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**Shin et al.**

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(54) **ELECTRONIC DEVICE**  
(71) Applicant: **LG ELECTRONICS INC.**, Seoul (KR)  
(72) Inventors: **Choonghwan Shin**, Seoul (KR); **Yongtae Kim**, Seoul (KR); **Byunghwa Lee**, Seoul (KR)  
(73) Assignee: **LG ELECTRONICS INC.**, Seoul (KR)  
(\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.  
This patent is subject to a terminal disclaimer.

(58) **Field of Classification Search**  
CPC ..... G03B 21/58  
See application file for complete search history.

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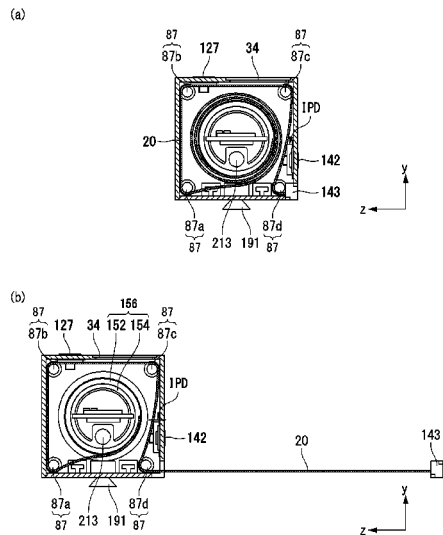
*Primary Examiner* — Christopher E Mahoney  
(74) *Attorney, Agent, or Firm* — KED & Associates LLP

(57) **ABSTRACT**

An electronic device is disclosed. The electronic device includes a housing, a roller positioned inside the housing, a display panel rollable on the roller, and a guide roller positioned at an edge inside the housing. A state of the display panel with respect to the roller includes a first state in which the display panel is rolled on the roller and a second state in which the display panel is unrolled from the roller. The roller includes an outer frame which rotates when the display panel is rolled on or unrolled from the roller, and an inner frame positioned inside the outer frame and fixed to an inside of the housing regardless of rolling and unrolling the display panel.

**4 Claims, 27 Drawing Sheets**

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(51) **Int. Cl.**  
**H05K 5/02** (2006.01)  
**G09F 9/30** (2006.01)  
(Continued)  
(52) **U.S. Cl.**  
CPC ..... **H05K 5/0217** (2013.01); **G01R 33/072** (2013.01); **G06F 1/1605** (2013.01);  
(Continued)



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|      | <b>H05K 1/11</b>   | (2006.01) |                  |         |               | 361/749   |
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|      | <b>G06F 3/0354</b> | (2013.01) |                  |         |               |           |

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| (52) | <b>U.S. Cl.</b> |   | KR | 10-1383092     | 4/2014 |  |
|      | CPC .....       | <b>G06F 1/1607</b> (2013.01); <b>G06F 1/1652</b>          | WO | WO 2010/011030 | 1/2010 |  |
|      |                 | (2013.01); <b>G09F 9/301</b> (2013.01); <b>H05K</b>       |    |                |        |  |
|      |                 | <b>1/028</b> (2013.01); <b>H05K 1/111</b> (2013.01);      |    |                |        |  |
|      |                 | <b>H05K 1/189</b> (2013.01); <b>H05K 5/0017</b>           |    |                |        |  |
|      |                 | (2013.01); <b>H05K 5/023</b> (2013.01); <b>G06F</b>       |    |                |        |  |
|      |                 | <b>3/03545</b> (2013.01); <b>H05K 2201/051</b> (2013.01); |    |                |        |  |
|      |                 | <b>H05K 2201/052</b> (2013.01); <b>H05K 2201/10128</b>    |    |                |        |  |
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FIG. 1

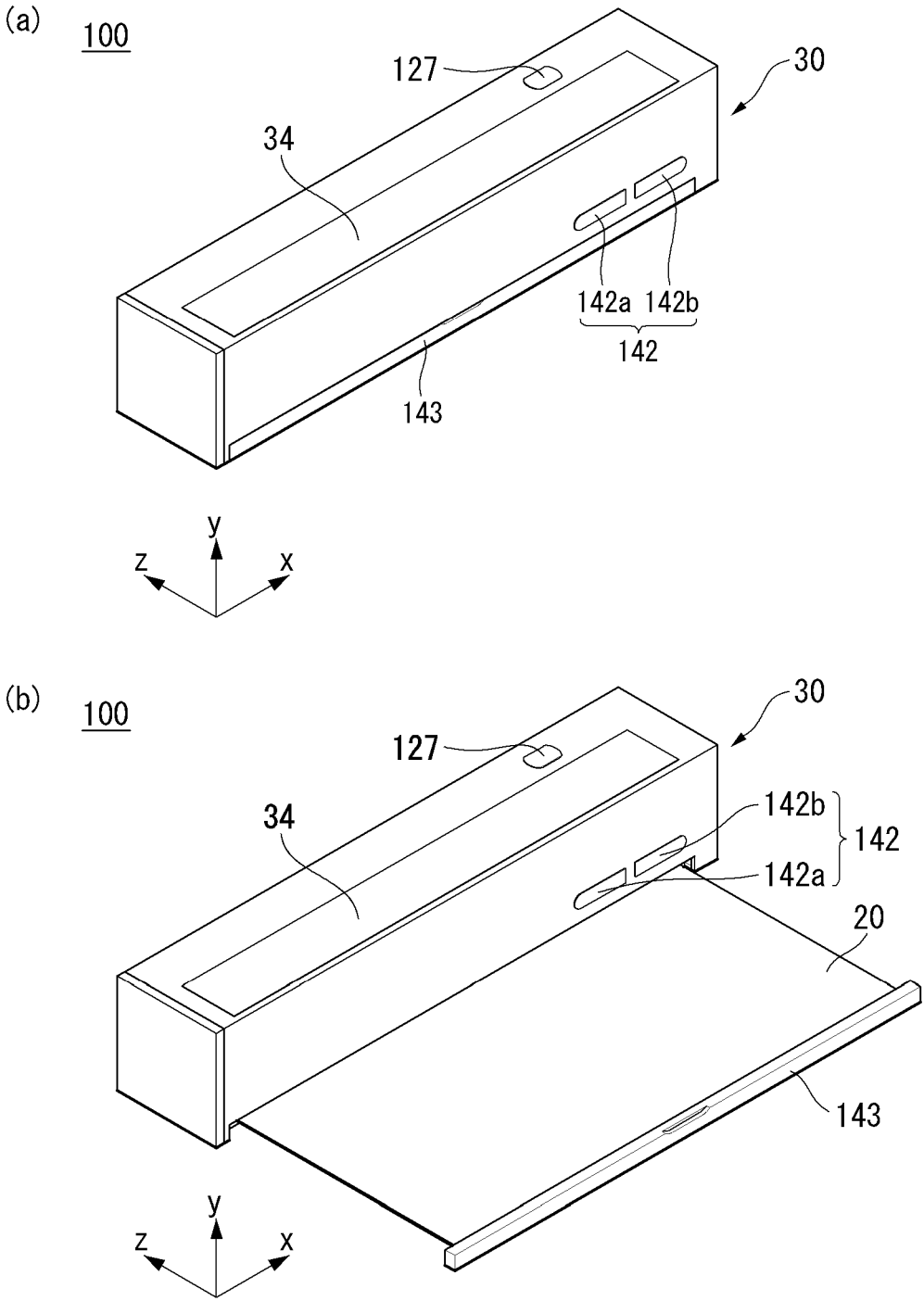


FIG. 2

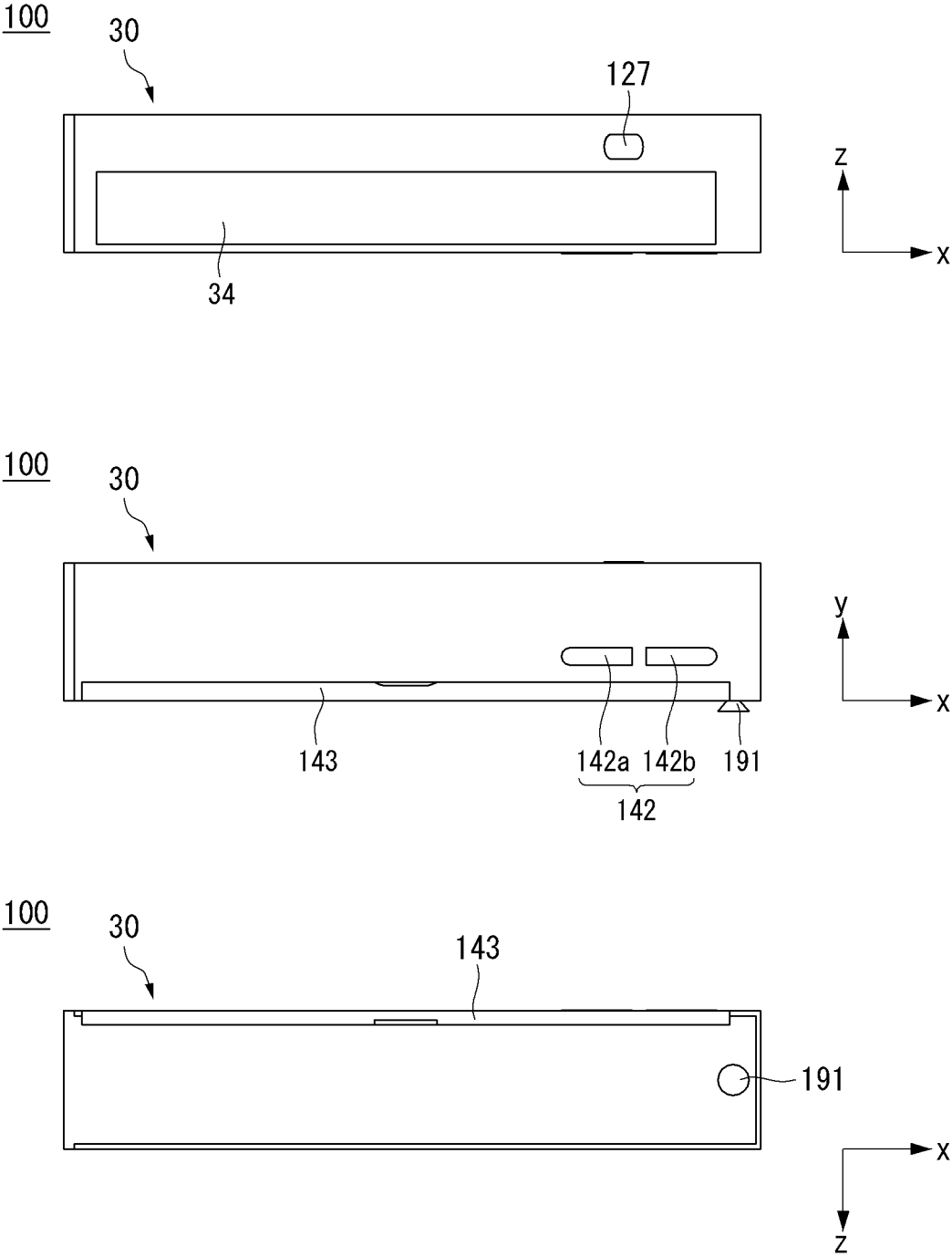


FIG. 3

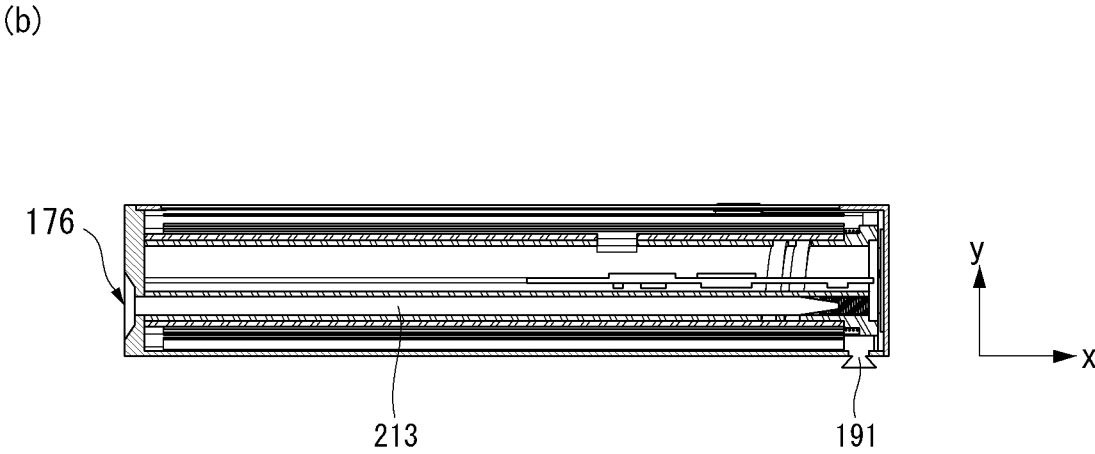
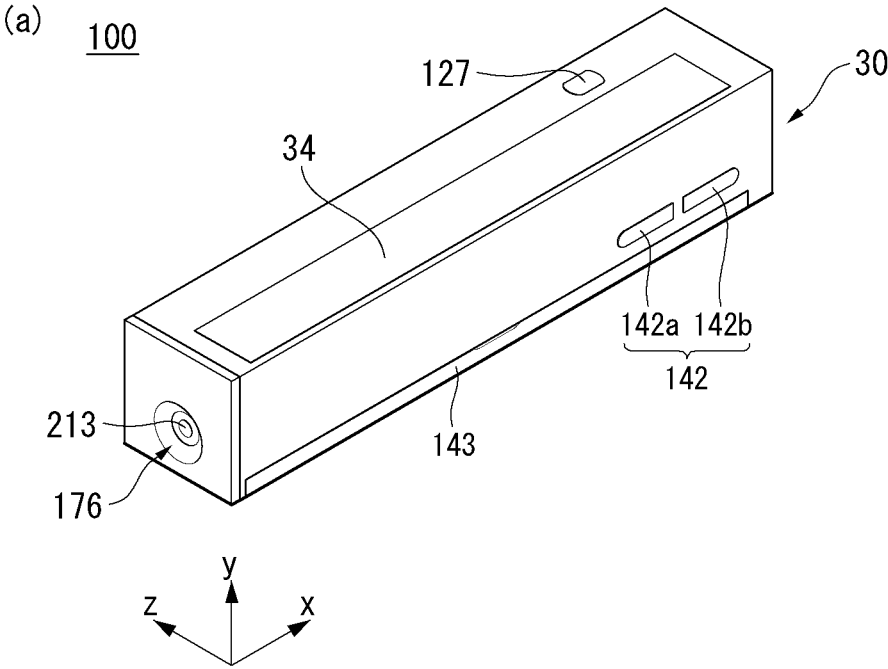


