magnified about a part of a vapor-deposition mask, a glass substrate and a weight of FIG. 1.

[0034] FIG. 3 is a schematic diagram showing a process prior to vapor-deposition for a glass substrate in the first embodiment.

[0035] FIG. 4 is a schematic diagram showing a process subsequent to the process of FIG. 3.

[0036] FIG. 5 is a schematic diagram showing a process subsequent to the process of FIG. 4.

[0037] **FIG. 6** is a schematic diagram showing a manufacturing apparatus of an organic EL panel according to a second embodiment of the present invention.

[0038] **FIG. 7** is a schematic diagram showing a manufacturing apparatus of an organic EL panel according to a third embodiment of the present invention.

[0039] **FIGS. 8A through 8E** are longitudinal sectional views showing a manufacturing process of an organic EL panel according to a fourth embodiment of the present invention.

DETAILED DESCRIPTION

First Embodiment

[0040] **FIG. 1** is a conceptual diagram showing a manufacturing method and a manufacturing apparatus of an organic EL panel according to a first embodiment of the present invention. **FIG. 1** shows a longitudinal section of a manufacturing apparatus of an organic EL panel.

[0041] A vapor-deposition chamber **1**, which is a manufacturing apparatus of an organic EL panel, is used for vacuum deposition for example, and the inside thereof is hermetically sealed. A vapor-deposition source **2** is provided on the bottom side of inside of the vapor-deposition chamber **1**. A vapor-deposition mask **3** formed by carrying out given processing for single crystal silicon, for example, with photolithography and etching and so forth is placed above the vapor-deposition source **2** inside the vapor-deposition chamber **1**. Apertures **3a** with a given shape are formed in the vapor-deposition mask **3** by etching and so forth. The apertures **3a** may have the conformation of a number of dot shapes formed corresponding to each pixel of a completed organic EL panel for example. Otherwise, a plurality of apertures **3a** of a slot shape may be formed in order to carry out vapor-deposition for pixels of one line arranged vertically or horizontally in a group.

[0042] A glass substrate **4**, which is a vapor-deposited substrate, is disposed in a manner of contacting the top surface of the vapor-deposition mask **3**. The glass substrate **4** is loaded inside the vapor-deposition chamber **1** before the deposition process, and then is accurately placed on a given position of the top surface of the vapor-deposition mask **3** by an alignment means (not shown).

[0043] Before the glass substrate **4** is loaded inside the vapor-deposition chamber **1**, wires composed of ITO and so forth, and part of electro luminescence layers (to be described later) in some case, are previously formed on the surface on the lower surface side (the side contacting the vapor-deposition mask **3**) of the glass substrate **4**.

[0044] Furthermore, one or more weights **5**, which are means for dynamically pressing, are disposed on the top surface of the glass substrate **4**. While **FIG. 1** shows that a plurality of weights **5** is disposed, only one weight of a flat plate shape may be disposed for example.

[0045] These weights **5** press the glass substrate **4** by means of gravity without using magnetic force and electric force so as to make the vapor-deposition mask **3** closely contact the glass substrate **4**. The means for dynamically pressing in the present invention refers to a means for pressing not by magnetic force and electric force but by

force of classical dynamics (i.e., physical force), and further refers to the weight **5** shown in the first embodiment, a means for mechanically pressing shown in a third embodiment to be described later, or the like.

[0046] In this way, after the vapor-deposition mask **3**, the glass substrate **4**, and the weights **5** are deposited, vapor-deposited materials are evaporated from the vapor-deposition source **2** so as to be deposited on the glass substrate **4**, and thus part or all of the electro luminescence layers such as light-emitting layers are formed.

[0047] **FIG. 2** is a conceptual diagram magnified about parts of the vapor-deposition mask **3**, the glass substrate **4**, and the weights **5** of **FIG. 1**. **FIG. 2** also shows a longitudinal section of these parts similarly to **FIG. 1**. Here, only one weight **5** is shown for convenience.

