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(71) Applicant: **INTEL CORPORATION** [US/US]; 2200
Mission College Boulevard, Santa Clara, California 95054
(US).

(72) Inventors: **SPRENGER, Mark E.**; 15116 SW Peachtree
Dr., Tigard, Oregon 97224 (US). **ARIK, Kenan**; 1212 NE

Parkside Dr., Hillsboro, Oregon 97124 (US). **MAGI, Aleksander**; 8346 SW Shawmut Drive, Aloha, Oregon 97007
(US). **RITTENHOUSE, David A.**; 8609 Ackerman Way,
Fair Oaks, California 95628 (US).

(74) Agent: **CAVEN, Jed W.**; Alpine Technology Law Group
LLC, 9249 S. Broadway, Unit 200-201, Highlands Ranch,
Colorado 80129 (US).

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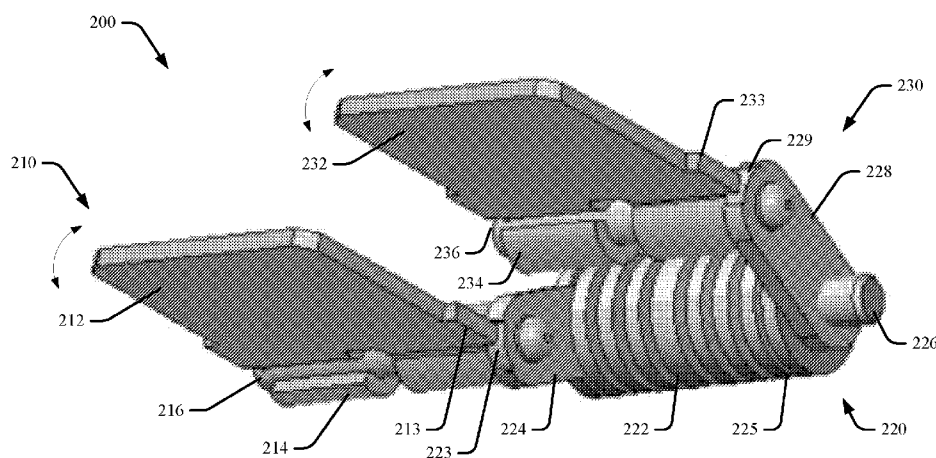


FIG. 2

(57) Abstract: In one example a hinge assembly for an electronic device comprises a first hinge comprising a first bracket coupled to a first bushing disposed at a first end of the first bracket and rotatable about a first shaft extending through the first bushing, a second hinge comprising a second bushing, a first linkage arm rotatable about a second shaft extending through the second bushing, and a second linkage arm rotatable about the second shaft extending through the second bushing and a third hinge comprising a second bracket coupled to a second bushing disposed at a first end of the second bracket and rotatable about a third shaft extending through the second bushing, wherein the first linkage arm is rotatably coupled to the first shaft and the second linkage arm is rotatably coupled to the third shaft. Other examples may be described.



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360 DEGREE HINGE ASSEMBLY FOR ELECTRONIC DEVICES

RELATED APPLICATIONS

This application claims priority under 35 U.S.C. § 365(c) to US Application No. 15/163,165 filed on May 24, 2017, entitled 360 DEGREE HINGE ASSEMBLY FOR ELECTRONIC DEVICES. The entire disclosure of these documents are incorporated by reference herein for all purposes.

BACKGROUND

The subject matter described herein relates generally to the field of electronic devices and more particularly to a 360 degree hinge assembly in electronic devices.

Electronic devices such as laptop computers, notebook computers, and the like comprise displays which are commonly coupled to a base section by a hinge assembly. Design advances in mobile computing devices have increased demand for hinge assemblies that allow a 360 degree range of rotation between a base section and a second section which may comprise a display. Accordingly additional hinge configurations may find utility.

BRIEF DESCRIPTION OF THE DRAWINGS

The detailed description is described with reference to the accompanying figures.

Fig. 1 is a schematic illustration of an electronic device which may be adapted to implement a 360 degree hinge assembly in accordance with some examples.

Fig. 2 is a perspective illustration of a 360 degree hinge assembly in accordance with an example.

