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　　　DeMaio　　　　　　　　　　　　(45) **Date of Patent:**　　**Nov. 10, 2020**

(54) **HINGE MECHANISM FOR ELECTRONIC DEVICES**

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(51) **Int. Cl.**
　　G06F 1/16　　　　　(2006.01)
　　E05D 3/06　　　　　(2006.01)

(52) **U.S. Cl.**
　　CPC *G06F 1/1681* (2013.01); *E05D 3/06* (2013.01); *E05Y 2900/606* (2013.01)

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　　CPC G06F 1/1616; G06F 1/1618; G06F 1/162; G06F 1/1647; G06F 1/1649; G06F 1/1681; E05D 3/06
　　USPC 361/679.26, 679.55, 679.56
　　See application file for complete search history.

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(57)　　　　　　　　**ABSTRACT**

A hinge mechanism for electronic devices is implemented by which a user can mechanically and communicatively connect two devices together. Each device supports a rotatable cylindrical shaft that is positioned near adjacent edges of each respective smartphone. The rotatable shaft includes spring-loaded tabs which lock into place against corresponding notches on a hinge pin that is positioned within a cavity of the rotatable shaft. User manipulation (e.g., rotation) of the devices translates to the rotatable shaft to thereby cause rotation of a device relative to the partner device. Upon authorized connection, various functionality can be enabled between the two devices, such as sharing displays to create one large display for viewing and sharing battery power between the devices.

14 Claims, 19 Drawing Sheets
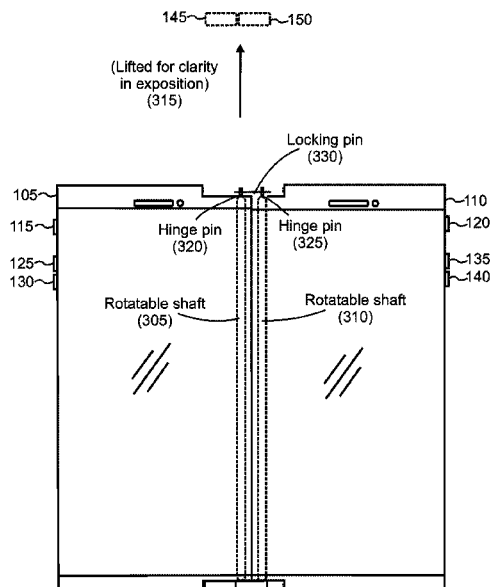
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FIG 1

Combine (170)

FIG 2

FIG 3

110
120
135
140

Locking pin
(330)

Hinge pin
(325)

Rotatable shaft
(310)

150

145
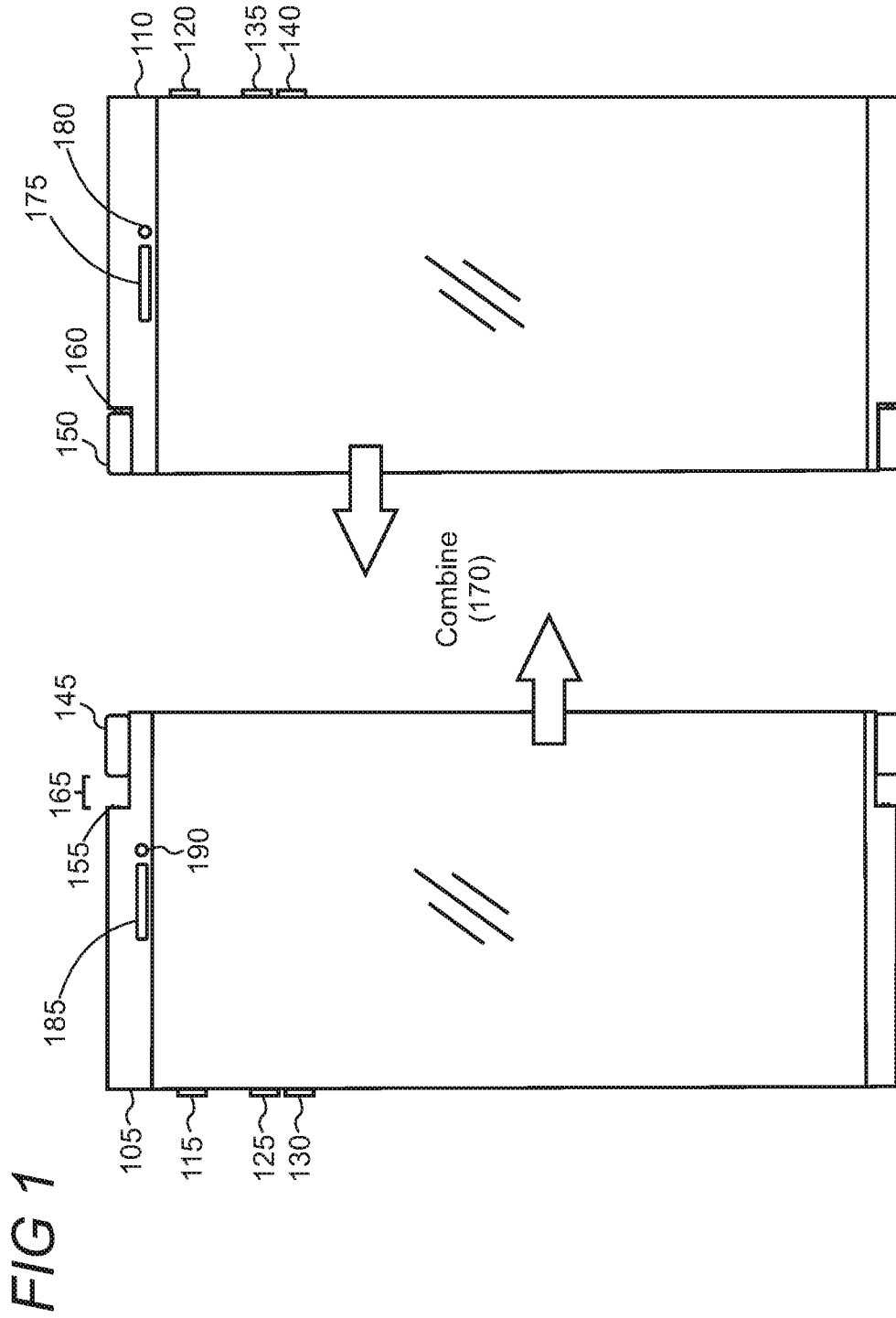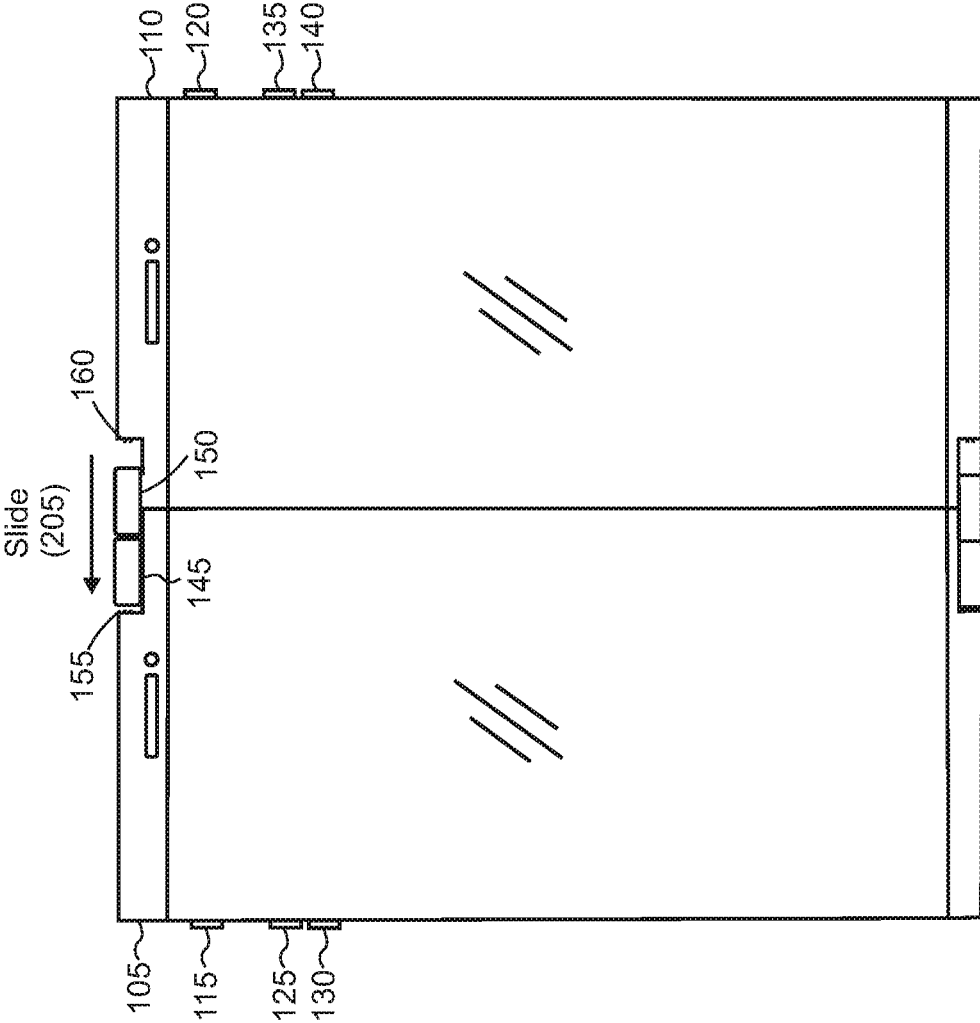
(Lifted for clarity
in exposition)
(315)

Hinge pin
(320)

Rotatable shaft
(305)