[0048] As shown in **FIG. 2A**, the glass substrate **4**, which has been loaded inside the vapor-deposition chamber **1** and has been placed on a given position on the top surface of the vapor-deposition mask **3** by the alignment means, bends considerably because of surface stresses and so forth, and therefore a gap **6** is generated between the vapor-deposition mask **3** and the glass substrate **4**. If vapor-deposition is carried out for the glass substrate **4** in this state, the deposited material enters the gap **6** and thus the material is deposited on a part that should be blocked by the vapor-deposition mask normally, so that the accuracy of deposition pattern is lowered. Accordingly, as shown in **FIG. 2B**, the glass substrate **4** is pressed by disposing the weights **5**, which are means for dynamically pressing, on the top surface of the glass substrate **4**, and thereby the vapor-deposition mask **3** closely contacts the glass substrate **4**. This substantially eliminates the gap **6**. Therefore, the vapor-deposited materials can be deposited on a given position so that the accuracy of deposition pattern can be enhanced.

[0049] If a plurality of weights **5** whose size is smaller than that of the glass substrate **4** is used, even when there are variations in the flatness of each glass substrate **4**, the vapor-deposition mask **3** can be closely contacted with the glass substrate **4** (refer to **FIG. 1**). In the manufacturing device of an organic EL panel shown in **FIG. 1**, when vapor-deposition for one glass substrate **4** is completed, the glass substrate is removed, and then the next glass substrate **4** is loaded inside the vapor-deposition chamber **1** and vapor-deposition is carried out. When vapor-deposition for the glass substrate **4** is thus carried out in sequence, the flatness (extent of bending) of each glass substrate **4** often involves some variations. At this time, if a plurality of weights **5** whose size is smaller than that of the glass substrate **4** is disposed on the glass substrate **4** as shown in **FIG. 1**, the pressing corresponding to the flatness of each glass substrate **4** can be implemented. Therefore, even when the flatness of the glass substrate **4** involves some variations, vapor-deposition can be implemented, and thereby reduce the manufacturing cost of the glass substrate **4**.

[0050] **FIGS. 3, 4 and 5** are schematic diagrams showing the processes from the process of loading the glass substrate **4** into the vapor-deposition chamber **1** to the process of vapor-depositing in the first embodiment. Here, **FIGS. 3, 4** and **5** show longitudinal sections of the manufacturing apparatus of an organic EL panel similarly to **FIG. 1**, and show the more specific structure of the manufacturing apparatus of an organic EL panel than **FIG. 1**.

[0051] First in the process of **FIG. 3**, the glass substrate **4** is loaded above the vapor-deposition mask **3** inside the vapor-deposition chamber **1** from an opening **8** for loading a glass substrate of the vapor-deposition chamber **1**. As described above, anodes composed of ITO and so forth have been already formed on the lower surface of the glass substrate **4** at this point. At this time, the weights **5** are lifted up above the vapor-deposition mask **3** and the glass substrate **4** by a lifting and lowering means **9** so as not to collide with the glass substrate **4**. In the first embodiment, the weights **5** are hung by a wire **10**. Also, in the process of **FIG. 3**, a shutter **11** of the vapor-deposition source **2** is closed and the vapor-deposition source **2** does not heat the vapor-deposited material. The above alignment means (not shown) is used to load the glass substrate **4** inside the vapor-deposition chamber **1**.

[0052] Next, in the process of **FIG. 4**, the glass substrate **4** is accurately deposited on a given position on the top surface of the vapor-deposition mask **3** by the alignment means (not shown). At this time, the glass substrate **4** is disposed on the vapor-deposition mask **3** so as to contact the vapor-deposition mask **3**. At this point, the weights **5** are still lifted up above the vapor-deposition mask **3** and the glass substrate **4** by the lifting and lowering means **9**, and the shutter **11** is still closed.

[0053] Then, in the process of **FIG. 5**, the weights **5** are disposed on the top surface of the glass substrate **4** by the lifting and lowering means **9**. The glass substrate **4** is pressed by the gravity acting on the weights **5**, and thereby the vapor-deposition mask **3** closely contacts the glass substrate **4**. The lifting and lowering means **9** may be controlled with an operation panel (not shown) operated by an operator. Otherwise, the weights **5** may be automatically lifted and lowered by the lifting and lowering means **9**.

[0054] After the process of **FIG. 5**, the opening **8** for loading a glass substrate is shut by an openable door (not shown) and then the shutter **11** is opened. Then, the vapor-deposition source **2** is heated to evaporate the vapor-deposited materials, and thereby carry out vapor-deposition of electro luminescence layers such as light-emitting layers. After the vapor-deposition is completed, the glass substrate **4** is taken out of the vapor-deposition chamber **1**.

