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Oh et al.

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(54) **DISPLAY APPARATUS AND MANUFACTURING METHOD THEREOF**

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G09F 9/33 (2006.01)
H01L 25/075 (2006.01)

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CPC ***G09F 9/3026*** (2013.01); ***G09F 9/33*** (2013.01); ***H01L 25/0753*** (2013.01)

(58) **Field of Classification Search**
None
See application file for complete search history.

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(57) **ABSTRACT**

A display apparatus includes a plurality of display modules, and a frame provided to support the plurality of display modules, the plurality of display modules being arranged in an M*N matrix on the frame, and the frame includes a frame panel including a first side and a second side opposite to the first side, the frame panel includes an insert portion passing through the frame panel and having a first opening being formed on the first side and a second opening being formed on the second side, and a size of a first opening being greater than a size of the second opening, and a stud provided in the insert portion.

16 Claims, 16 Drawing Sheets

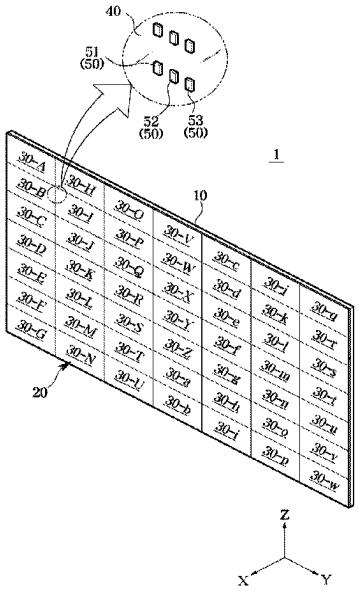

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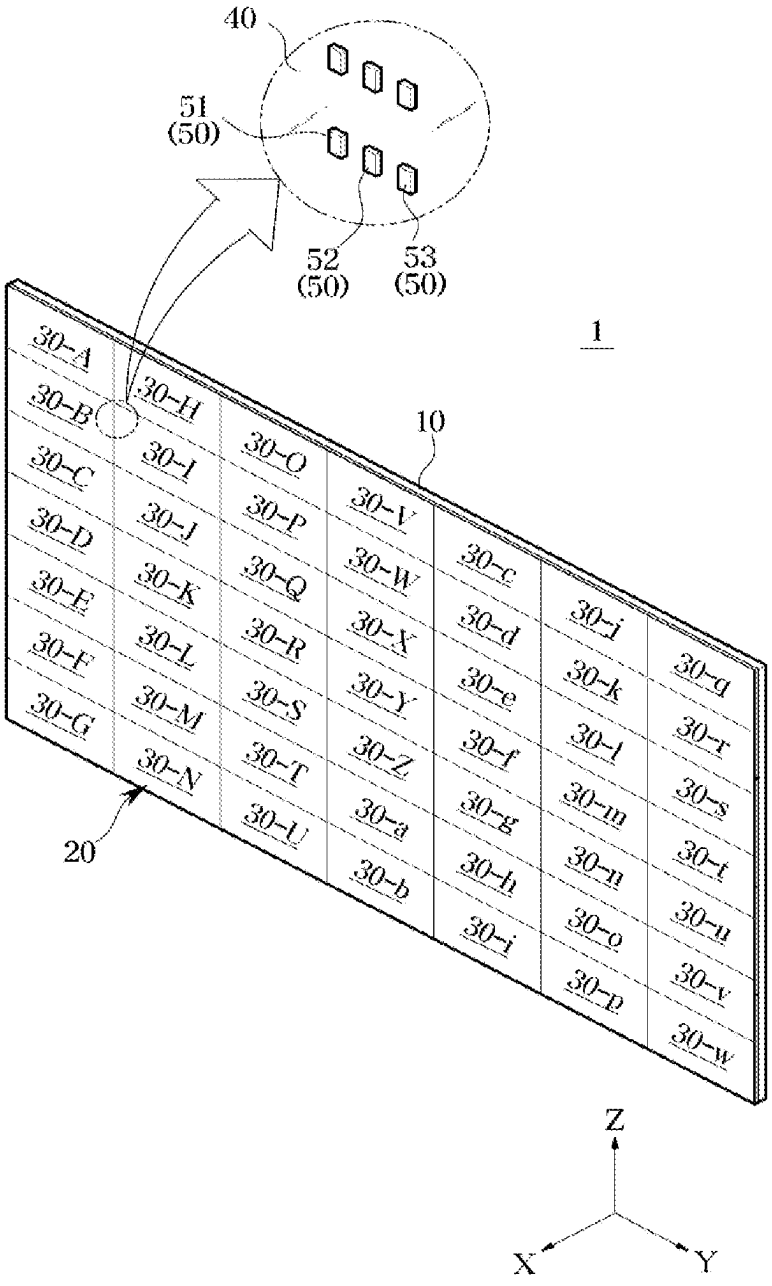
FIG. 1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(50)
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(50)
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30-T
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30-a
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30-n
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Z
X
Y

FIG. 2

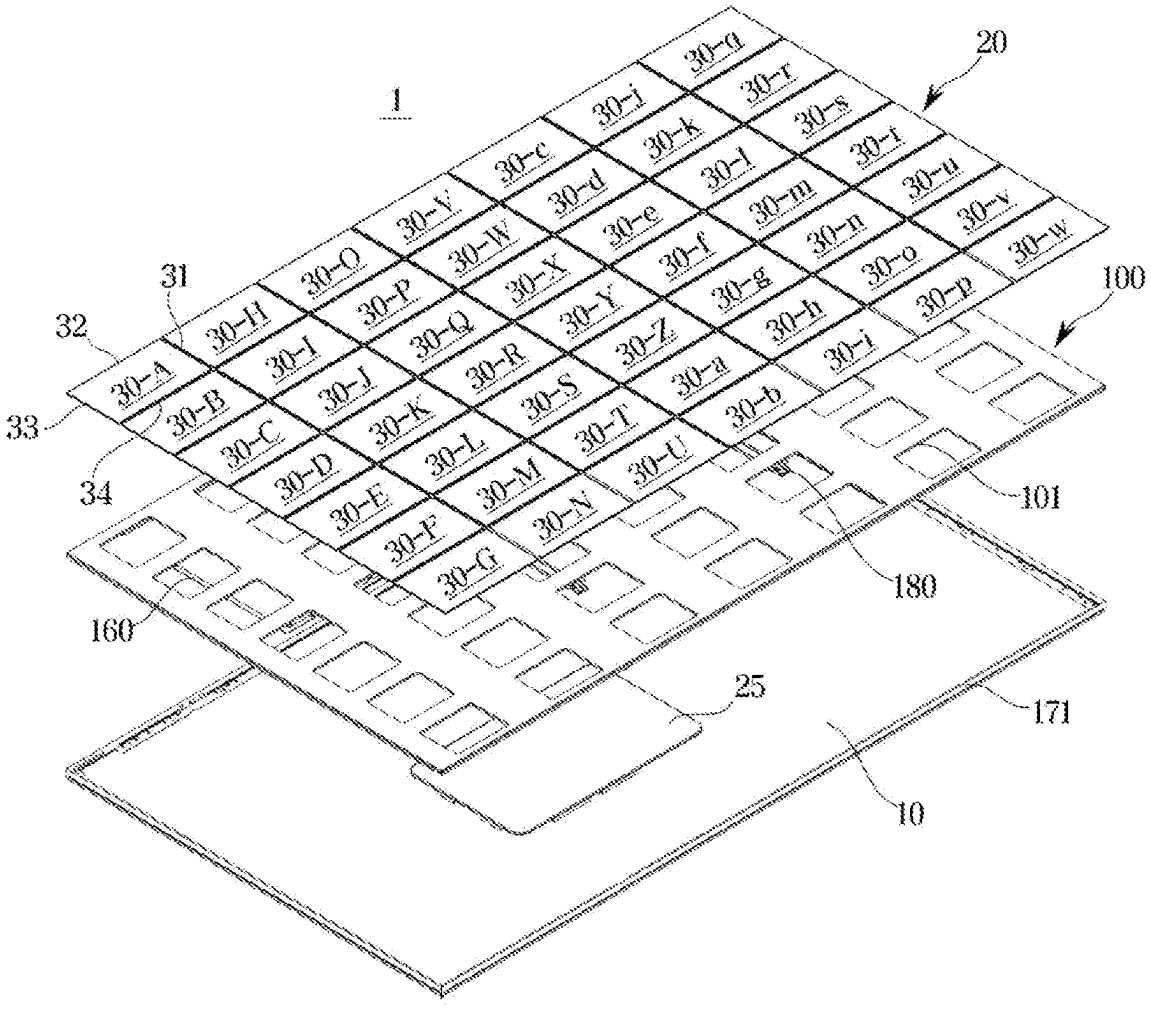
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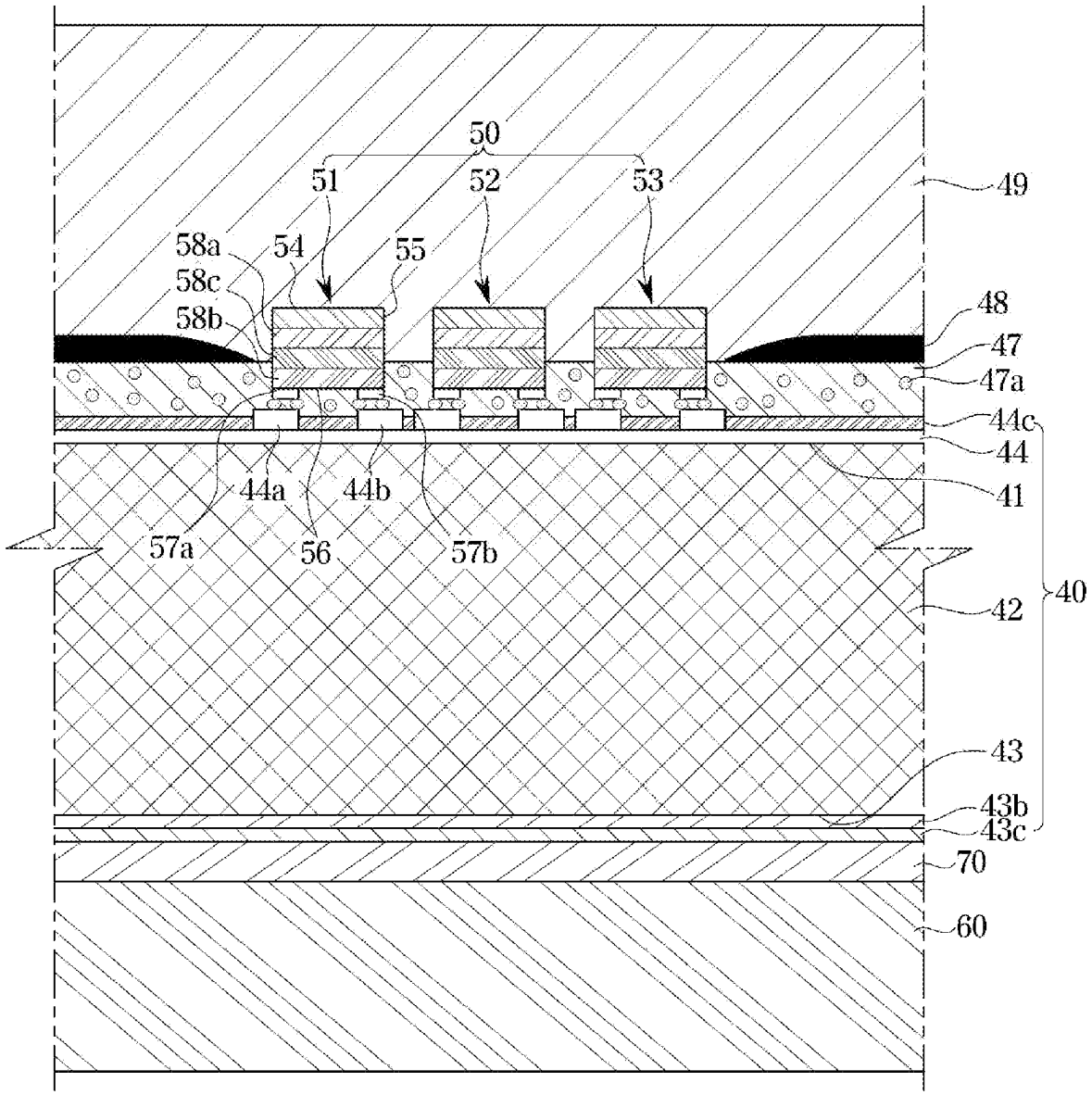
FIG. 3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58a
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58c
58b
48
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47a
44c
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44a
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57b
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42
43
43b
43c
70
60

