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(54) Title: IMAGING DEVICE FIELD OF VIEWS BASED ON HINGE ROTATIONS

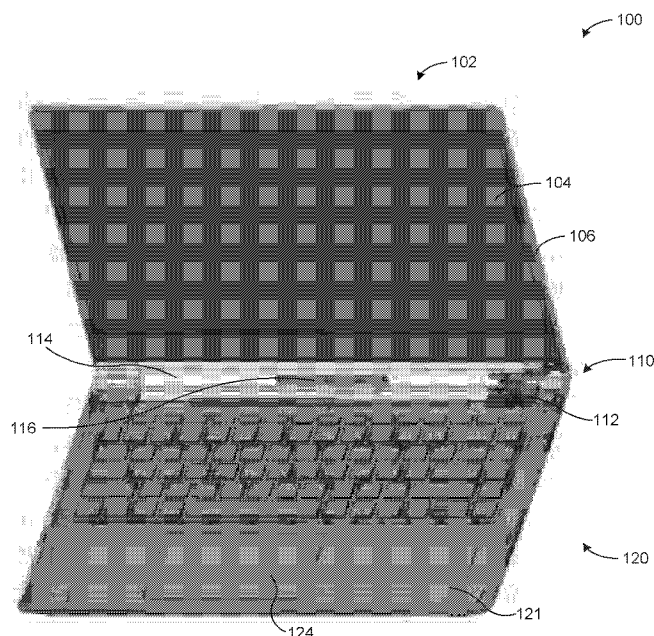


FIG. 1

(57) Abstract: A disclosed example electronic device includes a display, a first housing, where the display is located in the first housing, a second housing, an imaging device, and a hinge housing. The imaging device is disposed in the hinge housing. Further, the example electronic device also includes a hinge partially disposed in the hinge housing. The hinge is to set a rotation of the hinge housing based on an angular displacement between the first and second housings to control a field of view of the imaging device.



Declarations under Rule 4.17:

- *as to the identity of the inventor (Rule 4.17(i))*
- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

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IMAGING DEVICE FIELD OF VIEWS BASED ON HINGE ROTATIONS

BACKGROUND

[0001] In recent years, imaging devices (e.g., cameras) have been implemented in numerous electronic devices, such as laptops or tablets to take outwardly facing images or inward facing images (e.g., selfies). Typically, to take images from different viewing angles, multiple cameras that face different viewing angles are mounted onto an electronic device. Further, some known electronic devices employ cameras that are manually rotated to face different directions based on a current use-mode.

BRIEF DESCRIPTION OF THE DRAWINGS

[0002] FIG. 1 is a perspective view of an example electronic device in accordance with the teachings of this disclosure.

[0003] FIG. 2 is a detailed view of a portion of the example electronic device of FIG. 1 showing an example hinge.

[0004] FIG. 3 is a detailed view of the example hinge shown in FIGS. 1 and 2.

[0005] FIGS. 4A-4C depict different example use modes of examples disclosed herein.

[0006] FIG. 5 depicts different example angular rotation configurations that can be implemented in examples disclosed herein.

[0007] The figures are not to scale. In general, the same reference numbers are used throughout the drawing(s) and accompanying written description to refer to the same or like parts.

DETAILED DESCRIPTION

[0008] Imaging device field of views based on hinge rotations are disclosed. Some known electronic devices employ multiple imaging devices, such as cameras, to capture images at different viewing angles. However, implementing multiple imaging devices on a single electronic device can introduce significant complexity and/or increased costs. Further, mounted imaging devices of electronic devices can have limited viewing angles and, thus, some known electronic devices employ imaging devices that are manually rotated by users to a use-appropriate viewing angle.

[0009] Examples disclosed herein enable an imaging device of a folding/foldable electronic device or foldable apparatus, such as a mobile phone, a laptop, or a tablet for example, to be rotated to a use-appropriate angle based on a relative angular displacement between folding portions (e.g., housings) of the electronic device. In particular, examples disclosed herein include a hinge housing (e.g., a hinge cap) with an imaging device fixably coupled thereto. The hinge housing is movably coupled to a hinge that enables a first housing (e.g., a display or screen housing) to rotate relative to a second housing (e.g., an input device or keyboard/keypad housing). The hinge housing is moved along with the imaging device as the first and second housings rotate relative to one another. As a result, examples disclosed herein

enable accurate and cost-effective angular control of an imaging device fixably coupled to the hinge housing by coupling a rotational motion of the hinge housing with a displacement angle between the first and second housings.

[0010] In some examples, a gear system and/or gearing is used to direct a rotation of the hinge housing and the imaging device due to a rotational displacement between the first and second housings. In some such examples, the gear system includes helical gears. Additionally or alternatively, different gearing ratios are implemented to vary a relative angular motion of the hinge housing and the first housing from the second housing. In some examples, the electronic device is implemented as a laptop computer that can be converted between a laptop mode, a tablet mode, and a tent mode by rotating the first and second housings to appropriately angle the imaging device. In other words, the imaging device is angled based on user modes based on a rotational displacement angle between the first and second housings.

