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(54) **DISPLAY MODULE AND ELECTRONIC DEVICE**

(57) This application provides a display module and an electronic device. The display module includes a display panel, a first module stack layer, and a transmission layer that are stacked. The first module stack layer is located on a side away from a light-emitting surface of the display panel. A first substack layer of the first module stack layer is stacked between the transmission layer and the display panel. The first substack layer includes a hard material. At least two wiring connection structures of the display module are connected to the transmission layer, one of the at least two wiring connection structures

is configured to electrically connect to a first component in the electronic device, and another of the at least two wiring connection structures is configured to electrically connect to a second component in the electronic device, so that the transmission layer is configured to transmit a signal between the first component and the second component. In this application, a compact structure of the electronic device can be implemented through the display module, to help save internal space of the electronic device.

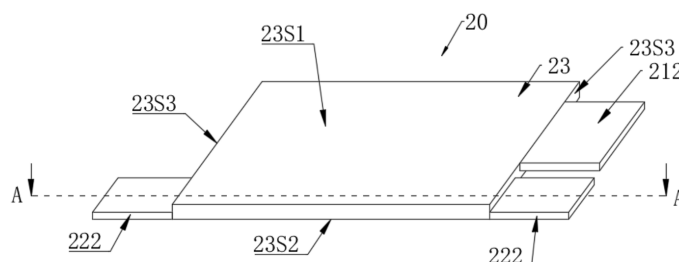


FIG. 5

Description

[0001] This application claims priority to Chinese Patent Application No. 202311715876.X, filed with the China National Intellectual Property Administration on December 13, 2023 and entitled "DISPLAY MODULE AND ELECTRONIC DEVICE", which is incorporated herein by reference in its entirety.

TECHNICAL FIELD

[0002] This application relates to the field of display technologies, and in particular, to a display module and an electronic device.

BACKGROUND

[0003] A large quantity of transmission lines (which may be signal transmission lines and power transmission lines) are distributed inside an electronic device like a terminal. For example, the transmission lines may be roughly classified into the following types: display signal, camera signal, radio frequency signal, audio signal, sensor, power supply, and the like. Arranging numerous transmission lines inside the electronic device requires design for line storage and organization while occupying internal space of the electronic device. For example, the transmission lines are designed in a form of a flexible printed circuit (Flexible Printed Circuit, FPC), to enable communication and power supply between a system on a chip (System on a chip, SoC) and each hardware interface. The FPC needs to be independently assembled and fastened. The FPC needs to occupy space in the electronic device, especially space in a thickness direction of the electronic device. This is not conducive to a compact structure and thin design of the electronic device.

SUMMARY

[0004] Embodiments of this application provide a display module and an electronic device. A display panel and a transmission layer are integrated into the display module. The transmission layer transmits a signal between a first component and a second component in the electronic device, so that an internal structure of the electronic device is compact and a thin design is easy to implement.

[0005] According to a first aspect, an embodiment of this application provides a display module, used in an electronic device. The display module includes a display panel, a first module stack layer, and a transmission layer that are stacked. The first module stack layer is located on a side away from a light-emitting surface of the display panel. The first module stack layer includes a first substack layer. The first substack layer is stacked between the transmission layer and the display panel. The first substack layer includes a hard material. The display

module further includes a display connection structure and at least two wiring connection structures. The display panel is electrically connected to a control unit in the electronic device through the display connection structure. The transmission layer is electrically connected to the at least two wiring connection structures. One of the at least two wiring connection structures is configured to electrically connect the transmission layer to a first component in the electronic device, and another of the at least two wiring connection structures is configured to electrically connect the transmission layer to a second component in the electronic device, so that the transmission layer transmits a signal between the first component and the second component.

[0006] In this application, the transmission layer and the display panel are integrated into the display module. The display module performs a display function through the display panel and a signal transmission function through the transmission layer. Signal transmission between the first component and the second component in the electronic device can be implemented through the transmission layer. There is no need to dispose more transmission lines in the electronic device, to reduce a quantity of transmission lines in an apparatus body of the electronic device and facilitate a light and thin design of the apparatus body. Because a line in the transmission layer is a patterned wiring structure, for the display module, a newly added line is prone to a pattern imprint. The pattern imprint may be understood as that an imprint formed by a pattern of an internal line can be seen on a display surface of the display module. The pattern imprint affects quality, reliability, and user experience of the display module. In this application, the first substack layer in the first module stack layer is disposed between the transmission layer and the display panel. The transmission layer is isolated from the display panel through the hard material of the first substack layer, to prevent a pattern imprint on the display module due to the transmission layer, and improve the quality and reliability of the display module.

[0007] In a possible implementation, the hard material of the first substack layer includes a carbon fiber or hard alloy material. In an implementation of this application, the hard material of the first substack layer may be specifically the carbon fiber or hard alloy material. The hard alloy material may be a 304 alloy, a titanium alloy, or the like.

[0008] In a possible implementation, the display module has a first window and a second window. In a thickness direction of the display module, the first window and the second window are located on a side that is of the transmission layer and that is away from the display panel. A direction in which the display panel, the first module stack layer, and the transmission layer are stacked is the thickness direction of the display module. One of the at least two wiring connection structures is electrically connected to the wiring layer of the transmission layer in the first window. Another of the at least two

wiring structures is electrically connected to the wiring layer of the transmission layer in the second window. In an implementation of this application, the first window and the second window are provided, so that the wiring connection structures can be connected to the wiring layer of the transmission layer in the windows. This facilitates a small size of an edge part of the display module, and improves a screen-to-body ratio of the display module. In addition, the hard material of the first substack layer in the first module stack layer is used to support the display panel at the first window and the second window. At positions of the windows, disposing the hard material of the first substack layer prevents a pattern imprint, to help ensure the quality and reliability of the display module.

[0009] In a possible implementation, the first module stack layer further includes a second substack layer. The second substack layer and the first substack layer are made of different materials. The transmission layer is located between the first substack layer and the second substack layer. The second substack layer is made of a flexible material and configured to form an electrostatic protection structure on a side that is of the transmission layer and that is away from the first substack layer. The first window and the second window penetrate the second substack layer. In an implementation of this application, the transmission layer is disposed between the second substack layer and the first substack layer. A pattern imprint problem is resolved through the hard material of the first substack layer. In addition, electrostatic protection provided by the second substack layer can safeguard a line in the transmission layer against static electricity, to ensure signal transmission stability and safety of the display module.

[0010] In a possible implementation, the first substack layer is made of a metal material. The first substack layer is configured to shield signal interference between the transmission layer and the display panel. In an implementation of this application, the first substack layer is set to the metal material, so that the first substack layer is not only configured to support the display panel, but also can shield the signal interference between the transmission layer and the display panel. This facilitates a thin design of the display module, and can ensure signal transmission stability of the display module.

[0011] In a possible implementation, a thickness of the first substack layer ranges from 100 μm to 300 μm ; and a thickness of the second substack layer ranges from 20 μm to 50 μm . Both the second substack layer and the first substack layer may be made of a metal material. Their dimensions in a thickness direction may determine whether they are hard or flexible. In an implementation of this application, the first substack layer is designed as a hard structure by limiting the thickness of the first substack layer, and the second substack layer is designed as a flexible structure by limiting the thickness of the second substack layer.

[0012] In a possible implementation, the first module

stack layer is located between the transmission layer and the display panel. The transmission layer is pasted to the first module stack layer through an adhesive layer. The transmission layer includes a substrate layer and the wiring layer. The wiring layer is stacked between the substrate layer and the first module stack layer. The first window and the second window penetrate the substrate layer. In an implementation of this application, the transmission layer is disposed at the bottom of the first module stack layer, that is, on a side that is of the first module stack layer and that is away from the display panel. The wiring layer is disposed between the substrate layer and the first module stack layer. The wiring layer is protected through the substrate. No additional protective layer structure needs to be disposed. In addition, the substrate is provided with the windows, so that the connections between the wiring connection structures and the wiring layer are located in the windows, and external space is not occupied, to facilitate a thin design of the display module.

[0013] In another implementation, the first module stack layer is located between the transmission layer and the display panel. The transmission layer is pasted to the first module stack layer through an adhesive layer. The transmission layer includes a substrate layer and the wiring layer. The wiring layer is stacked between the substrate layer and the first module stack layer. The substrate layer is a bottommost layer of the display module. An electrical connection structure is disposed in the substrate layer. The electrical connection structure is electrically connected to the wiring layer. The electrical connection structure is also configured to connect to the wiring connection structure. In an implementation of this application, the substrate layer does not need to be provided with a window. From a perspective of a manufacturing process, manufacturing is easy.

[0014] In a possible implementation, the first module stack layer is located between the transmission layer and the display panel. The transmission layer includes a substrate layer and the wiring layer. The substrate layer is pasted to the first module stack layer through an adhesive layer. The wiring layer is located on a side that is of the substrate layer and that is away from the first module stack layer. The display module further includes a bottom protective layer. The bottom protective layer covers the wiring layer on a side that is of the wiring layer and that is away from the substrate layer. The first window and the second window penetrate the bottom protective layer. In an implementation of this application, the transmission layer is disposed at the bottom of the first module stack layer. The wiring layer is disposed on the side that is of the substrate layer and that is away from the first module stack layer. The wiring layer is protected through the bottom protective layer. The first window and the second window penetrate the bottom protective layer, to facilitate manufacturing of the first window and the second window.

[0015] In a possible implementation, the display mod-

ule is capable of switching between a folded state and an unfolded state. The display module includes a first portion, a second portion, and a connection portion connected between the first portion and the second portion. The connection portion is configured to bend and deform in a process of switching between the folded state and the unfolded state. The wiring connection structure configured to electrically connect to the first component is connected to the first portion. The wiring connection structure configured to electrically connect to the second component is connected to the second portion. The first module stack layer includes a structure that has a bending function and that is located in the connection portion. For a foldable electronic device, the transmission layer is integrated into the display module, so that a design in which a transmission line passes through a rotating shaft in an apparatus body is eliminated, to reduce design costs and make a structure of the rotating shaft of the electronic device simpler and more reliable.

[0016] According to a second aspect, an embodiment of this application provides a display module, used in an electronic device. The display module includes a transmission layer and a display panel that are stacked. The transmission layer is located on a side away from a light-emitting surface of the display panel. The display module further includes a display connection structure and at least two wiring connection structures. The display panel is electrically connected to a control unit in the electronic device through the display connection structure. The at least two wiring connection structures each are connected to an edge of the transmission layer. One of the at least two wiring connection structures is configured to electrically connect the transmission layer to a first component in the electronic device, and another of the at least two wiring connection structures is configured to electrically connect the transmission layer to a second component in the electronic device, so that the transmission layer transmits a signal between the first component and the second component. In an implementation, the wiring connection structure is led out from an edge of the transmission layer. This can ensure integrity of a stacked structure formed by the display panel and the transmission layer, and eliminate a need to lead out the wiring connection structure through a window. Therefore, in a possible implementation of this application, a pattern imprint on the display module can be prevented, to help ensure quality and reliability of the display module.

[0017] In a possible implementation, the display module further includes a first module stack layer. The transmission layer is disposed between the first module stack layer and the display panel. Specifically, the transmission layer is disposed between the first module stack layer and the display panel, and the first module stack layer completely covers the transmission layer, to protect a line in the transmission layer. This helps ensure the quality and reliability of the display module.

[0018] In a possible implementation, the display panel includes a base layer, a shield layer, and a panel function

layer that are sequentially stacked. The shield layer includes a conductive material. The transmission layer is located between the first module stack layer and the base layer. The transmission layer includes a wiring layer. At least partial signal isolation is implemented between the wiring layer and the panel function layer through the conductive material of the shield layer. In a possible implementation, the shield layer is used to isolate signal interference between the wiring layer in the transmission layer and the panel function layer. A degree of integration is high, and no metal shield layer needs to be disposed in the transmission layer, to facilitate thinning of an electronic device.

[0019] In a possible implementation, the conductive material of the shield layer covers an entire surface of the base layer. In a possible implementation, patterning does not need to be performed on the shield layer, so that manufacturing is easy and manufacturing costs are low.

[0020] In a possible implementation, the shield layer is a patterned conductive layer structure. A specific shape of a pattern of the shield layer may be set for a pattern of the wiring layer in the transmission layer. The patterned conductive layer structure of the shield layer may be wider than a patterned conductive structure of the wiring layer in the transmission layer. The patterned conductive layer structure of the shield layer may completely cover the patterned conductive structure of the wiring layer in the transmission layer.

[0021] In a possible implementation, the transmission layer includes a substrate layer. The wiring layer is formed on a surface of the substrate layer. The wiring layer is pasted to the base layer and/or the first module stack layer through an adhesive layer.

[0022] In a possible implementation, a thickness of the substrate layer ranges from 10 μm to 50 μm . In a possible implementation, the thickness of the substrate layer is limited within a proper range. For a display module having a bending function, an excessively large thickness of the substrate layer, which exceeds 50 μm , impairs effect of the display module and compromises experience. An excessively small thickness of the substrate layer, which is less than 10 μm , leads to great difficulty in a manufacturing process of the transmission layer, making it challenging to ensure a product yield and resulting in high manufacturing costs.

[0023] In a possible implementation, an elastic modulus of the substrate layer is 2.5 GPa to 9 GPa. In a possible implementation, an elongation at break of the substrate layer needs to be greater than 5%. In a possible implementation, the elastic modulus and elongation at break of the substrate layer are limited to satisfy bending performance of the display module. The elastic modulus is 2.5 GPa to 9 GPa, and the elongation at break needs to be greater than 5%. Both conditions enable the display module to achieve good bending performance. An impedance requirement for signal transmission can also be met.

[0024] In a possible implementation, a thickness of the

wiring layer ranges from 3 μm to 10 μm . In a possible implementation, the thickness of the wiring layer is limited within a specific range, so that the display module can have good bending performance. Limiting the thickness of the wiring layer within a range of 3 μm to 10 μm also helps resolve a pattern imprint problem of the display module. An excessively large thickness of the wiring layer affects an overall thickness of the display module, which is not conducive to a thin design. It also affects bending performance and results in a pattern imprint. The pattern imprint may be understood as that a line imprint of the wiring layer can be seen on a light exit surface of the display module, which affects user experience of the electronic device.

[0025] In a possible implementation, the display module is used in an electronic device having a folding function. The display module is capable of switching between a folded state and an unfolded state. The display module includes a first portion, a second portion, and a connection portion connected between the first portion and the second portion. The connection portion is configured to bend and deform in a process of switching between the folded state and the unfolded state. The wiring connection structure configured to electrically connect to the first component is connected to the first portion. The wiring connection structure configured to electrically connect to the second component is connected to the second portion. Both the first portion and the second portion are rectangular. The transmission layer and the display panel form a stacked structure. The stacked structure includes a first edge and a second edge that are adjacent to each other. The first edge is a long edge of the first portion. A part of the second edge forms a short edge of the first portion. A part of the second edge forms a short edge of the second portion. The display connection structure is connected to the first edge. At least two of the wiring connection structures are connected to the second edge.

[0026] In a possible implementation, the display module is used in an electronic device having a folding function. The display module is capable of switching between a folded state and an unfolded state. The display module includes a first portion, a second portion, and a connection portion connected between the first portion and the second portion. The connection portion is configured to bend and deform in a process of switching between the folded state and the unfolded state. The wiring connection structure configured to electrically connect to the first component is connected to the first portion. The wiring connection structure configured to electrically connect to the second component is connected to the second portion. Both the first portion and the second portion are rectangular. The transmission layer and the display panel form a stacked structure. The stacked structure includes a first edge and a third edge that are opposite to each other. The display connection structure is connected to the first edge. One of the wiring connection structures is connected to the first edge and overlaps with the display connection structure. Another of the wiring connection

structures is connected to the third edge.

[0027] In a possible implementation, the display module is used in an electronic device having a folding function. The display module is capable of switching between a folded state and an unfolded state. The display module includes a first portion, a second portion, and a connection portion connected between the first portion and the second portion. The connection portion is configured to bend and deform in a process of switching between the folded state and the unfolded state. The wiring connection structure configured to electrically connect to the first component is connected to the first portion. The wiring connection structure configured to electrically connect to the second component is connected to the second portion. Both the first portion and the second portion are rectangular. The transmission layer and the display panel form a stacked structure. The stacked structure includes a first edge and a third edge that are opposite to each other. The display connection structure is connected to a first region of the first edge. One of the wiring connection structures is connected to a second region of the first edge and arranged side by side with the display connection structure. Another of the wiring connection structures is connected to the third edge.

[0028] In a possible implementation, the display module is used in an electronic device having a folding function. The display module is capable of switching between a folded state and an unfolded state. The display module includes a first portion, a second portion, and a connection portion connected between the first portion and the second portion. The connection portion is configured to bend and deform in a process of switching between the folded state and the unfolded state. The wiring connection structure configured to electrically connect to the first component is connected to the first portion. The wiring connection structure configured to electrically connect to the second component is connected to the second portion. Both the first portion and the second portion are rectangular. The transmission layer and the display panel form a stacked structure. The stacked structure includes a first edge. One of the wiring connection structures is connected to the first edge. The display connection structure is connected to the first edge. The display connection structure and the wiring connection structure connected to the first edge are connected to different flexible circuit boards. The display connection structure is electrically connected to the control unit in the electronic device through the flexible circuit board. The wiring connection structure implements a conductive connection between the transmission layer and a component in the electronic device through the flexible circuit board.

[0029] In a possible implementation, the display module is used in an electronic device having a folding function. The display module is capable of switching between a folded state and an unfolded state. The display module includes a first portion, a second portion, and a connection portion connected between the first portion and the second portion. The connection portion is configured to

bend and deform in a process of switching between the folded state and the unfolded state. The wiring connection structure configured to electrically connect to the first component is connected to the first portion. The wiring connection structure configured to electrically connect to the second component is connected to the second portion. Both the first portion and the second portion are rectangular. The transmission layer and the display panel form a stacked structure. The stacked structure includes a first edge. One of the wiring connection structures is connected to the first edge. The display connection structure is connected to the first edge. The display connection structure and the wiring connection structure connected to the first edge are connected to different positions of a same flexible circuit board. The display connection structure is electrically connected to the control unit in the electronic device through the flexible circuit board. The wiring connection structure implements a conductive connection between the transmission layer and a component in the electronic device through the flexible circuit board.

[0030] According to a third aspect, an embodiment of this application provides an electronic device, including an apparatus body and the display module according to any one of the possible implementations of the first aspect. A control unit, a first component, and a second component are disposed in the apparatus body. The display module is connected to the apparatus body. The display connection structure is electrically connected to the control unit. One of the wiring connection structures is electrically connected to the first component. Another of the wiring connection structures is electrically connected to the second component. In the electronic device provided in this application, signal transmission between the first component and the second component in the apparatus body is implemented through an integrated wiring portion in the display module, so that space in the apparatus body can be saved, to facilitate a thin design of the electronic device. The display module provided in a possible implementation of this application can further improve a capacitor capacity of the electronic device. A structure of a transmission line in the apparatus body is integrated into the display module. This can improve flexibility of an overall design of the electronic device. No transmission line needs to be disposed in a thickness direction of the battery, so that a thickness of the battery can be increased. In other words, a part of space originally for disposing the transmission line in the apparatus body is provided for the battery, so that the battery can have a larger capacity and a longer battery life.

BRIEF DESCRIPTION OF DRAWINGS

[0031]

FIG. 1A is a diagram of an electronic device at a specific position in a process of switching from an unfolded state to a folded state according to an

implementation;

FIG. 1B is a diagram of the electronic device shown in FIG. 1A in the folded state;

FIG. 2A is a diagram of an electronic device at a specific position in a process of switching from an unfolded state to a folded state according to an implementation;

FIG. 2B is a diagram of the electronic device shown in FIG. 2A in the folded state;

FIG. 3A is a diagram of an electronic device at a specific position in a process of switching from an unfolded state to a folded state according to an implementation;

FIG. 3B is a diagram of the electronic device shown in FIG. 3A in the folded state;

FIG. 4 is a diagram of interconnection between various functional components in an apparatus body of an electronic device through transmission lines according to an implementation;

FIG. 5 is a diagram of a display module according to an implementation of this application;

FIG. 6 is a diagram of a display module according to another implementation of this application;

FIG. 7 is a schematic sectional view taken along a dashed line A-A in the implementations shown in FIG. 5 and FIG. 6;

FIG. 8 is a schematic sectional view of a display module according to an implementation of this application;

FIG. 9 is a schematic sectional view of a display module according to an implementation of this application;

FIG. 10 is a schematic sectional view of a display module according to an implementation of this application;

FIG. 11 is a schematic sectional view of a display module according to an implementation of this application;

FIG. 12 is a schematic sectional view of a display module according to an implementation of this application;

FIG. 13A is a schematic plan view of an apparatus body of an electronic device according to an implementation;

FIG. 13B is a schematic plan view of a display module of an electronic device according to an implementation;

FIG. 14A is a diagram showing that the apparatus body provided in FIG. 13A and the display module provided in FIG. 13B are assembled together;

FIG. 14B is a diagram of an electrical connection between a component in a first body and a component in a second body through a transmission line in an apparatus body;

FIG. 15, FIG. 16, FIG. 17, FIG. 18, FIG. 19, and FIG. 20 are diagrams of display modules according to different implementations;

FIG. 21 is a schematic plan view of a stacked struc-

ture according to an implementation;

FIG. 22 is a schematic sectional view of a display module according to an implementation of this application;

FIG. 23 is a schematic sectional view of a display module according to an implementation of this application;

FIG. 24, FIG. 25, and FIG. 26 are diagrams of a solution in which a wiring connection structure and a display connection structure that are located on a same side of a stacked structure share one flexible circuit board, where FIG. 25 and FIG. 26 are schematic sectional views of the solution in which the flexible circuit board is shared, and FIG. 24 is a schematic plan view of the solution in which the flexible circuit board is shared in FIG. 25 and FIG. 26; FIG. 27 is a schematic sectional view of a display module according to an implementation of this application;

FIG. 28 is a schematic sectional view of a display module according to an implementation of this application;

FIG. 29 is a schematic sectional view of a stacked structure of a display module according to an implementation of this application;

FIG. 30 is a schematic sectional view of a stacked structure of a display module according to an implementation of this application;

FIG. 31 is a schematic sectional view of a stacked structure of a display module according to an implementation of this application;

FIG. 32 is a schematic sectional view of a stacked structure of a display module according to an implementation of this application; and

FIG. 33 is a schematic sectional view of a stacked structure of a display module according to an implementation of this application.

DESCRIPTION OF EMBODIMENTS

[0032] The following describes possible implementations of this application with reference to the accompanying drawings in the possible implementations of this application.

[0033] Embodiments of this application provide an electronic device and a display module. The display module is a part of the electronic device. Examples of the electronic device may include, but are not limited to, a smartphone, a mobile phone, a tablet personal computer ("PC"), a personal digital assistant ("PDA"), a portable multimedia player ("PMP"), a television, a game console, a watch-type electronic apparatus, a head-mounted display, a monitor of a personal computer, a laptop computer, an automotive navigation system, a vehicle's dashboard, a digital camera, a camcorder, an external billboard, an electronic billboard, various medical devices, various inspection devices, various household appliances (such as a refrigerator or a washing machine) that

display an image or a video on a display portion DPA, a physical electronic device, an internet-connected everyday item (such as an internet of things device), and/or the like. The electronic device may be a foldable apparatus.

The electronic device may alternatively be a bar-type device, namely, a non-foldable electronic device.

[0034] The term "foldable apparatus" used in this specification refers to an apparatus that can be folded and unfolded and a folded apparatus that remains in a folded state (for example, cannot be unfolded). A foldable electronic device may be folded at an angle between 0 degrees and approximately 180 degrees, but the present disclosure is not limited thereto. An electronic device that is set to be flat is considered to be set at 0 degrees and may be folded at an angle greater than or less than 180 degrees. In embodiments, for example, the electronic device may be folded relative to 0 degrees at an angle greater than or equal to 90 degrees and less than 180 degrees, or greater than or equal to 120 degrees and less than 180 degrees. In addition, the folded state may be a state resulting from folding from an unfolded state, even without complete folding.

[0035] In an implementation, the electronic device is a foldable mobile terminal, and the display module is a flexible display module. When the electronic device is folded, the display module is folded to achieve a small overall size for easy portability. When the electronic device is unfolded, the display module is unfolded and forms a large display interface. The electronic device provided in specific embodiments of this application may be a bi-fold device (as shown in FIG. 1A, FIG. 1B, FIG. 2A, and FIG. 2B) or a tri-fold device (as shown in FIG. 3A and FIG. 3B). For example, if the electronic device is a bi-fold device, the display module may adopt an inward-folding architecture (as shown in FIG. 1A and FIG. 1B) or an outward-folding architecture (as shown in FIG. 2A and FIG. 2B).