FIG. 4

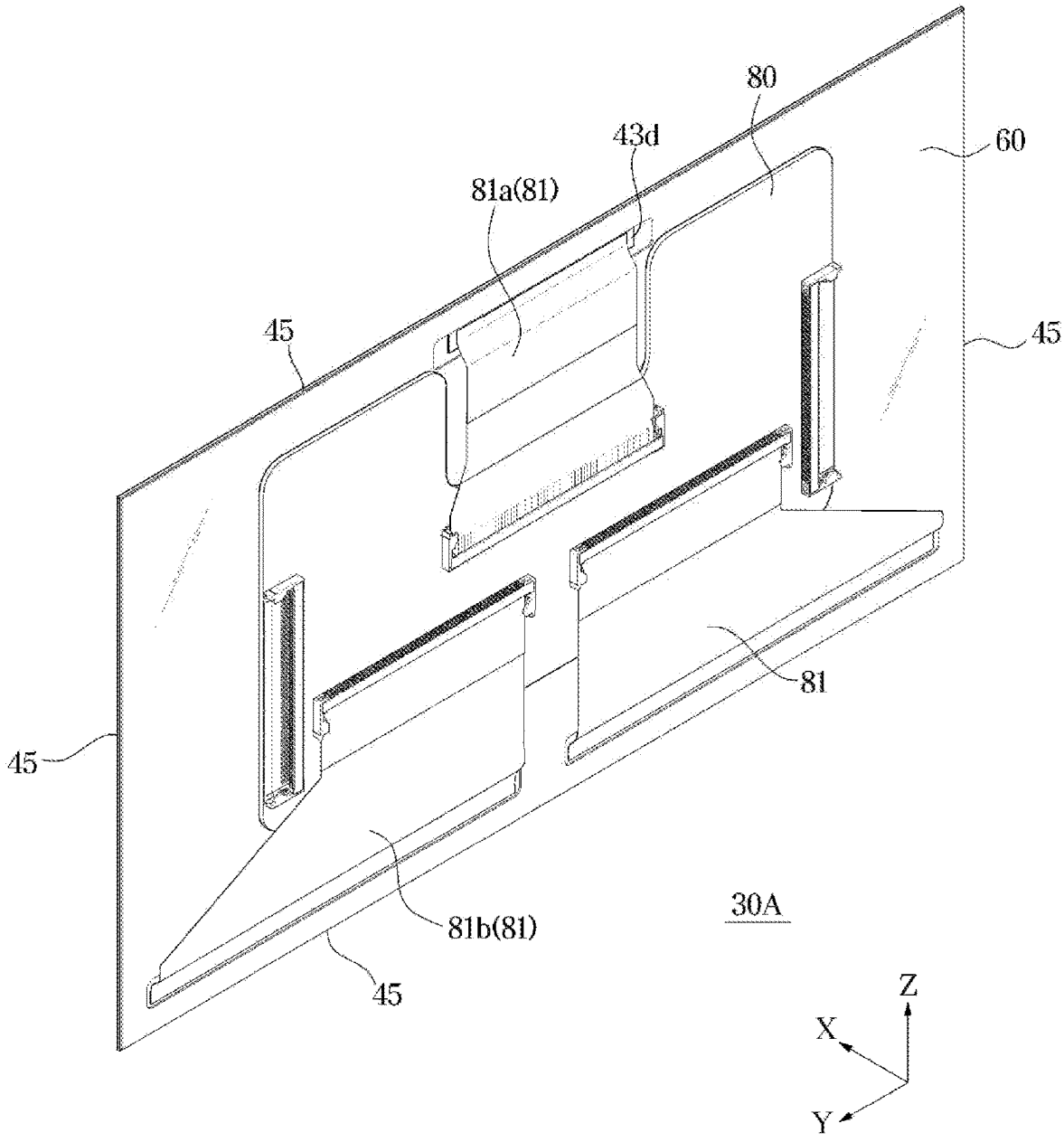


FIG. 5

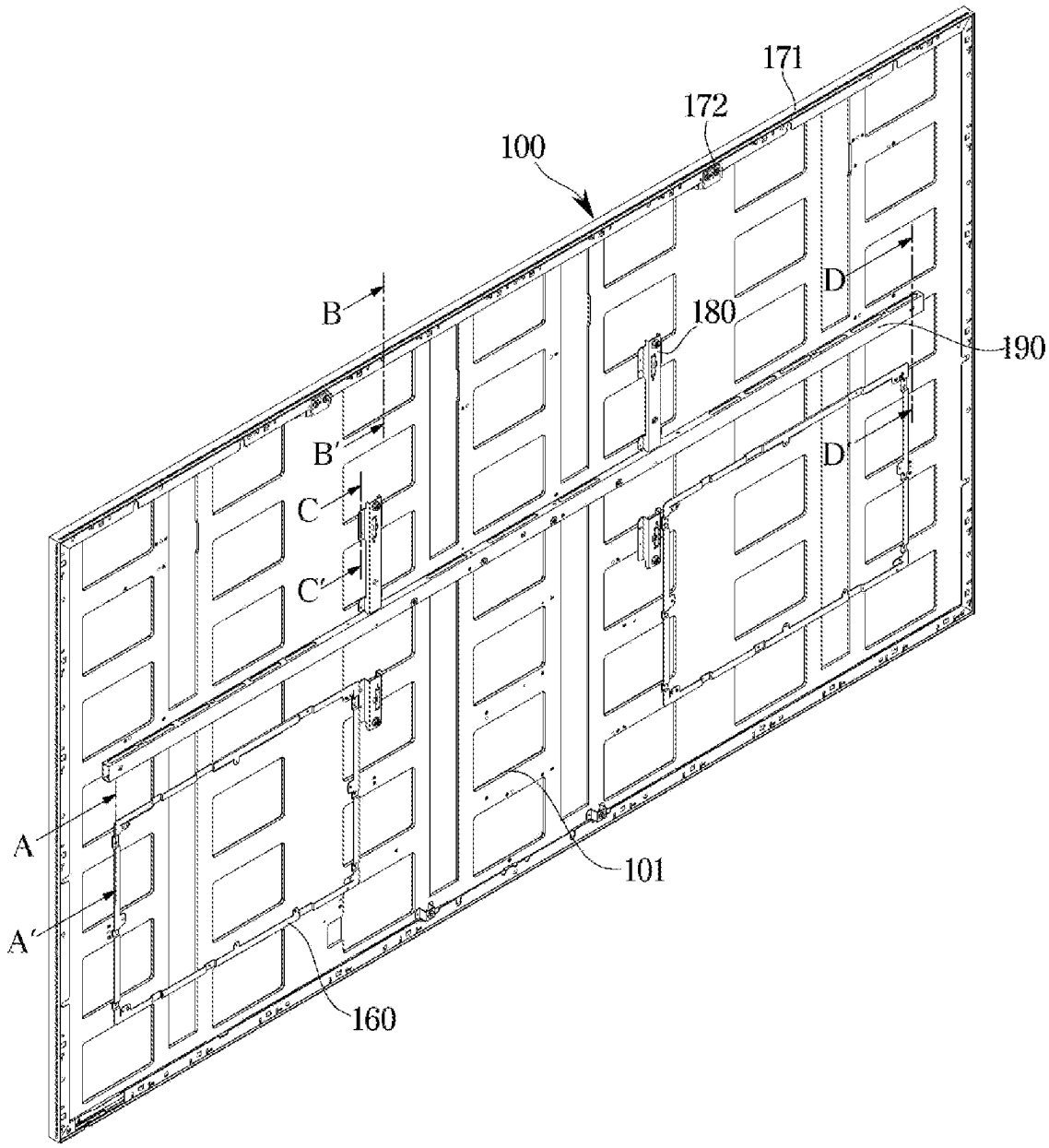


FIG. 6

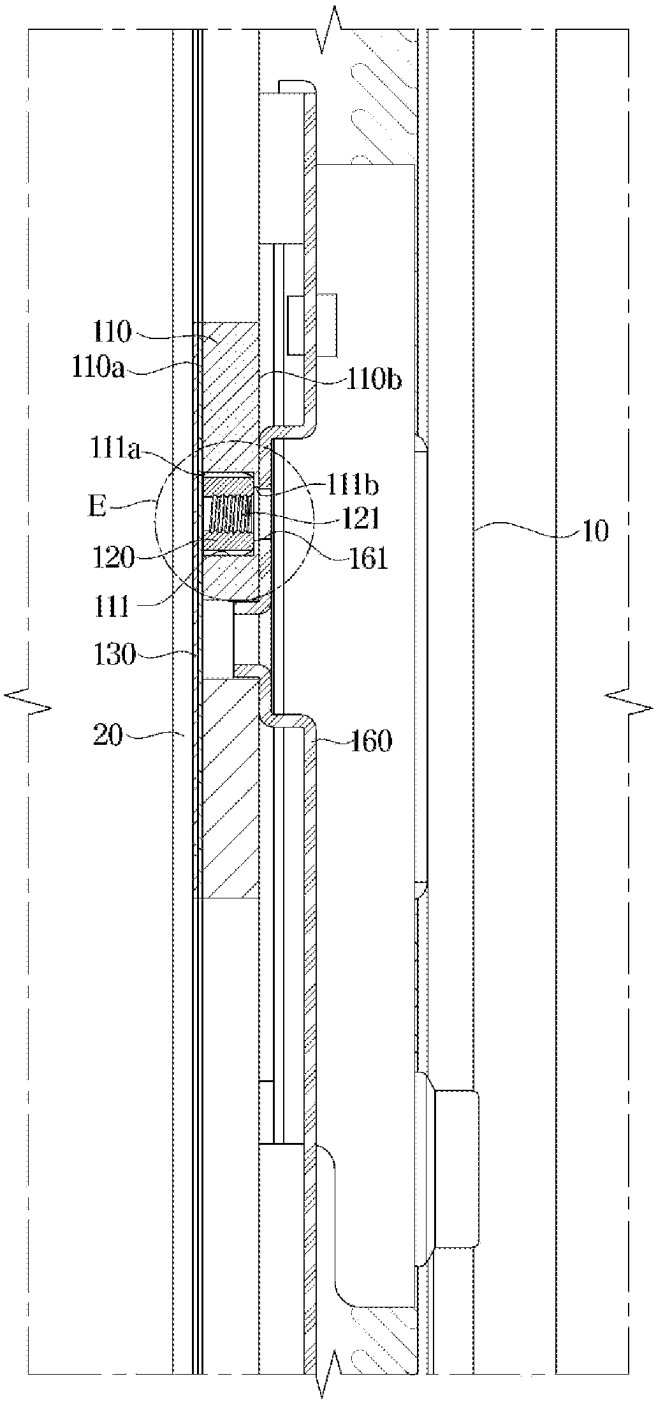
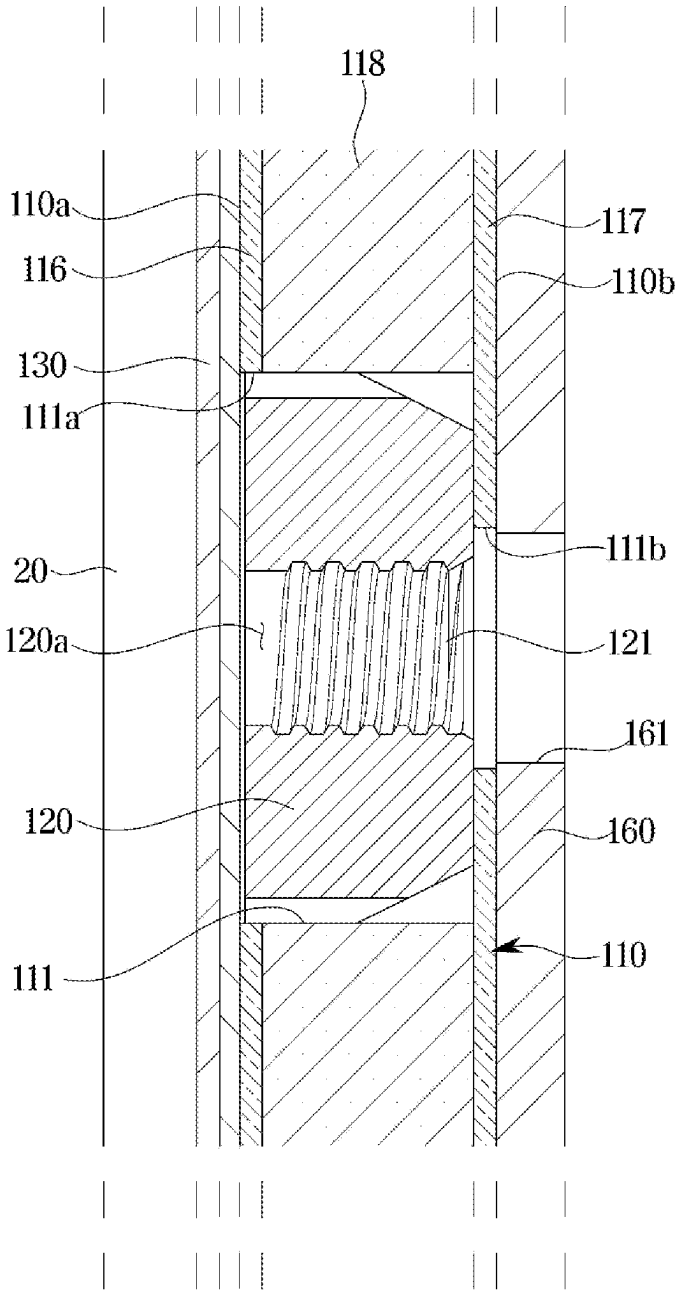


FIG. 7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111b
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120a
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120
160
110
111

