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Hinge apparatus including cam structure and electronic device including the same

Abstract

A hinge apparatus according to various embodiments may include: a bracket including a first coupling part formed in a first direction with respect to a middle of the bracket and a second coupling part formed in a second direction opposite to the first direction with respect to the middle of the bracket, a first body part including a first plate, a first rotation part coupled with the first plate fastened to the first coupling part of the bracket and configured to rotate about the bracket, and a first cam formed in the first rotation part, a second body part including a second plate, a second rotation part coupled with the second plate fastened to the second coupling part of the bracket and configured to rotate about the bracket, and a second cam formed in the second rotation part, and a torque provision unit, including a first follower including a first cam part engaged with the first cam structure and disposed in the bracket, a second follower including a second cam part engaged with the second cam structure and disposed in the bracket, and a pressurizing part disposed in the bracket between the first follower and the second follower and configured to provide an elastic force to the first follower and the second follower in opposite directions.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS (1) This application is a continuation of International Application No. PCT/KR2022/007841 designating the United States, filed on Jun. 2, 2022, in the Korean Intellectual Property Receiving Office and claiming priority to Korean Patent Application No. 10-2021-0074676, filed on Jun. 9, 2021, in the Korean Intellectual Property Office, the disclosures of which are incorporated by reference herein in their entireties.

BACKGROUND
Field
(1) The disclosure relates to a hinge apparatus including a cam structure and an electronic device including the hinge apparatus.
Description of Related Art
(2) A hinge apparatus is widely used in the industry as a structure for rotatably connecting an instrument. For example, a hinge structure may be applied to a foldable electronic device.
(3) With the development of a technology for an element included in an electronic device, electronic devices having various forms are being developed. In particular, as a foldable display is developed with the development of a technology for a display visually displaying information, an electronic device having a new concept is emerging.
(4) For example, a foldable electronic device may be implemented by applying a foldable display. As an electronic device having such a new form factor emerges, the need for the development of a technology for an element that rotatably connects a housing of the electronic device is gradually increasing.
(5) In order to increase usability in a folding process of a foldable electronic device, a pause operation and a free stop operation may be necessary. The pause operation may refer to an operation of an electronic device maintaining a corresponding state in the state in which the electronic device has been fully folded or the state in which the electronic device has been fully unfolded. The free stop operation may refer to an operation of an electronic device maintaining a corresponding state when an external force or higher is not applied to the electronic device in a process of the electronic device changing from a folding state to an unfolding state.
(6) In the case of a portable electronic device, it is important to implement the portable electronic device in a compact size. A hinge apparatus included in the electronic device needs to be compactly designed.
SUMMARY
(7) Embodiments of the disclosure may provide a hinge apparatus constructed as a relatively simple structure and implemented in a compact size and capable of implementing a pause operation and free stop operation of an electronic device and an electronic device including the same.
(8) A hinge apparatus according to various example embodiments of the disclosure may include: a bracket including a first coupling part formed in a first direction with respect to the middle of the bracket and a second coupling part formed in a second direction opposite to the first direction with respect to the middle of the bracket, a first body part including a first plate, a first rotation part coupled with the first plate fastened to the first coupling part of the bracket and configured to rotate about the bracket, and a first cam formed in the first rotation part, a second body part including a

second plate, a second rotation part coupled with the second plate fastened to the second coupling part of the bracket and configured to rotate about the bracket, and a second cam formed in the second rotation part, and a torque provision unit, including a first follower including a first cam part engaged with the first cam and disposed in the bracket, a second follower including a second cam part engaged with the second cam and disposed in the bracket, and a pressurizing member disposed in the bracket between the first follower and the second follower and configured to provide an elastic force to the first follower and the second follower in opposite directions.

(9) An electronic device according to various example embodiments of the disclosure may include: a display, a first housing, a second housing, and a hinge rotatably connecting the first housing and the second housing. The hinge may include: a bracket including a first coupling part formed in a first direction with respect to a middle of the bracket and a second coupling part formed in a second direction opposite to the first direction with respect to the middle of the bracket, a first body part including a first plate, a first rotation part coupled with the first plate fastened to the first coupling part of the bracket and configured to rotate about the bracket, and a first cam formed in the first rotation part, a second body part including a second plate, a second rotation part coupled with the second plate fastened to the second coupling part of the bracket and configured to rotate about the bracket, and a second cam formed in the second rotation part, and a torque provision unit, including a first follower including a first cam part engaged with the first cam structure and disposed in the bracket, a second follower including a second cam part engaged with the second cam structure and disposed in the bracket, and a pressurizing member disposed in the bracket between the first follower and the second follower and configured to provide an elastic force the first follower and the second follower in opposite directions.

(10) According to various example embodiments of the disclosure, a loss of torque which may occur in a process of delivering the torque can be reduced because the hinge apparatus having the structure capable of directly providing the torque to a part where the electronic device is rotated is used. An overall size of an electronic device can be compactly designed because the hinge apparatus can be implemented in a relatively compact size. The assembly productivity of the hinge apparatus can be improved, and a unit cost can be reduced.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

(1) In relation to the description of the drawings, the same or similar reference numerals may be used with respect to the same or similar elements. Further, the above and other aspects, features and advantages of certain embodiments of the present disclosure will be more apparent from the following detailed description, taken in conjunction with the accompanying drawings, in which:

(2) FIG. **1**A is a diagram illustrating an unfolding state of a foldable electronic device according to various embodiments;

(3) FIG. **1**B is a diagram illustrating a folding state of the foldable electronic device in FIG. **1**A according to various embodiments;

(4) FIG. **1**C is an exploded perspective view of the electronic device according to various embodiments;

(5) FIG. **2**A is a front view and side view of a hinge apparatus according to various embodiments;

(6) FIG. **2**B is a perspective view of the hinge apparatus according to various embodiments;

(7) FIG. **2**C is an exploded perspective view of the hinge apparatus according to various embodiments;

(8) FIG. **3**A is a front view of a bracket according to various embodiments;

(9) FIG. **3**B is a perspective view illustrating a bracket and a first body part coupled together according to various embodiments;

(10) FIG. **3**C is a perspective view illustrating the state in which the first body part has been partially rotated with respect to the bracket according to various embodiments;
(11) FIGS. **4** and **5** are partial perspective views of a rotation part according to various embodiments;
(12) FIG. **6** is a rear view of the hinge apparatus according to various embodiments;
(13) FIG. **7**A is a perspective view of a bracket and a torque provision unit according to various embodiments;
(14) FIG. **7**B is a cross-sectional view of the bracket and torque provision unit illustrated in FIG. **7**A, which is partially taken along line A-A according to various embodiments;
(15) FIGS. **7**C and **7**D are diagrams illustrating follower guide rails formed in a bracket according to various embodiments;
(16) FIGS. **8**A, **8**B and **8**C are diagrams illustrating contact relations between a cam part and a cam structure according to various embodiments;
(17) FIG. **9** is an exploded perspective view of a bracket and a follower according to various embodiments.

DETAILED DESCRIPTION

(18) It should be appreciated that various example embodiments of the present disclosure and the terms used therein are not intended to limit the technological features set forth herein to particular embodiments and include various changes, equivalents, or replacements for a corresponding embodiment.
(19) With regard to the description of the drawings, similar reference numerals may be used to refer to similar or related elements. It is to be understood that a singular form of a noun corresponding to an item may include one or more of the things, unless the relevant context clearly indicates otherwise.
(20) As used herein, each of such phrases as “A or B,” “at least one of A and B,” “at least one of A or B,” “A, B, or C,” “at least one of A, B, and C,” and “at least one of A, B, or C,” may include any one of, or all possible combinations of the items enumerated together in a corresponding one of the phrases. As used herein, such terms as “1st” and “2nd,” or “first” and “second” may be used to simply distinguish a corresponding component from another, and does not limit the components in other aspect (e.g., importance or order). It is to be understood that if an element (e.g., a first element) is referred to, with or without the term “operatively” or “communicatively”, as “coupled with,” “coupled to,” “connected with,” or “connected to” another element (e.g., a second element), the element may be coupled with the other element directly (e.g., wiredly), wirelessly, or via a third element.
(21) FIG. **1**A is a diagram illustrating an unfolded state of a foldable electronic device according to various embodiments. FIG. **1**B is a diagram illustrating a folded state of the foldable electronic device of FIG. **1**A according to various embodiments.
(22) Referring to FIG. **1**A, an electronic device **100** may include a pair of housing structures **110** and **120** rotatably coupled via a hinge structure (e.g., hinge structure **164** in FIG. **1**C) to be folded relative to each other, a hinge cover **165** covering the foldable portion of the pair of housing structures **110** and **120**, and a display **130** (e.g., flexible display or foldable display) disposed in the space formed by the pair of housing structures **110** and **120**.
(23) In the description, the surface on which the display **130** is disposed may be referred to as the front surface of the electronic device **100**, and the opposite side of the front surface may be referred to as the rear surface of the electronic device **100**.
(24) The surface surrounding the space between the front surface and the rear surface may be referred to as the side surface of the electronic device **100**.
(25) In the description, a facing direction of the front surface may be referred to as a first direction, and a facing direction of the rear surface may be referred to as a second direction.
(26) In the description, regards to explanation to an order of layer (e.g., the layer order of the