[0036] FIG. 1A is a diagram of an electronic device at a specific position in a process of switching from an unfolded state to a folded state according to an implementation. FIG. 1B is a diagram of the electronic device shown in FIG. 1A in the folded state. With reference to FIG. 1A and FIG. 1B, in an implementation, an electronic device 100 is a bi-fold device with an inward-folding solution. The electronic device 100 includes an apparatus body 10 and a display module 20. The display module 20 is connected to the apparatus body 10. The apparatus body 10 includes a first body 1, a second body 2, and a rotating shaft 3. The rotating shaft 3 is located between the first body 1 and the second body 2, so that the first body 1 and the second body 2 can be folded or unfolded relative to each other. The display module 20 includes a first portion 201, a second portion 203, and a connection portion 202 connected between the first portion 201 and the second portion 203. The first portion 201 is connected to the first body 1. The second portion 203 is connected to the second body 2. When the first body 1 and the second body 2 are folded relative to each other, the display

module 20 is located on an inner side of a folding direction. When the first body 1 and the second body 2 are folded relative to each other, the first portion 201 and the second portion 203 are folded relative to each other, and the connection portion 202 bends and deforms. In the folded state, the display module 20 is located between the first body 1 and the second body 2, and the first portion 201 and the second portion 203 are stacked. As shown in FIG. 1B, the display module 20 is hidden from view by the apparatus body 10.

[0037] FIG. 2A is a diagram of an electronic device at a specific position in a process of switching from an unfolded state to a folded state according to an implementation. FIG. 2B is a diagram of the electronic device shown in FIG. 2A in the folded state. With reference to FIG. 2A and FIG. 2B, in an implementation, an electronic device 100 is a bi-fold device with an outward-folding solution. When a first body 1 and a second body 2 of an apparatus body 10 are folded relative to each other, a display module 20 is located on an outer side of a folding direction, and a first body 1 and a second body 2 get close to each other, so that they are stacked in the folded state. In the folded state, the display module 20 is wrapped around a periphery of the apparatus body 10.

[0038] FIG. 3A is a diagram of an electronic device at a specific position in a process of switching from an unfolded state to a folded state according to an implementation. FIG. 3B is a diagram of the electronic device shown in FIG. 3A in the folded state. With reference to FIG. 3A and FIG. 3B, in an implementation, an electronic device 100 is a tri-fold device. An apparatus body 10 includes a first body 1, a second body 2, a rotating shaft 3, a rotating shaft 4, and a third body 5. The rotating shaft 3 is connected between the first body 1 and the second body 2. The rotating shaft 4 is connected between the third body 5 and the second body 2. A display module 20 includes a first portion 201, a connection portion 202, a second portion 203, a connection portion 204, and a third portion 205. The connection portion 202 is connected between the first portion 201 and the second portion 203. The connection portion 204 is connected between the third portion 205 and the second portion 203. The first portion 201 is connected to the first body 1. The second portion 203 is connected to the second body 2. The third portion 205 is connected to the third body 5. When the first body 1 and the second body 2 are folded relative to each other, the first portion 201 and the second portion 203 correspond to the outward-folding solution, that is, the first portion 201 and the second portion 203 are located on an outer side of a folding direction. When the second body 2 and the third body 5 are folded relative to each other, the second portion 203 and the third portion 205 correspond to the inward-folding solution, that is, the second portion 203 and the third portion 205 are located on an inner side of a folding direction. In the folded state, both the apparatus body 10 and the display module 20 are folded into a tri-fold architecture, and the first body 1, the second body 2, and the third body 5 are stacked. In

the folded state, the first portion 201 is located on an outer surface of the apparatus body 10 and configured to display an interface. The second portion 203 and the third portion 205 are sandwiched and hidden between the second body 2 and the third body 5.

[0039] FIG. 4 is a diagram of interconnection between various functional components in an apparatus body of an electronic device through transmission lines according to an implementation. With reference to FIG. 4, for example, the electronic device includes the following functional components: an SoC (system on chip, system on a chip), a display module, a radio frequency component, a camera component, an audio component, a power supply, and a sensor. The SoC is electrically connected to the display module through a transmission line L1. The SoC is electrically connected to the radio frequency component through a transmission line L2. The SoC is electrically connected to the camera component through a transmission line L3. The SoC is electrically connected to the audio component through a transmission line L4. The SoC is electrically connected to the power supply through a transmission line L5. The SoC is electrically connected to the sensor through a transmission line L6. FIG. 4 schematically shows the connections between the SoC and the other functional components through the transmission lines. It may be understood that a transmission line may be further needed between the other functional components. For example, the power supply may further supply power to a plurality of functional components. More functions of the electronic device leads to more functional components in the apparatus body of the electronic device and more transmission lines between various functional components. The transmission line is configured to transmit a signal between the functional components. The signal may be a data signal or a power signal. In an implementation, the transmission lines are disposed in the apparatus body. When there are a large quantity of functional components, a quantity of transmission lines also increases. Numerous transmission lines need to occupy large space in the apparatus body, making it difficult to implement a thin design for the apparatus body. In addition, when the electronic device is a foldable apparatus, the transmission line needs to pass through a rotating shaft of the electronic device to implement an electrical connection between functional components in different bodies. That the transmission line passes through the rotating shaft requires structural design for the rotating shaft and consideration of how the transmission line located at the rotating shaft affects an overall structure or a bending form, resulting in higher design costs.

[0040] In an implementation of this application, a transmission line configured to electrically connect different functional components in the electronic device is integrated into the display module. In a process of manufacturing the display module, the transmission line may be manufactured therein, to reduce a quantity of transmission lines in the apparatus body of the electronic device.

This is conducive to a light and thin design of the apparatus body. Alternatively, the transmission line may be made into a transmission layer with a structure matching a size of the display module, and integrated into the display module by pasting the transmission layer to a back surface of the display module and without the transmission line. For a foldable electronic device, a design in which a transmission line passes through a rotating shaft is further eliminated, to reduce design costs and make a structure of the rotating shaft simpler and more reliable.

[0041] FIG. 5 is a diagram of a display module according to an implementation of this application. FIG. 6 is a diagram of a display module according to another implementation of this application. With reference to FIG. 5 and FIG. 6, a display module 20 includes a stacked structure 23, and at least two wiring connection structures 222 and a display connection structure 212 that are connected to the stacked structure 23. FIG. 5 schematically shows an embodiment in which the display module 20 has one display connection structure 212 and two wiring connection structures 222. FIG. 6 schematically shows an embodiment in which the display module 20 has one display connection structure 212 and three wiring connection structures 222. The stacked structure 23 may be understood as a combination of all layer structures in the display module, for example, may include a display panel, a first module stack layer located on a backlight side of the display panel, a second module stack layer located on a light exit side of the display panel, and the like. The display panel is a structure that is of the display module and that is configured to perform a display function, for example, an OLED display panel.

[0042] In this application, an appropriate quantity of wiring connection structures 222 may be disposed based on a specific application scenario of the display module and a specific requirement. The stacked structure 23 is an integral structure. The stacked structure 23 includes a first surface 23S1 and a second surface 23S2 that are opposite to each other, and side surfaces 23S3 connected between the first surface 23S1 and the second surface 23S2. The first surface 23S1 is a light exit surface (also referred to as a display surface) of the display module 20. In the implementations shown in FIG. 5 and FIG. 6, the display connection structure 212 and the wiring connection structures 222 each are led out from the side surface 23S3 of the stacked structure 23. The display connection structure 212 and the wiring connection structures 222 each are connected to an edge of the stacked structure 23. In some implementations of this application, the wiring connection structure 222 may be led out from the second surface 23S2 of the stacked structure 23. To be specific, a position at which the wiring connection structure 222 is connected to the stacked structure 23 is located on the second surface 23S2 or inside the stacked structure 23.

[0043] The display module provided in implementations of this application can be used in the bi-fold electro-

nic devices shown in FIG. 1A, FIG. 1B, FIG. 2A, and FIG. 2B and the tri-fold electronic device shown in FIG. 3A and FIG. 3B.

[0044] FIG. 7 is a schematic sectional view taken along a dashed line A-A in the implementations shown in FIG. 5 and FIG. 6.

[0045] With reference to FIG. 7, in an implementation, the display module includes a display portion 21 and an integrated wiring portion 22. The display portion 21 includes a stacked assembly 211 (a part within a dashed-line box in FIG. 7 is the stacked assembly 211) and the display connection structure 212. The display connection structure 212 is connected to the stacked assembly 211 and located outside the stacked assembly 211. The display connection structure 212 extends from an edge of the stacked assembly 211. The display connection structure 212 is configured to electrically connect the stacked assembly 211 to a control unit (for example, a controller or a system on a chip located on a primary board of the electronic device) in the electronic device. The integrated wiring portion 22 includes a transmission layer 221 and the at least two wiring connection structures 222 (only two wiring connection structures 222 are shown in FIG. 7). The transmission layer 221 and the stacked assembly 211 are integrated into the integral stacked structure 23. The at least two wiring connection structures 222 are connected to the transmission layer 221, and are located outside or extend to the outside of the stacked structure 23. One of the at least two wiring connection structures 222 is configured to electrically connect to a first component in the electronic device, and another of the at least two wiring connection structures 222 is configured to electrically connect to a second component in the electronic device, so that the integrated wiring portion 22 transmits a signal between the first component and the second component. The signal transmitted by the integrated wiring portion 22 may be a digital signal or a virtual signal. The transmitted signal may be a current signal, a data signal, a radio frequency signal, or the like.

[0046] In the implementation shown in FIG. 7, the stacked assembly 211 includes a first module stack layer 2111, a display panel 2112, and a second module stack layer 2113 that are stacked. The display panel 2112 includes a light exit surface 12S1 and a bottom surface 12S2 that is away from the light exit surface 12S1. The bottom surface 12S2 faces the first module stack layer 2111. The first module stack layer 2111 may include a hard material. The hard material may include but is not limited to a carbon fiber or hard alloy material. The hard alloy material may include but is not limited to a 304 alloy or a titanium alloy. The first module stack layer 2111 may include a structure having a bending function, for example, a bamboo-book structure. In the display module, the structure having the bending function is correspondingly disposed at a bendable connection portion of the display module. The display module is used in a foldable electronic product. The connection portion of the display module needs to deform during folding or unfolding.

The structure having the bending function in the first module stack layer 2111 needs to bend and deform to adapt to structural forms of the display module in different states while supporting the display panel.

[0047] The light exit surface 12S1 of the display panel 2112 faces the second module stack layer 2113. The second module stack layer 2113 is located between the light exit surface 12S1 of the display panel 2112 and the first surface 23S1 of the stacked structure 23. The second module stack layer 2113 may be an optical layer structure or a protective layer on a light exit side of the display panel 2112. For example, the second module stack layer 2113 may include an optical layer structure such as a polarizer.

[0048] In the implementation shown in FIG. 7, the transmission layer 221 is located on a side that is of the first module stack layer 2111 and that is away from the bottom surface 12S2 of the display panel 2112. The wiring connection structure 222 extends from an edge of the transmission layer 221. In a specific implementation, the wiring connection structure 222 and the transmission layer 221 are an integral structure. They are integrally formed through a manufacturing process of the display module. This may be understood as that the wiring connection structure 222 and the transmission layer 221 may be synchronously manufactured through a process similar to a circuit board manufacturing process. A wire portion in the wiring connection structure 222 and a wire portion in the transmission layer 221 may be line structures arranged at a same layer, and are manufactured through one step. Internal wiring of the transmission layer 221 is blocked by the first module stack layer 2111, to prevent a pattern imprint on the display module. FIG. 7 schematically shows a position relationship between the first module stack layer 2111, the display panel 2112, and the second module stack layer 2113 in the stacked assembly 211, and the transmission layer 221 in the stacked structure 23. In a specific embodiment, an adhesive layer may be used for a connection between them. Another layer structure may be further disposed between two adjacent layers, at the top of the stacked assembly 211, or at the bottom of the transmission layer 221.

[0049] FIG. 8 is a schematic sectional view of a display module according to an implementation of this application. In combination with the implementation shown in FIG. 7, with reference to FIG. 8, the wiring connection structure 222 is connected to the second surface 23S2 of the stacked structure 23. The wiring connection structure 222 is connected to a surface that is of the transmission layer 221 and that is away from the stacked assembly 211. In a possible implementation, the wiring connection structure 222 and the transmission layer 221 are not an integral structure. The wiring connection structure 222 and the transmission layer 221 are structures independent of each other. The wiring connection structure 222 may be electrically connected to the transmission layer 221 through (but not limited to) a gold finger or another electrical connection structure. In a possible implementation, the transmission layer 221 is manufactured in the

stacked structure 23 through a process similar to a circuit board manufacturing process. The stacked structure 23 may be provided with a connection structure, for example, a conductive structure 221P (which may be a gold finger, a pad, a connector in another form, or the like), and fastened and electrically connected to the wiring connection structure 222 through the connection structure. For example, the wiring connection structure 222 may be a flexible circuit board structure.

[0050] FIG. 8 schematically shows a position at which the wiring connection structure 222 is connected to the transmission layer 221. In a specific implementation, at least a part of the wiring connection structure 222 is connected to the transmission layer 221 and attached to the surface of the stacked structure 23. In the implementation shown in FIG. 8, a part of the wiring connection structure 222 may be attached to the surface of the transmission layer 221.

[0051] FIG. 9 is a schematic sectional view of a display module according to an implementation of this application. In combination with the implementation shown in FIG. 7, with reference to FIG. 9, parts within dashed-line boxes in FIG. 9 represent the stacked assembly 211. The stacked assembly 211 is represented by two parts. To be specific, the two dashed-line boxes respectively represent the display panel 2112 and the second module stack layer 2113 that are located at the top of the transmission layer 221, and the first module stack layer 2111 located at the bottom of the transmission layer 221. The transmission layer 221 is located between the first module stack layer 2111 and the display panel 2112. The wiring connection structure 222 extends from an edge of the transmission layer 221. In a possible implementation, the wiring connection structure 222 and the transmission layer 221 may be an integral structure. They are integrally formed through a manufacturing process of the display module. This may be understood as that the wiring connection structure 222 and the transmission layer 221 may be synchronously manufactured through a process similar to a circuit board manufacturing process. A wire portion in the wiring connection structure 222 and a wire portion in the transmission layer 221 may be line structures arranged at a same layer, and are manufactured through one step.

[0052] In an implementation of this application, the transmission layer 221 is disposed between the first module stack layer 2111 and the display panel 2112. The first module stack layer 2111 completely covers the transmission layer 221, to protect a line in the transmission layer 221. The wiring connection structure is led out from an edge of the transmission layer 221. This can ensure integrity of the stacked structure formed by the display panel 2112 and the transmission layer 221, and eliminate a need to lead out the wiring connection structure 222 through a window. Therefore, the display module provided in an implementation of this application can prevent a pattern imprint on the display module, to help ensure quality and reliability of the display module.

[0053] In this implementation, the transmission layer 221 is disposed between the first module stack layer 2111 and the display panel 2112, so that the transmission layer 221 can be protected. In the display module provided in an implementation of this application, a metal portion in the display panel 2112 may be used as a shield structure of the transmission layer 221. This facilitates thinning of the transmission layer 221, enabling a thin design of the overall stacked structure 23.

[0054] FIG. 10 is a schematic sectional view of a display module according to an implementation of this application. In combination with the implementation shown in FIG. 9, with reference to FIG. 10, a position at which the wiring connection structure 222 is connected to the transmission layer 221 is located within a region surrounded by an edge of the transmission layer 221. In a possible implementation, the transmission layer 221 is located between the first module stack layer 2111 and the display panel 2112. A part of the wiring connection structure 222 passes through the first module stack layer 2111 and is connected to the transmission layer 221. In a possible implementation, the first module stack layer 2111 is provided with a window 11H. The transmission layer 221 is exposed through the window 11H. A position at which the transmission layer is exposed may be a conductive structure 221P. During manufacturing, an end of the wiring connection structure 222 extends into the window 11H. In addition, the wiring connection structure 222 is electrically connected to the conductive structure 221P on the transmission layer 221 and at the bottom of the window 11H.

[0055] In a possible implementation, in the implementation shown in FIG. 10, the wiring connection structure 222 is partially located in the window 11H. A part of the wiring connection structure 222 is attached to the transmission layer 221 at the bottom of the window 11H. A part of the wiring connection structure 222 is attached to the first module stack layer 2111 on a side wall of the window 11H. A part of the wiring connection structure 222 is attached to a surface that is of the first module stack layer 2111 and that is away from the transmission layer 221.

[0056] FIG. 11 is a schematic sectional view of a display module according to an implementation of this application. In combination with the implementation shown in FIG. 9, with reference to FIG. 11, the transmission layer 221 is located inside the first module stack layer 2111. This may be understood as that a part of the first module stack layer 2111 is located between the transmission layer 221 and the display panel 2112, and a part of the first module stack layer 2111 is located on a side that is of the transmission layer 221 and that is away from the display panel 2112. In a possible implementation, the transmission layer 221 is integrated inside the first module stack layer 2111. In this way, a structure of the first module stack layer 2111 can be reused to manufacture the transmission layer 221, to facilitate the thin design of the overall stacked structure 23. A part of the first module

stack layer 2111 can also be used to isolate the transmission layer 221 from the display panel 2112, to reduce interference between a signal of the transmission layer 221 and a signal of the display panel 2112. In addition, the transmission layer 221 is disposed inside the first module stack layer 2111, and a part of the first module stack layer 2111 is located between the transmission layer 221 and the display panel 2112, so that a pattern imprint problem of the display module can be resolved. The part of the first module stack layer 2111 makes it difficult for wiring of the transmission layer 221 to generate a pattern imprint. In a specific implementation, the part of the first module stack layer 2111 at the bottom of the transmission layer 221 may be a copper foil. The copper foil covers a bottom surface of the transmission layer 221, and has an anti-static function. In a specific implementation, the part of the first module stack layer 2111 at the top of the transmission layer 221 (between the transmission layer 221 and the display panel 2112) includes a hard material. The hard material may be but is not limited to a carbon fiber or hard alloy material. The hard alloy material may be but is not limited to a 304 alloy or a Ti alloy.

[0057] In the implementation shown in FIG. 11, the wiring connection structure 222 extends from an edge of the transmission layer 221. The wiring connection structure 222 and the transmission layer 221 may be an integral structure. They are integrally formed through a manufacturing process of the display module. This may be understood as that the wiring connection structure 222 and the transmission layer 221 may be synchronously manufactured through a process similar to a circuit board manufacturing process. A wire portion in the wiring connection structure 222 and a wire portion in the transmission layer 221 may be line structures arranged at a same layer, and are manufactured through one step.

[0058] FIG. 12 is a schematic sectional view of a display module according to an implementation of this application. In combination with the implementation shown in FIG. 11, with reference to FIG. 12, a position at which the wiring connection structure 222 is connected to the transmission layer 221 is located within a region surrounded by an edge of the transmission layer 221. In a possible implementation, the transmission layer 221 is located inside the first module stack layer 2111. A part of the first module stack layer 2111 covers a side that is of the transmission layer 221 and that is away from the display panel 2112. For ease of description, the part of the first module stack layer 2111 covering the side that is of the transmission layer 221 and that is away from the display panel 2112 is referred to as a bottom substrate 2111B. The wiring connection structure 222 passes through the bottom substrate 2111B and is connected to the transmission layer 221. In a possible implementation, the bottom substrate 2111B is provided with a window 11H. A transmission line in the transmission layer 221 is exposed through the window 11H. A position at which the transmission line is exposed may be a conductive structure. During manufacturing, a part of the

wiring connection structure 222 is placed in the window 11H. In addition, the wiring connection structure 222 is electrically connected to the conductive structure on the transmission layer 221 and at the bottom of the window 11H. As shown in FIG. 12, the part of the wiring connection structure 222 is disposed in the window 11H and attached to the transmission layer 221.

[0059] FIG. 13A is a schematic plan view of an apparatus body of an electronic device according to an implementation. FIG. 13B is a schematic plan view of a display module of an electronic device according to an implementation. With reference to FIG. 13A and FIG. 13B, the electronic device provided in this implementation is a foldable apparatus. An apparatus body 10 includes a first body 1, a second body 2, and a rotating shaft 3 connected between the first body 1 and the second body 2. A primary board and a battery are disposed in the first body 1. A secondary board and a battery are disposed in the second body. A stacked structure 23 of a display module 20 includes a first portion 201, a second portion 203, and a connection portion 202 connected between them. A region between dashed lines in FIG. 13B represents the connection portion 202. In a process of folding or unfolding the electronic device, the connection portion 202 deforms. A display connection structure 212 of the display module 20 is connected to the second portion 203. In a possible implementation, the display connection structure 212 is located at an edge position that is of the second portion 203 and that is opposite to the connection portion 202. Two wiring connection structures 222 of the display module 20 are respectively connected to the first portion 201 and the second portion 203. In a possible implementation, the wiring connection structure 222 connected to the second portion 203 is located at a top edge of the second portion 203. The top edge of the second portion 203 is connected between the rotating shaft and an edge at which the display connection structure 212 is located. The wiring connection structure 222 connected to the first portion 201 is located at a top edge of the first portion 201. The top edge of the first portion 201 is collinear with the top edge of the second portion 203. The display connection structure 212 includes a connector C1. The wiring connection structure 222 in the second portion 203 includes a connector C2. The wiring connection structure 222 in the first portion 201 includes a connector C3. A connector C1' and a connector C2' are disposed on the secondary board in the apparatus body 10. A connector C3' is disposed on the primary board in the apparatus body 10.

[0060] FIG. 14A is a diagram showing that the apparatus body provided in FIG. 13A and the display module provided in FIG. 13B are assembled together. With reference to FIG. 13A, FIG. 13B, and FIG. 14A, after the display module 20 is assembled onto the apparatus body 10, the connector C1 of the display connection structure 212 is connected to the connector C1' on the secondary board through insertion, the connector C2 of the wiring connection structure 222 in the second portion 203 is

connected to the connector C2' on the secondary board through insertion, and the connector C3 of the wiring connection structure 222 in the first portion 201 is connected to the connector C3' on the primary board through insertion. A dashed line within the display module 20 in FIG. 14A represents a transmission layer 221. The transmission layer 221 is electrically connected between the two wiring connection structures 222 that are opposite to each other. In an implementation, the primary board in the apparatus body 10 is a main heat source. Because the primary board is disposed in the first body 1, heat generated in the first body 1 is greater than that in the second body 2. The display connection structure 212 of the display module 20 is also a heat-generating component in a working state. In a possible implementation, the display connection structure 212 has a heat-generating component: DDIC (display driver integrated circuit, Display Driver IC). In the display module provided in an implementation of this application, the display connection structure 212 is connected to the secondary board, so that heat generated by the DDIC on the display connection structure 212 is distributed in the second body 2. This helps balance heat distribution in the first body 1 and the second body 2, and can avoid heat concentration caused by connecting the display connection structure 212 to the primary board, to avoid affecting user experience due to an excessively high temperature in a specific region of the electronic device. Heat distribution in different bodies also helps improve a heat dissipation capability of the electronic device. In the display module provided in an implementation of this application, a first component 6 on the secondary board may be electrically connected to a second component 7 on the primary board through an integrated wiring portion in the display module 20.

[0061] The DDIC on the display connection structure 212 needs to be electrically connected to an SoC on the primary board, to implement interaction between the DDIC and the SoC. In this application, the DDIC may be electrically connected to the SoC through the integrated wiring portion in the display module 20.

[0062] Because the first component 6 and the second component 7 are distributed on two sides of the rotating shaft, in the display module provided in an implementation of this application, the first component 6 is electrically connected to the second component 7 through the integrated wiring portion in the display module 20. There is no need to dispose a large quantity of transmission lines in the apparatus body 10, to facilitate a thin design of the electronic device, and avoid an increase in design costs and a complex structure of the rotating shaft that are caused when a transmission line passes through the rotating shaft in the apparatus body 10.

[0063] Because signal transmission between the first component and the second component in the apparatus body 10 is implemented through the integrated wiring portion in the display module, space in the apparatus body 10 can be saved, to facilitate the thin design of the electronic device. The display module provided in an

implementation of this application can further improve a capacitor capacity of the electronic device. A structure of a transmission line in the apparatus body is integrated into the display module. This can improve flexibility of an overall design of the electronic device. No transmission line needs to be disposed in a thickness direction of the battery, so that a thickness of the battery can be increased. In other words, a part of space originally for disposing the transmission line in the apparatus body is provided for the battery, so that the battery can have a larger capacity and a longer battery life.