FIG. 8

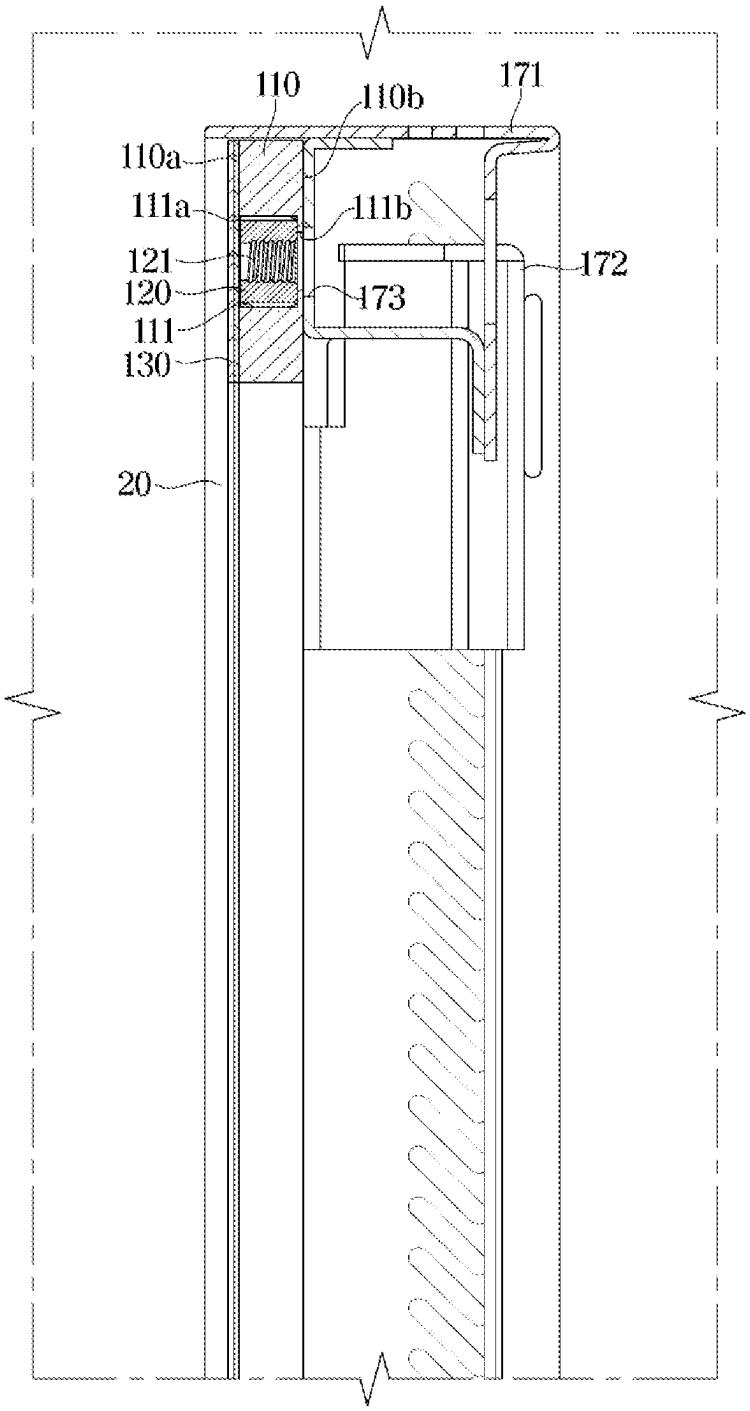


FIG. 9

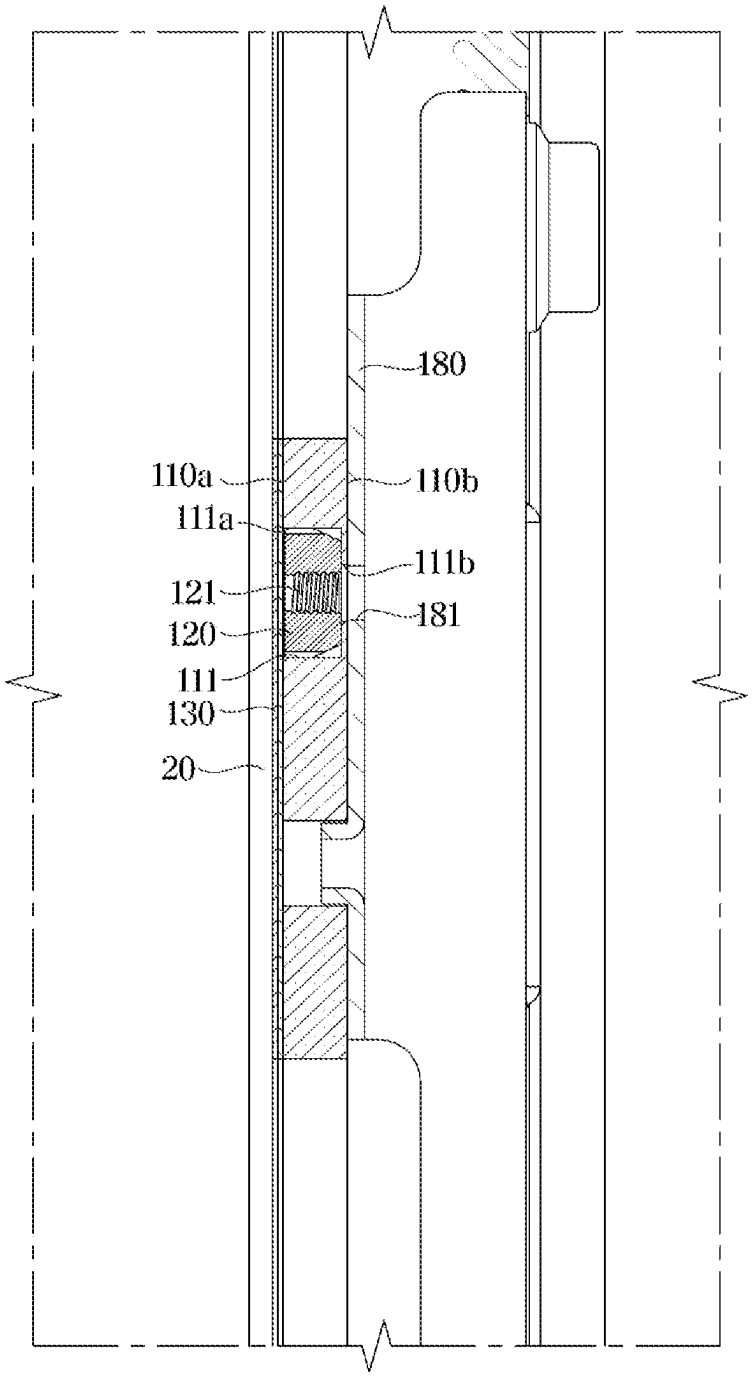


FIG. 10

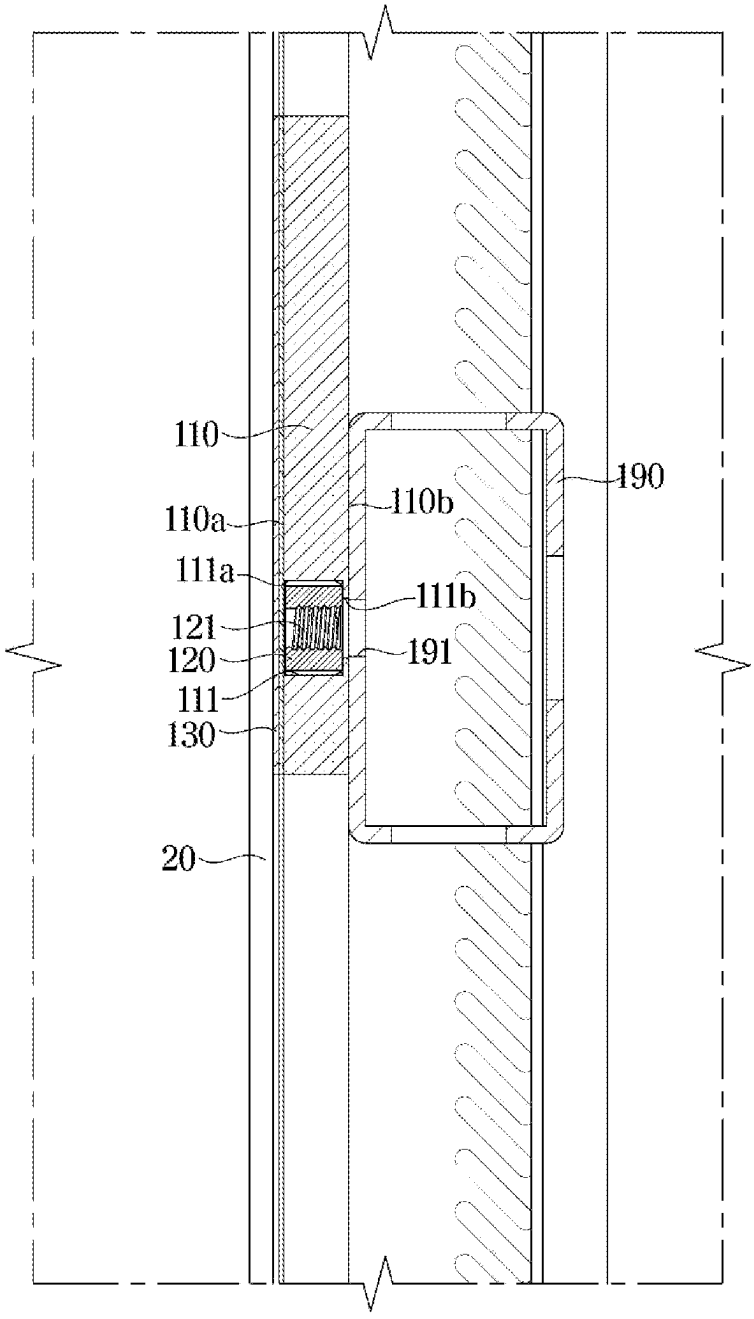


FIG. 11

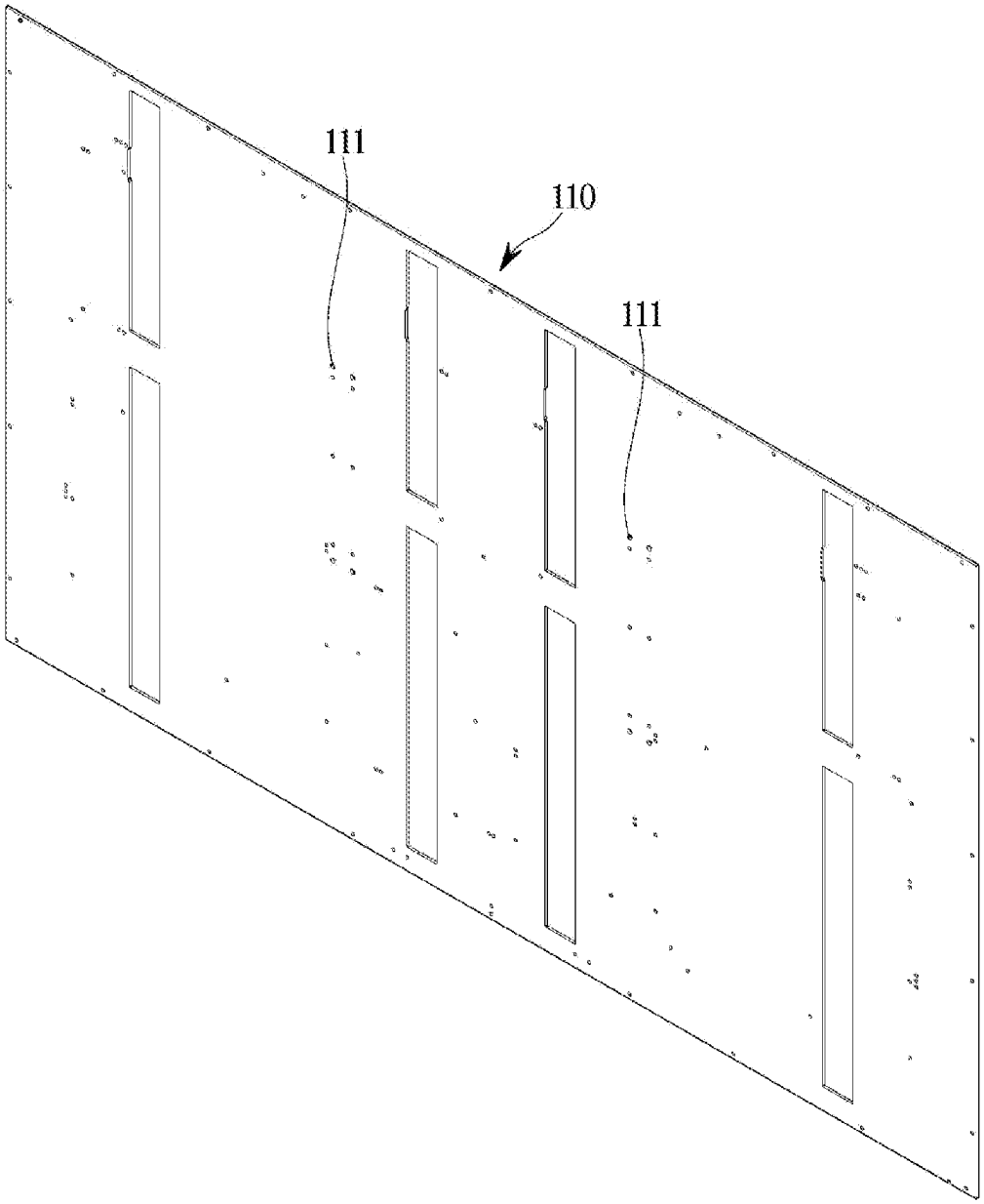


FIG. 12

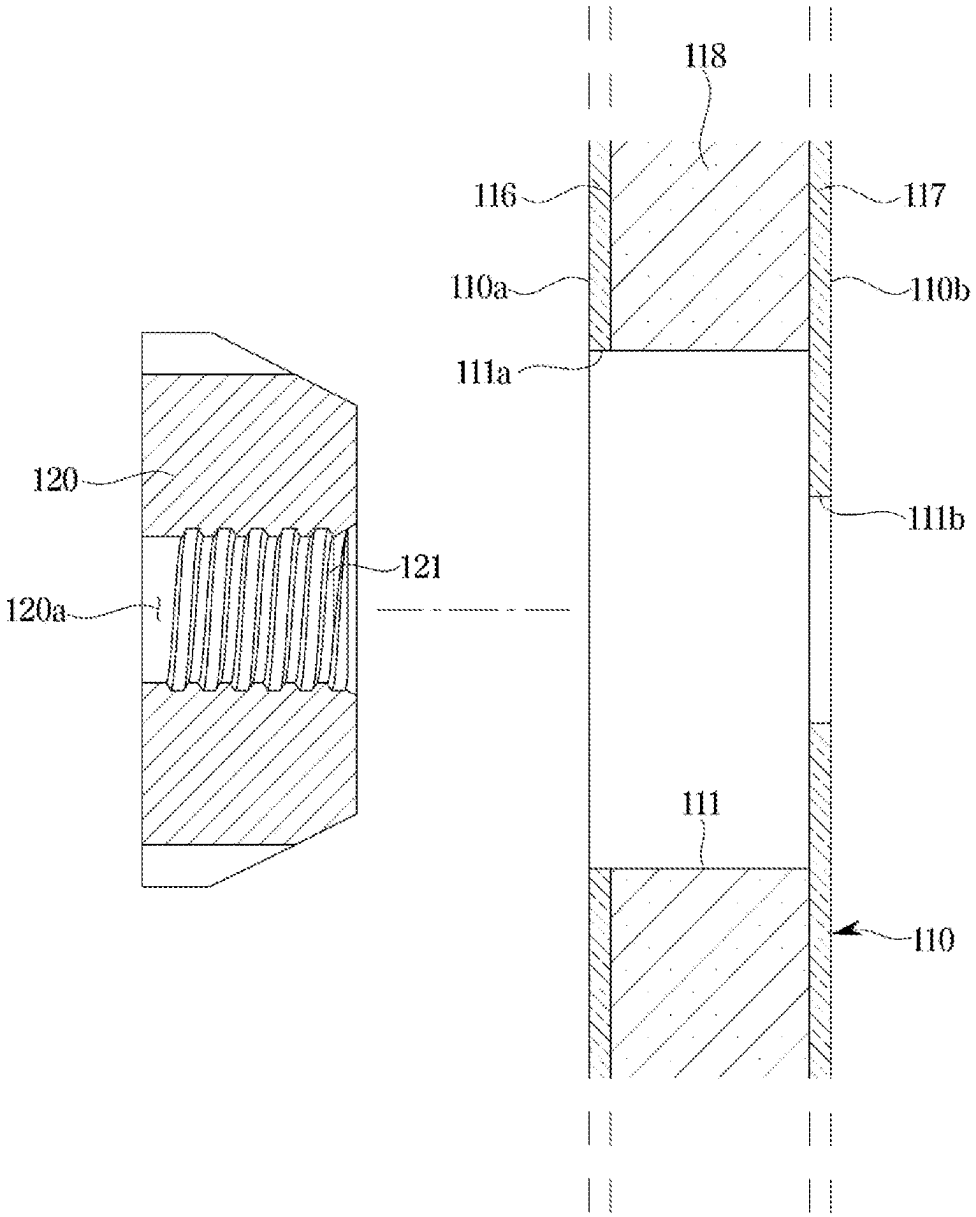


FIG. 13

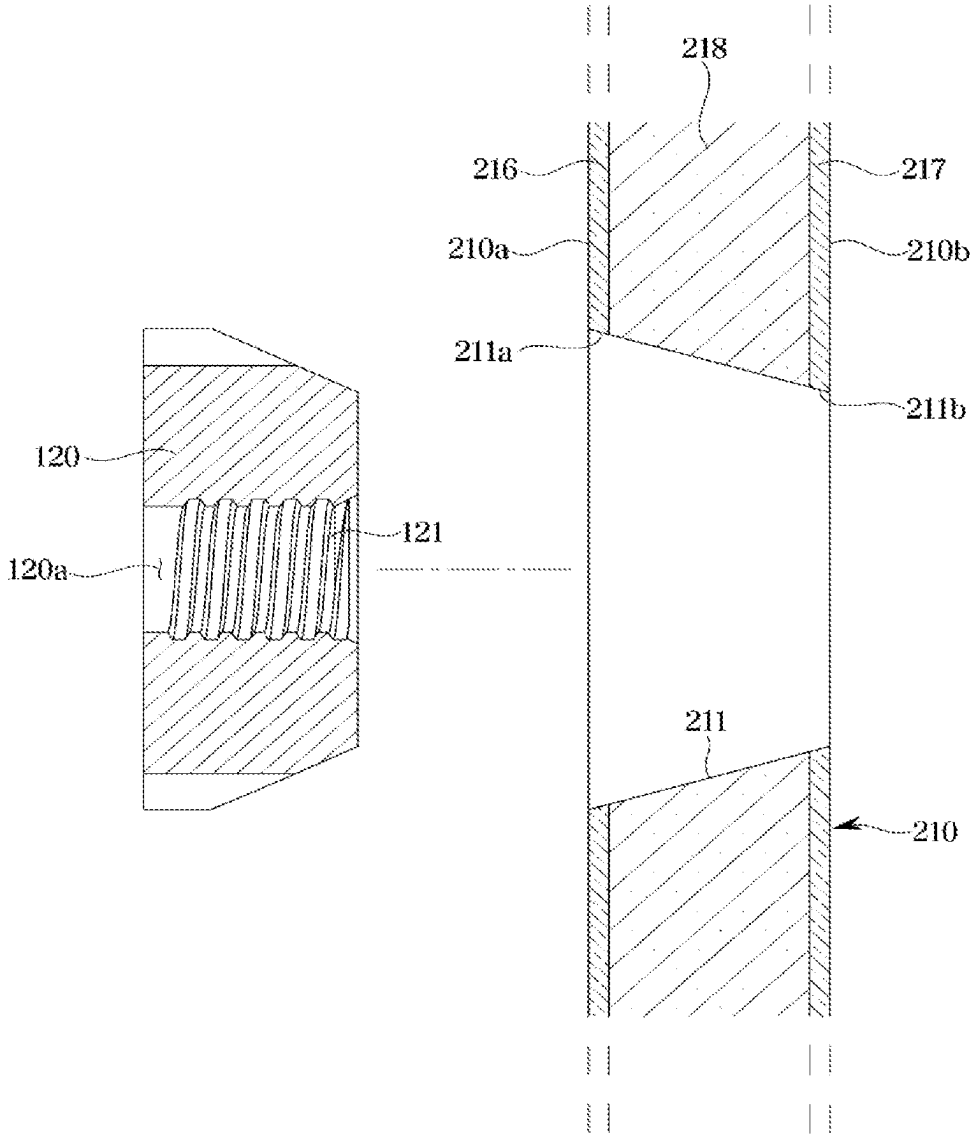


FIG. 14

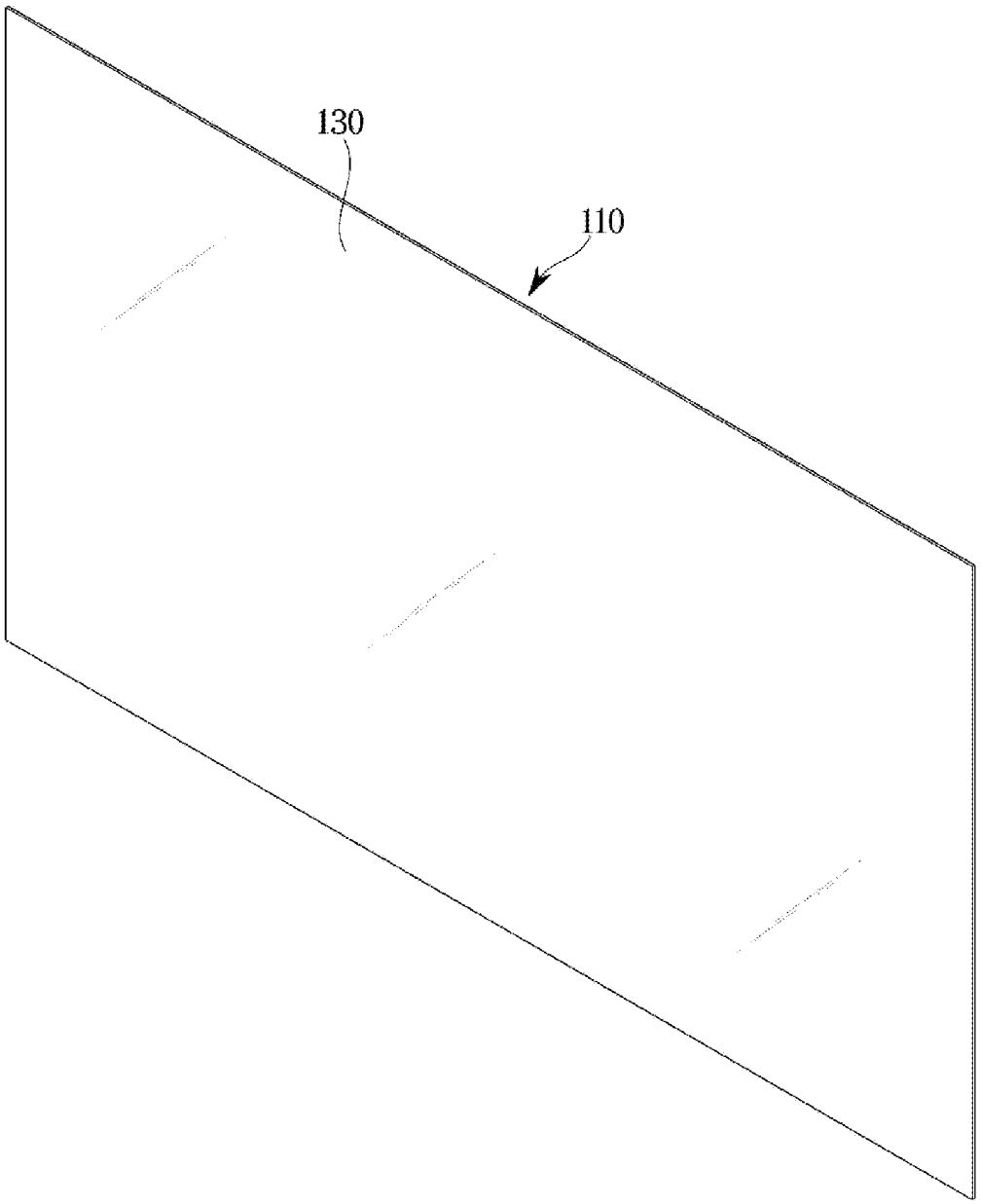


FIG. 15

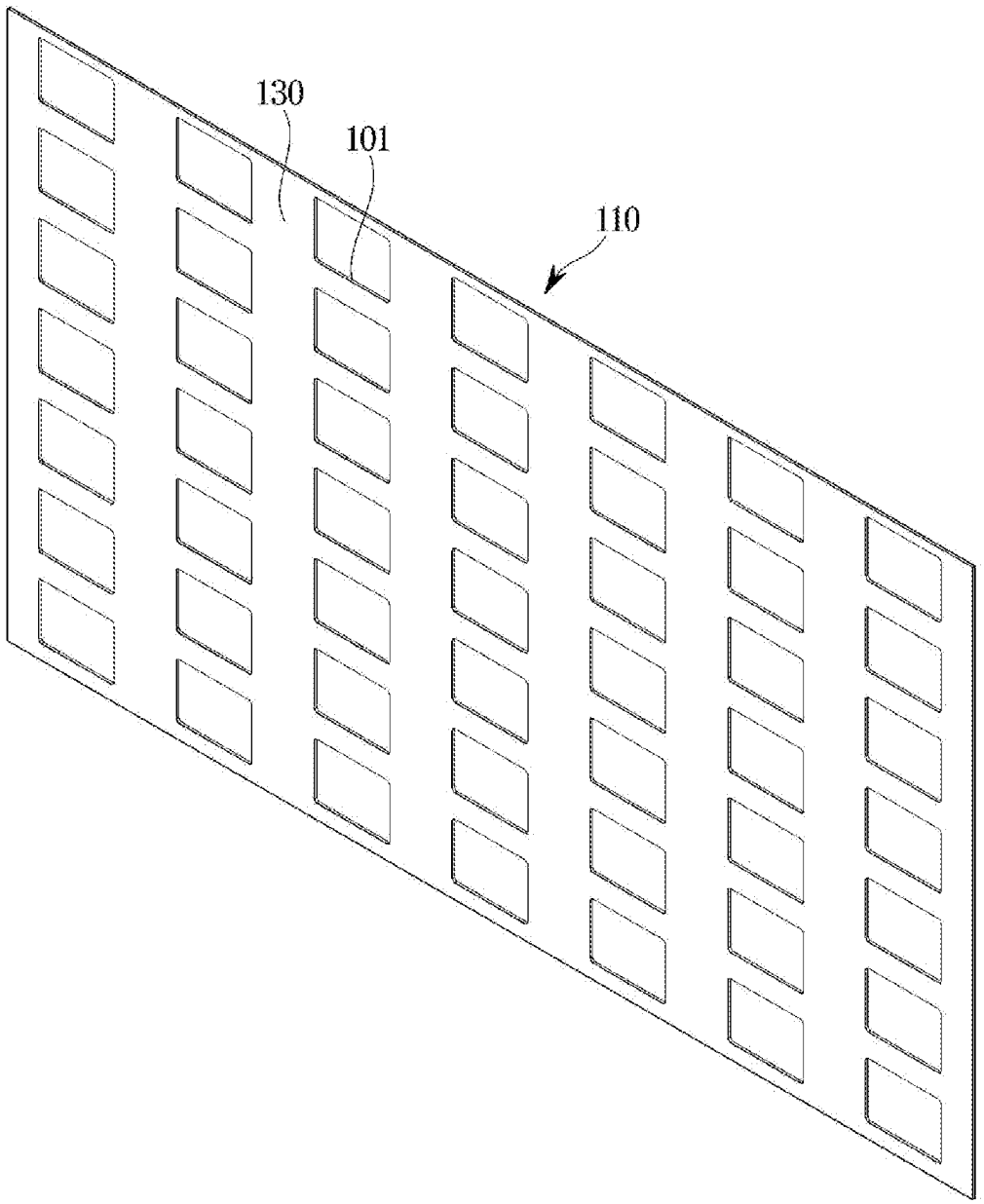