display), "B layer formed on A layer" may refer to B layer formed in the first direction to A layer. Or "B layer formed below A layer" may refer to B layer formed in the second direction to A layer.
(27) In an embodiment, the pair of housing structures **110** and **120** may include a first housing structure **110** including a sensor region **131***d*, a second housing structure **120**, a first rear cover **140**, and a second rear cover **150**. The pair of housing structures **110** and **120** of the electronic device **100** are not limited to the shape or combination illustrated in FIGS. **1** and **2**, but may be implemented in various shapes or combinations. For example, in another embodiment, the first housing structure **110** and the first rear cover **140** may be formed as a single body, and the second housing structure **120** and the second rear cover **150** may be formed as a single body.
(28) In an embodiment, the first housing structure **110** and the second housing structure **120** may be disposed at both sides with respect to the folding axis (A) and may be substantially symmetrical with respect to the folding axis (A). In an embodiment, the angle or distance between the first housing structure **110** and the second housing structure **120** may vary depending upon whether the electronic device **100** is in the flat state or closed state, the folded state, or the intermediate state. In an embodiment, the first housing structure **110** includes the sensor region **131***d* where various sensors are disposed, but may have a symmetrical shape with the second housing structure **120** in other regions. In another embodiment, the sensor region **131***d* may be disposed in a specific region of the second housing structure **120** or may be replaced.
(29) In an embodiment, during the flat state of the electronic device **100**, the first housing structure **110** may be connected to the hinge structure (e.g., hinge structure **164** in FIG. **1**C), and may include a first surface **111** facing the front surface of the electronic device **100**, a second surface **112** facing away from the first surface **111**, and a first side member **113** enclosing at least a portion of the space between the first surface **111** and the second surface **112**. In an embodiment, the first side member **113** may include a first side surface **113***a* disposed in parallel with the folding axis (A), a second side surface **113***b* extending from one end of the first side surface **113***a* in a direction perpendicular to the folding axis, and a third side surface **113***c* extending from the other end of the first side surface **113***a* in a direction perpendicular to the folding axis.
(30) In an embodiment, during the flat state of the electronic device **100**, the second housing structure **120** may be connected to the hinge structure (e.g., hinge structure **164** in FIG. **1**C), and may include a third surface **121** facing the front surface of the electronic device **100**, a fourth surface **122** facing away from the third surface **121**, and a second side member **123** enclosing at least a portion of the space between the third surface **121** and the fourth surface **122**. In an embodiment, the second side member **123** may include a fourth side surface **123***a* disposed in parallel with the folding axis (A), a fifth side surface **123***b* extending from one end of the fourth side surface **123***a* in a direction perpendicular to the folding axis, and a sixth side surface **123***c* extending from the other end of the fourth side surface **123***a* in a direction perpendicular to the folding axis. In an embodiment, the third surface **121** may face the first surface **111** in the folded state.
(31) In an embodiment, the electronic device **100** may include a recess **101** formed to accommodate the display **130** through a structural combination of the shapes of the first housing structure **110** and the second housing structure **120**. The recess **101** may have substantially the same size as the display **130**. In an embodiment, the recess **101** may have two or more different widths in a direction perpendicular to the folding axis (A) due to the sensor region **131***d*. For example, the recess **101** may have a first width (W**1**) between a first portion **120***a* of the second housing structure **120** parallel to the folding axis (A) and a first portion **110***a* of the first housing structure **110** formed at the edge of the sensor region **131***d*, and have a second width (W**2**) between a second portion **120***b* of the second housing structure **120** and a second portion **110***b* of the first housing structure **110** that does not correspond to the sensor region **113***d* and is parallel to the folding axis (A). Here, the second width (W**2**) may be wider than the first width (W**1**). In other words, the recess **101** may be formed to have the first width (W**1**) ranging from the first portion

110*a* of the first housing structure **110** to the first portion **120***a* of the second housing structure **120** (asymmetric shape), and the second width (W**2**) ranging from the second portion **110***b* of the first housing structure **110** to the second portion **120***b* of the second housing structure **120** (symmetric shape). In an embodiment, the first portion **110***a* and the second portion **110***b* of the first housing structure **110** may be located at different distances from the folding axis (A). The width of the recess **101** is not limited to the example shown above. In various embodiments, the recess **101** may have two or more different widths owing to the shape of the sensor region **113***d* or the asymmetry of the first housing structure **110** or the second housing structure **120**.

(32) In an embodiment, at least a portion of the first housing structure **110** and the second housing structure **120** may be made of a metal or non-metal material having a rigidity value selected to support the display **130**.

(33) In an embodiment, the sensor region **131***d* may be formed to have a preset area near to one corner of the first housing structure **110**. However, the arrangement, shape, or size of the sensor region **131***d* is not limited to the illustrated example. For example, in a certain embodiment, the sensor region **131***d* may be formed at another corner of the first housing structure **110** or in any region between the upper corner and the lower corner. In another embodiment, the sensor region **131***d* may be disposed at a portion of the second housing structure **120**. In another embodiment, the sensor region **131***d* may be formed to extend between the first housing structure **110** and the second housing structure **120**. In an embodiment, to perform various functions, the electronic device **100** may include components exposed to the front surface of the electronic device **100** through the sensor region **113***d* or through one or more openings provided in the sensor region **131***d*. The components may include, for example, at least one of a front camera, a receiver, a proximity sensor, an illuminance sensor, an iris recognition sensor, an ultrasonic sensor, or an indicator.

(34) In an embodiment, the first rear cover **140** may be disposed on the second surface **112** of the first housing structure **110** and may have a substantially rectangular periphery. In an embodiment, at least a portion of the periphery may be wrapped by the first housing structure **110**. Similarly, the second rear cover **150** may be disposed on the fourth surface **122** of the second housing structure **120**, and at least a portion of the periphery thereof may be wrapped by the second housing structure **120**.

(35) In the illustrated embodiment, the first rear cover **140** and the second rear cover **150** may have a substantially symmetrical shape with respect to the folding axis (A). In another embodiment, the first rear cover **140** and the second rear cover **150** may have various different shapes. In another embodiment, the first rear cover **140** may be formed as a single body with the first housing structure **110**, and the second rear cover **150** may be formed as a single body with the second housing structure **120**.

(36) In an embodiment, the first rear cover **140**, the second rear cover **150**, the first housing structure **110**, and the second housing structure **120** may be combined with each other so as to provide a space where various components (e.g., printed circuit board, antenna module, sensor module, and battery) of the electronic device **100** can be arranged. In an embodiment, one or more components may be disposed on or visually exposed via the rear surface of the electronic device **100**. For example, one or more components or sensors may be visually exposed through the first rear region **141** of the first rear cover **140**. The sensors may include a proximity sensor, a rear camera, and/or a flash. In another embodiment, at least a portion of the sub-display **152** may be visually exposed through the second rear region **151** of the second rear cover **150**.

(37) The display **130** may be disposed on the space formed by the pair of housing structures **110** and **120**. For example, the display **130** may be seated in the recess (e.g., recess **101** in FIG. **1**A) formed by the pair of housing structures **110** and **120**, and may be disposed to substantially occupy most of the front surface of the electronic device **100**. Hence, the front surface of the electronic device **100** may include the display **130**, a portion (e.g., edge region) of the first housing structure **110** close to the display **130**, and a portion (e.g. edge region) of the second housing structure **120**

close to the display **130**. In an embodiment, the rear surface of the electronic device **100** may include the first rear cover **140**, a portion (e.g., edge region) of the first housing structure **110** close to the first rear cover **140**, the second rear cover **150**, and a portion (e.g. edge region) of the second housing structure **120** close to the second rear cover **150**.

(38) In an embodiment, the display **130** may refer to a display in which at least a portion may be deformed into a flat or curved surface. In an embodiment, the display **130** may include a folding region **131***c*, a first region **131***a* disposed on one side (e.g., right side of the folding region **131***c*) with respect to the folding region **131***c*, and a second region **131***b* disposed on the other side (e.g., left side of the folding region **131***c*). For example, the first region **131***a* may be disposed on the first surface **111** of the first housing structure **110**, and the second region **131***b* may be disposed on the third surface **121** of the second housing structure **120**. This demarcation of the display **130** is only an example, and the display **130** may be subdivided into plural regions (e.g., four or more regions) according to the structure or functionality. For example, in the embodiment of FIG. **1**A, the area of the display **130** may be subdivided with respect to the folding region **131***c* or the folding axis (A) extending parallel to the y-axis. However, in another embodiment, the area of the display **130** may be subdivided with respect to a different folding region (e.g., folding region parallel to the x-axis) or a different folding axis (e.g., folding axis parallel to the x-axis). The aforementioned subdivision of the display is only a physical demarcation based on the pair of housing structures **110** and **120** and the hinge structure (e.g., hinge structure **164** in FIG. **1**C), and the display **130** may substantially present one full screen through the pair of housing structures **110** and **120** and the hinge structure (e.g., hinge structure **164** in FIG. **1**C). In an embodiment, the first region **131***a* and the second region **131***b* may have a symmetrical shape with respect to the folding region **131***c*. Although the first region **131***a* may include a notch region (e.g., notch region **133** in FIG. **1**C) cut according to the presence of the sensor region **131***d*, the first region **131***a* may have a symmetrical shape with the second region **131***b* in other portions. In other words, the first region **131***a* and the second region **131***b* may include portions with symmetrical shapes and portions with asymmetrical shapes.

(39) FIG. **1**B is a diagram illustrating a folded state of the electronic device of FIG. **1**A according to an embodiment of the disclosure.

(40) Referring to FIG. **1**B, the hinge cover **165** may be disposed between the first housing structure **110** and the second housing structure **120** so as to cover the internal components (e.g., hinge structure **164** in FIG. **1**C). In an embodiment, the hinge cover **165** may be covered by portions of the first housing structure **110** and the second housing structure **120** or be exposed to the outside according to the operating state (e.g., flat state or folded state) of the electronic device **100**.