105
115
125
130
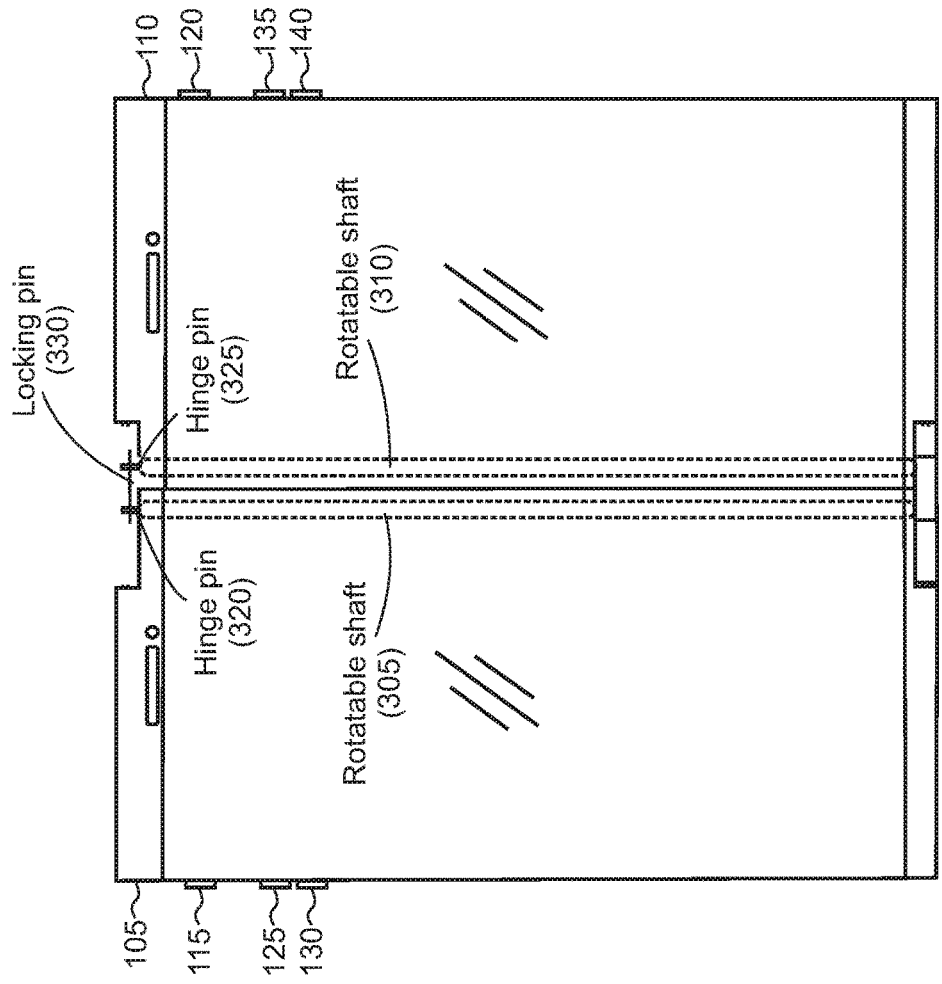
Overview of hinge system
(Computing devices not shown)
(405)
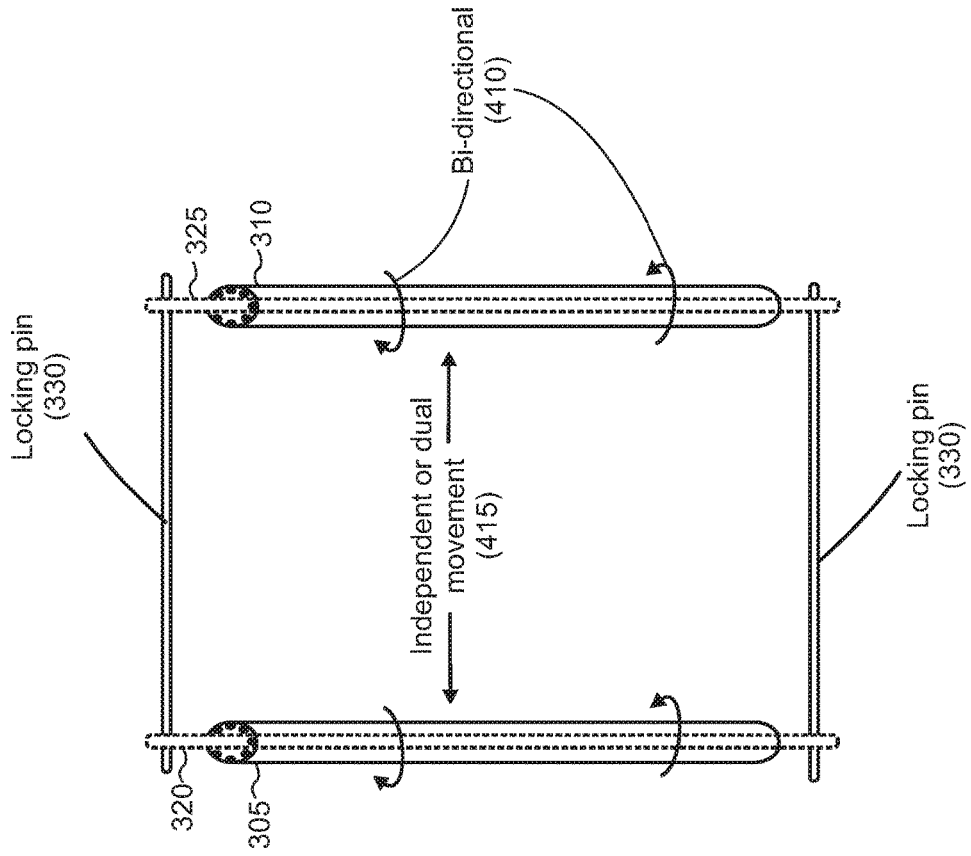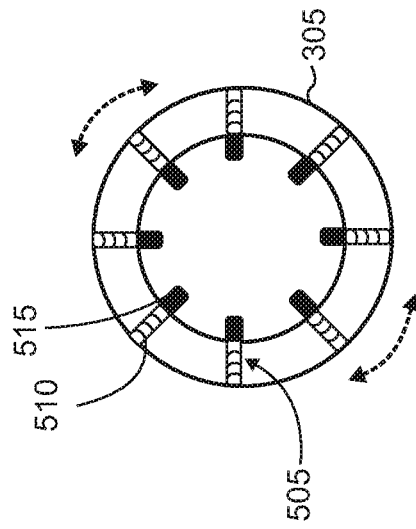
Locking pin
(330)

Locking pin
(330)

Bi-directional
(410)

Independent or dual
movement
(415)

325

310

320

305

FIG 4

FIG 6

Hinge pin

320

605

FIG 5

Rotatable shaft

305

515

510

505

FIG 8

FIG 7

905

330

325

FIG 9

FIG 10

FIG 11B

1105

330

150

FIG 11A

1105

150

FIG 11D

Slid back over to primary Smartphone

1105

325

320

150

145
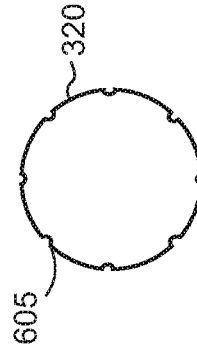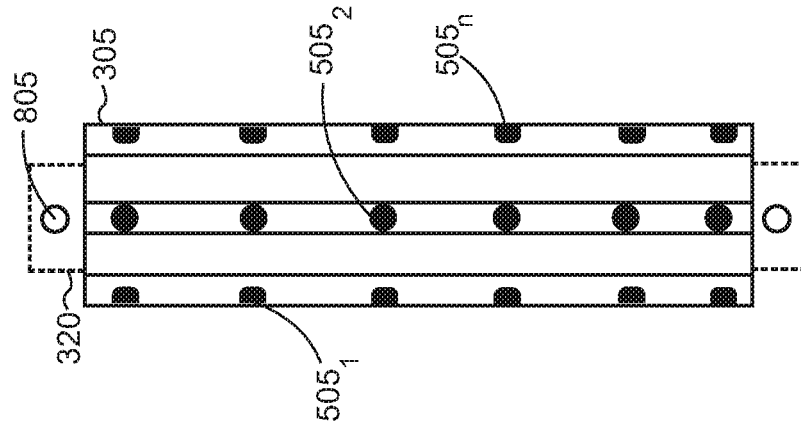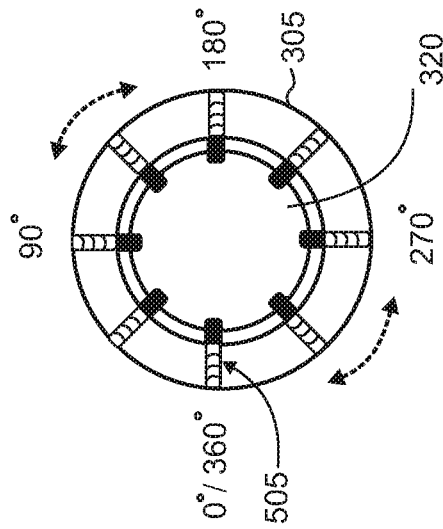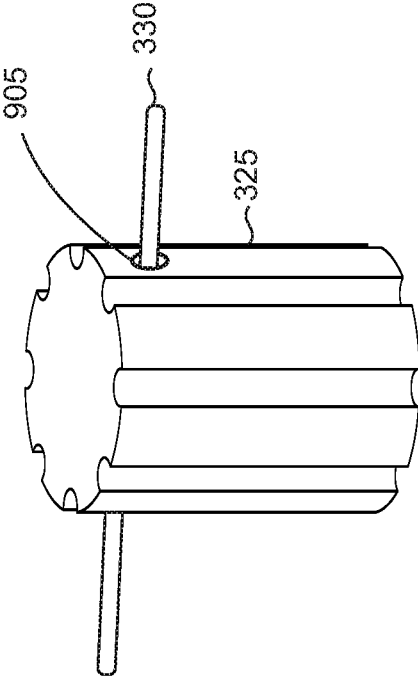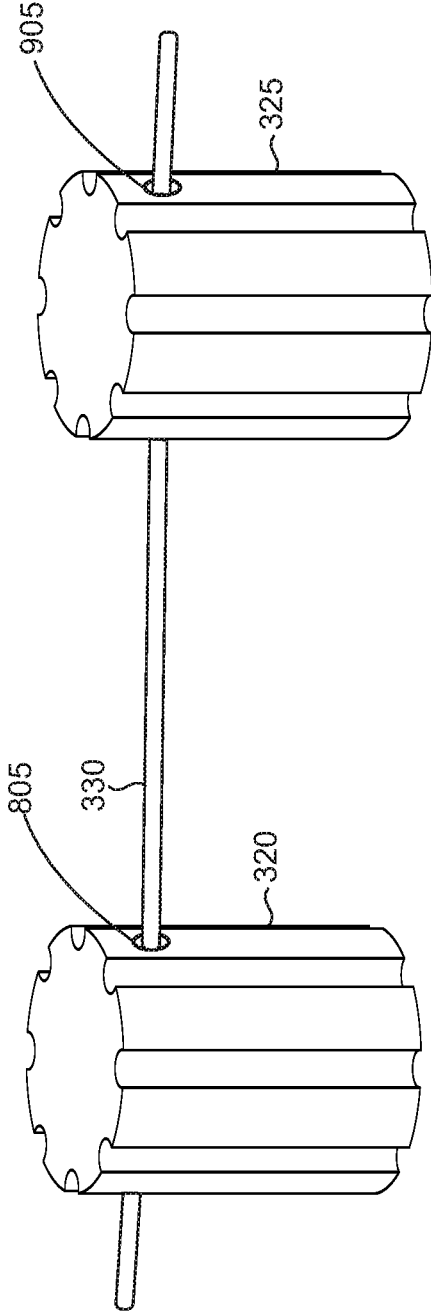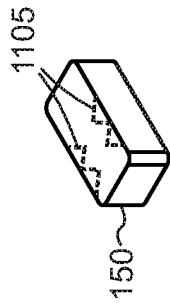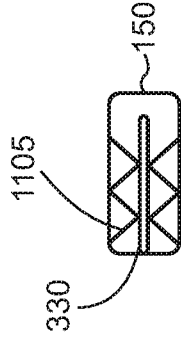
FIG 11C