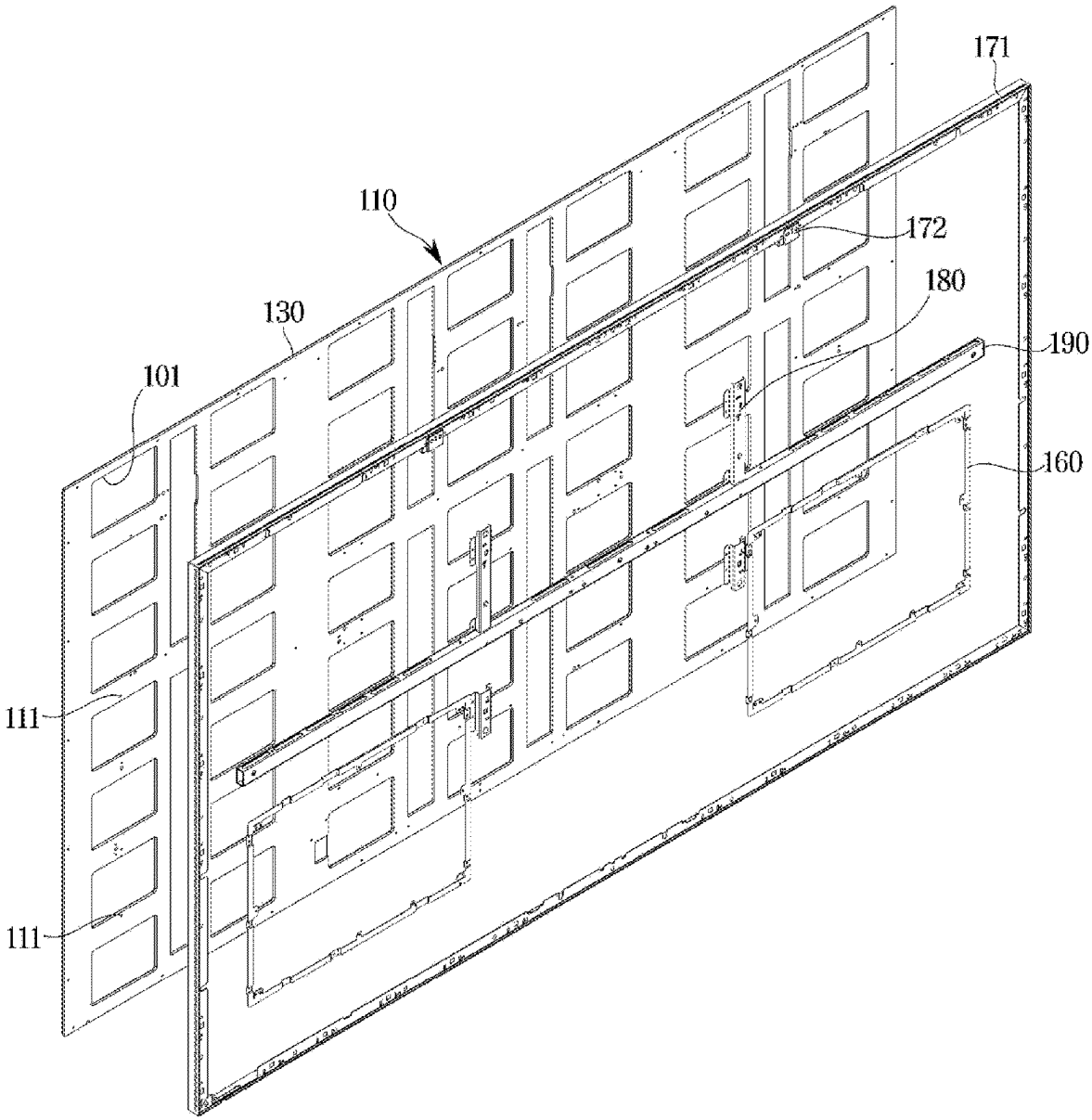


FIG. 16



DISPLAY APPARATUS AND MANUFACTURING METHOD THEREOF

CROSS-REFERENCE TO RELATED APPLICATION(S)

This is a bypass continuation application of PCT/KR2022/012929 filed Aug. 30, 2022, which claims priority from Korean Patent Application No. 10-2021-0172791 filed Dec. 6, 2021, which disclosure is incorporated herein in its entirety.