Figs. 3A-3E are schematic, perspective illustrations of a hinge assembly and an electronic device in accordance various examples in various degrees of rotation

Figs. 4A-4E are schematic cross-sectional illustrations of an electronic device which includes a 360 degree hinge assembly in accordance various examples in various degrees of rotation.

Fig. 5 is a side elevation view of an electronic device fully rotated into a table mode in accordance various examples.

Figs. 6-10 are schematic illustrations of electronic devices which may be adapted to implement a 360 degree hinge assembly in accordance with some examples.

DETAILED DESCRIPTION

Described herein are exemplary systems and methods to implement a 360 degree hinge assembly in electronic devices. In the following description, numerous specific details are set forth to provide a thorough understanding of various examples. However, it will be understood by those skilled in the art that the various examples may be practiced without the specific details. In other instances, well-known methods, procedures, components, and circuits have not been illustrated or described in detail so as not to obscure the particular examples.

As described above, it may be useful to provide electronic device displays with a 360 degree hinge assembly. The subject matter described herein addresses these and other issues by providing a hinge assembly for an electronic device which incorporates a first hinge coupled to the first section and comprising a first bracket coupled to a first bushing disposed at a first end of the first bracket and rotatable about a first shaft extending through the first bushing, a second hinge comprising, a second bushing, a first linkage arm rotatable about a second shaft extending through the second bushing, and a second linkage arm rotatable about the second shaft extending through the second bushing and a third hinge coupled to the second section and comprising a second bracket coupled to a second bushing disposed at a first end of the second bracket and rotatable about a third shaft extending through the second bushing, wherein the first linkage arm is rotatably coupled to the first shaft and the second linkage arm is rotatably coupled to the third shaft.

Further structural and operational details will be described with reference to Figs. 1-10, below.

Fig. 1 is a schematic illustration of an electronic device 100 which may be adapted to implement a 360 degree hinge assembly in accordance with some examples. In some examples electronic device 100 may include a chassis 160 having a first section 162 and a second section 164 rotatably coupled to the first section 162 by a hinge assembly. In various examples, electronic device 100 may include or be coupled to one or more accompanying input/output devices including a display, one or more speakers, a keyboard, one or more other I/O device(s), a mouse, a camera, or the like. Other exemplary I/O device(s) may include a touch screen, a voice-activated input device, a track ball, a geolocation device, an accelerometer/gyroscope, biometric feature input devices, and any other device that allows the electronic device 100 to receive input from a user.

The electronic device 100 includes system hardware 120 and memory 140, which may be implemented as random access memory and/or read-only memory. A file store may be communicatively coupled to electronic device 100. The file store may be internal to electronic device 100 such as, *e.g.*, eMMC, SSD, one or more hard drives, or other types of storage devices.

Alternatively, the file store may also be external to electronic device 100 such as, *e.g.*, one or more external hard drives, network attached storage, or a separate storage network.

System hardware 120 may include one or more processors 122, graphics processors 124, network interfaces 126, and bus structures 128. In one example, processor 122 may be embodied as an Intel® Atom™ processors, Intel® Atom™ based System-on-a-Chip (SOC) or Intel® Core2 Duo® or i3/i5/i7 series processor available from Intel Corporation, Santa Clara, California, USA. As used herein, the term "processor" means any type of computational element, such as but not limited to, a microprocessor, a microcontroller, a complex instruction set computing (CISC) microprocessor, a reduced instruction set (RISC) microprocessor, a very long instruction word (VLIW) microprocessor, or any other type of processor or processing circuit.

Graphics processor(s) 124 may function as adjunct processor that manages graphics and/or video operations. Graphics processor(s) 124 may be integrated onto the motherboard of electronic device 100 or may be coupled via an expansion slot on the motherboard or may be located on the same die or same package as the Processing Unit.

In one example, network interface 126 could be a wired interface such as an Ethernet interface (see, *e.g.*, Institute of Electrical and Electronics Engineers/IEEE 802.3-2002) or a wireless interface such as an IEEE 802.11a, b or g-compliant interface (see, *e.g.*, IEEE Standard for IT-Telecommunications and information exchange between systems LAN/MAN--Part II: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications Amendment 4: Further Higher Data Rate Extension in the 2.4 GHz Band, 802.11G-2003). Another example of a wireless interface would be a general packet radio service (GPRS) interface (see, *e.g.*, Guidelines on GPRS Handset Requirements, Global System for Mobile Communications/GSM Association, Ver. 3.0.1, December 2002).