Slid over to companion Smartphone

325

1105

305

320

150

Recess (1205)

330

110

150

115

FIG 13

160

Recess (1205)

325

150

FIG 12

FIG 14

FIG 15

FIG 16

FIG 17

105

115

125

130

110

120

135

140

Corresponding positions
for snug fit when
folded closed
(1725)

Recess
(1710)

Camera
(1720)

Recess
(1705)

Camera
(1715)

FIG 18B

110

105

FIG 18A

110

105
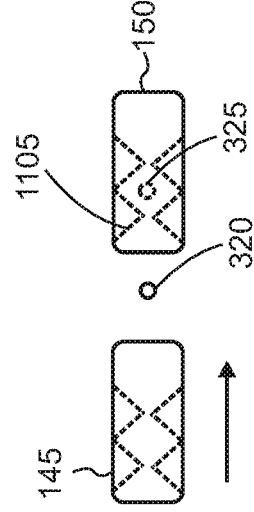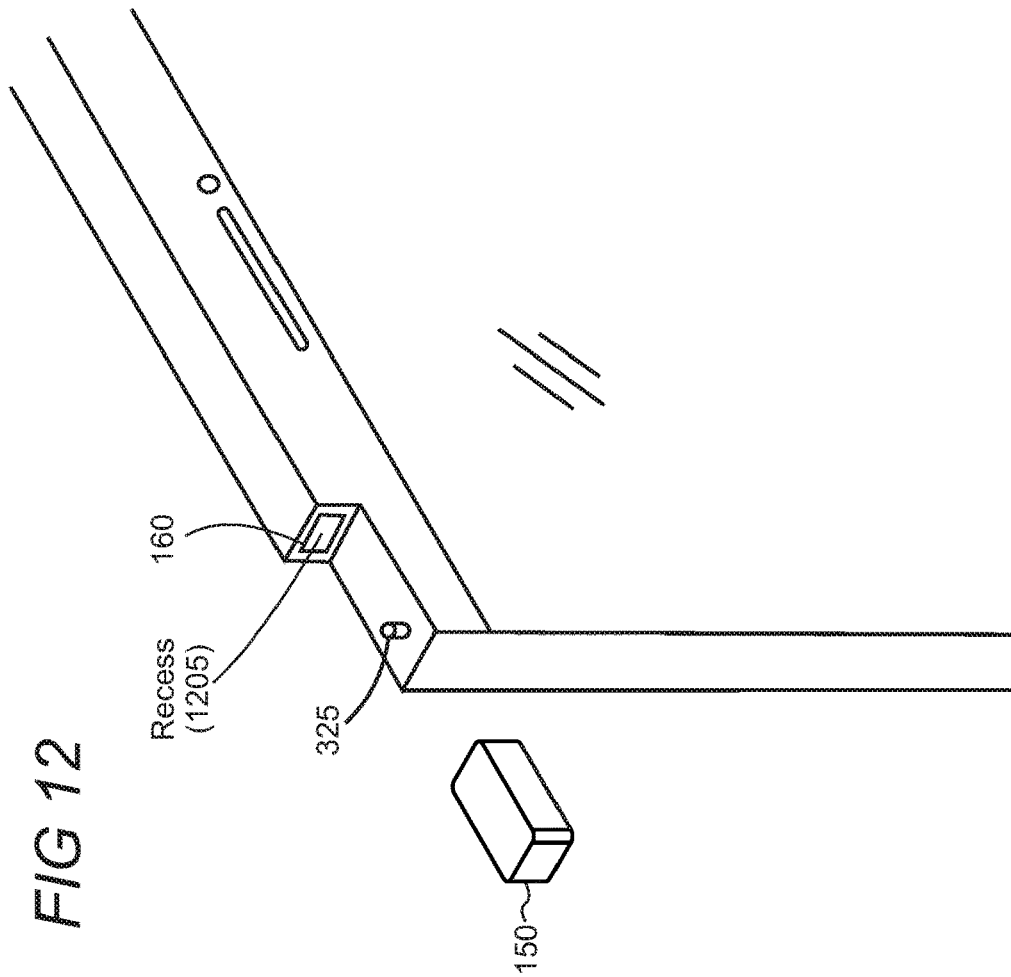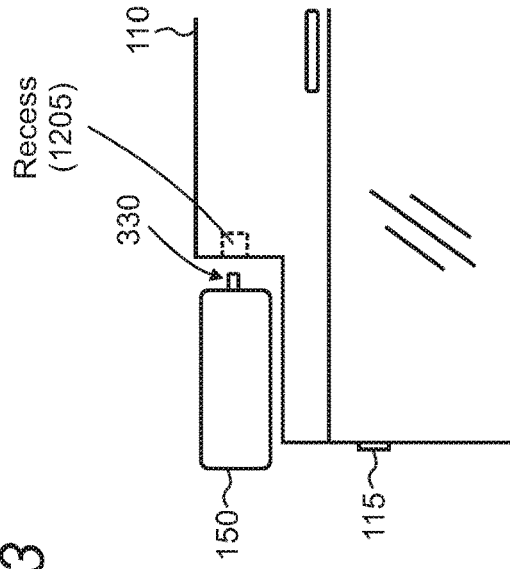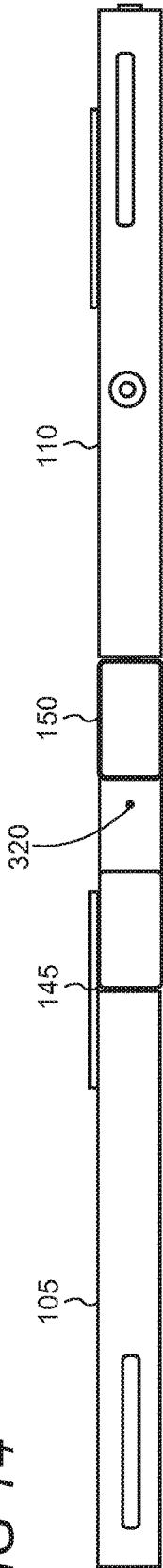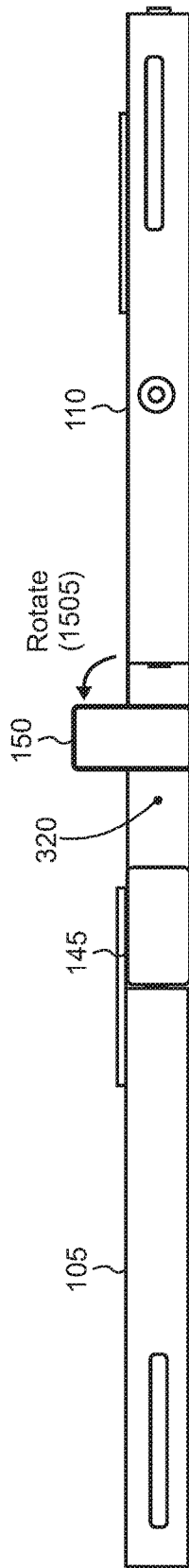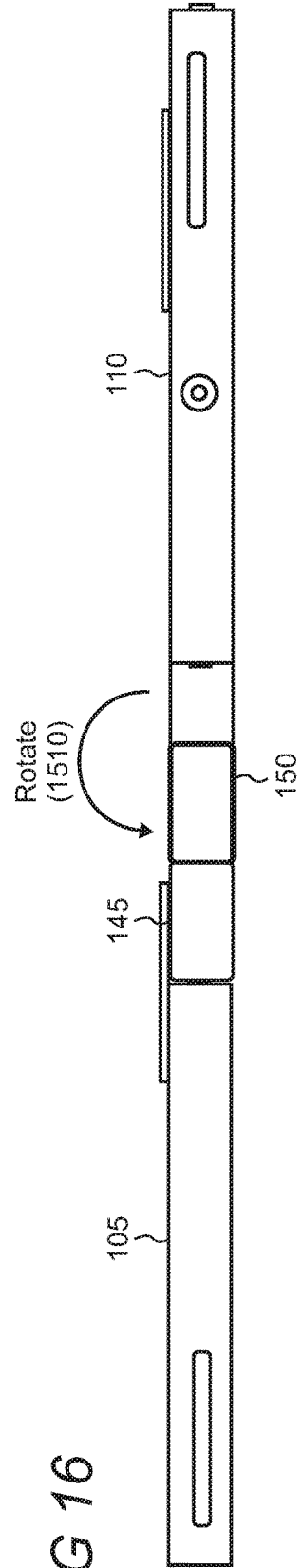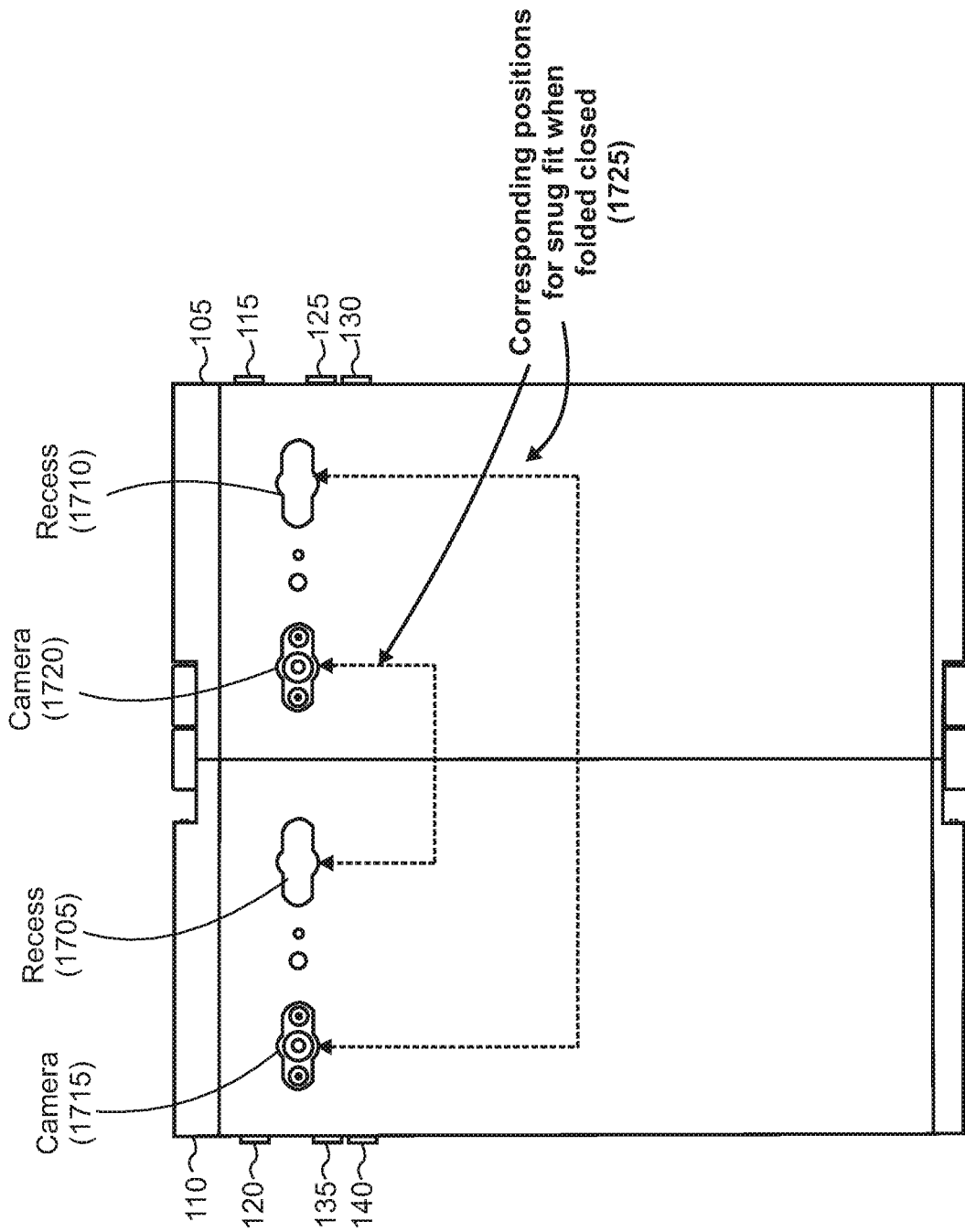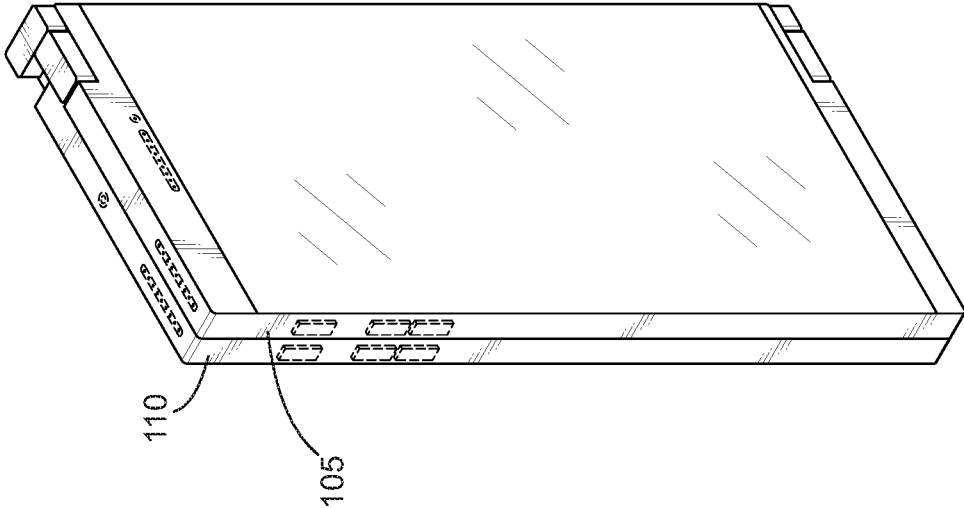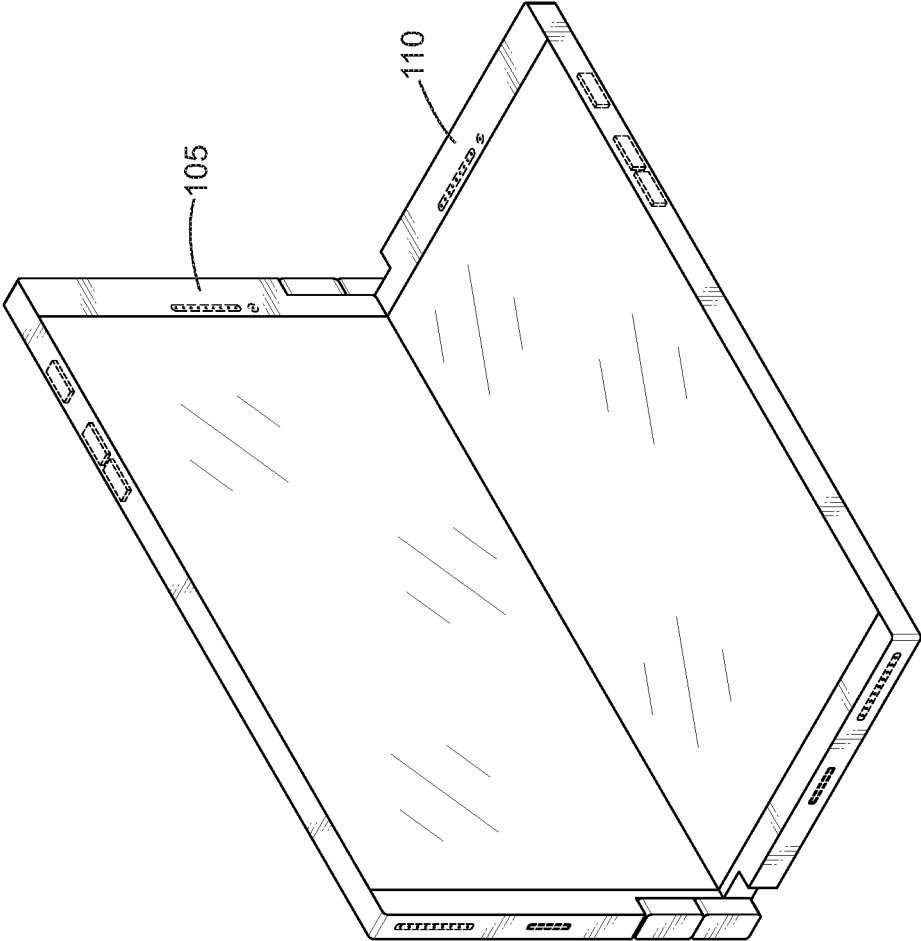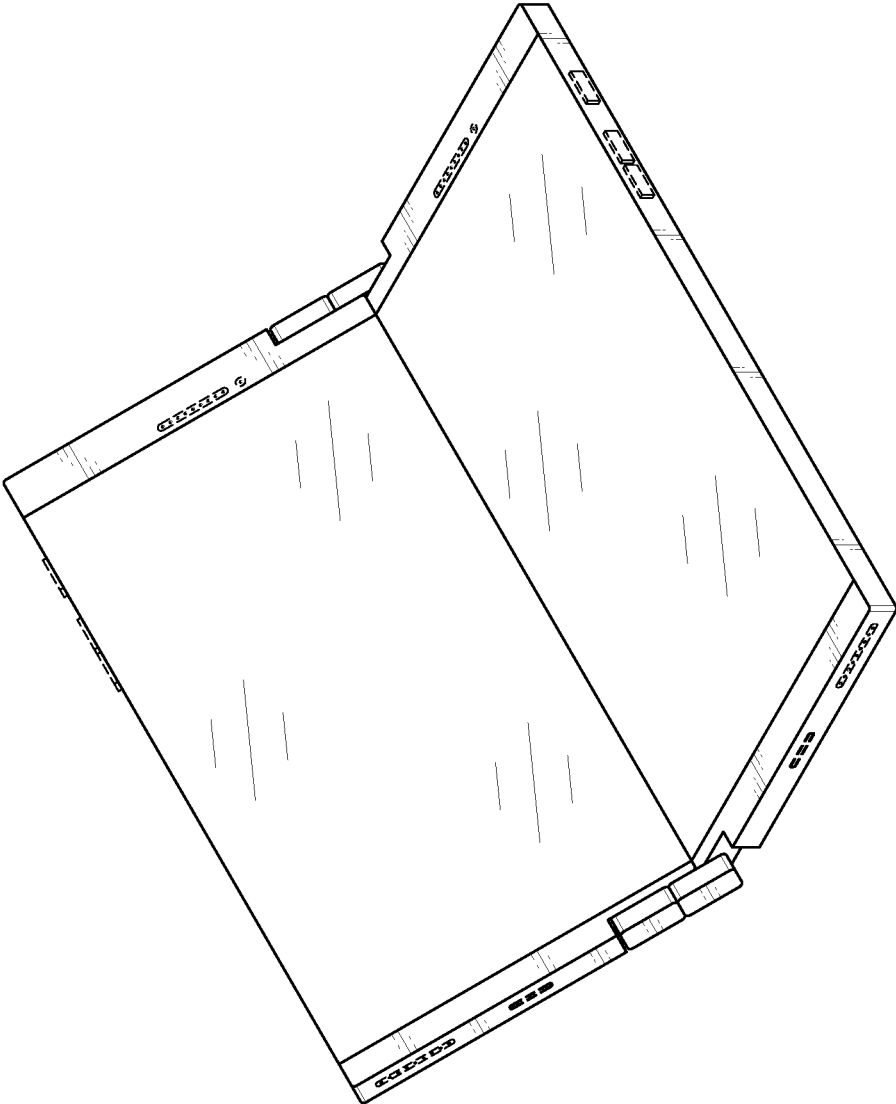
FIG 18C