BACKGROUND

1. Field

The disclosure relates to a display apparatus capable of displaying an image by combining modules in which a light emitting device is mounted on a substrate, and a manufacturing method thereof.

2. Related Art

A display apparatus is a type of an output device that visually displays data information such as characters and figures, and images.

In general, a display apparatus has mainly used a liquid crystal panel that requires a backlight or an organic light-emitting diode (OLED) panel provided with a film of an organic compound that emits light by itself in response to an electric current. However, the liquid crystal panel has difficulties such as a slow-response time, and high-power consumption, and further it is difficult to make the liquid crystal panel compact because the liquid crystal panel does not emit light by itself, and requires a backlight. In addition, because the OLED panel emits light by itself, the OLED panel does not require a backlight, and thus it is possible to make the OLED panel thin. However, the OLED panel is susceptible to screen burn-in. The screen burn-in is a phenomenon in which, if the same screen is displayed for a long time, the lifetime of the sub-pixels expires and the previous screen remains the same even when the screen is changed.

Accordingly, a micro light emitting diode (micro-LED or μLED) panel in which an inorganic light emitting device is mounted on a substrate and the inorganic light emitting device itself is used as a pixel has been studied as a new panel to replace the OLED panel.

A micro-light emitting diode display panel (hereinafter, micro-LED panel) is one of the flat display panels and is composed of a plurality of inorganic light emitting diodes (inorganic LEDs) that is 100 micrometers or less.

The micro-LED panel is also a self-light emitting device, but the micro-LED does not suffer from the screen burn-in and has excellent luminance, resolution, power consumption, and durability because of its inorganic nature.

In comparison with the LCD panel requiring a backlight, a micro-LED panel may offer better contrast, response times, and energy efficiency. Both organic light emitting diodes (OLEDs) and micro-LEDs corresponding to inorganic light emitting devices have good energy efficiency. However, the micro-LED has higher brightness and emission efficiency, and longer lifetime than the OLED.

In addition, by arraying the LEDs on a circuit board in pixel units, it is possible to manufacture a display module in a substrate unit, and it is easy to manufacture a display apparatus in various resolutions and screen sizes according to the customer's order.

SUMMARY

In accordance with an aspect of the disclosure, a display apparatus includes a plurality of display modules, and a frame provided to support the plurality of display modules, the plurality of display modules being arranged in an M*N matrix on the frame, and the frame includes a frame panel including a first side and a second side opposite to the first side, the frame panel includes an insert portion passing through the frame panel, a first opening being formed on the first side and a second opening being formed on the second side, and a size of the first opening being greater than a size of the second opening, and a stud provided in the insert portion.

The insert portion may be provided such that the first opening and the second opening form a step difference.

The insert portion may be formed in a shape that tapers from the first side toward the second side.

The stud may include a coupling portion having an opening toward the second opening, and the coupling portion may include a screw thread formed on an inner circumferential surface of the coupling portion.

The display apparatus may further include a bracket detachably coupled to the stud through the second opening, and the bracket may include at least one of a mounting bracket, a chassis bracket, a reinforcing bracket, and a board bracket.

The frame may further include a reinforcing member attached to the first side of the frame panel and provided to cover the first opening.

The plurality of display modules may be attached to the reinforcing member.

The frame panel may further include a first metal layer forming the first side of the frame panel, a second metal layer forming the second side of the frame panel, and a resin layer arranged between the first metal layer and the second metal layer.

A size of a portion of the insert portion formed in the resin layer may be a same as a size of another portion of the insert portion formed in the first metal layer.

Each of a surface formed on the first side and a surface formed on the second side may be flat.

In accordance with another aspect of the disclosure, a manufacturing method of a display apparatus includes providing a frame panel including a first side and a second side opposite to the first side, forming an insert portion to pass through the frame panel, the insertion portion including a first opening formed on the first side and a second opening formed on the second side, a size of the first opening being greater than a size of the second opening, inserting a stud into the insert portion through the first opening, and detachably coupling a bracket to the stud through the second opening.

The forming of the insert portion may include forming the insertion portion such that the first opening and the second opening form a step difference.

The forming of the insert portion may include forming the insert portion in a shape that tapers from the first side toward the second side.

The stud may include a coupling portion having an opening toward the second opening, and the coupling portion may include a screw thread formed on an inner circumferential surface of the coupling portion.

The manufacturing method may further include attaching a reinforcing member to the first side of the frame panel after inserting the stud into the insert portion.

The manufacturing method may further include forming a module opening on the frame panel and the reinforcing member after attaching the reinforcing member to the first side of the frame panel.

The manufacturing method may further include attaching a plurality of display modules to the reinforcing member after forming the module opening.

The bracket may include at least one of a mounting bracket, a chassis bracket, a reinforcing bracket, and a board bracket.

The forming of the insert portion may include forming the insert portion from the first side by using at least one of a shape processing apparatus, a water jet, and a laser.

Each of a surface formed on the first side and a surface formed on the second side may be flat.

DESCRIPTION OF THE DRAWINGS

FIG. **1** is a view illustrating a display apparatus according to an embodiment of the disclosure.

FIG. **2** is an exploded-view illustrating a main configuration of the display apparatus of FIG. **1**.

FIG. **3** is an enlarged cross-sectional view illustrating a part of one display module shown in FIG. **1**.

FIG. **4** is a rear view illustrating a display module of the display apparatus shown in FIG. **1**.

FIG. **5** is a view illustrating a frame and a bracket coupled to a rear side of the frame shown in FIG. **2**.

FIG. **6** is a cross-sectional view taken along line A-A' of FIG. **5**.

FIG. **7** is an enlarged view illustrating a part E of FIG. **6**.

FIG. **8** is a cross-sectional view taken along line B-B' of FIG. **5**.

FIG. **9** is a cross-sectional view taken along line C-C' of FIG. **5**.

FIG. **10** is a cross-sectional view taken along line D-D' of FIG. **5**.

FIG. **11** is a view illustrating a state in which the frame panel shown in FIG. **5** is provided.

FIG. **12** is a view illustrating a state in which a stud is inserted into an insert portion of the frame panel shown in FIG. **11**.

FIG. **13** is a view illustrating another embodiment of the insert portion of the frame panel shown in FIG. **12**.

FIG. **14** is a view illustrating a state in which a reinforcing member is attached to the frame panel shown in FIG. **12**.

FIG. **15** is a view illustrating a state in which module openings are formed in the frame shown in FIG. **14**.

FIG. **16** is a view illustrating a state in which the brackets are mounted to the frame shown in FIG. **15**.

DESCRIPTION

Additional aspects of the disclosure will be set forth in part in the description which follows and, in part, will be obvious from the description, or may be learned by practice of the disclosure.

Embodiments described in the disclosure and configurations shown in the drawings are merely examples of the embodiments of the disclosure, and the scope of the disclosure should be understood to include various modifications or equivalents to replace the embodiments at the time of filing of the present application.

The singular forms "a," "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. The shapes and sizes of elements in the drawings may be exaggerated for the clear description.

In this disclosure, the terms "including", "having", and the like are used to specify features, numbers, steps, operations, elements, components, or combinations thereof, but do not preclude the presence or addition of one or more of the features, elements, steps, operations, elements, components, or combinations thereof.

Also, in the present description, the meaning of "identical" includes things that are similar to each other in properties or are similar within a certain range. Also, "identical" means "substantially identical". It should be understood that "substantially identical" means that a value corresponding to differences within a negligible range with respect to a reference value or a numerical value corresponding to a manufacturing error range are included in the range of "identical".

Hereinafter, embodiments according to the disclosure will be described in detail with reference to the accompanying drawings.

FIG. **1** is a view illustrating a display apparatus according to an embodiment of the disclosure, FIG. **2** is an exploded-view illustrating a main configuration of the display apparatus of FIG. **1**, FIG. **3** is an enlarged cross-sectional view illustrating a part of one display module shown in FIG. **1**, and FIG. **4** is a rear view illustrating a display module of the display apparatus shown in FIG. **1**.

A part of a configuration of a display apparatus **1** as well as a plurality of inorganic light emitting devices **50** illustrated in the drawings is a component in a micro-unit having a size of several μm to hundreds of μm, and for convenience of description, some components (the plurality of inorganic light emitting devices **50** and a black matrix **48**, etc.) are exaggerated.

The display apparatus **1** is a device that displays information, material, data, etc. as characters, figures, graphs, images, etc. and a television, a personal computer, a mobile, and a digital signage may be implemented as the display apparatus **1**.

According to an embodiment of the disclosure, as shown in FIGS. **1** and **2**, the display apparatus **1** may include a display panel **20** provided to display an image, a power supply device (not shown) configured to supply power to the display panel **20**, a main board **25** configured to control an overall operation of the display panel **20**, a frame **100** provided to support the display panel **20**, and a rear cover **10** provided to cover a rear surface of the frame **100**.

The display panel **20** may include a plurality of display modules **30**A-**30***w*, a driver board (not shown) configured to drive each of the display modules **30**A-**30***w*, and a timing controller (T-con) board configured to generate a timing signal to control the each of the display modules **30**A-**30***w*.

The rear cover **10** may support the display panel **20**. The rear cover **10** may be installed on the floor through a stand (not shown), or may be installed on a wall through a hanger (not shown).

The plurality of display modules **30**A-**30***w* may be arranged vertically and horizontally to be adjacent to each other. The plurality of display modules **30**A-**30***w* may be arranged in an M*N matrix. In the embodiment, 49 display modules **30**A-**30***w* are provided and arranged in a matrix of 7*7, but the number and the arrangement method of the plurality of display modules **30**A-**30***w* are not limited thereto.

The plurality of display modules **30**A-**30***w* may be installed in the frame **100**. The plurality of display modules **30**A-**30***w* may be installed in the frame **100** through various known methods such as magnetic force using a magnet, a mechanical fitting structure, or an adhesion. The rear cover

10 may be coupled to the rear of the frame 100, and the rear cover 10 may form a rear exterior of the display apparatus 1.

The rear cover 10 may include a metal material. Accordingly, heat generated from the plurality of display modules 30A-30*w* and the frame 100 may be easily conducted to the rear cover 10 to increase the heat dissipation efficiency of the display apparatus 1.

As described above, the display apparatus 1 according to an embodiment of the disclosure may implement a large screen by tiling the plurality of display modules 30A-30*w*.

Unlike the embodiment of the disclosure, a single display module in the plurality of display modules 30A-30*w* may be applied to a display apparatus. That is, as a single unit, the display modules 30A-30*w* may be installed and applied in a wearable device, a portable device, a handheld device, an electronic product or an electronical component that requires a display. As described in an embodiment of the disclosure, the plurality of display modules 30A-30*w* may be assembled in a matrix type and then applied to a display apparatus such as a monitor for a personal computer (PC), a high-resolution TV, a signage, or an electronic display.

The plurality of display modules 30A-30*w* may include the same configuration. Accordingly, a description of any one display module described below may be equally applied to all other display modules.

Hereinafter, each of the plurality of display modules 30A-30*w* will be described with reference to a first display module 30A because all of the plurality of display modules 30A-30*w* are formed identically.

Among the plurality of display modules 30A-30*w*, the first display module 30A may be formed in a quadrangle type. Alternatively, the first display module 30A may be provided in a rectangular type or a square type.

Accordingly, the first display module 30A may include edges 31, 32, 33, and 34 formed in up, down, left and right directions with respect to a first direction X, which is the front.

As illustrated in FIG. 3, each of the plurality of display modules 30A-30*w* may include a substrate 40 and a plurality of inorganic light emitting devices 50 mounted on the substrate 40. The plurality of inorganic light emitting devices 50 may be mounted on a mounting surface 41 of the substrate 40 facing the first direction X. In FIG. 3, for convenience of description, a thickness of the substrate 40 in the first direction X is shown to be enlarged.

The substrate 40 may be formed in a quadrangle type. As described above, the each of the plurality of display modules 30A-30*w* may be provided in a quadrangle type, and thus the substrate 40 may be formed in a quadrangle type to correspond to the type of the display module.

Alternatively, the substrate 40 may be provided in a rectangle type or a square type.

Therefore, as for the first display module 30A, the substrate 40 may include 4 edges corresponding to the edges 31, 32, 33, and 34 of the first display module 30A formed in four directions of up, down, left and right with respect to the first direction X that is the front.

The substrate 40 may include a base substrate 42, the mounting surface 41 forming one surface of the base substrate 42, a rear surface 43 arranged on the opposite side to the mounting surface 41 and forming the other surface of the base substrate 42, and a side surface 45 arranged between the mounting surface 41 and the rear surface 43.

The substrate 40 may include a thin film transistor (TFT) layer 44 formed on the base substrate 42 to drive the inorganic light emitting devices 50. The base substrate 42 may include a glass substrate. That is, the substrate 40 may include a Chip on Glass (COG) type substrate. First and second pad electrodes 44*a* and 44*b* provided to electrically connect the inorganic light emitting devices 50 to the TFT layer 44 may be formed on the substrate 40.

A thin film transistor (TFT) forming the TFT layer 44 is not limited to a specific structure or type, and may be configured in various embodiments. That is, the TFT of the TFT layer 44 according to an embodiment of the disclosure may be implemented as an organic TFT and a graphene TFT as well as a Low Temperature Poly Silicon (LTPS) TFT, an oxide TFT, and a Si TFT such as a poly silicon, or a-silicon TFT.

Alternatively, based on the base substrate 42 of the substrate 40 being formed of a silicon wafer, the TFT layer 44 may be replaced with a complementary metal-oxide semiconductor (CMOS) transistor, n-type metal-oxide semiconductor field-effect-transistor (MOSFET) or p-type MOSFET transistor.

The plurality of inorganic light emitting devices 50 may be formed of an inorganic material, and may include inorganic light emitting devices having sizes of several μm to several tens of μm in width, length, and height, respectively. The micro-inorganic light emitting device may have a length of 100 μm or less on a short side among width, length, and height. That is, the inorganic light emitting device 50 may be picked up from a sapphire or silicon wafer and directly transferred onto the substrate 40. The plurality of inorganic light emitting devices 50 may be picked up and transported through an electrostatic method using an electrostatic head or a stamp method using an elastic polymer material such as Polydimethylsiloxane (PDMS) or silicon as a head.

