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Ho et al.

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(54) **HINGES FOR ELECTRONIC DEVICES**

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E05D 5/14	(2006.01)
F16C 11/04	(2006.01)
E05D 3/02	(2006.01)

(52) **U.S. Cl.**

CPC ***G06F 1/1681*** (2013.01); ***F16C 11/04*** (2013.01); *E05D 3/02* (2013.01); *E05D 5/14* (2013.01); *E05Y 2999/00* (2024.05)

(58) **Field of Classification Search**

CPC G06F 1/1681; G06F 1/1616; F16C 11/04
USPC 16/221
See application file for complete search history.

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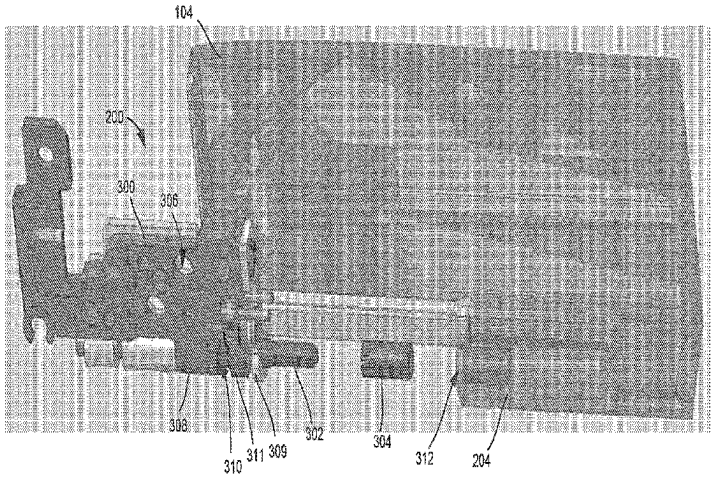
(57) **ABSTRACT**

Hinges for electronic devices are disclosed herein. An example hinge includes a bracket capable of being coupled to a first portion of the electrical device. The bracket has a barrel defining a first opening. The hinge also includes a shaft in the first opening. The shaft is rotatable in the first opening. The hinge further includes a sleeve capable of being inserted into a bore in a second portion of the electronic device. The sleeve defines a second opening to receive a portion of the shaft.

17 Claims, 10 Drawing Sheets



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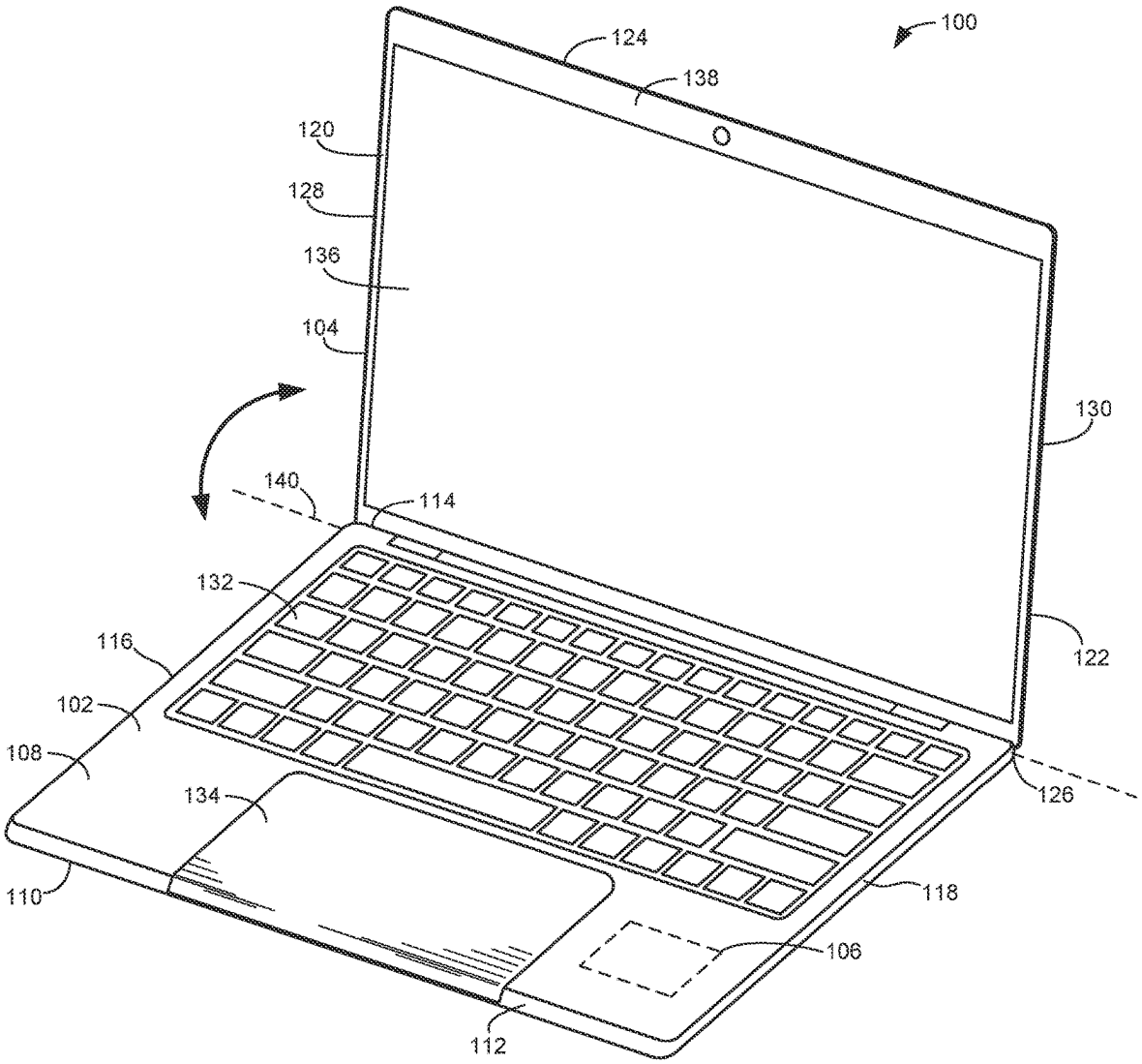
100
124
138
120
128
136
104
130
140
114
132
116
122
102
108
134
126
110
118
106
112