FIG 18D

FIG 18E

FIG 18F

FIG 19

Computing device architecture (1900)

Sensor(s) 1914

Processors 1902

Network I/F 1916

1910

I/O controller 1918

Memory (1904)

Storage device (1912)

RAM (1906)

ROM (1908)

Battery/ power supply 1920

FIG 20
2000

HINGE MECHANISM FOR ELECTRONIC DEVICES

CROSS-REFERENCE TO RELATED APPLICATIONS

This Non-Provisional Patent Application claims benefit and priority to U.S. Non-Provisional Design patent Ser. No. 29/706209, filed Sep. 18, 2019, entitled ONE OR MORE ELECTRONIC DEVICES, the entire contents of which is hereby incorporated herein by reference.

BACKGROUND

Smartphone computers are typically utilized individually by a user or, in some scenarios, can be supplemented by an additional computing device using a wired or wireless (e.g., Bluetooth®) connection. Typically, the smartphone may be connected to a user's personal computer (PC) or laptop using a universal serial bus (USB) or other connector to transfer media files like photos or music. Users with multiple smartphones may find it tedious to effectively leverage the operations and functionality of both phones simultaneously, if at all.

SUMMARY

A hinge mechanism for electronic devices is implemented by which a user can mechanically and communicatively connect two devices together. Authorized connection of the two devices can enable each device to leverage the partner device's functionality, battery power, applications, screen real estate, etc. While the disclosure herein references a primary smartphone and a companion smartphone as the two electronic devices, other types of electronic devices for the present implementation are also possible, such as tablets and laptop computers.