The plurality of inorganic light emitting devices 50 may be a light emitting structure including an n-type semiconductor 58*a*, an active layer 58*c*, a p-type semiconductor 58*b*, a first contact electrode 57*a*, and a second contact electrode 57*b*.

Although not shown in the drawing, one of the first contact electrode 57*a* and the second contact electrode 57*b* may be electrically connected to the n-type semiconductor 58*a*, and the other of the first contact electrode 57*a* and the second contact electrode 57*b* may be electrically connected to the p-type semiconductor 58*b*.

The first contact electrode 57*a* and the second contact electrode 57*b* may be a flip chip type in which the first contact electrode 57*a* and the second contact electrode 57*b* are horizontally arranged to face the same direction (a direction opposite to an emission direction).

The inorganic light emitting device 50 may include a light emitting surface 54 arranged to face the first direction X, a side surface 55, and a bottom surface 56 arranged to be opposite to the light emitting surface 54, which are based on arrangement in which the inorganic light emitting device 50 is mounted on the mounting surface 41. The first contact electrode 57*a* and the second contact electrode 57*b* may be formed on the bottom surface 56.

That is, the first and second contact electrodes 57*a* and 57*b* of the inorganic light emitting device 50 may be arranged on the opposite side of the light emitting surface 54, and accordingly, the first and second contact electrodes 57*a* and 57*b* may be arranged on the opposite side to the direction in which light is emitted.

The first and second contact electrodes 57*a* and 57*b* may be arranged to face the mounting surface 41, and provided to be electrically connected to the TFT layer 44. The light emitting surface 54 emitting light may be arranged in a

direction opposite to the direction in which the first and second contact electrodes **57***a* and **57***b* are arranged.

Therefore, in response to the light generated from the active layer **58***c* and emitted in the first direction X through the light emitting surface **54**, the light may be emitted toward the first direction X without the interference of the first contact electrode **57***a* or the second contact electrode **57***b*.

That is, the first direction X may be defined as a direction in which the light emitting surface **54** is arranged to emit light.

The first contact electrode **57***a* and the second contact electrode **57***b* may be electrically connected to a first pad electrode **44***a* and a second pad electrode **44***b*, respectively, formed on the mounting surface **41** of the substrate **40**.

The inorganic light emitting device **50** may be directly connected to the pad electrodes **44***a* and **44***b* through an anisotropic conductive layer **47** or a bonding structure such as solder.

The anisotropic conductive layer **47** may be formed on the substrate **40** to mediate electrical bonding between the contact electrodes **57***a* and **57***b* and the pad electrodes **44***a* and **44***b*. The anisotropic conductive layer **47** may include a structure in which an anisotropic conductive adhesive is attached on a protective film, and particularly, a structure in which conductive balls **47***a* are dispersed in an adhesive resin. The conductive ball **47***a* may be a conductive sphere surrounded by a thin insulating film, and may electrically connect conductors to each other as the insulating film is broken by pressure.

The anisotropic conductive layer **47** may include an anisotropic conductive film (ACF) in the form of a film and an anisotropic conductive paste (ACP) in the form of a paste.

Therefore, by a pressure applied to the anisotropic conductive layer **47** in a state in which the plurality of inorganic light emitting devices **50** are mounted on the substrate **40**, the insulating film of the conductive balls **47***a* may be broken and thus the contact electrodes **57***a* and **57***b* of the inorganic light emitting device **50** may be electrically connected to the pad electrodes **44***a* and **44***b* of the substrate **40**.

However, although not shown in the drawings, the plurality of inorganic light emitting devices **50** may be mounted on the substrate **40** through solder (not shown) instead of the anisotropic conductive layer **47**. After the inorganic light emitting device **50** is aligned on the substrate **40**, the inorganic light emitting device **50** may be bonded to the substrate **40** through a reflow process.

The plurality of inorganic light emitting devices **50** may include a red light emitting device **51**, a green light emitting device **52**, and a blue light emitting device **53**. As for the inorganic light emitting device **50**, a series of the red light emitting device **51**, the green light emitting device **52**, and the blue light emitting device **53** may be mounted on the mounting surface **41** of the substrate **40** as one unit. A series of the red light emitting device **51**, the green light emitting device **52**, and the blue light emitting device **53** may form a single pixel. In this case, the red light emitting device **51**, the green light emitting device **52**, and the blue light emitting device **53** may form a sub pixel, respectively.

The red light emitting device **51**, the green light emitting device **52**, and the blue light emitting device **53** may be arranged in a line at a predetermined interval according to the embodiment of the disclosure, and alternatively, arranged in other shapes such as a triangular shape.

The substrate **40** may include a light absorbing layer **44***c* provided to absorb external light to improve contrast. The light absorbing layer **44***c* may be formed on the entire mounting surface **41** of the substrate **40**. The light absorbing layer **44***c* may be formed between the TFT layer **44** and the anisotropic conductive layer **47**.

The plurality of display modules **30**A-**30***w* may further include a black matrix **48** formed between the plurality of inorganic light emitting devices **50**.

The black matrix **48** may perform a function of supplementing the light absorbing layer **44***c* formed entirely on the mounting surface **41** of the substrate **40**. That is, the black matrix **48** may absorb external light to allow the substrate **40** to appear black, thereby improving the contrast of the screen.

The black matrix **48** may have a black color.

According to the embodiment, the black matrix **48** may be arranged between pixels formed by a series of the red light emitting device **51**, the green light emitting device **52**, and the blue light emitting device **53**. Unlike the embodiment, the black matrix **48** may be formed more precisely to partition each of the light emitting devices **51**, **52**, and **53** corresponding to the sub-pixel.

The black matrix **48** may be formed in a grid shape having a horizontal pattern and a vertical pattern to be arranged between pixels.

The black matrix **48** may be formed by applying a light-absorbing ink on the anisotropic conductive layer **47** and then curing the light-absorbing ink through an ink-jet process, or by coating a light-absorbing film on the anisotropic conductive layer **47**.

That is, on the anisotropic conductive layer **47** formed on the entire mounting surface **41**, the black matrix **48** may be arranged on a space, in which the plurality of inorganic light emitting devices **50** is not mounted, between the plurality of inorganic light emitting devices **50**.

The plurality of display modules **30**A-**30***w* may include a front cover **49** arranged in the first direction X on the mounting surface **41** to cover the mounting surface **41** of the plurality of display modules **30**A-**30***w*.

The front cover **49** may be provided in plurality so as to be respectively formed in the first direction X on the plurality of display modules **30**A-**30***w*.

The front cover **49** may include a film (not shown).

The film (not shown) of the front cover **49** may be provided as a functional film having optical performance.

The front cover **49** may be provided to cover the substrate **40** to protect the substrate **40** from external force.

Typically, an adhesive layer (not shown) of the front cover **49** may be provided to have a predetermined height or more in the first direction X which the mounting surface **41** or the light emitting surface **54** faces. This is to sufficiently fill a gap that may be formed between the front cover **49** and the plurality of inorganic light emitting devices **50** in response to arranging the front cover **49** on the substrate **40**.

Each of the plurality of display modules **30**A-**30***w* may include a heat dissipation member **60** provided on the rear surface **43** of the substrate **40** to dissipate heat generated from the substrate **40**.

The heat generated from the substrate **40** may include heat generated in various components. Among various kinds of heat generated from the substrate **40** and transferred to the rear surface **43**, heat that occupies the largest proportion is heat generated in response to emission of the plurality of inorganic light emitting devices **50**. Further, heat may be generated in a plurality of components arranged on the mounting surface **41** of the substrate **40** such as the TFT layer **44**, and then the heat may be transferred into the substrate **40**.

In addition, heat may be transferred from the outside of the substrate **40** to the substrate **40**, and heat may be transferred to the substrate **40** through components other than the substrate **40**. Accordingly, heat may be generated in the substrate **40**.

Heat, which is generated in the substrate **40**, described below refers to heat that is generated in the plurality of components, including the plurality of inorganic light emitting devices **50**, arranged on the substrate **40** and then transferred to the substrate **40**.

Particularly, as described above, because the most heat generated from the plurality of inorganic light emitting devices **50** is transferred into the substrate **40**, the largest proportion of the heat generated from the substrate **40** is heat generated from the plurality of inorganic light emitting devices **50**. However, as described above, it may be described that heat is generated in the substrate **40** by various components other than the plurality of inorganic light emitting devices **50** and by heat generated outside the substrate **40**. In addition, each of the plurality of display modules **30**A-**30***w* may include an adhesive tape **70** arranged between the rear surface **43** and the heat radiation member **60** to adhere the rear surface **43** of the substrate **40** and the heat radiation member **60**.

The plurality of inorganic light emitting devices **50** may be electrically connected to a pixel driving wiring (not shown) formed on the mounting surface **41**, and an upper wiring layer (not shown) extending through the side surface **45** of the substrate **40** and formed as the pixel driving wiring (not shown).

The upper wiring layer (not shown) may be electrically connected to a side wiring (not shown) formed on the side surface **45** of the substrate **40**. The side wiring (not shown) may be provided in the form of a thin film.

The upper wiring layer (not shown) may be connected to the side wiring (not shown) by an upper connection pad (not shown) formed on the edge side of the substrate **40**.

The side wiring (not shown) may extend along the side surface **45** of the substrate **40** and may be connected to a rear wiring layer **43***b* formed on the rear surface **43**.

An insulating layer **43***c* covering the rear wiring layer **43***b* may be formed on the rear wiring layer **43***b* in a direction which the rear surface of the substrate **40** faces.

That is, the plurality of inorganic light emitting devices **50** may be sequentially and electrically connected to the upper wiring layer (not shown), the side wiring (not shown), and the rear wiring layer **43***b*.

Further, as shown in FIG. **4**, the display module **30**A may include a driver circuit board **80** provided to electrically control the plurality of inorganic light emitting devices **50** mounted on the mounting surface **41**. The driver circuit board **80** may be formed of a printed circuit board. The driver circuit board **80** may be arranged on the rear surface **43** of the substrate **40** in the first direction X. The driver circuit board **80** may be arranged on the heat dissipation member **60** bonded to the rear surface **43** of the substrate **40**.

The display module **30**A may include a flexible film **81** connecting the driver circuit board **80** to the rear wiring layer **43***b* to allow the driver circuit board **80** to be electrically connected to the plurality of inorganic light emitting devices **50**.

One end of the flexible film **81** may be connected to a rear connection pad **43***d* arranged on the rear surface **43** of the substrate **40** and electrically connected to the plurality of inorganic light emitting devices **50**.

The rear connection pad **43***d* may be electrically connected to the rear wiring layer **43***b*. Accordingly, the rear connection pad **43***d* may electrically connect the rear wiring layer **43***b* to the flexible film **81**.

Because the flexible film **81** is electrically connected to the rear connection pad **43***d*, the flexible film **81** may transmit power and an electrical signal from the driver circuit board **80** to the plurality of inorganic light emitting devices **50**.

The flexible film **81** may be formed of a flexible flat cable (FFC) or a chip on film (COF).

The flexible film **81** may include a first flexible film **81***a* and a second flexible film **81***b* that are respectively arranged in the up and down directions with respect to the first direction X.

The first and second flexible films **81***a* and **81***b* are not limited thereto, and may be arranged in the left and right directions with respect to the first direction X, or may be arranged in at least two directions in the up, down, left, and right directions, respectively.

The second flexible films **81***b* may be provided in plurality. However, the disclosure is not limited thereto, and a single second flexible film **81***b* may be provided, and the first flexible films **81***a* may also be provided in plurality.

The first flexible film **81***a* may transmit a data signal from the driver circuit board **80** to the substrate **40**. The first flexible film **81***a* may be formed of COF.

The second flexible film **81***b* may transmit power from the driver circuit board **80** to the substrate **40**. The second flexible film **81***b* may be formed of FFC.

However, the disclosure is not limited thereto, and the first flexible film **81***a* may transmit power from the driver circuit board **80** to the substrate **40** and be formed of FFC, and the second flexible film **81***b* may transmit a data signal from the driver circuit board **80** to the substrate **40** and be formed of COF.

Although not shown in the drawings, the driver circuit board **80** may be electrically connected to the main board **25** (refer to FIG. **2**). The main board **25** may be arranged on the rear side of the frame **100**, and at the rear of the frame **100**, the main board **25** may be connected to the driver circuit board **80** through a cable (not shown).

As described above, the heat dissipation member **60** may be provided to be in contact with the substrate **40**. The heat dissipation member **60** and the substrate **40** may be bonded to each other by the adhesive tape **70** arranged between the rear surface **43** of the substrate **40** and the heat dissipation member **60**.

The heat dissipation member **60** may be formed of a metal material having a high thermal conductivity or implemented with a component having a high thermal conductivity. For example, the heat dissipation member **60** may be formed of an aluminum material.

Heat generated by the plurality of inorganic light emitting devices **50** mounted to the substrate **40** and the TFT layer **44** may be transferred to the heat dissipation member **60** through the adhesive tape **70** along the rear surface **43** of the substrate **40**.

Accordingly, heat generated by the substrate **40** may be easily transferred to the heat dissipation member **60** and it is possible to prevent a temperature of the substrate **40** from being greater than or equal to a predetermined temperature.

The plurality of display modules **30**A-**30***w* may be arranged in various positions in the form of an M*N matrix. Each of the display modules **30**A-**30***w* is provided to be individually movable. In this case, each of the display modules **30**A-**30***w* may include the heat dissipation member **60** to maintain a certain level of heat dissipation perfor-

mance regardless of a position in which each of the display modules **30**A-**30***w* is arranged.

The plurality of display modules **30**A-**30***w* may be provided in the form of various M*N matrixes so as to form various-sized screen of the display apparatus **1**. Accordingly, in comparison with the heat dissipation through a single heat dissipation member provided for the heat dissipation, each of the display modules **30**A-**30***w* according to an embodiment of the disclosure may include an independent heat dissipation member **60** so as to individually dissipate the heat, thereby improving the heat dissipation performance of the entire display apparatus **1**.

Based on a single heat dissipation member being arranged inside the display apparatus **1**, a part of the heat dissipation member may not be arranged at a position corresponding to a position where some display modules are arranged in the front and rear directions, and the heat dissipation member may be arranged at a position corresponding to a position where any display module is not arranged in the front and rear directions. Therefore, the heat dissipation efficiency of the display apparatus **1** may be reduced.

That is, regardless of the position of the display modules **30**A-**30***w*, the display modules **30**A-**30***w* may perform self-dissipation by the heat dissipation member **60** arranged on the display modules **30**A-**30***w*, and thus it is possible to improve the heat dissipation performance of the entire display apparatus **1**.