(41) For example, when the electronic device **100** is in the flat state as illustrated in FIG. **1**A, the hinge cover **165** may be covered by the first housing structure **110** and the second housing structure **120** so as not to be exposed. When the electronic device **100** is in the folded state (e.g., completely folded state) as illustrated in FIG. **1**B, the hinge cover **165** may be exposed to the outside between the first housing structure **110** and the second housing structure **120**. When the electronic device **100** is in the intermediate state where the first housing structure **110** and the second housing structure **120** make a certain angle, the hinge cover **165** may be partially exposed to the outside between the first housing structure **110** and the second housing structure **120**. In this case, the exposed portion may be less than that for the fully folded state. In an embodiment, the hinge cover **165** may include a curved surface.

(42) Next, a description is given of configurations of the first housing structure **110** and the second housing structure **120** and regions of the display **130** according to the operating state (e.g. flat state or folded state) of the electronic device **100**.

(43) In an embodiment, when the electronic device **100** is in the flat state (e.g., state of FIG. **1**A), the first housing structure **110** and the second housing structure **120** may make an angle of 180 degrees, and the first region **131***a* and the second region **131***b* of the display may be disposed to face in the same direction. In addition, the folding region **131***c* may be coplanar with the first

region **131***a* and the second region **131***b*.
(44) In an embodiment, when the electronic device **100** is in the folded state (e.g., state of FIG. **1**B), the first housing structure **110** and the second housing structure **120** may be disposed to face each other. The first region **131***a* and the second region **131***b* of the display **130** may face each other, making a narrow angle (e.g., between 0 degrees and 10 degrees). At least a portion of the folding region **131***c* may form a curved surface with a preset curvature.
(45) In an embodiment, when the electronic device **100** is in the intermediate state, the first housing structure **110** and the second housing structure **120** may be disposed to make a certain angle. The first region **131***a* and the second region **131***b* of the display **130** may form an angle greater than that for the folded state and less than that for the flat state. At least a portion of the folding region **131***c* may form a curved surface with a preset curvature. This curvature may be less than that for the folded state.
(46) FIG. **1**C is an exploded perspective view of an electronic device according to various embodiments.
(47) Referring to FIG. **1**C, in an embodiment, the electronic device **100** may include a display **130**, a support member assembly **160**, at least one printed circuit board **170**, a first housing structure **110**, a second housing structure **120**, a first rear cover **140**, and a second rear cover **150**. In the description, the display **130** may be referred to as a display unit, display module, or display assembly.
(48) The display **130** may include a display panel **131** (e.g., flexible display panel), and at least one plate **132** or layer on which the display panel **131** is seated. In an embodiment, one or more plates **132** may include a conductive plate (e.g., Cu sheet or SUS sheet) disposed between the display panel **131** and the support member assembly **160**. According to an embodiment, the conductive plate may be formed to have substantially the same area as that of the display, and an area facing a folding area of the display may be formed to be bendable. The plate **132** may include at least one subsidiary material layer (e.g., graphite member) disposed at a rear surface of the display panel **131**. In an embodiment, the plate **132** may be formed in a shape corresponding to the display panel **131**. For example, a partial area of the first plate **132** may be formed in a shape corresponding to the notch area **133** of the display panel **131**.
(49) The support member assembly **160** may include a first support member **161**, a second support member **162**, a hinge structure **164** disposed between the first support member **161** and the second support member **162**, a hinge cover **165** to cover the hinge structure **164** when viewed from the outside, and a wiring member **163** (e.g., flexible printed circuit board (FPCB)) that crosses the first support member **161** and the second support member **162**.
(50) In an embodiment, the support member assembly **160** may be disposed between the plate **132** and at least one printed circuit board **170**. For example, the first support member **161** may be disposed between the first region **131***a* of the display **130** and the first printed circuit board **171**. The second support member **162** may be disposed between the second region **131***b* of the display **130** and the second printed circuit board **172**.
(51) In an embodiment, at least a portion of the wiring member **163** and the hinge structure **164** may be disposed within the support member assembly **160**. The wiring member **163** may be disposed in a direction crossing the first support member **161** and the second support member **162** (e.g., x-axis direction). The wiring member **163** may be disposed in a direction (e.g., x-axis direction) perpendicular to the folding axis (e.g., y-axis or folding axis (A) in FIG. **1**B) of the folding region **131***c*.
(52) The at least one printed circuit board **170** may include, as described above, the first printed circuit board **171** disposed on the side of the first support member **161**, and the second printed circuit board **172** disposed on the side of the second support member **162**. The first printed circuit board **171** and the second printed circuit board **172** may be disposed inside the space formed by the support member assembly **160**, the first housing structure **110**, the second housing structure **120**,

the first rear cover **140**, and the second rear cover **150**. Various components for implementing functions of the electronic device **100** may be mounted on the first printed circuit board **171** and the second printed circuit board **172**.

(53) In an embodiment, a first space of the first housing structure **110** may include a first printed circuit board **171** disposed in a space formed through the first support member **161**, a first battery **191** disposed at a position facing a first swelling hole **1611** of the first support member **161**, at least one sensor module **181**, or at least one camera module **182**. The first housing structure **110** may include a window glass **183** disposed to protect at least one sensor module **181** and at least one camera module **182** at a position corresponding to the notch area **133** of the display **130**. In an embodiment, the second space of the second housing structure **120** may include a second printed circuit board **172** disposed in a second space formed through the second support member **162** and a second battery **192** disposed at a position facing the second swelling hole **1621** of the second support member **162**. According to an embodiment, the first housing structure **110** and the first support member **161** may be integrally formed. According to an embodiment, the second housing structure **120** and the second support member **162** may also be integrally formed. According to an embodiment, a sub display **152** may be disposed in the second space of the second housing structure **120**. According to an embodiment, the sub display **152** (e.g., the second display) may be disposed to be visible from the outside through at least a partial area of the second rear cover **150**.

(54) In an embodiment, the first housing structure **110** may include a first rotary support surface **114**, and the second housing structure **120** may include a second rotary support surface **124** corresponding to the first rotary support surface **114**. The first rotary support surface **114** and the second rotary support surface **124** may include a curved surface corresponding to the curved surface included in the hinge cover **165**.

(55) In an embodiment, when the electronic device **100** is in the flat state (e.g., state of FIG. **1**A), the first rotary support surface **114** and the second rotary support surface **124** may cover the hinge cover **165** so that the hinge cover **165** may be not or minimally exposed to the rear surface of the electronic device **100**. When the electronic device **100** is in the folded state (e.g., state of FIG. **1**B), the first rotary support surface **114** and the second rotary support surface **124** may rotate along the curved surface included in the hinge cover **165** so that the hinge cover **165** may be maximally exposed to the rear surface of the electronic device **100**.

(56) FIG. **2**A is a front view and side view of a hinge apparatus according to various embodiments. Referring to FIG. **2**A (a) is a front view of the hinge apparatus, and (b) and (c) of FIG. **2**A are side views of the hinge apparatus. FIG. **2**B is a perspective view of the hinge apparatus according to various embodiments. FIG. **2**C is an exploded perspective view of the hinge apparatus according to various embodiments In the following description, the same or similar elements are described using the same reference numerals.

(57) A hinge apparatus **200** described hereinafter may be included in the electronic device **100** described with reference to FIGS. **1**A, **1**B and **1**C. For example, the hinge apparatus **200** may be included in the hinge **164** in FIG. **1**C. The hinge apparatus **200** may be installed between a first housing (e.g., the first housing **110** in FIG. **1**A) and second housing (e.g., the second housing **120** in FIG. **1**A) of the electronic device, and may rotatably connect the first housing and the second housing. For example, a state of the electronic device may change into a folding state (e.g., the state illustrated in FIG. **1**B), the intermediate state, or an unfolding state (e.g., the state illustrated in FIG. **1**A) depending on a degree that the first housing and the second housing are rotated by the hinge apparatus **200**. FIG. **1**A illustrates by way of non-limiting example the electronic device that is folded using a length direction (e.g., the axis A in FIG. **1**A) as an axis, but the hinge apparatus **200** may be used for a folding operation of an electronic device that is folded using a width direction perpendicular to the length direction as an axis. In addition, the hinge apparatus **200** may be used in various electronic devices in which an instrument installed in a way to be relatively rotated is used.

(58) With reference to FIGS. **2**A, **2**B and **2**C, the hinge apparatus **200** may include a bracket **210**, a

first body part **220** and a second body part **230**, a torque provision unit **240**, a first arm **250** and a second arm **260** and an interlocking member **270**. The aforementioned elements of the hinge apparatus **200** are merely examples. At least one of the aforementioned elements may be omitted if necessary, and the hinge apparatus **200** may be constructed by adding another element. For example, the first arm **250**, the second arm **260** and the interlocking member **270** may be omitted if necessary. With reference to FIG. **5**, a hinge apparatus **201**, including the first arm **250**, the second arm **260** and the interlocking member **270**, and a hinge apparatus **202**, not including the first arm **250**, the second arm **260** and the interlocking member **270**, may be mixed and installed in the hinge of the electronic device.

(59) In an embodiment, the bracket **210** may be a body of the hinge apparatus **200** by which elements of the hinge apparatus **200** may be mutually coupled together. The elements of the hinge apparatus **200** may be disposed centering around the bracket **210** and may be mutually coupled together or installed in a way to be interlocked. The first body part **220** and the second body part **230** may be rotated and the first arm **250** and the second arm **260** may be rotated around the middle of the bracket **210**. A central axis K of the bracket **210** may be a rotation axis of the electronic device by the hinge apparatus **200**. Accordingly, the bracket **210** may be disposed in the electronic device so that the central axis K of the bracket **210** and a rotation axis (e.g., the axis A in FIG. **1**A) of the electronic device are identical with each other. The bracket **210** may be formed using various materials. For example, the bracket **210** may be formed using a metal material or a synthetic resin material. The bracket **210** may be formed using a very strong material in a way to stably support various elements of the hinge apparatus **200**.