[0064] FIG. 14B is a diagram of an electrical connection between a component in a first body and a component in a second body through a transmission line in an apparatus body. As shown in FIG. 14B, because a transmission line 9 is disposed in an apparatus body 10, internal space of the apparatus body 10 is occupied. This results in a complex structure in the apparatus body 10, and is not conducive to a light and thin design. The transmission line 9 needs to pass through a rotating shaft 3 to implement an electrical connection between a component in a first body 1 and a component in a second body 2. A hole 301 for the transmission line 9 to pass through needs to be designed in the rotating shaft 3. In a design process, reliability of the rotating shaft 3, stability of a bending form of an electronic product, and the like need to be considered, resulting in higher design costs.

[0065] FIG. 15, FIG. 16, FIG. 17, FIG. 18, FIG. 19, and FIG. 20 are diagrams of display modules according to different implementations. In these implementations, a display connection structure and at least two wiring connection structures each are connected to an edge of a stacked structure. Specific descriptions of the implementations are as follows:

[0066] With reference to FIG. 15, in an implementation, both a first portion 201 and a second portion 203 of a display module 20 are rectangular. A stacked structure 23 includes a first edge E1 and a third edge E3 that are opposite to each other. The first edge E1 is a long edge of the first portion 201. The third edge E3 is a long edge of the second portion 203. In a possible implementation, a display connection structure 212 is connected to the first edge E1. One wiring connection structure 222 is connected to the first edge E1. Another wiring connection structure 222 is connected to the third edge E3. The display connection structure 212 overlaps a part of the wiring connection structure 222.

[0067] In combination with the implementation shown in FIG. 15, with reference to FIG. 16, the display connection structure 212 connected to the first edge E1 and the wiring connection structure 222 connected to the first edge E1 are arranged side by side and do not overlap. The display connection structure 212 is located in a central region of the first edge E1. The wiring connection structure 222 is located in a peripheral region of the first edge E1. The wiring connection structure 222 is located between a bottom edge of the display connection structure 212 and a bottom end of the first edge E1. There is a

gap between the wiring connection structure 222 and the display connection structure 212 in an extension direction of the first edge E1. The gap helps ensure that bending assembly of the wiring connection structure 222 does not interfere with that of the display connection structure 212 in a process of assembling the display module onto an apparatus body. In the implementation shown in FIG. 15, the wiring connection structure 222 connected to the third edge E3 is adjacent to a top end of the third edge E3. A distance between the wiring connection structure 222 and a bottom end of the third edge E3 is greater than a distance between the wiring connection structure 222 and the top end of the third edge E3.

[0068] In combination with the implementation shown in FIG. 16, with reference to FIG. 17, the wiring connection structure 222 connected to the second portion 203 is at a different position. With reference to FIG. 17, in a possible implementation, the wiring connection structure 222 is not connected to the third edge E3 of the stacked structure 23. The stacked structure 23 includes a second edge E2. A part of the second edge E2 forms a short edge of the second portion 203. A part of the second edge E2 forms a short edge of the first portion 201. The wiring connection structure 222 connected to the second portion 203 is connected to the second edge E2. In a possible implementation, in an extension direction of the second edge E2, a distance between the third edge E3 and the wiring connection structure 222 connected to the second portion 203 is less than a distance between a connection portion 202 and the wiring connection structure 222 connected to the second portion 203.

[0069] In combination with the implementation shown in FIG. 17, with reference to FIG. 18, the wiring connection structure 222 connected to the first portion 201 is at a different position. With reference to FIG. 18, in a possible implementation, the wiring connection structure 222 connected to the first portion 201 is connected to the second edge E2. The two wiring connection structures 222 are located on a same side of the stacked structure 23. The two wiring connection structures 222 are both connected to the second edge E2. In a specific implementation, the two wiring connection structures 222 are symmetrically distributed on two sides of the connection portion 202.

[0070] In combination with the implementation shown in FIG. 18, with reference to FIG. 19, the wiring connection structure 222 connected to the second portion 203 is connected to the third edge E3. In a possible implementation, the wiring connection structure 222 connected to the second portion 203 is located at a position that is of the third edge E3 and that is adjacent to the second edge E2. The wiring connection structure 222 connected to the second portion 203 is close to a top end of the second portion 203.

[0071] In combination with the implementation shown in FIG. 19, with reference to FIG. 20, the wiring connection structure 222 connected to the second portion 203 is at a different position. With reference to FIG. 20, in a possible implementation, the wiring connection structure

222 connected to the second portion 203 is connected to a fourth edge E4. The fourth edge E4 is a bottom edge of the stacked structure 23. The fourth edge E4 is opposite to the second edge E2. The wiring connection structure 222 connected to the first portion 201 is connected to the second edge E2.

[0072] FIG. 21 is a schematic plan view of a stacked structure 23 according to an implementation. In the implementation shown in FIG. 21, a display connection structure 212 is connected to an edge of the stacked structure 23. At least two wiring connection structures 222 each are connected to an internal region of the stacked structure 23. In FIG. 21, a rectangular box is used to represent a position at which the wiring connection structure 222 is connected to the stacked structure 23. The rectangular box cannot represent a specific form of the wiring connection structure 222.

[0073] FIG. 22 is a schematic sectional view of a display module according to an implementation of this application. With reference to FIG. 22, in a possible implementation, a stacked structure 23 includes a first module stack layer 2111, a transmission layer 221, a display panel 2112, and a second module stack layer 2113 that are sequentially stacked. The transmission layer 221 is pasted to the display panel 2112 through an adhesive layer 231. The transmission layer 221 is pasted to the first module stack layer 2111 through an adhesive layer 232. In a possible implementation, the transmission layer 221 includes a substrate layer 2211 and a wiring layer 2212. In a process of manufacturing the display module, the transmission layer 221 is separately manufactured. In a process of manufacturing the transmission layer 221, a metal layer is laid on a surface of the substrate layer 2211 and patterned to form the wiring layer 2212. After being manufactured, the transmission layer 221 is attached to a surface of the first module stack layer 2111. In a possible implementation, the wiring layer 2212 faces the first module stack layer 2111, and the transmission layer 221 is pasted and fastened to the first module stack layer 2111 through the adhesive layer 232. The adhesive layer 232 encapsulates the wiring layer 2212 on a bottom surface (a surface that is of the substrate layer 2211 and that faces the first module stack layer 2111) of the substrate layer 2211. The wiring layer 2212 of the display module provided in an implementation of this application is formed on the bottom surface of the substrate layer 2211. This can ensure flatness of a top surface of the substrate layer 2211, and reduce pattern imprints on the display module due to the wiring layer 2212 of the transmission layer 221.

[0074] With reference to FIG. 22, in a possible implementation, a wiring connection structure 222 includes a substrate layer 2221, a wiring layer 2222, and a protective layer 2223 that are stacked. The wiring layer 2222 is located between the substrate layer 2221 and the protective layer 2223. The protective layer 2223 and the adhesive layer 231 may be made of a same material, and may be formed on a surface of the wiring layer 2222

through a same manufacturing process step. In a specific implementation, the wiring connection structure 222 and the transmission layer 221 are an integral structure. The wiring connection structure 222 and the transmission layer 221 are synchronously manufactured in a process of manufacturing an integrated wiring portion through a circuit board manufacturing process. The substrate layer 2221 of the wiring connection structure 222 and the substrate layer 2211 of the transmission layer 221 are a same layer structure. In a possible implementation, the substrate layer 2221 of the wiring connection structure 222 and the substrate layer 2211 of the transmission layer 221 may have a same material, a same thickness, and a same manufacturing process. The wiring layer 2222 of the wiring connection structure 222 and the wiring layer 2212 of the transmission layer 221 are a same layer structure. Similarly, they may have a same material, a same thickness, and a same manufacturing process.

[0075] In an implementation, the process of manufacturing the integrated wiring portion shown in FIG. 22 includes the following steps: Manufacture a substrate layer (including the substrate layer 2211 of the transmission layer and the substrate layer 2221 of the wiring connection structure). Manufacture the wiring layer 2212 of the transmission layer and the wiring layer 2222 of the wiring connection structure on a surface of the substrate layer, where the wiring layer 2222 of the wiring connection structure 222 and the wiring layer 2212 of the transmission layer 221 form a continuous transmission line. Manufacture the adhesive layer 232 and the protective layer 2223 of the wiring connection structure. A surface of the adhesive layer 232 and a surface of the protective layer 2223 may form a flat surface. In an implementation, the first module stack layer 2111 may be further manufactured on the adhesive layer 232 of the manufactured integrated wiring portion. Alternatively, the adhesive layer of the integrated wiring portion may be pasted and fastened to the first module stack layer 2111 through a pasting process.

[0076] FIG. 23 is a schematic sectional view of a display module according to an implementation of this application. In the display module provided in an implementation of this application, a position of a transmission layer 221 in a stacked structure 23 is the same as that in the implementation shown in FIG. 22, and is between a first module stack layer 2111 and a display panel 2112. A difference between the implementation shown in FIG. 23 and the implementation shown in FIG. 22 lies in specific structures of the transmission layer 221 and a wiring connection structure 222. With reference to FIG. 23, in the display module provided in an implementation of this application, the transmission layer 221 includes a substrate layer 2211 and a wiring layer 2212. The wiring layer 2212 is disposed on one side of the substrate layer 2211. A surface of the other side of the substrate layer 2211 is a flat surface. In a process of disposing the transmission layer 221 on the first module stack layer 2111, the flat surface, on which the wiring layer 2212 is not disposed, of

the substrate layer 2211 in the display module provided in an implementation of this application faces the first module stack layer 2111. The flat surface is pasted to the first module stack layer 2111 through an adhesive layer 232. In the display module provided in an implementation of this application, the transmission layer 221 further includes a flat layer 2213. The flat layer 2213 covers a surface of the wiring layer 2212 and fills a gap formed by the wiring layer 2212 on the substrate layer 2211. The flat layer 2213 is configured to implement a surface that is of the transmission layer 221 and that is used to carry the display panel 2112 as a flat surface. This can reduce pattern imprints on the display module due to the wiring layer 2212 of the transmission layer 221. The flat layer 2213 is pasted to the display panel 2112 through an adhesive layer 231.

[0077] In the implementation shown in FIG. 23, the wiring connection structure 222 includes a substrate layer 2221, a wiring layer 2222, and a protective layer 2223 that are stacked. The wiring layer 2222 is located between the substrate layer 2221 and the protective layer 2223. The protective layer 2223 and the flat layer 2213 may be made of a same material, and may be formed on a surface of the wiring layer 2222 through a same manufacturing process step. In a specific implementation, the wiring connection structure 222 and the transmission layer 221 are an integral structure. The wiring connection structure 222 and the transmission layer 221 are synchronously manufactured in a process of manufacturing an integrated wiring portion through a circuit board manufacturing process. The substrate layer 2221 of the wiring connection structure 222 and the substrate layer 2211 of the transmission layer 221 are a same layer structure. In a possible implementation, the substrate layer 2221 of the wiring connection structure 222 and the substrate layer 2211 of the transmission layer 221 may have a same material, a same thickness, and a same manufacturing process. The wiring layer 2222 of the wiring connection structure 222 and the wiring layer 2212 of the transmission layer 221 are a same layer structure. Similarly, they may have a same material, a same thickness, and a same manufacturing process.

[0078] In an implementation, steps of the process of manufacturing the integrated wiring portion shown in FIG. 23 may be as follows: Manufacture a substrate layer (including the substrate layer 2211 of the transmission layer and the substrate layer 2221 of the wiring connection structure). Manufacture the wiring layer 2212 of the transmission layer and the wiring layer 2222 of the wiring connection structure on a surface of the substrate layer, where the wiring layer 2222 of the wiring connection structure 222 and the wiring layer 2212 of the transmission layer 221 form a continuous transmission line. Manufacture the flat layer 2213 and the protective layer 2223 on a surface of the continuous transmission line. The flat layer 2213 covers the wiring layer 2212 of the transmission layer 221. The protective layer 2223 covers the wiring layer 2222 of the wiring connection structure

222. A surface of the flat layer 2213 and a surface of the protective layer 2223 may form a continuous and flat surface. In an implementation, the substrate layer 2211 of the transmission layer 221 is pasted to a surface of the first module stack layer 2111 through the adhesive layer 232. The display panel 2112 is pasted to the surface of the flat layer 2213 through the adhesive layer 231.

[0079] With reference to FIG. 22 and FIG. 23, in an implementation, one wiring connection structure 222 and a display connection structure 212 are located on a same side of the stacked structure 23. The wiring connection structure 222 and the display connection structure 212 that are located on the same side of the stacked structure 23 are connected to different flexible circuit boards. In a possible implementation, a DDIC (display driver integrated circuit, Display Driver IC) is disposed on the display connection structure 212. The DDIC is configured to drive the display panel 2112. The display connection structure 212 is connected to a flexible circuit board F2. The flexible circuit board F2 may electrically connect the display panel 2112 to a control unit in an electronic device, and may also electrically connect the DDIC to the control unit in the electronic device. The wiring connection structure 222 is connected to a flexible circuit board F1, and is electrically connected to a first component in the electronic device through the flexible circuit board F1. Another wiring connection structure 222 is connected to a flexible circuit board F3, and is electrically connected to a second component in the electronic device through the flexible circuit board F3. Therefore, the display module provided in an implementation of this application can be electrically connected between the first component and the second component through the transmission layer 221, to implement signal transmission between the first component and the second component.

[0080] FIG. 24, FIG. 25, and FIG. 26 are diagrams of a solution in which a wiring connection structure and a display connection structure that are located on a same side of a stacked structure share one flexible circuit board. FIG. 25 and FIG. 26 are schematic sectional views of the solution in which the flexible circuit board is shared. FIG. 24 is a schematic plan view of the solution in which the flexible circuit board is shared in FIG. 25 and FIG. 26.

[0081] With reference to FIG. 24, in an implementation, one wiring connection structure 222 and a display connection structure 212 are located at a same side edge of a stacked structure 23. They are arranged side by side. The wiring connection structure 222 is located at the bottom of the display connection structure 212. A partial region of a flexible circuit board F4 is connected to the wiring connection structure 222. Another partial region of the flexible circuit board F4 is connected to the display connection structure 212.

[0082] A structure of a transmission layer 221 in a display module provided in an implementation shown in FIG. 25 and its position design in the stacked structure 23 are the same as those in the implementation shown in FIG. 23. A difference between the implementation shown

in FIG. 25 and the implementation shown in FIG. 23 lies in that, in the implementation shown in FIG. 25, the wiring connection structure 222 and the display connection structure 212 that are located on a same side of the stacked structure 23 share the flexible circuit board F4. With reference to FIG. 25, a part that is of the wiring connection structure 222 and that is connected to the flexible circuit board F4 is located on an upper surface of the flexible circuit board F4, and a part that is of the display connection structure 212 and that is connected to the flexible circuit board F4 is also located on the upper surface of the flexible circuit board F4. The flexible circuit board F4 is configured to connect to a first component. The flexible circuit board F3 is configured to connect to a second component. The flexible circuit board F4, one wiring connection structure 222, the transmission layer 221, another wiring connection structure 222, and the flexible circuit board F3 are sequentially connected, to implement signal transmission between the first component and the second component.

[0083] A structure of a transmission layer 221 in a display module provided in an implementation shown in FIG. 26 and its position design in the stacked structure 23 are the same as those in the implementation shown in FIG. 22. A difference between the implementation shown in FIG. 26 and the implementation shown in FIG. 22 lies in that, in the implementation shown in FIG. 26, the wiring connection structure 222 and the display connection structure 212 that are located on a same side of the stacked structure 23 share the flexible circuit board F4. With reference to FIG. 26, a part that is of the wiring connection structure 222 and that is connected to the flexible circuit board F4 is located on a lower surface of the flexible circuit board F4, and a part that is of the display connection structure 212 and that is connected to the flexible circuit board F4 is located on an upper surface of the flexible circuit board F4. The wiring connection structure 222 and the display connection structure 212 are respectively fastened to two sides of the flexible circuit board F4. The flexible circuit board F4 is configured to connect to a first component. The flexible circuit board F3 is configured to connect to a second component. The flexible circuit board F4, one wiring connection structure 222, the transmission layer 221, another wiring connection structure 222, and the flexible circuit board F3 are sequentially connected, to implement signal transmission between the first component and the second component.

[0084] FIG. 27 is a schematic sectional view of a display module according to an implementation of this application. With reference to FIG. 27, in a possible implementation, a transmission layer 221 is located between a first module stack layer 2111 and a display panel 2112. The transmission layer 221 adopts an architecture with two wiring layers. In another implementation, the transmission layer 221 may alternatively include three or more wiring layers. This may be understood as that the transmission layer 221 may adopt an architecture similar to a

multi-layer flexible circuit board. In the implementation shown in FIG. 27, the transmission layer 221 includes a substrate layer 2211, two wiring layers 2212, and two flat layers 2213. One of the two wiring layers 2212 is located on a top surface of the substrate layer 2211, and the other is located on a bottom surface of the substrate layer 2211. The two wiring layers 2212 are electrically connected through a conductive hole or a conductive column that penetrates the substrate layer 2211. One of the two flat layers 2213 covers the wiring layer 2212 located on the top surface of the substrate layer 2211. The other of the two flat layers 2213 covers the wiring layer 2212 located on the bottom surface of the substrate layer 2211. A stacked structure 23 has a first window 11H1 and a second window 11H2. In a possible implementation, the first window 11H1 and the second window 11H2 penetrate the first module stack layer 2111 and the flat layer 2213 adjacent to the first module stack layer 2111. One of two wiring connection structures 222 is electrically connected to the wiring layer 2212 of the transmission layer 221 in the first window 11H1. The other of the two wiring connection structures 222 is electrically connected to the wiring layer 2212 of the transmission layer 221 in the second window 11H2.

[0085] In this application, the stacked structure 23 is provided with windows (the first window 11H1 and the second window 11H2), and the wiring connection structures 222 are connected to the transmission layer 221 in the windows, to facilitate a large screen-to-body ratio of the display module. If the wiring connection structure 222 is located at an edge of the stacked structure 23, peripheral space around the edge of the stacked structure 23 is occupied, resulting in a large black border at an edge of a display of an electronic device.

[0086] In the implementation shown in FIG. 27, a display connection structure 212 is connected to a flexible circuit board F. Signal transmission between the display panel 2112 and a control unit in the electronic device is implemented through the flexible circuit board F. The two wiring connection structures 222 may also be flexible circuit boards. One of the two wiring connection structures 222 is connected to a first component, and the other is connected to a second component. Signal transmission between the first component and the second component can be implemented through the transmission layer 221.

[0087] FIG. 28 is a schematic sectional view of a display module according to an implementation of this application. With reference to FIG. 28, in a possible implementation, a transmission layer 221 adopts an architecture with one wiring layer. The transmission layer 221 includes a substrate layer 2211 and a wiring layer 2212. The wiring layer 2212 is formed on a surface of the substrate layer 2211. An adhesive layer 232 covers the wiring layer 2212. The adhesive layer 232 is connected to a first module stack layer 2111. A stacked structure 23 has a first window 11H1 and a second window 11H2. In a possible implementation, the first window 11H1 and the

second window 11H2 penetrate the first module stack layer 2111 and the adhesive layer 232. One of two wiring connection structures 222 is electrically connected to the wiring layer 2212 of the transmission layer 221 in the first window 11H1. The other of the two wiring connection structures 222 is electrically connected to the wiring layer 2212 of the transmission layer 221 in the second window 11H2.

[0088] FIG. 29 is a schematic sectional view of a stacked structure of a display module according to an implementation of this application. With reference to FIG. 29, a stacked structure 23 includes a first module stack layer 2111, a transmission layer 221, a display panel 2112, and a second module stack layer 2113 that are sequentially stacked. The display panel 2112 includes a base layer 21123, a shield layer 21122, and a panel function layer 21121 that are sequentially stacked. The shield layer 21122 includes a conductive material. The transmission layer 221 is located between the first module stack layer 2111 and the base layer 21123 of the display panel 2112. The transmission layer 221 includes a substrate layer 2211, a wiring layer 2212, and a flat layer 2213. The wiring layer 2212 is formed on a surface that is of the substrate layer 2211 and that faces the display panel 2112. The wiring layer 2212 of the transmission layer 221 is a patterned design formed on the surface of the substrate layer 2211. The flat layer 2213 covers the wiring layer 2212 and constructs a flat surface used to carry the display panel 2112. The flat layer is pasted to the base layer 21123 of the display panel 2112 through an adhesive layer 231. At least partial signal isolation is implemented between the wiring layer 2212 of the transmission layer 221 and the panel function layer 21121 of the display panel 2112 through the conductive material of the shield layer 21122, so that signal interference between the wiring layer 2212 and the panel function layer 21121 can be reduced. The display module provided in an implementation of this application uses the shield layer 21122 to isolate signal interference between the wiring layer 2212 in the transmission layer 221 and the panel function layer 21121. A degree of integration is high, and no metal shield layer needs to be disposed in the transmission layer 221, to facilitate thinning of an electronic device.

[0089] In an implementation, the conductive material of the shield layer 21122 covers an entire surface of the base layer 21123. The shield layer 21122 may be made of a metal material. The display module provided in an implementation of this application does not require patterning on the shield layer 21122, making it easy to manufacture with low manufacturing costs.

[0090] In an implementation, the shield layer 21122 is a patterned conductive layer structure. A specific shape of a pattern of the shield layer 21122 may be set for a pattern of the wiring layer in the transmission layer. The patterned conductive layer structure of the shield layer may be wider than a patterned conductive structure of the wiring layer in the transmission layer. The patterned conductive

layer structure of the shield layer may completely cover the patterned conductive structure of the wiring layer in the transmission layer.

[0091] In an implementation, a thickness of the substrate layer 2211 in the transmission layer 221 ranges from 10 μm to 50 μm . For example, in a specific implementation, the thickness of the substrate layer 2211 is 25 μm . The thickness of the substrate layer 2211 in the display module provided in an implementation of this application is limited within a proper range. For a display module having a bending function, an excessively large thickness of the substrate layer, which exceeds 50 μm , impairs effect of the display module and compromises experience. An excessively small thickness of the substrate layer, which is less than 10 μm , leads to great difficulty in a manufacturing process of the transmission layer 221, making it challenging to ensure a product yield and resulting in high manufacturing costs.

[0092] In an implementation, an elastic modulus of the substrate layer 2211 in the transmission layer 221 is 2.5 GPa to 9 GPa. In an implementation, an elongation at break of the substrate layer 2211 in the transmission layer 221 needs to be greater than 5%. The elastic modulus and elongation at break of the substrate layer in the display module provided in an implementation of this application are limited within proper ranges, to satisfy bending performance of the display module. The elastic modulus is 2.5 GPa to 9 GPa, and the elongation at break needs to be greater than 5%. Both conditions enable the display module to achieve good bending performance. An impedance requirement for signal transmission can also be met.

[0093] In an implementation, a thickness of the wiring layer 2212 in the transmission layer 221 ranges from 3 μm to 10 μm . The thickness of the wiring layer in the display module provided in an implementation of this application is limited within a proper range, so that the display module can have good bending performance. Limiting the thickness of the wiring layer 2212 within a range of 3 μm to 10 μm also helps resolve a pattern imprint problem of the display module. An excessively large thickness of the wiring layer 2212 affects an overall thickness of the display module, which is conducive to a thin design. It also affects bending performance and results in a pattern imprint. The pattern imprint may be understood as that a line imprint of the wiring layer can be seen on a light exit surface of the display module, which affects user experience of the electronic device. In a possible implementation, a material of the wiring layer 2212 is copper. An elongation at break of the wiring layer 2212 needs to be greater than 5%.

[0094] In an implementation, as shown in FIG. 29, the first module stack layer 2111 includes a second substack layer 21111, a spacing layer 21113, and a first substack layer 21112. Both the first substack layer 21112 and the second substack layer 21111 are metal layers. The first substack layer 21112 and the second substack layer 21111 are made of different materials. For example,

the second substack layer 21111 is a Cu foil, and the first substack layer 21112 is a carbon fiber, 304 alloy, or Ti alloy. The second substack layer 21111 is made of a flexible material. The second substack layer 21111 is configured to form an electrostatic protection structure at the bottom of the stacked structure 23, to prevent static electricity from entering the stacked structure 23.

[0095] The spacing layer 21113 between the second substack layer 21111 and the first substack layer 21112 may be an adhesive layer. In a possible implementation, the second substack layer 21111 is pasted to the first substack layer 21112 through an adhesive layer.