The heat dissipation member **60** may be provided in a quadrangular shape substantially corresponding to the shape of the substrate **40**.

An area of the substrate **40** may be at least equal to or greater than an area of the heat dissipation member **60**. In response to the substrate **40** and the heat dissipation member **60** being arranged side by side in the first direction X, the four edges of the substrate **40** having a rectangular shape may be formed to correspond to the four edges of the heat dissipation member **60** with respect to the center of the substrate **40** and the heat dissipation member **60**, or the four edges of the substrate **40** having a rectangular shape may be formed to be arranged on the outer side than the four edges of the heat dissipation member **60** with respect to the center of the substrate **40** and the heat dissipation member **60**.

The four edges of the substrate **40** may be provided to be arranged outside the four edges of the heat dissipation member **60**. That is, the area of the substrate **40** may be provided to be greater than the area of the heat dissipation member **60**.

The substrate **40** and the heat dissipation member **60** may be thermally expanded by heat transferred to each of the display modules **30**A-**30***w*. Because the heat dissipation member **60** has a higher coefficient of thermal expansion than the substrate **40**, a value at which the heat dissipation member **60** is expanded is greater than a value at which the substrate **40** is expanded.

In this case, in response to the four edges of the substrate **40** being formed to correspond to the four edges of the heat dissipation member **60** or being arranged on the inner side than the four edges of the heat dissipation member **60**, the edge of the heat dissipation member **60** may protrude to the outside of the substrate **40**.

Accordingly, a separation distance between gaps formed between the respective display modules **30**A-**30***w* may be irregularly formed by the thermal expansion of the heat dissipation member **60** of each of the display modules **30**A-**30***w*. Therefore, some of seams may be easily recognized and thus the integrity of the screen of the display panel **20** may be reduced.

However, even when the substrate **40** and the heat dissipation member **60** are thermally expanded, the heat dissipation member **60** may not protrude to the outside of the four edges of the substrate **40** because the four edges of the substrate **40** are arranged outside the four edges of the heat dissipation member **60**. Accordingly, the separation distance of the gap formed between the display modules **30**A-**30***w* may be constantly maintained.

According to an embodiment of the disclosure, the area of the substrate **40** may be provided to substantially correspond to the area of the heat dissipation member **60**. Accordingly, heat generated from the substrate **40** may be evenly dissipated in the entire region of the substrate **40** without being isolated to a partial region of the substrate **40**.

The heat dissipation member **60** may be bonded to the rear surface **43** of the substrate **40** by the adhesive tape **70**.

The adhesive tape **70** may be provided in a size corresponding to that of the heat dissipation member **60**. That is, the area of the adhesive tape **70** may be provided to correspond to the area of the heat dissipation member **60**. The heat dissipation member **60** may be provided in a substantially quadrangular shape, and the adhesive tape **70** may be provided in a quadrangular shape to correspond to the shape of the heat dissipation member **60**.

The edge of the heat dissipation member **60** and the edge of the adhesive tape **70** in the rectangular shape may be formed to correspond to each other with respect to the center of the heat dissipation member **60** and the adhesive tape **70**.

Accordingly, the heat dissipation member **60** and the adhesive tape **70** may be easily manufactured in a single coupling configuration, and thus it is possible to increase the manufacturing efficiency of the entire display apparatus **1**.

That is, in response to the heat dissipation member **60** being cut from one plate into a unit number, the adhesive tape **70** may be pre-bonded to one plate before the heat dissipation member **60** is cut, and thus the adhesive tape **70** and the heat dissipation member **60** may be simultaneously cut into a unit number, thereby reducing the process.

Heat generated by the substrate **40** may be transferred to the heat dissipation member **60** through the adhesive tape **70**. Accordingly, the adhesive tape **70** may be provided to bond the heat dissipation member **60** to the substrate **40** while transferring the heat generated by the substrate **40** to the heat dissipation member **60**.

Accordingly, the adhesive tape **70** may include a material having high heat dissipation performance.

The adhesive tape **70** may include a material having an adhesive property to bond the substrate **40** and the heat dissipation member **60**.

The adhesive tape **70** may include a material having higher heat dissipation performance than a material having general adhesive property. Accordingly, the adhesive tape **70** may efficiently transfer heat from between the substrate **40** and the heat dissipation member **60** to each component.

In addition, the material having the adhesive property of the adhesive tape **70** may be formed of a material having higher heat dissipation performance than the adhesive material forming the general adhesive.

A material having higher heat dissipation performance means a material that effectively transfers heat with high thermal conductivity, high heat transfer, and low specific heat.

For example, the adhesive tape **70** may include a graphite material. However, the disclosure is not limited thereto, and the adhesive tape **70** may be generally formed of a material having the high heat dissipation performance.

Flexibility of the adhesive tape **70** may be greater than that of the substrate **40** and that of the heat dissipation member **60**. Accordingly, the adhesive tape **70** may be formed of a material having high flexibility while having an adhesive property and heat dissipation property. The adhesive tape **70** may be formed of an inorganic double-sided tape. As described above, the adhesive tape **70** is formed of an inorganic double-sided tape and thus the adhesive tape **70** may be provided as a single layer in which a base material, which supports one surface bonded to the substrate **40** and the other surface bonded to the heat dissipation member **60**, is not provided between the one surface and the other surface.

Because the adhesive tape **70** does not include the base material, the adhesive tape **70** may not include a material that interferes with the heat conduction, thereby increasing the heat dissipation performance. However, the adhesive tape **70** is not limited to the inorganic double-sided tape, and may be provided as a heat-dissipating tape having better heat dissipation performance than a general double-sided tape.

Because the substrate **40** is formed of a glass material and the heat dissipation member **60** is formed of a metal material, the material property of the glass material and the material property of the metal material may be different from each other and thus a degree of deformation of the material by the same heat may be different. That is, in response to heat generated in the substrate **40**, the substrate **40** and the heat dissipation member **60** may be thermally expanded to different sizes due to the heat. Accordingly, the display module **30**A may be damaged.

The substrate **40** and the heat dissipation member **60** have different expansion values at the same temperature, and thus in response to the substrate **40** and the heat dissipation member **60** expanded to different sizes in a state in which the substrate **40** and the heat dissipation member **60** are fixed to each other, stress may be generated in the substrate **40** and the heat dissipation member **60**.

As for the material property, each material of the substrate **40** and the heat dissipation member **60** has a different coefficient of thermal expansion and thus there is difference in the physical deformation of the material caused by the heat. Particularly, a coefficient of thermal expansion of the metal material is greater than a coefficient of thermal expansion of the glass, and thus in response to the same heat applied to the substrate **40** and the heat dissipation member **60**, the heat dissipation member **60** may be expanded and deformed more than the substrate **40**.

Conversely, in response to the substrate **40** and the heat dissipation member **60** being cooled after the heat generation in the substrate **40** is terminated, the heat dissipation member **60** may be contracted and deformed more than the substrate **40**.

The substrate **40** and the heat dissipation member **60** are in a state of being bonded to each other by the adhesive tape **70**, and thus in response to the heat dissipation member **60** being deformed more than the substrate **40**, an external force may be transmitted to the substrate **40**.

Conversely, an external force may be transmitted to the heat dissipation member **60** by the substrate **40**, but the substrate **40** may be damaged because the rigidity of the glass substrate **40** is less than the rigidity of the metal heat dissipation member **60**.

The adhesive tape **70** may be arranged between the substrate **40** and the heat dissipation member **60** to absorb external force that is transmitted from different components while the substrate **40** and the heat dissipation member **60** are expanded to different sizes.

Accordingly, it is possible to prevent the external force from being transmitted to the substrate **40** and the heat dissipation member **60**, and further to prevent the substrate **40** from being damaged.

The adhesive tape **70** may be formed of a material with high flexibility so as to absorb the external force transmitted from the substrate **40** and the heat dissipation member **60**. Particularly, the flexibility of the adhesive tape **70** may be greater than that of the substrate **40** and that of the heat dissipation member **60**.

Accordingly, in response to the external force, which is generated by the size change of the substrate **40** and the heat dissipation member **60**, being transmitted to the adhesive tape **70**, the adhesive tape **70** itself may be deformed and thus the adhesive tape **70** may prevent the external force from being transmitted to different components.

The adhesive tape **70** may have a predetermined thickness in the first direction X. In response to the thermal expansion of the heat dissipation member **60** by the heat or the contraction of the heat dissipation member **60** by the cooling, the heat dissipation member **60** may be expanded or contracted in a direction perpendicular to the first direction X, as well as the first direction X and thus the external force may be transmitted to the substrate **40**.

The display panel **20** may display a screen by the plurality of display modules **30**A-**30***w*. In this case, the integrity of the screen may be deteriorated by a seam formed by a gap formed between the plurality of display modules **30**A-**30***w*.

Accordingly, in order to minimize the recognition of the seam of the display panel **20**, the plurality of display modules **30**A-**30***w* may be arranged on the frame **100** to form regular gaps. This is because, when gaps are irregularly formed by the plurality of display modules **30**A-**30***w*, the recognition of the seam may be increased by some of the irregular gaps.

In a conventional display apparatus, a frame provided to support the display panel is formed of a metal material. A plurality of display modules may be tiled on a metal frame.

The substrate forming the plurality of display modules **30**A-**30***w* may be thermally expanded by heat generated from the display panel while the display apparatus is driven. As described above, because the plurality of display modules **30**A-**30***w* are supported by the frame formed of a metal material, a gap may be irregularly formed between the plurality of display modules **30**A-**30***w* due to the thermal expansion of the substrate and the thermal expansion of the frame. Accordingly, the recognition of the seam may be increased.

That is, because all of the substrate of the plurality of display modules **30**A-**30***w* is formed of a glass material, the substrate may be thermally expanded to a certain value. However, due to the thermal expansion of the metal frame supporting the substrate, a width between gaps may be irregular among the gaps between the plurality of display modules **30**A-**30***w*. This is because a material property of the metal material is different from that of the glass material.

The material property of the material may have different values depending on the coefficient of thermal expansion, specific heat, and thermal conductivity. Particularly, a degree of thermal expansion between the substrate and the frame may be different due to a difference between the coefficient of thermal expansion of the metal material and the coefficient of thermal expansion of the glass.

Due to the thermal expansion of the frame to which the plurality of display modules **30**A-**30***w* is bonded, in addition to the thermal expansion of the substrate of the plurality of

display modules **30**A-**30***w*, a separation distance of the gaps between the plurality of display modules **30**A-**30***w* may change irregularly.

As described above, in order to prevent the irregular gap between the plurality of display modules **30**A-**30***w* caused by the thermal expansion of the frame of the metal material on which the plurality of display modules **30**A-**30***w* is arrayed, the frame **100** of the display apparatus **1** according to an embodiment of the disclosure may allow the plurality of display modules **30**A-**30***w* to be adhered thereto, and be formed of a material having a material property that is similar to a material property of the substrate **40** of the plurality of display modules **30**A-**30***w*.

That is, the frame **100** may be provided to have the material property similar to that of the substrate **40** in order to maintain a constant distance between the gaps formed between the respective display modules **30**A-**30***w*.

That the frame **100** is formed of a material having a material property similar to that of the above-described substrate **40** may include a meaning that the coefficient of thermal expansion, specific heat, and thermal conductivity of the frame **100** are similar to those of the substrate **40**. Particularly, according to an embodiment of the disclosure, it may be understood that the coefficient of thermal expansion of the substrate **40** corresponds to the coefficient of thermal expansion of the frame **100**.

The entire frame **100** may be formed of a material similar to the material property of the substrate **40** or may be formed of a material having a similar coefficient of thermal expansion. The frame **100** may be formed of a material having the same value as the coefficient of thermal expansion of the substrate **40**.

However, the disclosure is not limited thereto, and thus the frame **100** may include a front layer (not shown) formed of a material having a material property corresponding to the material property of the substrate **40**.

In response to the same heat transferred to the substrate **40** and the front layer (not shown) in a second direction Y or a third direction Z perpendicular to the first direction X in a state in which the substrate **40** is adhered to the front layer (not shown) in the first direction X, the substrate **40** and the front layer (not shown) may be expanded to a length corresponding to each other.

That is, in a state in which the entire frame **100** is formed of a material having a material property corresponding to the substrate **40**, or only the front layer (not shown) forming the front surface of the frame **100** is formed of a material having a material property corresponding to the substrate **40**, the front surface, to which the substrate **40** of the plurality of display modules **30**A-**30***w* is adhered, may be thermally expanded to the same value as the substrate **40** in response to the thermal expansion of the substrate **40** due to heat that is generated during the operation of the display apparatus **1**.

Because the front surface of the frame **100** corresponding to the base surface, to which the plurality of display modules **30**A-**30***w* is adhered, is thermally expanded to the same value as the substrate **40** of the plurality of display modules **30**A-**30***w*, the same distance of gap formed between the plurality of display modules **30**A-**30***w* may be maintained.

Accordingly, the distance of the gap formed between the plurality of display modules **30**A-**30***w* after the thermal expansion of the substrate **40** may be maintained at the same as the distance of the gap before the thermal expansion of the substrate **40**. Therefore, it is possible to maintain a predetermined level of seam and to maintain the integrity of the screen.

Therefore, even when the heat generated according to the driving of the display apparatus **1** is applied to the substrate **40** of the plurality of display modules **30**A-**30***w*, the distance of the gaps between the plurality of display modules **30**A-**30***w* may be constant, and thus it is possible to prevent a phenomenon in which some of the seams are increased and the integrity of the screen is deteriorated.

The frame **100** may be provided to support the display panel **20** and to have a rigidity greater than or equal to a predetermined level. Accordingly, the frame **100** may be formed of a metal material having a rigidity greater than or equal to a predetermined level, and the front surface of the frame **100** may be formed of a glass material corresponding to the substrate **40**. However, the disclosure is not limited thereto, and the frame **100** may be formed of a material having a value different from the coefficient of thermal expansion of the substrate **40**.

Hereinafter, the frame **100** according to an embodiment of the disclosure will be described in detail.

FIG. **5** is a view illustrating a frame and brackets coupled to a rear side of the frame shown in FIG. **2**. FIG. **6** is a cross-sectional view taken along line A-A' of FIG. **5**. FIG. **7** is an enlarged view illustrating a part E of FIG. **6**. FIG. **8** is a cross-sectional view taken along line B-B' of FIG. **5**. FIG. **9** is a cross-sectional view taken along line C-C' of FIG. **5**. FIG. **10** is a cross-sectional view taken along line D-D' of FIG. **5**.