(60) With reference to FIG. **2**C, the bracket **210** may include a first coupling part **211** and a second coupling part **212** (refer to FIG. **3**A). The first coupling part **211** may be a part fastened to a first rotation part **222** of the first body part **220**. The second coupling part **212** may be a part fastened to a second rotation part **233** of the second body part **230**. The first rotation part **222** may be fastened to the first coupling part **211** so that the first rotation part **222** is rotatable around the bracket **210**. The second rotation part **233** may be fastened to the second coupling part **212** so that the second rotation part **233** is rotatable around the bracket **210**.

(61) With reference to FIG. **2**C, the bracket **210** may include a third coupling part **213** and a fourth coupling part **214**. The third coupling part **213** may be a part fastened to a third rotation part **223** of the first body part **220**. The fourth coupling part **214** may be a part fastened to a fourth rotation part **232** of the second body. The third rotation part **223** may be fastened to the third coupling part **213** so that the third rotation part **223** is rotatable around the bracket **210**. The fourth rotation part **232** may be fastened to the fourth coupling part **214** so that the fourth rotation part **232** is rotatable around the bracket **210**.

(62) Hereinafter, reference is also made to FIGS. **3**A, **3**B and **3**C in descriptions of coupling parts (e.g., the first coupling part, the second coupling part, the third coupling part and the fourth coupling part) and rotation parts (e.g., the first rotation part, the second rotation part, the third rotation part and the fourth rotation part).

(63) FIG. **3**A is a front view of a bracket according to various embodiments. FIG. **3**B is a diagram illustrating a shape in which the bracket and the first body part are coupled together according to various embodiments. FIG. **3**C is a diagram illustrating the state in which the first body part has been partially rotated with respect to the bracket according to various embodiments.

(64) With reference to FIG. **3**A, the first coupling part **211** may include a first opening **211-1** and a first rotation guide **211-2**. The first opening **211-1** may be formed in the bracket **210**. The first rotation guide **211-2** may be a part protruded and formed toward the first opening **211-1**. The first rotation guide **211-2** may be inserted into a first rotation rail (e.g., a first rotation rail **222-1** in FIG. **4**) formed in the first rotation part **222**. The first rotation guide **211-2** and the first rotation rail may be formed in a form corresponding to each other. The first rotation guide **211-2** and the first rotation rail may have their cross section formed in a circle. As illustrated in FIGS. **3**B and **3**C, in

the state in which the first rotation guide **211-2** of the first coupling part **211** has been inserted into the first rotation rail of the first rotation part **222**, the first rotation part **222** may rotate around the bracket **210**. A center C.sub.A of the first rotation guide **211-2** and the first rotation rail may be a rotation center of the first rotation part **222** rotating around the bracket **210**.

(65) For example, the second coupling part **212** may include a second opening **212-1** and a second rotation guide **212-2**. The second opening **212-1** may be formed in the bracket **210**. The second rotation guide **212-2** may be a part protruded and formed toward the second opening **212-1**. The second rotation guide **212-2** may be inserted into a second rotation rail formed in the second rotation part **233**. Although not illustrated, the second rotation rail may be understood as an element similar to a first rotation rail (e.g., the first rotation rail **222-1** in FIG. **4**). The second rotation guide **212-2** and the second rotation rail may be formed in a form corresponding to each other. The second rotation guide **212-2** and the second rotation rail may have their cross section formed in a circle. In the state in which the second rotation guide **212-2** of the second coupling part **212** has been inserted into the second rotation rail of the second rotation part **233**, the second rotation part **233** may rotate around the bracket **210**. A center C.sub.D of the second rotation guide **212-2** and the second rotation rail may be a rotation center of the second rotation part **233** around the bracket **210**.

(66) For example, the third coupling part **213** may include a third opening **213-1** and a third rotation guide **213-2**. The third opening **213-1** may be formed in the bracket **210**. The third rotation guide **213-2** may be a part protruded and formed toward the third opening **213-1**. The third rotation guide **213-2** may be inserted into a third rotation rail (e.g., the third rotation rail **223-1** in FIG. **2**C) formed in the third rotation part **223**. The third rotation guide **213-2** and the third rotation rail may be formed in a form corresponding to each other. The third rotation guide **213-2** and the third rotation rail may have their cross sections formed in a circle. As illustrated in FIGS. **3**B and **3**C, in the state in which the third rotation guide **213-2** of the third coupling part **213** has been inserted into the third rotation rail of the third rotation part **223**, the third rotation part **223** may rotate around the bracket **210**. A center C.sub.C of the third rotation guide **213-2** and the third rotation rail may be a rotation center of the third rotation part **223** rotating around the bracket **210**.

(67) For example, the fourth coupling part **214** may include a fourth opening **214-1** and a fourth rotation guide **214-2**. The fourth opening **214-1** may be formed in the bracket **210**. The fourth rotation guide **214-2** may be a part protruded and formed toward the fourth opening **214-1**. The fourth rotation guide **214-2** may be inserted into a fourth rotation rail formed in the fourth rotation part **232**. Although not illustrated, the fourth rotation rail may be understood as an element similar to a first rotation rail (e.g., the first rotation rail **222-1** in FIG. **4**). The fourth rotation guide **214-2** and the fourth rotation rail may be formed in a form corresponding to each other. The fourth rotation guide **214-2** and the fourth rotation rail may have their cross sections formed in a circle. In the state in which the fourth rotation guide **214-2** of the fourth coupling part **214** has been inserted into the fourth rotation rail of the fourth rotation part **232**, the fourth rotation part **232** may rotate around the bracket **210**. A center C.sub.B of the fourth rotation guide **214-2** and the fourth rotation rail may be a rotation center of the fourth rotation part **232** around the bracket **210**.

(68) In an embodiment, the first coupling part **211** and the second coupling part **212** may be formed at different locations with respect to a middle M of the bracket **210**. With reference to FIG. **3**A, the first coupling part **211** may be formed in a first direction (e.g., a −Y direction in FIG. **3**A) with respect to the middle M of the bracket **210**. The second coupling part **212** may be formed in a second direction (e.g., a +Y direction in FIG. **3**A) with respect to the middle M of the bracket **210**. The first rotation part **222** fastened to the first coupling part **211** and the second rotation part **233** fastened to the second coupling part **212** may be disposed at different locations with respect to the middle of the bracket **210** depending on locations where the first coupling part **211** and the second coupling part **212** are formed.

(69) In an embodiment, the third coupling part **213** and the fourth coupling part **214** may be formed

at different locations with respect to the middle M of the bracket **210**. With reference to FIG. **3**A, the third coupling part **213** may be formed in the second direction (e.g., the +Y direction in FIG. **3**A) with respect to the middle M of the bracket **210**. The fourth coupling part **214** may be formed in the first direction (e.g., the −Y direction in FIG. **3**A) with respect to the middle M of the bracket **210**. The third rotation part **223** fastened to the third coupling part **213** and the fourth rotation part **232** fastened to the fourth coupling part **214** may be disposed at different locations with respect to the middle M of the bracket **210** depending on locations where the third coupling part **213** and the fourth coupling part **214** are formed.

(70) With reference to FIG. **3**A, a distance L**1** from the middle M of the bracket **210** to the first coupling part **211** and a distance L**3** from the middle M of the bracket **210** to the third coupling part **213** may be different from each other. For example, the distance L**1** from the middle M of the bracket **210** to the first coupling part **211** may be longer than the distance L**3** from the middle M of the bracket **210** to the third coupling part **213**. A distance L**4** from the middle M of the bracket **210** to the fourth coupling part **214** and a distance L**2** from the middle M of the bracket **210** to the second coupling part **212** may be different from each other. For example, the distance L**2** from the middle M of the bracket **210** to the second coupling part **212** may be longer than the distance L**4** from the middle M of the bracket **210** to the fourth coupling part **214**. In an embodiment, the first coupling part **211**, the second coupling part **212**, the third coupling part **213** and the fourth coupling part **214** may be disposed symmetrically with respect to the middle M of the bracket **210**. For example, the distance L**1** from the middle M of the bracket **210** to the first coupling part **211** and the distance L**2** from the middle M of the bracket **210** to the second coupling part **212** may be the same. The distance L**3** from the middle M of the bracket **210** to the third coupling part **213** and the distance L**4** from the middle M of the bracket **210** to the fourth coupling part **214** may be the same.

(71) In an embodiment, the first body part **220** and the second body part **230** may be installed in the bracket **210** in a way to be rotatable around the bracket **210**. With reference to FIG. **2**C, the first body part **220** may be disposed in a third direction (e.g., a +X direction in FIG. **2**C) with respect to the bracket **210**. The second body part **230** may be disposed in a fourth direction (e.g., a −X direction in FIG. **2**C) with respect to the bracket **210**. The first body part **220** may include a first plate **221**, the first rotation part **222** and the third rotation part **223**. The second body part **230** may include a second plate **231**, the second rotation part **233** and the fourth rotation part **232**.

(72) In an embodiment, the first plate **221** and the second plate **231** may support a display (e.g., the display **130** in FIG. **1**A). The display may include a first area (e.g., the first area **131***a* in FIG. **1**A), a second area (e.g., the second area **131***b* in FIG. **1**A) and a third area (e.g., the folding area **131***c* in FIG. **1**A) between the first area and the second area. The first area, the second area and the third area may be conceptually divided from an area of the display for description, and may not be visually divided areas. The first plate **221** may support the first area of the display of the electronic device. The second plate **231** may support the second area of the electronic device. As the first plate **221** and the second plate **231** are rotated around the bracket **210**, the first area and second area of the display may also rotate around the bracket **210**. When the first area and second area of the display are rotated, the first area and the second area may be bent with respect to the third area.