FIG. 1

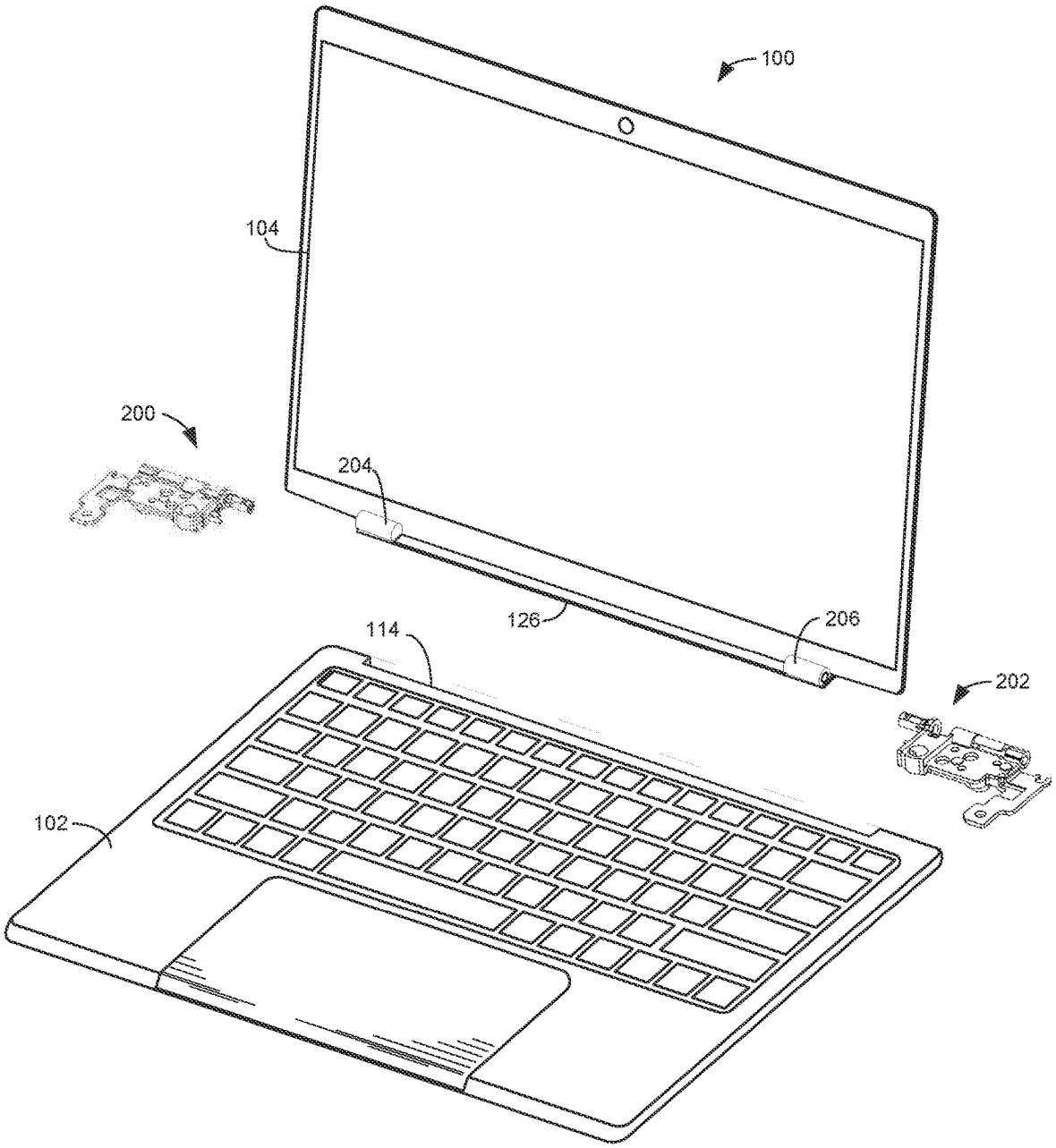

FIG. 2

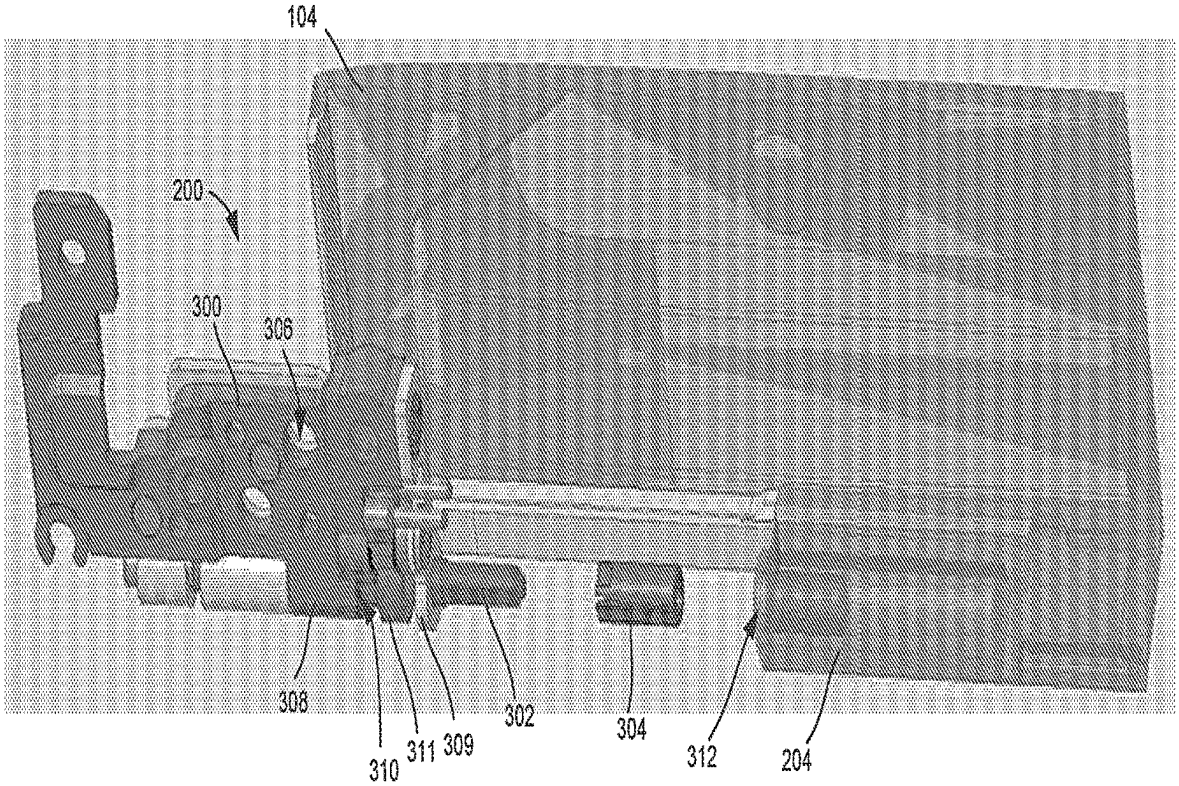

FIG. 3

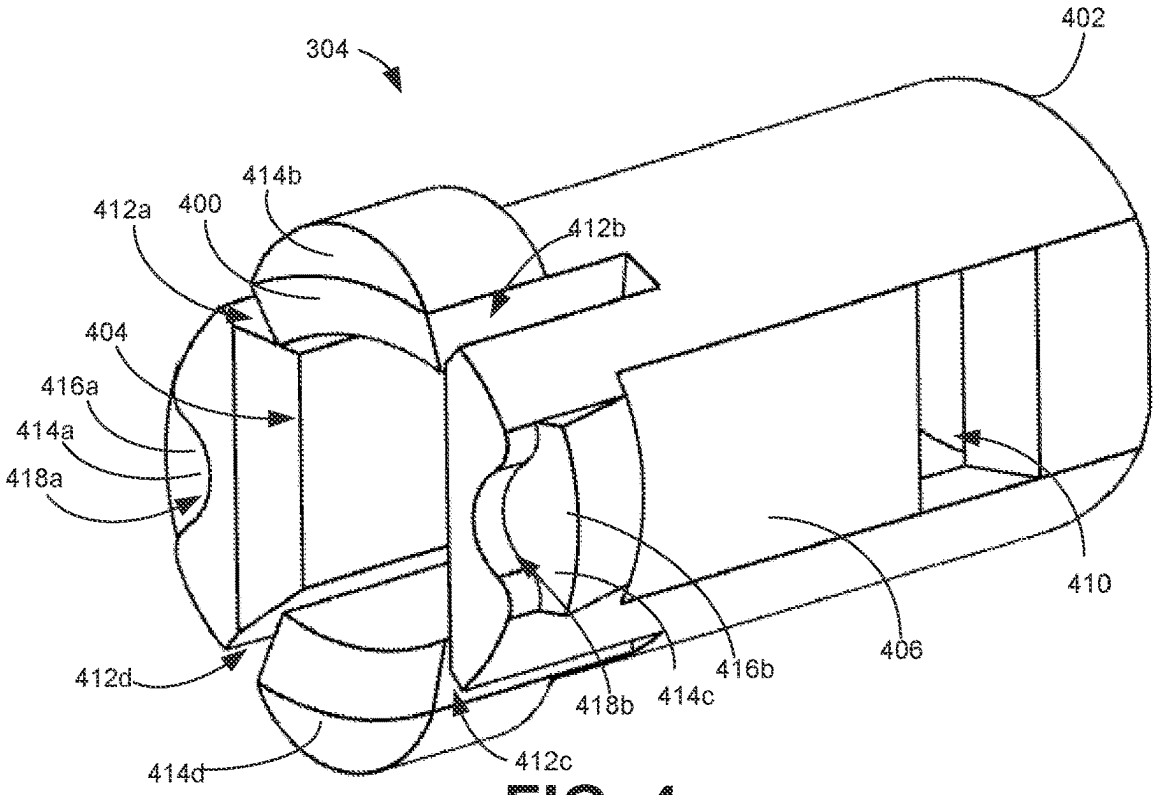
304
402
414b
412a
400
412b
404
416a
414a
418a
410
406
416b
414c
418b
412d
412c
414d