[0011] As used herein, the term “housing” refers to an enclosure (sealed or otherwise), a walled compartment, a partially-open enclosure, an enclosure body, etc. Accordingly, the term “housing” can refer to a part (e.g., a molded or die-cast part) or an assembly of components. As used herein, the term “imaging device” refers to any device that includes a line of sight to a subject to capture data. Accordingly, the term “imaging device” can refer to, but is not limited to, an optical sensor, a camera, a camera module, a thermal imaging device, an infrared sensor, a scanner, etc. As used herein, the term

“hinge” refers to a component and/or assembly that rotationally couples two portions (e.g., foldable portions). As used herein, the terms “rotational displacement” and “angular displacement” refer to an angular difference/differential between two portions or components.

[0012] FIG. 1 is a perspective view of an example electronic device (e.g., a computing device) 100 in accordance with the teachings of this disclosure. The electronic device 100 of the illustrated example includes a display portion or assembly (e.g., a first folding portion) 102 having a display 104 mounted to and/or within a housing (e.g., a first housing) 106. Further, the electronic device 100 includes a hinge portion 110 with a hinge (e.g., a hinge assembly) 112, and a hinge housing (e.g., a hinge cap, a hinge cap housing, a hinge linkage, etc.) 114 with an imaging device (e.g., a camera module, an optical scanner, an optical sensor, etc.) 116 disposed within. The example electronic device 100 also includes an input device portion (e.g., a second folding portion) 120 having a housing (e.g., a second housing) 121 that positions and mounts a keyboard 122 as well as a trackpad 124.

[0013] To vary the electronic device 100 between different functional user modes, the display portion 102 is rotated relative to the input device portion 120 and vice-versa. In particular, the example display portion 102 can be rotated relative to the input device portion 120 to operate as a laptop in a first mode, a tablet in a second mode, and a stand-up tent mode in a third mode. In the aforementioned first, second, and third modes, the imaging device 116, which is implemented as a camera module that is fixably coupled to the hinge housing 114 in this example, functions with an associated viewing

angle relative to the electronic device 100 (e.g., in a user-facing mode when the electronic device 100 is folded to a tablet).

[0014] To control a rotational angle of the hinge housing 114 and, thus, the imaging device 116 based on a relative rotation of the display portion 102 to the input device portion 120, the hinge 112 couples an angular rotational difference (e.g., an angular rotational differential) between the display portion 102 and the input device portion 120 to the rotational angle of the hinge housing 114 and the imaging device 116. In other words, a relative angular rotation between the display portion 102 and the input device portion 120 defines one of the user modes, and the hinge 112 correspondingly orients the imaging device 116 based on the respective user mode.

[0015] In this example, a rotation of the hinge housing 114 is set along with an entire range of relative angular displacement(s) between the display portion 102 and the input device portion 120. In other words, the example hinge housing 114 does not rotate independently of angular motion encountered at the hinge 112. Further, the rotation of the hinge housing 114 is not specifically tied to one of the display portion 102 or the input device portion 120. In other examples, the rotation of the hinge housing 114 is decoupled from motion of the hinge 112 in a defined angular displacement range (e.g., 0 to 10 degrees) between the display portion 102 and the input device portion 120. In such examples, a clutch, a cam, or other similar device can be employed.

[0016] FIG. 2 is a detailed view of a portion of the example electronic device 100 of FIG. 1 including the example hinge 112. According to the

illustrated example, the hinge 112 is shown rotatably coupling the display portion 102 to the input device portion 120. In the illustrated view of FIG. 2, the hinge 112 includes a display portion arm 202 that is coupled to the display portion 102, a gear assembly 204 with a synchronization gear 206, a hinge housing (e.g., a gear cover, etc.) 208, and hinge housing mounts (e.g., pivot mounts, etc.) 210. Further, an input portion arm 212 is coupled to the input device portion 120.

[0017] In operation, the display portion 102 and the input device portion 120 pivot about different axes 220, 222, respectively, which are offset from one another. The gear assembly 204 couples rotational movement between the display portion arm 202, the input portion arm 212, and the hinge housing mounts 210. In particular, as a result of a rotational displacement between the display portion arm 202 and the input portion arm 212, the gear 204 causes the translation and/or rotational movement of the hinge housing mounts 210, thereby rotating the hinge housing 114 along with the imaging device 116. In this example, the display portion arm 202 and the input portion arm 212 exhibit a generally L-shaped geometry to provide structural support to the electronic device 100 proximate the hinge 112. However, any appropriate geometry and/or structure of the display portion arm 202 and the input portion arm 212 can be implemented instead.

[0018] FIG. 3 is a detailed view of the example hinge 112 of FIGS. 1 and 2. The hinge 112 of the illustrated example is shown with the hinge housing 208 (of FIG. 2) removed for clarity. The example hinge 112 includes the display portion arm 202, the synchronization gear 206, the hinge housing

mounts 210, and the input portion arm 212 described above in connection with FIG. 2. Further, the example hinge 112 also includes a first helical gear 302, a second helical gear 304, and support brackets 306, 308.

[0019] To cause a rotation of the hinge housing mounts 210 and, in turn, rotate the hinge housing 114 to vary a viewing angle (e.g., a field of view) of the imaging device 116, either the first helical gear 302 or the second helical gear 304 is moved based on rotation of the display portion arm 202 or the input portion arm 212, respectively. In particular, movement of the first helical gear 302 and/or the second helical gear 304 causes the synchronization gear 206 to rotate about an axis 320 perpendicular to respective axes 322, 324 of the first and second helical gears 302, 304, thereby moving the housing mounts 210 and, thus, rotating the hinge housing 114 and the imaging device 116. In this example, the housing mounts 210 are implemented as rotatable joints positioned at two different positions of the hinge housing 114 such that translational and/or rotational movement a first of the housing mounts 210 or both of the housing mounts 210 controls a pivot of the hinge housing 114 and, in turn, orients the imaging device 116 to a desired viewing angle(s) based on different use modes. In other words, the hinge housing 114 of the illustrated example acts as a rotatable linkage between the display portion arm 202 and the input portion arm 212.