FIG. 4

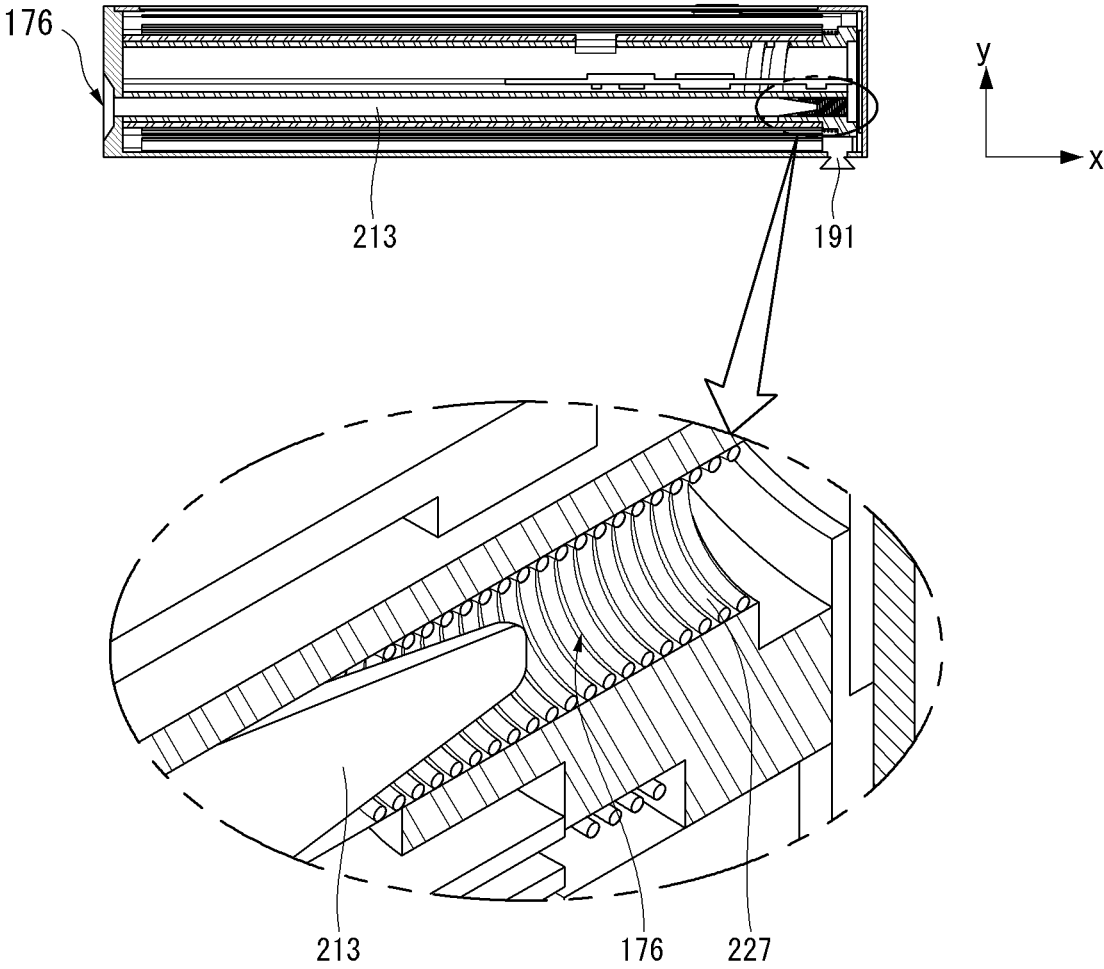


FIG. 5

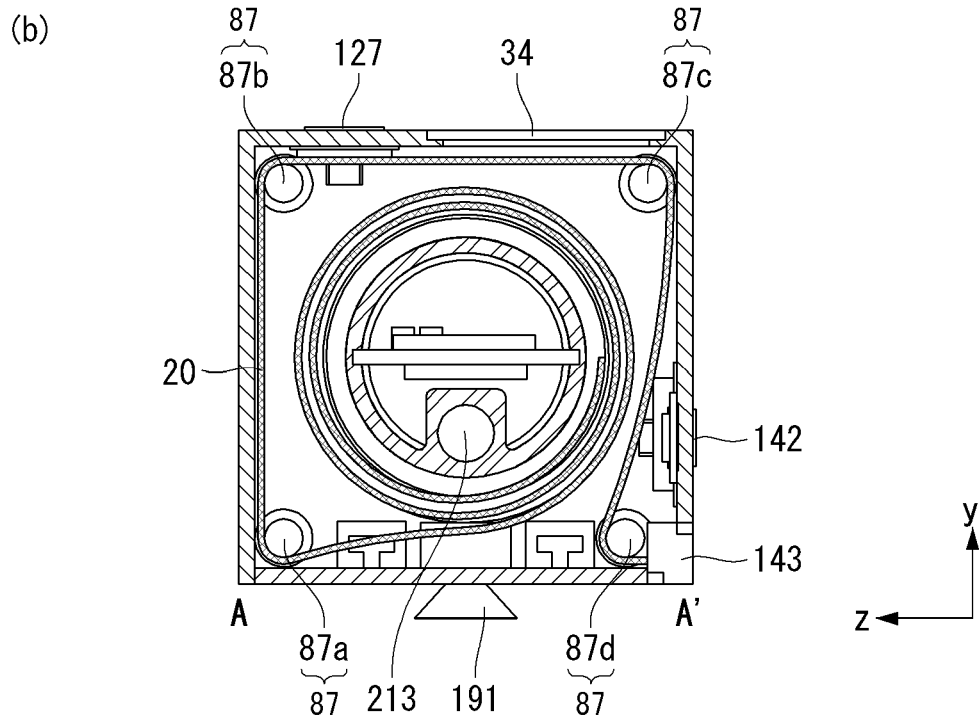
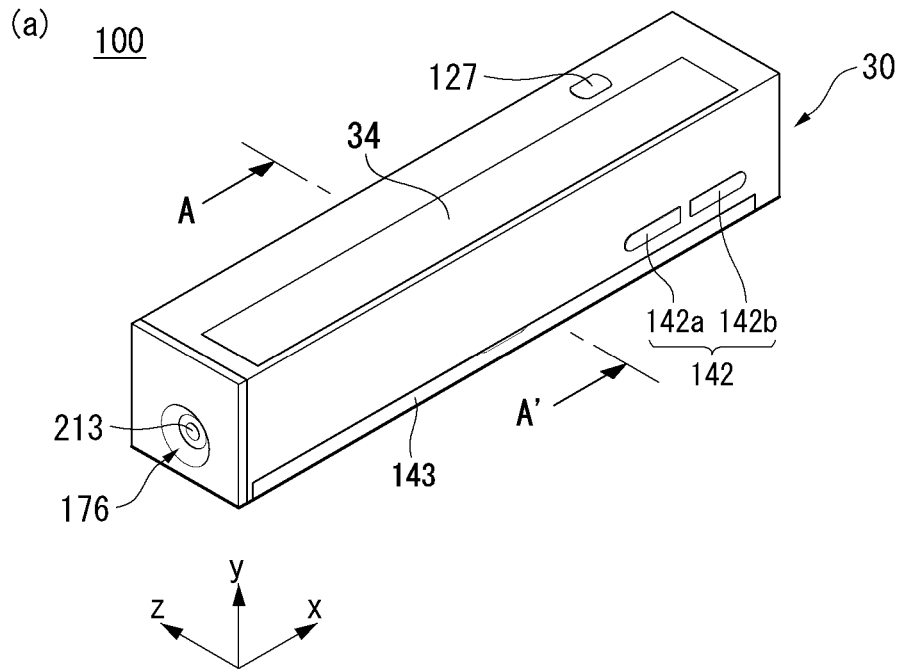
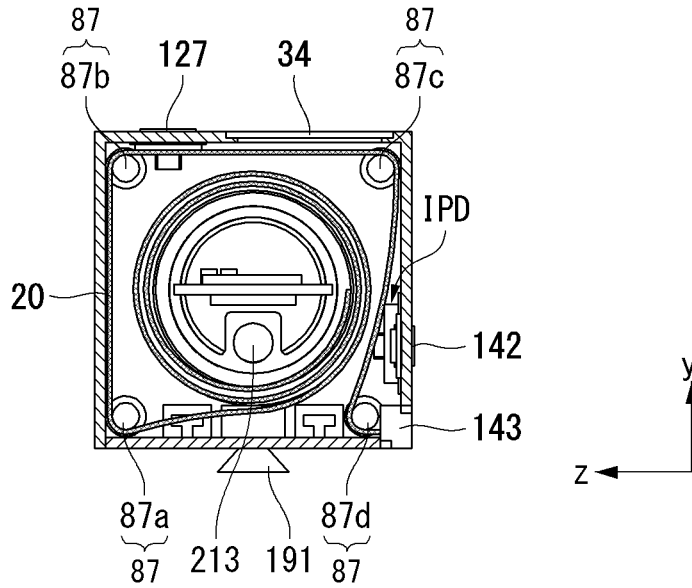


FIG. 6

(a)



(b)

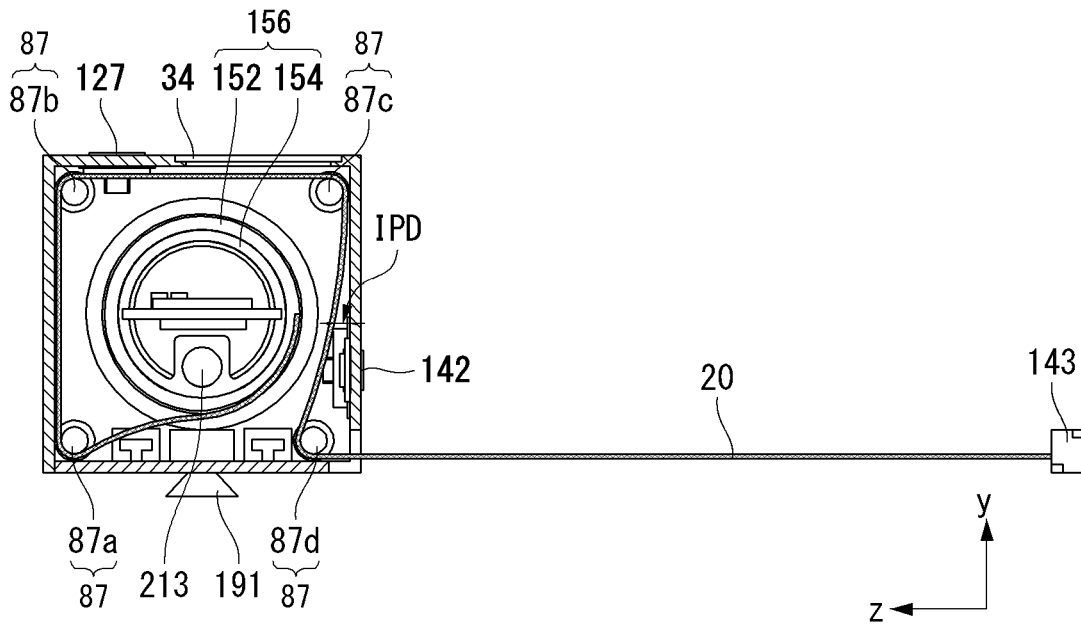
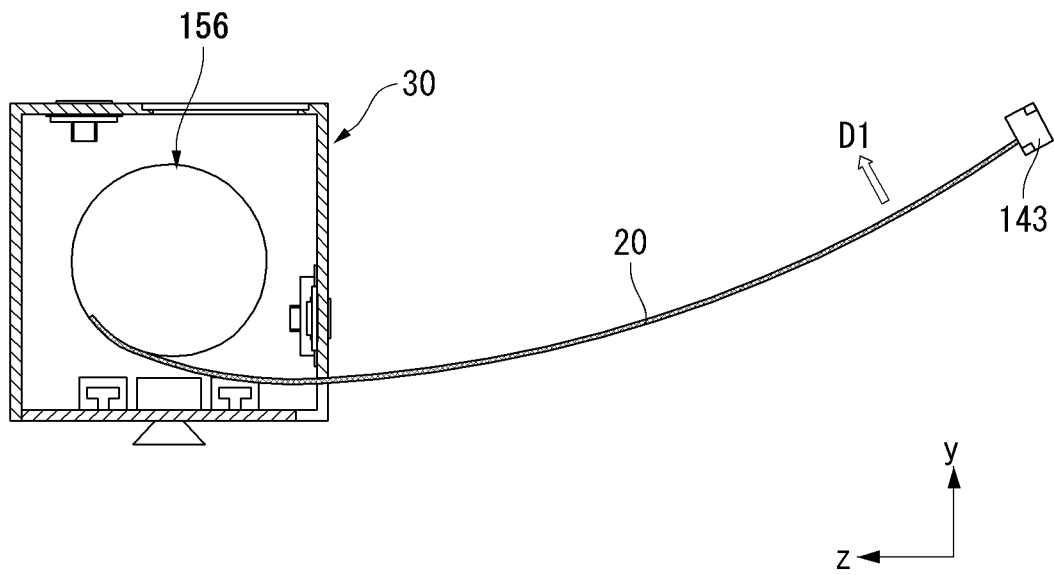




FIG. 7

(a)



(b)

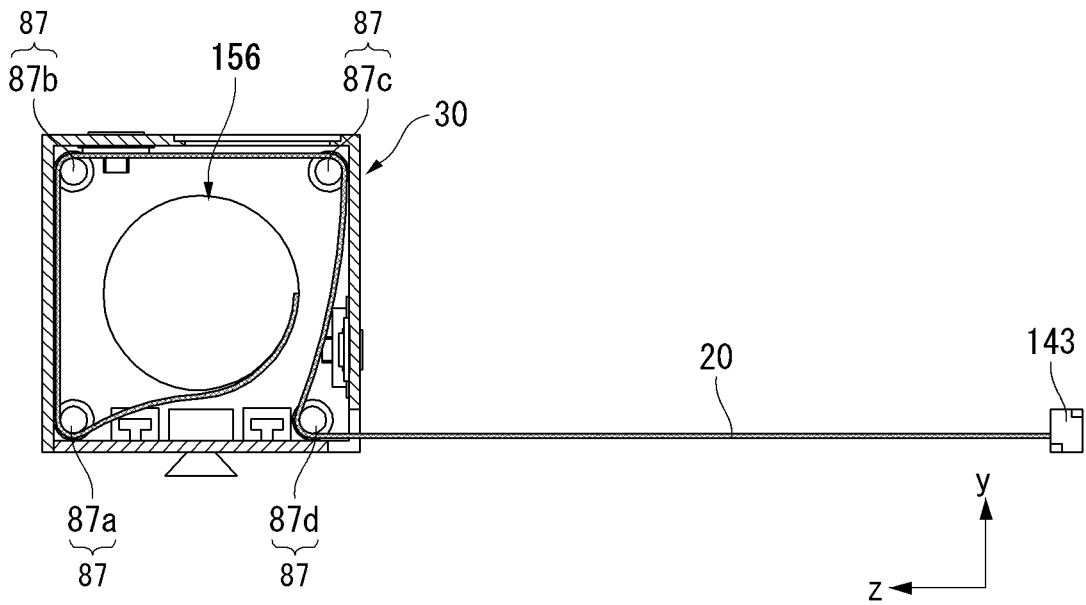
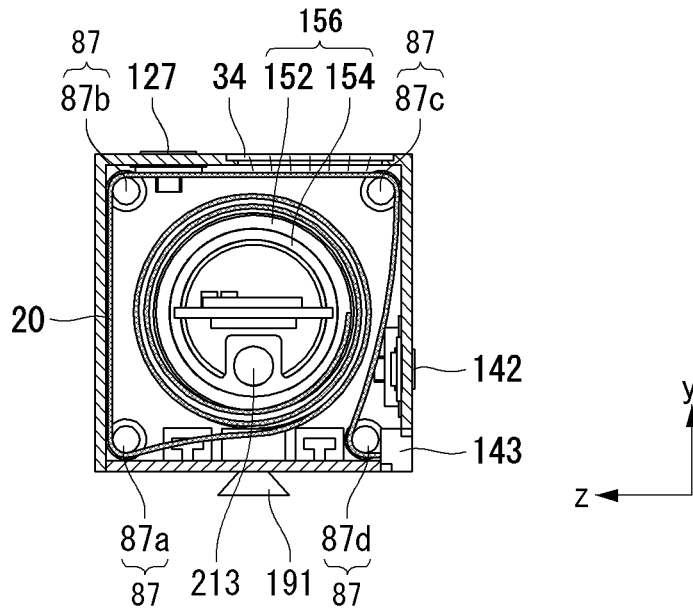


FIG. 8

(a)



(b)

(b)