[0055] In the first embodiment, the glass substrate **4**, which is a vapor-deposited substrate, is pressed by the weights **5**, and thereby the vapor-deposition mask **3** closely contacts the glass substrate **4**. Therefore, when depositing, no gap **6** is generated between the vapor-deposition mask **3** and the glass substrate **4** so that the accuracy of deposition pattern can be enhanced.

[0056] In addition, since the glass substrate **4** is classically dynamically pressed without using magnetic force and electric force so as to be closely contacted with the vapor-deposition mask **3**, the vapor-deposition mask **3** does not attach to the glass substrate **4** and they may be readily separated from each other.

Second Embodiment

[0057] **FIG. 6** is a schematic diagram showing a manufacturing apparatus of an organic EL panel according to a second embodiment of the present invention. **FIG. 6** shows a longitudinal section of a manufacturing apparatus of an

organic EL panel similar to **FIG. 1** of the first embodiment. The manufacturing apparatus of an organic EL panel according to the second embodiment uses a weight **5a**, springs **13**, and plunger pins **14** as a means for dynamically pressing. Other features are the same as those of the manufacturing apparatus of an organic EL panel of the first embodiment, and the lifting and lowering means **9**, the wire **10**, and so forth of **FIG. 3** are omitted.

[0058] In the manufacturing apparatus of an organic EL panel according to the second embodiment, one weight **5a** is provided above the vapor-deposition mask **3** and the glass substrate **4** inside the vapor-deposition chamber **1**. A plurality of springs **13** serving as an elastic body is provided for the weight **5a**, and the plunger pins **14** are attached to the springs **13**. The plunger pins **14** move inside tube guides **15** formed in the weight **6a** in the vertical direction. If desired, only one spring **13** and one plunger pin **14** may be provided.

[0059] In the second embodiment, after the glass substrate **4** is loaded inside the vapor-deposition chamber **1** so as to be disposed on a given position on the top surface of the vapor-deposition mask **3** by the alignment means (not shown), the weight **6a** coupled to the wire **10** (not shown in **FIG. 6**) is lowered by the lifting and lowering means **9** (not shown in **FIG. 6**). When the weight **5a** is lowered, the plunger pins **14** contact the glass substrate **4** so as to press the glass substrate **4** through the springs **13**. This makes the vapor-deposition mask **3** be in close contact with the glass substrate **4**.

[0060] The glass substrate **4** may be directly pressed by an elastic body such as the springs **13** without providing the plunger pins **14**. Also, as shown in the third embodiment to be described later, the glass substrate **4** may be pressed by vertically moving the weight **5a** with a metal rod or the like by the driving means. Moreover, the glass substrate **4** may be pressed by using a flat plate weight instead of the weight **5a**, the springs **13**, and the plunger pins **14** and attaching a sponge elastic body to the lower surface of the weight.

[0061] In the second embodiment, the weight **5a** includes one or more springs **13** so as to elastically press the glass substrate **4** via the springs **13**. Therefore, the glass substrate **4** is prevented from being damaged. Furthermore, even when there are variations in the flatness of the glass substrates **4**, the vapor-deposition mask **3** can accurately closely contact the glass substrate **4**.

[0062] Moreover, since the plunger pins **14** that move only along a specific direction contact the glass substrate **4** to press it, a given position of the glass substrate **4** can be accurately pressed.

[0063] Other effects are the same as in the first embodiment.

Third Embodiment

[0064] **FIG. 7** is a schematic diagram showing a manufacturing apparatus of an organic EL panel according to a third embodiment of the present invention. **FIG. 7** shows a longitudinal section of a manufacturing apparatus of an organic EL panel similarly to **FIG. 1** of the first embodiment. The manufacturing apparatus of an organic EL panel according to the third embodiment uses arms **17** and a driving means **18** as the means for dynamically pressing.

Other features are the same as the manufacturing apparatus of an organic EL panel of the first embodiment.

[0065] In the manufacturing apparatus of an organic EL panel according to the third embodiment, the glass substrate 4 is pressed by means of the arms 17 instead of the weights 5 in the first embodiment. The arms 17 move vertically by means of the driving means 18. For example, the driving means 18 is provided on the top surface of the inside of the vapor-deposition chamber 1, and the arms 17 are attached to the vapor-deposition chamber 1 directly. The arms 17 press the glass substrate 4 so as to make the vapor-deposition mask 3 be in close contact with the glass substrate 4.