[0020] In some examples, the first helical gear 302, the second helical gear 304, and/or the synchronization gear 206 (e.g., two of the first helical gear 302, the second helical gear 304, or the synchronization gear 206) include a different teeth pitch and/or spacing to vary relative rotational displacements

between the hinge housing 114, the display portion 102, and/or the input device portion 120. In such examples, the hinge housing 114 and the display portion 102 can be rotated at a different angular rate from the input device portion 120. In some examples, the first helical gear 302, the second helical gear 304, and/or the synchronization gear 206 is partially composed of stainless steel. However, any appropriate material can be used in alternative examples.

[0021] While the first helical gear 302, the second helical gear 304, and the synchronization gear 206 are implemented as helical gears in this example, other gearing, gearing types, linkage arrangement, or other implementations can be used in alternative examples. For example, spur gears can be implemented.

[0022] FIGS. 4A-4C depict different example use modes of examples disclosed herein. Turning to FIG. 4A, the electronic device 100 is shown in a laptop mode with the display portion 102 angled at approximately 90-120 degrees from the input device portion 120, as generally indicated by a double arrow 401. Further, a viewing angle (e.g., a viewing cone, a camera view cone) 402 of the imaging device 116 is also depicted based on a resultant orientation of the hinge portion 110.

[0023] FIG. 4B depicts the computing device 100 in a tablet mode. Accordingly, the display portion 102 is shown fully angled away from (e.g., approaching approximately 360 degrees from and generally parallel to) the input device portion 120 as generally indicated by a double arrow 410.

Further, a resultant viewing angle 412 of the imaging device 116 is also shown based on a corresponding orientation of the hinge portion 110.

[0024] Turning to FIG. 4C, the computing device 100 is shown in a tent mode. According to the illustrated example, the display portion 102 is angled away from the input device portion 120 at an angular range of approximately 300 to 330 degrees, as generally indicated by a double arrow 414. As a result, viewing angle 416 is also depicted in FIG. 4C based on an orientation of the hinge portion 110.

[0025] The angular ranges and associated viewing angles shown in FIGS. 4A-4C are examples, and any angular displacement ranges and viewing angles can be implemented in alternative examples.

[0026] FIG. 5 depicts different example angular orientation configurations that can be implemented in examples disclosed herein. In particular, the electronic device 100 is shown in a fully folded configuration 500 in which the display portion 102 is folded towards input device portion 120 with the display 104 (shown in FIG. 1) facing towards the input device portion 120. Further, an unfolded configuration 502 is shown depicting an example in which both the hinge portion 110 and the display portion 102 rotate at a same or similar angle relative to the input device portion 120 when the display portion 102 is folded away from the input device portion 120. In particular, a 1:1 gearing ratio is implemented in this example that results in a viewing angle 503.

[0027] As can be seen in the illustrated view of FIG. 5, an unfolded configuration 504 is also shown. In this example, different gear ratios of the

hinge 112 are implemented to vary an angular movement between the hinge portion 110 and the display portion 102 relative to the input device portion 120 as the display portion 102 is folded away from the input device portion 120. In contrast to the unfolded configuration 502 mentioned above, example, different gear ratios are implemented. In this particular example, a viewing angle 503 associated with the unfolded configuration 504 is angled higher relative to ground or a support surface than the viewing angle 503 of the unfolded configuration 502 due to the hinge portion 110 rotationally displacing at a greater angle in the unfolded configuration 504. Conversely, in other examples, the hinge portion 110 can be rotationally displaced at other angles including, for example a relatively smaller angle or larger angle, based on different gear ratios. Thus, different gear ratios may be used to change the position of the field of view of the imaging device.

[0028] “Including” and “comprising” (and all forms and tenses thereof) are used herein to be open ended terms. Thus, whenever a claim employs any form of “include” or “comprise” (e.g., comprises, includes, comprising, including, having, etc.) as a preamble or within a claim recitation of any kind, it is to be understood that additional elements, terms, etc. may be present without falling outside the scope of the corresponding claim or recitation. In addition, the term “and/or” when used, for example, in a form such as A, B, and/or C refers to any combination or subset of A, B, C such as (1) A alone, (2) B alone, (3) C alone, (4) A with B, (5) A with C, (6) B with C, and (7) A with B and with C.

[0029] Examples disclosed herein enable cost-effective and accurate angular rotation adjustments of an imaging device of a foldable electronic device. Examples disclosed herein enable automated rotational adjustments of the imaging device based on different use cases of the foldable electronic device (e.g., use cases defined by different folding configurations of the foldable electronic device). Examples disclosed herein enable use of a single imaging device or camera, thereby saving on cost and complexity typically associated with integrating multiple imaging devices. Further, examples disclosed herein enable thinner camera-mounted sections for electronic devices.

[0030] While examples disclosed herein are related to a folding electronic device with an imaging device, examples disclosed herein can be applied to other folding applications of other devices in which a viewing angle or vector associated with a rotatable portion is of interest.