FIG. 4

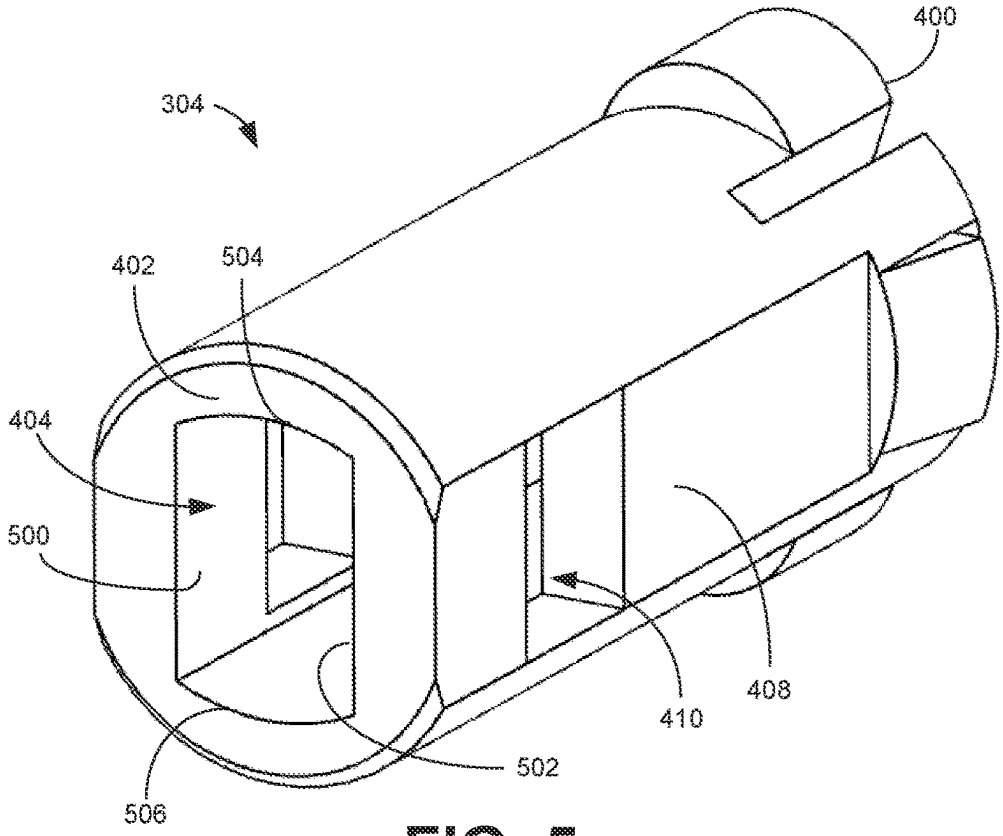
400
304
402
504
404
500
408
410
502
506

FIG. 5

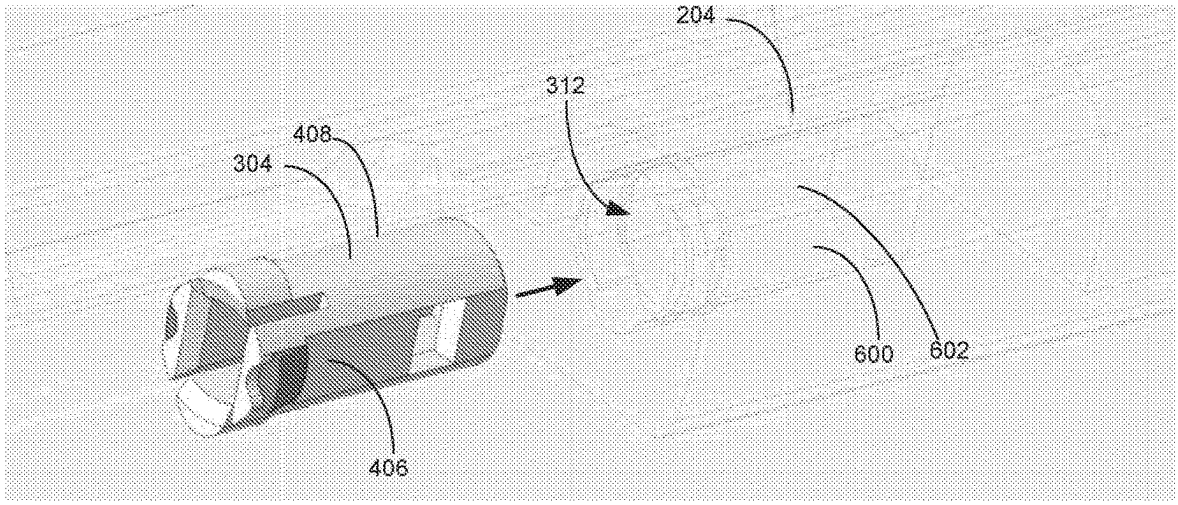

FIG. 6

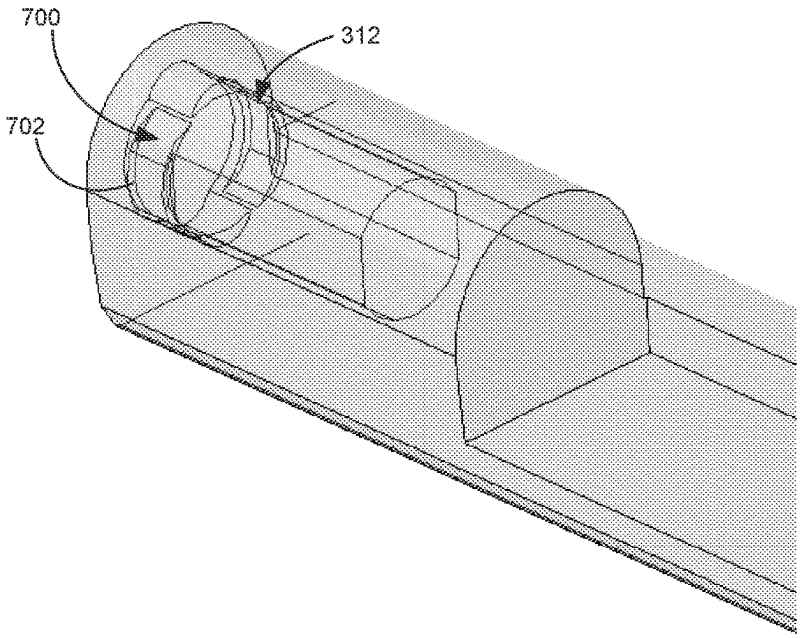

FIG. 7

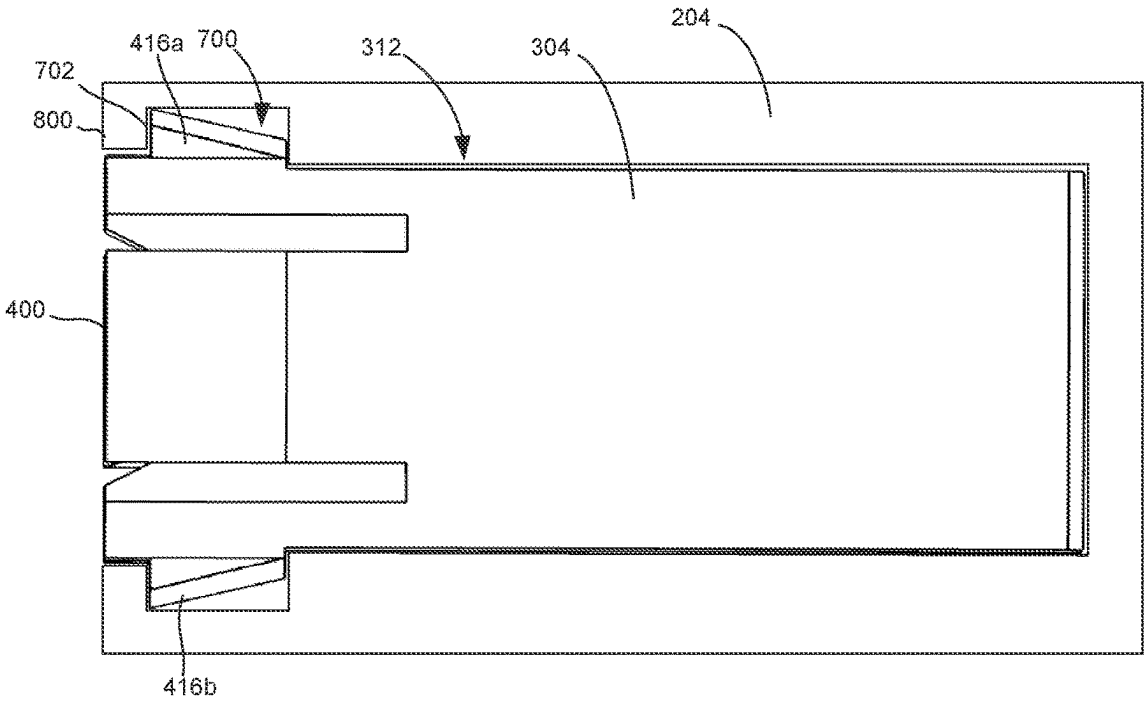
204
416a
700
312
304
702
800
400
416b

FIG. 8

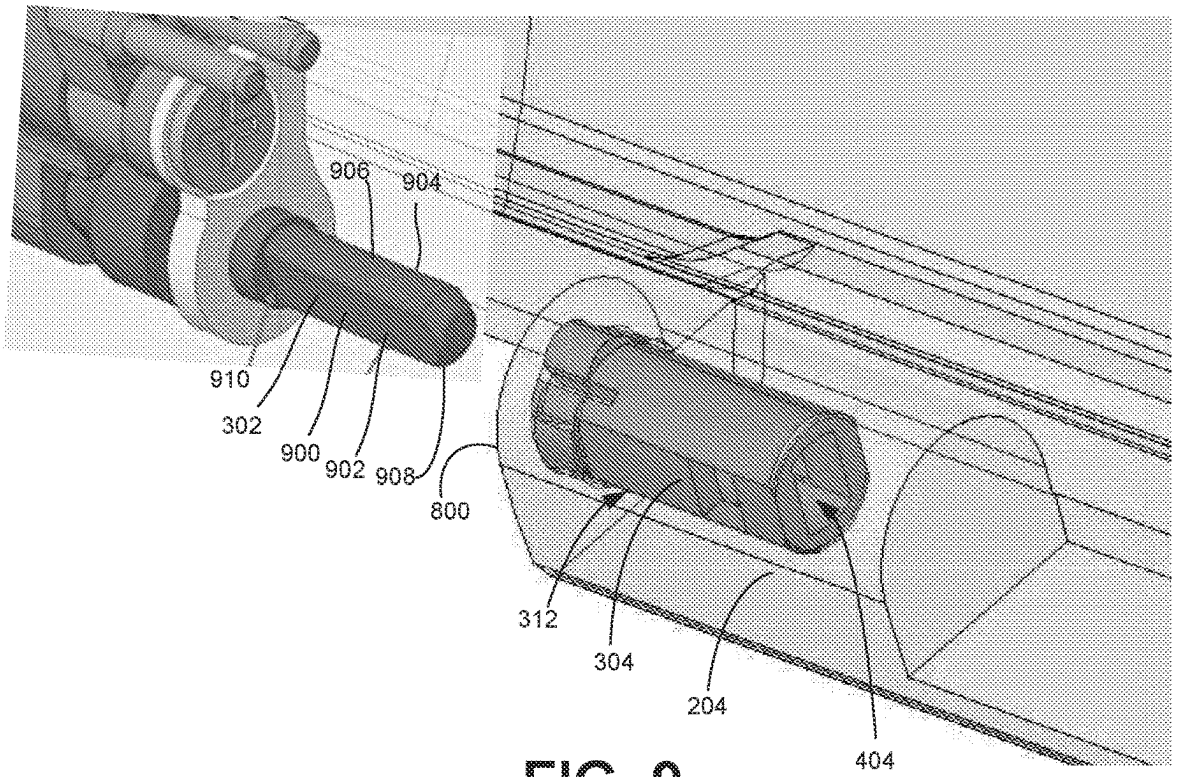
906
904
910
302
900
902
908
800
312
304
204
404