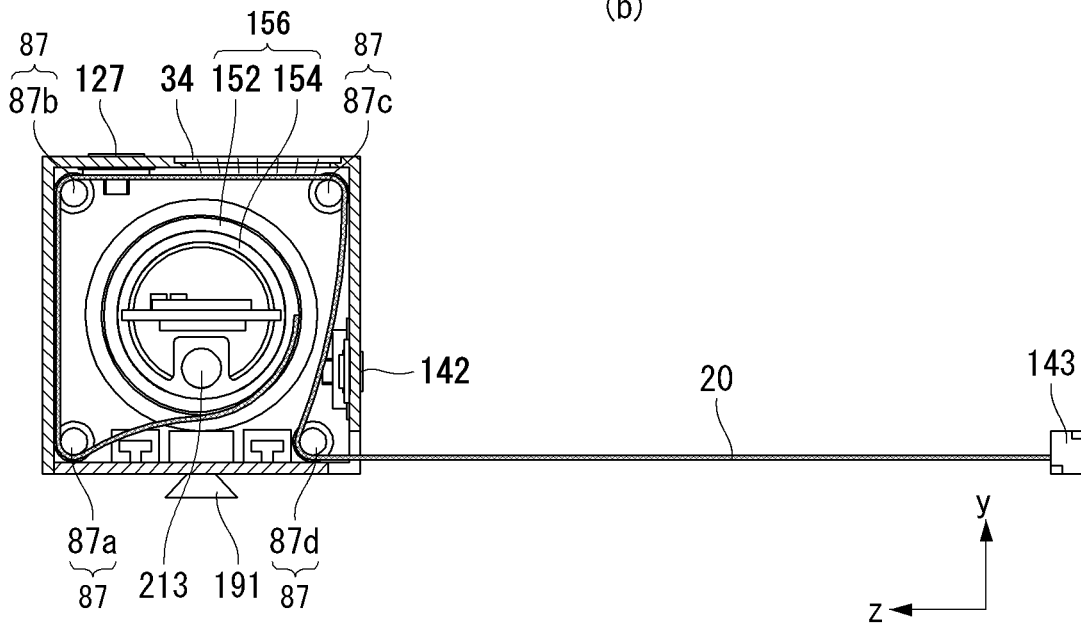


FIG. 9

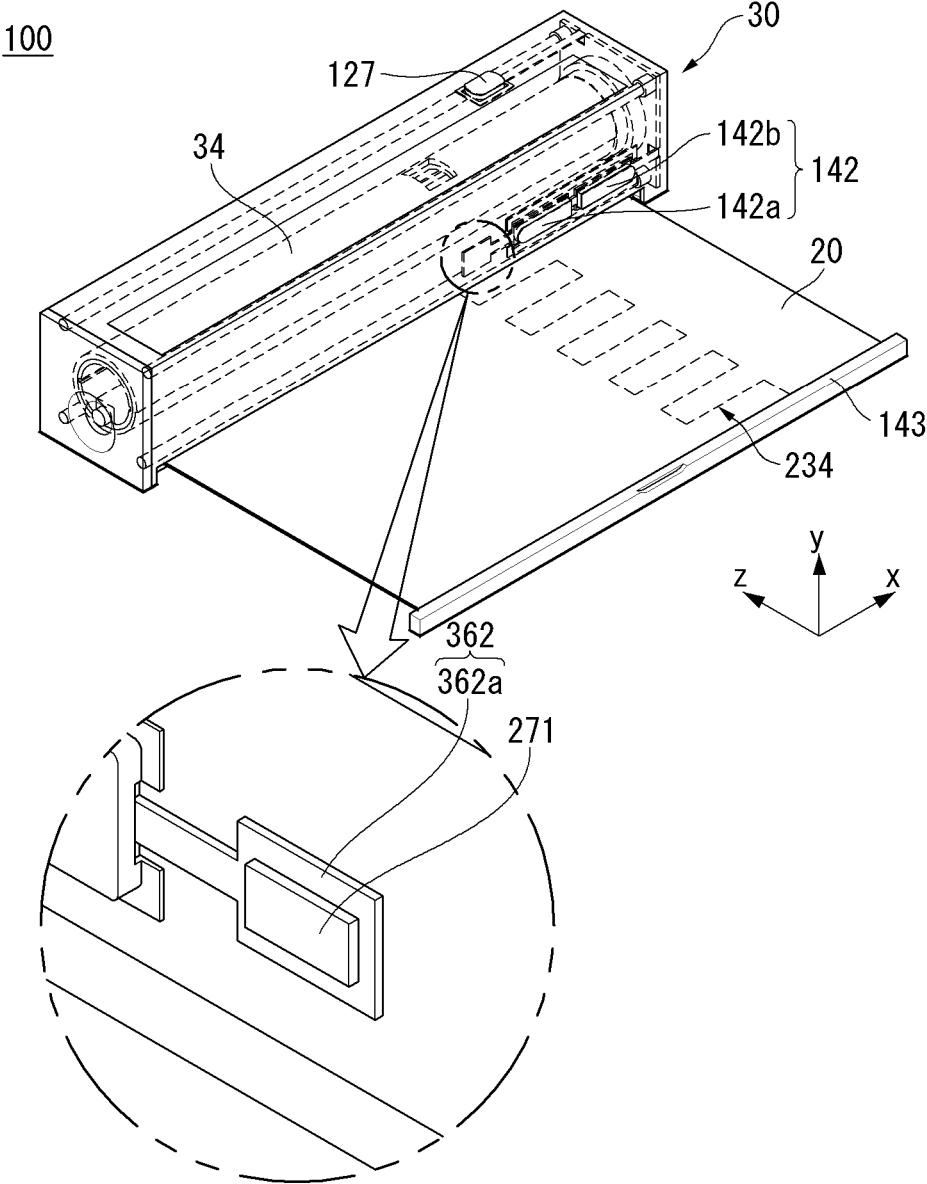


FIG. 10

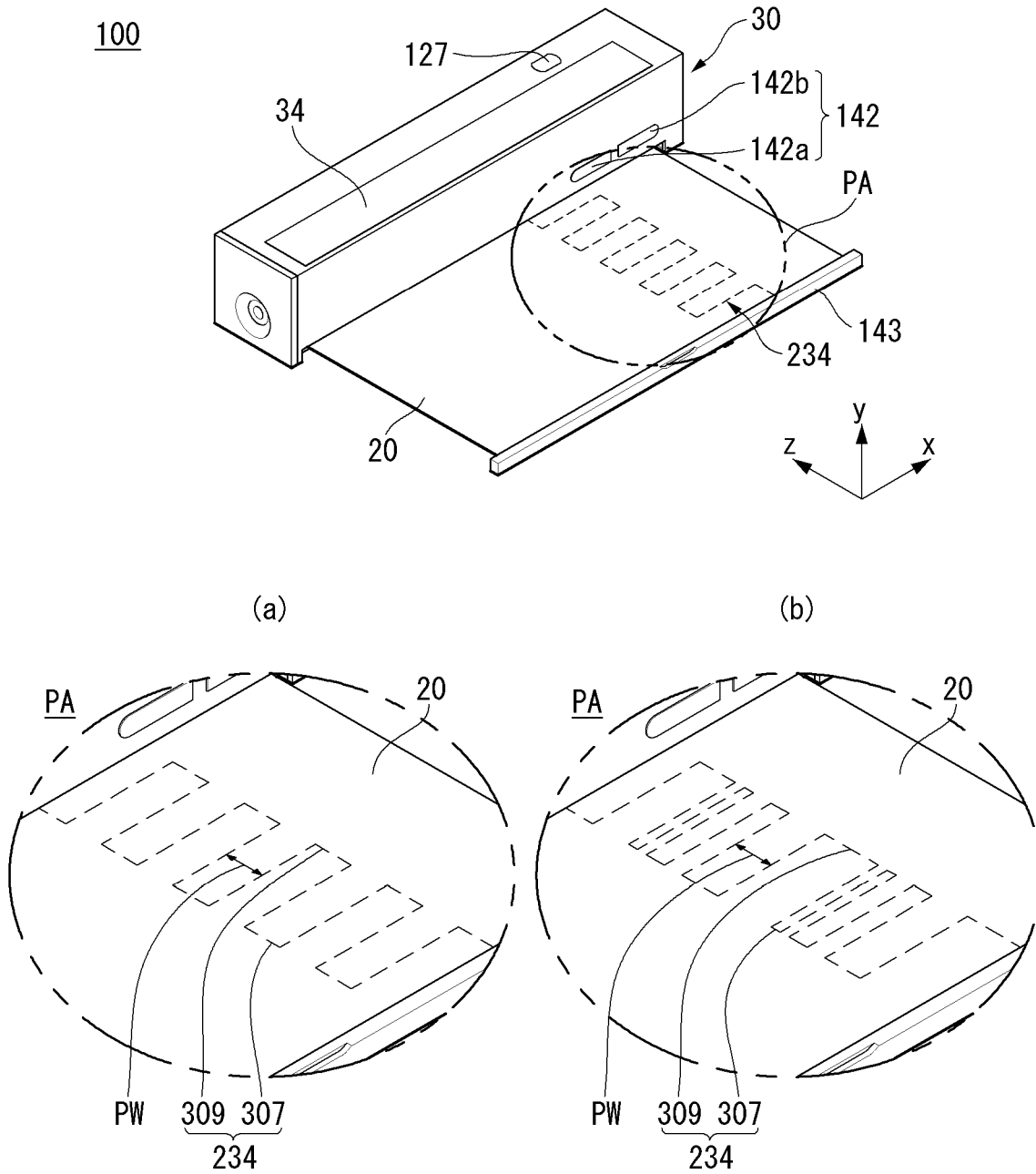


FIG. 11

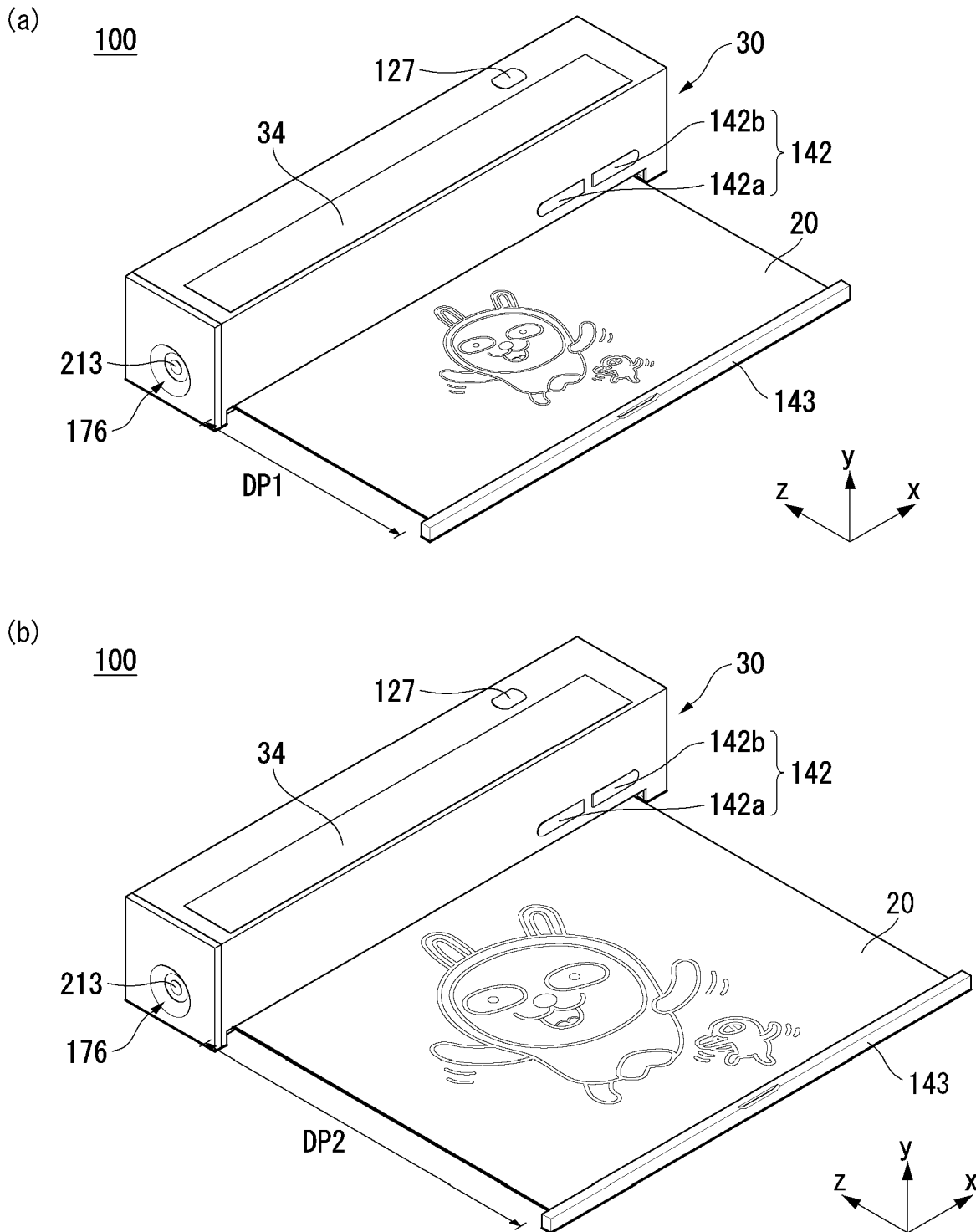


FIG. 12

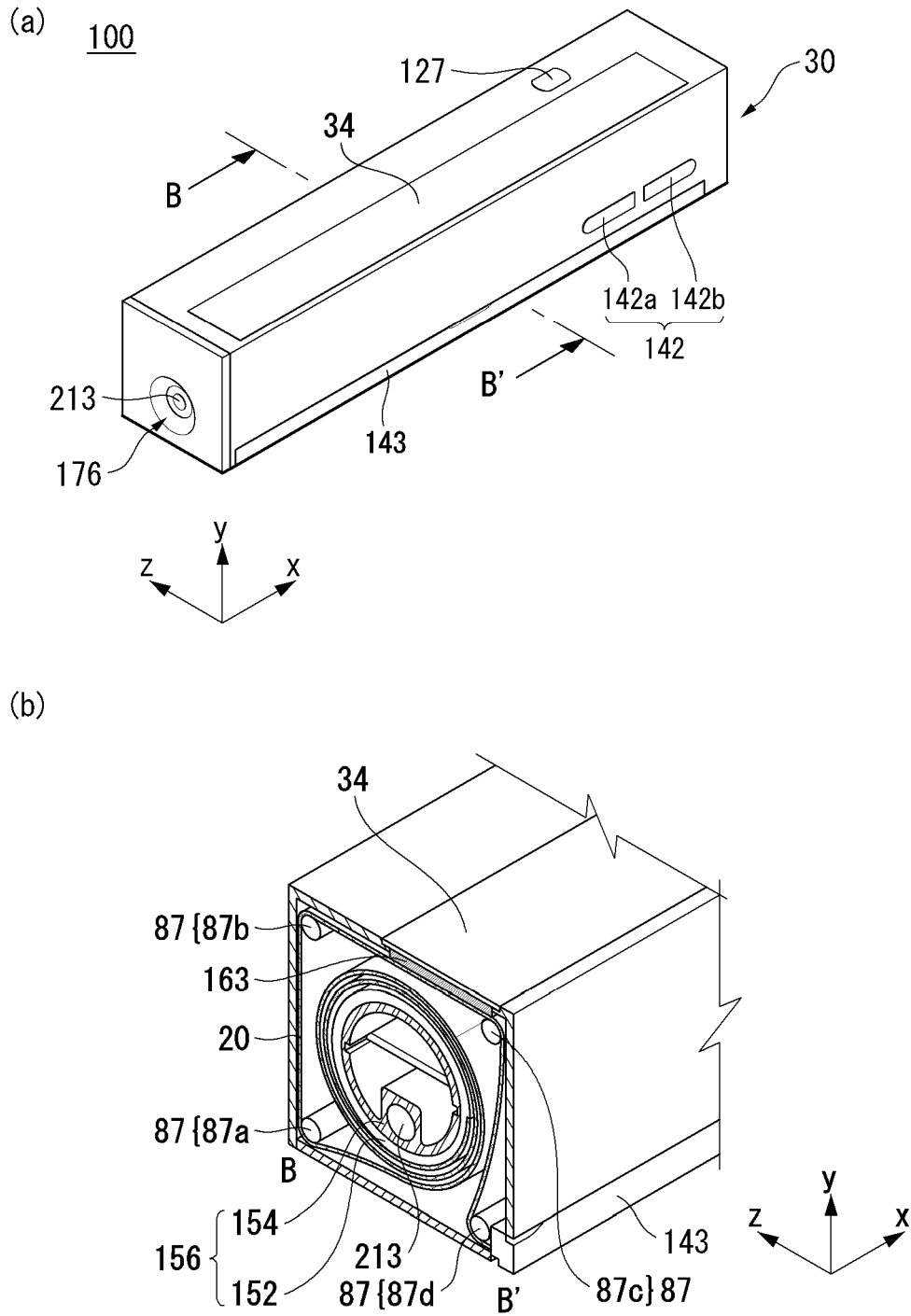


FIG. 13

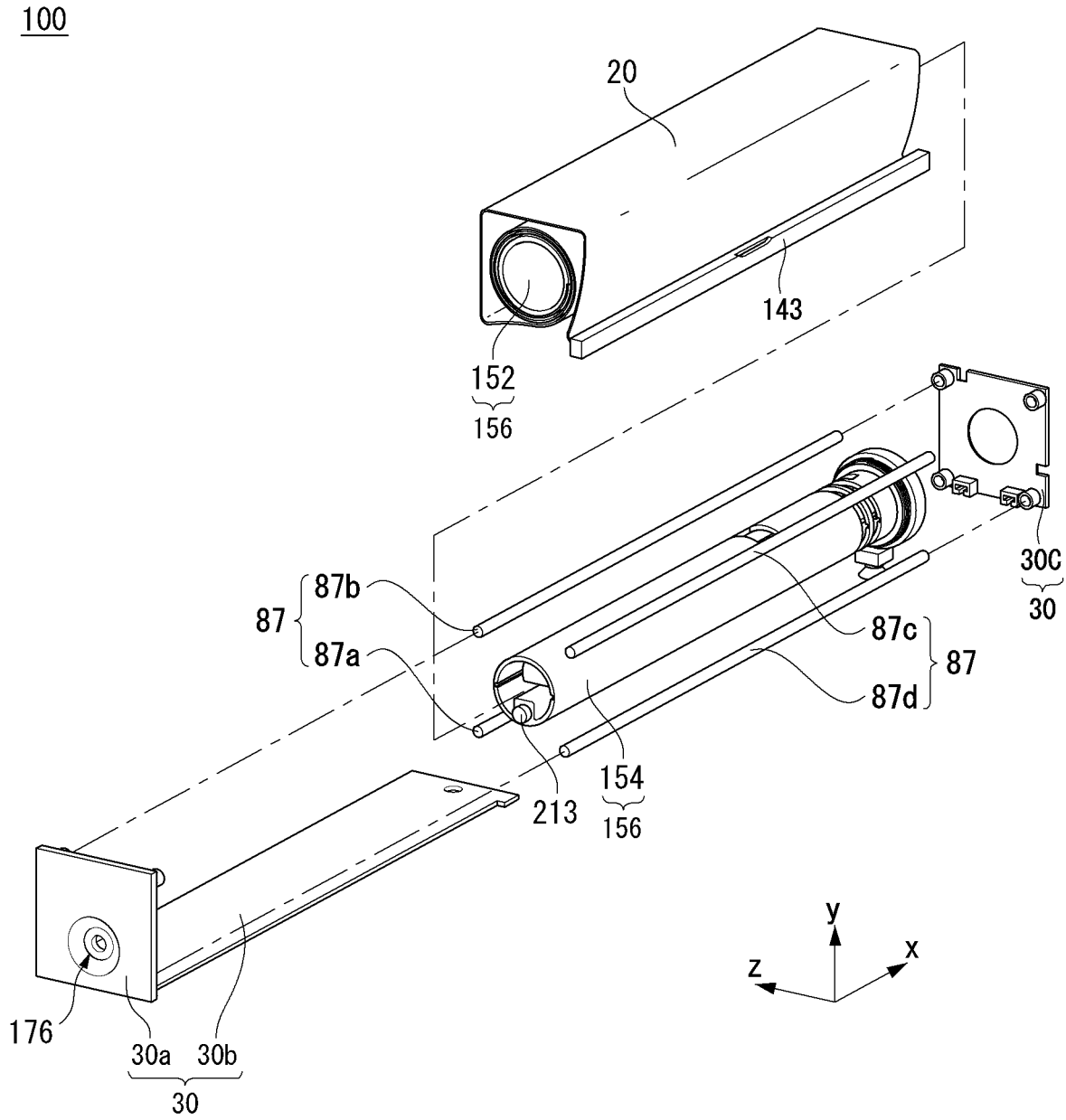
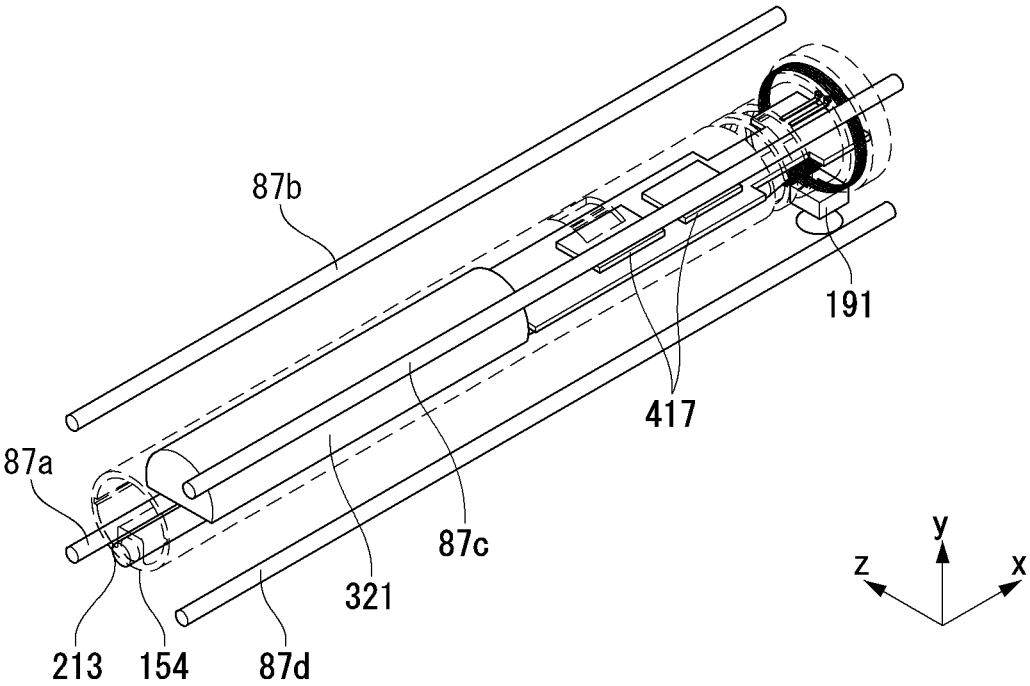