[0031] Although certain example methods, apparatus and articles of manufacture have been disclosed herein, the scope of coverage of this patent is not limited thereto. On the contrary, this patent covers all methods, apparatus and articles of manufacture fairly falling within the scope of the claims of this patent.

What Is Claimed Is:

1. An electronic device comprising:
 - a display;
 - a first housing, wherein the display is located in the first housing;
 - a second housing;
 - an imaging device;
 - a hinge housing, the imaging device disposed in the hinge housing; and
 - a hinge partially disposed in the hinge housing, the hinge to set a rotation of the hinge housing based on an angular displacement between the first and second housings to control a field of view of the imaging device.
2. The electronic device of claim 1, further including:
 - a first gear coupled to the first housing;
 - a second gear coupled to the second housing; and
 - a synchronization gear coupled to the hinge housing, the first and second gears operatively coupled with the synchronization gear to move the hinge housing to control the field of view of the imaging device.
3. The electronic device of claim 2, wherein the first gear, the second gear, and the synchronization gear include a helical gear.
4. The electronic device of claim 3, wherein two of the first gear, the second gear, or the synchronization gear have differing gear ratios to vary an

angular displacement between the first housing and the hinge housing relative to the second housing.

5. The electronic device of claim 1, wherein the hinge housing is operatively coupled between the first and second housings to act as a linkage therebetween.

6. The electronic device of claim 1, wherein the hinge housing is to rotate away from the second housing at a first angle different from a second angle between the first housing and the second housing.

7. The electronic device of claim 1, wherein the hinge housing is to rotate with the hinge.

8. A hinge assembly of a foldable electronic device, the hinge assembly comprising:

a hinge;

a first arm rotatably coupled to the hinge, the first arm coupled to a first housing that mounts a display,

a second arm rotatably coupled to the hinge the second arm coupled to a second housing that mounts an input device;

a hinge housing mount to mount a hinge housing carrying an imaging device; and

a gear system to vary a rotation of the hinge housing based on an angular displacement between first and second arms to vary a field of view of the imaging device.

9. The hinge of claim 8, wherein the gear system includes first and second helical gears coupled to the first and second housings, respectively.

10. The hinge of claim 9, further including a synchronization gear to couple a motion between the first and second helical gears.

11. The hinge of claim 10, wherein two of the first helical gear, the second helical gear, or the synchronization gear have a different gear ratio to vary angular displacements between the first housing and the hinge housing relative to the second housing when the first housing is folded away from the second housing.

12. The hinge of claim 10, wherein the synchronization gear rotates about an axis perpendicular to rotational axes of the first and second helical gears.

13. An electronic device comprising:
a first folding portion;
a second folding portion;
a hinge housing extending between the first and second folding portions;

an imaging device fixably coupled to the hinge housing; and
a hinge partially disposed in the hinge housing, the hinge to rotate the hinge housing based on a rotational displacement between the first and second folding portions.

14. The electronic device of claim 13, wherein the hinge includes:

a first helical gear coupled to the first folding portion;
a second helical gear coupled to the second folding portion; and
a synchronization gear coupled to the hinge housing and operatively coupled between the first and second helical gears.

15. The electronic device of claim 14, wherein two of the first helical gear, the second helical gear, and the synchronization gear have different gear ratios.

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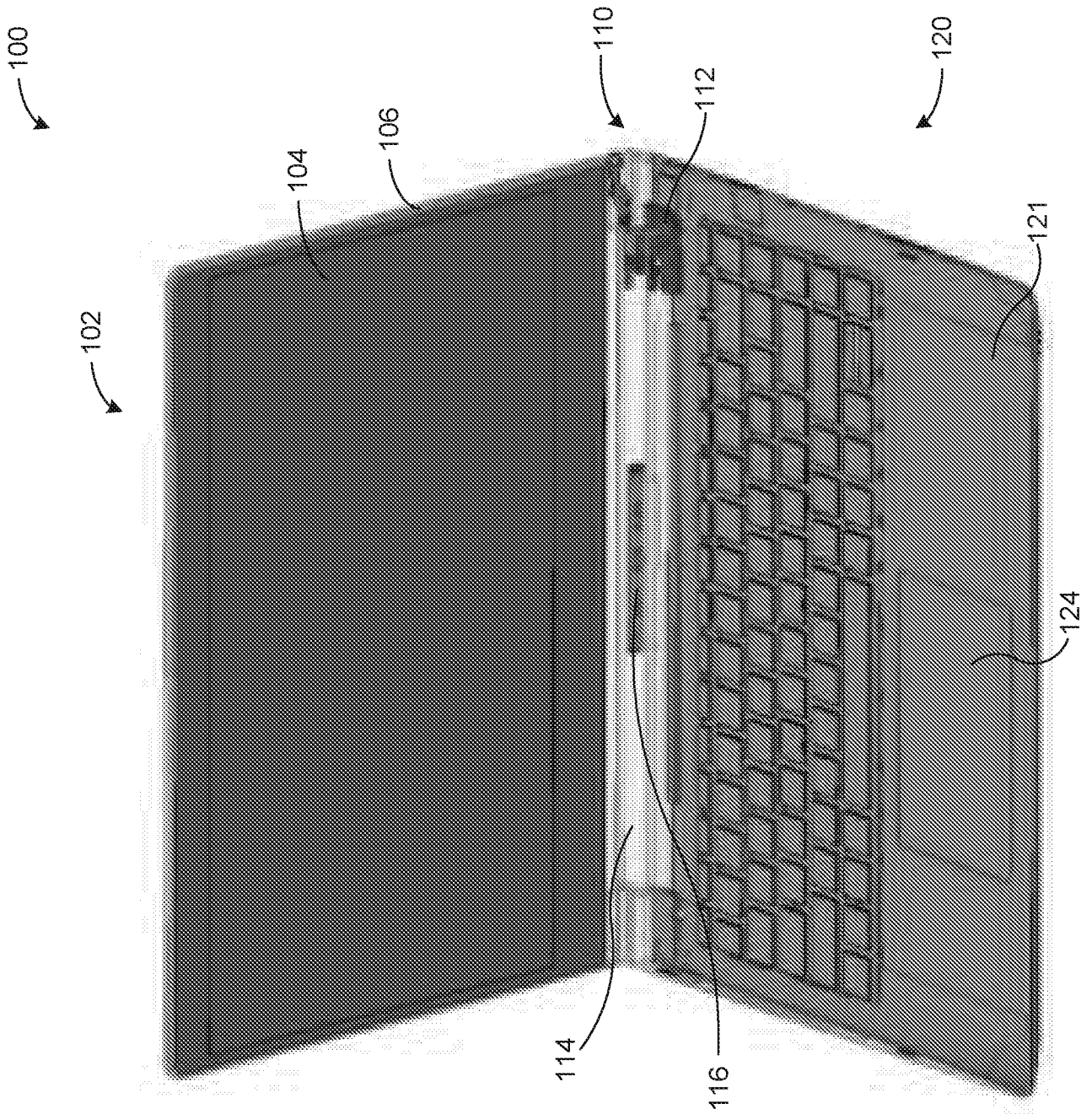