FIG. 9

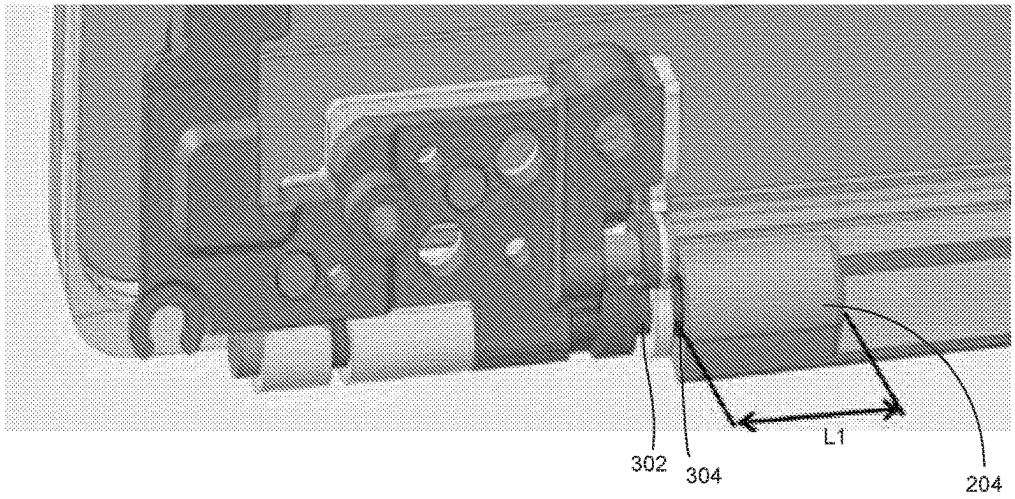

FIG. 10

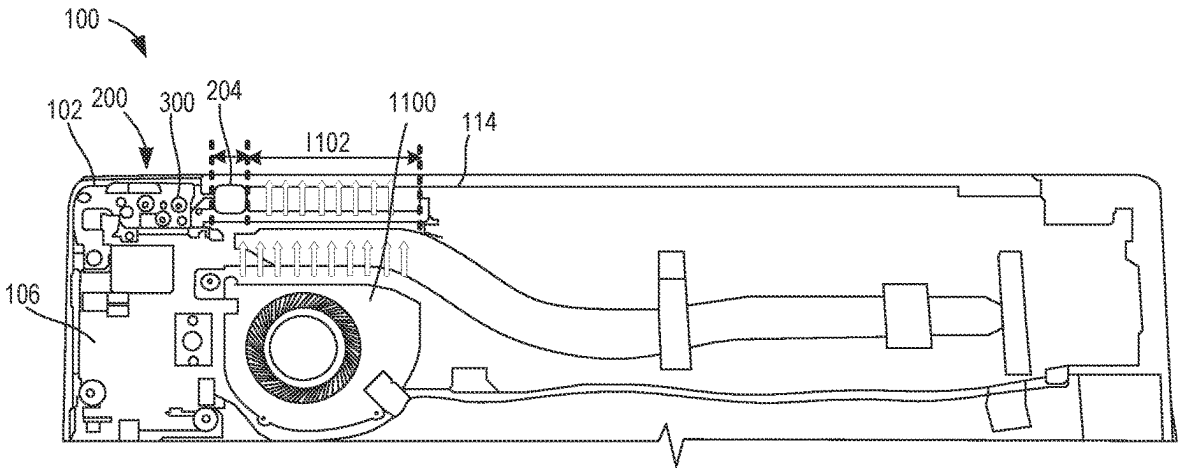

FIG. 11

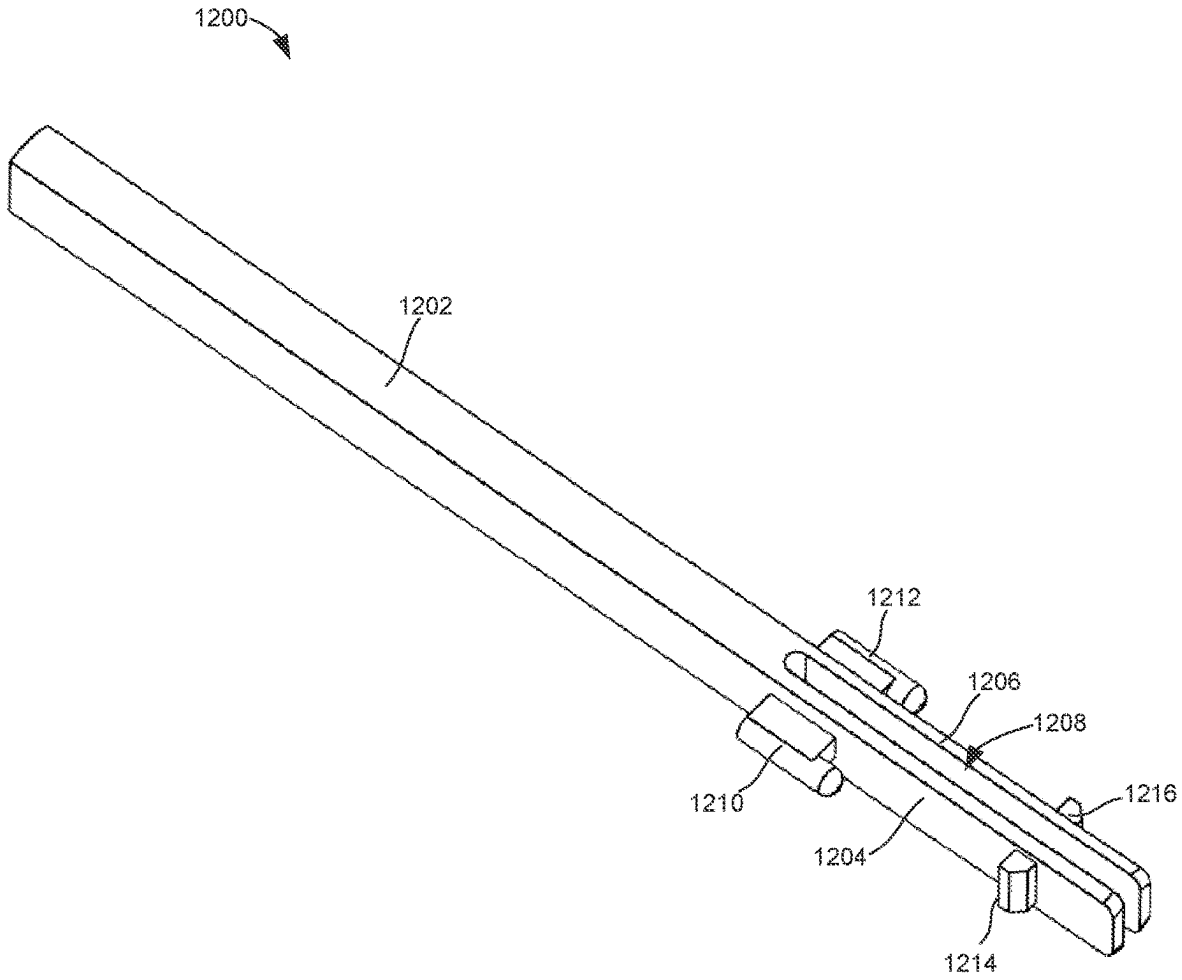

FIG. 12

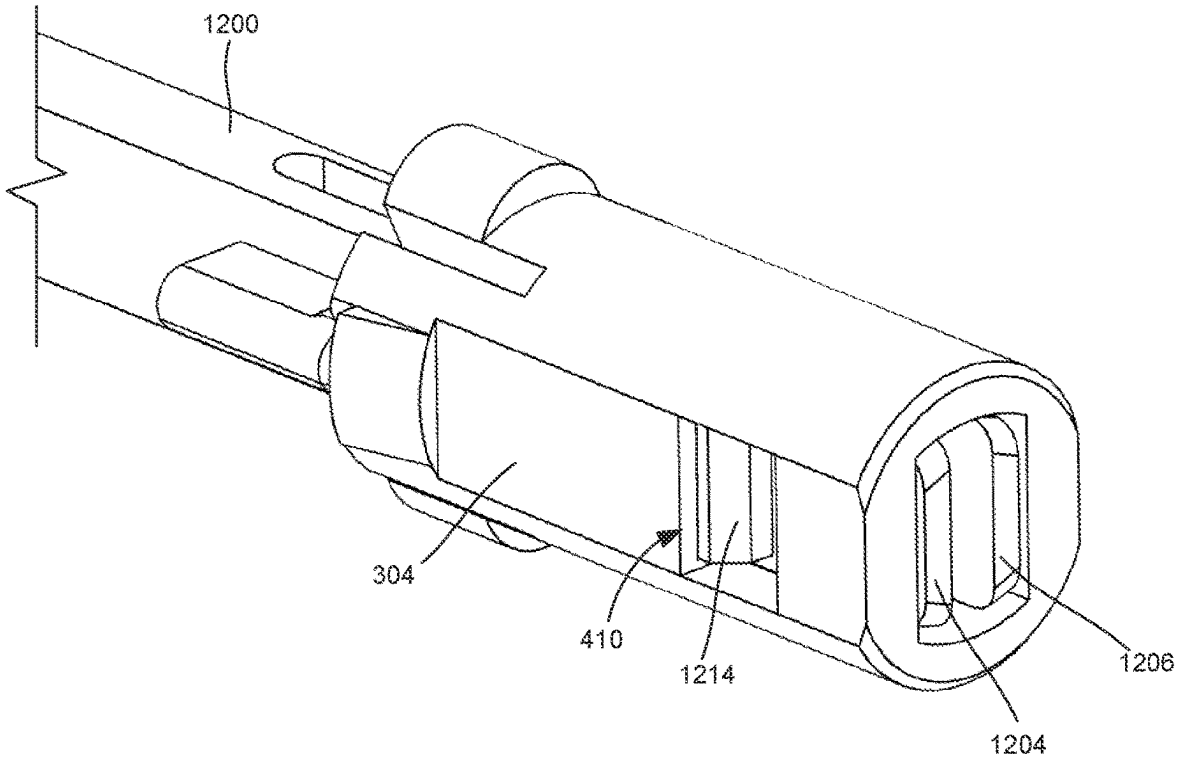
1200
304
410
1214
1206
1204

FIG. 13

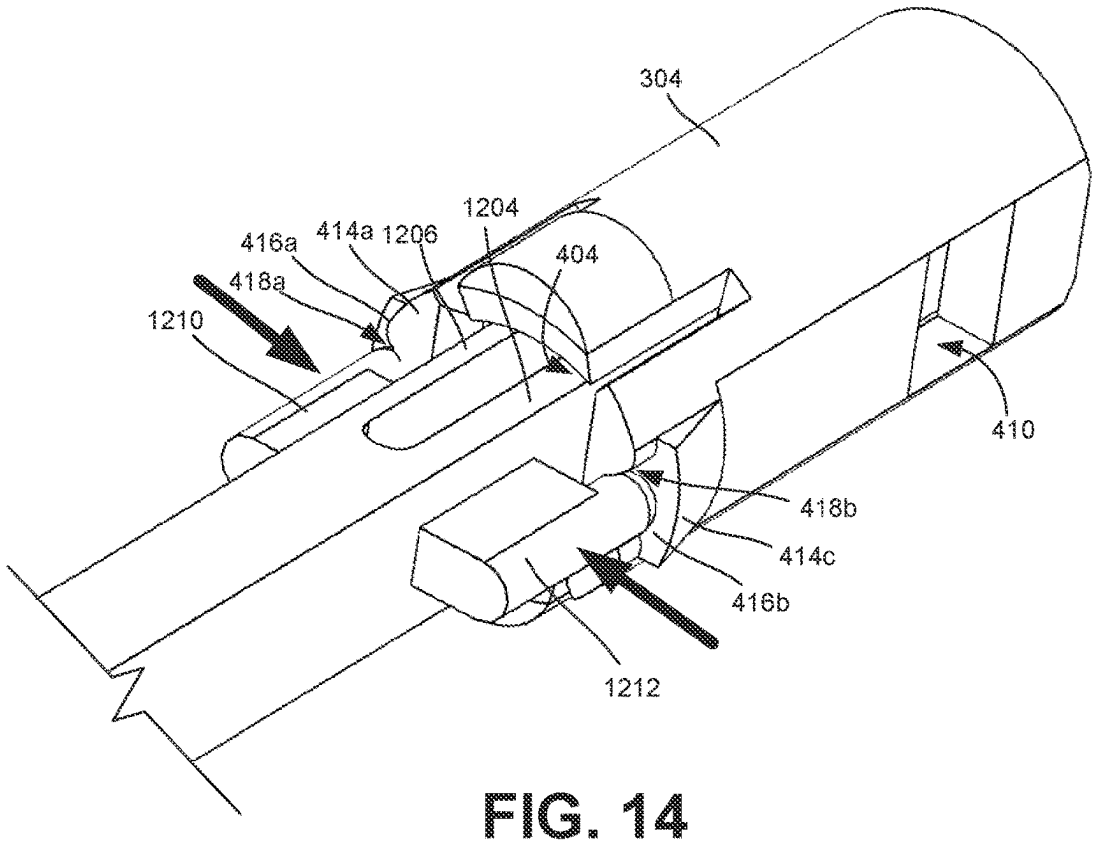
304
1204
416a
414a
1206
404
418a
1210
410
418b
414c
416b
1212