(73) In an embodiment, the first rotation part **222** and the third rotation part **223** may be coupled with the first plate **221**. The first rotation part **222**, the third rotation part **223** and the first plate **221** may be moved together. For example, the first rotation part **222** and the third rotation part **223** may be integrated and formed with the first plate **221**. The first rotation part **222** and the third rotation part **223** may be coupled with the first plate **221** in various coupling ways (e.g., bolt coupling, rivet coupling, adhesion coupling, or welding coupling). The second rotation part **233** and the fourth rotation part **232** may be coupled with the second plate **231**. The second rotation part **233**, the fourth rotation part **232** and the second plate **231** may be moved together. For example, the second rotation part **233** and the fourth rotation part **232** may be integrated and formed with the second plate **231**. The second rotation part **233** and the fourth rotation part **232** may be coupled with the

second plate **231** in various coupling ways (e.g., bolt coupling, rivet coupling, adhesion coupling, or welding coupling).

(74) As illustrated in FIGS. **3**B and **3**C, as the first rotation part **222** and the third rotation part **223** are installed in a way to be rotatable around the bracket **210**, the first plate **221** may rotate around the bracket **210**. As the second rotation part **233** and fourth rotation part **232** of the second body part **230** are installed in a way to be rotatable around the bracket **210**, the second plate **231** may rotate around the bracket **210**.

(75) The rotation of the first plate **221** around the bracket **210** may be performed using the center C.sub.A of the first rotation guide **211**-**2** with which the first rotation part **222** is coupled and the center C.sub.C of the third rotation guide **213**-**2** with which the third rotation part **223** is coupled as their rotation centers. The center C.sub.A of the first rotation guide **211**-**2** may be understood as the rotation center of the first rotation part **222**. The center C.sub.C of the third rotation guide **213**-**2** may be understood as the rotation center of the third rotation part **223**. In an embodiment, the rotation center C.sub.A of the first rotation part **222** and the rotation center C.sub.C of the third rotation part **223** may pass through the same straight line C**1**, and may be parallel to a rotation axis (e.g., the axis A in FIG. **1**A) of the electronic device. The rotation center C.sub.A of the first rotation part **222** and the rotation center C.sub.C of the third rotation part **223** may pass through the rotation axis C**1** of the first body part **220** around the bracket **210**. The rotation axis of the first body part **220** is hereinafter referred to as a first rotation axis C**1**.

(76) The rotation of the second plate **231** around the bracket **210** may be performed using the center C.sub.B of the second rotation guide **212**-**2** with which the second rotation part **233** is coupled and the center C.sub.D of the fourth rotation guide **214**-**2** with which the fourth rotation part **232** is coupled as rotation centers. The center C.sub.B of the second rotation guide **212**-**2** may be understood as the rotation center of the second rotation part **233**. The center C.sub.D of the fourth rotation guide **214**-**2** may be understood as the rotation center of the fourth rotation part **232**. In an embodiment, the rotation center C.sub.B of the second rotation part **233** and the rotation center C.sub.D of the fourth rotation part **232** may pass through the same straight line, and may be parallel to the rotation axis of the electronic device. The rotation center C.sub.B of the second rotation part **233** and the rotation center C.sub.D of the fourth rotation part **232** may be a rotation axis C**2** of the second body part **230** around the bracket **210**. The rotation axis C**2** of the second body part **230** may be hereinafter referred to as a second rotation axis C**2**.

(77) In an embodiment, the torque provision unit **240** may include a first follower **242**, a second follower **243** and a pressurizing member **241**.

(78) With reference to FIGS. **2**A, **2**B and **2**C, the pressurizing member **241** may be disposed in the bracket **210** between the first follower **242** and the second follower **243**. The pressurizing member **241** may pressurize the first follower **242** and the second follower **243** in opposite directions. The pressurizing member **241** may include an elastic member such as a spring. The first follower **242** may be closely attached to the first rotation part **222** and the fourth rotation part **232** by being pressurized by the pressurizing member **241**. The second follower **243** may be closely attached to the second rotation part **233** and the third rotation part **223** by being pressurized by the pressurizing member **241**. The first follower **242** may include a first cam part **421** and a fourth cam part **424**. The second follower **243** may include a second cam part **422** and a third cam part **423**. They are described in detail later.

(79) In an embodiment, the torque provision unit **240** may include two shafts **244** rotatably installed in the bracket **210**. The two shafts **244** may be installed in the bracket **210**. The first follower **242** and the second follower **243** may be installed at both ends of the shafts **244**, respectively. The pressurizing member **241** may be inserted into each of the shafts **244**. The pressurizing member **241** may be a spring, for example. With reference to FIGS. **2**A, **2**B and **2**C, the pressurizing members **241** inserted into the shafts **244** may be compressed against the first follower **242** and the second follower **243** installed at both ends of the shafts **244**. The pressurizing

members **241** inserted into the shafts **244** in the compressed state may pressurize the first follower **242** and the second follower **243** in opposite directions.

(80) In an embodiment, the torque provision unit **240** may be fixed and installed in the bracket by a fixing part **245**.

(81) In an embodiment, the first arm **250** may be rotatably installed in the bracket **210**. With reference to FIG. **2**C, the first arm **250** may be rotatably installed in the bracket **210** through a first shaft **310** inserted into the bracket **210**. The first shaft **310** may be a rotation axis of the first arm **250**. The first arm **250** may be connected to the first body part **220**. The first arm **250** may be connected to the first body part **220** through a first pin **330**. The second arm **260** may be rotatably installed in the bracket **210**. With reference to FIGS. **2**A and **2**C, the second arm **260** may be rotatably installed in the bracket **210** through a second shaft **320** inserted into the bracket **210**. The second shaft **320** may be a rotation axis of the second arm **260**. The second arm **260** may be connected to the second body part **230**. The second arm **260** may be connected to the second body part **230** through a second pin **340**.

(82) In an embodiment, the interlocking member **270** may interlock the rotation of the first arm **250** and the second arm **260** around the bracket **210**. The first arm **250** and the second arm **260** may rotate around the bracket **210** by being interlocked by the interlocking member **270**. The first arm **250** and the second arm **260** may be interlocked by the interlocking member **270** in a way to be rotated in opposite directions. The first arm **250** and the second arm **260** may be rotated together in a direction in which the electronic device is unfolded or folded. The interlocking member **270** may include a plurality of gears as illustrated in FIG. **2**C, for example. The plurality of gears included in the interlocking member **270** may be an even number so that the first arm **250** and the second arm **260** are interlocked and rotated in opposite directions. Some of the plurality of gears may be inserted into the first shaft **310** and the second shaft **320**. In an embodiment, the interlocking member **270** may include an interlocking body **280**. The interlocking body **280** may be inserted into the first shaft **310** and the second shaft **320**. With reference to FIG. **2**C, the gears of the interlocking member **270**—the first arm **250**—the interlocking body **280** may be inserted into the first shaft **310**. A fixing member **301** fitted into the end of the first shaft **310** may enable elements inserted into the first shaft **310** to maintain the state in which the elements have been inserted into the first shaft **310**. The gears of the interlocking member **270**, the second arm **260**, the interlocking body **280** may be inserted into the second shaft **320**. The fixing member **301** fitted into the end of the second shaft **320** may enable elements inserted into the second shaft **320** to maintain the state in which the elements have been inserted into the second shaft **320**.

(83) In an embodiment, the first arm **250** and the first body part **220** may be connected by the first pin **330**. The first arm **250** and the first body part **220** connected to the first pin **330** may be rotated together around the bracket **210**. The rotation axis (the first shaft **310**) of the first arm **250** and the rotation axis (the first rotation axis C**1**) of the first body part **220** may be disposed at different locations. For this reason, rotation tracks of the first arm **250** and the first body part **220** may be different from each other. In order to compensate for such a difference, the first pin **330** may be inserted into a first compensation rail **224** formed in the first body part **220**. The first compensation rail **224** may be formed in one direction (e.g., the X axis direction in FIG. **2**C) of the first body part **220**. In a process of the first arm **250** and the first body part **220** rotating, the first pin **330** may move along the first compensation rail **224**. The second arm **260** and the second body part **230** may be connected by the second pin **340**. The second arm **260** and the second body part **230** connected to the second pin **340** may be rotated around the bracket **210**. The rotation axis (the second shaft **320**) of the second arm **260** and the rotation axis (the second rotation axis C**2**) of the second body part **230** may be disposed at different locations. For this reason, rotation tracks of the second arm **260** and the second body part **230** may be different from each other. In order to compensate for such a difference, the second pin **340** may be inserted into a second compensation rail **234** formed in the second body part **230**. The second compensation rail **234** may be formed in one direction

(e.g., the X axis direction in FIG. **2**C) of the second body part **230**. In a process of the second arm **260** and the second body part **230** rotating, the second pin **340** may move along the second compensation rail **234**. Since the first arm **250** and the first body part **220** are connected and rotated together and the second arm **260** and the second body part **230** are connected and rotated together, the rotations of the first body part **220** and the second body part **230** may also be interlocked by the interlocking member **270** that interlocks the first arm **250** and the second arm **260**. The interlocking member **270** may interlock the rotations of the first body part **220** and the second body part **230** so that the first body part **220** and the second body part **230** are rotated in opposite directions. With reference to FIG. **2**C, since the fixing members **301** are fitted into the ends of the first pin **330** and the second pin **340**, respectively, the first body part **220** and the first arm **250** can maintain the state in which they have been inserted into the first pin **330**, and the second body part **230** and the second arm **260** can maintain the state in which they have been inserted into the second pin **340**.