FIG. 1

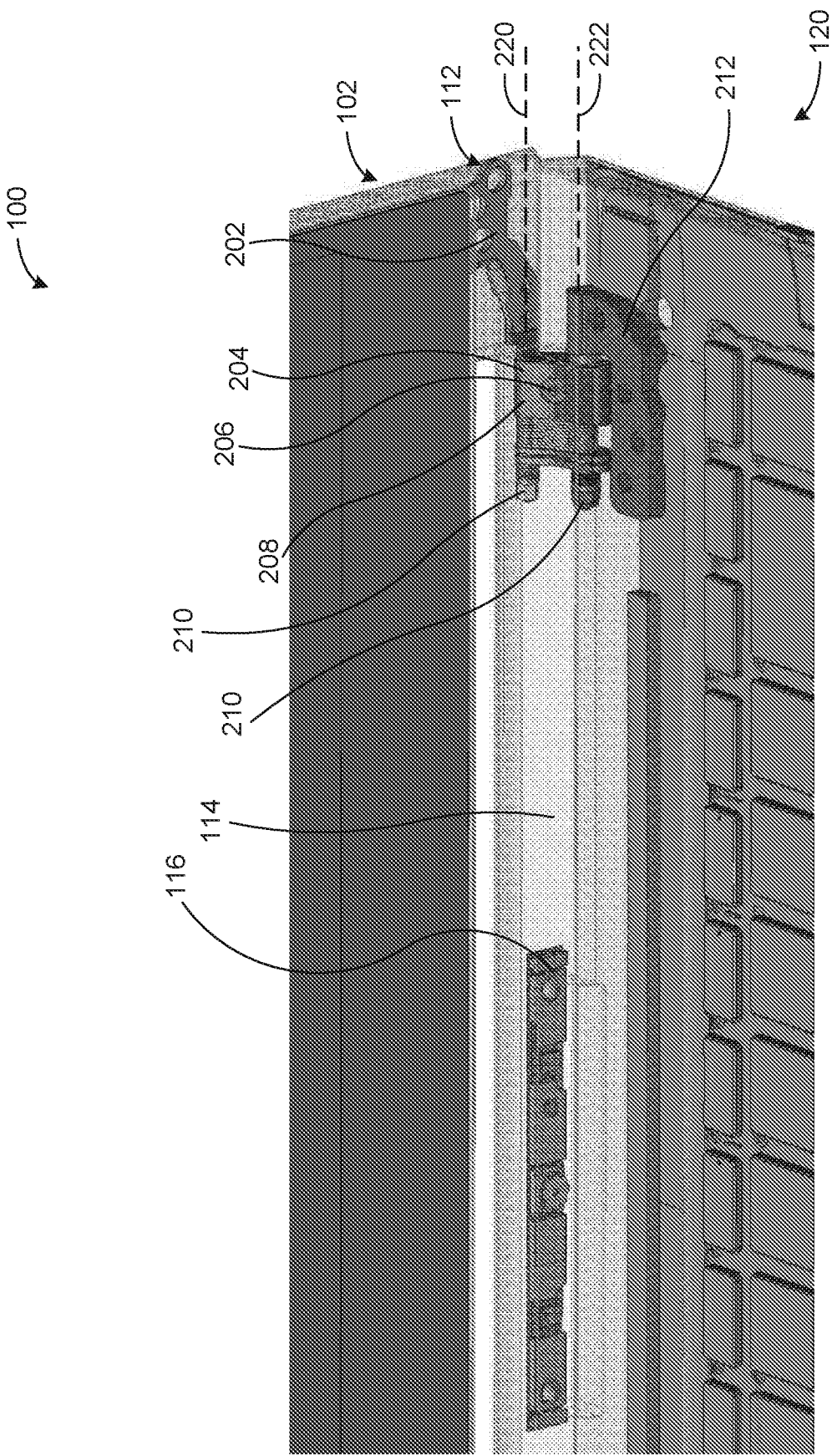


FIG. 2

112

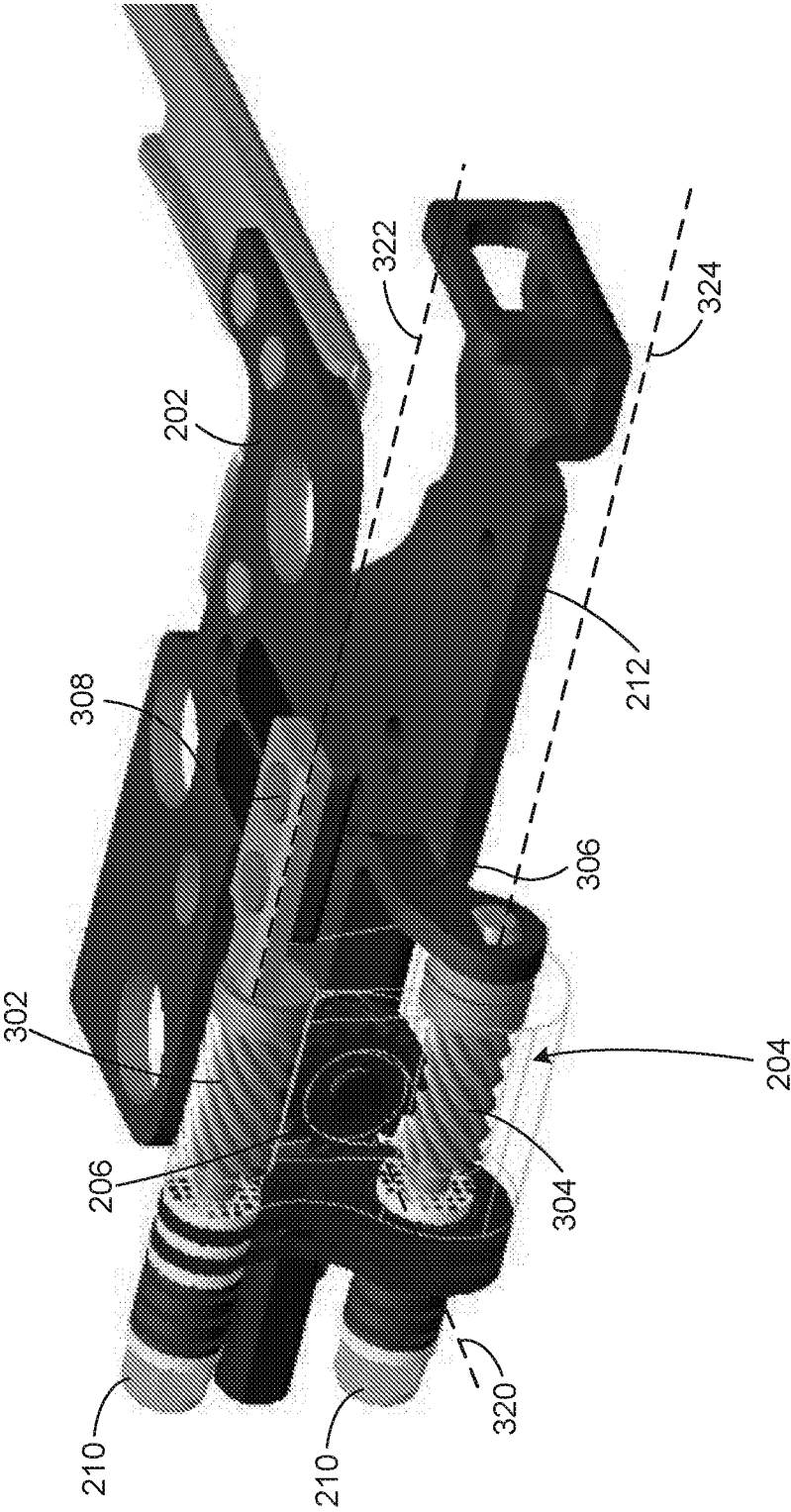


FIG. 3

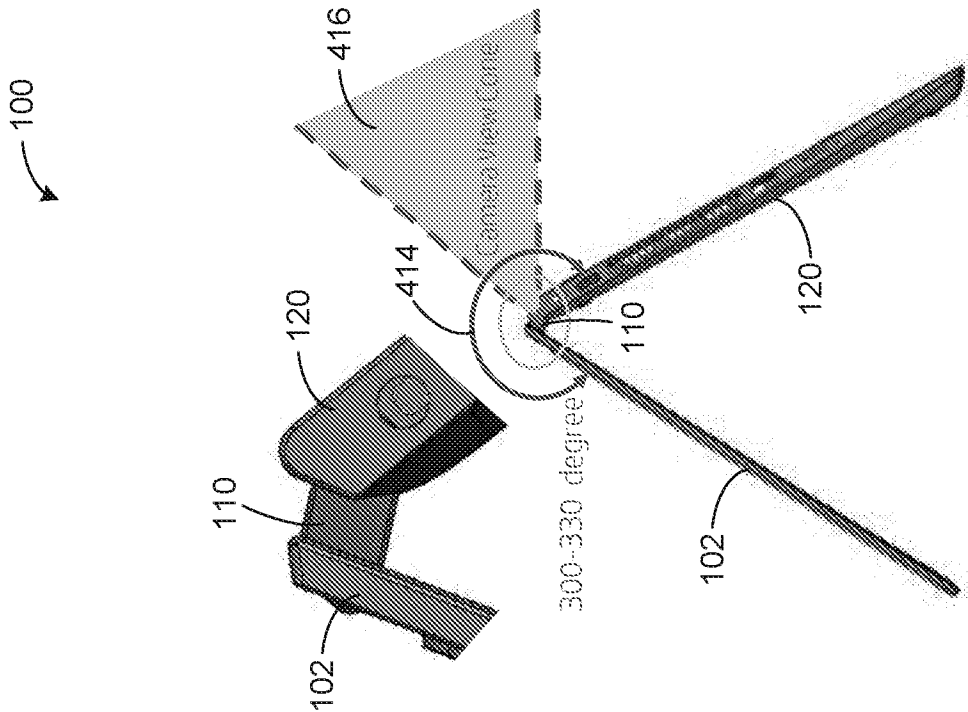


FIG. 4C

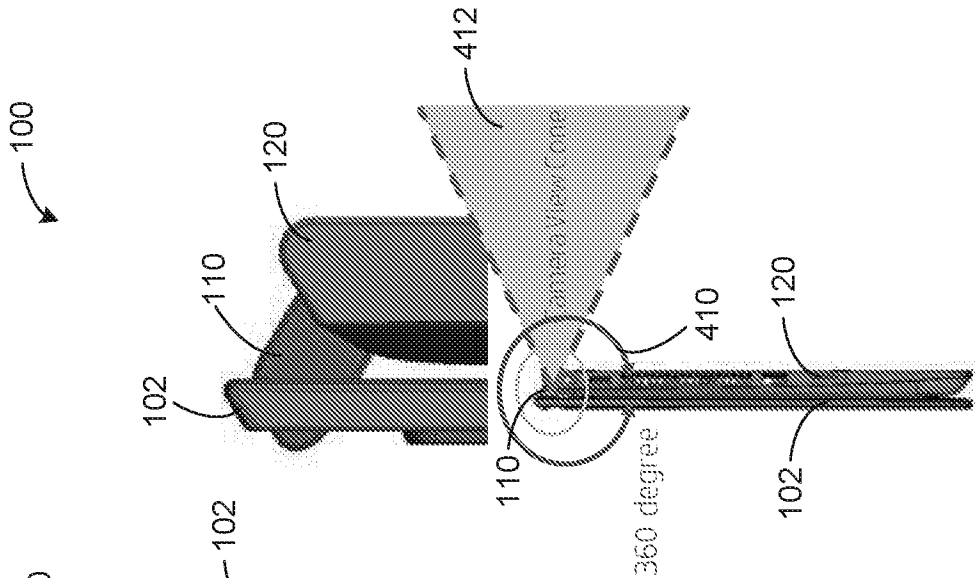


FIG. 4B

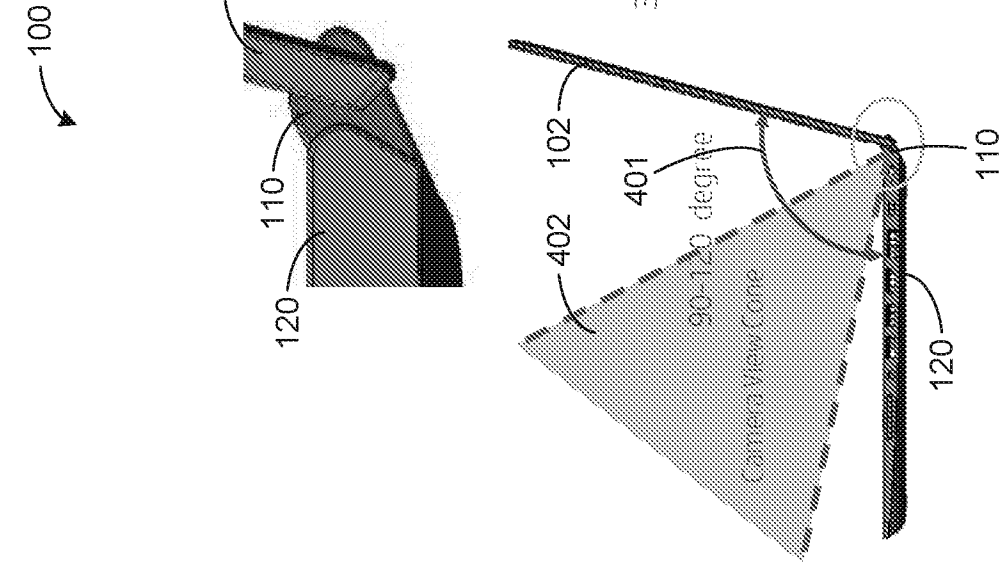


FIG. 4A

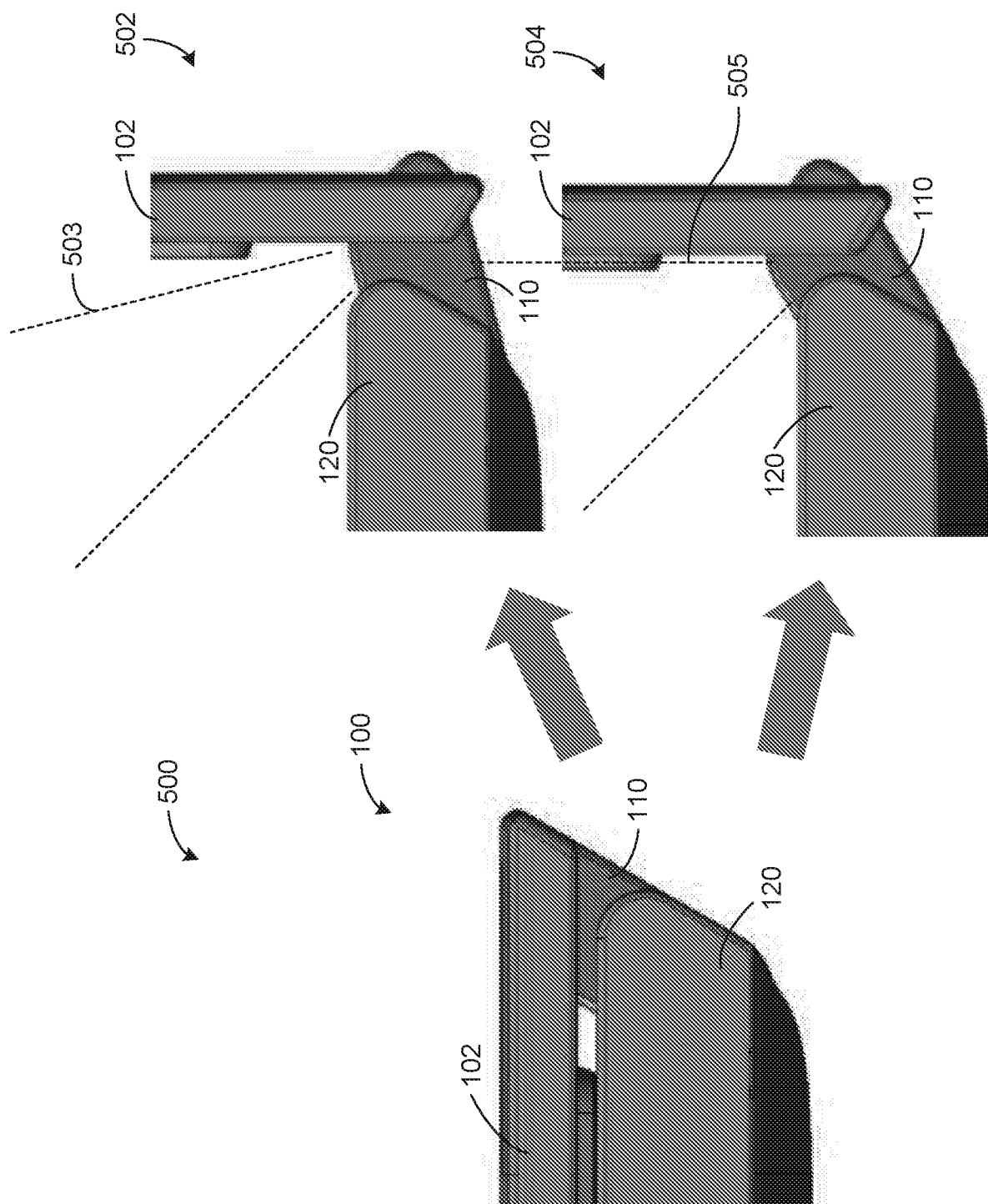


FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 2018/049747

A. CLASSIFICATION OF SUBJECT MATTER <i>G06F 1/16 (2006.01)</i>		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) G06F 1/00, 1/16; H05K 5/00, 7/00; E05D 3/00 –3/12; E05C 17/00, 17/60		