FIG. 14

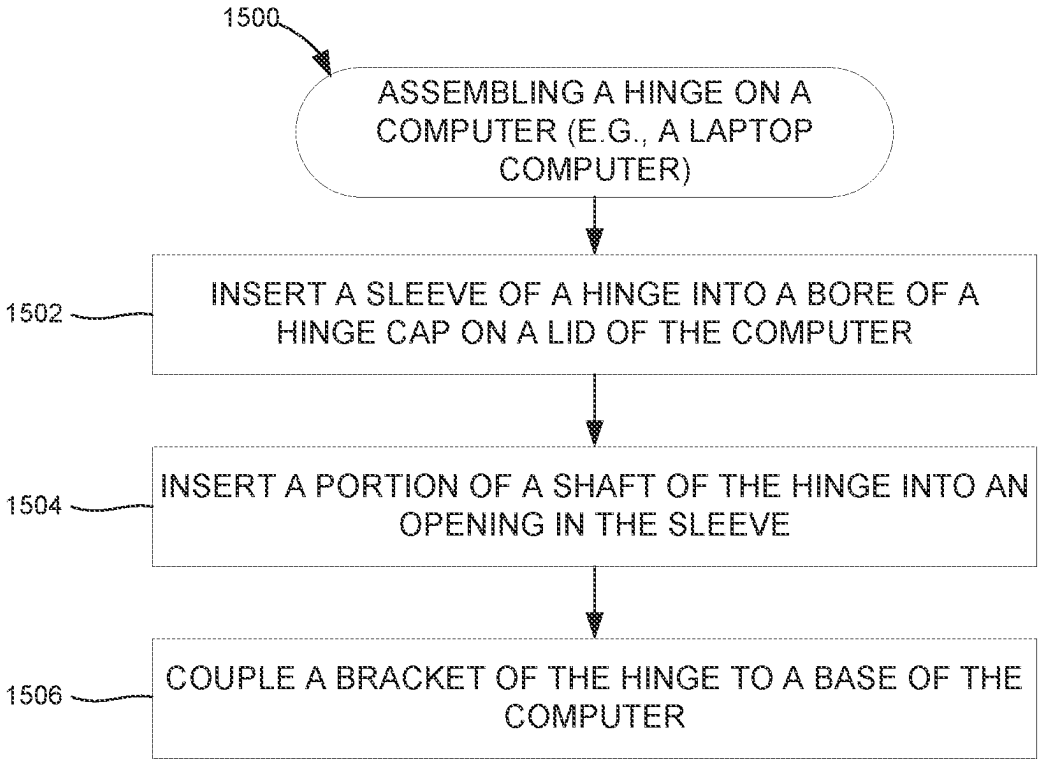
1500
ASSEMBLING A HINGE ON A COMPUTER (E.G., A LAPTOP COMPUTER)
1502
INSERT A SLEEVE OF A HINGE INTO A BORE OF A HINGE CAP ON A LID OF THE COMPUTER
1504
INSERT A PORTION OF A SHAFT OF THE HINGE INTO AN OPENING IN THE SLEEVE
1506
COUPLE A BRACKET OF THE HINGE TO A BASE OF THE COMPUTER

FIG. 15

HINGES FOR ELECTRONIC DEVICES

FIELD OF THE DISCLOSURE

This disclosure relates generally to hinges and, more particularly, to hinges for electronic devices.

BACKGROUND

Some electronic devices include two body portions that are rotatably coupled by one or more hinges. For example, laptop computers typically include a base and a lid that are coupled by two hinges to enable the lid to rotate relative to the base.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of an example laptop computer having an example base and an example lid rotatably coupled to the example base.

FIG. **2** is a partially exploded view of the example laptop computer of FIG. **1** showing example hinges used to rotatably couple the example base and the example lid.

FIG. **3** is an enlarged view of an example hinge cap on the example lid of the example laptop of FIG. **1** and a partially exploded view of one of the example hinges of FIG. **2**.

FIG. **4** is a perspective view of an example sleeve of the example hinge of FIG. **3**.

FIG. **5** is another perspective view of the example sleeve of FIG. **4**.

FIG. **6** shows the example sleeve of FIGS. **4** and **5** and the example hinge cap of FIG. **3**. The example hinge cap is shown as transparent.

FIG. **7** is another view of the example hinge cap of FIG. **3** shown as transparent.

FIG. **8** is a side view showing the example sleeve of FIGS. **4** and **5** inserted into the example hinge cap of FIGS. **6** and **7**.

FIG. **9** shows the example sleeve of FIGS. **4** and **5** in the example hinge cap and an example shaft of the example hinge aligned with the example sleeve.

FIG. **10** shows the example shaft of FIG. **9** inserted into the example sleeve.

FIG. **11** is a top view of the example laptop computer of FIG. **1** showing an example fan in the example base and an example section of vent openings for the example fan.

FIG. **12** is a perspective view of an example tool that can be used to remove the example sleeve of FIGS. **4** and **5** from the example hinge cap of FIGS. **6** and **7**.

FIG. **13** is a perspective view showing the example tool of FIG. **12** inserted into the example sleeve of FIGS. **4** and **5**.

FIG. **14** is another perspective view show the example tool inserted into the example sleeve of FIGS. **4** and **5**.

FIG. **15** is a flowchart representative of an example method of assembling an example hinge on an example laptop computer.

In general, the same reference numbers will be used throughout the drawing(s) and accompanying written description to refer to the same or like parts. The figures are not to scale. Instead, the thickness of the layers or regions may be enlarged in the drawings. Although the figures show layers and regions with clean lines and boundaries, some or all of these lines and/or boundaries may be idealized. In reality, the boundaries and/or lines may be unobservable, blended, and/or irregular.

As used in this patent, stating that any part (e.g., a layer, film, area, region, or plate) is in any way on (e.g., positioned on, located on, disposed on, or formed on, etc.) another part, indicates that the referenced part is either in contact with the other part, or that the referenced part is above the other part with one or more intermediate part(s) located therebetween.

As used herein, connection references (e.g., attached, coupled, connected, and joined) may include intermediate members between the elements referenced by the connection reference and/or relative movement between those elements unless otherwise indicated. As such, connection references do not necessarily infer that two elements are directly connected and/or in fixed relation to each other. As used herein, stating that any part is in "contact" or "engaged" with another part is defined to mean that there is no intermediate part between the two parts.

Unless specifically stated otherwise, descriptors such as "first," "second," "third," etc., are used herein without imputing or otherwise indicating any meaning of priority, physical order, arrangement in a list, and/or ordering in any way, but are merely used as labels and/or arbitrary names to distinguish elements for ease of understanding the disclosed examples. In some examples, the descriptor "first" may be used to refer to an element in the detailed description, while the same element may be referred to in a claim with a different descriptor such as "second" or "third." In such instances, it should be understood that such descriptors are used merely for identifying those elements distinctly that might, for example, otherwise share a same name.

As used herein, "approximately" and "about" modify their subjects/values to recognize the potential presence of variations that occur in real world applications. For example, "approximately" and "about" may modify dimensions that may not be exact due to manufacturing tolerances and/or other real world imperfections as will be understood by persons of ordinary skill in the art. For example, "approximately" and "about" may indicate such dimensions may be within a tolerance range of +/−10% unless otherwise specified in the below description.

As used herein, "processor circuitry" is defined to include (i) one or more special purpose electrical circuits structured to perform specific operation(s) and including one or more semiconductor-based logic devices (e.g., electrical hardware implemented by one or more transistors), and/or (ii) one or more general purpose semiconductor-based electrical circuits programmable with instructions to perform specific operations and including one or more semiconductor-based logic devices (e.g., electrical hardware implemented by one or more transistors). Examples of processor circuitry include programmable microprocessors, Field Programmable Gate Arrays (FPGAs) that may instantiate instructions, Central Processor Units (CPUs), Graphics Processor Units (GPUs), Digital Signal Processors (DSPs), XPUs, or microcontrollers and integrated circuits such as Application Specific Integrated Circuits (ASICs). For example, an XPU may be implemented by a heterogeneous computing system including multiple types of processor circuitry (e.g., one or more FPGAs, one or more CPUs, one or more GPUs, one or more DSPs, etc., and/or a combination thereof) and application programming interface(s) (API(s)) that may assign computing task(s) to whichever one(s) of the multiple types of processor circuitry is/are best suited to execute the computing task(s).

DETAILED DESCRIPTION

Some electronic devices have two body portions or sections that are rotatably or pivotably connected by one or

more hinges to enable the body portions to be moved (e.g., transitioned, converted, folded) between two or more positions. For example, some computers, such as laptop computers, include a base (which includes a keyboard and houses the electronic components) and a lid (which includes a display such as a touchscreen) that is rotatably coupled to the base by two hinges. The hinges enable the lid to be rotated between a closed position, in which the lid is parallel to and disposed along the base, and an open position, in which the lid is angled relative to the base.

Some known hinges for laptop computers include two brackets rotatably coupled by a shaft. One of the brackets is coupled to the base and one of the brackets is coupled to the lid. Press-in unibody hinges are gaining popularity on laptop computers with narrow display bezels because they do not require a bracket to be mounted on the lid. Instead, the hinge shaft is press fit directly into a hinge cap on the lid. This enables the display bezel to remain relatively narrow and thin. However, to ensure the hinge can handle the resulting stresses/loads, this requires a relatively long interface between the hinge shaft and the hinge cap. As such, known hinge caps are relatively long. As a result, the hinge caps tend to block at least a portion of the fan outlet(s) and/or ventilation hole(s) on the rear side of the base of the laptop computer, which reduces the cooling capability of the laptop computer.

Further, with known press-in hinges, the hinge shaft is undetachable from the hinge cap after insertion. The lid material is limited to softer materials (e.g., aluminum) to ensure the hinge cap is soft enough for insertion of the hinge shaft. This often deforms the hinge cap, such that the hinge cannot be repaired or replaced without a complete replacement of the lid.

Disclosed herein are example hinges that can be used on laptop computers and other electronic devices, such as tablets, phones, etc. The example hinges disclosed herein include a sleeve that is inserted into the bore in the hinge cap. The hinge shaft is inserted into an opening in the sleeve. As such, the sleeve forms an interface between the hinge shaft and the hinge cap. The sleeve has a guiding design to ease the hinge shaft into the sleeve (and, thus, the hinge cap) and help keep the hinge centered at the desired design angle. The use of the sleeve reduces structural yield stress, which enables the hinge cap to be shortened or reduced in length. Shorter hinge caps allow more room for the fan outlet(s) and/or ventilation hole(s) on the rear side of the base. As such, the example hinges disclosed herein improve thermal performance of the system. The reduced hinge cap length also provides more flexibility for the interior design/layout of the electronic components in the base.

Further, the example sleeve is detachable or removable from the hinge cap without damaging the hinge. As such, the hinge can be easily repair and/or replaced without having to replace the entire lid. This significantly reduces repair/replacement costs. Further, because the sleeve does not deform the hinge cap like in known hinges, the lid can be constructed of various types of material, and not just limited to softer material like aluminum. For example, the lid and the hinge cap can be constructed of harder materials such as stainless steel and/or magnesium. This also enables recycling of like-for-like materials, instead of mixed materials. For example, the hinge and the lid can be constructed of the same type of recyclable material.

While the example hinges disclosed are described in connection with laptop computers, it is understood the example hinges can also be used on any other electronic device that uses a hinge. For example, the hinges disclosed herein can be used on tablets (e.g., foldable tablets), phones, and/or foldable display screens.

FIG. **1** is a perspective view of an example electronic device **100** in which example hinges disclosed herein can be implemented. In this examples, the electronic device **100** is implemented as a computer, namely, a laptop computer, referred to herein as the laptop computer **100**. However, the example hinges disclosed herein can be implemented in connection with other types of electronic devices.