Each smartphone supports a rotatable cylindrical shaft that is positioned near an edge of the respective phone. The rotatable shaft may be 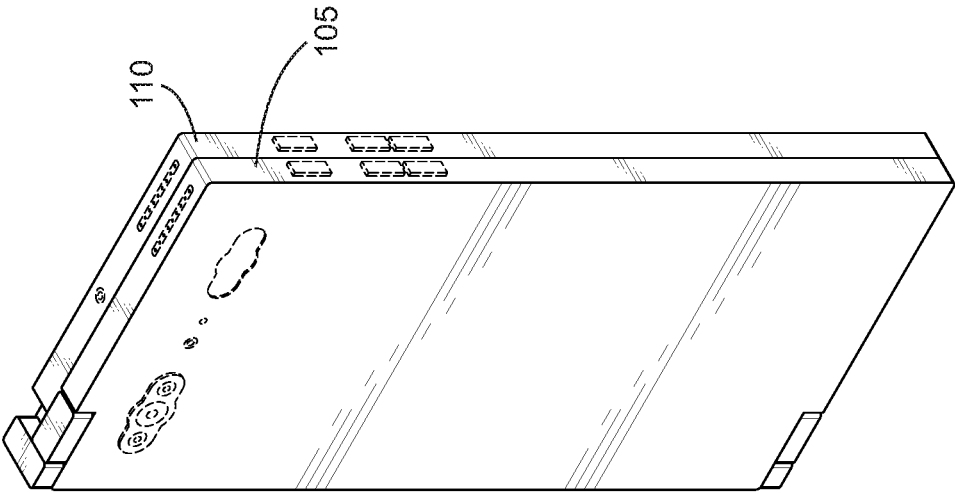positioned on a left side portion of a primary smartphone and a right side portion of a companion smartphone. Respective hinge pins are positioned inside cavities of the rotatable shafts and extend outside from an inside of the primary and companion smartphones. The hinge pin on the companion smartphone is protected via a sliding element that lo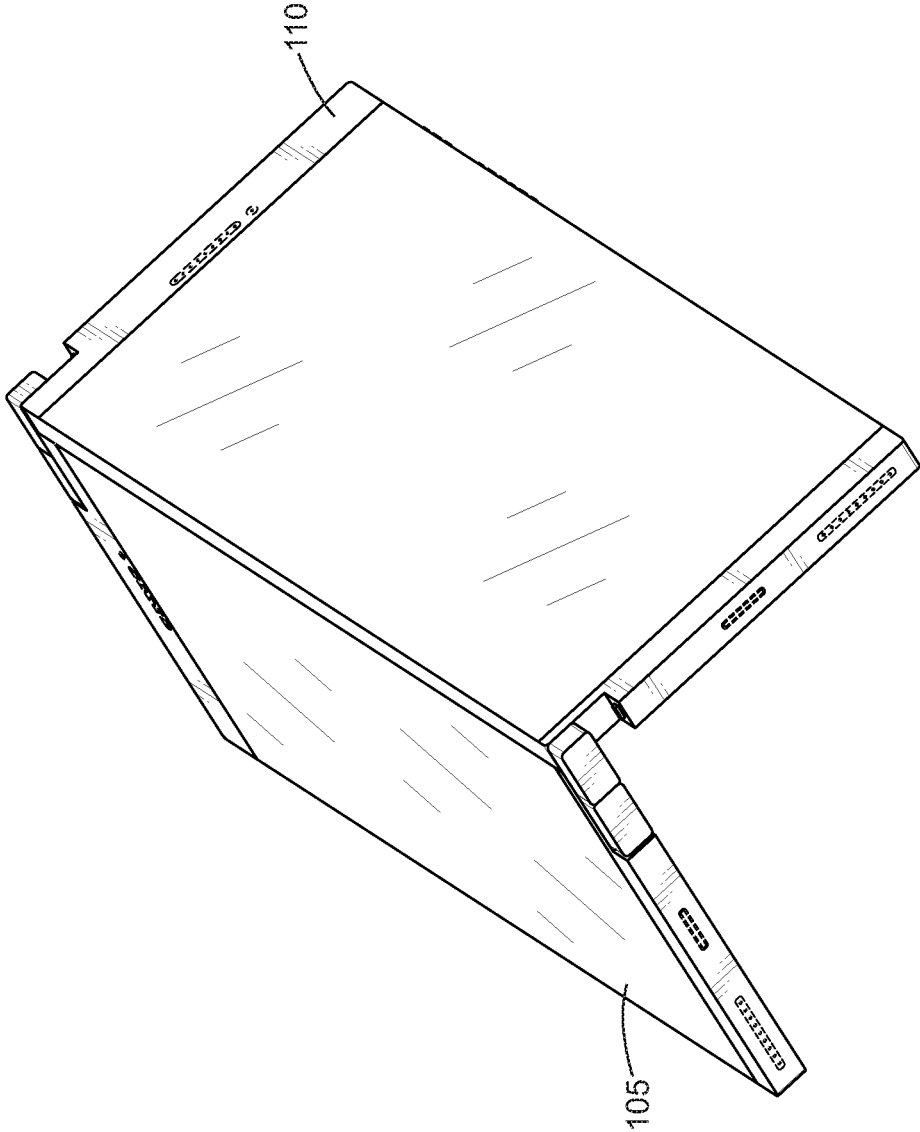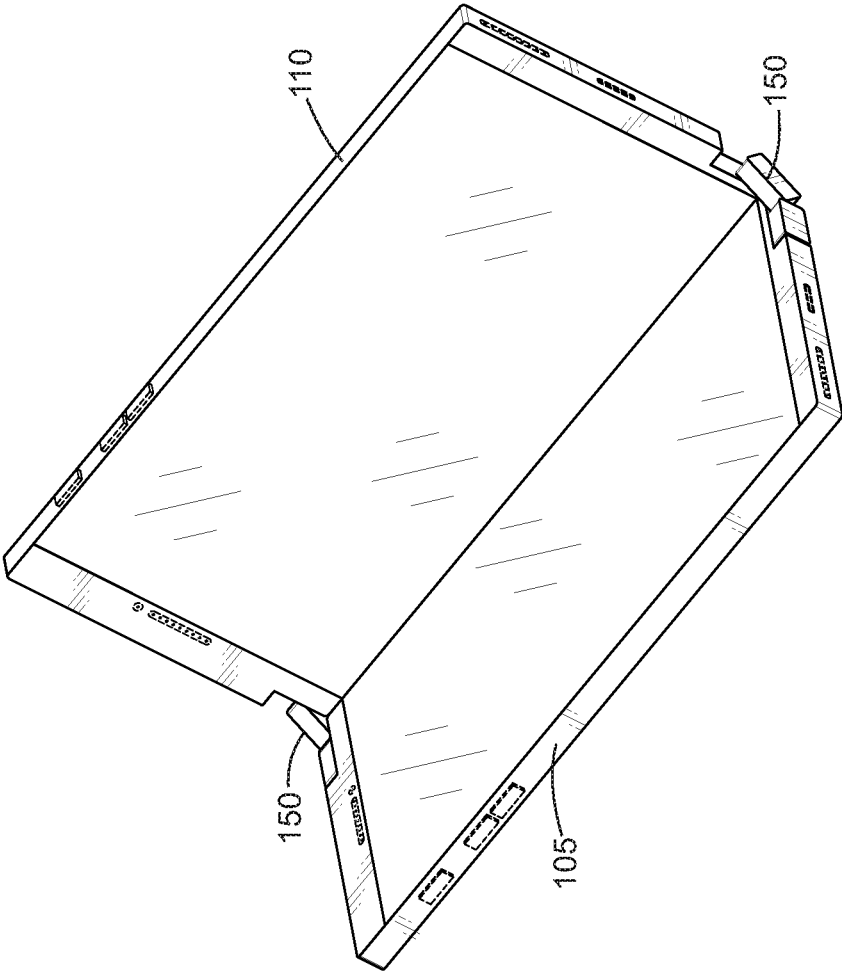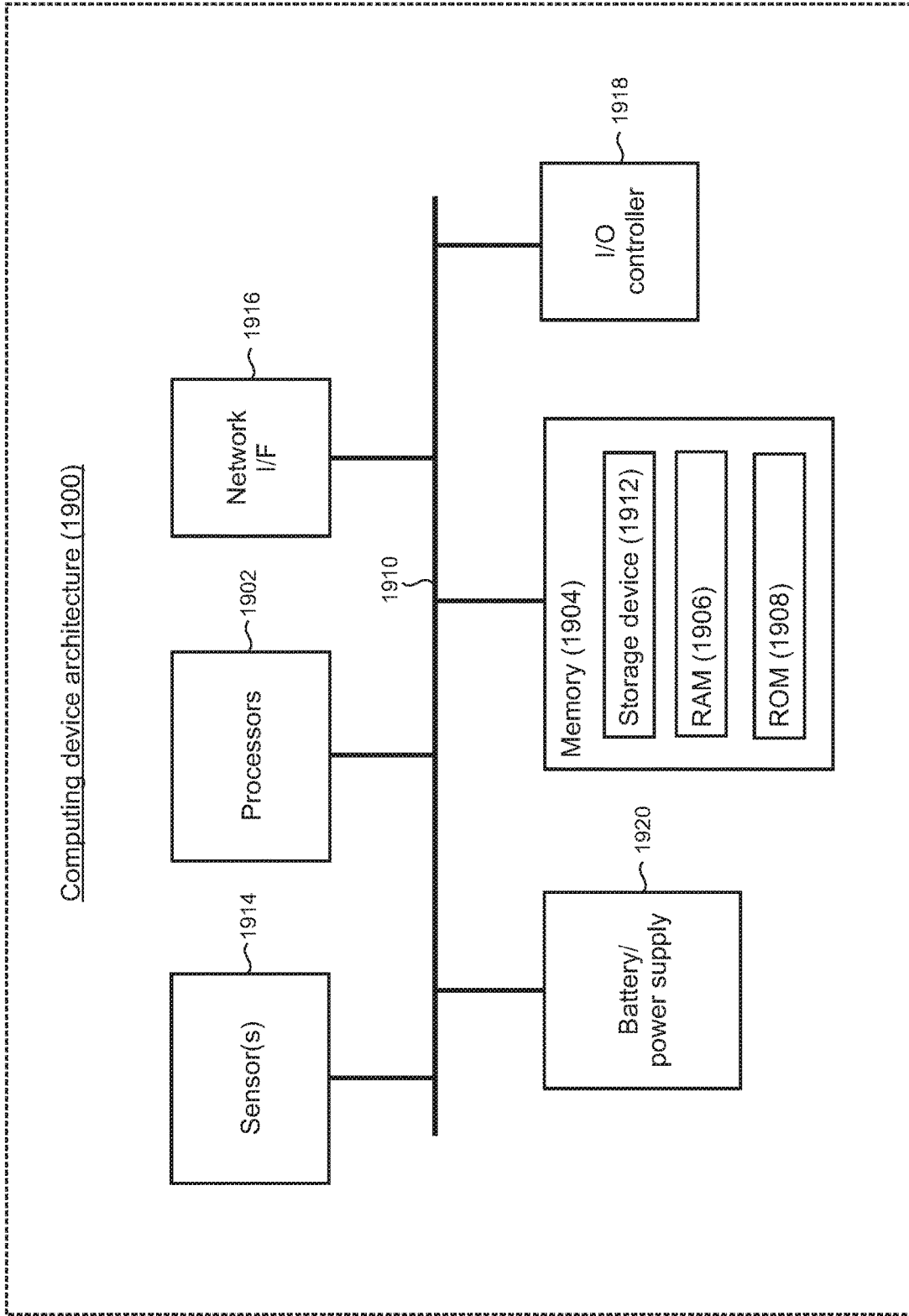cks into place above the hinge pin. Likewise, the hinge pin on the primary smartphone is protected via a separate sliding element that locks into place above its hinge pin. The sliding elements fill a cut-out on the respective smartphones which are constructed for the hinge mechanism. In typical implementations, both sliding elements are congruent in size and shape.