Bus structures 128 connect various components of system hardware 128. In one example, bus structures 128 may be one or more of several types of bus structure(s) including a memory bus, a peripheral bus or external bus, and/or a local bus using any variety of available bus architectures including, but not limited to, 11-bit bus, Industrial Standard Architecture (ISA), Micro-Channel Architecture (MSA), Extended ISA (EISA), Intelligent Drive Electronics (IDE), VESA Local Bus (VLB), Peripheral Component Interconnect (PCI), Universal Serial Bus (USB), Advanced Graphics Port (AGP), Personal Computer Memory Card International Association bus (PCMCIA), and Small Computer Systems Interface (SCSI), a High Speed Synchronous Serial Interface (HSI), a Serial Low-power Inter-chip Media Bus (SLIMbus®), or the like.

Electronic device 100 may include an RF transceiver 130 to transceive RF signals, a Near Field Communication (NFC) radio 134, and a signal processing module 132 to process signals received by RF transceiver 130. RF transceiver may implement a local wireless connection via a protocol such as, e.g., Bluetooth or 802.11X. IEEE 802.11a, b or g-compliant interface (see, 5 e.g., IEEE Standard for IT-Telecommunications and information exchange between systems LAN/MAN--Part II: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications Amendment 4: Further Higher Data Rate Extension in the 2.4 GHz Band, 802.11G-2003). Another example of a wireless interface would be a WCDMA, LTE, general packet radio service (GPRS) interface (see, e.g., Guidelines on GPRS Handset Requirements, 10 Global System for Mobile Communications/GSM Association, Ver. 3.0.1, December 2002).

Electronic device 100 may further include one or more input/output interfaces such as, e.g., a keypad 136 and a display 138. In some examples electronic device 100 may not have a keypad and use the touch panel for input.

Memory 140 may include an operating system 142 for managing operations of electronic 15 device 100. In one example, operating system 142 includes a hardware interface module 154 that provides an interface to system hardware 120. In addition, operating system 140 may include a file system 150 that manages files used in the operation of electronic device 100 and a process control subsystem 152 that manages processes executing on electronic device 100.

Operating system 142 may include (or manage) one or more communication interfaces 146 20 that may operate in conjunction with system hardware 120 to transceive data packets and/or data streams from a remote source. Operating system 142 may further include a system call interface module 144 that provides an interface between the operating system 142 and one or more application modules resident in memory 130. Operating system 142 may be embodied as a UNIX operating system or any derivative thereof (*e.g.*, Linux, Android, *etc.*) or as a Windows® 25 brand operating system, or other operating systems.

In some examples an electronic device may include a controller 170, which may comprise one or more controllers that are separate from the primary execution environment. The separation may be physical in the sense that the controller may be implemented in controllers which are physically separate from the main processors. Alternatively, the trusted execution 30 environment may logical in the sense that the controller may be hosted on same chip or chipset that hosts the main processors.

By way of example, in some examples the controller 170 may be implemented as an independent integrated circuit located on the motherboard of the electronic device 100, e.g., as a dedicated processor block on the same SOC die. In other examples the trusted execution engine

may be implemented on a portion of the processor(s) 122 that is segregated from the rest of the processor(s) using hardware enforced mechanisms

In the example depicted in Fig. 1 the controller 170 comprises a processor 172, a memory module 174, and an I/O interface 178. In some examples the memory module 174 may comprise a persistent flash memory module and the various functional modules may be implemented as logic instructions encoded in the persistent memory module, e.g., firmware or software. The I/O module 178 may comprise a serial I/O module or a parallel I/O module. Because the controller 170 is separate from the main processor(s) 122 and operating system 142, the controller 170 may be made secure, i.e., inaccessible to hackers who typically mount software attacks from the host processor 122.

In various examples the electronic device 100 may be implemented as a mobile information processing platform, e.g., a laptop computer, a tablet device, a mobile phone, an electronic reader, a dual-screen device, or the like.

Fig. 2 is a perspective illustration of a 360 degree hinge assembly in accordance with an example. Referring to Fig. 2, in some examples a hinge assembly 200 which may be used with an electronic device 100 comprises a first hinge 210 comprising a first bracket 212 coupled to a first bushing 214 disposed at a first end of the first bracket 212 and rotatable about a first shaft 216 extending through the first bushing 214.