FIG. 14

(a)



(b)

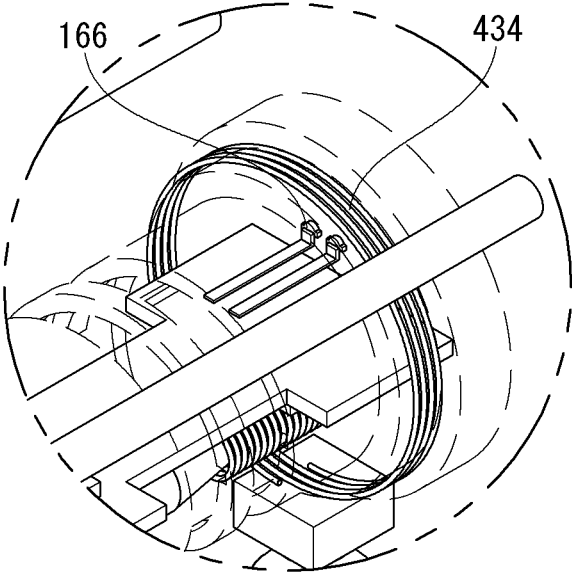
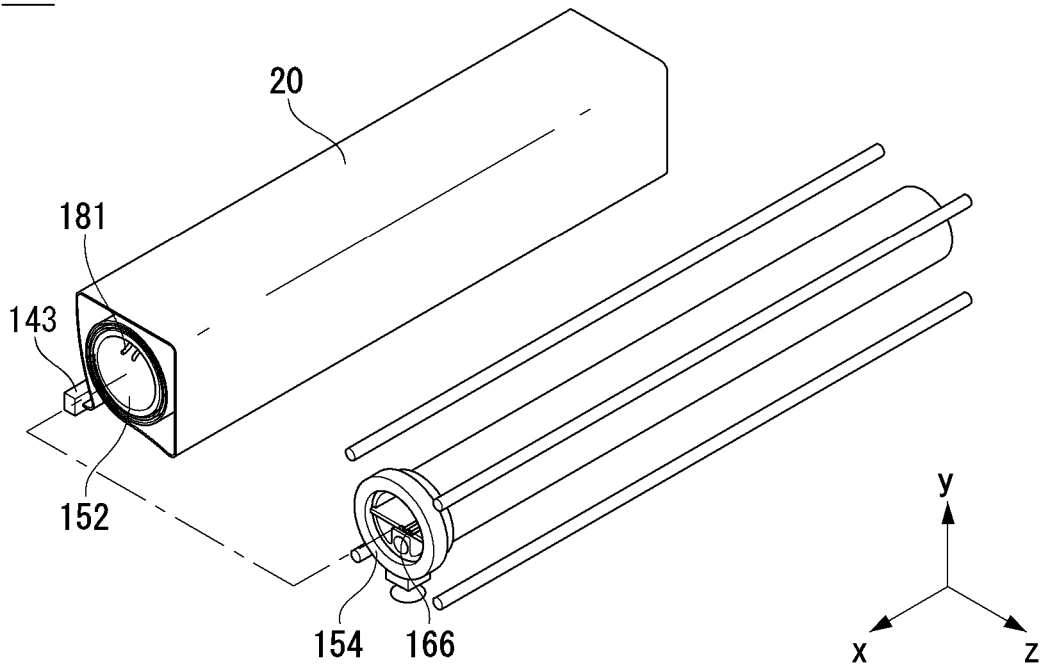






FIG. 16

(a) 100



(b)

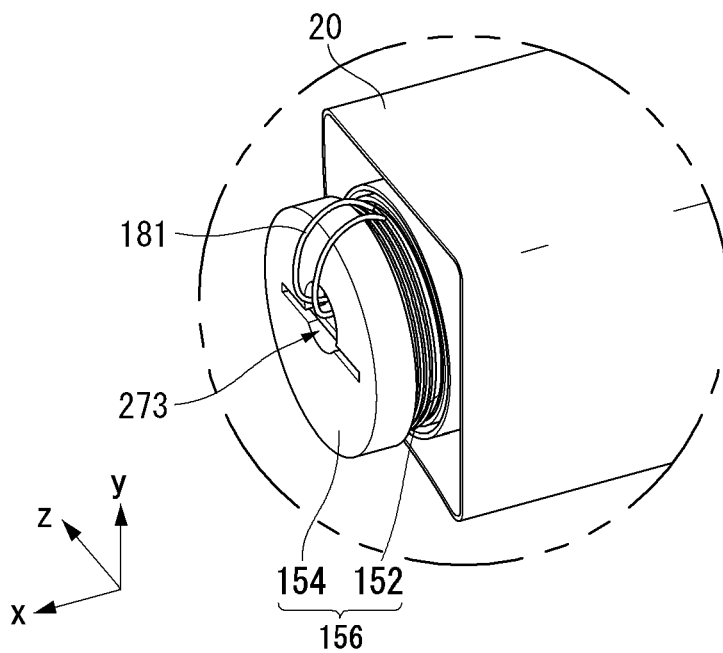


FIG. 17

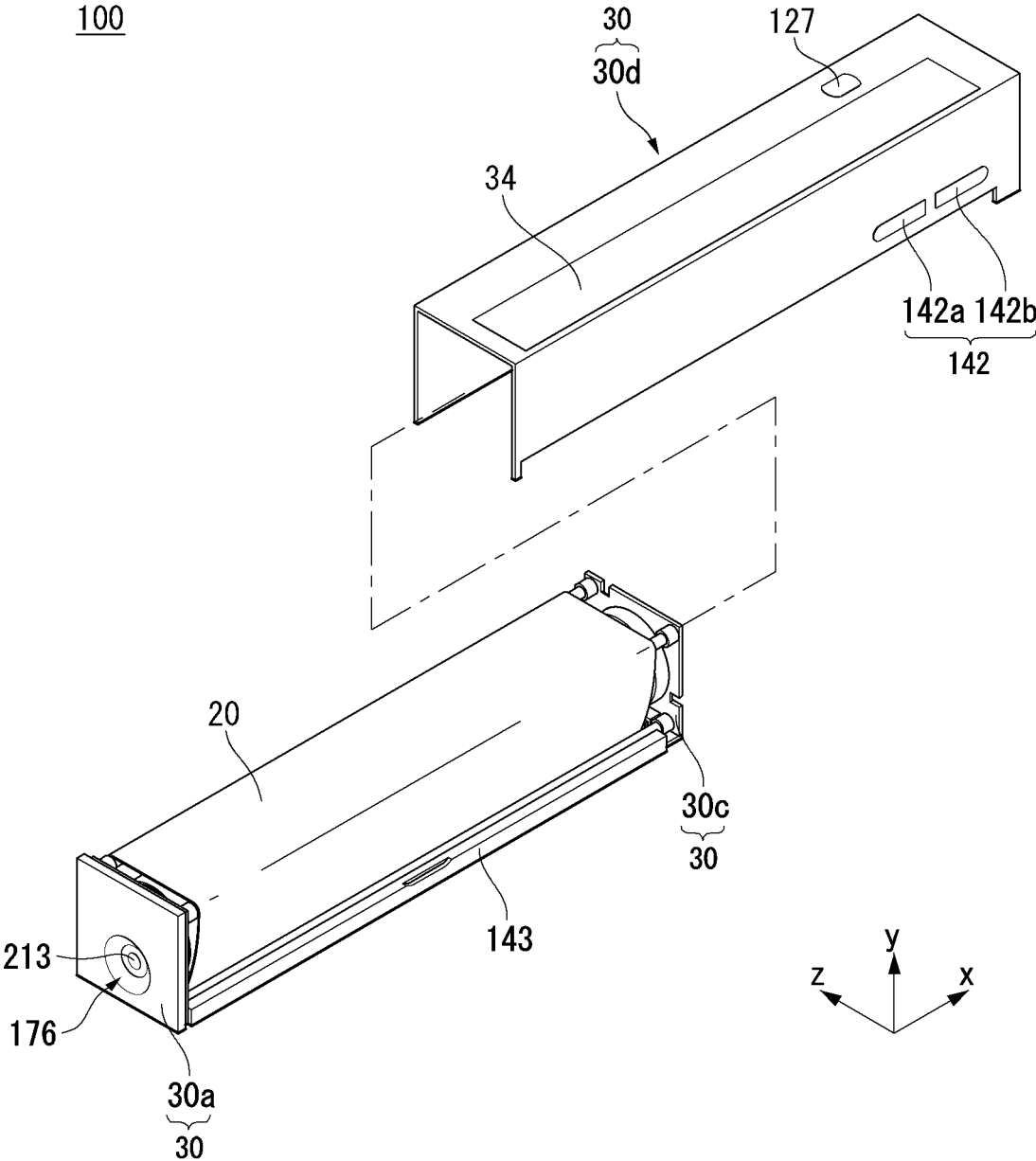


FIG. 18

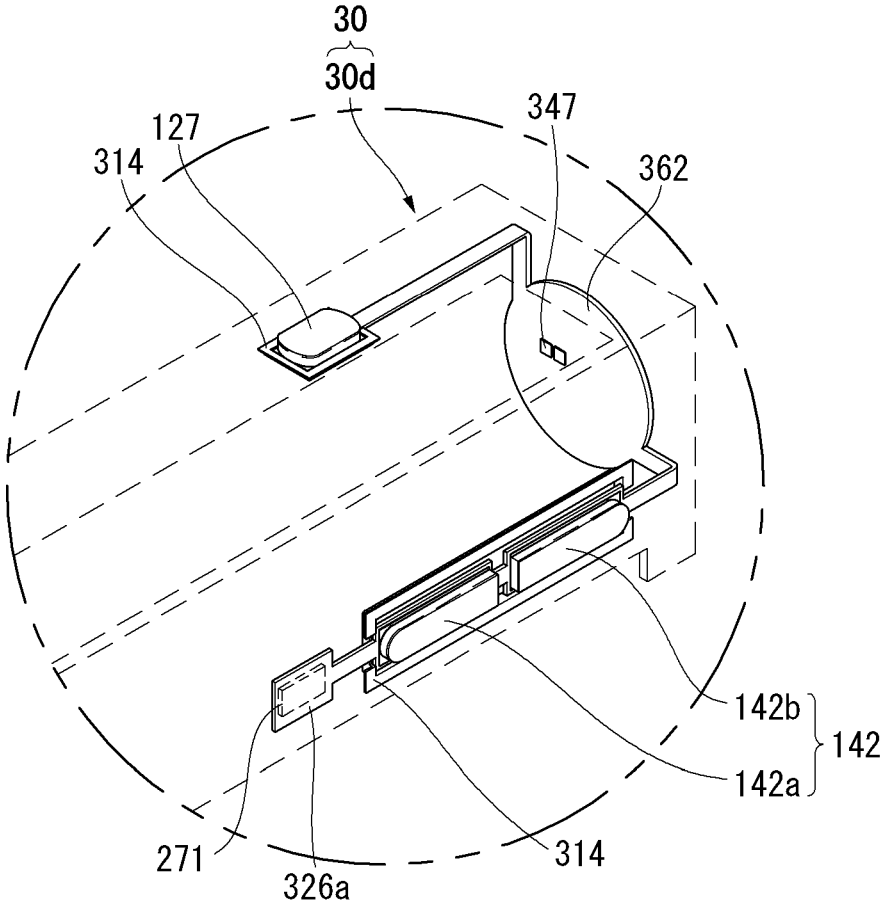


FIG. 19

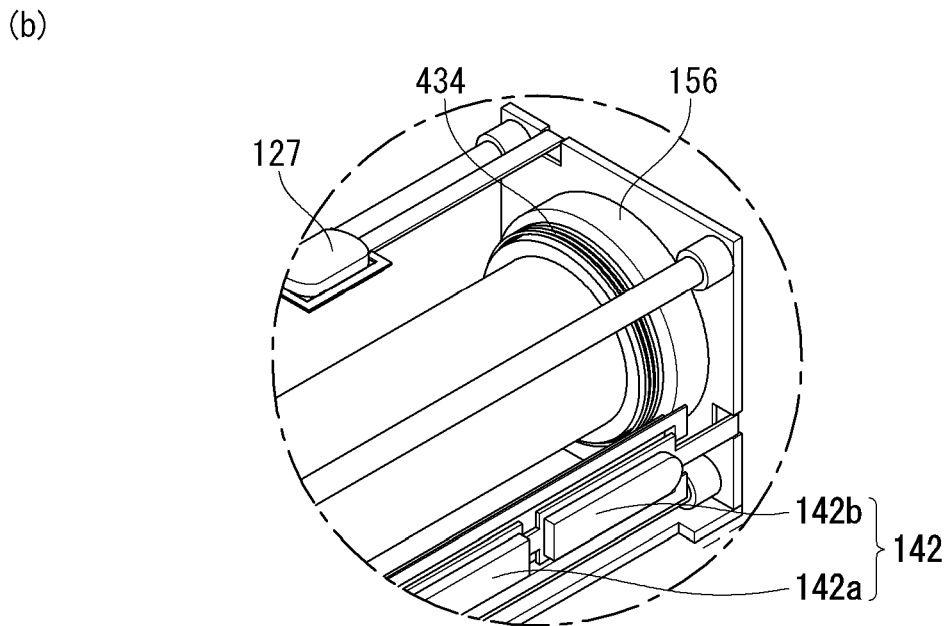
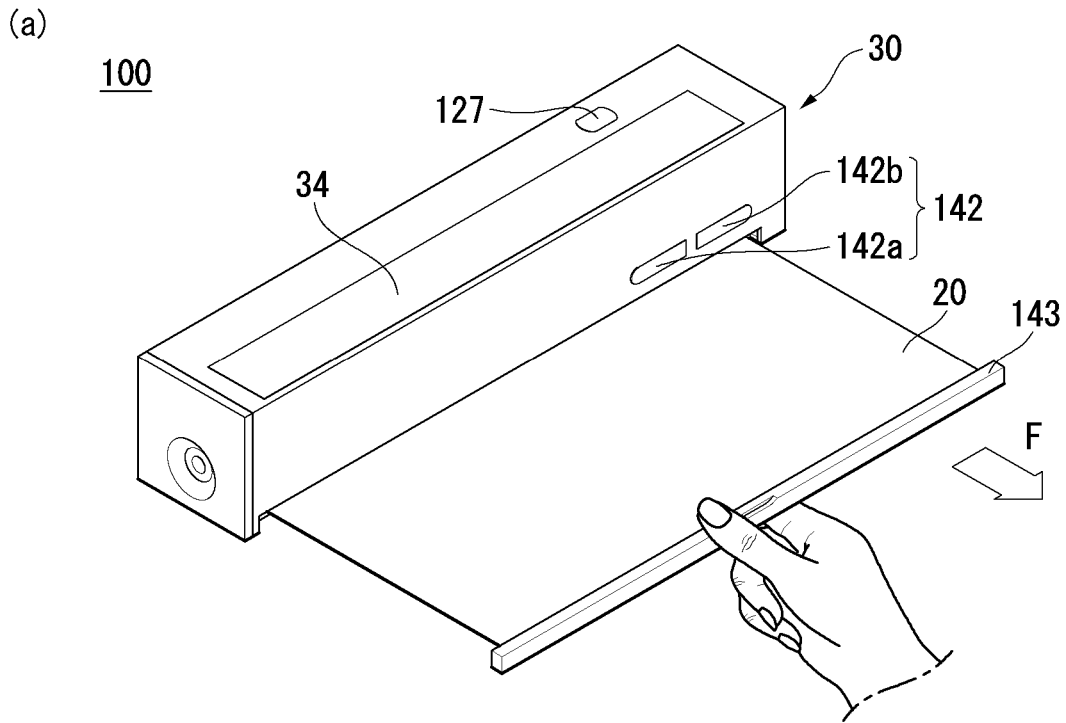