In the illustrated example, the laptop computer **100** includes a first portion **102** and a second portion **104** that are moveably coupled (e.g., hingedly coupled). In this example, the first portion **102** is a base, referred to herein as the base **102**, and the second portion **104** is a lid, referred to herein as the lid **104**. The lid **104** can also be referred to as a top or cover. The base **102** and the lid **104** may together form a clamshell housing. The base **102** and/or the lid **104** may be constructed of aluminum, plastic, and/or any other material or combination of materials (e.g., stainless steel). The base **102** contains (e.g., houses) one or more electrical components **106** of the laptop computer **100**. The electrical components **106** may include, for example, processor circuitry (e.g., a central processing unit (CPU), a graphics processing unit (GPU), processor core(s), etc.), one or more storage devices (e.g., solid state memory), one or more batteries, one or more cooling devices (e.g., fans), and/or other hardware and/or circuitry.

As shown in FIG. **1**, the base **102** has a first side **108**, referred to herein as a top side **108**, and a second side **110**, referred to herein as a bottom side **110**, opposite the top side **108**. The base **102** also has a first edge **112**, referred to herein as a front edge **112**, a second edge **114**, referred to herein as a rear edge **114**, opposite the front edge **112**, a third edge **116**, referred to as a left edge **116**, and a fourth edge **118**, referred to as right edge **118**, opposite the left edge **116**. The lid **104** has a first side **120**, referred to herein as a front side **120**, and a second side **122**, referred to herein as a back side **122**, opposite the front side **120**. The lid **104** also has a first edge **124**, referred to herein as a top edge **124**, a second edge **126**, referred to herein as a bottom edge **126**, opposite the top edge **124**, a third edge **128**, referred to as a left edge **128**, and a fourth edge **130**, referred to as a right edge **130**, opposite the left edge **128**.

In the illustrated example, the laptop computer **100** includes a keyboard **132** and a touch pad **134** carried by the base **102** and a display **136** (e.g., a screen) carried by the lid **104**. The display **136** is disposed at (and may form part of) the front side **120** of the lid **104**. The display **136** is to present images in response to electrical signals from one or more of the electrical components **106**. The display **136** may be located in a recess formed in the lid **104** and may be completely or partially surrounded by a bezel **138**. The bezel **138** may or may not be flush with the display **136**. In some examples, the base **102** can also include one or more displays.

In the illustrated example of FIG. **1**, the base **102** and the lid **104** are rotatably or pivotably coupled along their rear and bottom edges **114**, **126**. The lid **104** may be rotated between an open position, as shown in FIG. **1**, in which the lid **104** is angled relative to the base **102**, and a closed position, in which the front side **120** of the lid **104** is adjacent and/or engaged with the top side **108** of the base **102**. The base **102** and the lid **104** are pivotably coupled by one or more hinges, examples of which are disclosed in further detail herein. The base **102** and the lid **104** are pivotably coupled along a hingeline or axis **140** defined by the hinge(s). In some examples, the hinge(s) create sufficient

friction to hold the lid **104** (and, thus, the display **136**) at any desired angle relative to the base **102**.

FIG. **2** is a partially exploded view of the laptop computer **100**. The lid **104** is shown as disconnected from the base **102**. In the illustrated example of FIG. **2**, the laptop computer **100** includes a first hinge **200** and a second hinge **202**. The first and second hinges **200**, **202** rotatably couple the base **102** and the lid **104**. This enables the lid **104** to rotate between the open and closed positions relative to the base **102**.

In this example, the first and second hinges **200**, **202** couple the rear edge **114** of the base **102** and the bottom edge **126** of the lid **104**. In the illustrated example, the lid **104** has a first hinge cap **204** and a second hinge cap **206** along the bottom edge **126** of the lid **104**. The first and second hinge caps **204**, **206** may also be referred to as sockets. The first and second hinge caps **204**, **206** may be formed integrally (e.g., as a monolithic structure) with one or more portions of the lid **104**. For example, the first and second hinge caps **204**, **206** can be formed integrally with a panel or cover that forms the back side **122** (FIG. **1**) of the lid **104**. The first and second hinge caps **204**, **206** define bores (e.g., openings, channels, tunnels) to receive a portion of the first and second hinges **200**, **202**, respectively. The first hinge **200** pivotably couples the first hinge cap **204** and the base **102**, and the second hinge **202** pivotably couples the second hinge cap **206** and the base **102**. Therefore, the first and second hinges **200**, **202** pivotably or rotatably couple the base **102** and the lid **104**.

The first and second hinges **200**, **202** are substantially the same, expect they are oriented in the opposite or reverse direction. To avoid redundancy, only the first hinge **200** is disclosed in further detail herein. However, it is understood that any of the example aspects disclosed in connection with the first hinge **200** can likewise apply to the second hinge **202**. Further, it is understood that in other examples, the laptop computer **100** may include only one hinge or more than two hinges.

FIG. **3** shows the first hinge **200** and a portion of the lid **104** including the first hinge cap **204**. The first hinge **200** is shown in a partially exploded state. The first hinge cap **204** is shown as transparent to expose an internal bore, as disclosed in further detail herein.

In the illustrated example, the first hinge **200** includes a bracket **300**, a shaft **302**, and a sleeve **304**. The bracket **300** is capable of being coupled to the base **102** (FIGS. **1** and **2**) (the first portion) of the laptop computer **100**. In particular, when the first hinge **200** is assembled with the laptop computer **100**, the bracket **300** is coupled to the base **102**). For example, in the illustrated example, the bracket **300** includes a plurality of openings **306** (one of which is referenced in FIG. **3**). The openings **306** receive fasteners (e.g., bolts, screws) to couple the bracket **300** to the base **102**. In other examples, the bracket **300** can be coupled to the base **102** via other chemical and/or mechanical fastening techniques. In some examples, the bracket **300** is formed by two or more bracket portions that are coupled together.

In the illustrated example of FIG. **3**, the shaft **302** is rotatably coupled to the bracket **300**. The bracket **300** has a barrel **308**, sometimes referred to as a knuckle, loop, or node. The barrel **308** is formed by a curved portion of the bracket **300**. The barrel **308** defines an opening **310**. In some examples, the bracket **308** has multiple barrels that form or define the opening **310**. The shaft **302** is disposed in the opening **310** of the barrel **308**. In particular, a portion of the shaft **302** is disposed in the opening **310**, and another portion of the shaft **302** extends outward from the opening **310**. The shaft **302** is rotatable in the opening **310**. In the illustrated example, the first hinge **200** includes an end plate **309** coupled (e.g., via one or more threaded fasteners) to the bracket **300**. In the illustrated example, the shaft **302** has an enlarged portion **311**, which is disposed between the bracket **300** and the end plate **309**. This prevents the shaft **302** from being removed from the barrel **308**.

In the illustrated example of FIG. **3**, the first hinge cap **204** defines a bore **312** (e.g., an opening, a tunnel). The sleeve **304** is capable of being inserted into the bore **312**. In particular, when the first hinge **200** is assembled, the sleeve **304** is disposed in the bore **312** of the first hinge cap **204** on the lid **104**. The sleeve **304** has an opening, shown in further detail herein, to receive a portion of the shaft **302** when the first hinge **200** is assembled. Therefore, the sleeve **304** forms the interface between the shaft **302** and the first hinge cap **204** of the lid **104**. When the first hinge **200** is assembled, the sleeve **304** is non-rotatably disposed in the first hinge cap **204**, and the shaft **302** is non-rotatably disposed in the sleeve **304**. However, the shaft **302** is rotatable relative to the bracket **300** (which is coupled to the base **102**). This enables the lid **104** to rotate relative to the base **102**.

FIGS. **4** and **5** are perspective views of opposite sides of the sleeve **304**. As shown in FIGS. **4** and **5**, the sleeve **304** has a first end **400** and a second end **400** opposite the first end **400**. The sleeve defines an opening **404**. When the first hinge **200** (FIG. **3**) is assembled, a portion of the shaft **302** (FIG. **3**) is inserted into the opening **404**. In this example, the opening **404** extends through the sleeve **304** between the first end **400** and the second end **402**. In other examples, the opening **404** may extend only partially into the first end **400**.

In the illustrated example, the opening **404** has a stadium-shaped cross-section (sometimes referred to as a rounded-rectangular shape). In particular, as shown in FIG. **5**, an inner surface of the sleeve **304** defining the opening **404** has two flattened inner side surfaces **500**, **502** and two rounded side surface **504**, **506**. The shaft **302** (FIG. **3**) has a cross-sectional shape that matches the cross-sectional shape of the opening **404**. The flattened inner side surfaces **500**, **502** of the opening **404** help center the shaft **302** in the sleeve **304** and prevent or limit the shaft **302** from rotating in the sleeve **304**.

In the illustrated example of FIGS. **4** and **5**, the sleeve **304** is substantially cylindrical-shaped. However, the sleeve **304** has opposing flattened outer side surfaces **406**, **408**. The inner surface of the bore **312** (FIG. **3**) has matching flattened surfaces. When the sleeve **304** is disposed in the bore **312**, the flattened side surfaces **406**, **408** are disposed along and/or engaged with the corresponding surfaces in the bore **312**. This helps guide and center the sleeve **304** when the sleeve **304** is inserted into the bore **312**. The flattened outer side surfaces **406**, **408** also prevent or limit the sleeve **304** from rotating in the bore **312** when the sleeve **304** is disposed in the bore **312**. In the illustrated example, the sleeve **304** has an opening **410** extending between the flattened outer side surfaces **406**, **408**. The opening **410** extends through the sleeve **304** in a direction that is transverse to the opening **404**. The opening **410** is used to receive hooks on a tool for removing the sleeve **304** from the bore **312**, as disclosed in further detail herein.

As shown in FIG. **4**, the sleeve **304** has four slots **412***a*-**412***d* extending into the first end **400**. Four flexible or elastic arms **414***a*-**414***d* are defined between the slots **412***a*-**412***d*. As such, the sleeve **304** has flexible arms **414***a*-**414***d* on the first end **400**. The arms **414***a*-**414***d* can flex radially inward or outward, which is useful when installing or removing the sleeve **304** into/from the bore **312** (FIG. **3**) of

the first hinge cap **204** (FIG. **3**). In this example, the sleeve **304** has four arms **414***a*, **414***d*. However, in other examples, the sleeve **304** can include more or fewer arms.

In the illustrated example, the first and third arms **414***a*, **414***c* have first and second tabs **416***a*, **416***b*, respectively, extending radially outward. The tabs **416***a*, **416***b* are used to lock the sleeve **304** in the bore **312**, as disclosed in further detail herein. Further, as shown in FIG. **4**, the first and third arms **414***a*, **414***c* have notches **418***a*, **418***b* (e.g., grooves, recesses), which are used to receive a tool for removing the sleeve **304** from the bore **312**, as disclosed in further detail herein.

FIG. **6** shows the sleeve **304** aligned with the bore **312** in the first hinge cap **204** before being inserted into the bore **312**. The first hinge cap **204** is shown as transparent. As shown in FIG. **6**, the inside of the bore **312** has first and second flattened inner side surfaces **600**, **602**. The sleeve **304** is to be inserted into the bore **312** in one of two orientations such that the flattened outer side surfaces **406**, **408** of the sleeve **304** are aligned with the flattened inner side surfaces **600**, **602** of the bore **312**.