When opposing edges of the primary smartphone and the companion smartphone are touching, each sliding element moves left, that is, the companion smartphone's sliding element moves to an end of its cut-out and the primary smartphone's sliding element overlaps with the cut-out on the primary and companion smartphones. The companion smartphone's cut-out on which the sliding element is positioned is 1½ times the size of the individual sliding elements to accommodate an entire body of the companion smartphone's sliding element and half the body of the primary smartphone's sliding element. In typical implementations, the cut-out on the primary smartphone is substantially a one-to-one ratio to the size of the sliding element. Positioned underneath and attached to the primary smartphone's sliding element is a locking pin that dually connects to the primary

and companion smartphone's respective hinge pins. Each sliding element comes equipped with a locking mechanism (e.g., a structural configuration that functions as a cotter pin or split pin) that engages and disengages with one or more of the hinge pins responsive to manual pressure and which secures the components together.

Each rotatable shaft is configured with spring-loaded tabs that secure against corresponding spaced notches on the hinge pins. In typical implementations, each rotatable shaft and hinge pin have eight spring-loaded tabs and notches, respectively, which are evenly distributed about 360°. The rotatable shaft rotates about the hinge pin which is fixed in place via the locking pin that dually and simultaneously engages the respective smartphone's hinge pins. Rotation of a rotatable shaft corresponds to movement of the respective smartphone relative to the partner smartphone. The spring-loaded tabs disengage from the hinge pin's notches responsive to receiving pressure from the device user (e.g., by manipulating one or both smartphones) and then re-engage when the tabs and notches align again. Each rotatable shaft can operate individually or in combination with the other rotatable shaft. For example, to find an ideal position, a user can manipulate only the primary smartphone relative to the companion phone or vice versa, or can manipulate both smartphone's simultaneously relative to each other.

This Summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This Summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended to be used as an aid in determining the scope of the claimed subject matter. Furthermore, the claimed subject matter is not limited to implementations that solve any or all disadvantages noted in any part of this disclosure. It will be appreciated that the above-described subject matter may be implemented as a computer-controlled apparatus, a computer process, a computing system, or as an article of manufacture such as one or more computer-readable storage media. These and various other features will be apparent from a reading of the following Detailed Description and a review of the associated drawings.

DESCRIPTION OF THE DRAWINGS

FIG. 1 shows an illustrative environment in which a primary smartphone and companion smartphone are positioned adjacent to each other;

FIG. 2 shows an illustrative environment in which the primary and companion smartphones are locked together via sliding elements;

FIG. 3 shows an illustrative environment in which cylinders, hinge pins, and a locking pin operate together to form a hinge system between the two smartphones;

FIG. 4 shows an illustrative diagram of the hinge system without the respective smartphones;

FIG. 5 shows an illustrative diagram of the cylinder with spring-loaded tabs;

FIG. 6 shows an illustrative diagram of the hinge pin with spaced apart notches;

FIG. 7 shows an illustrative diagram of the assembled cylinder and hinge pin;

FIG. 8 shows an illustrative cut-out view of the hinge system;

FIG. 9 shows an illustrative diagram of the locking pin extending through a hole on the hinge pin;

FIG. **10** shows an illustrative diagram in which the locking in is inserted through respective holes on the hinge pins for the primary and companion smartphones;

FIGS. **11A-D** show illustrative diagrams in which a locking mechanism is employed on the sliding element to secure the sliding element to one or more of the hinge pins protruding from an end of the respective smartphones;

FIG. **12** shows an illustrative diagram of a recess on the connector mechanism for the primary smartphone;

FIG. **13** shows an illustrative diagram of the locking pin extending beyond an end of the primary smartphone's sliding element;

FIGS. **14-16** show illustrative diagrams showing consecutive rotational movements of the sliding element according to another embodiment;

FIG. **17** shows an illustrative environment in which cameras and cut-outs on a rear of the smartphones are correspondingly positioned to enable a snug fit when the hinge closes a rear of both devices on top of one another;

FIGS. **18A-F** show various angles at which the smartphones can bend using the hinge mechanism;

FIG. **19** is a simplified block diagram of an illustrative computer system that may be used in part to implement the present hinge mechanism for electronic devices; and

FIG. **20** is a simplified block diagram of an illustrative computing system that may be used in part to implement the present hinge mechanism for electronic devices.

Like reference numerals indicate like elements in the drawings. Elements are not drawn to scale unless otherwise indicated.

DETAILED DESCRIPTION

FIG. **1** shows an illustrative environment in which a primary smartphone **110** and companion smartphone **105** are positioned adjacent to each other. A user may wish to combine **170** the smartphones to, for example, form a single display screen or charge the other phone's battery. The disclosure herein references the hinge mechanisms positioned on a top of the respective smartphones as a reference, but the bottom of each smartphone has symmetrical components which operate like the top. Thus, any discussion pertaining to the top of the hinge mechanisms herein additionally apply to the hinge mechanisms positioned on the bottom of the respective smartphones.

Each smartphone device can be configured with components to operate as computing devices, including one or more processors, memory, input/output buttons, network interface controllers (NICs), and the like. For example, each smartphone has a power button **115**, **120**, an increase volume button **125**, **135**, and a decrease volume button **130**, **140**. The smartphones additionally have speakers **185**, **175** to, for example, listen to phone calls and a front-facing camera **180**, **190** for capturing images or video.

When a user wishes to combine **170** both smartphones, the user may position each smartphone adjacent to each other such that the edges are touching (FIG. **2**). Each smartphone has respective sliding elements **145** and **150**. The sliding element **145** on the companion smartphone **105** is principally implemented to protect a hinge pin (not shown in FIG. **1**) positioned underneath it and which extends from a top and bottom of the smartphone's casing. The sliding element **150** on the primary smartphone **110** likewise protects a hinge pin positioned underneath it and which extends from the smartphone's casing. The primary smartphone's sliding element **150** is secured in place to the connecting mechanism **160** positioned to the right of the sliding element

on a wall of the cut-out in which the sliding element is positioned. The connecting mechanism may be, for example, male/female mating members to which the sliding element engages and disengages with the opposing mating member. The companion smartphone's cut-out that supports the sliding element **145** is approximately 1½ times larger than the cut-out on the primary smartphone, as representatively shown by numeral **165**. The cut-out is larger on the companion smartphone to accommodate a the entire sliding element **145** and at least approximately half of the sliding element **150**, as shown in FIG. **2**.

FIG. **2** shows an illustrative environment in which the companion smartphone **105** and the primary smartphone **110** are positioned adjacent to each other and opposing edges are touching. The sliding elements **145** and **150** have slid to the left, as representatively shown by numeral **205**, such that the sliding elements **145** and **150** are touching or near-touching responsive to manual manipulation by a user. The respective cut-outs and sliding elements may have corresponding or complementary grooves or tracks to enable the sliding movement. Sliding the sliding elements over causes the sliding element **150** to simultaneously overlap with the primary and companion smartphones. The sliding element **150** engages with the hinge pin which was previously protected by the companion smartphone's sliding element **145**. A locking pin affixed to the sliding element **150** correspondingly moves with the sliding element and dually engages with hinge pins extending from the primary and companion smartphones (not shown in FIG. **2**).

FIG. **3** shows an illustrative environment in which components of the hinge mechanism are exposed, and FIG. **4** shows an overview of the hinge system **405** without the computing devices of FIGS. **1-3**. Sliding elements **145** and **150**, in FIG. **3**, have been lifted to expose the components of the hinge mechanism, as representatively shown by numeral **315**. Unless otherwise indicated, the drawings are not drawn to scale and are represented for clarity in exposition.

A cylindrical rotatable shaft **310** extends vertically through a left side of the primary smartphone **110** and a cylindrical rotatable shaft **305** extends vertically through a right side of the companion smartphone **105**. Hinge pins **320** and **325** are respectively positioned inside a cavity of the rotatable shafts **305**, **310**, and extend out a top and bottom of the respective smartphone's housing. The locking pin **330** extends perpendicularly through holes (not shown in FIGS. **3** and **4**) on each hinge pin to thereby lock and prevent movement of the hinge pins. Each component (e.g., the rotatable shafts, hinge pins, locking pins) of the hinge system may be comprised of titanium to create a reliable and resistant system, although other types of metals suitable for the purposes discussed herein are also possible.

Each sliding element **145**, **150** comes equipped with a locking mechanism (not shown in FIGS. **3** and **4**) attached thereto which structurally and functionally operates as a cotter or split pin, and which engages with the hinge pins. The locking mechanism may be an additional component attached to the sliding element or may be formed of the same piece of material. Manual pressure on a sliding element causes the locking mechanism to engage with the hinge pins **320**, **325**. The locking mechanism on the primary smartphone's sliding element prevents the sliding element from disengaging with the hinge pin. Since the locking pin dually engages with and prevents rotational movement of each hinge pin, the locking mechanism prevents the sliding element **150** from moving and thereby the locking pin from disengaging with the hinge pins, such as when the user is rotating the smartphones and the rotatable shaft. Typically,

the locking mechanism simultaneously locks and unlocks in place with each hinge pin responsive to user manipulation.

The rotatable shafts are attached to the respective smartphones such that movement of the rotatable shaft translates to movement of the smartphone, and vice versa. The rotatable shafts may be integrated with the smartphone by being mounted to and/or welded to its internal casing. The rotatable shafts are bi-directional **410** (i.e., they move clockwise and counterclockwise). Movement of each rotatable shaft is independent of the other and can also dually operate in tandem to provide user's with greater freedom in selecting the hinge's position, as representatively shown by numeral **415**. For example, the companion smartphone's rotatable shaft can move relative to the future smartphone, the future smartphone's rotatable shaft can move relative to the companion smartphone, or both can move together to increase the number of available positions to the user.

FIGS. **5** and **6** show illustrative structural diagrams of the rotatable shaft **305** and hinge pin **320**, respectively. The rotatable shaft includes spring-loaded tabs **505**, each of which includes springs **510** and tabs **515** which move forward and backward based on the amount of pressure exerted against the springs. The hinge pin includes spaced-apart notches (or grooves) **605** around its perimeter which correspond to the positioning of the spring-loaded tabs. The spring-loaded tabs snap into place when aligned with the notches of the hinge pin.