[0096] In the implementation shown in FIG. 29, a wiring connection structure 222 and a display connection structure 212 each are led out from an edge of the stacked structure 23. In a possible implementation, the display connection structure 212 is connected to an edge of the base layer 21123. The wiring connection structure 222 is connected to an edge of the wiring layer 2212. The first module stack layer 2111 does not need to be provided with a window. The first module stack layer 2111 completely covers the transmission layer, to protect a line in the transmission layer 221. The wiring connection structure 222 in the display module provided in an implementation of this application is led out from an edge of the stacked structure 23 formed by the display panel 2112 and the transmission layer 221, and eliminate a need to lead out the wiring connection structure 222 through a window. Therefore, the display module provided in an implementation of this application can prevent a pattern imprint on the display module, to help ensure quality and reliability of the display module.

[0097] FIG. 30 is a schematic sectional view of a stacked structure of a display module according to an implementation of this application. With reference to FIG. 30, in a possible implementation, a transmission layer 221 is located on a side that is of a first module stack layer 2111 and that is away from a display panel 2112. In other words, the transmission layer 221 is located at the bottom of the first module stack layer 2111. A first substack layer 21112 in the first module stack layer 2111 is pasted to the display panel 2112 through an adhesive layer 231. There is a spacing layer 21113 between the first substack layer 21112 and a second substack layer 21111 in the first module stack layer 2111. The spacing layer 21113 may be an adhesive layer. The transmission layer 221 includes a substrate layer 2211 and a wiring layer 2212. The substrate layer 2211 is pasted to the second substack layer 21111 in the first module stack layer 2111 through an adhesive layer 232. The wiring layer 2212 is stacked on a side that is of the substrate layer 2211 and that is away from the first module stack layer 2111. The wiring layer 2212 is located at the bottom of the substrate layer 2211. The display module further includes a bottom protective layer 2215. The bottom protective layer 2215 covers the wiring layer 2212 on a side that is of the wiring layer 2212 and that is away from the substrate layer 2211.

The display module has a first window 11H1 and a second window 11H2. The first window 11H1 and the second window 11H2 penetrate the bottom protective layer 2215.

[0098] In an implementation of this application, the first window 11H1 and the second window 11H2 are provided, so that wiring connection structures can be connected to the wiring layer of the transmission layer in the windows. This facilitates a small size of an edge part of the display module, and improves a screen-to-body ratio of the display module. In addition, a hard material of the first module stack layer is used to support the display panel at the first window and the second window. At positions of the windows, disposing the hard material of the first module stack layer prevents a pattern imprint, to ensure quality and reliability of the display module.

[0099] FIG. 31 is a schematic sectional view of a stacked structure of a display module according to an implementation of this application. With reference to FIG. 31, in a possible implementation, a transmission layer 221 is located on a side that is of a first module stack layer 2111 and that is away from a display panel 2112. The transmission layer 221 includes a substrate layer 2211 and a wiring layer 2212. The wiring layer 2212 is located at the top of the substrate layer 2211, that is, located between the substrate layer 2211 and the first module stack layer 2111. The wiring layer 2212 is pasted to a second substack layer 21111 in the first module stack layer 2111 through an adhesive layer 232. The substrate layer 2211 is a bottommost layer structure of the display module. A first window 11H1 and a second window 11H2 penetrate the substrate layer 2211.

[0100] FIG. 32 is a schematic sectional view of a stacked structure of a display module according to an implementation of this application. With reference to FIG. 32, in a possible implementation, a transmission layer 221 is located on a side that is of a first module stack layer 2111 and that is away from a display panel 2112. The transmission layer 221 includes a substrate layer 2211 and a wiring layer 2212. The wiring layer 2212 is located at the top of the substrate layer 2211, that is, located between the substrate layer 2211 and the first module stack layer 2111. The wiring layer 2212 is pasted to a second substack layer 21111 in the first module stack layer 2111 through an adhesive layer 232. In an implementation of this application, the display module is not provided with a window. An electrical connection structure 2216 is disposed in the substrate layer 2211. The electrical connection structure 2216 is electrically connected to the wiring layer 2212. The electrical connection structure 2216 is also configured to connect to a wiring connection structure 222. In a possible implementation, the electrical connection structure 2216 is a structure such as a metal hole or a metal column in the substrate layer 2211, and may be directly manufactured in the substrate layer 2211 through a circuit board manufacturing process.

[0101] FIG. 33 is a schematic sectional view of a stacked structure of a display module according to an

implementation of this application. With reference to FIG. 33, in a possible implementation, a transmission layer 221 is located between a second substack layer 21111 and a first substack layer 21112 in a first module stack layer 2111. The first substack layer 21112 is located between a display panel 2112 and the transmission layer 221. The first substack layer 21112 includes a hard material. The transmission layer 221 is located between the first substack layer 21112 and the second substack layer 21111. The second substack layer 21111 is made of a flexible material and configured to form an electrostatic protection structure on a side that is of the transmission layer 221 and that is away from the first substack layer 21112. The transmission layer 221 includes a substrate layer 2211 and a wiring layer 2212. The wiring layer 2212 is located at the bottom of the substrate layer 2211. The substrate layer 2211 is pasted to the first substack layer 21112 through an adhesive layer 232. A spacing layer 21113 in the first module stack layer 2111 is located between the second substack layer 21111 and the wiring layer 2212. The spacing layer 21113 may be an adhesive layer. A first window 11H1 and a second window 11H2 penetrate the second substack layer 21111 and the spacing layer 21113.

[0102] In an implementation of this application, the first window 11H1 and the second window 11H2 are provided on a bottom side of a stacked structure 23. Wiring connection structures 222 are connected to the wiring layer 2212 in the transmission layer 221 through the first window 11H1 and the second window 11H2. The first window 11H1 and the second window 11H2 penetrate the second substack layer 21111.

[0103] In an implementation of this application, the transmission layer is disposed between the second substack layer and the first substack layer in the first module stack layer. A pattern imprint problem is resolved through the hard material of the second substack layer. In addition, electrostatic protection provided by the first substack layer can safeguard a line in the transmission layer against static electricity, to ensure signal transmission stability and safety of the display module.

[0104] In an implementation, the first substack layer 21112 is made of a metal material. The first substack layer 21112 is configured to shield signal interference between the transmission layer 221 and the display panel 2112, to ensure signal transmission stability of the display module.

[0105] In a possible implementation, a thickness of the first substack layer 21112 ranges from 100 μm to 300 μm ; and a thickness of the second substack layer 21111 ranges from 20 μm to 50 μm . Both the second substack layer 21111 and the first substack layer 21112 may be made of a metal material. Their dimensions in a thickness direction may determine whether they are hard or flexible. In an implementation of this application, the first substack layer 21112 is designed as a hard structure by limiting the thickness of the first substack layer 21112, and the second substack layer 21111 is designed

as a flexible structure by limiting the thickness of the second substack layer 21111.

[0106] The foregoing descriptions are merely specific implementations of this application, but are not intended to limit the protection scope of this application. Any variation or replacement readily figured out by a person skilled in the art within the technical scope disclosed in this application shall fall within the protection scope of this application. Therefore, the protection scope of this application shall be subject to the protection scope of the claims.

Claims

1. A display module, wherein the display module is used in an electronic device, the display module comprises a display panel, a first module stack layer, and a transmission layer that are stacked, the first module stack layer is located on a side away from a light-emitting surface of the display panel, the first module stack layer comprises a first substack layer, the first substack layer is stacked between the transmission layer and the display panel, and the first substack layer comprises a hard material; and the display module further comprises a display connection structure and at least two wiring connection structures, the display panel is electrically connected to a control unit in the electronic device through the display connection structure, the transmission layer is electrically connected to the at least two wiring connection structures, one of the at least two wiring connection structures is configured to electrically connect the transmission layer to a first component in the electronic device, and another of the at least two wiring connection structures is configured to electrically connect the transmission layer to a second component in the electronic device, so that the transmission layer transmits a signal between the first component and the second component.

2. The display module according to claim 1, wherein the hard material of the first substack layer comprises a carbon fiber or hard alloy material.

3. The display module according to claim 1 or 2, wherein the display module has a first window and a second window;

in a thickness direction of the display module, the first window and the second window are located on a side that is of the transmission layer and that is away from the display panel, and a direction in which the display panel, the first module stack layer, and the transmission layer are stacked is the thickness direction of the display module; and one of the at least two wiring connection struc-

- tures is electrically connected to the wiring layer of the transmission layer in the first window, and another of the at least two wiring structures is electrically connected to the wiring layer of the transmission layer in the second window. 5
4. The display module according to claim 3, wherein the first module stack layer further comprises a second substack layer, the second substack layer and the first substack layer are made of different materials, the transmission layer is located between the first substack layer and the second substack layer, the second substack layer is made of a flexible material and configured to form an electrostatic protection structure on a side that is of the transmission layer and that is away from the first substack layer, and the first window and the second window penetrate the second substack layer. 10
 5. The display module according to claim 4, wherein a thickness of the first substack layer ranges from 100 μm to 300 μm ; and a thickness of the second substack layer ranges from 20 μm to 50 μm . 20
 6. The display module according to claim 3, wherein the first module stack layer is located between the transmission layer and the display panel, the transmission layer is pasted to the first module stack layer through an adhesive layer, the transmission layer comprises a substrate layer and the wiring layer, the wiring layer is stacked between the substrate layer and the first module stack layer, and the first window and the second window penetrate the substrate layer. 25 30
 7. The display module according to claim 3, wherein the first module stack layer is located between the transmission layer and the display panel, the transmission layer comprises a substrate layer and the wiring layer, the substrate layer is pasted to the first module stack layer through an adhesive layer, the wiring layer is located on a side that is of the substrate layer and that is away from the first module stack layer, the display module further comprises a bottom protective layer, the bottom protective layer covers the wiring layer on a side that is of the wiring layer and that is away from the substrate layer, and the first window and the second window penetrate the bottom protective layer. 35 40 45
 8. A display module, used in an electronic device, wherein the display module comprises a transmission layer and a display panel that are stacked, and the transmission layer is located on a side away from a light-emitting surface of the display panel; and the display module further comprises a display connection structure and at least two wiring connection structures, the display panel is electrically connected to a control unit in the electronic device through the display connection structure, the at least two wiring connection structures each are connected to an edge of the transmission layer, and one of the at least two wiring connection structures is configured to electrically connect the transmission layer to a first component in the electronic device, and another of the at least two wiring connection structures is configured to electrically connect the transmission layer to a second component in the electronic device, so that the transmission layer transmits a signal between the first component and the second component. 50
 9. The display module according to claim 8, wherein the display panel comprises a base layer, a shield layer, and a panel function layer that are sequentially stacked, and the shield layer comprises a conductive material; and the transmission layer comprises a wiring layer, and at least partial signal isolation is implemented between the wiring layer and the panel function layer through the conductive material of the shield layer. 55
 10. The display module according to claim 9, wherein the conductive material of the shield layer covers an entire surface of the base layer.
 11. The display module according to claim 9 or 10, wherein the transmission layer comprises a substrate layer, the wiring layer is formed on a surface of the substrate layer, and the wiring layer is pasted to the base layer and/or the first module stack layer through an adhesive layer.
 12. The display module according to claim 11, wherein a thickness of the substrate layer ranges from 10 μm to 50 μm .
 13. The display module according to claim 11 or 12, wherein an elastic modulus of the substrate layer is 2.5 GPa to 9 GPa; and/or an elongation at break of the substrate layer needs to be greater than 5%.
 14. The display module according to any one of claims 9 to 13, wherein a thickness of the wiring layer ranges from 3 μm to 10 μm .
 15. The display module according to any one of claims 9 to 14, wherein the display module is used in an electronic device having a folding function, the display module is capable of switching between a folded state and an unfolded state, the display module comprises a first portion, a second portion, and a connection portion connected between the first portion and the second portion, the connection portion is configured to bend and deform in a process of switching between the folded state and the unfolded state, the wiring connection structure configured to

electrically connect to the first component is connected to the first portion, the wiring connection structure configured to electrically connect to the second component is connected to the second portion, both the first portion and the second portion are rectangular, the transmission layer and the display panel form a stacked structure, the stacked structure comprises a first edge and a second edge that are adjacent to each other, the first edge is a long edge of the first portion, a part of the second edge forms a short edge of the first portion, a part of the second edge forms a short edge of the second portion, the display connection structure is connected to the first edge, and at least two of the wiring connection structures are connected to the second edge.

16. The display module according to any one of claims 9 to 14, wherein the display module is used in an electronic device having a folding function, the display module is capable of switching between a folded state and an unfolded state, the display module comprises a first portion, a second portion, and a connection portion connected between the first portion and the second portion, the connection portion is configured to bend and deform in a process of switching between the folded state and the unfolded state, the wiring connection structure configured to electrically connect to the first component is connected to the first portion, the wiring connection structure configured to electrically connect to the second component is connected to the second portion, both the first portion and the second portion are rectangular, the transmission layer and the display panel form a stacked structure, the stacked structure comprises a first edge and a third edge that are opposite to each other, the display connection structure is connected to the first edge, one of the wiring connection structures is connected to the first edge and overlaps with the display connection structure, and another of the wiring connection structures is connected to the third edge.

17. The display module according to any one of claims 9 to 14, wherein the display module is used in an electronic device having a folding function, the display module is capable of switching between a folded state and an unfolded state, the display module comprises a first portion, a second portion, and a connection portion connected between the first portion and the second portion, the connection portion is configured to bend and deform in a process of switching between the folded state and the unfolded state, the wiring connection structure configured to electrically connect to the first component is connected to the first portion, the wiring connection structure configured to electrically connect to the second component is connected to the second portion, both the first portion and the second portion are

rectangular, the transmission layer and the display panel form a stacked structure, the stacked structure comprises a first edge and a third edge that are opposite to each other, the display connection structure is connected to a first region of the first edge, one of the wiring connection structures is connected to a second region of the first edge and arranged side by side with the display connection structure, and another of the wiring connection structures is connected to the third edge.

18. The display module according to any one of claims 9 to 14, wherein the display module is used in an electronic device having a folding function, the display module is capable of switching between a folded state and an unfolded state, the display module comprises a first portion, a second portion, and a connection portion connected between the first portion and the second portion, the connection portion is configured to bend and deform in a process of switching between the folded state and the unfolded state, the wiring connection structure configured to electrically connect to the first component is connected to the first portion, the wiring connection structure configured to electrically connect to the second component is connected to the second portion, both the first portion and the second portion are rectangular, the transmission layer and the display panel form a stacked structure, the stacked structure comprises a first edge, one of the wiring connection structures is connected to the first edge, the display connection structure is connected to the first edge, the display connection structure and the wiring connection structure connected to the first edge are connected to different flexible circuit boards, the display connection structure is electrically connected to the control unit in the electronic device through the flexible circuit board, and the wiring connection structure implements a conductive connection between the transmission layer and a component in the electronic device through the flexible circuit board.

19. The display module according to any one of claims 9 to 14, wherein the display module is used in an electronic device having a folding function, the display module is capable of switching between a folded state and an unfolded state, the display module comprises a first portion, a second portion, and a connection portion connected between the first portion and the second portion, the connection portion is configured to bend and deform in a process of switching between the folded state and the unfolded state, the wiring connection structure configured to electrically connect to the first component is connected to the first portion, the wiring connection structure configured to electrically connect to the second component is connected to the second portion,

tion, both the first portion and the second portion are rectangular, the transmission layer and the display panel form a stacked structure, the stacked structure comprises a first edge, one of the wiring connection structures is connected to the first edge, the display connection structure is connected to the first edge, the display connection structure and the wiring connection structure connected to the first edge are connected to different positions of a same flexible circuit board, the display connection structure is electrically connected to the control unit in the electronic device through the flexible circuit board, and the wiring connection structure implements a conductive connection between the transmission layer and a component in the electronic device through the flexible circuit board.

20. The display module according to any one of claims 8 to 19, wherein the display module further comprises the first module stack layer, and the transmission layer is disposed between the display panel and the first module stack layer.
21. An electronic device, comprising an apparatus body and the display module according to any one of claims 1 to 20, wherein a control unit, a first component, and a second component are disposed in the apparatus body, the display module is connected to the apparatus body, the display connection structure is electrically connected to the control unit, one of the wiring connection structures is electrically connected to the first component, and another of the wiring connection structures is electrically connected to the second component.

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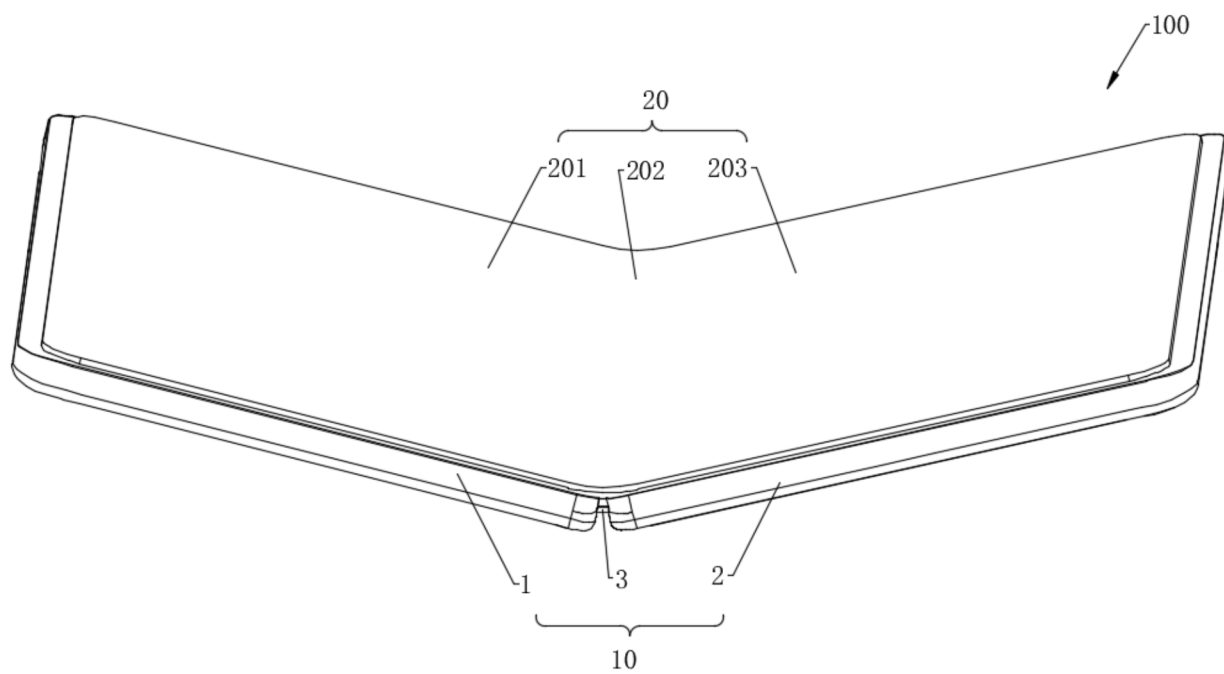