(84) In the above description, the first body part **220** has been described as including the first rotation part **222** and the third rotation part **223** and the second body part **230** has been described as including the second rotation part **232** and the fourth rotation part **233**, but the first body part **220** may include only the first rotation part **222** and the second body part **230** may include only the second rotation part **232**. In this case, an element (e.g., the third coupling part **213**, the third cam part **423**) corresponding to the third rotation part **223** may be omitted. An element (e.g., the fourth coupling part **214**, the fourth cam part **424**) corresponding to the fourth rotation part **233** may be omitted.

(85) FIGS. **4** and **5** are perspective views of a rotation part according to various embodiments.

(86) Hereinafter, a rotation part **222** (e.g., the first rotation part **222**, the second rotation part **232**, the third rotation part **223** and the fourth rotation part **233**) is described with reference to FIGS. **4** and **5**. In the following description, the first rotation part **222** to the fourth rotation part **233** are unified and described as the "rotation part **222**."

(87) With reference to FIG. **4**, a part of a cross section of the rotation part **222** may be formed in a circle. A rotation rail **222-1** extended along a part formed in a circle may be formed on one side of the rotation part **222**. When the rotation part **222** is installed in a coupling part (e.g., the first coupling part **211**, the second coupling part **212**, the third coupling part **213** and the fourth coupling part **214**), a rotation guide (e.g., the first rotation guide **211-2**, the second rotation guide **212-2**, the third rotation guide **213-2** and the fourth rotation guide **214-2**) of the coupling part may be inserted into the rotation rail **222-1**. The rotation of the rotation part **222** around the bracket **210** may be performed by the rotation guide inserted into the rotation rail **222-1**.

(88) With reference to FIG. **5**, a cam structure **411** may be formed along the rotation part **222** formed in a circle on the other side of the rotation part **222**. The cam structure **411** may be formed in a part of the rotation part **222**. The cam structure **411** may be engaged with a cam part **420** formed in a follower (e.g., the first follower **242**, the second follower **243** in FIG. **2**C) of the torque provision unit **240** that is described later, thereby generating torque.

(89) FIG. **6** is a rear view of the hinge apparatus according to various embodiments.

(90) With reference to FIG. **6**, when viewed in a −Y direction in FIG. **6**, the first rotation part **222** and the fourth rotation part **232** may be disposed in the bracket **210** in a way to be partially overlapped. When viewed in a +Y direction in FIG. **6**, the second rotation part **233** and the third rotation part **223** may be disposed in the bracket **210** in a way to be partially overlapped. A rotational radius (e.g., R**1** in FIG. **8**A) of the first rotation part **222** and a rotational radius (e.g., R**2** in FIG. **8**A) of the fourth rotation part **232** may be disposed to overlap.

(91) The rotations of first body part **220** and the second body part **230** may be composed of the rotation of the first rotation part **222** and the third rotation part **223** and the rotation of the second rotation part **233** and the fourth rotation part **232** around the bracket **210**. The radius of the rotation part may be formed so that the first rotation part **222**, the second rotation part **233**, the third rotation part **223** and the fourth rotation part **232** are stably installed in the bracket **210**. If the radius of the

rotation part is great, the rotation can be stably performed because an area of the rotation part coming into contact with the bracket **210** is increased. Meanwhile, a separation distance between a first rotation axis (e.g., the first rotation axis C**1** in FIG. **3**A) and a second rotation axis (e.g., the second rotation axis C**2** in FIG. **3**A) may be determined based on a radius of curvature of a display. In this case, the radius of curvature may refer, for example, to the radius of curvature in which the display can be stably folded. The radius of curvature may be a design specification of a display and may be variously changed depending on a design of a display. For example, folding curvature may be different depending on a material that includes a display or a support structure for a display. The separation distance between the first rotation axis C**1** and the second rotation axis may be determined based on a radius of curvature of a display. For example, in the case of a display having a large radius of curvature, the separation distance between the first rotation axis C**1** and the second rotation axis C**2** may be large compared to a display having a small radius of curvature. If the radius of the rotation part is increased, as illustrated in FIG. **8**A, the rotational radius R**1** of the first rotation part **222** and the third rotation part **223** and the rotational radius R**2** of the second rotation part **233** and the fourth rotation part **232** may be overlapped. Locations where the first coupling part **211** and the fourth coupling part **214** are formed may be determined so that the first rotation part **222** and the fourth rotation part **232** are overlapped. Locations where the second coupling part **212** and the third coupling part **213** are formed may be determined so that the second rotation part **233** and the third rotation part **223** are overlapped. By structures in which the first rotation part **222** and the fourth rotation part **232** are overlapped and the second rotation part **233** and the third rotation part **223** are overlapped, the radius of the rotation part can be increased, and the first rotation axis C**1** and the second rotation axis C**2** can be sufficiently brought close to each other depending on a radius of curvature of a display.

(92) In an embodiment, the first follower **242** may include a first cam part **421** formed in a shape corresponding to a first cam structure **411** in a way to be engaged with the first cam structure **411** and a fourth cam part **424** formed in a shape corresponding to a fourth cam structure **414** in a way to be engaged with the fourth cam structure **414**. With reference to FIG. **6**, a distance to the first rotation part **222** in which the first cam structure **411** is formed and a distance to the fourth rotation part **232** in which the fourth cam structure **414** is formed with respect to the middle of the bracket **210** may be different from each other. Shapes of a part where the first cam part **421** has been formed and a part where the fourth cam part **424** has been formed in the first follower **242** may be determined so that the first follower **242** can be pressurized by the pressurizing member **241** and closely attached to the first rotation part **222** and the fourth rotation part **232**. For example, if the distance L**1** from the middle M of the bracket **210** to the first rotation part **222** is longer than the distance L**4** from the middle M of the bracket **210** to the fourth rotation part **232** as illustrated in FIG. **3**A, as illustrated in FIG. **6**, a length LA from one end of the first follower **242** to a part where the first cam structure **411** has been formed may be longer than a length L.sub.D from the one end of the first follower **242** to a part where the fourth cam structure **414** has been formed. When the pressurizing member **241** pressurizes the first follower **242**, the first follower **242** may be closely attached to the first rotation part **222** and the fourth rotation part **232**, thus pressurizing the first rotation part **222** and the fourth rotation part **232**. Torque may occur in the first rotation part **222** and the fourth rotation part **232** due to the engagement structure of the first cam structure **411** and the first cam part **421** and the engagement structure of the fourth cam structure **414** and the fourth cam part **424**.

(93) In an embodiment, the second follower **243** may include a second cam part **422** formed in a shape corresponding to a second cam structure **412** in a way to be engaged with the second cam structure **412** and a third cam part **423** formed in a shape corresponding to a third cam structure **413** in a way to be engaged with the third cam structure **413**. With reference to FIG. **6**, a distance to the second rotation part **233** in which the second cam structure **412** is formed and a distance to the third rotation part **223** in which the third cam structure **413** is formed with respect to the middle of

the bracket **210** may be different from each other. Shapes of a part where the second cam part **422** has been formed and a part where the third cam part **423** has been formed in the second follower **243** may be determined so that the second follower **243** may be pressurized by the pressurizing member **241** and closely attached to the second rotation part **233** and the third rotation part **223**. For example, if the distance L**2** from the middle M of the bracket **210** to the second rotation part **233** is longer than the distance L**3** from the middle M of the bracket **210** to the third rotation part **223** as illustrated in FIG. **3**A, with reference to FIG. **6**, a length L.sub.B from one end of the second follower **243** to a part where the second cam structure **412** has been formed may be longer than a length L.sub.C from the one end of the second follower **243** to a part where the third cam structure **413** has been formed. When the pressurizing member **241** pressurizes the second follower **243**, the second follower **243** may be closely attached to the second rotation part **233** and the third rotation part **223**, thus pressurizing the second rotation part **233** and the third rotation part **223**. At this time, torque may occur in the second rotation part **233** and the third rotation part **223** due to the engagement structure of the second cam structure **412** and the second cam part **422** and the engagement structure of the third cam structure **413** and the third cam part **423**.

(94) As the pressurizing member **241** of the torque provision unit **240** closely attaches the first follower **242** and the second follower **243** to the rotation parts **222**, **223**, **232**, and **233**, torque may be provided to the rotation parts **222**, **223**, **232**, and **233**. The torque may be involved in an operation of requiring an external force or higher for the rotations of the rotation parts **222**, **223**, **232**, and **233** (hereinafter referred to as a "pause operation"). Furthermore, the torque may be involved in an operation of stopping rotation in the state in which an external force has not been provided (hereinafter referred to as a "free stop operation") when the electronic device is in the intermediate state between the unfolding state and the folding state.

(95) FIG. **7**A is a perspective view of a bracket and a torque provision unit according to various embodiments. FIG. **7**B is a cross-sectional view of the bracket and torque provision unit illustrated in FIG. **7**A, which is partially taken along line A-A. FIGS. **7**C and **7**D are diagrams illustrating follower guide rails formed in a bracket according to various embodiments.

(96) In an embodiment, the torque provision unit **240** may be fixed to the bracket **210** by the fixing part **245**. With reference to FIGS. **7**A and **7**B, the fixing part **245** may be fixed to the bracket **210** and may fix the torque provision unit **240**. For example, the fixing part **245** may be fixed to the bracket **210** in a bolt (**245-1**) coupling way. With reference to FIG. **7**B, when the fixing part **245** is fixed to the bracket **210**, a rib **245**A of the fixing part **245** may come into contact with each of ribs **242**A and **243**A formed in the first follower **242** and the second follower **243**, respectively. The rib **245**A of the fixing part **245** fixed to the bracket **210** comes into contact with each of the ribs **242**A and **243**A formed in the first follower **242** and the second follower **243**, respectively, so that the first follower **242** and the second follower **243** may not move in a direction (e.g., a +Z direction in FIG. **7**B) in which the first follower **242** and the second follower **243** become distant from the bracket **210**. The fixing part **245** may fix the first follower **242** and the second follower **243** so that the first follower **242** and the second follower **243** do not move in the +Z direction in FIG. **7**B with respect to the bracket **210** in a process of the first follower **242** and the second follower **243** being moved with respect to the bracket **210** by being pressurized by the pressurizing member **241**.