[0066] The driving means 18 may be controlled in such a manner that the arms 17 are moved while an operator monitors the position and so forth of the arms 17. Alternatively, the driving means 18 may be provided with a pressure sensor (not shown) or the like so as to be controlled automatically so that a given pressure is placed on the glass substrate 4. As described above, the weight 5a, the springs 13, and the plunger pins 14 as shown in FIG. 6 of the second embodiment may be attached to arms such as metal rods so as to be moved by a driving means.

[0067] While the arms 17 and the driving means 18 classically-dynamically press the glass substrate 4, it should be noted that electric force or the like may be used as the driving force for the driving means 18 itself.

[0068] In the third embodiment, the glass substrate 4, which is a vapor-deposited substrate, is pressed by the arms 17, and thereby the vapor-deposition mask 3 closely contacts the glass substrate 4. Therefore, when depositing, no gap is generated between the vapor-deposition mask 3 and the glass substrate 4 so that the accuracy of deposition pattern can be enhanced.

[0069] In addition, since the glass substrate 4 is pressed by the arms 17 and the driving means 18 that do not use magnetic force and electric force so as to be closely contacted with the vapor-deposition mask 3, the vapor-deposition mask 3 does not attach to the glass substrate 4 and they may be readily separated from each other.

Fourth Embodiment

[0070] FIGS. 8A through 8E are longitudinal sectional views showing a manufacturing process of an organic EL panel according to a fourth embodiment of the present invention.

[0071] While pixels and so forth are schematically illustrated in FIG. 8, a number of pixels are formed in an actual organic EL panel.

[0072] This organic EL panel is manufactured with the manufacturing apparatuses of an organic EL panel as shown in the first, second, and third embodiments. While in FIG. 8 an organic EL panel that is a passive driving type and a bottom emission type in which light is emitted toward the alkali-free glass 4a side (lower side in FIG. 8) is shown, an active driving type or top emission type one may also be manufactured by using substantially the same manufacturing process, and therefore can be manufactured by using the same manufacturing apparatus of an organic EL panel.

[0073] First, anodes 20 composed of indium tin oxide (ITO) are formed on one surface of the alkali-free glass 4a

for each pixel by sputtering and so forth, and silicon oxide layers 21 are formed on parts other than the anodes 20 (FIG. 8A). When the anodes 20 and the silicon oxide layers 21 are formed by sputtering, the sputtering may be carried out by using the manufacturing apparatuses of an organic EL panel shown in the first, second and third embodiments.

[0074] Then, a hole injection layer 22 and a hole transport layer 23 are vapor-deposited on the top surfaces of the anodes 20 and the silicon oxide layers 21 (FIG. 8B). In the process of FIG. 8B, the hole injection layer 22 and the hole transport layer 23 are vapor-deposited not for each pixel but on the top surfaces of the anodes 20 and the silicon oxide layers 21 excluding a peripheral part 25 in a group. At this time, a dedicated vapor-deposition mask (not shown) is used in order to shield the peripheral part 25. The manufacturing apparatus of an organic EL panel in the first embodiment and so forth may be used in order to press the vapor-deposition mask.

[0075] The alkali-free glass 4a on which the anodes 20, the silicon oxide layers 21, the hole injection layers 22, and the hole transport layers 23 are formed refers to the glass substrate 4. The processes up to FIG. 8B are also carried out for the glass substrate 4 in the first, second and third embodiments.

[0076] Then, by using the manufacturing apparatus of an organic EL panel as shown in the first, second and third embodiments, a red light emitting layer 26R, a green light emitting layer 26G and a blue light emitting layer 26B are formed on the top surface of the glass substrate 4 by vapor-deposition (FIG. 8C). At this time, only parts corresponding to light emitting layers of one color are opened as the apertures 3a (refer to FIG. 1) of the vapor-deposition mask 3. For example, after the vapor-deposition for the red light emitting layer 26R is completed, the vapor-deposition mask 3 is moved and the green light emitting layer 26G is vapor-deposited, and then the blue light emitting layer 26B is vapor-deposited similarly. The vapor-deposition process of the light emitting layers is carried out by vapor co-depositing a host material and dope material of an organic EL material in general.

[0077] Particularly, when vapor-depositing the red light emitting layer 26R, the green light emitting layer 26G and the blue light emitting layer 26B, an highly accurate organic EL panel can be manufactured by pressing the glass substrate 4 so as to make the vapor-deposition mask 3 closely contact the glass substrate 4.