FIG. 20

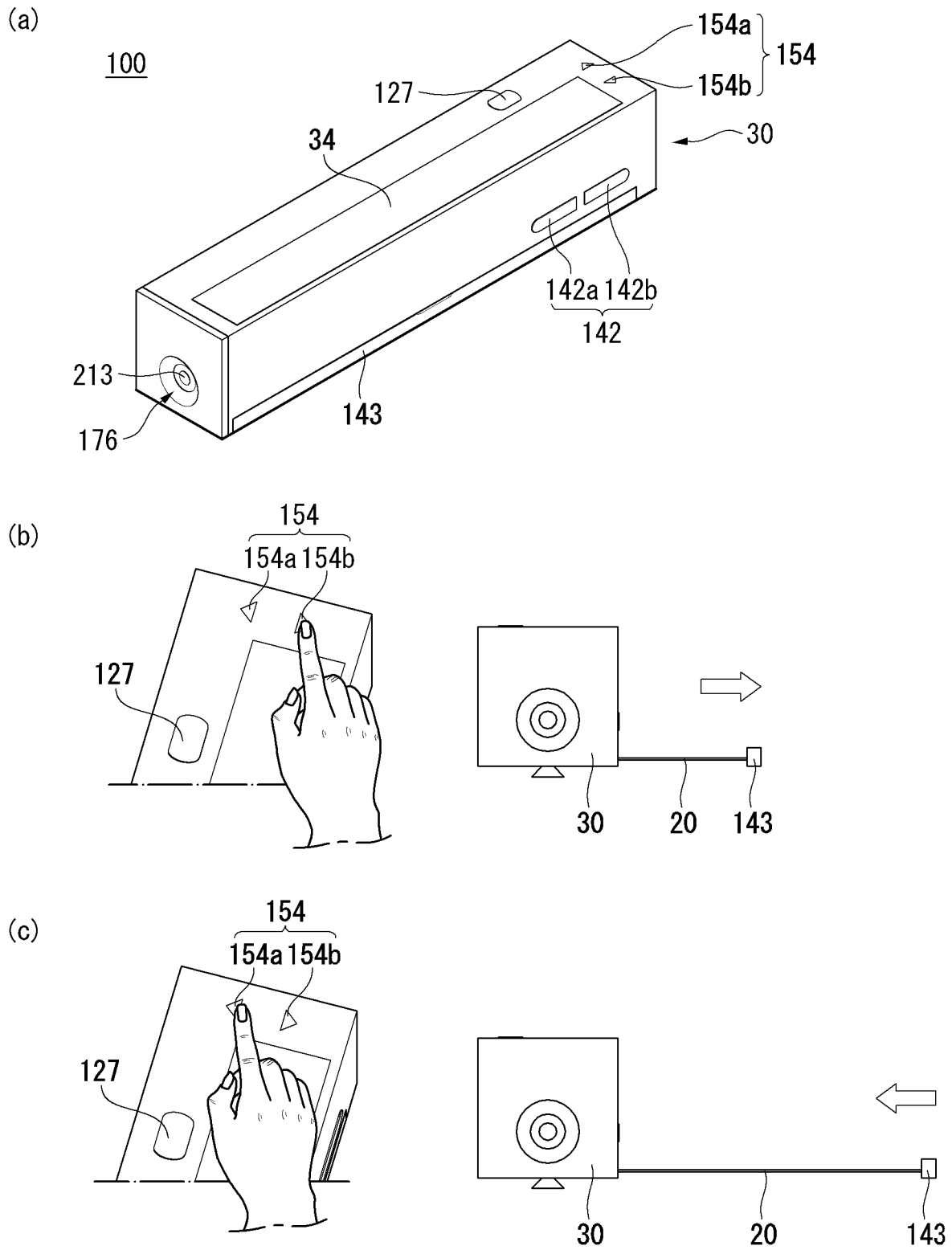
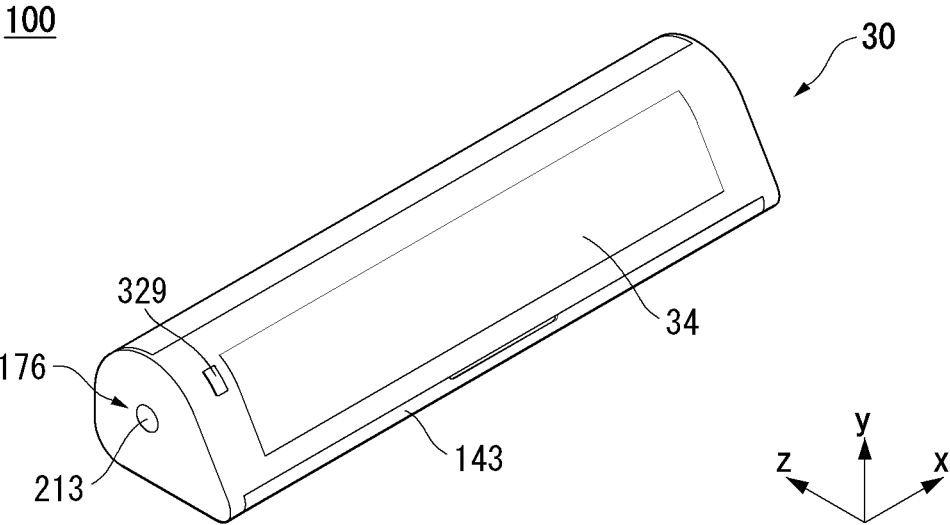


FIG. 21

(a)



(b)

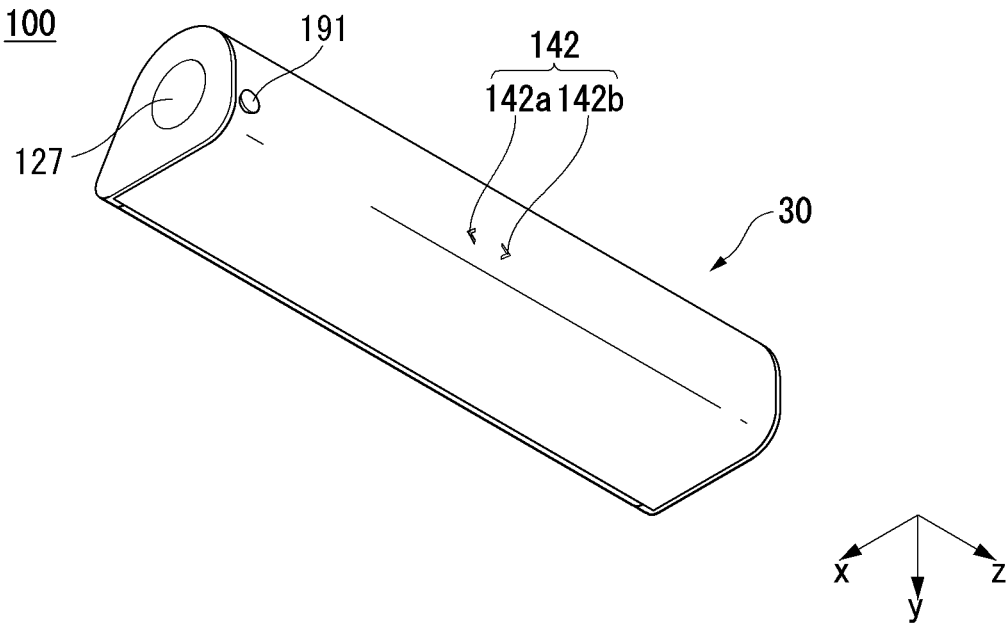


FIG. 22

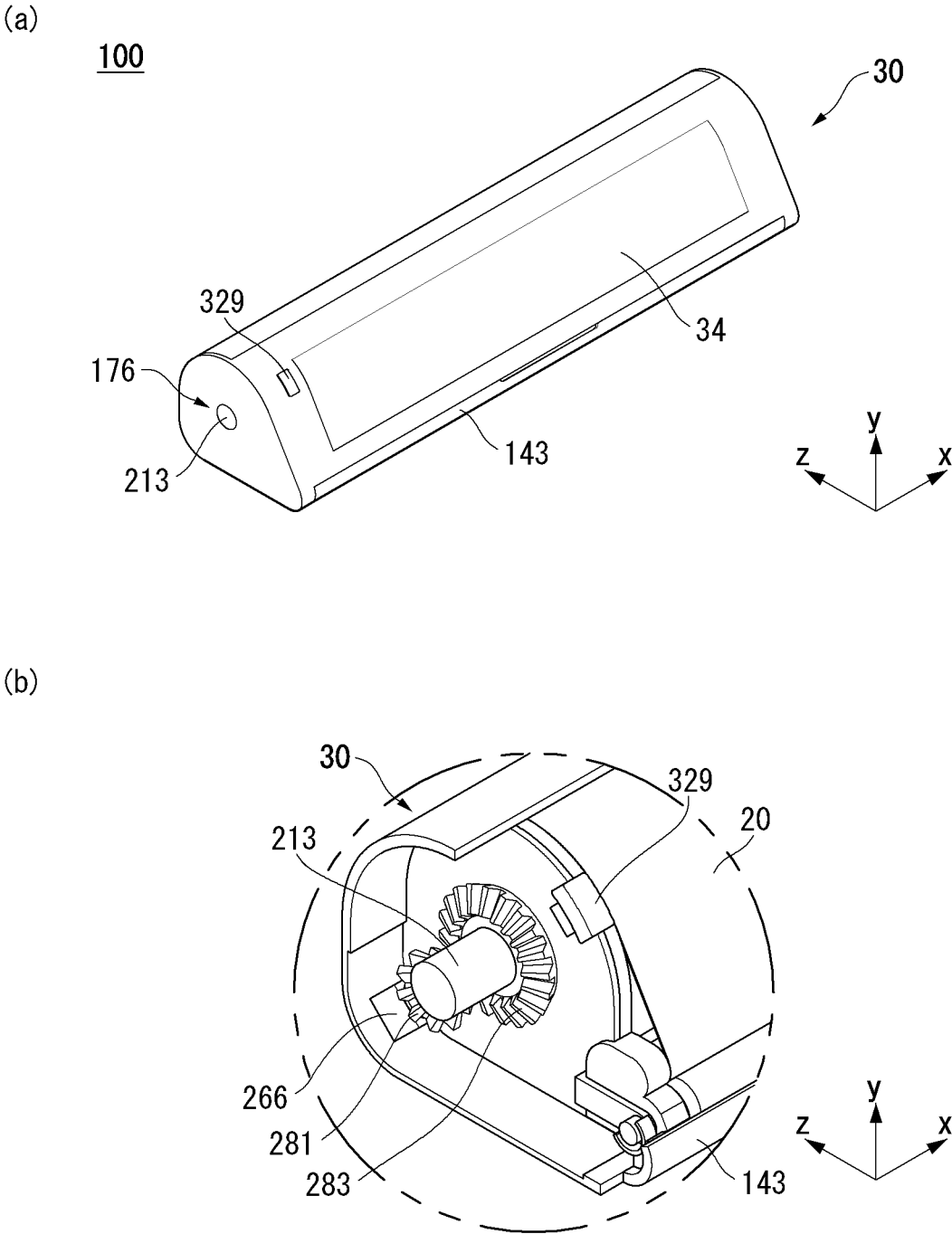
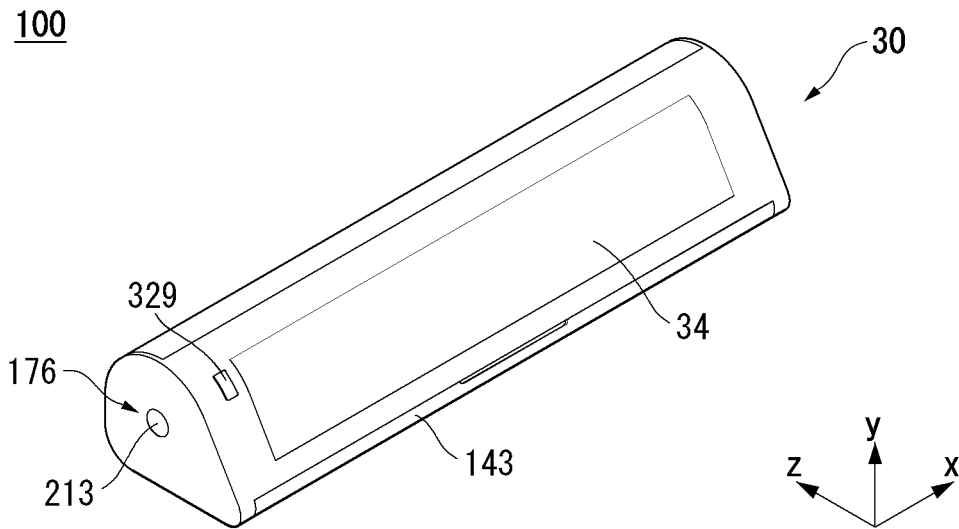




FIG. 23

(a)



(b)