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) PatSearch, Esp@cenet, PAJ, USPTO, WIPO, RUPTO		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6253419 B1 (SHENG-NAN LU), 03.07.2001, col. 1 lines 3-7, 24-41, col. 2 line 50 –col. 3 line 16, fig. 1-7, abstract	1, 5, 7, 13
Y		2-4, 6, 8-12, 14, 15
Y	US 2017/0235337 A1 (KABUSHIKI KAISHA TOSHIBA), 17.08.2017, [0027]-[0030], [0033]-[0034], [0038], [0045]-[0048], fig. 1-8, abstract	2-4, 6, 8-12, 14, 15
A	US 2007/0060217 A1 (LG ELECTRONICS INC.), 15.03.2017	1-15
A	US 2016/0215540 A1 (LENOVO (BEIJING) CO., LTD.), 28.07.2016	1-15
☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
*	Special categories of cited documents: “A” document defining the general state of the art which is not considered to be of particular relevance “E” earlier document but published on or after the international filing date “L” document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) “O” document referring to an oral disclosure, use, exhibition or other means “P” document published prior to the international filing date but later than the priority date claimed “T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention “X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone “Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art “&” document member of the same patent family	
Date of the actual completion of the international search	Date of mailing of the international search report	
22 March 2019 (22.03.2019)	04 April 2019 (04.04.2019)	
Name and mailing address of the ISA/RU: Federal Institute of Industrial Property, Berezhkovskaya nab., 30-1, Moscow, G-59, GSP-3, Russia, 125993 Facsimile No: (8-495) 531-63-18, (8-499) 243-33-37	Authorized officer O. Tsykanovskaya Telephone No. 499-240-60-15	