FIG. **7** shows an illustrative diagram in which the hinge pin **320** is assembled and inserted into a cavity of the rotatable shaft **305**, and FIG. **8** shows an illustrative cut-out diagram of the assembled hinge system. The hole **805** on the primary smartphone's hinge pin receives the locking pin **330** and dually locks the primary and companion smartphones' respective hinge pins in place (FIG. **3**). A compression system is employed to tightly compress the hinge pin and rotatable shaft to each other. This compression methodology can reliably secure these components in place and prevent any of the components from loosening. The spring-loaded tabs **505** enable a user to manipulate (e.g., rotate) the companion smartphone **105** in which the pressure exerted on the smartphone **105** translates to the springs **510** on the spring-loaded tabs **505**. The pressure causes the springs to compress and thereby the tabs disengage from the notches **605** on the hinge pin **320**. As the rotatable shaft continues to rotate responsive to the user's manipulation of the smartphone, the spring-loaded tabs lock into place when the tabs and notches align again (e.g., every 45° in this example).

In typical implementations, the spring-loaded tabs **505** are evenly spaced about 360°. While FIGS. **5-7** show eight spring-loaded tabs and notches spaced every 45°, other implementations can have less or more spring-loaded tabs and notches that may or may not be evenly spaced. For example, the spring-loaded tabs may be positioned at particular locations to enable the smartphone to snap into particular hinged positions (e.g., 45° and 315° angles only). While reference numerals and discussions for FIGS. **5-8** are tailored to components on the companion smartphone, such discussion likewise applies to the primary smartphone.

FIGS. **9** and **10** show illustrative diagrams of the hinge pin **325** and locking pin **330**. The primary smartphone's hinge pin **325** includes a hole **905** to receive the locking pin **330**. The hinge pin **320** on the companion smartphone **105** likewise has a hole **805** through which the locking pin extends.

FIG. **10** depicts a scenario in which the primary and companion smartphones are adjacent to one another and ready for connecting. The user can slide the sliding element

150 over to the companion smartphone (FIG. **2**), responsive to which the locking pin locks into the companion smartphone's hinge pin **320**. The locking pin dually locks into each smartphone's hinge pin **320** and **325**. The locking pin may maintain connection to the primary smartphone's hinge pin **325** since the sliding element to which it attaches will typically revert back to the cut-out on the primary smartphone. Thus, the locking pin may engage and disengage from the hinge pin **320** on the companion smartphone **105** but, in typical implementations, maintains a connection to the primary smartphone's hinge pin **325**.

FIGS. **11**A-D show illustrative diagrams of the primary smartphone's sliding element **150** from various angles to show the various components and their configuration within the hinge system. FIGS. **11**A, **11**C, and **11**D represent a top view of the sliding element and FIG. **11**B represents an underside view of the sliding element and its components. Dashed lines represent that which is beneath the sliding element.

The sliding element includes a locking mechanism **1105** which locks into the primary smartphone's hinge pin **325** and the companion smartphone's hinge pin **320** with sufficient manual exertion from a user. The locking mechanisms in this example structurally functions as a cotter pin or a split pin such that the hinge pins can be locked or unlocked from the sliding element with sufficient force to overcome a respective groove. For example, FIG. **11**C shows an example in which the primary smartphone's sliding element **150** has been slid over to overlap with the companion smartphone (FIG. **2**). Here, the sliding element's locking pin engages with the hole in each hinge pin, and thereby prevents movement relative to the rotating shaft (not shown), and its locking mechanism secures the sliding element to each hinge pin. In FIG. **11**D, the sliding element **150** has been slid back over to the primary smartphone's cut-out. The locking mechanism on the sliding element and the locking pin disengage from the companion smartphone's hinge pin **320**, and the primary smartphone's hinge pin is then placed within a new groove within the locking mechanism, as shown in FIG. **11**D. The companion smartphone's sliding element **145** can move back over to its hinge pin **320** and lock into place using its own locking mechanism to protect the hinge pin from exposure and damage.

The combination of the locking mechanism **1105** and locking pin **330** enable the locking pin to dually and simultaneously connect each smartphone's hinge pin and connect the smartphones together. The locking mechanism is implemented so the connection does not come undone without sufficient user pressure (e.g., by manually sliding the sliding element back over to the primary smartphone **110**).

FIGS. **12** and **13** show illustrative diagrams in which the connecting mechanism **160** on the primary smartphone **110** has a recess **1205** to accept a portion of the locking pin **330**. The connecting mechanism **160** may be a male/female connector that detachably locks the sliding element **150** in place in the cut-out of the smartphone. FIG. **13** depicts the locking pin **330** extending beyond an end of the sliding element **150**. The portion that extends, when the sliding element is positioned in the cut-out of the primary smartphone **110**, is received into the smartphone's recess **1205** to enable the sliding element to lay snug in the cut-out and not extend beyond an edge of the smartphone. A similar connection mechanism may be employed on the companion smartphone, although the recess may not be necessary since the locking pin is positioned on the primary smartphone's sliding element.

FIGS. **14-16** show an embodiment in which the sliding element **150** on the primary smartphone **110** rotates 180° to lock in place on the companion smartphone **105**. Instead of sliding the sliding element from the primary smartphone to the companion smartphone **105** as depicted in FIGS. **1-2**, the sliding element can alternatively or additionally rotate 180° about its axis and lock into place, as representatively shown by numerals **1505** and **1510**. The locking pin underneath the sliding element can lock into the hinge pin and thereby create the hinge mechanism between the two smartphones. In this example, a different type of connection between the locking pin and hinge pin may be employed since the locking pin will be rotating instead of sliding, such as a tab and notch mechanism, snap or friction fit, etc.

FIG. **17** shows an illustrative diagram in which the outer hardware of the primary and companion smartphones **110**, **105** have been constructed to enable seamless operation between the two hinged devices. For example, recesses **1710** and **1705** on each smartphone have been constructed to receive the cameras **1710**, **1715** of the opposing smartphone when the hinge is completely closed, so that the rear of the two smartphones can lie snug against one another, as representatively shown by numeral **1725**. The primary smartphone's camera **1715** fits into the recess **1710** of the companion smartphone, and the companion smartphone's camera **1720** fits into the recess **1705** of the primary smartphone.

FIGS. **18A-E** show various folding positions about the hinge mechanism in which the primary and companion smartphones **110**, **105** can be placed. For example, FIG. **18A** shows the hinge bent to put the smartphones screen-to-screen and FIG. **18B** shows the hinge bent to put the smartphones rear-to-rear such that the cameras are snug fit inside the opposing smartphone's recess (FIG. **17**). FIGS. **18C-E** show various angles that the hinge mechanism can create between the two smartphones. FIG. **18E** shows a 90° angle in which the rotatable shafts of the smartphones are manipulated to show the different types of angles that can be created by the dual hinge system.

When both smartphones are connected, a user may be prompted to enter a password to enable each device to communicate with the other. Thus, for example, while a user could manually connect two devices together using the hinge assembly discussed herein, doing so would not enable the devices to communicate (e.g., send signals, messages, share battery power, etc.) with each other without the user unlocking each phone with a password, PIN, biometric scan, and the like. The authorization prompt may show up on one or both devices. Once authorized, the devices may begin sharing battery power (e.g., one device can charge the other), sharing screen real-estate to enable a user to look at one full screen instead of two split screens, among other functions. Such functionality can be triggered upon connecting the two phones together and/or upon the user entering the proper authorization credentials.

FIG. **19** shows an illustrative architecture **1900** for a device, such as a smartphone or tablet, capable of executing the various components described herein for hinge mechanism for electronic devices. The architecture **1900** illustrated in FIG. **19** includes one or more processors **1902** (e.g., central processing unit, dedicated AI chip, graphics processing unit, etc.), a system memory **1904**, including RAM (random access memory) **1906**, ROM (read only memory) **1908**, and long-term storage devices **1912**. The system bus **1910** operatively and functionally couples the components in the architecture **1900**. A basic input/output system containing the basic routines that help to transfer information

between elements within the architecture **1900**, such as during startup, is typically stored in the ROM **1908**. The architecture **1900** further includes a long-term storage device **1912** for storing software code or other computer-executed code that is utilized to implement applications, the file system, and the operating system. The storage device **1912** is connected to the processor **1902** through a storage controller (not shown) connected to the bus **1910**. The storage device **1912** and its associated computer-readable storage media provide non-volatile storage for the architecture **1900**. Although the description of computer-readable storage media contained herein refers to a long-term storage device, such as a hard disk or CD-ROM drive, it may be appreciated by those skilled in the art that computer-readable storage media can be any available storage media that can be accessed by the architecture **1900**, including solid stage drives and flash memory.

By way of example, and not limitation, computer-readable storage media may include volatile and non-volatile, removable and non-removable media implemented in any method or technology for storage of information such as computer-readable instructions, data structures, program modules, or other data. For example, computer-readable media includes, but is not limited to, RAM, ROM, EPROM (erasable programmable read only memory), EEPROM (electrically erasable programmable read only memory), Flash memory or other solid state memory technology, CD-ROM, DVDs, HD-DVD (High Definition DVD), Blu-ray, or other optical storage, magnetic cassettes, magnetic tape, magnetic disk storage or other magnetic storage devices, or any other medium which can be used to store the desired information and which can be accessed by the architecture **1900**.

According to various embodiments, the architecture **1900** may operate in a networked environment using logical connections to remote computers through a network. The architecture **1900** may connect to the network through a network interface unit **1916** connected to the bus **1910**. It may be appreciated that the network interface unit **1916** also may be utilized to connect to other types of networks and remote computer systems. The architecture **1900** also may include an input/output controller **1918** for receiving and processing input from a number of other devices, including a keyboard, mouse, touchpad, touchscreen, control devices such as buttons and switches or electronic stylus (not shown in FIG. **19**). Similarly, the input/output controller **1918** may provide output to a display screen, user interface, a printer, or other type of output device (also not shown in FIG. **19**).

It may be appreciated that any software components described herein may, when loaded into the processor **1902** and executed, transform the processor **1902** and the overall architecture **1900** from a general-purpose computing system into a special-purpose computing system customized to facilitate the functionality presented herein. The processor **1902** may be constructed from any number of transistors or other discrete circuit elements, which may individually or collectively assume any number of states. More specifically, the processor **1902** may operate as a finite-state machine, in response to executable instructions contained within the software modules disclosed herein. These computer-executable instructions may transform the processor **1902** by specifying how the processor **1902** transitions between states, thereby transforming the transistors or other discrete hardware elements constituting the processor **1902**.

Encoding the software modules presented herein also may transform the physical structure of the computer-readable storage media presented herein. The specific transformation

of physical structure may depend on various factors in different implementations of this description. Examples of such factors may include, but are not limited to, the technology used to implement the computer-readable storage media, whether the computer-readable storage media is characterized as primary or secondary storage, and the like. For example, if the computer-readable storage media is implemented as semiconductor-based memory, the software disclosed herein may be encoded on the computer-readable storage media by transforming the physical state of the semiconductor memory. For example, the software may transform the state of transistors, capacitors, or other discrete circuit elements constituting the semiconductor memory. The software also may transform the physical state of such components in order to store data thereupon.