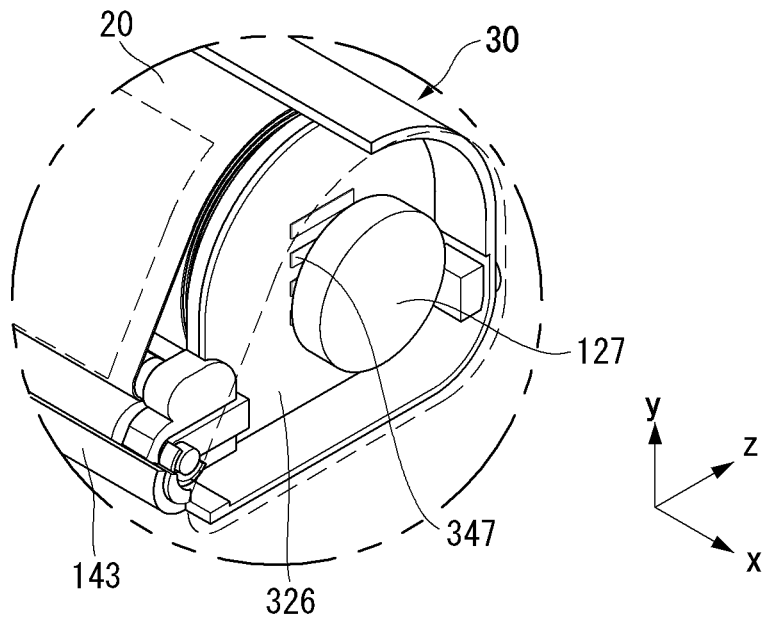


FIG. 24

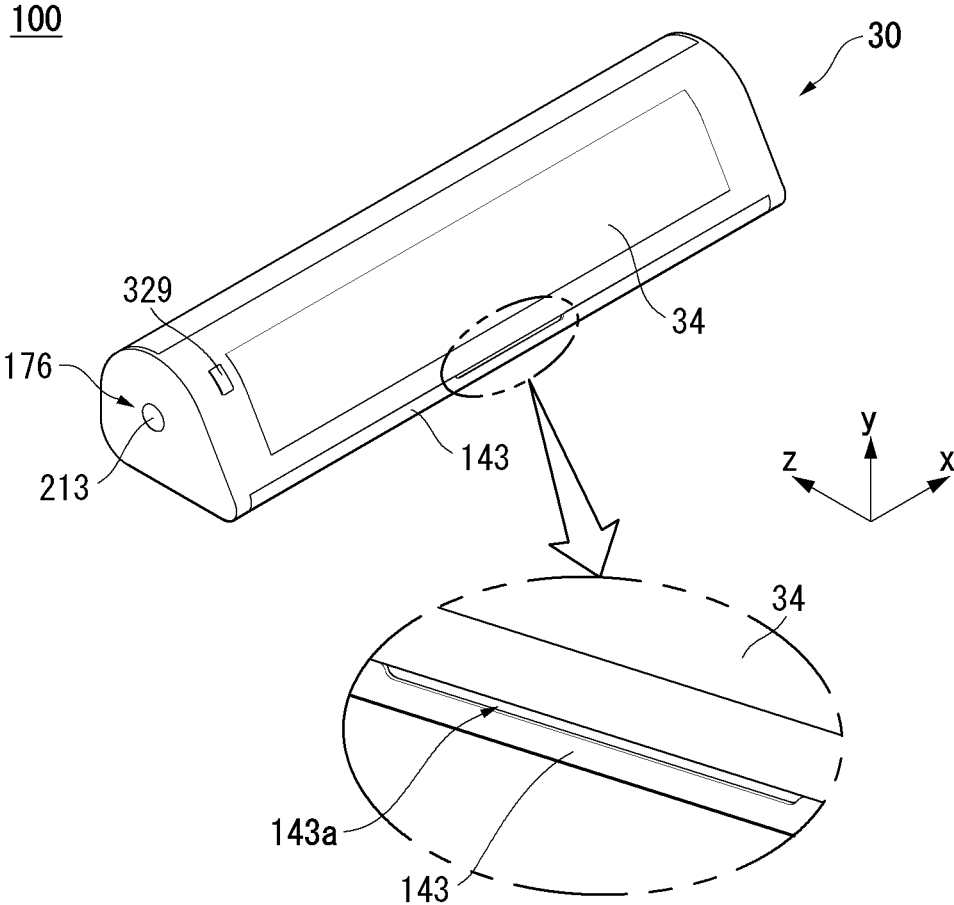


FIG. 25

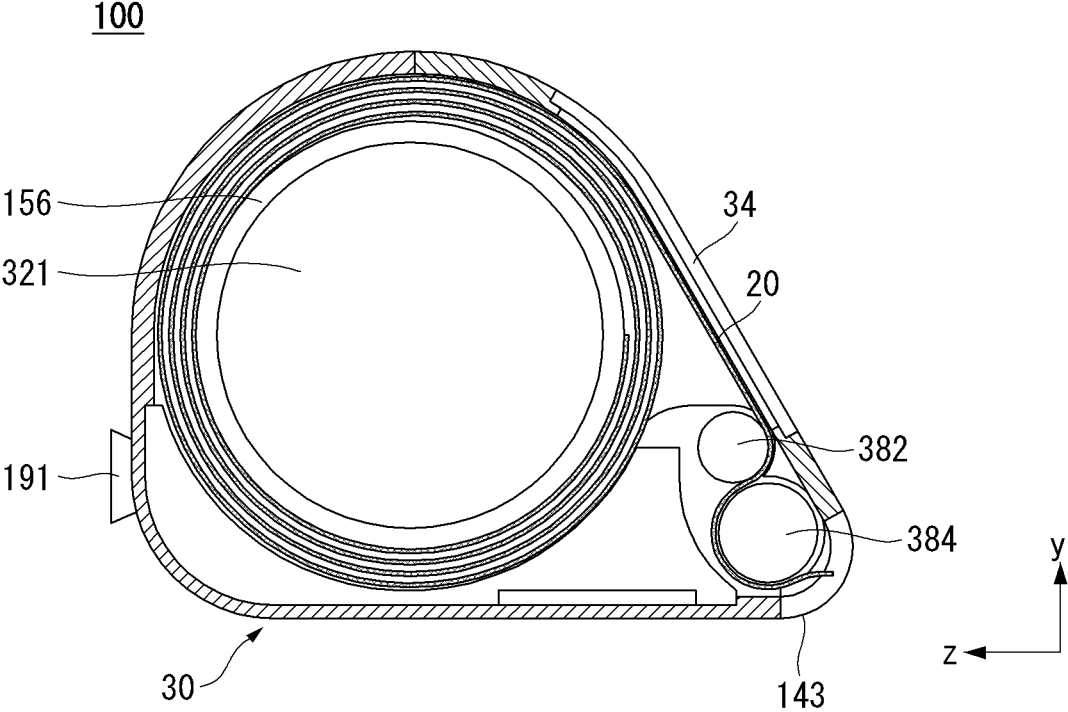


FIG. 26

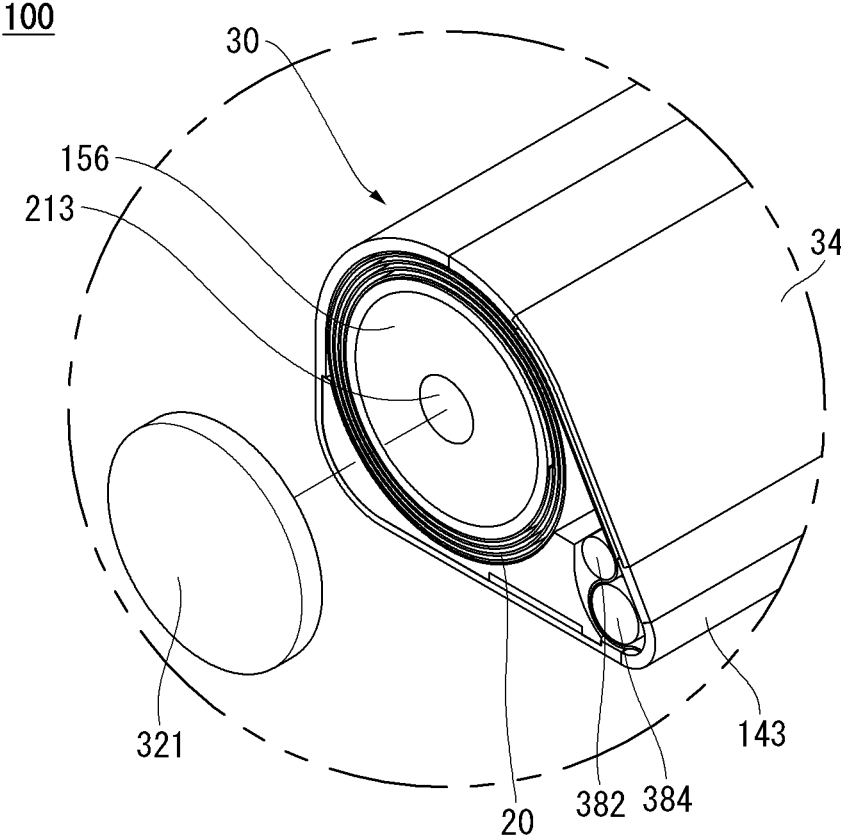
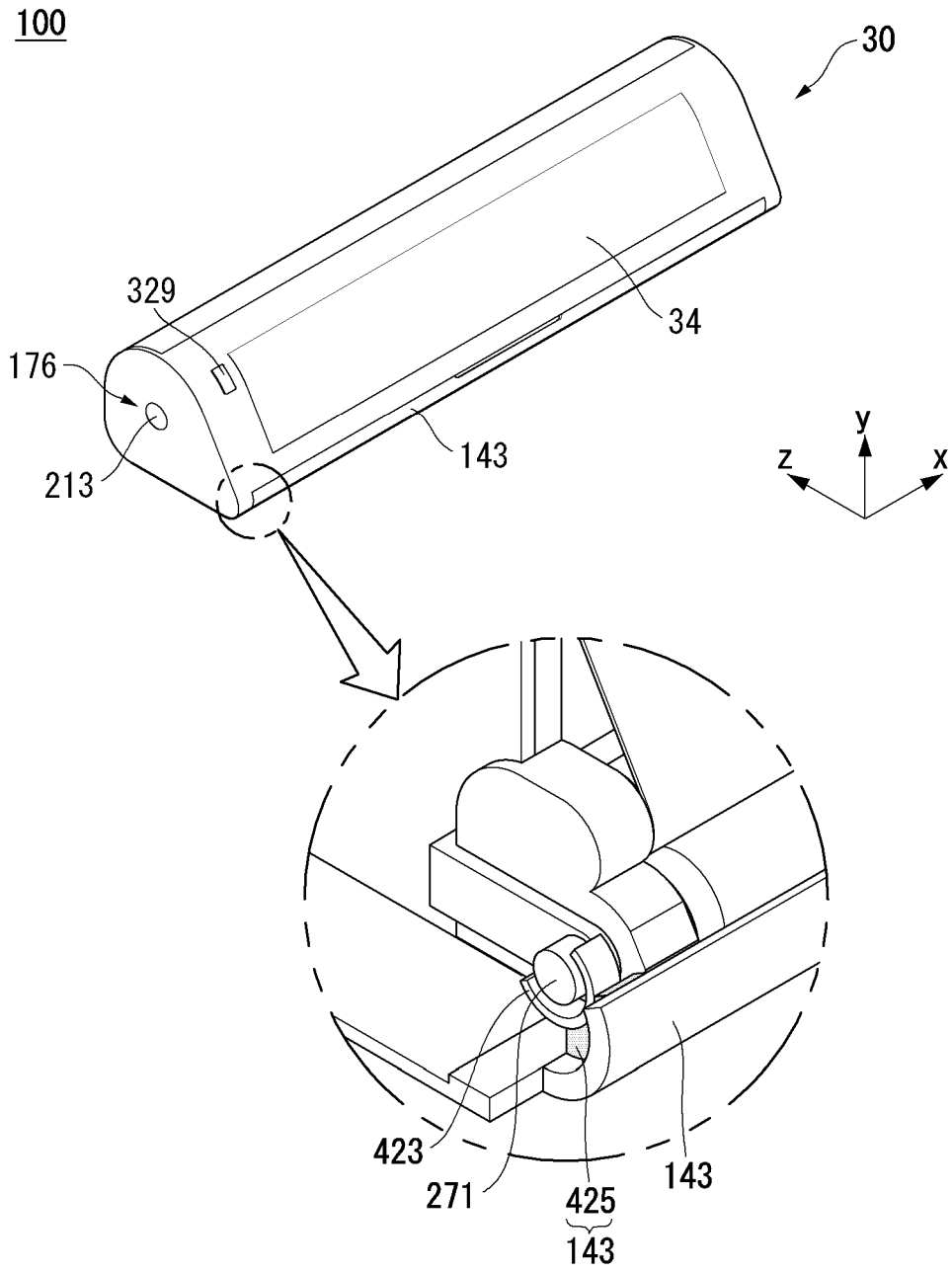


FIG. 27



**ELECTRONIC DEVICE****CROSS-REFERENCE TO RELATED APPLICATIONS**

This application is a Continuation Application of U.S. patent application Ser. No. 15/396,953 filed Jan. 3, 2017, which claims priority under 35 U.S.C. § 119 to Korean Application Nos. 10-2016-0000278 and 10-2016-0000280 filed Jan. 4, 2016, whose entire disclosures are hereby incorporated by reference.

**BACKGROUND****1. Field**

The present disclosure relates to an electronic device. More specifically, the present disclosure relates to an electronic device, in which various electronic parts can be mounted inside an inner frame because the inner frame does not rotate regardless of rolling and unrolling a display panel.

**2. Background**

With the development of the information society, various demands for electronic devices have been increasing. Hence, electronic devices have increasingly more functions. Examples of the functions include data and voice communications, taking pictures and video using a camera, recording audio, playing music files using a speaker system, and displaying images and video on a display. Some electronic devices include additional functionality which supports game playing, while other electronic devices are configured as multimedia players. More recently, the electronic devices have been configured to receive broadcast and multicast signals which permit viewing of content such as videos and television programs.

As the electronic devices have increasingly more functions, the electronic devices have been implemented as multimedia players of multiple functions having taking pictures and video, playing music files or video, game playing, receiving broadcast, etc.

**BRIEF DESCRIPTION OF THE DRAWINGS**

The embodiments will be described in detail with reference to the following drawings in which like reference numerals refer to like elements wherein:

FIGS. 1 to 20 illustrate configuration of an electronic device according to an embodiment of the disclosure; and

FIGS. 21 to 27 illustrate configuration of an electronic device according to another embodiment of the disclosure.

**DETAILED DESCRIPTION**

Reference will now be made in detail embodiments of the disclosure examples of which are illustrated in the accompanying drawings. Since the present disclosure may be modified in various ways and may have various forms, specific embodiments are illustrated in the drawings and are described in detail in the present specification. However, it should be understood that the present disclosure are not limited to specific disclosed embodiments, but include all modifications, equivalents and substitutes included within the spirit and technical scope of the present disclosure.

The terms ‘first’, ‘second’, etc. may be used to describe various components, but the components are not limited by

such terms. The terms are used only for the purpose of distinguishing one component from other components. For example, a first component may be designated as a second component without departing from the scope of the present disclosure. In the same manner, the second component may be designated as the first component.

The term “and/or” encompasses both combinations of the plurality of related items disclosed and any item from among the plurality of related items disclosed.

When an arbitrary component is described as “being connected to” or “being linked to” another component, this should be understood to mean that still another component (s) may exist between them, although the arbitrary component may be directly connected to, or linked to, the second component. In contrast, when an arbitrary component is described as “being directly connected to” or “being directly linked to” another component, this should be understood to mean that no component exists between them.

The terms used in the present application are used to describe only specific embodiments or examples, and are not intended to limit the present disclosure. A singular expression can include a plural expression as long as it does not have an apparently different meaning in context.

In the present application, the terms “include” and “have” should be understood to be intended to designate that illustrated features, numbers, steps, operations, components, parts or combinations thereof exist and not to preclude the existence of one or more different features, numbers, steps, operations, components, parts or combinations thereof, or the possibility of the addition thereof.

Unless otherwise specified, all of the terms which are used herein, including the technical or scientific terms, have the same meanings as those that are generally understood by a person having ordinary knowledge in the art to which the present disclosure pertains. The terms defined in a generally used dictionary must be understood to have meanings identical to those used in the context of a related art, and are not to be construed to have ideal or excessively formal meanings unless they are obviously specified in the present application.

The following embodiments of the present disclosure are provided to those skilled in the art in order to describe the present disclosure more completely. Accordingly, shapes and sizes of elements shown in the drawings may be exaggerated for clarity.

Electronic devices disclosed herein may be implemented using a variety of different types of devices. Examples of such devices include cellular phones, smart phones, user equipment, laptop computers, digital broadcast terminals, personal digital assistants (PDAs), portable multimedia players (PMPs), navigators, portable computers (PCs), slate PCs, tablet PCs, ultra books, wearable devices (for example, smart watches, smart glasses, head mounted displays (HMDs)), and the like.

By way of non-limiting example only, further description will be made with reference to particular types of electronic devices. However, such teachings apply equally to other types of electronic devices, such as those types noted above. In addition, these teachings may also be applied to stationary terminals such as digital TV, desktop computers, and the like.

Hereinafter, embodiments of the disclosure are described using an organic light emitting diode (OLED) display panel as an example of a display panel, but are not limited thereto. Other display panels may be used. For example, a liquid crystal display (LCD) panel, a plasma display panel (PDP), and a field emission display (FED) panel may be used.

FIGS. 1 to 20 illustrate configuration of an electronic device according to an embodiment of the disclosure.

Referring to FIG. 1, an electronic device 100 according to an embodiment of the disclosure may include a display panel 20 and a housing 30.

The housing 30 may shield a plurality of components for operating the electronic device 100. Thus, the housing 30 may protect the plurality of components from an external impact and may provide a neat appearance of the electronic device 100.

The display panel 20 may be in one of a first state in which the display panel 20 is positioned inside the housing 30, and a second state in which the display panel 20 is exposed to the outside of the housing 30. When the display panel 20 is in the first state, the display panel 20 may be rolled on a roller positioned inside the housing 30. When the display panel 20 is changed from the first state to the second state, the display panel 20 may be unrolled from the roller and may be exposed to the outside of the housing 30.

The display panel 20 may be an OLED display panel. However, embodiments of the disclosure are not limited thereto. For example, the display panel 20 may be an LCD panel.

A knob 143 may be positioned at an end of the housing 30. The knob 143 may be pulled out of the housing 30. When the knob 143 is pulled out, the display panel 20 may spread. The knob 143 may be thicker than display panel 20 so that a user can easily hold and pull out the knob 143.

In the electronic device 100 according to the embodiment of the disclosure, the display panel 20 may be in one of the first state and the second state. Hence, only when the user watches the electronic device 100, the display panel 20 may be exposed to the outside of the housing 30 and may perform a space-saving function.

Referring to FIG. 2, the electronic device 100 according to the embodiment of the disclosure may include various buttons and various components on the housing 30.

A window 34 and a power button 127 may be positioned on an upper surface of the housing 30. The window 34 may include a material with light transmission. Namely, the user may see the inside of the housing 30 through the window 34. For example, the window 34 may include glass or tempered glass.

The power button 127 may be spaced apart from the window 34. The power button 127 may turn on or off the electronic device 100. The user may turn on or off the electronic device 100 through a long touch or a short touch of the power button 127. The power button 127 may be one of a touch button and a push button.

A control button 142 and the knob 143 may be positioned on one side of the housing 30 in a direction of the z-axis. The control button 142 may be spaced apart from the knob 143. The control button 142 may include first and second control buttons 142a and 142b. The first and second control buttons 142a and 142b may be spaced apart from each other and positioned opposite each other. For example, the first and second control buttons 142a and 142b may perform a volume control or a motion control of an object on a display screen.

A camera 191 may be positioned on a lower surface of the housing 30. The camera 191 may protrude from the housing 30. The camera 191 may process an image frame, such as a still image and a video, obtained by an image sensor. The processed image frame may be displayed on the display panel 20 and stored in a memory. The camera 191 may perform a function of taking pictures and video. FIG. 2 illustrates that the camera 191 is positioned on the lower

surface of the housing 30. However, embodiments of the disclosure are not limited thereto. For example, the camera 191 may be positioned on the side or the upper surface of the housing 30, so that a bottom surface of the housing 30 is flat.

Referring to FIG. 3, an insertion hole 176 may be positioned at one side of the housing 30 in a direction of the x-axis. The insertion hole 176 may have a shape depressed toward the inside of the housing 30. The insertion hole 176 may be a portion into which a touch pen 213 is inserted. A diameter of the insertion hole 176 on the housing 30 may be greater than a diameter of the insertion hole 176 that is depressed to the inside of the housing 30. Hence, the user may easily insert the touch pen 213 into an entrance of the insertion hole 176.

Because the touch pen 213 is inserted into the inside of the housing 30, a length of the touch pen 213 may be less than a width of the housing 30 in the x-axis direction.

The display panel 20 may include a capacitive sensor (not shown) sensing a capacitance of a touched portion of the display panel 20. The capacitive sensor may include a plurality of sensor arrays that is insulated from one another. Because the sensor arrays are insulated from one another, the adjacent sensor arrays may not be affected by capacitances sensed by the adjacent sensor arrays. Further, because the sensor arrays are insulated from one another, the sensor arrays can prevent a ghost phenomenon resulting from a multi-touch. The ghost phenomenon is a phenomenon in which when two or more locations are touched, all of multi-touched locations are not detected, and a center point of the multi-touched locations is recognized as a touch point. The capacitive sensor may sense a portion touched by the touch pen 213 and may transfer a touch signal to a controller. When the controller recognizes the touch signal, the controller may generate an event corresponding to a touch operation.

Referring to FIG. 4, a spring 227 may be positioned at a depressed end of the insertion hole 176. Namely, when the touch pen 213 is inserted into the insertion hole 176, the spring 227 may be disposed in a portion of the insertion hole 176 corresponding to a tip of the touch pen 213. The spring 227 may be configured so that the touch pen 213 can be fixed to the inside of the insertion hole 176.

More specifically, when the touch pen 213 is pressed to the inside of the insertion hole 176 and then a pressing force is removed, the touch pen 213 may be fixed to the inside of the insertion hole 176. Afterwards, when the fixed touch pen 213 is again pressed to the inside of the insertion hole 176 and then a pressing force is removed, the touch pen 213 may receive a force from the outside of the insertion hole 176 by an elastic force of the spring 227.

The touch pen 213 may be fixed to the inside of the insertion hole 176 by the spring 227 positioned inside the insertion hole 176 or may receive the force from the outside of the insertion hole 176 by the spring 227. Hence, the user can easily carry the electronic device 100 because the touch pen 213 is usually fixed to the inside of the housing 30.

Referring to FIG. 5, a guide roller 87 may be positioned at an edge inside the housing 30. Before the display panel 20 rolled on a panel roller 156 is exposed to the outside, the guide roller 87 may evenly spread the display panel 20.

The guide roller 87 may include first to fourth guide rollers 87a to 87d. The first guide roller 87a may be positioned opposite an entrance of the housing 30, to which the display panel 20 is exposed. The first guide roller 87a of the guide rollers 87a to 87d may be closest to a location, at which the display panel 20 is unrolled from the panel roller

156. The second to fourth guide rollers **87b** to **87d** may be positioned in the order named in a clockwise direction based on the first guide roller **87a**.

The display panel **20** may be adjacent to an inner surface of the housing **30** by the first to fourth guide rollers **87a** to **87d**. Hence, the display panel **20** may be adjacent to the window **34**.

Referring to FIG. 6, the first to third guide rollers **87a** to **87c** may guide an inner surface of the display panel **20**, and the fourth guide roller **87d** may guide an outer surface of the display panel **20**. Hence, the display panel **20** between the third guide roller **87c** and the fourth guide roller **87d** may not bend to the inner surface of the housing **30** and may be spaced apart from the housing **30** by a predetermined distance IPD.

Namely, as shown in (a) of FIG. 6, even when the display panel **20** is rolled on the panel roller **156** in the first state in which the display panel **20** is positioned inside the housing **30**, at least a portion of the display panel **20** may evenly spread by the first to fourth guide rollers **87a** to **87d**.

As shown in (b) of FIG. 6, in the second state in which the display panel **20** is exposed to the outside of the housing **30**, the display panel **20** may be exposed via the fourth guide roller **87d**. Namely, the display panel **20** may be unrolled from the panel roller **156** and may be exposed to the outside after passing through the first to fourth guide rollers **87a** to **87d**. The display panel **20** may evenly spread while passing through the first to fourth guide rollers **87a** to **87d**.