[0078] Thereafter, an electron transport layer 27 is formed on the top surfaces of the hole transport layer 23, the red light emitting layer 26R, the green light emitting layer 26G, and the blue light emitting layer 26B at one time. Moreover, a very thin electron injection layer (not shown) and a cathode 28 composed of aluminum and so forth are formed thereon by sputtering and so forth (FIG. 8D). At this time, by using a dedicated vapor-deposition mask (not shown) similar to the process of FIG. 8B, the electron transport layer 27 and so forth are not deposited on the peripheral part 25. In the present invention, an electro luminescence layer refers to the hole injection layer 22, the hole transport layer 23, the red light emitting layer 26R, the green light emitting layer 26G, the blue light emitting layer 26B, the electron transport layer 27, and the electron injection layer. However, all these layers are not necessarily formed.

[0079] Finally, a sealing glass **30** to which a drying agent **29** is attached is joined to the glass substrate **4** on which the electron transport layer **27** and so forth are formed with an adhesive and so forth, and thereby completing an organic EL panel (**FIG. 8E**).

[0080] Although only the red light emitting layer **26R**, the green light emitting layer **26G**, and the blue light emitting layer **26B** are vapor-deposited by using the above manufacturing apparatus of an organic EL panel in the fourth embodiment, the hole injection layer **22** and the hole transport layer **23** may be individually formed for each pixel by using the manufacturing apparatus of an organic EL panel as shown in the first, second and third embodiments. Also, the electron transport layer **27**, the electron injection layer, and so forth may be individually formed for each pixel.

[0081] The organic EL panel of the fourth embodiment is manufactured with a manufacturing apparatus including a means for dynamically pressing as shown in the first, second and third embodiments, and therefore has a highly accurate vapor-deposition pattern of electro luminescence layers and has less defects and damage.

FIELD OF INDUSTRIAL APPLICATION

[0082] The manufacturing method and manufacturing apparatus of an organic EL panel as shown in the first, second and third embodiments of the present invention can also be applied to the fabrication of a color filter in a liquid crystal display by a dye deposition method and the fabrication of an organic transistor and so forth.

What is claimed is:

1. A method of manufacturing an organic electro luminescence panel in which at least a part of an electro luminescence layer formed of a plurality of layers is formed by vapor-deposition using a vapor-deposition mask, comprising:

disposing a substrate on a given position on the vapor-deposition mask for vapor-depositing;

dynamically pressing the substrate to make the vapor-deposition mask closely contact the substrate; and

vapor-depositing at least the part of the electro luminescence layer on the substrate through the vapor-deposition mask.

2. The method of manufacturing an organic electro luminescence panel according to claim 1, wherein at least one weight is used to perform the dynamically pressing step.

3. The method of manufacturing an organic electro luminescence panel according to claim 1, wherein at least one elastic body is used to perform the dynamically pressing step by pressing the substrate via the elastic body.

4. The method of manufacturing an organic electro luminescence panel according to claim 3, wherein a plunger pin is attached to the at least one elastic body, the plunger pin being brought into contact with and pressing the substrate.

5. The method of manufacturing an organic electro luminescence panel according to claim 1, wherein the vapor-deposition mask comprises a single crystal silicon.

6. A manufacturing apparatus of an organic electro luminescence panel, comprising:

means for disposing a substrate on a given position on a vapor-deposition mask for vapor-depositing;

means for dynamically pressing the substrate to make the vapor-deposition mask closely contact the substrate; and

means for vapor depositing a layer on the substrate through the vapor-deposition mask.

7. The manufacturing apparatus of claim 6 wherein the means for dynamically pressing further comprises at least one weight.

8. The manufacturing apparatus of claim 6 wherein the means for dynamically pressing further comprises at least elastic body.

9. An organic electro luminescence panel manufactured with the manufacturing apparatus of an organic electro luminescence panel according to claim 6.

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专利名称(译)	制造有机电致发光板的方法，有机电致发光板的制造装置和有机电致发光板		
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摘要(译)

提供一种制造有机电致发光面板的方法，其中通过使用气相沉积掩模的气相沉积形成由多个层形成的电致发光层的一部分或全部。该方法包括将气相沉积掩模设置在气相沉积基板(玻璃基板)上的给定位置，并动态地压制气相沉积基板，以使气相沉积掩模与气相沉积基板紧密接触。