FIG. 1A

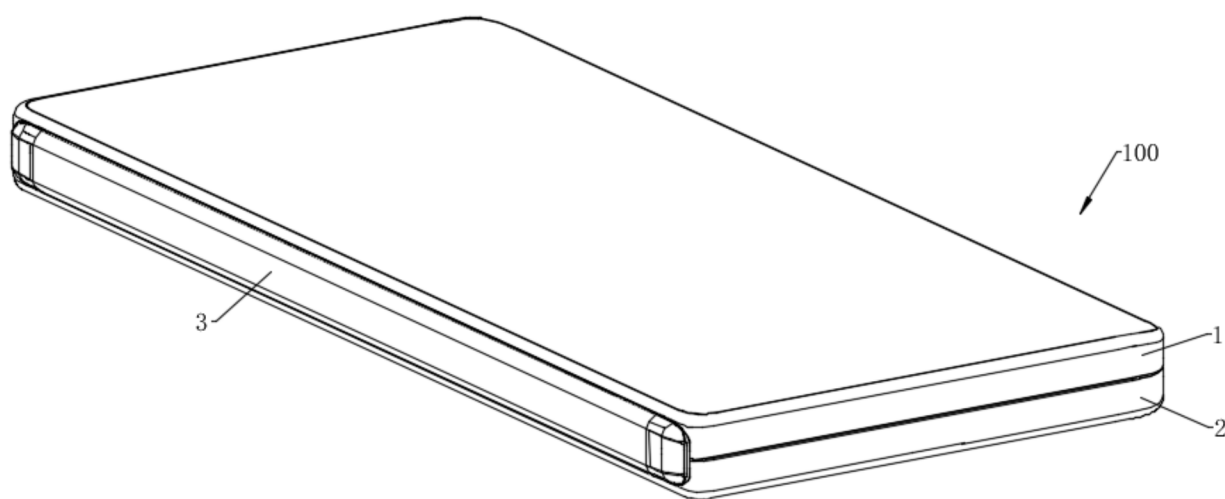


FIG. 1B

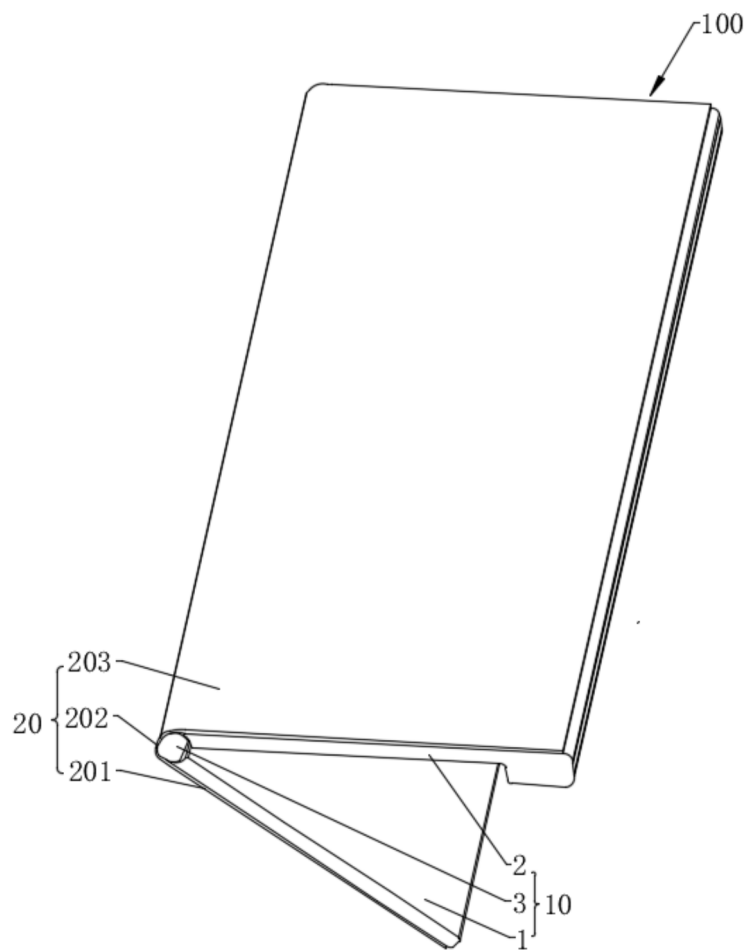


FIG. 2A

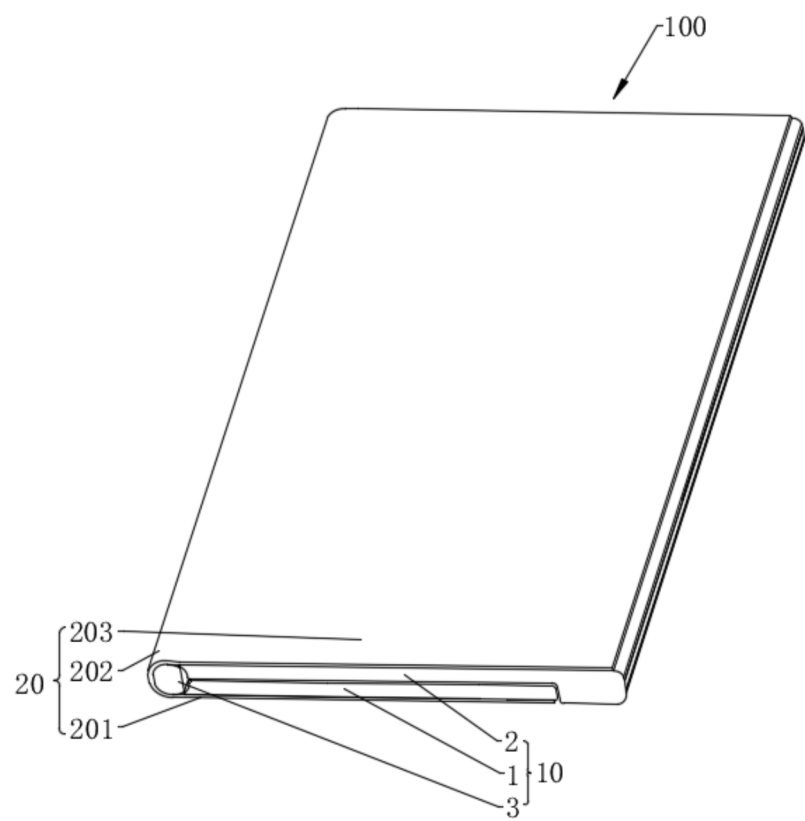


FIG. 2B

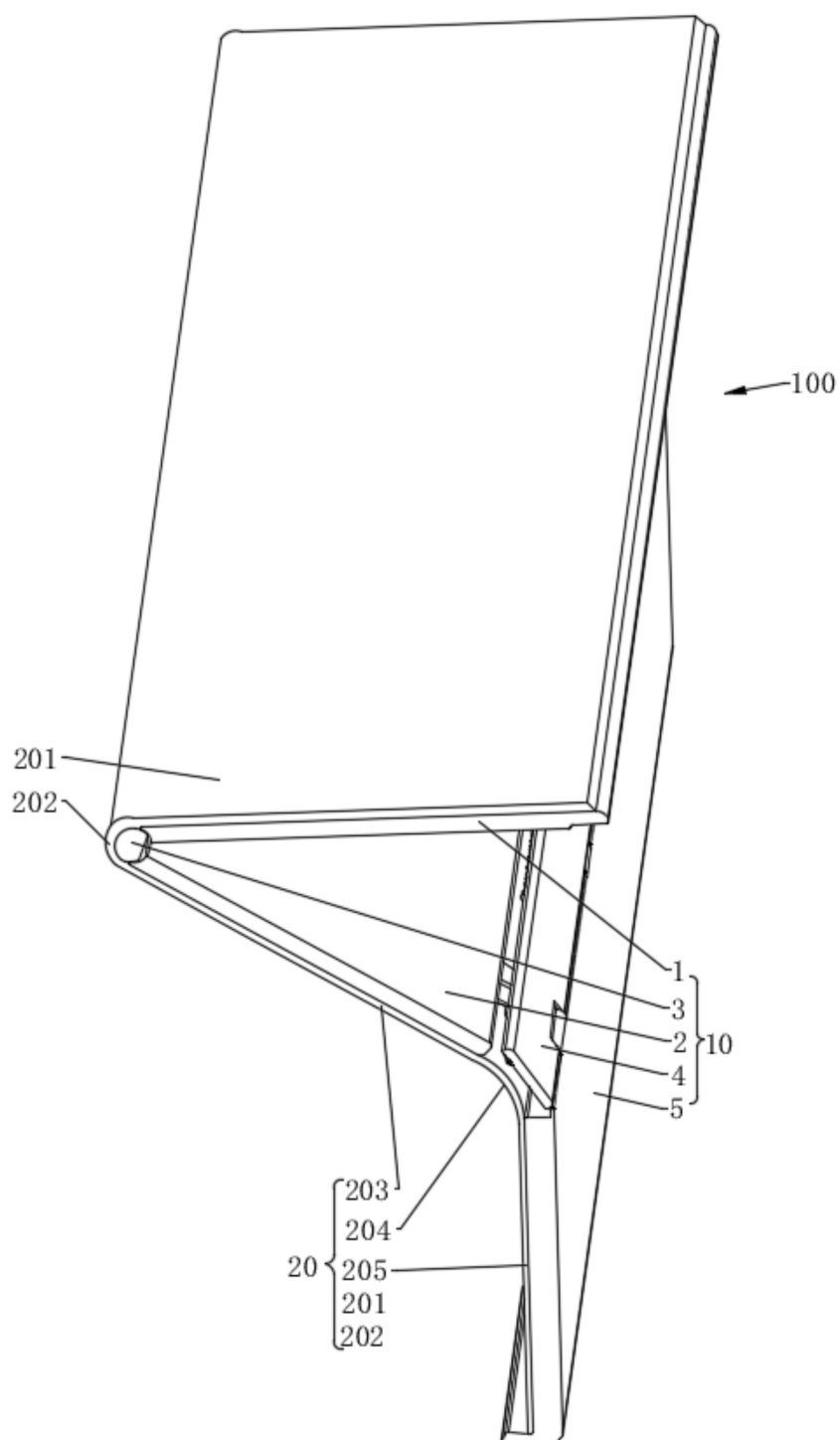


FIG. 3A

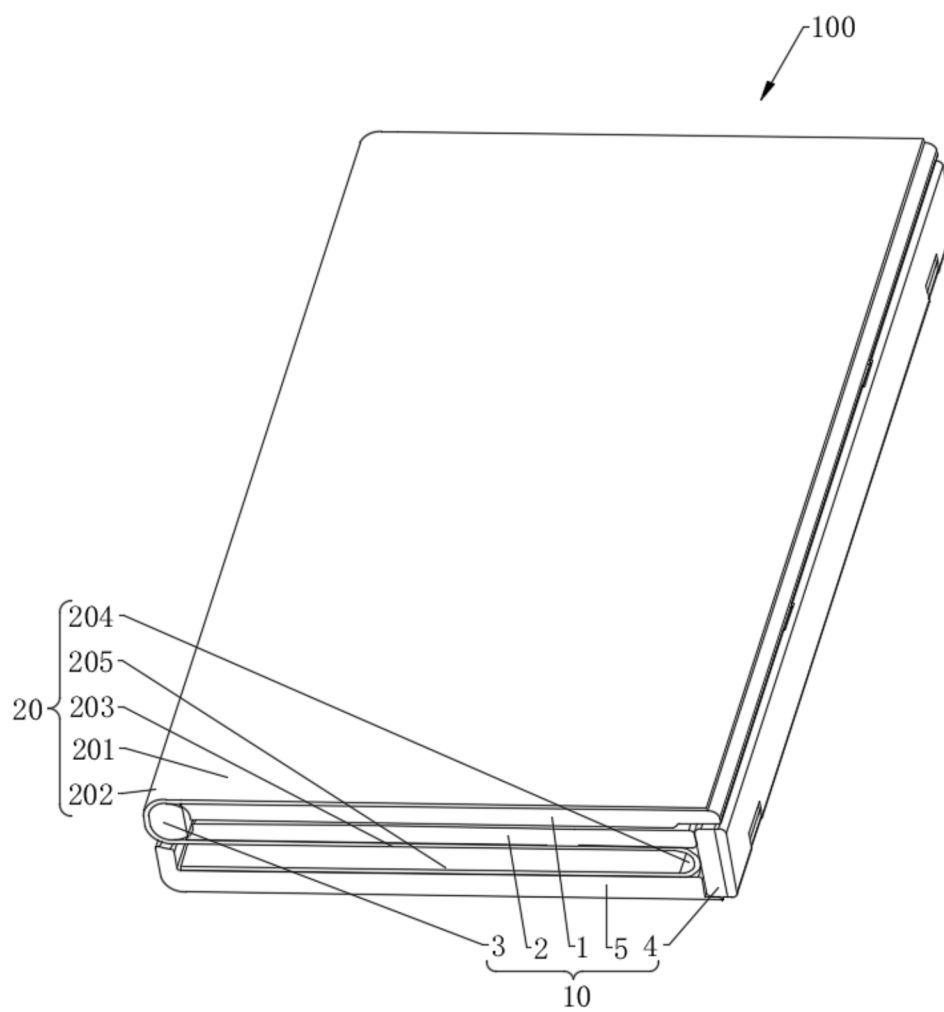


FIG. 3B

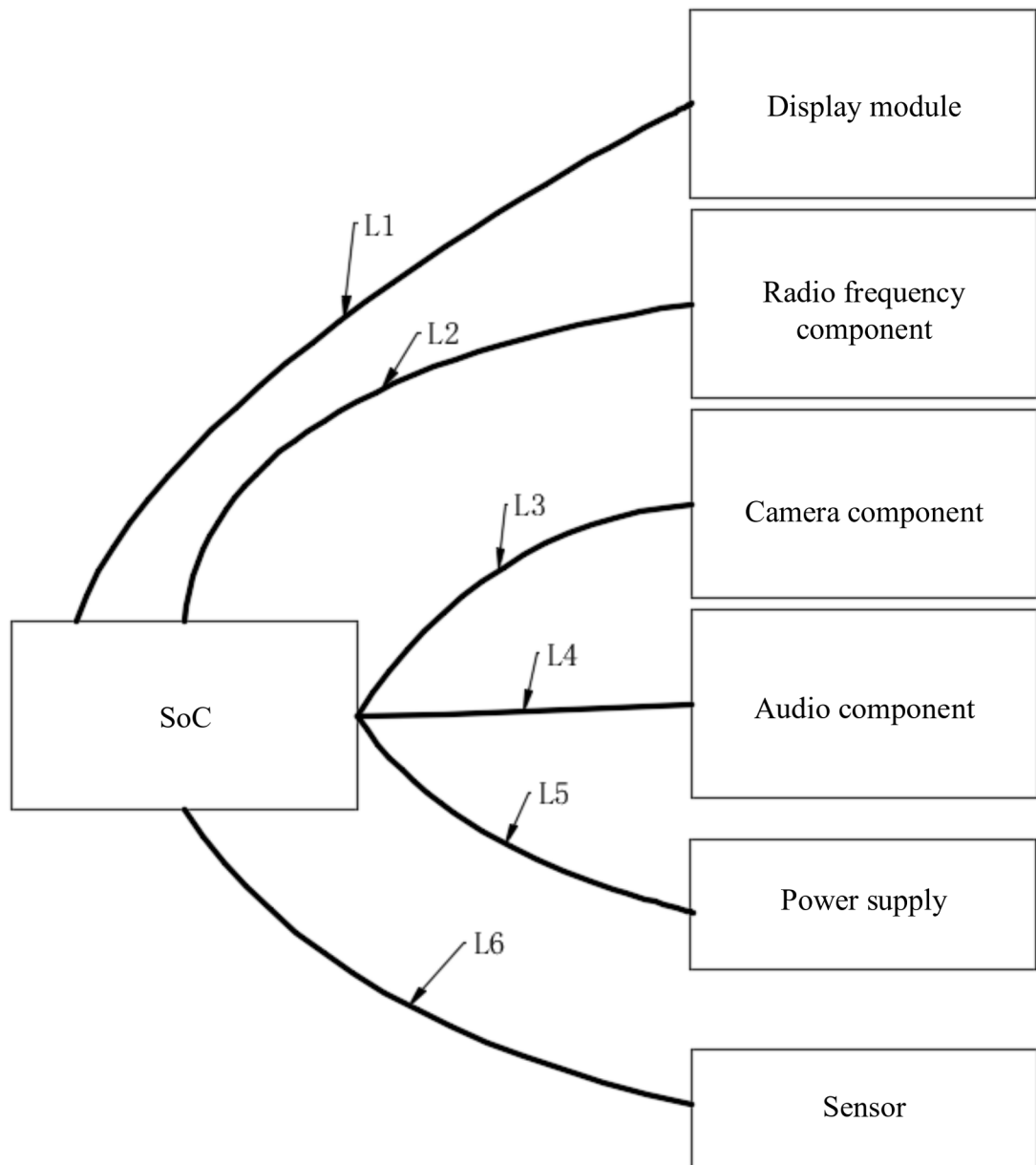


FIG. 4

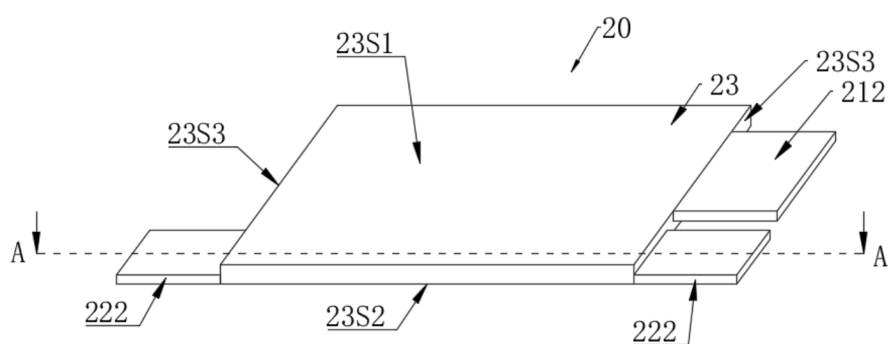


FIG. 5

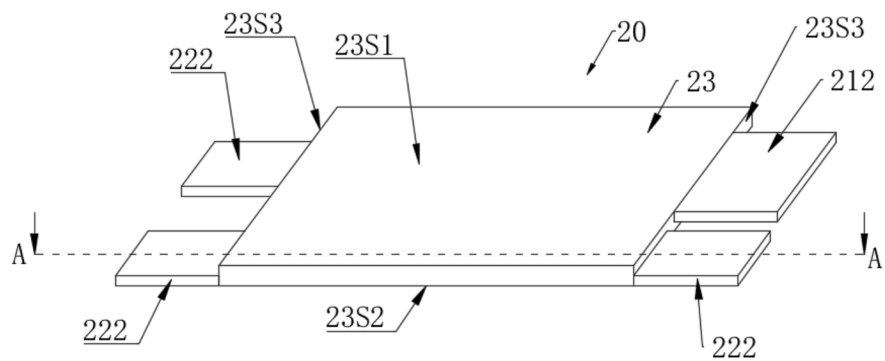


FIG. 6

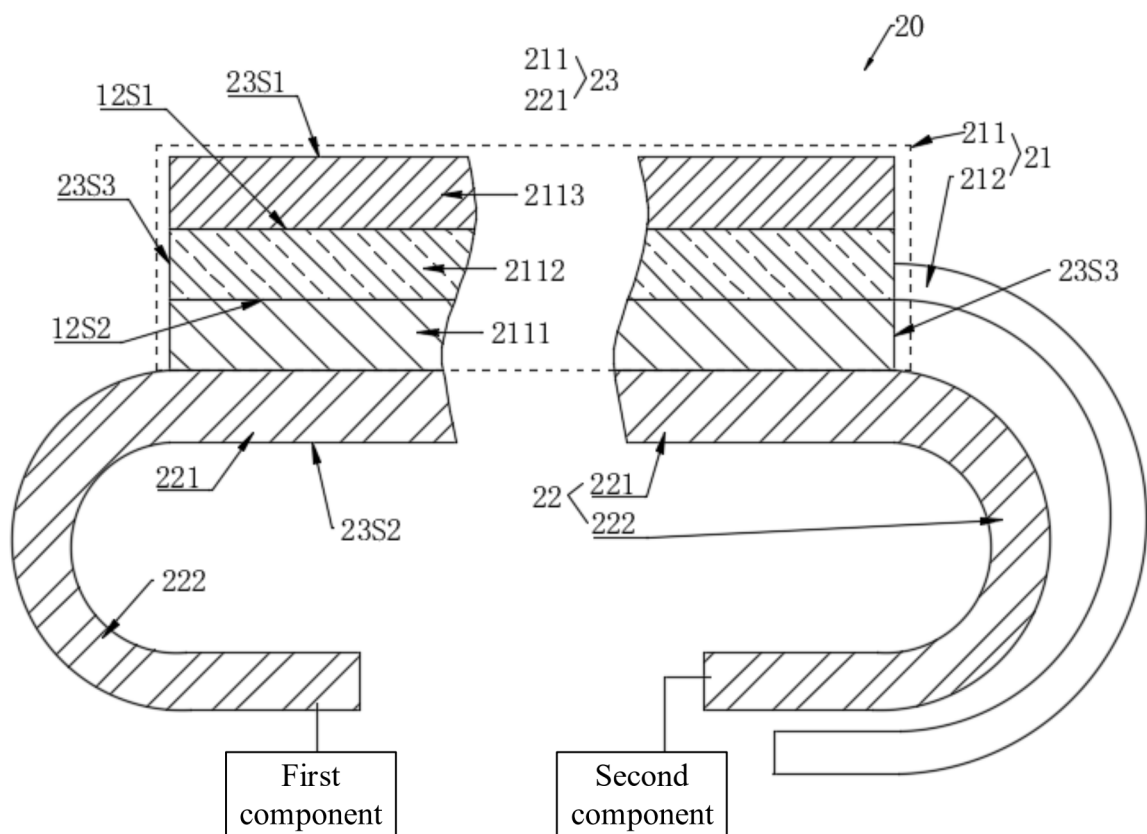


FIG. 7

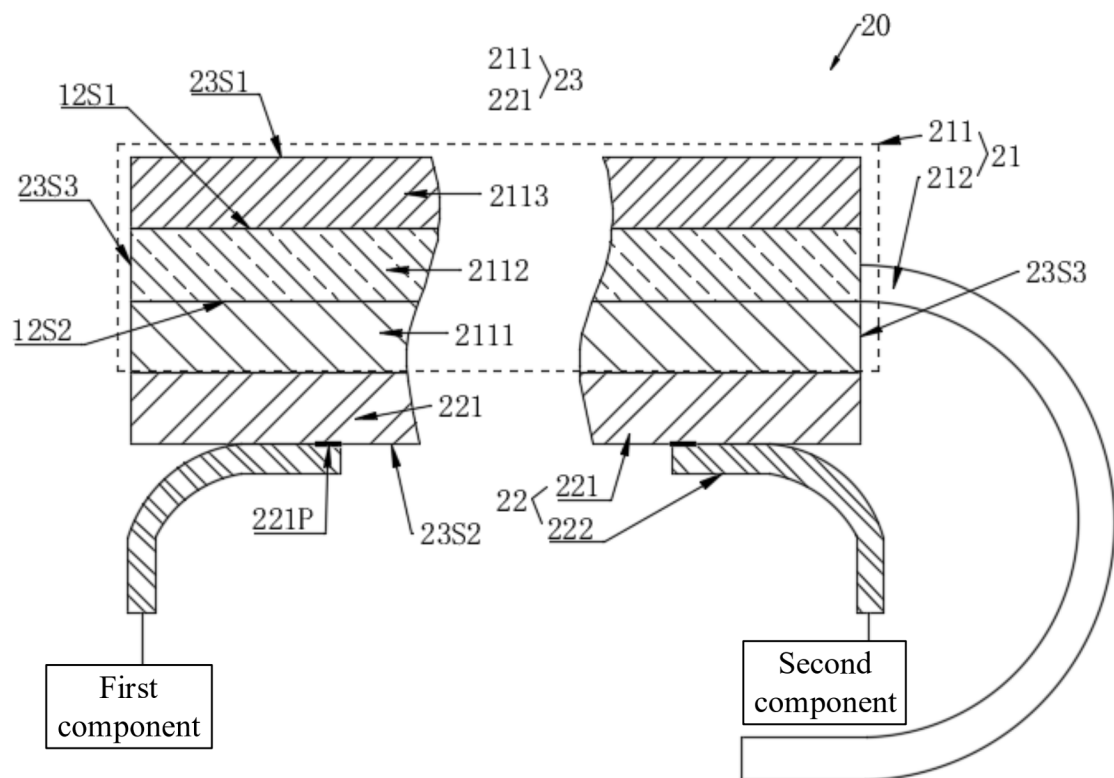


FIG. 8

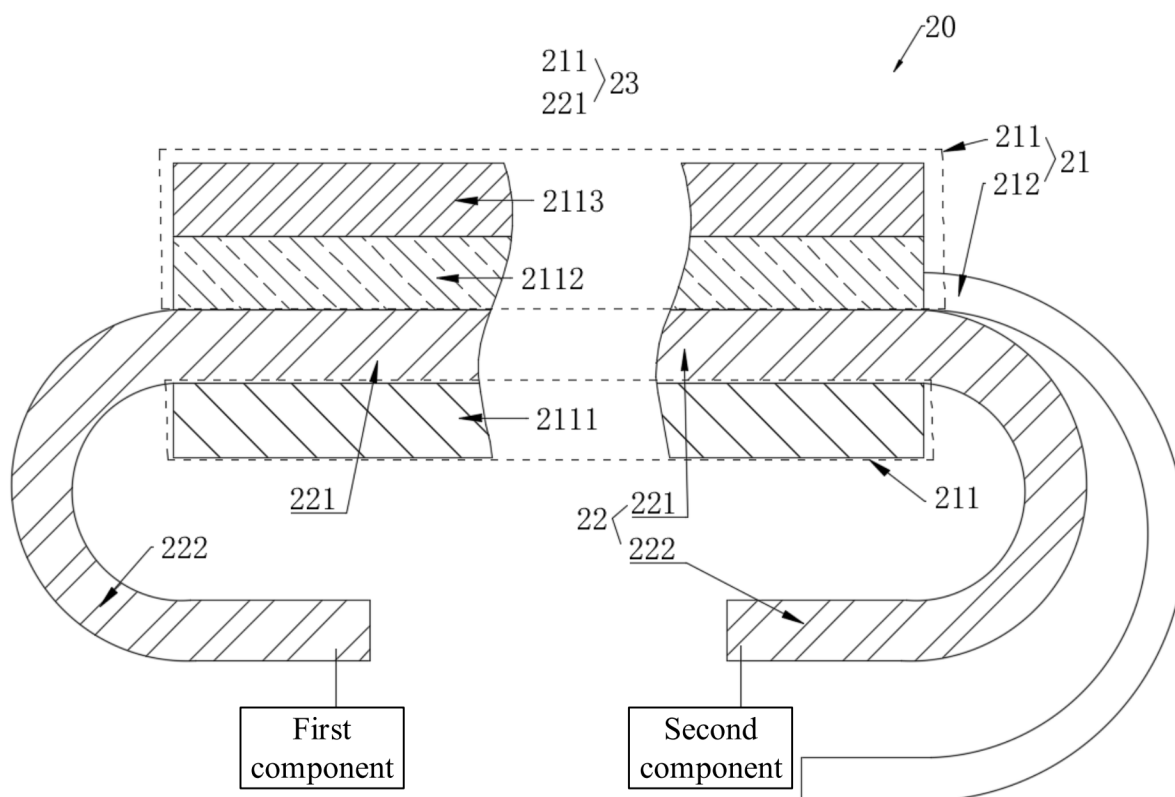


FIG. 9

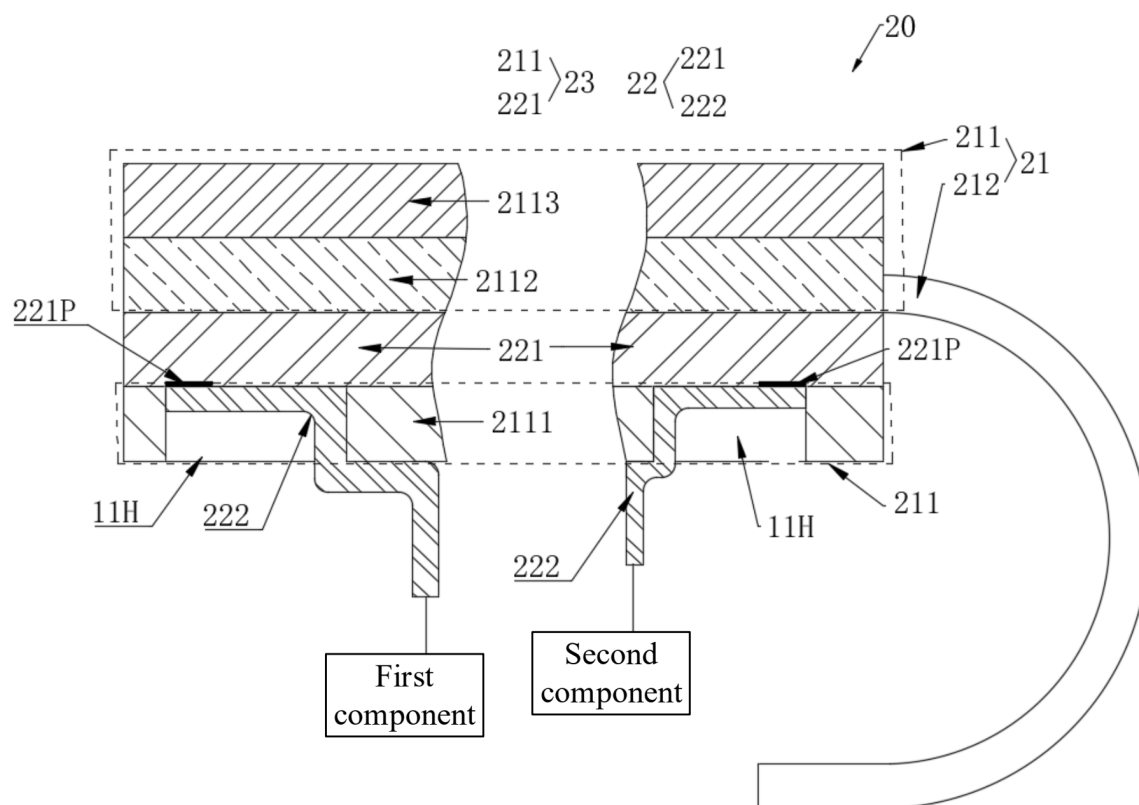


FIG. 10

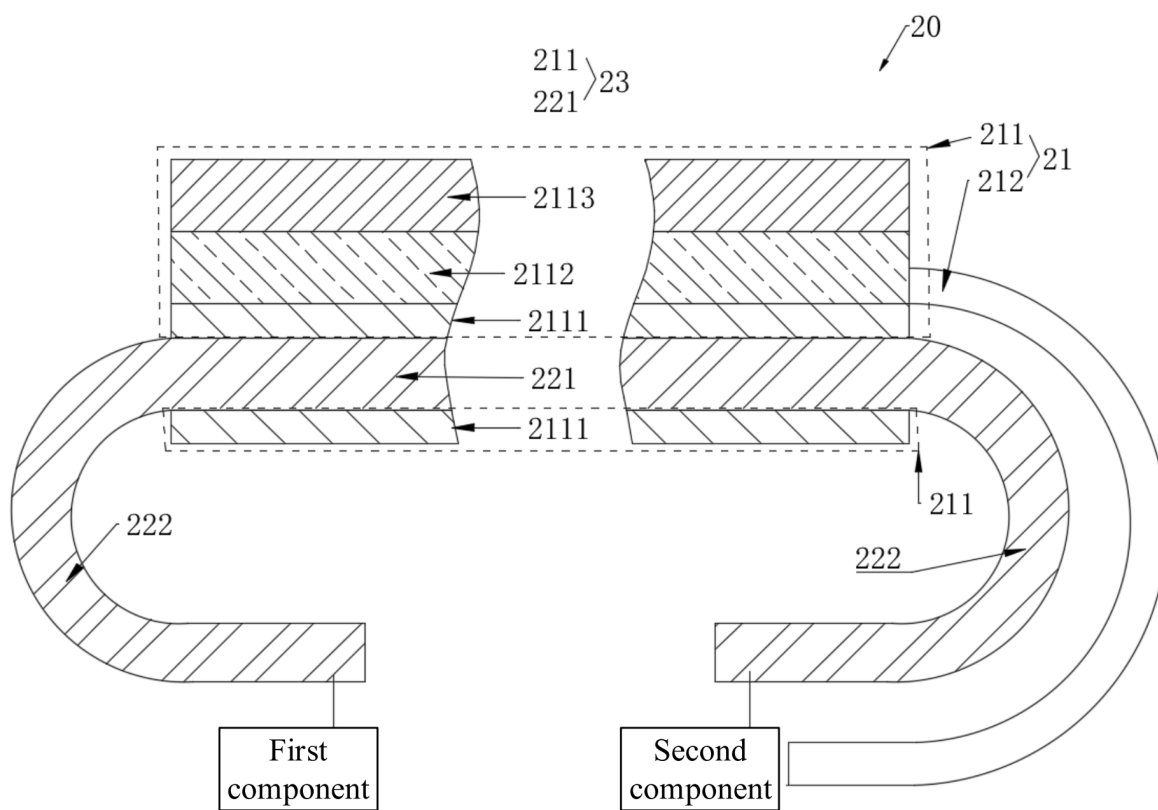


FIG. 11

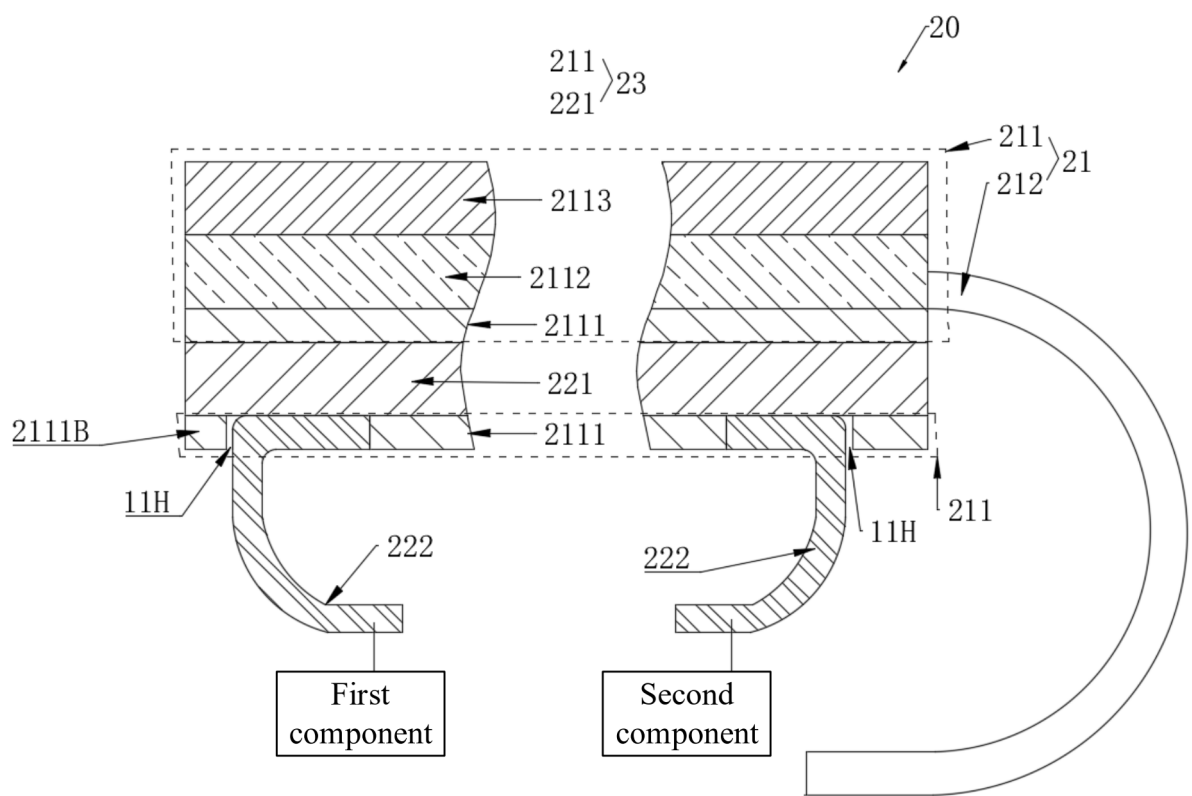


FIG. 12

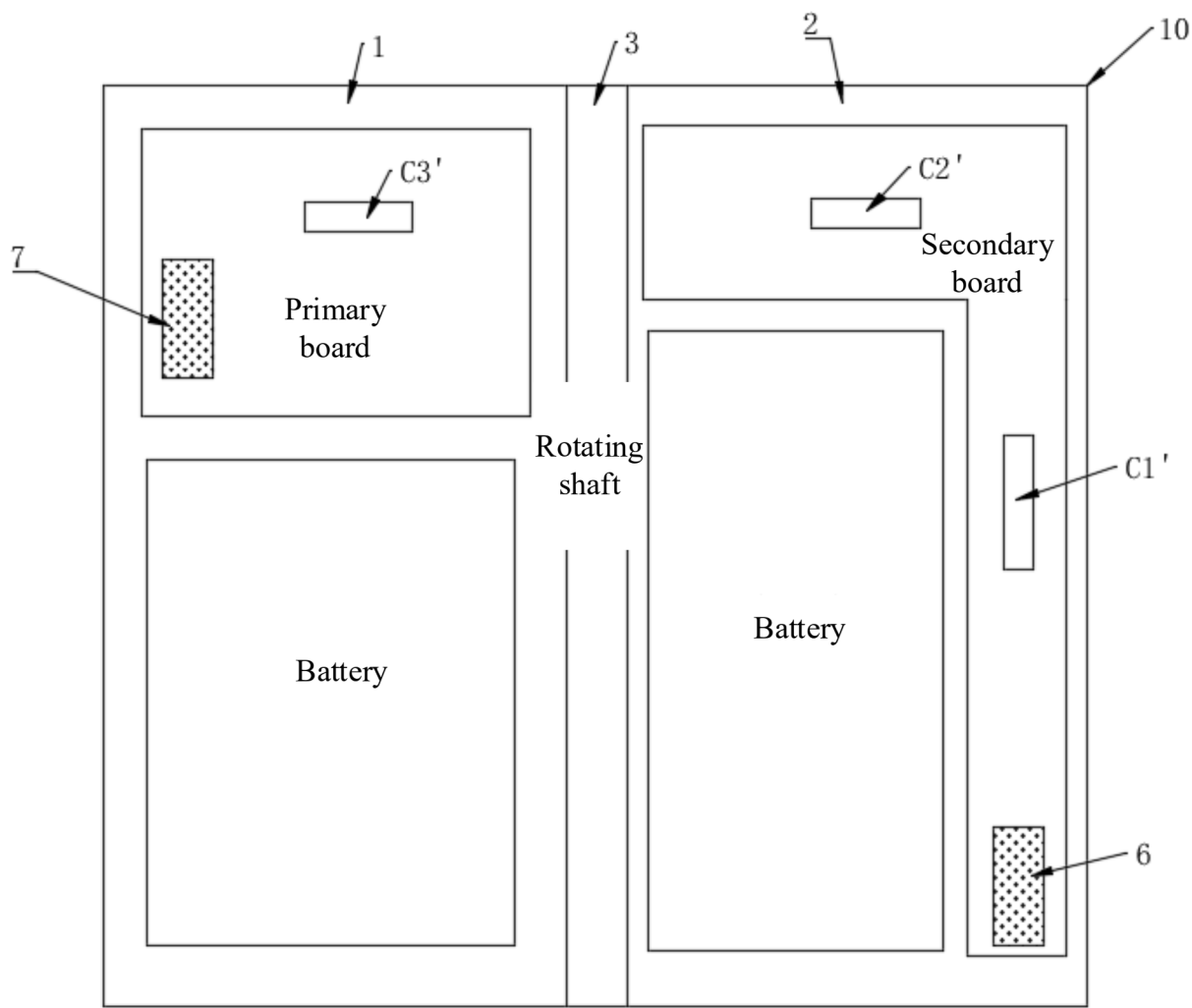


FIG. 13A

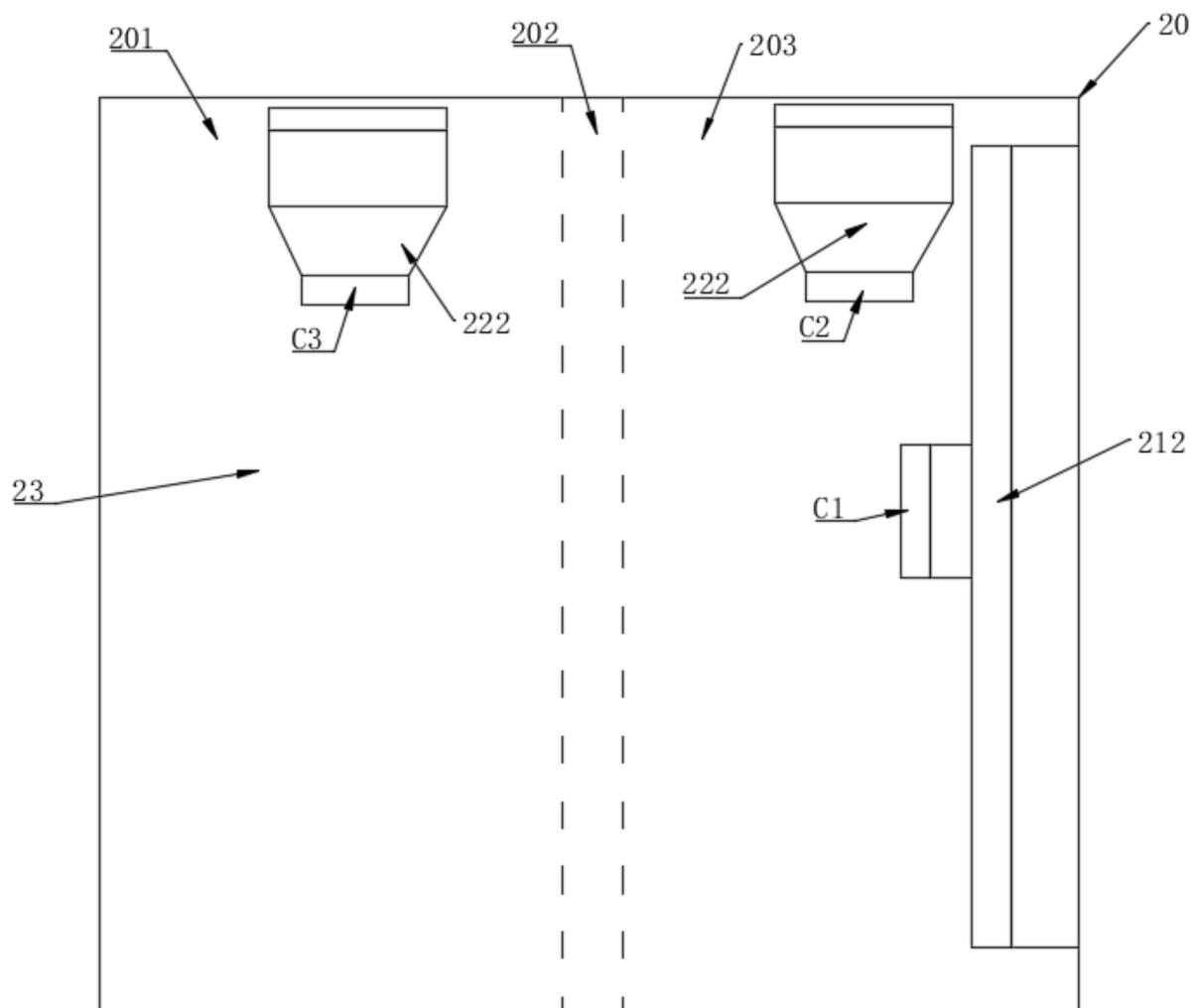


FIG. 13B

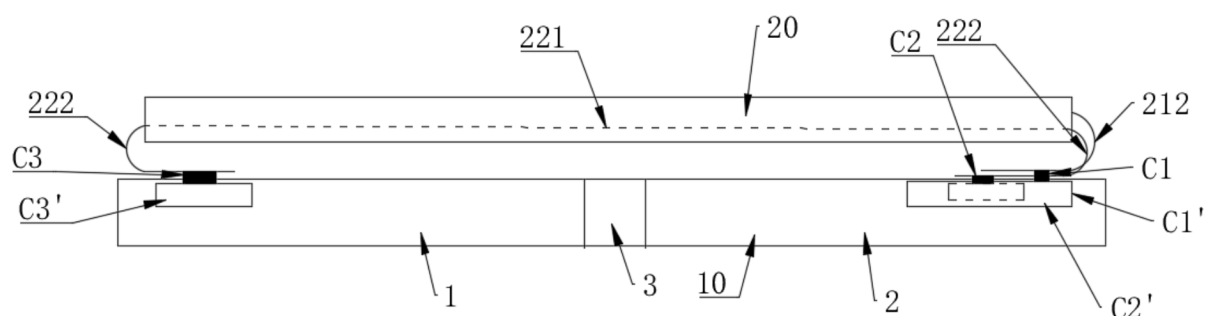


FIG. 14A

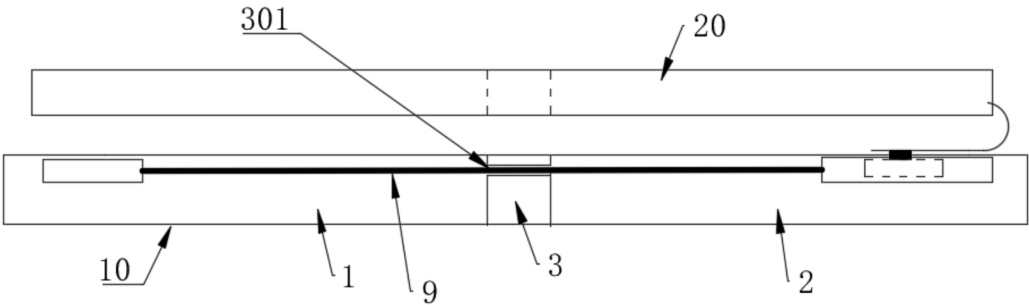


FIG. 14B

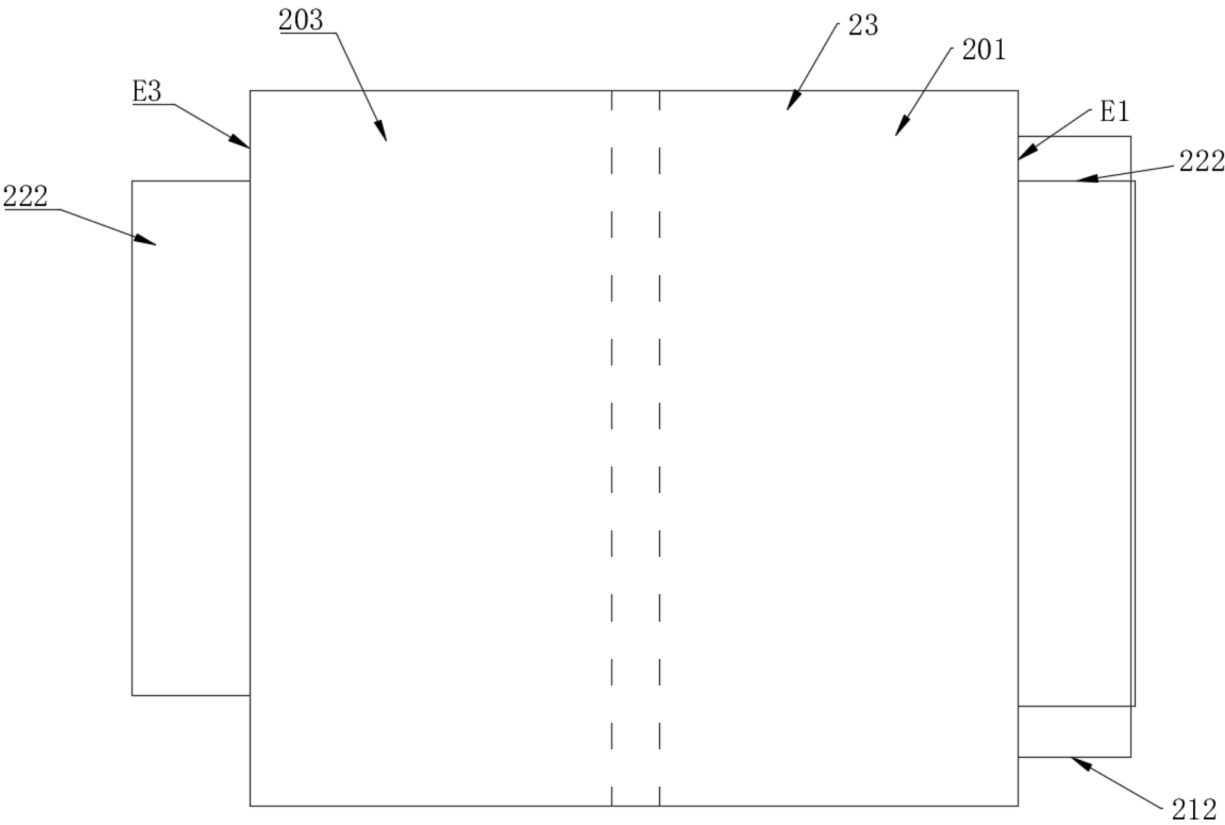


FIG. 15

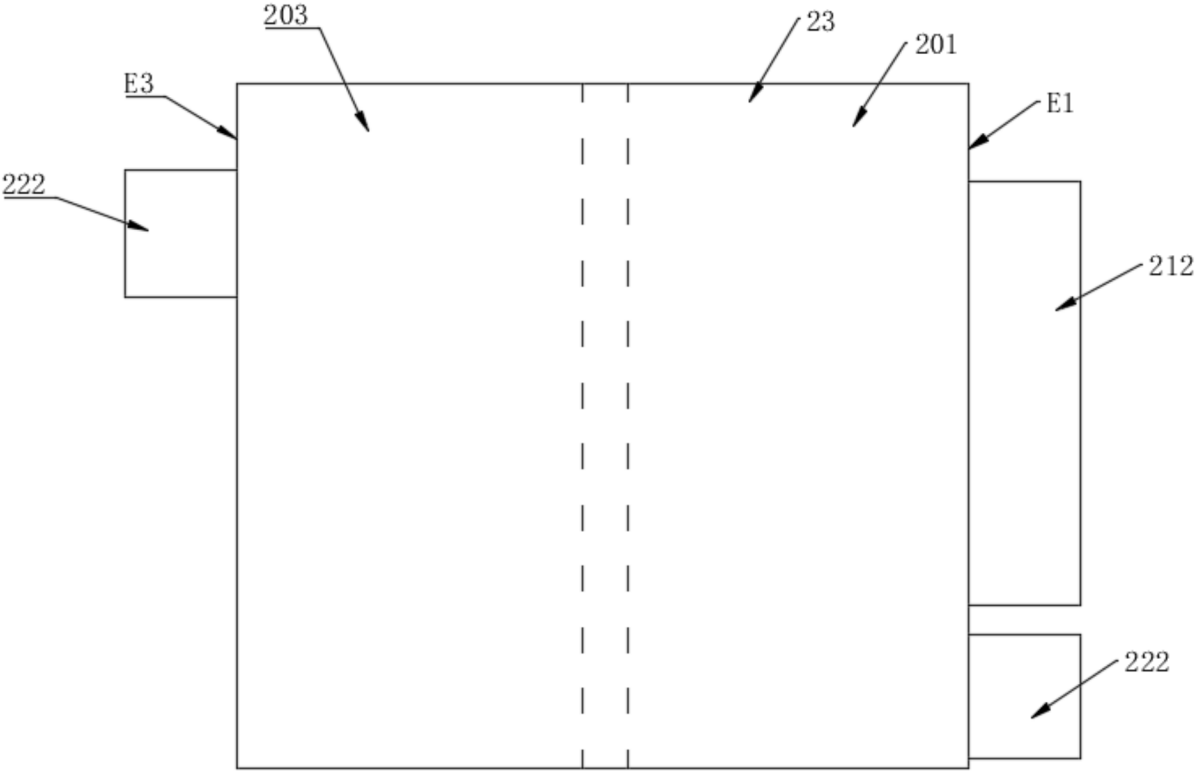


FIG. 16

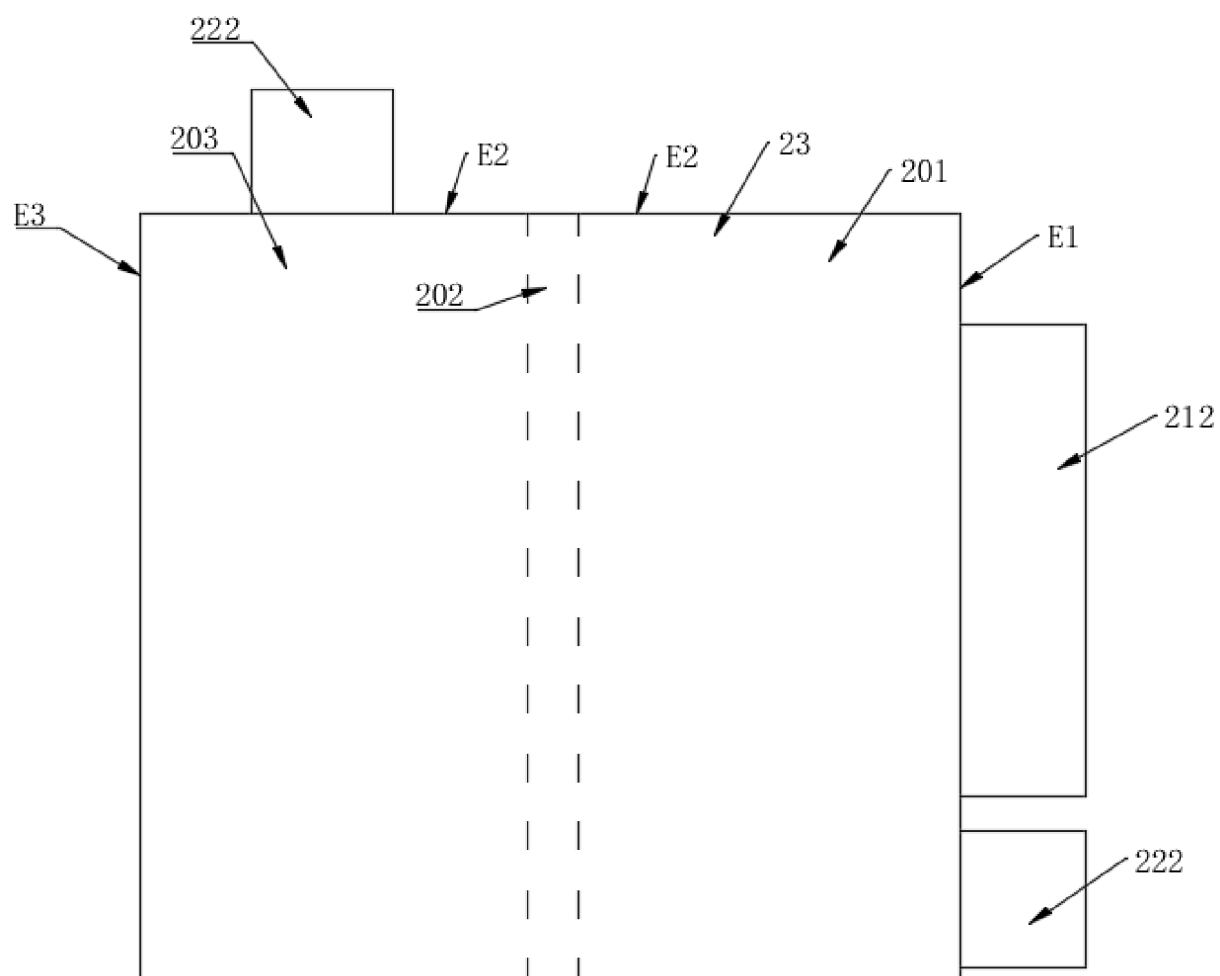


FIG. 17

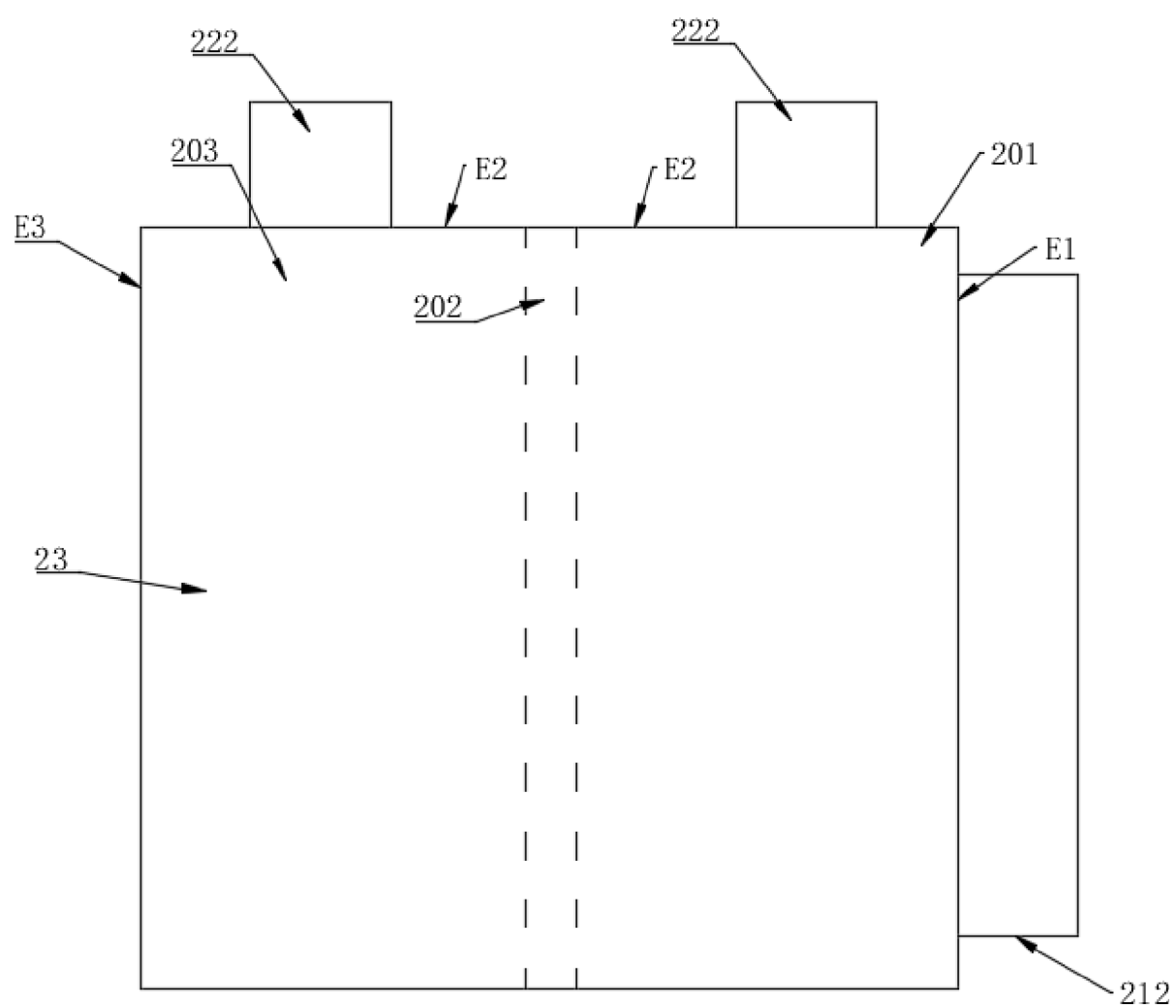


FIG. 18

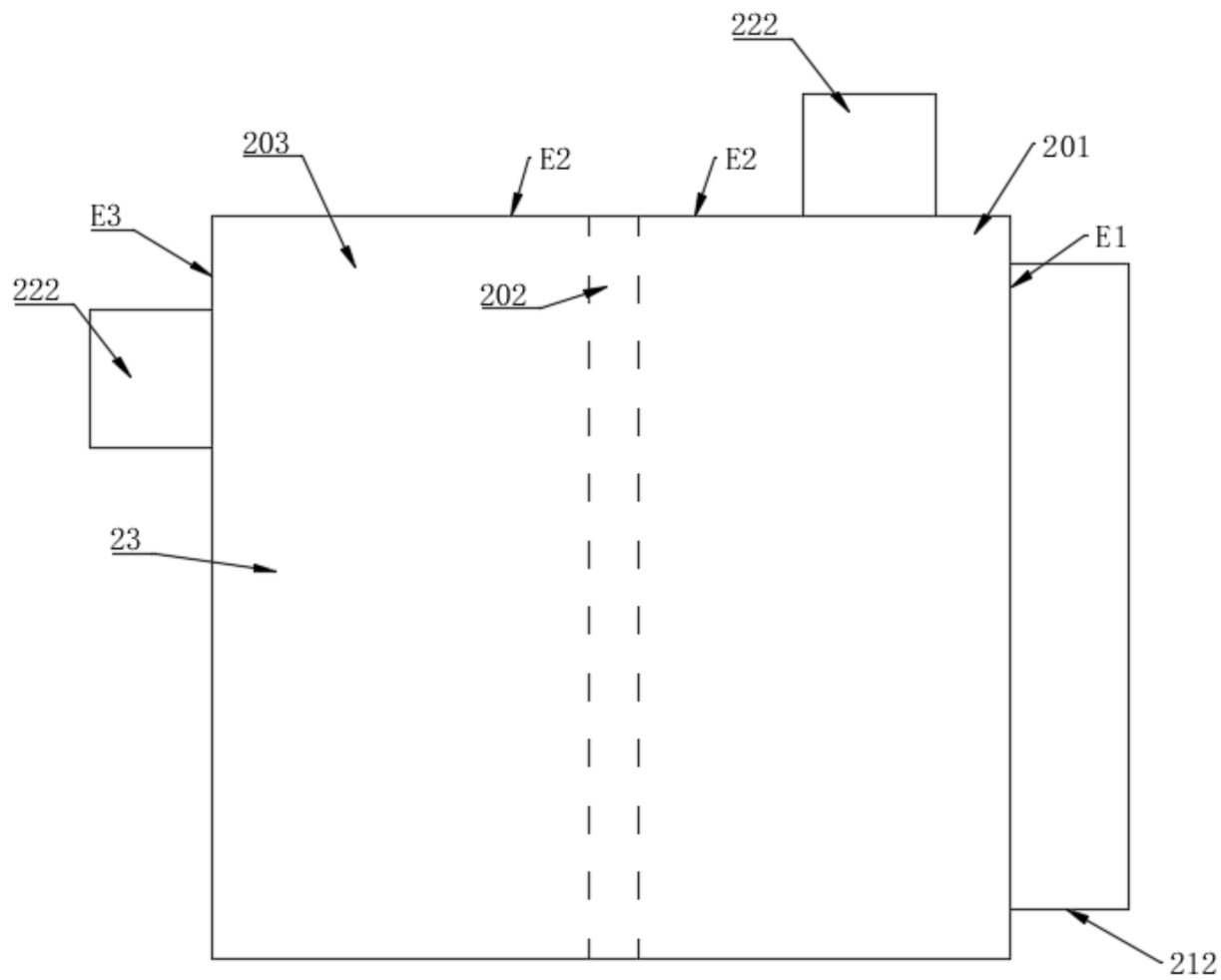


FIG. 19

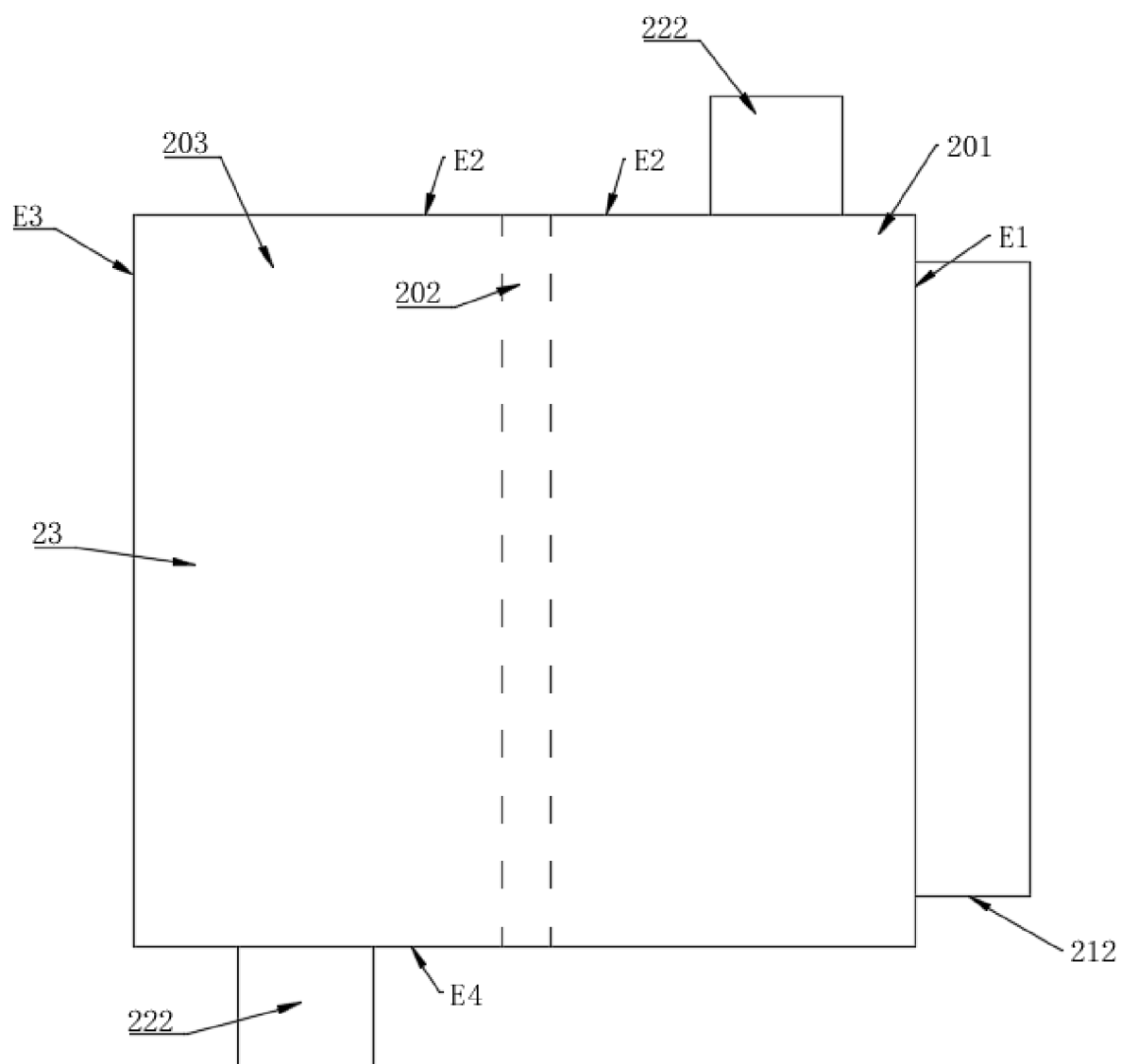