As shown in FIG. **7**, the bore **312** has an enlarged section **700** that forms a shoulder **702**. The shoulder **702** has a smaller diameter than the tabs **416***a*, **416***b* on the sleeve **304**. When the sleeve **304** is inserted into the bore **312**, the first and third arms **414***a*, **414***c* are flexed inward until the tabs **416***a*, **416***b* clear the shoulder **702**, and then the first and third arms **414***a*, **414***c* flex outward such that the tabs **416***a*, **416***b* are disposed beyond the shoulder **702**. For example, FIG. **8** is a side view showing the first and second tabs **416**, **416***b* in the enlarged portion **700**. The first and second tabs **416***a*, **416***b* are engaged and/or otherwise blocked by the shoulder **702**. This prevents the sleeve **304** from being removed from the bore **312**. Further, the flattened inner side surfaces **600**, **602** (FIG. **6**) of the bore **312** and the flattened outer side surfaces **406**, **408** (FIGS. **4** and **5**) of the sleeve **304** non-rotatably couple the sleeve **304** in the bore **312**.

In some examples, the sleeve **304** and the bore **312** are dimensioned to form a transition fit (sometimes referred to as a slip fix or push fit) between the sleeve **304** and the first hinge cap **204**. This enables the sleeve **304** to be easily inserted and/or removed into/from the bore **312** without damaging the sleeve **304** or the first hinge cap **204**. In some examples, the tolerance for the sleeve **304** and the bore **312** is ±0.05 millimeters (mm). In other examples, other tolerance can be used. In other examples, the sleeve **304** and the bore **312** can be dimensioned to form a clearance fit or interference fit. In some examples, when the sleeve **304** is inserted into the bore **312**, the first end **400** of the sleeve **304** is aligned with an end surface **800** of the first hinge cap **204**. In other examples, the first end **400** may protrude outward from or be recessed relative to the end surface **800** of the first hinge cap **204**.

FIG. **9** shows the sleeve **304** in the bore **312** of the first hinge cap **204** and the shaft **302** aligned with the sleeve **304** before insertion. The shaft **302** has a portion **900** to be inserted into the opening **404** in the sleeve **304**. The portion **900** of the shaft **302** has the same cross-sectional shape (e.g., a stadium shape) as the opening **404** in the sleeve **304**. In particular, the portion **900** of the shaft has two flattened outer side surfaces **902**, **904** and two curved outer side surfaces **906**, **908**. When the shaft **302** is inserted into the opening **404** of the sleeve, the flattened outer side surfaces **902**, **904** are disposed along and/or engaged with the two flattened inner side surfaces **500**, **502** (FIG. **5**) of the opening **404**. As such, when the shaft **302** is inserted into the sleeve **304**, the shaft **302** does not rotate relative to the sleeve **304**. This non-rotatably couples the shaft **302** and the sleeve **304**. While in this example the opening **404** and the shaft **302** have a cross-sectional shape with two flattened side surfaces, in other examples, the opening **404** and the shaft **302** can have more or fewer flattened side surfaces and/or other cross-sectional shapes. In some examples, the shaft **302** and the opening **404** are dimensioned to form a transition fit between the shaft **302** and the sleeve **304**. This enables the shaft **302** to be easily inserted and/or removed into/from the opening **404** without damaging the shaft **302** or the sleeve **304**. In other examples, the shaft **302** and the opening **404** can dimensioned to form a clearance fit or interference fit.

In the illustrated example, the shaft **302** has an enlarged portion forming a shoulder **910** (e.g., a stop plane). In some examples, when the portion **900** of the shaft **302** is inserted into the opening **404** of the sleeve **304**, the shoulder **910** engages the end surface **800** of the first hinge cap **204**.

FIG. **10** shows the shaft **302** inserted into the sleeve **304**. The use of the sleeve **304** with the flattened surfaces (inner and outer) forms a relatively strong, rigid interface between the shaft **302** and the first hinge cap **204**. This reduces stress on the shaft **302**, which enables the first hinge cap **204** to be shortened while still providing sufficient structural rigidity and support. As shown in FIG. **10**, the first hinge cap **204** has a length of L**1**. In some examples, L**1** is about 10 millimeters (mm) (e.g., +0.5 mm) or less. Known laptop computers have hinge caps of 20 mm or larger. Therefore, the first hinge cap **204** can be significantly shorter than known hinge caps. This is beneficial because it allows more for vent air flow from the base **102**. In other examples, the length L**1** can be longer than 10 mm.

FIG. **11** is a top view of laptop computer **100** with the top side **108** (FIG. **1**) of the base **102** removed. The bracket **300** of the first hinge **200** is coupled to the base **102**. The laptop computer **100** includes a fan **1100** (e.g., a blower) in the base **102** to exhaust hot/warm air from the base **102** to help cool the electrical components **106**. The rear edge **114** of the base **102** has a section **1102** with one or more vent openings. The fan **1100** is positioned to blow the air through the vent opening(s). As disclosed above, the first hinge cap **204** is relatively short compared to known hinge caps. This enables more room for the vent opening(s) for the fan **1100**. It is generally known that electronic components operate more efficiently in cooler temperatures. As such, the reduced length hinge cap improves (e.g., increases) the cooling capacity of the fan **1100** and thereby improves efficiency of the laptop computer **100**.

As disclosed above, in some examples, the first hinge **200** can be disconnected from the base **102** and the lid **104** for repair and/or replacement. The first hinge **200** can be disconnected from the base **102** and the lid **104** without damage to the base **102** or the lid **104**. This reduces costs associated with repair or replacement of the first hinge **200**.

FIG. **12** is a perspective view of an example tool **1200** constructed in accordance with the teachings of this disclosure. The example tool **1200** can be used to remove the sleeve **304** from the bore **312** of the first hinge cap **204**. This enables the sleeve **304** to be easily repaired or replaced if the sleeve **304** fails. In some examples, the example tool **1200** can be included as part of a kit or assembly that is manufactured and sold with one or more of the hinges. In some examples, the tool **1200** is provided as part of the laptop computer **100**. In other examples, the tool **1200** is provided (e.g., sold) separately from the hinges **200**, **202** and/or the laptop computer **100**.

In the illustrated example, the tool **304** has a handle portion **1202** that can be held in the hand of a person. The

tool **1200** also has first and second prongs **1204**, **1206** (e.g., tines) extending from the handle portion **1202**. The prongs **1204**, **1206** are separated by a slot or cut-out **1208**, which enables the first and second prongs **1204**, **1206** to be flexed toward each other (e.g., pinched together). The tool **1200** has first and second pins **1210**, **1212** on the outer sides of the first and second prongs **1204**, **1206**, respectively. The tool **1200** also has first and second hooks **1214**, **1216** on the outer sides of the first and second prongs **1204**, **1206**, respectively. In some examples, the tool **1200** is constructed as a single unitary part or component (e.g., a monolithic structure). In some examples, the tool **1200** is constructed of plastic and/or metal. In other examples, the tool **1200** can be constructed as multiple parts or components that are coupled together.

To remove the sleeve **304** from the bore **312**, a user can insert the prongs **1204**, **1206** into the opening **404** of the sleeve **304**. The hooks **1214**, **1216** are tapered or angled, such that when the prongs **1204**, **1206** are inserted into the opening **404**, the hooks **1214**, **1216** engage the sleeve **304** and flex the prongs **1204**, **1206** together. FIG. **13** shows the prongs **1204**, **1206** of the tool **1200** inserted into the opening **404** of the sleeve **304**. When the hooks **1214**, **1216** reach the opening **410**, the prongs **1204**, **1206** expand (e.g., move apart) such that such that the hooks **1214**, **1216** are disposed in the opening **410**. This attaches the sleeve **304** to the tool **1200** so that the tool **1200** can pull the sleeve **304** from the bore **312**.

As shown in FIG. **14**, when the prongs **1204**, **1206** are inserted into the opening **404** for the sleeve **304**, the pins **1210**, **1212** slide into the notches **418***a*, **418***b* in the first and third arms **414***a*, **414***c* of the sleeve **304**. Then, a user can pinch the prongs **1204**, **1206** together (as shown by the arrows), which causes the pins **1210**, **1212** to move the first and third arms **414***a*, **414***c* radially inward so that that the tabs **416***a*, **416***b* clear the shoulder **702** (FIG. **7**). When the tabs **416***a*, **416***b* are clear of the shoulder **702**, the user can pull the tool **1200** outward, which slides the sleeve **304** outward from the bore **312** of the first hinge cap **204**. When the user pinches the prongs **1204**, **1206** together, the hooks **1214**, **1216** (FIGS. **12** and **13**) remain in the opening **410**, which enables the tool **1200** to pull the sleeve **304** outward from the bore **312** of the first hinge cap **204**.

FIG. **15** is a flowchart representative of an example method **1500** of assembling or installing the first hinge **200** on the laptop computer **100**. The example method **1500** is described in connection with the first hinge **200**. The example method **1500** can be similarly performed in connection with the second hinge **202**. In the example method **1500**, it is assumed the shaft **302** of the first hinge **200** is already rotatably coupled to the bracket **300**.

The example method **1500** includes inserting the sleeve **304** of the first hinge **200** into the bore **312** of the first hinge cap **204** (block **1502**). In some examples, the sleeve **304** is inserted until the first and second tabs **416***a*, **416***b* clear the shoulder **702**, which locks the sleeve **304** in the bore **312**. In some examples, the sleeve **304** is inserted by a user (e.g., a person). In other examples, the sleeve **304** is inserted by a machine or tool. In some examples, the sleeve **304** and the bore **312** are dimensioned to form a transition fit between the sleeve **304** and the first hinge cap **204**. As such, the sleeve **304** can be easily slid into the bore **312**.

The method **1500** includes inserting the portion **900** of the shaft **302** into the opening **404** in the sleeve **304** (block **1504**). In some examples, the shaft **302** is inserted by a user (e.g., a person). In other examples, the shaft **302** is inserted by a machine or tool. In some examples, the shaft **302** and the opening **404** are dimensioned to form a transition fit between the shaft **302** and the sleeve **304**. As such, the shaft **302** can be easily slid into the opening **404** of the sleeve **304**.

The method **1500** includes coupling the bracket **300** of the first hinge **200** to the base **102** of the laptop computer **100** (block **1506**). For example, one or more threaded fasteners can be inserted through the openings **306** and screwed into the base **102**. In some examples, the shaft **302** is inserted into the sleeve **304** first, and then the bracket **300** is coupled to the base **102**. In other examples, the bracket **300** can be coupled to the base first, and then the shaft **302** is inserted into the sleeve **304**. In other examples, the shaft **302** is inserted into the sleeve **304** first, and then the sleeve **304** with the shaft **302** are inserted into the bore **312** of the first hinge cap **204**.