Referring to FIGS. **5** to **10**, the frame **100** according to an embodiment of the disclosure may include a frame panel **110**. The frame panel **110** may include a first side **110***a* facing the plurality of display modules **30**A-**30***w* and a second side **110***b* opposite to the first side **110***a*. The first side **110***a* may face forward, and the second side **110***b* may face rearward.

Referring to FIGS. **6** and **7**, the frame panel **110** may include an insert portion **111** formed to pass through the frame panel **110** in the front and rear directions. The insert portion **111** may be provided to allow a stud **120** to be inserted into the insert portion **111**. The insert portion **111** may be provided in a position and number corresponding to brackets **160**, **172**, **180**, and **190** to be coupled to the frame **100**.

A first opening **111***a* may be formed in the first side **110***a* of the frame panel **110**. A second opening **111***b* may be formed in the second side **110***b* of the frame panel **110**. The first opening **111***a* may have a size different from a size of the second opening **111***b*. The first opening **111***a* may have a larger size than the second opening **111***b*. The insert portion **111** may be provided such that the first opening **111***a* and the second opening **111***b* form a step difference.

The second opening **111***b* is formed to be smaller than the first opening **111***a*, and thus in response to the brackets **160**, **172**, **180**, and **190** being coupled to the stud **120** in a state in which the stud **120** is inserted into the insert portion **111**, a portion of the frame panel **110** forming the second opening **111***b* may support the stud **120**. Therefore, it is possible to improve the pulling force or torque resistance applied to the frame **100**.

In addition, the second opening **111***b* is formed to be smaller than the first opening **111***a*, and thus in response to the stud **120** being press-fitted into the insert portion **111**, a surface formed on the first side **110***a* and a surface formed on the second side **110***b* of the frame panel **110** may be formed to be flat without a protruding portion.

Particularly, because the surface formed on the first side **110***a* of the frame panel **110** is flat without a protruding portion, the display apparatus **1** according to an embodiment

of the disclosure may secure a flat surface to tile the plurality of display modules **30**A-**30***w* that are attached to the front surface of the frame **100**.

In addition, because the surface formed on the second side **110***b* of the frame panel **110** is flat without a protruding portion, it is possible to prevent an unnecessary increase in the thickness of the display apparatus **1**.

Referring to FIG. **7**, the frame panel **110** may include a first metal layer **116** forming the first side **110***a*, a second metal layer **117** forming the second side **110***b*, and a resin layer **118** arranged between the first metal layer **116** and the second metal layer **117**. According to the configuration, the frame panel **110** may have relatively better flatness, and improved rigidity relative to weight.

A size of a portion of the insert portion **111** formed on the resin layer **118** may be approximately the same as a size of another portion of the insert portion **111** formed in the first metal layer **116**. That is, the size of one portion of the insert portion **111** formed in the resin layer **118** may be greater than the size of still another portion of the insert portion **111** formed in the second metal layer **117**.

The first opening **111***a* may be formed in the first metal layer **116**, and the second opening **111***b* may be formed in the second metal layer **117**.

Referring to FIG. **7**, the stud **120** may be inserted into the insert portion **111** through the first opening **111***a*. The stud **120** may include a coupling portion **120***a* opened toward the second opening **111***b*. A screw thread **121** may be formed on an inner circumferential surface of the coupling portion **120***a*. The coupling portion **120***a* may be opened toward the first opening **111***a*. The stud **120** may be supported by a portion of the frame panel **110** forming the second opening **111***b*.

The frame **100** may include a plurality of module openings **101** formed to correspond to the plurality of display modules **30**A-**30***w*.

The brackets **160**, **172**, **180**, and **190** may be detachably mounted on the rear surface of the frame panel **110**. The brackets **160**, **172**, **180**, and **190** may be detachably coupled to the stud **120**. The brackets **160**, **172**, **180**, and **190** may include at least one of a board bracket **160**, a chassis bracket **172**, a mounting bracket **180**, and a reinforcing bracket **190**.

Referring to FIGS. **5** and **6**, a circuit board (not shown) configured to drive the display apparatus **1** may be mounted on the board bracket **160**. The board bracket **160** may be provided in plurality. The board bracket **160** may include a board bracket hole **161**. The board bracket hole **161** may be formed to correspond to the second opening **111***b* of the frame panel **110**. As a fastening member (not shown) passes through the board bracket hole **161** and is coupled to the screw thread **121** of the stud **120**, the board bracket **160** may be fixed to the frame **100**.

Referring to FIGS. **5** and **8**, the chassis bracket **172** may be provided to fix a front chassis **171** provided to cover the edge of the frame **100** to the frame **100**. The chassis bracket **172** may be provided in plurality. The chassis bracket **172** may include a chassis bracket hole **173**. The chassis bracket hole **173** may be formed to correspond to the second opening **111***b* of the frame panel **110**. As a fastening member (not shown) passes through the chassis bracket hole **173** and is coupled to the screw thread **121** of the stud **120**, the chassis bracket **172** may be fixed to the frame **100**. The front chassis **171** may be fixed to the chassis bracket **172** fixed to the frame **100**.

Referring to FIGS. **5** and **9**, the mounting bracket **180** may be provided to be coupled to a wall mount (not shown) in response to the display apparatus **1** being fixed to a wall. The mounting bracket **180** may include a mounting bracket hole **181**. The mounting bracket hole **181** may be formed to correspond to the second opening **111***b* of the frame panel **110**. As a fastening member (not shown) passes through the mounting bracket hole **181** and is coupled to the screw thread **121** of the stud **120**, the mounting bracket **180** may be fixed to the frame **100**.

Referring to FIGS. **5** and **10**, the reinforcing bracket **190** may be provided to increase the strength of the frame **100**. The reinforcing bracket **190** may extend in an approximately horizontal direction. The reinforcing bracket **190** may include a reinforcing bracket hole **191**. The reinforcing bracket hole **191** may be formed to correspond to the second opening **111***b* of the frame panel **110**. As a fastening member (not shown) passes through the reinforcing bracket hole **191** and is coupled to the screw thread **121** of the stud **120**, the reinforcing bracket **190** may be fixed to the frame **100**.

Although not shown, the display apparatus **1** may include a stand. An insert portion **111**, into which a stud **120** for a bracket to which the stand is coupled may be inserted, may be formed in the frame **100**.

The frame **100** may include a reinforcing member **130** attached to the first side **110***a* of the frame panel **110**. The reinforcing member **130** may be provided to cover the first opening **111***a*. The plurality of display modules **30**A-**30***w* may be installed on the reinforcing member **130**. The reinforcing member **130** may include carbon fiber reinforced plastics (CFRP).

FIG. **11** is a view illustrating a state in which the frame panel shown in FIG. **5** is provided. FIG. **12** is a view illustrating a state in which a stud is inserted into an insert portion of the frame panel shown in FIG. **11**. FIG. **13** is a view illustrating another embodiment of the insert portion of the frame panel shown in FIG. **12**. FIG. **14** is a view illustrating a state in which a reinforcing member is attached to the frame panel shown in FIG. **12**. FIG. **15** is a view illustrating a state in which module openings are formed in the frame shown in FIG. **14**. FIG. **16** is a view illustrating a state in which the brackets are mounted to the frame shown in FIG. **15**.

A process of manufacturing the display apparatus **1** according to an embodiment of the disclosure will be described with reference to FIGS. **11** to **16**.

Referring to FIG. **11**, the frame panel **110** including the first metal layer **116**, the second metal layer **117**, and the resin layer **118** may be provided. The insert portion **111** may be formed in the frame panel **110**. The insert portion **111** may be formed in the first side **110***a* of the frame panel **110**. The insert portion **111** may be formed to pass through the second side **110***b* from the first side **110***a* of the frame panel **110**. The insert portion **111** may be formed at various positions according to the type of brackets **160**, **172**, **180**, and **190** to be mounted on the frame **100**.

The insert portion **111** may be formed in various ways. The insert portion **111** may be formed on the first side **110***a* of the frame panel **110** by using at least one of a shape processing apparatus, a water jet, and a laser.

The insert portion **111** may be formed by a shape processing apparatus (not shown). The shape processing apparatus may include a router. Based on the insert portion **111** being formed by the shape processing apparatus, the insert portion **111** may be formed to have a shape in which a step difference is formed between the first opening **111***a* and the second opening **111***b*, as shown in FIG. **12**.

Alternatively, an insert portion **211** may be formed by a water jet and/or a laser. Based on the insert portion **211** being formed by the water jet and/or the laser, an insert portion **211**

may be formed to have a shape that tapers from the first opening **211***a* to the second opening **211***b*, as shown in FIG. **13**. The insert portion **211** may be formed to decrease in size from the first metal layer **116** to the second metal layer **117**.

Referring to FIG. **12**, the stud **120** may be inserted into the frame panel **110** on which the insert portion **111** is formed. The stud **120** may be press-fitted from the first side **110***a*. The stud **120** may be inserted into the insert portion **111** in a direction that is toward the second opening **111***b* through the first opening **111***a*. Accordingly, in response to the stud **120** being inserted into the insert portion **111**, the stud **120** may be supported by a portion of the frame panel **110** in which the portion of the frame panel **110** forms the second opening **111***b*.

Referring to FIG. **14**, after the stud **120** is inserted into the insert portion **111** of the frame panel **110**, the reinforcing member **130** may be attached to the first side **110***a* of the frame panel **110**. Accordingly, the first opening **111***a* of the insert portion **111** may be covered by the reinforcing member **130**.

Referring to FIG. **15**, after attaching the reinforcing member **130** to the frame panel **110**, the module openings **101** may be formed in the frame panel **110** and the reinforcing member **130**. Because the module openings **101** are formed after attaching the reinforcing member **130** to the frame panel **110**, it is possible to simplify a manufacturing process.

Referring to FIG. **16**, the brackets **160**, **172**, **180**, and **190** may be mounted on the frame **100** in which the module openings **101** are formed. Particularly, the board bracket **160** may be mounted to the frame **100** as being coupled to a first stud at the second side **110***b* of the frame panel **110**. The chassis bracket **172** may be mounted to the frame **100** as being coupled to a second stud at the second side **110***b* of the frame panel **110**. The mounting bracket **180** may be mounted to the frame **100** as being coupled to a third stud at the second side **110***b* of the frame panel **110**. The reinforcing bracket **190** may be mounted to the frame **100** as being coupled to a fourth stud at the second side **110***b* of the frame panel **110**. The brackets **160**, **172**, **180**, and **190** may be detachably coupled to the first to fourth studs through the second openings **111***b* of the frame panel **110**. Each of the first to fourth studs has a shape corresponding to the shape of the stud **120**.

After mounting the brackets **160**, **172**, **180**, and **190** on the frame **100**, the plurality of display modules **30**A-**30***w* may be installed on the front surface of the frame **100**.

As is apparent from the above description, a display apparatus and a manufacturing method thereof may improve a pulling force or a torque resistance of a frame provided to support a plurality of display modules, by forming an insert portion of the frame, which is for inserting a stud to which a bracket is detachably coupled, in such a way that a size of a first opening formed on a first side is different from a size of a second opening formed on a second side.

According to various embodiments, the display apparatus is capable of improving a pulling force or a torque resistance of a frame provided to support a plurality of display modules.

According to various embodiments, the display apparatus may secure a flat surface to tile the plurality of display modules attached to a front surface of the frame because a surface formed on a first side of a frame panel is flat without a protruding portion.

Although a few embodiments of the disclosure have been shown and described, it would be appreciated by those skilled in the art that changes may be made in these embodiments without departing from the principles and spirit of the disclosure, the scope of which is defined in the claims and their equivalents.

What is claimed is:

1. A display apparatus comprising:

a plurality of display modules; and

a frame provided to support the plurality of display modules, the plurality of display modules being arranged in an M*N matrix on the frame,

wherein the frame comprises a frame panel comprising a first side and a second side opposite to the first side, and

wherein the frame panel comprises:

an insert portion passing through the frame panel and having a first opening formed on the first side and a second opening formed on the second side, and a size of the first opening being greater than a size of the second opening; and

a stud provided in the insert portion,

wherein the insert portion is formed in a shape that tapers from the first side toward the second side.

2. The display apparatus of claim **1**, wherein the stud comprises a coupling portion having an opening toward the second opening, and

wherein the coupling portion comprises a screw thread formed on an inner circumferential surface of the coupling portion.

3. The display apparatus of claim **1**, further comprising:

a bracket detachably coupled to the stud through the second opening,

wherein the bracket comprises at least one of a mounting bracket, a chassis bracket, a reinforcing bracket, and a board bracket.

4. The display apparatus of claim **1**, wherein the frame further comprises a reinforcing member attached to the first side of the frame panel and provided to cover the first opening.

5. The display apparatus of claim **4**, wherein the plurality of display modules are attached to the reinforcing member.

6. The display apparatus of claim **1**, wherein the frame panel further comprises:

a first metal layer forming the first side of the frame panel;

a second metal layer forming the second side of the frame panel; and

a resin layer arranged between the first metal layer and the second metal layer.

7. The display apparatus of claim **6**, wherein a size of a portion of the insert portion formed in the resin layer is a same as a size of another portion of the insert portion formed in the first metal layer.

8. The display apparatus of claim **1**, wherein each of a surface formed on the first side of the frame panel and a surface formed on the second side of the frame panel is flat.

9. A manufacturing method of a display apparatus, the method comprising:

providing a frame panel including a first side and a second side opposite to the first side;

forming an insert portion to pass through the frame panel and having a first opening formed on the first side and a second opening formed on the second side, and a size of the first opening being greater than a size of the second opening;

inserting a stud into the insert portion through the first opening; and

detachably coupling a bracket to the stud through the second opening,

wherein the forming of the insert portion comprises forming the insert portion in a shape that tapers from the first side toward the second side.

10. The manufacturing method of claim **9**, wherein the stud includes a coupling portion having an opening toward the second opening, and the coupling portion includes a screw thread formed on an inner circumferential surface of the coupling portion.

11. The manufacturing method of claim **9**, further comprising:

attaching a reinforcing member to the first side of the frame panel after inserting the stud into the insert portion.

12. The manufacturing method of claim **11**, further comprising:

forming a module opening on the frame panel and the reinforcing member after attaching the reinforcing member to the first side of the frame panel.

13. The manufacturing method of claim **12**, further comprising:

attaching a plurality of display modules to the reinforcing member after forming the module opening.

14. The manufacturing method of claim **9**, wherein the bracket includes at least one of a mounting bracket, a chassis bracket, a reinforcing bracket, and a board bracket.

15. The manufacturing method of claim **14**, wherein the forming of the insert portion comprises forming the insert portion from the first side by using at least one of a shape processing apparatus, a water jet, and a laser.

16. The manufacturing method of claim **9**, wherein each of a surface formed on the first side of the frame panel and a surface formed on the second side of the frame panel is flat.

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