FIG. 20

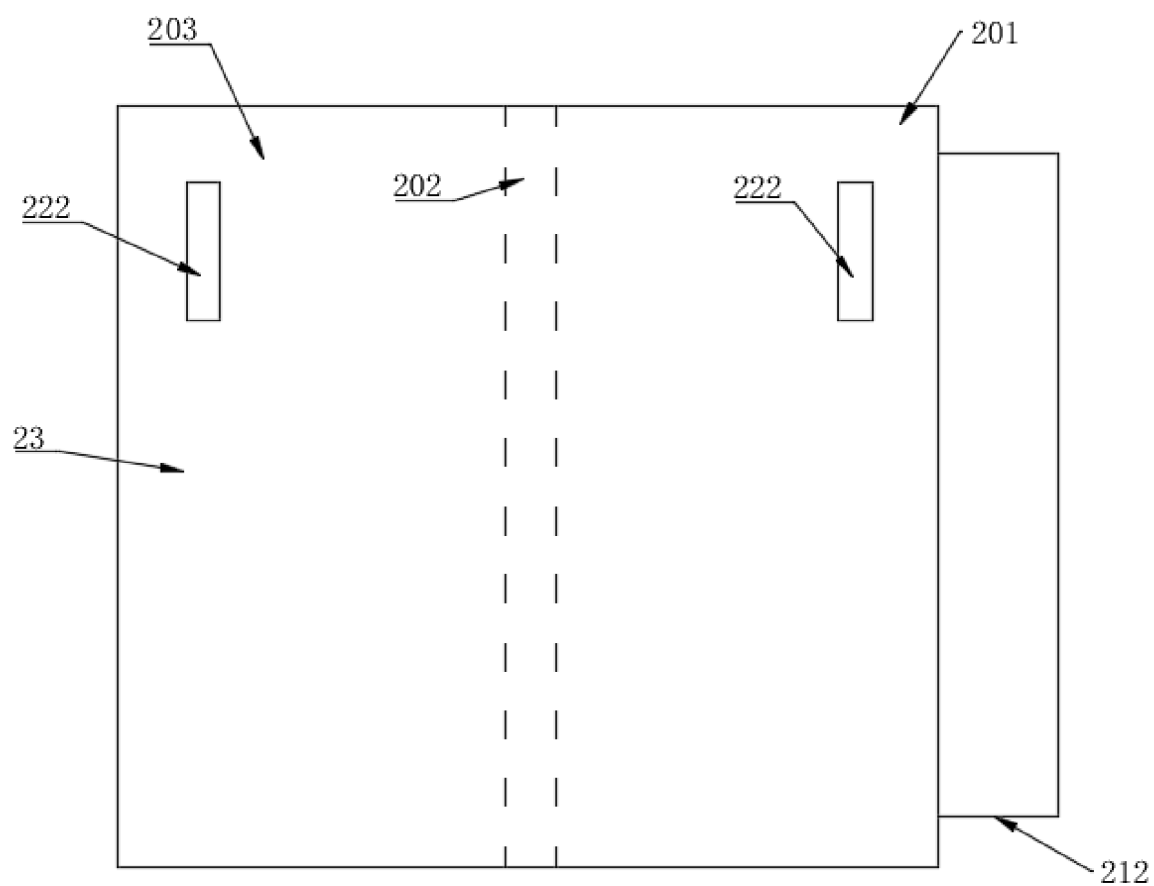


FIG. 21

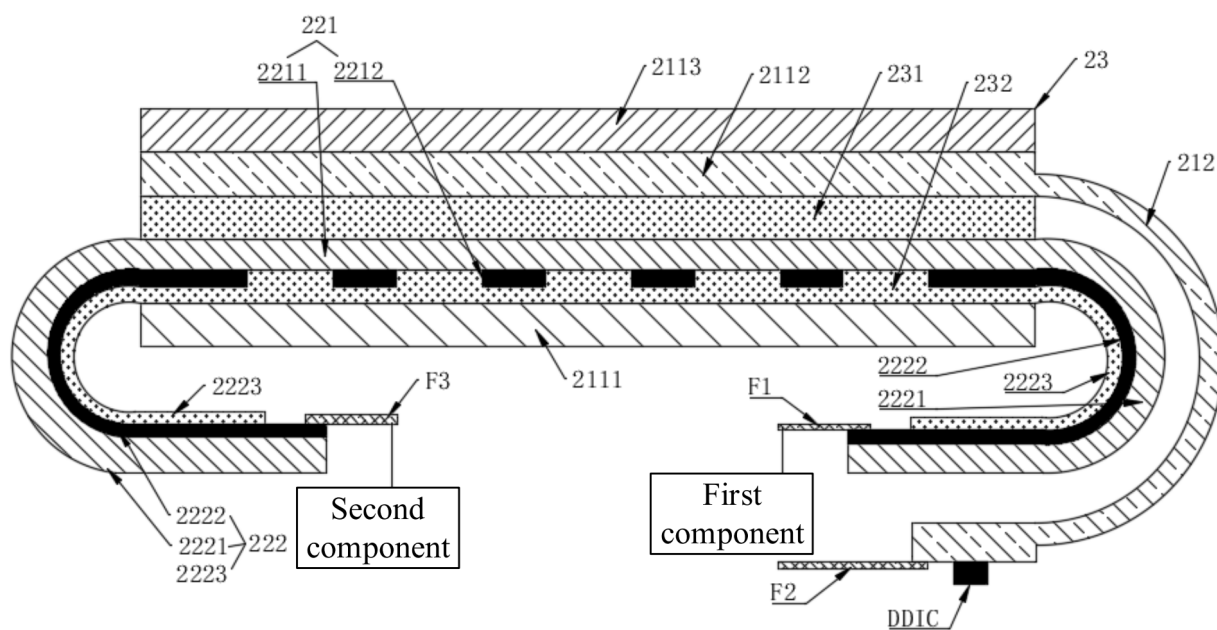


FIG. 22

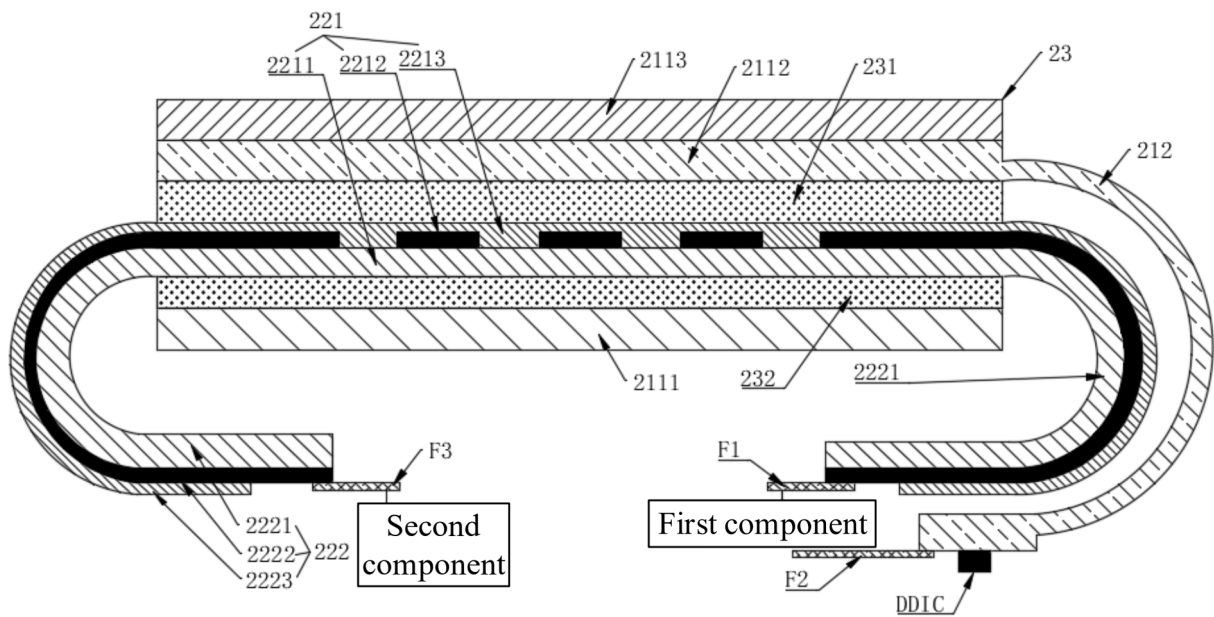


FIG. 23

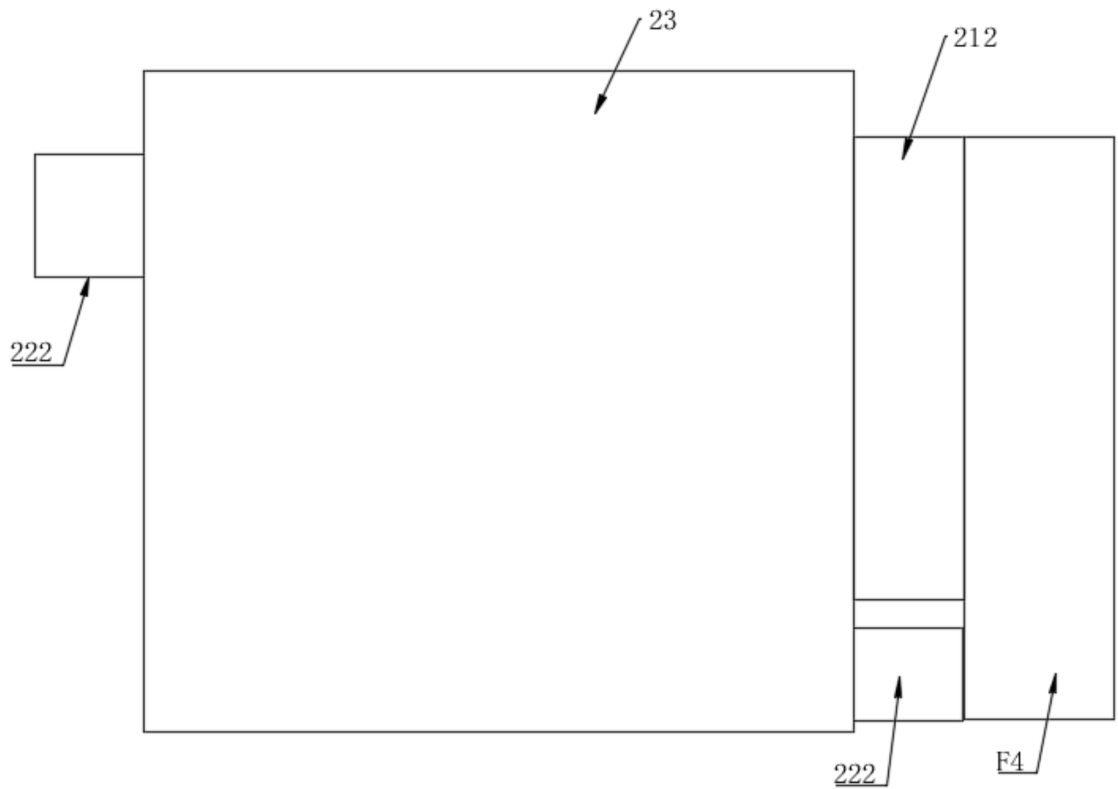


FIG. 24

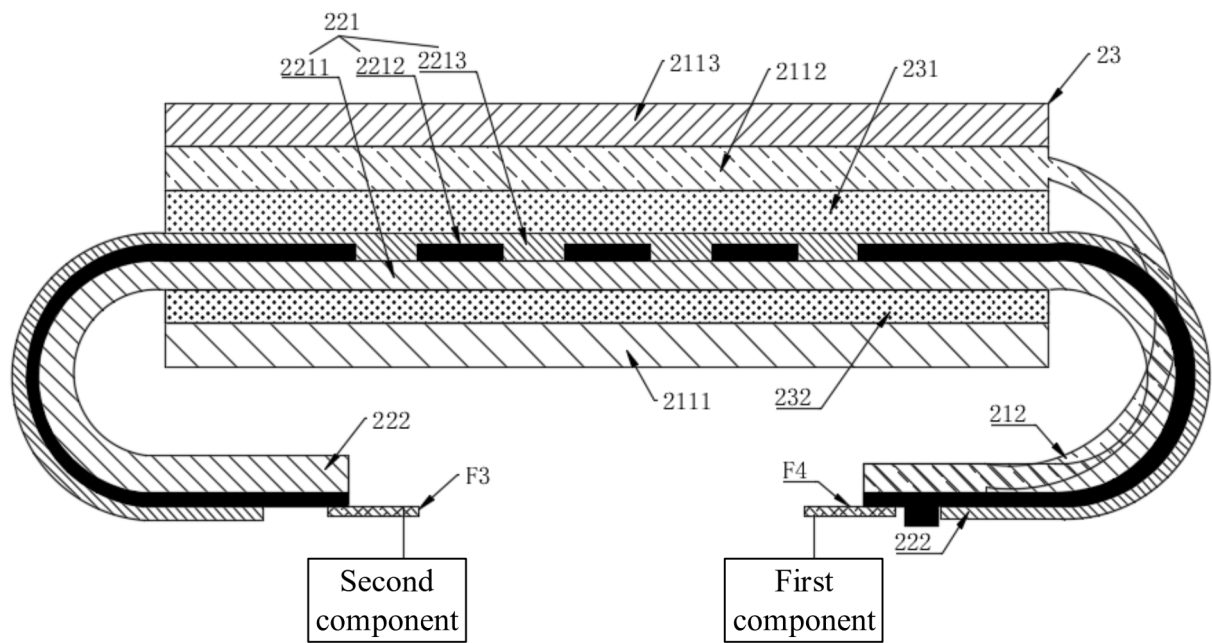


FIG. 25

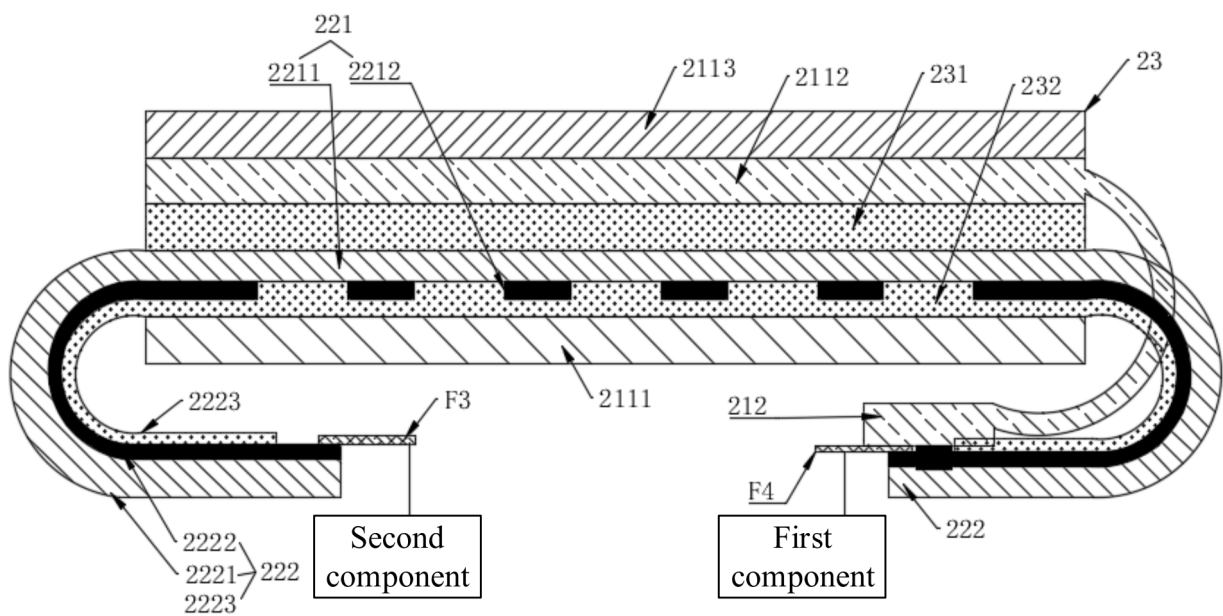


FIG. 26

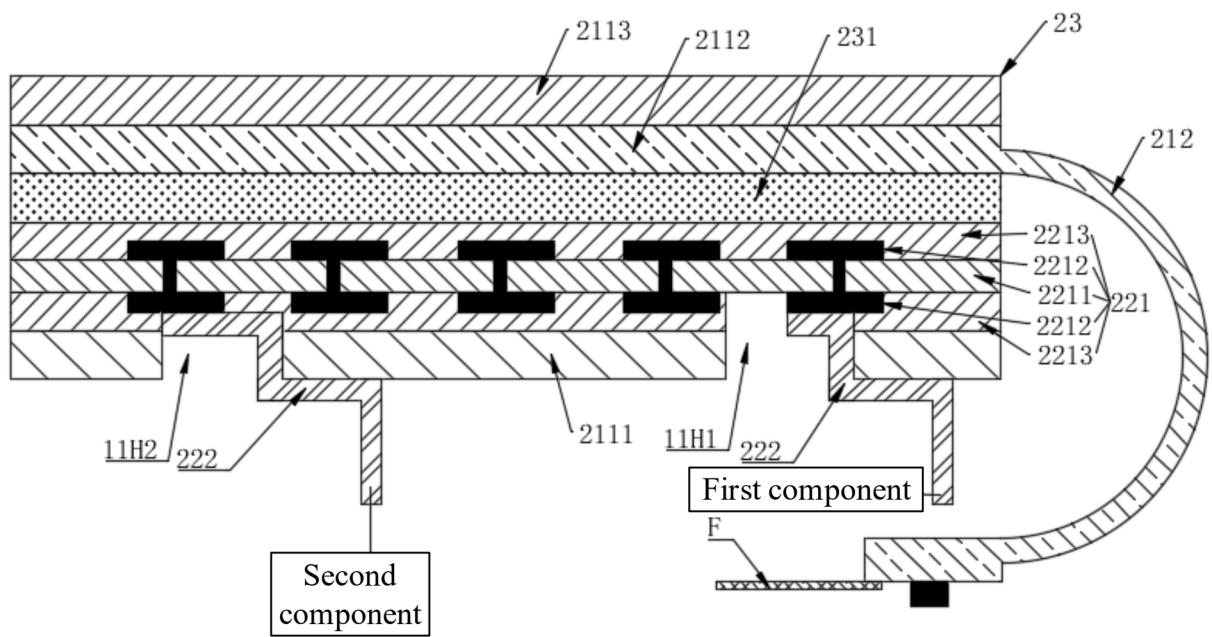


FIG. 27

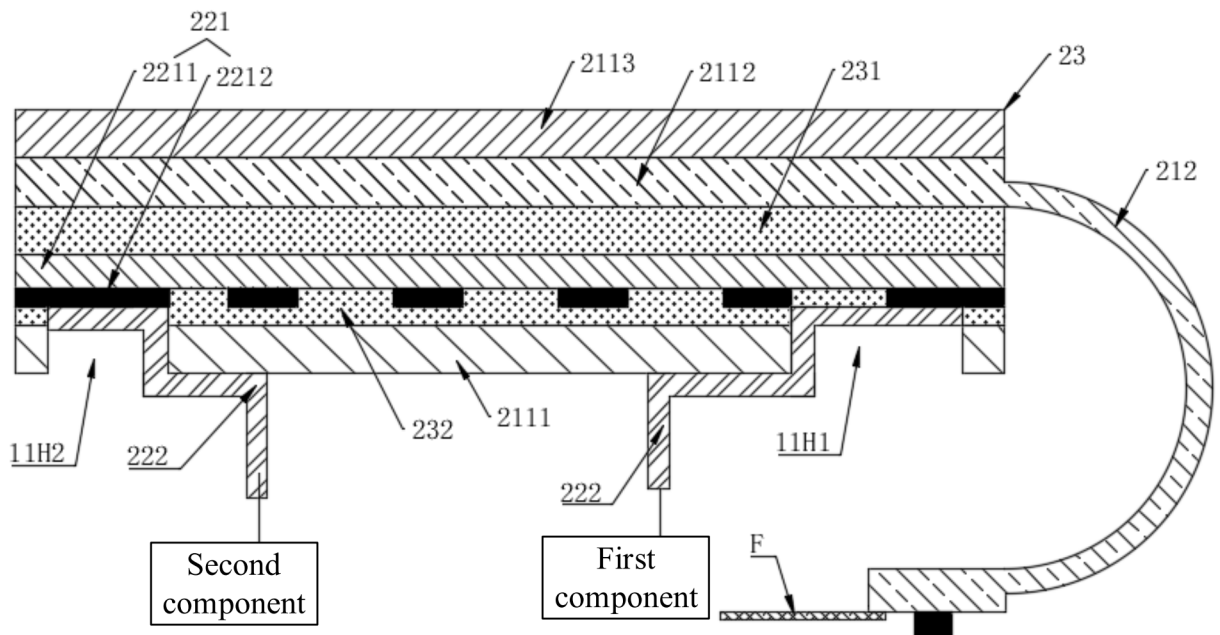


FIG. 28

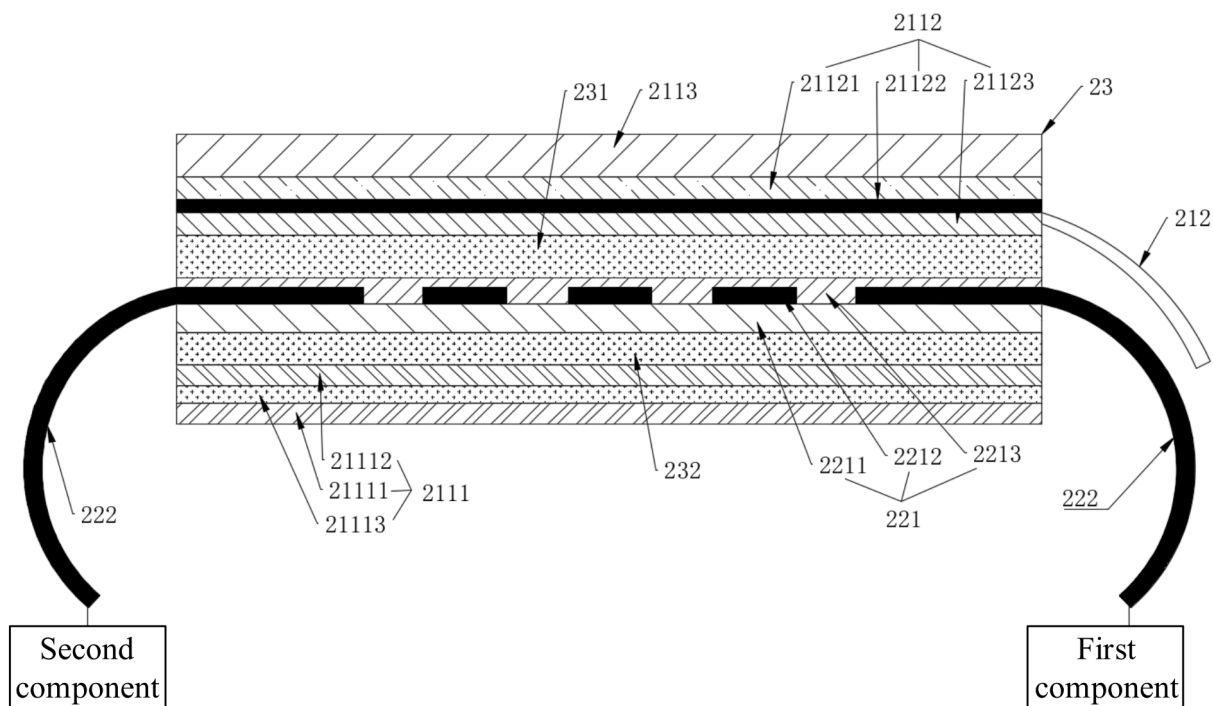


FIG. 29

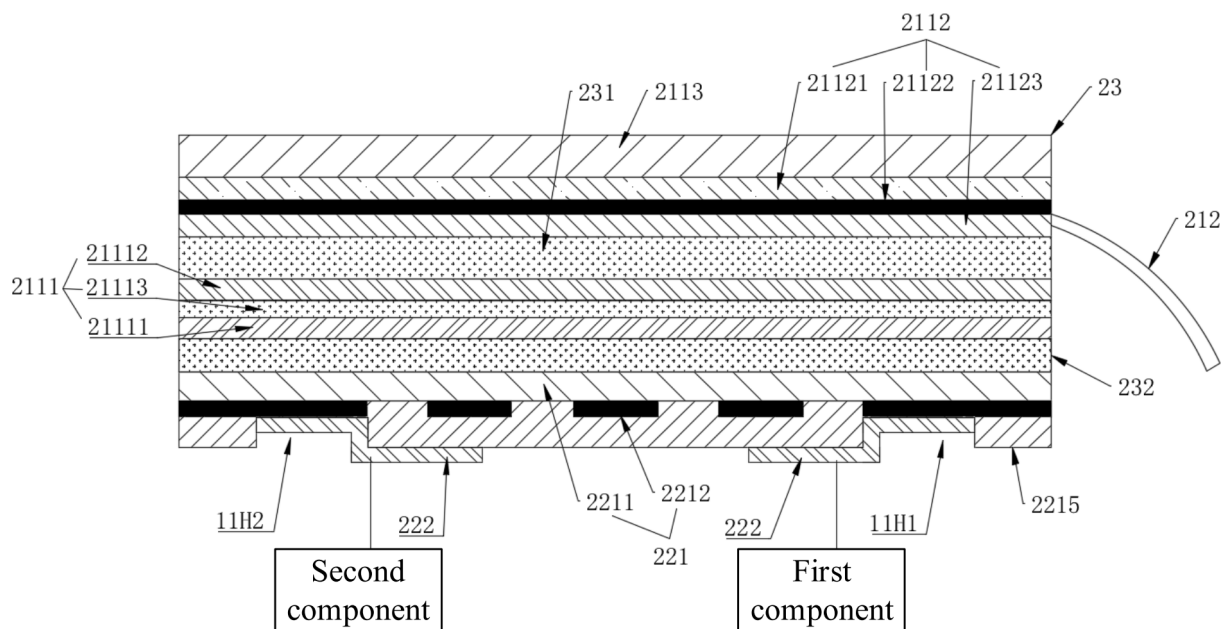


FIG. 30

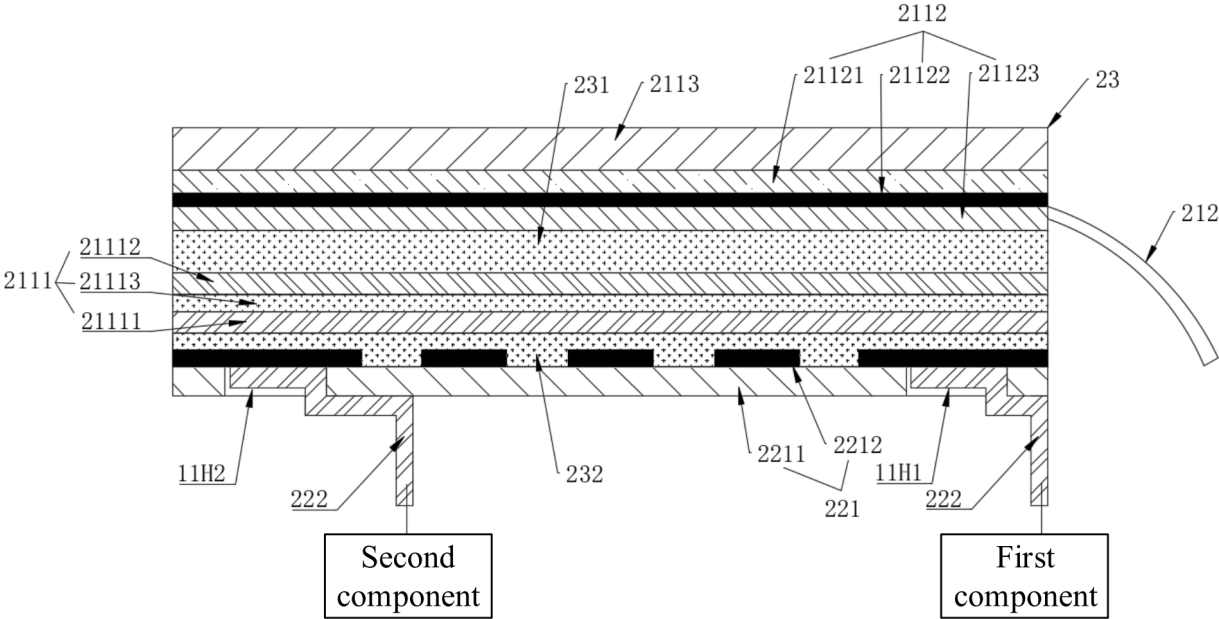


FIG. 31

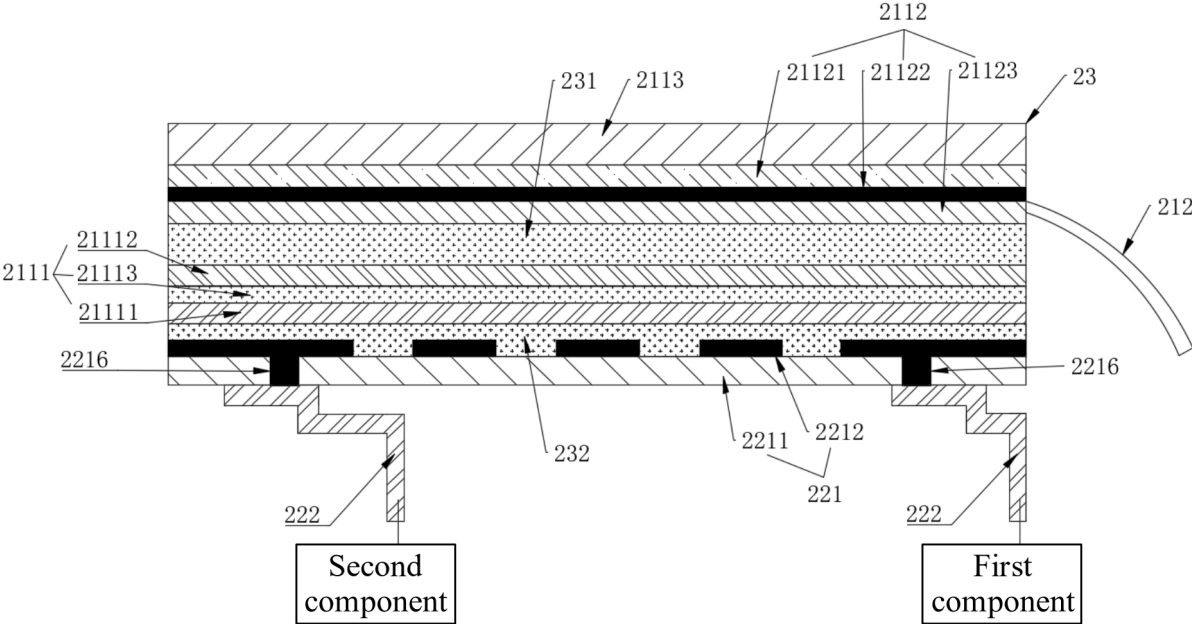


FIG. 32

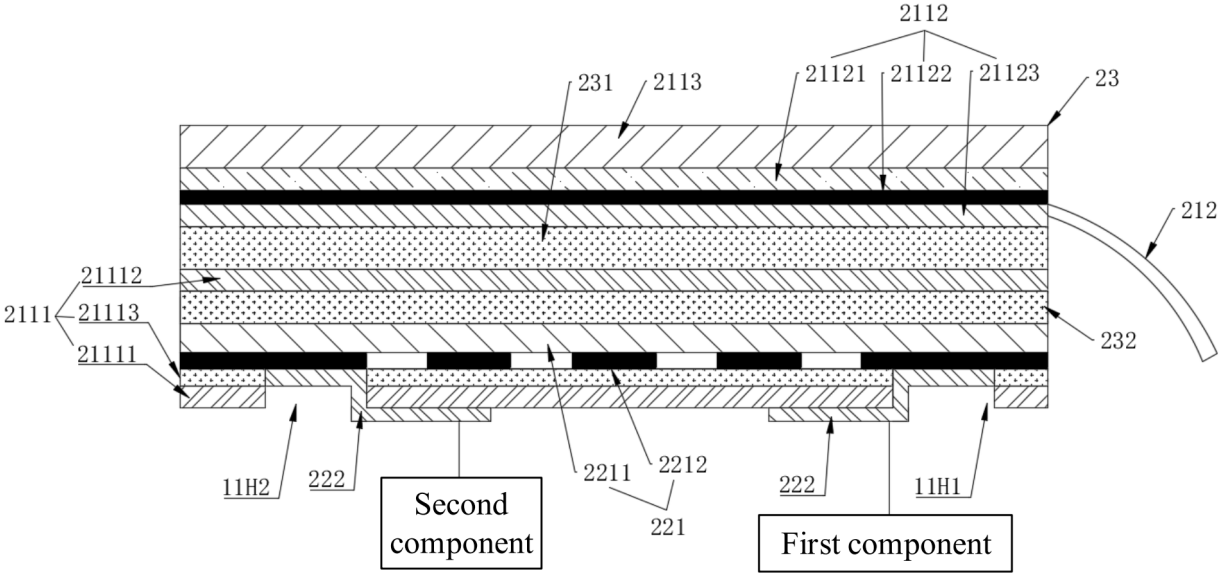


FIG. 33

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2024/137964

A. CLASSIFICATION OF SUBJECT MATTER

G09F9/30(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC:G09F

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

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

CNABS, CNTXT: 显示面板, 显示模组, 显示模块, 显示单元, 显示屏, 柔性屏, 传输, 电路, 走线, 线路, 电子器件, 电子部件, 电子元件; VEN, EPTXT, USTXT, WOTXT: display panel, display module, display unit, display screen, flexible screen, transmit, transmission, circuit, wire, wiring, line, electronic component, electronic device, electronic element