As shown in (a) of FIG. 7, in an electronic device according to a related art, a guide roller may not be positioned inside a housing **30**. Hence, a display panel **20** may not evenly spread in a second state. Namely, even when the display panel **20** is unrolled from a panel roller **156**, the display panel **20** may try to be rolled on the panel roller **156**.

Hence, in the second state, the display panel **20** may be curled in a first direction D1. The user cannot concentrate on a screen of the display panel **20** because the display panel **20** exposed to the outside of the housing **30** is not flat.

On the other hand, as shown in (b) of FIG. 7, in the electronic device according to the embodiment of the disclosure, the first to fourth guide rollers **87a** to **87d** may be positioned inside the housing **30**. Hence, the display panel **20** may spread while maintaining an even state before being exposed to the outside. Namely, the display panel **20** may spread inside the housing **30** several times by the first to fourth guide rollers **87a** to **87d**.

Thus, the display panel **20** may not be curled and may evenly spread in the second state. The user can concentrate more on a display screen of the flat display panel **20**.

Referring to FIG. 8, when the display panel **20** is positioned inside the housing **30**, a display screen may be displayed on a portion of the display panel **20** corresponding to the window **34**. Namely, the user may watch the display screen through the window **34** under any circumstances.

When the display panel **20** is changed from the first state to the second state, a portion of the display panel **20** corresponding to the window **34** may be changed. Hence, a portion of the display panel **20**, on which the display screen is displayed, may continuously change inside the housing **30**. A method of sensing a portion of the display panel **20**, on which the display screen is displayed, will be described later.

Even in the second state, the display screen may be displayed on a portion of the display panel **20** corresponding to the window **34**. Namely, the display screen may be displayed on both the display panel **20** exposed to the outside of the housing **30** and a portion of the display panel

**20** corresponding to the window **34**. Difference screens may be displayed on the display panel **20** exposed to the outside of the housing **30** and a portion of the display panel **20** corresponding to the window **34**. However, embodiments of the disclosure are not limited thereto. For example, the same screen may be displayed on the display panel **20** exposed to the outside of the housing **30** and a portion of the display panel **20** corresponding to the window **34**.

In the electronic device **100** according to the embodiment of the disclosure, the display screen may be displayed on at least a portion of the display panel **20** positioned inside the housing **30**. Hence, the user can more easily watch the display screen.

Referring to FIG. 9, a pattern **234** may be displayed on the inside of the display panel **20**. The pattern **234** may include a magnetic material. The pattern **234** may have a shape extended from one end to the other end of the display panel **20**. Because the pattern **234** is positioned inside the display panel **20**, the pattern **234** may not be exposed to the outside. Hence, the user can watch a clear display screen, on which the pattern **234** is not seen.

A hall sensor **271** may be positioned inside a surface of the housing **30**, on which the control button **142** is positioned. The hall sensor **271** may be spaced apart from a formation portion of the control button **142**. The hall sensor **271** may be positioned on a protrusion **362a** of a flexible printed circuit board (FPCB) **362** extended from a back surface of the control button **142**.

The electronic device **100** according to the embodiment of the disclosure may include the controller. The controller may generate a control signal. The controller may be configured so that multiple applications for the electronic device **100** and data, commands, etc. for an operation of the electronic device **100** are executed.

The hall sensor **271** may sense a magnetic field of the pattern **234**. More specifically, when the display panel **20** is rolled and unrolled, the hall sensor **271** may sense a magnetic field of the pattern **234** passing around the hall sensor **271**. When the hall sensor **271** senses a specific magnetic field of the pattern **234**, the controller may activate at least a portion of the display panel **20**.

Referring to FIG. 10, the pattern **234** positioned inside the display panel **20** may have various shapes.

As shown in (a) of FIG. 10, the pattern **234** may include valley portions **307** and peak portions **309**. The valley portions **307** and the peak portions **309** may be alternately disposed in a third direction.

A hall sensor may be installed near the pattern **234**. For instance, the hall sensor may be disposed at a location corresponding to a line connecting the valley portions **307** and the peak portions **309**. Hence, the hall sensor may sense a magnetic field or a variance of a magnetic field when the pattern **234** passes by the hall sensor.

Distances PW between the peak portions **309** of the pattern **234** may be uniform. Namely, the peak portions **309** may be disposed at intervals of the predetermined distance PW. Hence, the hall sensor may determine a portion (or a location) of the display panel **20**, that will be activated, through the number of lines passing through the hall sensor. Namely, a portion of the display panel **20** to be activated may be determined through the number of magnetic fields sensed by the hall sensor.

On the other hand, as shown in (b) of FIG. 10, distances PW between the peak portions **309** of the pattern **234** may be non-uniform. Namely, the peak portions **309** may be spaced apart from one another by the different distances PW. In this instance, the hall sensor may determine a portion (or



a location) of the display panel 20, that will be activated, through distances between lines passing through the hall sensor. Namely, a portion of the display panel 20 to be activated may be determined through time intervals of magnetic fields sensed by the hall sensor.

Referring to FIG. 11, the electronic device 100 according to the embodiment of the disclosure may sense a width of a display screen exposed to the outside of the housing 30 by a magnetic field sensed by the hall sensor.

For example, as shown in (a) of FIG. 11, when the display panel 20 is spreading while being changed from the first state to the second state, a width DP1 of the display panel 20 exposed to the outside of the housing 30 in the z-axis direction may be relatively short. In this instance, the controller of the electronic device 100 may adjust an aspect ratio based on the exposed width DP1 of the display panel 20 in the z-axis direction.

Further, as shown in (b) of FIG. 11, when the display panel 20 fully spreads and is in the second state, a width DP2 of the display panel 20 exposed to the outside of the housing 30 in the z-axis direction may be relatively long. In this instance, the controller of the electronic device 100 may adjust an aspect ratio based on the exposed width DP2 of the display panel 20 in the z-axis direction.

The exposed width DP2 of the display panel 20 in the second state may be greater than the exposed width DP1 of the display panel 20 in other state. Hence, a display screen of the display panel 20 in the second state may be larger than a display screen of the display panel 20 in other state.

The electronic device 100 according to the embodiment of the disclosure may change an aspect ratio of the display screen based on the exposed width of the display panel 20. Hence, the user can watch the entire display screen without the screen cutting while the display panel 20 is being rolled and unrolled.

Referring to FIG. 12, the electronic device 100 according to the embodiment of the disclosure may include a sub-display panel 163 positioned inside the window 34. The sub-display panel 163 does not move and may display a screen only through the window 34. Hence, a width of the sub-display panel 163 may be the same as or similar to a width of the window 34.

When the sub-display panel 163 is positioned inside the housing 30, the display panel 20 may be rolled in a counterclockwise direction. Namely, the guide roller 87 may guide the outer surface of the display panel 20, on which the screen is displayed. Because the sub-display panel 163 is separately positioned, the outer surface of the display panel 20 may not face an inner surface of the housing 30.

In this instance, the guide roller 87 may include first to third guide rollers 87a to 87c. Because the display panel 20 is rolled in the counterclockwise direction, a direction of spreading the display panel 20 may not rapidly change at an entrance of the housing 30 as shown in FIG. 12. Hence, the guide roller 87 may not include a fourth guide roller 87d. As a result, a manufacturing process can be simplified, and the manufacturing cost may be reduced.

The electronic device 100 according to the embodiment of the disclosure may include the sub-display panel 163 positioned inside the window 34. Hence, the display panel 20 may not display the screen inside the housing 20. Thus, because the hall sensor does not need to be positioned inside the housing 30, the manufacturing cost may be reduced.

Referring to FIG. 13, the guide roller 87 and the panel roller 156 may be inserted into the inside of the housing 30. More specifically, one end of the guide roller 87 and one end of the panel roller 156 may be fixed to a first surface 30a

corresponding to the side of the housing 30. And then, the other end of the guide roller 87 and the other end of the panel roller 156 may be fixed to a third surface 30c opposite the first surface 30a of the housing 30.

The panel roller 156 may include an inner frame 154 and an outer frame 152. The outer frame 152 may have a shape of wrapping the inner frame 154. The inner frame 154 may be fixed to the housing 30 together with the guide roller 87. Various electronic parts may be mounted inside the inner frame 154.

The camera 191 may be positioned at a lower end of the inner frame 154. When the inner frame 154 is fixed to the first surface 30a, the camera 191 may be inserted into an opening positioned in a second surface 30b corresponding to a lower surface of the housing 30.

Referring to FIG. 14, the touch pen 213, a battery 321, at least one printed circuit board (PCB) 417, and a contact terminal 166 may be positioned inside the inner frame 154.

The battery 321 may be positioned on a flat surface inside the inner frame 154. The battery 321 may have a semi-circular shape. A flat portion of the battery 321 of the semi-circular shape may contact the flat surface inside the inner frame 154.

At least one PCB 417 may be positioned on the flat surface inside the inner frame 154. At least one PCB 417 may be electrically connected to the battery 321.

A plurality of PCBs 417 may be provided and may be spaced apart from one another. The PCBs 417 may perform different functions. For example, at least one PCB 417 may be a main board. The main board may provide an interface for operating the electronic device. Further, the main board may check and control an operation state of each electronic part included in the electronic device and may optimally make the operation state of each electronic part.

As another example, at least one PCB 417 may be a timing controller board. The timing controller board may transfer an input signal to the display panel. Further, the timing controller board may control an image.

The contact terminal 166 may be positioned on the flat surface inside the inner frame 154. At least a portion of the contact terminal 166 may protrude from the flat surface of the inner frame 154 to the outside. The protrusion of the contact terminal 166 may contact the inner surface of the housing 30. The contact terminal 166 may transfer a signal received from a button on the housing 30 to at least one PCB 417. Hence, although not shown, one end of the contact terminal 166 may be connected to at least one PCB 417. The contact terminal 166 may include a material with high conductivity, so as to smoothly carry the signal.

In the electronic device 100 according to the embodiment of the disclosure, various electronic parts may be mounted inside the inner frame 154 of the panel roller 156. Hence, a space of the electronic device 100 can be saved.

Referring to FIG. 15, the inner frame 154 and the outer frame 152 may be coupled. The outer frame 152 may be inserted between both ends of the inner frame 154 while a middle portion of the inner frame 154 is inserted into the outer frame 152. A diameter of the middle portion of the inner frame 154 may be less than a diameter of the outer frame 152, and a diameter between both ends of the inner frame 154 may be greater than the diameter of the outer frame 152.

Wires 181 may be connected to one end of the outer frame 152. The wires 181 may be used to carry an electrical signal. The wires 181 may be inserted into the side of the inner frame 154 and may be connected to at least one PCB 417.

Hence, the wires **181** may be connected to one end of the outer frame **152**, at which at least one PCB **417** of the inner frame **154** is positioned.

The display panel **20** may be rolled on the panel roller **156**. Hence, the panel roller **156** may rotate. In the electronic device **100** according to the embodiment of the disclosure, the outer frame **152** of the panel roller **156** may rotate, and the inner frame **154** of the panel roller **156** may be fixed. Namely, the outer frame **152** may not be coupled with the inner frame **154**. The outer frame **152** may rotate on the inner frame **154**.

Because the inner frame **154** does not rotate when the display panel **20** is rolled on the panel roller **156**, the electronic parts inside the inner frame **154** may stably operate. Further, the inner frame **154** may be fixed and may be a rotation shaft of the outer frame **152**.

Referring to FIG. **16**, a wire hole **273** may be positioned at one side of the inner frame **154**. The wire hole **273** may be a portion, in which the wires **181** connected to the outer frame **152** are inserted into the inner frame **154**.

When the outer frame **152** rotates, the wire hole **273** can prevent the wires **181** from being tangled. Hence, the wire hole **273** may have a relatively large width or diameter.

A centered portion of the wire hole **273** may have a circular shape or a cylindrical shape, and both wings of the wire hole **273** may be extended from the centered portion of the wire hole **273** in parallel with each other. However, embodiments of the disclosure are not limited thereto. The wire hole **273** may have various shapes as long as the wire hole **273** has a relatively large width or diameter to the extent of preventing the wires **181** from being tangled when the outer frame **152** rotates.

In the electronic device **100** according to the embodiment of the disclosure, the inner frame **154** may include the wire hole **273**. Hence, because the wire hole **273** can prevent the wires **181** from being tangled when the outer frame **152** rotates, the disconnection or a problem of the signal transfer is not caused.

Referring to FIG. **17**, a housing case **30d** may be positioned on first to third surfaces **30a** to **30c** of the housing **30** coupled with the panel roller **156**. The housing case **30d** may shield a surface of the housing **30** except the first to third surfaces **30a** to **30c**. The housing case **30d** may be coupled to the third surface **30c** using a latch. However, embodiments of the disclosure are not limited thereto. For example, the housing case **30d** may be coupled to the first to third surfaces **30a** to **30c** using a screw.

The power button **127** and the control button **142** may be positioned on the housing case **30d** and may transfer a signal to the electronic device **100**. Further, the housing case **30d** may additionally shield the third surface **30c**. At least one button of the housing case **30d** may transfer a signal to the electronic device **100** through the third surface **30c**. A method of transferring a signal using at least one button will be described later.

The electronic device **100** according to the embodiment of the disclosure may be assembled by inserting the housing case **30d** into the first to third surfaces **30a** to **30c** of the housing **30**, to which a roller is installed. Hence, the user can easily assemble or separate the electronic device **100**. As a result, it is easy to replace and repair the electronic device **100**.

Referring to FIG. **18**, the FPCB **362** may be connected to a button so as to carry a signal from the button.

The FPCB **362** may be attached to the inner surface of the housing case **30d**. The FPCB **362** may be extended from the power button **127** and the control button **142** to the end

portion of the housing case **30d**. The FPCB **362** may include a pad **347** on the end portion of the housing case **30d**. When the housing case **30d** is coupled with the panel roller, the pad **347** may contact the contact terminal and carry an electrical signal. Hence, the pad **347** may include a conductive material. Because the pad **347** contacts the protrusion of the contact terminal, the pad **347** does not protrude from the FPCB **362** and may be flat and mounted on the side of the housing case **30d**. However, embodiments of the disclosure are not limited thereto. The pad **347** may protrude from the FPCB **362** so that the pad **347** maintains the contact with the contact terminal.

The FPCB **362** may further include a protrusion **362a** extended to the side, and the hall sensor **271** may be positioned on the protrusion **362a**.

One surface of the power button **127** and one surface of the control button **142** may be supported by a plate **314**. The plate **314** may have a shape of protruding toward the inner surface of the housing case **30d**. When the user presses at least one button, a protrusion of the plate **314** may support a pressing force of the user. Namely, the plate **314** can prevent deformation of a portion corresponding to the button of the housing case **30d**. The plate **314** may include a stainless material. Hence, corrosion and deformation of the plate **314** can be prevented.

Referring to FIG. **19**, the user may pull out the knob **143** using an external force **F** and may change the electronic device **100** in the second state, in which the display panel **20** is exposed to the outside of the housing **20**.

A wind spring **434** may be positioned on one side of the panel roller **156**. The wind spring **434** may apply a force in a direction of rolling the display panel **20** on the panel roller **156**. For example, the wind spring **434** may apply the force so that the panel roller **156** rotates in a clockwise direction. Hence, when the external force **F** applied by the user is greater than the force of the wind spring **434** for rotating the panel roller **156**, the display panel **20** may be unrolled from the panel roller **156**.

Further, the wind spring **434** may fix the panel roller **156** so that the display panel **20** is in the second state. More specifically, when the user pulls the display panel **20** to the maximum and then removes the force, the panel roller **156** may not rotate and may be fixed.

Afterwards, when the user again pulls the fixed display panel **20** and then removes the force, the wind spring **434** may apply the force to rotate the panel roller **156**. Hence, the display panel **20** may be more strongly rolled on the panel roller **156**.

In the electronic device **100** according to the embodiment of the disclosure, the wind spring **434** may cause the panel roller **156** to be fixed in the second state and cause the display panel **20** to rapidly change from the second state to the first state. Hence, the user can change more easily the state of the display panel **20**.

As shown in (a) of FIG. **20**, a rolling button **154** may be positioned on one side of the upper surface of the housing **30**. The rolling button **154** may be spaced apart from the power button **127** or the window **34**.

The rolling button **154** may include first and second rolling buttons **154a** and **154b**. The first and second rolling buttons **154a** and **154b** may be spaced apart from each other and may be positioned opposite each other. The first and second rolling buttons **154a** and **154b** may function to rotate the panel roller **156** so that the display panel **20** is rolled on and unrolled from the panel roller **156**.

For example, as shown in (b) of FIG. **20**, when the user touches or presses the second rolling button **154b**, the

display panel **20** may be unrolled from the panel roller **156**. Namely, when the user touches or presses the second rolling button **154b**, the display panel **20** may spread toward the outside of the housing **30**.

On the contrary, as shown in (c) of FIG. **20**, when the user touches or presses the first rolling button **154a**, the display panel **20** may be rolled on the panel roller **156**. Namely, when the user touches or presses the first rolling button **154a**, the display panel **20** may be inserted into the inside of the housing **30**.

The electronic device **100** according to the embodiment of the disclosure may roll or unroll the display panel **20** using the first and second rolling buttons **154a** and **154b**. Hence, the user can easily roll or unroll the display panel **20** without using the force.

FIGS. **21** to **27** illustrate configuration of an electronic device according to another embodiment of the disclosure.

Referring to FIG. **21**, an electronic device **100** according to an embodiment of the disclosure may include a housing **30**. The housing **30** does not have a cuboid shape, and may have a shape, in which at least one surface of the housing **30** is flat, and a portion symmetrical to the flat surface is a curved surface. In this instance, because an appearance of the electronic device **100** has not a straight line shape but a curved line shape, the user may feel the appearance of the electronic device **100** to be neater.

Because at least one surface of the housing **30** is flat, it may be convenient to place the housing **30** on the floor. Further, because a surface opposite the flat surface of the housing **30** is a curved surface, the user can easily carry the electronic device **100** with his/her hand.