(97) In an embodiment, with reference to FIGS. **7**C and **7**D, follower guide rails **215** may be formed in the bracket **210** and the fixing part **245**. The follower guide rails **215** may be grooves concavely formed in the bracket **210** and the fixing part **245** so that follower guides (not illustrated) formed in the first follower **242** and the second follower **243** are accommodated in the grooves. The follower guides formed in the first follower **242** and the second follower **243** may be protruded and formed in the first follower **242** and the second follower **243** in a way to be inserted into the follower guide rails **215**. The follower guide rails **215** may guide motion directions of the first follower **242** and the second follower **243**. The follower guide rails **215** may be extended and formed in directions in which the first follower **242** and the second follower **243** are moved. As the

follower guides of the first follower **242** and the second follower **243** are inserted into the follower guide rails **215**, the first follower **242** and the second follower **243** may linearly move without being shaken in a direction (e.g., a Y axis direction in FIG. **7**A) in which the bracket **210** is extended.

(98) The first arm **250**, the second arm **260** and the interlocking member **270** may interlock the first body part **220** and the second body part **230**. In this case, the interlocking of the first body part **220** and the second body part **230** may not be perfectly performed according to circumstances. For example, the first body part **220** and the second body part **230** may not move together due to a manufacturing tolerance. In this case, one of a contact between the first cam part **421** of the first follower **242** and the first cam structure **411** and a contact between the fourth cam part **424** thereof and the fourth cam structure **414** may first occur. As described above, although one of the first cam part **421** or fourth cam part **424** of the first follower **242** first comes into contact with the other instrument, the first follower **242** can perform a designated motion (a straight-line motion in the direction (e.g., the Y axis direction in FIG. **2**C) in which the bracket **210** is extended) because the follower guides are inserted into the follower guide rails **215**. Likewise, one of a contact between the second cam part **422** of the second follower **243** and the second cam structure **412** and a contact between the third cam part **423** thereof and the third cam structure **413** may first occur. Although the second cam part **422** or third cam part **423** of the second follower **243** first comes into contact with the other instrument, the second follower **243** can perform a designated motion (a straight-line motion in the direction (e.g., the Y axis direction in FIG. **2**C) in which the bracket **210** is extended) because the follower guides are inserted into the follower guide rails **215**.

(99) FIGS. **8**A, **8**B and **8**C are diagrams for describing contact relations between a cam part and a cam structure according to various embodiments. Referring to FIG. **8**A, (A) is a diagram illustrating a shape when the electronic device is in the folding state. (B) of FIG. **8**A is a schematic diagram of a contact relation between the cam part and the cam structure when the electronic device is in the folding state. (A) of FIG. **8**B is a diagram illustrating a shape when the electronic device is in the intermediate state. (B) of FIG. **8**B is a schematic diagram of a contact relation between the cam part and the cam structure when the electronic device is in the intermediate state. (A) of FIG. **8**C is a diagram illustrating a shape when the electronic device is in the unfolding state. (B) of FIG. **8**C is a schematic diagram of a contact relation between the cam part and the cam structure when the electronic device is in the unfolding state.

(100) The pressurizing member **241** of the torque provision unit **240** may pressurize the first follower **242** and the second follower **243** so that the first follower **242** and the second follower **243** are moved in the direction (e.g., the Y axis direction in FIG. **2**C) in which the bracket **210** is extended). The first cam part **421** of the first follower **242** may be engaged with the first cam structure **411** of the first rotation part **222**. The fourth cam part **424** may be engaged with the fourth cam structure **414** of the fourth rotation part **232**. Furthermore, the second cam part **422** of the second follower **243** may be engaged with the second cam structure **412** of the second rotation part **233**. The third cam part **423** may be engaged with the third cam structure **413** of the third rotation part **223**.

(101) A relation between forces acting when the electronic device is in the folding state is described with reference to FIG. **8**A. When the first follower **242** and the second follower **243** are pressurized by the pressurizing member **241**, the cam part **420** may pressurize (F.sub.A) the cam structure **410**. The cam part **420** engaged with the cam structure **410** may be rightward applied with a force F**1** on the basis of (B) of FIG. **8**A. The force may be torque that rotates the first body part **220** and the second body part **230** in a direction (e.g., a direction R.sub.A in (A) of FIG. **8**A) in which the electronic device is folded. Accordingly, the pause operation in which the electronic device may maintain the folding state may be implemented by an engaged shape of the cam part **420** and the cam structure **410** and the pressurization of the cam part **420**.

(102) A relation between forces when the electronic device is in the intermediate state is described

with reference to FIG. **8**B. When the electronic device is in the intermediate state, as illustrated in (B) of FIG. **8**B, an engaged part of the cam part **420** and the cam structure **410** may have a slope. When the cam part **420** pressurizes (F.sub.B) the cam structure **410** due to the slope, the cam structure **410** may be rightward applied with a force F**2** on the basis of (B) of FIG. **8**B. Torque generated by the force may be torque that rotates the first body part **220** and the second body part **230** in a direction (e.g., the direction R.sub.A in (A) of FIG. **8**B) in which the electronic device is folded. A basic state of a display of the electronic device is a state in which the display has been fully unfolded, so a restoring force by which the display is to be unfolded from the folding state may act on the display. The intermediate state is a state in which the display of the electronic device has been partially folded. In this state, the first body part **220** and the second body part **230** may be applied with a force in a direction (e.g., a direction R.sub.B (A) of FIG. **8**B) in which the electronic device is unfolded by the restoring force of the display. As the cam part **420** provides torque to the first body part **220** and the second body part **230** in the direction R.sub.A in which the electronic device is folded by pressurizing the cam structure **410**, equilibrium of a force with the restoring force of the display may be achieved. Accordingly, the free stop operation in which the electronic device may maintain the intermediate state without the supply of an external force can be implemented.

(103) A relation between forces when the electronic device is in the unfolding state is described with reference to FIG. **8**C. When the first follower **242** and the second follower **243** are pressurized by the pressurizing member **241**, the cam part **420** may pressurize (Fc) the cam structure **410**. The cam structure **410** engaged with the cam part **420** may be leftward applied with a force F**3** on the basis of (B) of FIG. **8**B. The force may be torque that rotates the first body part **220** and the second body part **230** in a direction (e.g., R.sub.A in (A) of FIG. **8**C) in which the electronic device is unfolded. Accordingly, the pause operation in which the electronic device may maintain the unfolding state can be implemented by an engaged shape of the cam part **420** and the cam structure **410** and the pressurization of the cam part **420**.

(104) FIG. **9** is a partial exploded perspective view of a bracket and a follower according to various embodiments.

(105) According to various embodiments, the hinge apparatus **200** may further include a bearing member **900**. In an embodiment, the bearing member **900** may include a ball guide rail **910** and balls **920**.

(106) With reference to FIG. **9**, the ball guide rail **910** may be formed between the first follower **242** and the bracket **210** and between the second follower **243** and the bracket **210**. The balls **920** may be accommodated in the ball guide rail **910**. The balls **920** accommodated in the ball guide rail **910** may guide motions of the first follower **242** and the second follower **243** for the bracket **210** so that the motions are smoothly performed. The bearing member **900** may compensate for a tolerance between the bracket **210**, and the first follower **242** and the second follower **243**. The bearing member **900** may guide motions of the first follower **242** and the second follower **243** so that the motions of the first follower **242** and the second follower **243** for the bracket **210** are linearly performed without shaking.

(107) The first arm **250**, the second arm **260** and the interlocking member **270** described with reference to FIGS. **2**A, **2**B and **2**C may interlock the first body part **220** and the second body part **230**. However, the interlocking of the first body part **220** and the second body part **230** may not be perfectly performed according to circumstances. For example, the first body part **220** and the second body part **230** may not move together due to a manufacturing tolerance. In this case, one of a contact between the first cam part **421** of the first follower **242** and the first cam structure **411** and a contact between the fourth cam part **424** thereof and the fourth cam structure **414** may first occur. As described above, although one of the first cam part **421** or fourth cam part **424** of the first follower **242** first comes into contact with the other instrument, the first follower **242** may perform a designated motion (a straight-line motion in a direction (e.g., the Y axis direction in FIG. **2**C) in

which the bracket **210** is extended)) due to the bearing member **900**. Likewise, one of a contact between the second cam part **422** of the second follower **243** and the second cam structure **412** and a contact between the third cam part **423** thereof and the third cam structure **413** may first occur. Although one of the second cam part **422** or third cam part **423** of the second follower **243** first comes into contact with the other instrument, the second follower **243** may perform a designated motion (a straight-line motion in a direction (e.g., the Y axis direction in FIG. **2**C) in which the bracket **210** is extended) due to the bearing member **900**.

(108) A hinge apparatus according to various example embodiments may include: a bracket including a first coupling part formed in a first direction with respect to a middle of the bracket and a second coupling part formed in a second direction opposite to the first direction with respect to the middle of the bracket, a first body part including a first plate, a first rotation part coupled with the first plate fastened to the first coupling part of the bracket and configured to rotate about the bracket, and a first cam formed in the first rotation part, a second body part including a second plate, a second rotation part coupled with the second plate fastened to the second coupling part of the bracket and configured to rotate about the bracket, and a second cam formed in the second rotation part, and a torque provision unit, including a first follower including a first cam part engaged with the first cam and disposed in the bracket, a second follower including a second cam part engaged with the second cam and disposed in the bracket, and a pressurizing member disposed in the bracket between the first follower and the second follower and configured to provide an elastic force to the first follower and the second follower in opposite directions.