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 115037820 A (VIVO COMMUNICATION TECHNOLOGY CO., LTD.) 09 September 2022 (2022-09-09) description, paragraphs 26-59, and figures 1-8	1-7, 21
X	CN 117133190 A (HONOR TERMINAL CO., LTD.) 28 November 2023 (2023-11-28) description, paragraphs 76-194, and figures 1-22	1-7, 21
X	CN 114038330 A (WUHAN CHINA STAR OPTOELECTRONICS SEMICONDUCTOR DISPLAY TECHNOLOGY CO., LTD.) 11 February 2022 (2022-02-11) description, paragraphs 36-62, and figures 1-8	8-21
X	CN 117082804 A (VIVO COMMUNICATION TECHNOLOGY CO., LTD.) 17 November 2023 (2023-11-17) description, paragraphs 19-37, and figures 1-3	8-21
A	CN 111029396 A (VIVO COMMUNICATION TECHNOLOGY CO., LTD.) 17 April 2020 (2020-04-17) entire document	1-21

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:

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“D” document cited by the applicant in the international application

“E” earlier application or patent but published on or after the international filing date

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“O” document referring to an oral disclosure, use, exhibition or other means

“P” document published prior to the international filing date but later than the priority date claimed

“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

“&” document member of the same patent family

Date of the actual completion of the international search

06 March 2025

Date of mailing of the international search report

11 March 2025

Name and mailing address of the ISA/CN

China National Intellectual Property Administration (ISA/
CN)
China No. 6, Xitucheng Road, Jimenqiao, Haidian District,
Beijing 100088

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2024/137964

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2017228058 A1 (HTC CORP.) 10 August 2017 (2017-08-10) entire document	1-21

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/CN2024/137964

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
CN	115037820	A	09 September 2022	WO	2023236867	A1	14 December 2023
				CN	115037820	B	07 January 2025
CN	117133190	A	28 November 2023	WO	2024152763	A1	25 July 2024
				CN	117133190	B	01 November 2024
CN	114038330	A	11 February 2022	CN	114038330	B	30 June 2023
CN	117082804	A	17 November 2023	None			
CN	111029396	A	17 April 2020	CN	111029396	B	19 August 2022
US	2017228058	A1	10 August 2017	None			

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CN 202311715876X [0001]