A window **34** may be positioned on a surface connected to the flat surface of the housing **30**. A portion of the housing **30** corresponding to the window **34** may be flat. Hence, the user can concentrate more on a screen displayed on the window **34**.

A home button **329** may be positioned on one side of the window **34**. The home button **329** and the window **34** may be positioned on the same surface to be spaced apart from each other. When the user touches or presses the home button **329**, a controller of the electronic device **100** may convert a display screen into a home screen. Namely, when the user touches or presses the home button **329**, the controller may end an application, that is being executed, and may return to the home screen.

A knob **143** may be formed at a location where the flat surface of the housing **20** and a formation surface of the window **34** are connected. Further, a camera **191** and a control button **142** may be positioned on the surface of the housing **20** opposite the formation surface of the window **34**. Because the control button **142** is positioned opposite the window **34** and the knob **143**, the user may easily touch or press the control button **142** while watching a screen displayed on the window **34** or a display panel **20** (see FIG. **22**). Functions and structures of the window **34**, the control button **142**, the knob **143**, and the camera **191** shown in FIG. **21** may be substantially the same as those illustrated in FIGS. **1** to **20**.

In the electronic device **100** according to the embodiment of the disclosure, at least one surface of the housing **30** may be the flat surface, and another surface of the housing **30** may be the curved surface. Hence, the user can easily place the electronic device **100** on the floor and also easily carry the electronic device **100**.

Referring to FIG. **22**, a motor assembly may be positioned on one side inside the housing **30**. The motor assembly may rotate a panel roller **156**, so that the display panel **20** is rolled

on and unrolled from the panel roller **156**. The motor assembly may include a motor **266**, a pinion gear **281**, and a ring gear **283**.

The motor **266** may be positioned on one side inside the housing **30**. The motor **266** may receive an electrical signal and convert the electrical signal into a physical force. The motor **266** may transfer a rotational force to the pinion gear **281**.

The pinion gear **281** may transfer the rotational force to a ring gear **283**. A rotational speed of the ring gear **283** may be smaller than a rotational speed of the pinion gear **281**. The pinion gear **281** may have a sawtooth shape. When the motor **266** rotates in a first direction, the pinion gear **281** may rotate in the first direction at the same time as the motor **266**. Further, when the motor **266** rotates in a second direction, the pinion gear **281** may rotate in the second direction at the same time as the motor **266**.

The ring gear **283** may have a ring shape. An outer periphery of the ring gear **283** may be geared in the pinion gear **281**. The ring gear **283** may have a sawtooth shape, in which the outer periphery of the ring gear **283** is engaged with the pinion gear **281**. The ring gear **283** may receive the rotational force from the pinion gear **281** and rotate while having a rotational axis different from a rotational axis of the pinion gear **281**.

When the ring gear **283** rotates, the panel roller **156** may rotate at the same time as the ring gear **283**. Namely, the ring gear **283** and the panel roller **156** may have the same rotation shaft. Hence, the display panel **20** may be rolled or unrolled as the ring gear **283** rotates.

The electronic device **100** according to the embodiment of the disclosure may drive the panel roller **156** by the pinion gear **281** and the ring gear **283**. Hence, when the panel roller **156** is driven, a small noise may be generated, and the display panel **20** may be smoothly rolled and unrolled.

Referring to FIG. **23**, a power button **127** may be positioned on the other side of the housing **30**. The power button **127** may have a disk shape extended toward the z-axis. The power button **127** may contact a pad **347** on a FPCB **326** spaced apart from one side of the panel roller **156**. The pad **347** may contact the power button **127** and carry the electrical signal through the FPCB **326**.

An insertion hole **176**, into which a touch pen **213** is inserted, may be positioned in the housing **300**. The insertion hole **176** may have a shape of digging in the housing **300**. Although not shown, the insertion hole **176** may be overlapped with the rotational axis of the panel roller **156**.

In the electronic device **100** according to the embodiment of the disclosure, the insertion hole **176** may be positioned in the center of the rotation shaft of the panel roller **156**. The insertion hole **176** may not be a barrier to the rotation of the panel roller **156**.

Referring to FIG. **24**, the knob **143** may include a groove **143a** positioned in the center of the knob **143** in the x-axis direction. The groove **143a** may be depressed more inward than other portion of the knob **143**. A depth of the groove **143a** in the y-axis direction may be shorter than a length of the knob **143** in the y-axis direction. Hence, the user can insert his/her fingers into the groove **143a** and can easily pull out the knob **143**.

FIG. **24** illustrates that the groove **143a** is positioned in the center of the knob **143** in the x-axis direction. However, embodiments of the disclosure are not limited thereto. For example, the groove **143a** may be positioned throughout the knob **143** in the x-axis direction. In this instance, the user can insert his/her fingers into the groove **143a** in any direction and can easily pull out the knob **143**.

Referring to FIG. 25, a flat roller 382 and a curling roller 384 may be positioned at an entrance of the display panel 20 inside the housing 30. The flat roller 382 may be positioned inside an end of the window 34. Namely, the flat roller 382 may be disposed at a location at which the window 34 of the housing 30 ends.

The flat roller 382 may be spaced apart from the window 34 by a very short distance. Hence, the display panel 20 guided by the flat roller 382 may be very close to the window 34. A screen displayed on the window 34 may be evenly provided by the flat roller 382. Thus, the user may concentrate more on the screen displayed on the window 34.

The flat roller 382 may guide the display panel 20 so that the display panel 20 maintains a flat shape. Hence, a curling phenomenon of the display panel 20 may be reduced.

The curling roller 384 may be positioned adjacent to the flat roller 382. The curling roller 384 may be spaced apart from the flat roller 382 by a thickness of the display panel 20. The curling roller 384 may guide a surface opposite a surface of the display panel 20 the flat roller 382 guides. For example, when the flat roller 382 guides an inner surface of the display panel 20, the curling roller 384 may guide an outer surface of the display panel 20. Because the flat roller 382 and the curling roller 384 respectively guide the opposite surfaces of the display panel 20, the curling phenomenon when the two rollers are used can be further reduced compared to the curling when only one roller is used.

The curling roller 384 may have a diameter greater than a diameter of the flat roller 382, so as to further prevent the curling phenomenon. However, embodiments of the disclosure are not limited thereto. For example, the diameter of the curling roller 384 may be equal to or less than the diameter of the flat roller 382.

Referring to FIG. 26, a battery 321 may be mounted on the other side inside the housing 30. More specifically, the battery 321 may be mounted at the other end of the panel roller 156. The battery 321 may be coupled with the panel roller 156 and may shield the insertion hole 176 and the touch pen 213.

As described above, because an inner frame of the electronic device 100 according to the embodiment of the disclosure does not rotate, the battery 321 may be stably mounted.

In the electronic device 100 according to the embodiment of the disclosure, the battery 321 may shield the insertion hole 176 and the touch pen 213. Hence, the touch pen 213 may not be easily detached from the other side of the panel roller 156.

Referring to FIG. 27, the knob 143 may include a magnet 425 positioned inside the knob 143. The magnet 425 may include a magnetic material. Further, one surface of the magnet 425 may be covered by the knob 143.

Sheets 423 may be positioned at both ends inside the housing 30. The sheet 423 may be positioned corresponding to the magnet 425 when the knob 143 is coupled to the housing 30. The sheet 423 may include a metal material. Hence, the sheet 423 may be strongly coupled to the magnet 425 using magnetic properties. The sheet 423 may have a semi-circular shape corresponding to a shape of the magnet 425. When the knob 143 is coupled to the housing 30, the magnet 425 may have the shape covering the sheet 423.

A hall sensor 271 may be positioned inside the sheet 423. The hall sensor 271 may be positioned corresponding to the magnet 425 when the knob 143 is coupled to the housing 30. The hall sensor 271 may have a circular shape. The hall sensor 271 may be spaced apart from the sheet 423 and covered by the sheet 423.

The hall sensor 271 may sense a magnetic field of the magnet 425. More specifically, the hall sensor 271 may sense a magnetic field of the magnet 425 adjacent to the hall sensor 271 when the knob 143 is coupled to the housing 30. When the hall sensor 271 senses the magnetic field of the magnet 425, a portion of the display panel 20 corresponding to the window 34 may be activated.

The electronic device 100 according to the embodiment of the disclosure may sense whether or not the knob 143 is coupled to the housing 30, using the hall sensor 271. Hence, the user can watch the display screen through the window 34 in the first state without another operation.

Accordingly, an object of the present disclosure is to address the above-described and other problems.

Another aspect of the present disclosure is to provide an electronic device capable of mounting various electronic parts inside an inner frame.

In one aspect, there is provided an electronic device including a housing, a roller positioned inside the housing, a display panel rollable on the roller, and a guide roller positioned at an edge inside the housing, wherein a state of the display panel with respect to the roller includes a first state in which the display panel is rolled on the roller and a second state in which the display panel is unrolled from the roller.

The guide roller may include first to fourth guide rollers. The first to third guide rollers may guide the display panel in a first rotational direction. The fourth guide roller may guide the display panel in a second rotational direction opposite the first rotational direction.

The fourth guide roller may be spaced apart from the edge by a predetermined distance.

The guide roller may include first to third guide rollers. The first to third guide rollers may guide the display panel in a second rotational direction.

The housing may include a window that is positioned on the housing and is see-through.

A display screen may be displayed on a portion of the display panel inside the housing, and the portion of the display panel may be corresponding to the window.

A display screen displayed on another portion of the display panel exposed to the outside of the housing in the second state may be the same as the display screen displayed on the portion of the display panel corresponding to the window.

A display screen displayed on another portion of the display panel exposed to the outside of the housing in the second state may be different from the display screen displayed on the portion of the display panel corresponding to the window.

A display screen may be displayed on the portion of the display panel corresponding to the window only when the display panel is in the first state.

The electronic device may further include a sub-display panel positioned on an inner surface of the housing at a location corresponding to the window.

The display panel may include a pattern having at least one valley portion and at least one peak portion.

The pattern may include a magnetic material.

The housing may include a hall sensor positioned inside a front surface of the housing. The pattern may have a line connecting the at least one valley portion and the at least one peak portion. The hall sensor may sense the line when the line passes by the hall sensor.

The electronic device may further include a controller configured to generate a control signal. The controller may

activate at least a portion of the display panel in accordance with lines sensed by the hall sensor.

The housing may include a window on the housing, and the window may include a transparent material. The at least a portion of the display panel may be corresponding to the window.

The electronic device may further include a controller configured to generate a control signal. The controller may activate at least a portion of the display panel in accordance with a distance between lines sensed by the hall sensor.

The electronic device may further include a controller configured to generate a control signal. The controller may adjust an aspect ratio of a display screen displayed on the display panel based on a width of the display panel exposed to the outside, so that the display screen is displayed on an exposed portion of the display panel.

Two neighboring valley portions of the pattern among the valley portions of the pattern may be spaced apart from each other by a uniform distance.

At least one of distances between neighboring valley portions may be different from at least one of distances between other neighboring valley portions.

The electronic device may further include a knob positioned on at least one surface of the housing and rolling and unrolling the display panel.

The roller may include an outer frame which rotates when the display panel is rolled on or unrolled from the roller, and an inner frame positioned inside the outer frame and fixed to an inside of the housing regardless of rolling and unrolling the display panel.

At least one printed circuit board may be mounted at an end of the inner frame and positioned in the inner frame.

A battery may be mounted at another end of the inner frame and positioned in the inner frame

The inner frame and the outer frame may be connected to each other through at least one wire.

The inner frame may include a wire hole positioned at a side of the inner frame, and the wire connected from the outer frame may be inserted into the wire hole.

The electronic device may further include a touch pen inserted into the housing. The touch pen may be inserted into an insertion hole depressed to an inside of the inner frame.

A spring may be positioned at one end of the insertion hole and may hold the touch pen.

The inner frame may include a contact terminal protruding toward a surface of the housing, and the contact terminal may be positioned at an end of the inner frame and includes a conductive material.

The contact terminal may contact a flexible printed circuit board attached to an inner surface of the housing and may transfer an electrical signal from the flexible printed circuit board to the inner frame.

The contact terminal may contact a pad on the flexible printed circuit board, and the pad may be positioned at a location corresponding to the contact terminal.

The electronic device may further include a motor assembly positioned in the housing and coupled with the roller.

The motor assembly may include a motor, a pinion gear connected to the motor, and a ring gear having a ring shape including an outer periphery. The pinion gear may have the same shaft as the motor, and the outer periphery of the ring gear may contact the pinion gear.

The pinion gear may have a sawtooth shape, and the pinion gear may be geared in the outer periphery of the ring gear.

The electronic device may further include a knob positioned on at least one surface of the housing, and the knob may be configured to roll and unroll the display panel.

The knob may include a groove formed on a middle portion of the knob.

The housing may include a power button positioned on an outer surface of the housing, a control button positioned on the outer surface of the housing, and plates positioned on an inner surface of the housing at a location corresponding to the power button and the control button, respectively.

The plates may protrude toward the inside of the housing.

The electronic device may further include a sub-display panel positioned on the housing and displaying a display screen.

The housing may include a window that is positioned on the housing and is see-through. A display screen may be displayed on a portion of the display panel, and the portion of the display may be corresponding to the window.

The roller may include a wind spring that is positioned on the roller and applies a torque to the roller.

According to at least one aspect of the present disclosure, the present disclosure can provide an electronic device, in which various electronic parts are mounted inside an inner frame because the inner frame does not rotate regardless of rolling and unrolling a display panel.

Additional features and advantages of the disclosure will be set forth in the description which follows, and in part will be apparent from the description, or may be learned by practice of the disclosure. It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory and are intended to provide further explanation of the disclosure as claimed.

The foregoing embodiments are merely examples and are not to be considered as limiting the present disclosure. The present teachings can be readily applied to other types of methods and apparatuses. The features, structures, methods, and other characteristics of the embodiments described herein may be combined in various ways to obtain additional and/or alternative embodiments.

Although embodiments have been described with reference to a number of illustrative embodiments thereof, it should be understood that numerous other modifications and embodiments can be devised by those skilled in the art that will fall within the scope of the principles of this disclosure. More particularly, various variations and modifications are possible in the component parts and/or arrangements of the subject combination arrangement within the scope of the disclosure, the drawings and the appended claims. In addition to variations and modifications in the component parts and/or arrangements, alternative uses will also be apparent to those skilled in the art.

Any reference in this specification to “one embodiment,” “an embodiment,” “example embodiment,” etc., means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the disclosure. The appearances of such phrases in various places in the specification are not necessarily all referring to the same embodiment. Further, when a particular feature, structure, or characteristic is described in connection with any embodiment, it is submitted that it is within the purview of one skilled in the art to affect such feature, structure, or characteristic in connection with other ones of the embodiments.

Although embodiments have been described with reference to a number of illustrative embodiments thereof, it should be understood that numerous other modifications and embodiments can be devised by those skilled in the art that

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will fall within the spirit and scope of the principles of this disclosure. More particularly, various variations and modifications are possible in the component parts and/or arrangements of the subject combination arrangement within the scope of the disclosure, the drawings and the appended claims. In addition to variations and modifications in the component parts and/or arrangements, alternative uses will also be apparent to those skilled in the art.

What is claimed is:

1. An electronic device comprising:

a housing;

a roller positioned in a central area of the housing;

a display panel to be provided on the roller, the display panel to move between the first state and the second state, the display panel is to overlap with and is rollable on the roller; and

at least one guide roller at an edge in the housing,

wherein when the display panel is in the first state, at least a portion of the display panel is rolled on the roller, and in the second state, at least a portion of the display panel is unrolled from the roller and is exposed to outside of the housing,

wherein a diameter of the roller is greater than a diameter of the at least one guide roller; and

wherein the at least one guide roller includes a first guide roller, a second guide roller, a third guide roller and a fourth guide roller,

wherein the first, second and third guide rollers to guide a first surface of the display panel, and

wherein the fourth guide roller to guide a second surface of the display panel.

2. The electronic device of claim 1, wherein the fourth guide roller is spaced from the edge in the housing by a predetermined distance.

3. An electronic device comprising:

a housing;

a wrapping device in a central area of the housing;

a display panel to be provided on the wrapping device, the display panel to change from a first state to a second state, the display panel is to overlap with and is rollable on the wrapping device; and

a plurality of guide rollers including a first guide roller, a second guide roller, a third guide roller and a fourth guide roller to guide the display panel from the wrapping device to outside of the housing, wherein in the first state, at least a portion of the display panel is wrapped around the wrapping device, and in the second state, at least a portion of the display panel is removed from the wrapping device,

wherein a diameter of the wrapping device is greater than a diameter of each separate one of the guide rollers,

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wherein the first guide roller to contact a first surface of the display panel, and the fourth guide roller to contact a second surface of the display panel,

wherein the first, second and third guide rollers are disposed at first, second and third edges in the housing, and the fourth guide roller is disposed in a vicinity of a fourth edge in which a knob is detachably attached in the housing,

wherein the first and third guide rollers are disposed to face each other centering around the wrapping device in the housing, and

wherein the second and fourth guide rollers are disposed to face each other centering around the wrapping device in the housing.

4. An electronic device comprising:

a housing;

a display panel to move between a first position to a second position, wherein when the display panel is in the second position, a portion of the display panel is external of the housing;

a rotating device, at a central area of the housing, to move the display panel between the first position and the second position, the display panel is to overlap with and is rollable on the rotating device; and

a plurality of guide rollers including a first guide roller, a second guide roller, a third guide roller and a fourth guide roller to guide the display panel such that the portion of the display panel is external to the housing when the display panel is in the second position,

wherein a diameter of the rotating device is greater than a diameter of each separate one of the guide rollers,

wherein the first guide roller to contact a first surface of the display panel, and the fourth guide roller to contact a second surface of the display panel,

wherein the first, second and third guide rollers are disposed at first, second and third edges in the housing, and the fourth guide roller is disposed in a vicinity of a fourth edge in which a knob is detachably attached in the housing,

wherein the first and third guide rollers are disposed to face each other centering around the rotating device in the housing, and

wherein the second and fourth guide rollers are disposed to face each other centering around the rotating device in the housing.

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