As another example, the computer-readable storage media disclosed herein may be implemented using magnetic or optical technology. In such implementations, the software presented herein may transform the physical state of magnetic or optical media, when the software is encoded therein. These transformations may include altering the magnetic characteristics of particular locations within given magnetic media. These transformations also may include altering the physical features or characteristics of particular locations within given optical media to change the optical characteristics of those locations. Other transformations of physical media are possible without departing from the scope and spirit of the present description, with the foregoing examples provided only to facilitate this discussion.

In light of the above, it may be appreciated that many types of physical transformations take place in the architecture **1900** in order to store and execute the software components presented herein. It also may be appreciated that the architecture **1900** may include other types of computing devices, including wearable devices, handheld computers, embedded computer systems, smartphones, PDAs, and other types of computing devices known to those skilled in the art. It is also contemplated that the architecture **1900** may not include all of the components shown in FIG. **19**, may include other components that are not explicitly shown in FIG. **19**, or may utilize an architecture completely different from that shown in FIG. **19**.

FIG. **20** is a simplified block diagram of an illustrative computer system **2000** such as a smartphone, tablet computer, laptop computer, or personal computer (PC) which the present hinge mechanism for electronic devices may be implemented. Computer system **2000** includes a processor **2005**, a system memory **2011**, and a system bus **2014** that couples various system components including the system memory **2011** to the processor **2005**. The system bus **2014** may be any of several types of bus structures including a memory bus or memory controller, a peripheral bus, or a local bus using any of a variety of bus architectures. The system memory **2011** includes read only memory (ROM) **2017** and random access memory (RAM) **2021**. A basic input/output system (BIOS) **2025**, containing the basic routines that help to transfer information between elements within the computer system **2000**, such as during startup, is stored in ROM **2017**. The computer system **2000** may further include a hard disk drive **2028** for reading from and writing to an internally disposed hard disk, a magnetic disk drive **2030** for reading from or writing to a removable magnetic disk (e.g., a floppy disk), and an optical disk drive **2038** for reading from or writing to a removable optical disk **2043** such as a CD (compact disc), DVD (digital versatile disc), or other optical media. The hard disk drive **2028**, magnetic disk drive **2030**, and optical disk drive **2038** are

connected to the system bus **2014** by a hard disk drive interface **2046**, a magnetic disk drive interface **2049**, and an optical drive interface **2052**, respectively. The drives and their associated computer-readable storage media provide non-volatile storage of computer-readable instructions, data structures, program modules, and other data for the computer system **2000**. Although this illustrative example includes a hard disk, a removable magnetic disk **2033**, and a removable optical disk **2043**, other types of computer-readable storage media which can store data that is accessible by a computer such as magnetic cassettes, Flash memory cards, digital video disks, data cartridges, random access memories (RAMs), read only memories (ROMs), and the like may also be used in some applications of the present hinge mechanism for electronic devices. In addition, as used herein, the term computer-readable storage media includes one or more instances of a media type (e.g., one or more magnetic disks, one or more CDs, etc.). For purposes of this specification and the claims, the phrase "computer-readable storage media" and variations thereof, are intended to cover non-transitory embodiments, and does not include waves, signals, and/or other transitory and/or intangible communication media.

A number of program modules may be stored on the hard disk, magnetic disk, optical disk **2043**, ROM **2017**, or RAM **2021**, including an operating system **2055**, one or more application programs **2057**, other program modules **2060**, and program data **2063**. A user may enter commands and information into the computer system **2000** through input devices such as a keyboard **2066**, pointing device (e.g., mouse) **2068**, or touch-screen display **2073**. Other input devices may include a microphone, joystick, game pad, satellite dish, scanner, trackball, touchpad, touch-sensitive device, voice-command module or device, user motion or user gesture capture device, or the like. These and other input devices are often connected to the processor **2005** through a serial port interface **2071** that is coupled to the system bus **2014**, but may be connected by other interfaces, such as a parallel port, game port, or universal serial bus (USB). A monitor **2073** or other type of display device is also connected to the system bus **2014** via an interface, such as a video adapter **2075**. In addition to the monitor **2073**, personal computers typically include other peripheral output devices (not shown), such as speakers and printers. The illustrative example shown in FIG. **20** also includes a host adapter **2078**, a Small Computer System Interface (SCSI) bus **2083**, and an external storage device **2076** connected to the SCSI bus **2083**.

The computer system **2000** is operable in a networked environment using logical connections to one or more remote computers, such as a remote computer **2088**. The remote computer **2088** may be selected as another personal computer, a server, a router, a network PC, a peer device, or other common network node, and typically includes many or all of the elements described above relative to the computer system **2000**, although only a single representative remote memory/storage device **2090** is shown in FIG. **20**. The logical connections depicted in FIG. **20** include a local area network (LAN) **2093** and a wide area network (WAN) **2095**. Such networking environments are often deployed, for example, in offices, enterprise-wide computer networks, intranets, and the Internet.

When used in a LAN networking environment, the computer system **2000** is connected to the local area network **2093** through a network interface or adapter **2096**. When used in a WAN networking environment, the computer system **2000** typically includes a broadband modem **2098**,

network gateway, or other means for establishing communications over the wide area network **2095**, such as the Internet. The broadband modem **2098**, which may be internal or external, is connected to the system bus **2014** via a serial port interface **2071**. In a networked environment, program modules related to the computer system **2000**, or portions thereof, may be stored in the remote memory storage device **2090**. It is noted that the network connections shown in FIG. **20** are illustrative and other means of establishing a communications link between the computers may be used depending on the specific requirements of an application of the present hinge mechanism for electronic devices.

Various exemplary embodiments of the present immutable blob storage for cloud service providers are now presented by way of illustration and not as an exhaustive list of all embodiments. An example includes a hinge mechanism for a primary computing device, comprising: a rotatable shaft positioned inside the primary computing device and which extends from at least an upper portion to a lower portion of the primary computing device; and a hinge pin positioned inside a cavity of the rotatable shaft and about which the rotatable shaft rotates, wherein the rotatable shaft snaps into one or more positions against the hinge pin responsive to rotational movement.

In another example, the rotatable shaft extends vertically inside the primary computing device. As another example, clockwise or counterclockwise rotation of the rotatable shaft facilitates corresponding movement of the primary computing device. As another example, the rotatable shaft is cylindrical in shape. As another example, the rotatable shaft includes spring-loaded tabs to secure the cylinder against notches on the hinge pin. In another example, the positioning of the tabs on the rotatable shaft correspond to positioning of the notches on the hinge pin. In another example, the tabs and notches are evenly distributed about the rotatable shaft and hinge pin, respectively. As another example, a locking pin extends perpendicularly to and intersects with the hinge pin to prevent movement of the hinge pin. In another example, the hinge pin has a hole through which the locking pin extends. In another example, the sliding element includes a locking mechanism which secures the sliding element to the hinge pin. As a further example, a companion computing device to which the primary computing device is connected, wherein the hinge mechanism enables the primary computing device to rotate relative to the companion computing device when connected. In another example, wherein the companion computing device also includes a hinge mechanism, rotatable shaft, and hinge pin, and wherein the companion computing device's rotatable shaft enables the companion computing device to rotate relative to the primary computing device. In another example, the respective hinge mechanisms for the primary and companion computing devices enable dual rotation of each computing devices relative to each other. As another example, the locking pin extends through hinge pins on the primary and companion computing devices to connect the computing devices together and prevent rotational movement of each hinge pin when respective rotatable shafts are rotating. In another example, the rotatable shaft rotates clockwise and counterclockwise. As another example, the primary computing device is any one of a tablet device, smartphone, or laptop.

Another embodiment includes a primary computing device configured with a hinge mechanism to rotate relative to a companion computing device, comprising: a housing having a vertically oriented cavity; a display screen attached

to the housing and configured to display graphical elements to a user; one or more processors positioned internal to the housing; memory storing instructions executable by the one or more processors; a rotatable shaft positioned inside the cavity of the housing and fixedly secured to the housing such that manipulation of the primary computing device translates to the rotatable shaft about the cavity.

As another example, the primary computing device of claim **16**, wherein a hinge pin is positioned inside the cavity and is surrounded by the rotatable shaft. In another example, the rotatable shaft and hinge pin have corresponding tab and notch mechanisms that enable the rotatable shaft to releasably secure in place. As another example, the corresponding tabs and notches are evenly spaced 360° about the rotatable shaft and hinge pin.

Although the subject matter has been described in language specific to structural features and/or methodological acts, it is to be understood that the subject matter defined in the appended claims is not necessarily limited to the specific features or acts described above. Rather, the specific features and acts described above are disclosed as example forms of implementing the claims.

What is claimed:

1. A hinge mechanism for a primary computing device, comprising:
   a rotatable shaft positioned inside the primary computing device and which extends from at least an upper portion to a lower portion of the primary computing device;
   a hinge pin positioned inside a cavity of the rotatable shaft and about which the rotatable shaft rotates, wherein the rotatable shaft snaps into one or more positions against the hinge pin responsive to rotational movement; and
   a locking pin that extends perpendicularly to and intersects with the hinge pin to prevent movement of the hinge pin.

2. The hinge mechanism of claim **1**, wherein the rotatable shaft extends vertically inside the primary computing device.

3. The hinge mechanism of claim **2**, wherein the rotatable shaft is cylindrical in shape.

4. The hinge mechanism of claim **3**, wherein the rotatable shaft includes spring-loaded tabs to secure the cylindrical rotatable shaft against notches on the hinge pin.

5. The hinge mechanism of claim **4**, wherein positioning of the tabs on the rotatable shaft correspond to positioning of the notches on the hinge pin.

6. The hinge mechanism of claim **5**, wherein the tabs and notches are evenly distributed about the rotatable shaft and hinge pin, respectively.

7. The hinge mechanism of claim **1**, wherein clockwise or counterclockwise rotation of the rotatable shaft facilitates corresponding movement of the primary computing device.

8. The hinge mechanism of claim **1**, wherein the hinge pin has a hole through which the locking pin extends.

9. The hinge mechanism of claim **8**, wherein a sliding element includes a locking mechanism which secures the sliding element to the hinge pin.

10. The hinge mechanism of claim **1**, further comprising:
    a companion computing device to which the primary computing device is connected, wherein the hinge mechanism enables the primary computing device to rotate relative to the companion computing device when connected.

11. The hinge mechanism of claim **10**, wherein the companion computing device also includes a hinge mechanism, rotatable shaft, and hinge pin, and wherein the com-

panion computing device's rotatable shaft enables the companion computing device to rotate relative to the primary computing device.

12. The hinge mechanism of claim 11, wherein the respective hinge mechanisms for the primary and companion computing devices enable dual rotation of each computing device relative to each other.

13. The hinge mechanism of claim 11, wherein the locking pin extends through hinge pins on the primary and companion computing devices to connect the computing devices together and prevent rotational movement of each hinge pin when respective rotatable shafts are rotating.

14. The hinge mechanism of claim 1, wherein the primary computing device is any one of a tablet device, smartphone, or laptop.

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