(109) Furthermore, a part of a cross section of the first rotation part of the first body part may be formed in a circle, and the first cam structure may be formed in a part of the first rotation part. A part of a cross section of the second rotation part of the second body part may be formed in a circle, and the second cam structure may be formed in a part of the second rotation part.

(110) Furthermore, the bracket may further include a third coupling part isolated from the second coupling part in the second direction with respect to the middle of the bracket and a fourth coupling part isolated from the first coupling part in the first direction with respect to the middle of the bracket. The first body part may further include a third rotation part coupled with the first plate fastened to the third coupling part of the bracket and configured to rotate about the bracket, and a third cam formed in the third rotation part. The second body part may further include a fourth rotation part coupled with the second plate fastened to the fourth coupling part of the bracket and configured to rotate about the bracket, and a fourth cam formed in the fourth rotation part.

(111) Furthermore, a distance from the middle of the bracket to the first coupling part may be less than a distance from the middle to the fourth coupling part, and a distance from the middle of the bracket to the third coupling part may be greater than a distance from the middle of the bracket to the second coupling part.

(112) Furthermore, the first follower of the torque provision unit may further include a fourth cam part engaged with the fourth cam. The second follower of the torque provision unit may further include a third cam part engaged with the third cam.

(113) Furthermore, a rotation center of the first rotation part and a rotation center of the third rotation part may pass through a same straight line. A rotation center of the second rotation part and a rotation center of the fourth rotation part may pass through a same straight line.

(114) Furthermore, when viewed in the first direction, parts of the first rotation part and the fourth rotation part may overlap and parts of the second rotation part and the third rotation part may overlap.

(115) Furthermore, the bracket may further include a follower guide rail formed in a part where the first follower and the second follower come into contact with each other so that motions of the first follower and the second follower pressurized by the pressurizing member of the torque provision unit are guided.

(116) Furthermore, the hinge apparatus may further include guide rails formed between the bracket

and the first follower and between the bracket and the second follower, respectively, and a bearing member including balls accommodated in the guide rails.

(117) An electronic device according to various example embodiments may include: a display, a first housing, a second housing, and a hinge rotatably connecting the first housing and the second housing. The hinge may include: a bracket including a first coupling part formed in a first direction with respect to a middle of the bracket and a second coupling part formed in a second direction opposite to the first direction with respect to the middle of the bracket, a first body part including a first plate, a first rotation part coupled with the first plate fastened to the first coupling part of the bracket and configured to rotate about the bracket, and a first cam formed in the first rotation part, a second body part including a second plate, a second rotation part coupled with the second plate fastened to the second coupling part of the bracket and configured to rotate about the bracket, and a second cam formed in the second rotation part, and a torque provision unit, including a first follower including a first cam part engaged with the first cam and disposed in the bracket, a second follower including a second cam part engaged with the second cam and disposed in the bracket, and a pressurizing member disposed in the bracket between the first follower and the second follower and configured to provide an elastic force to the first follower and the second follower in opposite directions.

(118) Furthermore, a part of a cross section of the first rotation part of the first body part may be formed in a circle, and the first cam may be formed in a part of the first rotation part. A part of a cross section of the second rotation part of the second body part may be formed in a circle, and the second cam may be formed in a part of the second rotation part.

(119) Furthermore, the bracket of the hinge may further include a third coupling part isolated from the second coupling part in the second direction with respect to the middle of the bracket and a fourth coupling part isolated from the first coupling part in the first direction with respect to the middle of the bracket. The first body part of the hinge may further include a third rotation part coupled with the first plate fastened to the third coupling part of the bracket and configured to rotate about the bracket, and a third cam formed in the third rotation part. The second body part of the hinge may further include a fourth rotation part coupled with the second plate fastened to the fourth coupling part of the bracket and configured to rotate about the bracket, and a fourth cam formed in the fourth rotation part.

(120) Furthermore, in the hinge, a distance from the middle of the bracket to the first coupling part may be less than a distance from the middle of the bracket to the fourth coupling part, and a distance from the middle of the bracket to the third coupling part may be greater than a distance from the middle of the bracket to the second coupling part.

(121) Furthermore, the first follower of the torque provision unit may further include a fourth cam part engaged with the fourth cam. The second follower of the torque provision unit may further include a third cam part engaged with the third cam.

(122) Furthermore, in the hinge, a rotation center of the first rotation part and a rotation center of the third rotation part may pass through a same straight line, and a rotation center of the second rotation part and a rotation center of the fourth rotation part may pass through a same straight line.

(123) Furthermore, in the hinge, when viewed in the first direction, parts of the first rotation part and the fourth rotation part may overlap and parts of the second rotation part and the third rotation part may overlap.

(124) Furthermore, the bracket of the hinge may further include a follower guide rail formed in a part where the first follower and the second follower come into contact with each other so that motions of the first follower and the second follower provided with an elastic force by the pressurizing member of the torque provision unit are guided.

(125) Furthermore, the hinge may further include guide rails formed between the bracket and the first follower and between the bracket and the second follower, respectively, and a bearing member including balls accommodated in the guide rails.

(126) Furthermore, the hinge apparatus may further include a first arm rotatably installed in the bracket and connected to the first body part, a second arm rotatably installed in the bracket and connected to the second body part, and an interlocking member comprising a gear configured to interlock rotations of the first arm and the second arm.
(127) Furthermore, the first arm of the hinge apparatus may be configured to be rotated about the bracket in a rotation axis different from a rotation axis of the first body part and may be connected to the first body part through a first pin inserted into a first compensation rail formed in the first body part in a length direction thereof. The second arm of the hinge may be configured to be rotated about the bracket in a rotation axis different from a rotation axis of the second body part and may be connected to the second body part through a second pin inserted into a second compensation rail formed in the second body part in a length direction thereof.
(128) While the disclosure has been illustrated and described with reference to various example embodiments, it will be understood that the various example embodiments are intended to be illustrative, not limiting. Accordingly, all changes or modified forms derived based on the technical spirit of various embodiments disclosed herein should be understood as being included in the scope of disclosure. It will also be understood that any of the embodiment(s) described herein may be used in conjunction with any other embodiment(s) described herein.

Claims

1. An electronic device comprising: a display; a first housing; a second housing; and a hinge apparatus rotatably connecting the first housing and the second housing, wherein the hinge apparatus comprises: a bracket comprising a first coupling part formed in a first direction with respect to a middle of the bracket, a second coupling part formed in a second direction opposite to the first direction with respect to the middle of the bracket, a third coupling part isolated from the second coupling part in the second direction with respect to the middle of the bracket, and a fourth coupling part isolated from the first coupling part in the first direction with respect to the middle of the bracket; a first body part comprising a first plate, a first rotation part coupled with the first plate fastened to the first coupling part of the bracket and configured to rotate about the bracket, a third rotation part coupled with the first plate fastened to the third coupling part of the bracket and configured to rotate about the bracket, a first cam formed in the first rotation part, and a third cam formed in the third rotation part; a second body part comprising a second plate, a second rotation part coupled with the second plate fastened to the second coupling part of the bracket and configured to rotate about the bracket, a fourth rotation part coupled with the second plate fastened to the fourth coupling part of the bracket and configured to rotate about the bracket, a second cam formed in the second rotation part, and a fourth cam formed in the fourth rotation part; and a torque provision unit, comprising a first follower comprising a first cam part engaged with the first cam and disposed in the bracket, a second follower comprising a second cam part engaged with the second cam and disposed in the bracket, and a pressurizing part disposed in the bracket between the first follower and the second follower and configured to provide an elastic force to the first follower and the second follower in opposite directions.
2. The electronic device of claim 1, wherein: a part of a cross section of the first rotation part of the first body part is formed in a partial circle, and the first cam is formed in a part of the first rotation part, and a part of a cross section of the second rotation part of the second body part is formed in a partial circle, and the second cam is formed in a part of the second rotation part.
3. The electronic device of claim 1, wherein in the hinge apparatus, a distance from the middle of the bracket to the first coupling part is greater than a distance from the middle of the bracket to the fourth coupling part, and a distance from the middle of the bracket to the third coupling part is less than a distance from the middle of the bracket to the second coupling part.
4. The electronic device of claim 1, wherein: the first follower of the torque provision unit further

comprises a fourth cam part engaged with the fourth cam, and the second follower of the torque provision unit further comprises a third cam part engaged with the third cam.

5. The electronic device of claim 1, wherein in the hinge apparatus, a rotation center of the first rotation part and a rotation center of the third rotation part pass through an identical straight line, and a rotation center of the second rotation part and a rotation center of the fourth rotation part pass through an identical straight line.

6. The electronic device of claim 1, wherein the hinge apparatus further comprises: a first arm rotatably installed in the bracket and connected to the first body part, a second arm rotatably installed in the bracket and connected to the second body part; and an interlocking member comprising a gear configured to interlock rotations of the first arm and the second arm.

7. The electronic device of claim 6, wherein: the first arm of the hinge apparatus is configured to be rotated about the bracket in a rotation axis different from a rotation axis of the first body part and is connected to the first body part through a first pin inserted into a first compensation rail formed in the first body part in a length direction thereof, and the second arm of the hinge apparatus is configured to be rotated about the bracket in a rotation axis different from a rotation axis of the second body part and is connected to the second body part through a second pin inserted into a second compensation rail formed in the second body part in a length direction thereof.