To remove or disassemble the first hinge **200**, the example method **1500** can be performed in reverse. For example, the bracket **300** can be disconnected (e.g., unscrewed) from the base **102**. Then, the shaft **302** can be slid out of the sleeve **304**. Then, the sleeve **304** can be removed from the first hinge cap **204**. In some examples, to remove the sleeve **304** from the bore **312** of the first hinge cap **204**, the tool **1200** can be used, as disclosed in connection with FIGS. **12-14**.

While in some examples disclosed herein the bracket **300** is coupled to the base **102** and the shaft **302** is connected to the lid **104**, in other examples, the hinge connections can be reversed. For example, in some examples, the bracket **300** can be coupled (e.g., screwed) to the lid **104**, and the shaft **302** and the sleeve **304** can be inserted into a hinge cap on the base **102**. The hinge connections can be varied based on the type of electronic device.

"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. As used herein, when the phrase "at least" is used as the transition term in, for example, a preamble of a claim, it is open-ended in the same manner as the term "comprising" and "including" are open ended. 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, or (7) A with B and with C. As used herein in the context of describing structures, components, items, objects and/or things, the phrase "at least one of A and B" is intended to refer to implementations including any of (1) at least one A, (2) at least one B, or (3) at least one A and at least one B. Similarly, as used herein in the context of describing structures, components, items, objects and/or things, the phrase "at least one of A or B" is intended to refer to implementations including any of (1) at least one A, (2) at least one B, or (3) at least one A and at least one B. As used herein in the context of describing the performance or execution of processes, instructions, actions, activities and/or steps, the phrase "at least one of A and B" is intended to refer to implementations including any of (1) at least one A, (2) at least one B, or (3) at least one A and at least one B. Similarly, as used herein in the context of describing the performance or execution of processes, instructions, actions, activities and/or steps, the phrase "at least one of A or B" is intended to refer to implementations including any of (1) at least one A, (2) at least one B, or (3) at least one A and at least one B.

As used herein, singular references (e.g., "a", "an", "first", "second", etc.) do not exclude a plurality. The term "a" or "an" object, as used herein, refers to one or more of that object. The terms "a" (or "an"), "one or more", and "at least one" are used interchangeably herein. Furthermore, although individually listed, a plurality of means, elements or method actions may be implemented by, e.g., the same entity or object. Additionally, although individual features may be included in different examples or claims, these may possibly be combined, and the inclusion in different examples or claims does not imply that a combination of features is not feasible and/or advantageous.

From the foregoing, it will be appreciated that example laptop computer hinges have been disclosed that enable shorter hinge caps on the lid of the laptop computer. Shorter hinge caps allow more room for the fan outlet opening(s), which improves the cooling capability of the system and reduces temperatures in the laptop computer. The example hinges disclosed herein are also removable and replaceable without damage to the laptop computer. This reduces costs associated with repairing and/or replacing parts of the laptop computer.

Examples and combinations of examples disclosed herein include the following:

Example 1 is a hinge for an electronic device. The hinge comprises a bracket capable of being coupled to a first portion of the electrical device. The bracket has a barrel defining a first opening. The hinge also comprises a shaft in the first opening. The shaft is rotatable in the first opening. The hinge further comprises a sleeve capable of being inserted into a bore in a second portion of the electronic device, the sleeve defining a second opening to receive a portion of the shaft.

Example 2 includes the hinge of Example 1, wherein an inner surface of the sleeve has flattened inner side surfaces, and wherein the portion of the shaft has flattened outer side surfaces.

Example 3 includes the hinge of Examples 1 or 2, wherein the sleeve has opposing flattened outer side surfaces.

Example 4 includes the hinge of any of Examples 1-3, wherein the sleeve has a first end and a second end opposite the first end, the second opening extending through the sleeve between the first end and the second end.

Example 5 includes the hinge of Example 4, wherein the sleeve has flexible arms on the first end.

Example 6 includes the hinge of Example 5, wherein two of the flexible arms have tabs to engage a shoulder in the bore of the second portion of the laptop computer.

Example 7 includes the hinge of any of Examples 4-6, wherein the sleeve has a third opening extending in a direction that is transverse to the second opening.

Example 8 includes the hinge of any of Examples 1-7, further including an end plate coupled to the bracket, the shaft having an enlarged portion between the bracket and the end plate.

Example 9 includes the hinge of any of Examples 1-8, wherein the shaft and the second opening of the sleeve are dimensioned to form a transition fit between the shaft and the sleeve.

Example 10 includes the hinge of any of Examples 1-9, wherein the bracket has an opening to receive a threaded fastener to couple the bracket to the second portion of the laptop computer.

Example 11 is a computer comprising a base, a lid, the lid having a hinge cap defining a bore, and a hinge rotatably coupling the base and the lid. The hinge includes a sleeve in the bore of the hinge cap, the sleeve defining an opening, a bracket coupled to the base, and a shaft rotatably coupled to the bracket, the shaft extending into the opening in the sleeve.

Example 12 includes the computer of Example 11, wherein the bore has an enlarged section forming a shoulder, the sleeve having a tab engaged with the shoulder to prevent the sleeve from being removed from the bore.

Example 13 includes the computer of Examples 11 or 12, wherein the bore has flattened inner side surfaces and the sleeve has flattened outer side surfaces to non-rotatably couple the sleeve in the bore.

Example 14 includes the computer of any of Examples 11-13, wherein the opening in the sleeve has a stadium-shaped cross-section.

Example 15 includes the computer of Example 14, wherein the shaft has a cross-sectional shape that matches the opening in the sleeve.

Example 16 includes the computer of any of Examples 11-15, wherein the hinge cap has a length of about 10 millimeters or less.

Example 17 includes the computer of any of Examples 11-16, further including a keyboard carried by the base and a display carried by the lid.

Example 18 is a method comprising inserting a sleeve of a hinge into a bore in a hinge cap on a lid of a computer. The hinge includes a bracket and a shaft rotatably coupled to the bracket. The method further comprises inserting the shaft into the sleeve and coupling the bracket to a base of the computer.

Example 19 includes the method of Example 18, wherein the sleeve and the bore of the hinge cap are dimensioned to form a transition fit between the sleeve and the hinge cap.

Example 20 includes the method of Examples 18 or 19, wherein the shaft and an opening in the sleeve are dimensioned to form a transition fit between the shaft and the sleeve.

Example 21 is an assembly comprising a hinge for a computer. The hinge includes a sleeve to be inserted into a bore of a hinge cap on the computer. The sleeve has an opening to receive a hinge shaft. The assembly also comprises a tool to remove the sleeve from the bore of the hinge cap. The tool includes a handle portion, first and second prongs extending from the handle portion, first and second pins on the first and second prongs, and first and second hooks on the first and second prongs.

Example 22 includes the assembly of Example 21, wherein the opening is a first opening, the sleeve defining a second opening, wherein, when the first and second prongs of the tool are inserted into the first opening of the sleeve, the first and second hooks extend into the second opening of the sleeve.

Example 23 includes the assembly of Examples 21 or 22, wherein the sleeve has first and second arms with first and second notches, wherein, when the first and second prongs of the tool are inserted into the opening of the sleeve, the first and second pins extend into the first and second notches.

The following claims are hereby incorporated into this Detailed Description by this reference. Although certain example systems, 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 systems, methods, apparatus, and articles of manufacture fairly falling within the scope of the claims of this patent.

What is claimed is:

1. A hinge for an electronic device, the hinge comprising:

a bracket capable of being coupled to a first portion of the electronic device, the bracket having a barrel defining a first opening;

a shaft in the first opening, the shaft rotatable in the first opening; and

a sleeve capable of being inserted into a bore in a second portion of the electronic device, the sleeve defining a second opening to receive a portion of the shaft, the sleeve having a first end and a second end opposite the first end, the sleeve having flexible arms on the first end, at least two of the flexible arms having tabs to engage a shoulder in the bore of the second portion of the electronic device.

2. The hinge of claim **1**, wherein an inner surface of the sleeve has flattened inner side surfaces, and wherein the portion of the shaft has flattened outer side surfaces.

3. The hinge of claim **1**, wherein the sleeve has opposing flattened outer side surfaces.

4. The hinge of claim **1**, wherein the second opening extends through the sleeve between the first end and the second end.

5. The hinge of claim **4**, wherein the sleeve has a third opening extending in a direction that is transverse to the second opening.

6. The hinge of claim **1**, including an end plate coupled to the bracket, the shaft having an enlarged portion between the bracket and the end plate.

7. The hinge of claim **1**, wherein the shaft and the second opening of the sleeve are dimensioned to form a transition fit between the shaft and the sleeve.

8. The hinge of claim **1**, wherein the bracket has an opening to receive a threaded fastener to couple the bracket to the second portion of the electronic device.

9. A computer comprising:

a base;

a lid, the lid having a hinge cap defining a bore, the bore having a shoulder at an enlarged section; and

a hinge rotatably coupling the base and the lid, the hinge including:

a sleeve in the bore of the hinge cap, the sleeve defining an opening, the sleeve having a first end and a second end opposite the first end, the sleeve having slots extending into the first end such that flexible arms are defined between the slots, a first one of the flexible arms having a tab engaged with the shoulder to prevent the sleeve from being removed from the bore;

a bracket coupled to the base; and

a shaft rotatably coupled to the bracket, the shaft extending into the opening in the sleeve.

10. The computer of claim **9**, wherein the bore has flattened inner side surfaces and the sleeve has flattened outer side surfaces to non-rotatably couple the sleeve in the bore.

11. The computer of claim **9**, wherein the opening in the sleeve has a rounded-rectangular cross-section.

12. The computer of claim **11**, wherein the shaft has a cross-sectional shape that matches the opening in the sleeve.

13. The computer of claim **9**, wherein the hinge cap has a length of about 10 millimeters or less.

14. The computer of claim **9**, including a keyboard carried by the base and a display carried by the lid.

15. A method comprising:

inserting a sleeve of a hinge into a bore in a hinge cap on a lid of a computer, the hinge including a bracket and a shaft rotatably coupled to the bracket, the bore having a shoulder, the sleeve having a first end and a second end opposite the first end, the first end having flexible arms, at least two of the flexible arms having respective tabs, the tabs having an outer diameter that is larger than an inner diameter of the shoulder, such that when the sleeve is inserted into the bore and the tabs clear the shoulder, the tabs prevent the sleeve from being removed from the bore;

inserting the shaft into the sleeve; and

coupling the bracket to a base of the computer.

16. The method of claim **15**, wherein the sleeve and the bore of the hinge cap are dimensioned to form a transition fit between the sleeve and the hinge cap.

17. The method of claim **15**, wherein the shaft and an opening in the sleeve are dimensioned to form a transition fit between the shaft and the sleeve.

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