Hinge assembly 210 further comprises a second hinge 220 comprising a second bushing 222, a first linkage arm 224 rotatable about a second shaft 226 extending through the second bushing 222, and a second linkage arm 228 rotatable about the second shaft 226 extending through the second bushing 222.

Hinge assembly 200 further comprises a third hinge 230 comprising a second bracket 232 coupled to a third bushing 234 disposed at a first end of the second bracket 232 and rotatable about a third shaft 236 extending through the second bushing 234. In some examples the first linkage arm 224 is rotatably coupled to the first shaft 216 and the second linkage arm 228 is rotatably coupled to the third shaft 236.

In some examples the first bracket 212 is rotatable about the first shaft 216 through a first range of angular rotation. In the example depicted in Fig. 2 the first range of angular rotation is defined by a tab 213 on the first bracket 212 which rotates within a groove 223 formed on a surface of the first linkage arm 224. The bracket 212 in Fig. 2 is depicted at a first limit within the first range of angular rotation. The bracket 212 is free to rotate about the first shaft 216 within the angular range of motion defined by the groove 223.

In some examples the first bushing 214 provides a first rotational resistance for the first hinge 210. In the example depicted in Fig. 2 the first bushing 214 is formed to provide a

frictional engagement with first shaft 216 in order to provide a first rotational resistance for the first hinge 210.

5 In some examples the first linkage arm 224 and the second linkage arm 226 are rotatable about the second shaft 226 through a 360 degree range of angular motion. In the embodiment depicted in Fig. 2 the second bushing 234 comprises a torque engine 225 to provide a second rotational resistance. The torque engine 225 may be implemented as a tension spring and/or a constant torque spring.

10 In some examples the second bracket 232 is rotatable about the third shaft 236 through a third range of angular rotation. In the example depicted in Fig. 2 the third range of angular rotation is defined by a tab 233 on the first bracket 232 which rotates within a groove 229 formed on a surface of the second linkage arm 228. The bracket 232 in Fig. 2 is depicted at a first limit within the first range of angular rotation. The bracket 232 is free to rotate about the third shaft 236 within the angular range of motion defined by the groove 229.

15 In some examples the second bushing 234 provides a third rotational resistance. In the example depicted in Fig. 2 the second bushing 234 is formed to provide a frictional engagement with third shaft 236 in order to provide a third rotational resistance for the third hinge 230.

20 In some examples the first hinge 210 may have a first rotational resistance which is less than the second rotational resistance of the second hinge 220. Further, the second rotational resistance of the second hinge 220 may be less than the third rotational resistance of the third hinge 230.

Hinge assembly 200 may be formed from suitably rigid materials. In some examples some or all of the various components of hinge assembly 200 may be formed from one or more suitable metals, e.g., steel or aluminum, while in other examples some or all of the various components of hinge assembly may be formed from a suitably rigid polymer.

25 In one example one or more hinge assemblies 200 may be incorporated into a chassis for an electronic device such as electronic device 100. In such examples the first bracket 212 may be secured to the first section 162 of the electronic device 100 and the second bracket 232 may be secured to the second section 164 of the electronic device 100 to provide a 360 degree hinge assembly for the electronic device 100.

30 Operation of the hinge assembly 200 will be explained with reference to Figs. 3A-3E and Figs. 4A-4E. Referring to Fig. 3A and Fig. 4A, when the electronic device 100 is in a closed configuration, referred to as clamshell mode in Fig. 3A, the hinge assembly is in the configuration depicted in Fig. 3A. In some examples the chassis of the electronic device 100 may comprise one or more magnets 166 (Fig. 4A) positioned proximate opposing surfaces of the first

section 162 and the second section 164 to help secure the electronic device 100 in a closed configuration.

As described above, in some examples the first hinge 210 may have a first rotational resistance which is less than the second rotational resistance of the second hinge 220. Thus, when a user begins to open the electronic device 100 the first hinge 210 rotates independently from the configuration depicted in Fig. 3A to the configuration depicted in Fig. 3B and Fig. 4B. Rotation of the first hinge stops when the tab 213 of bracket 212 reaches the upper edge of the groove 223 in linkage arm 224.

When a user continues to open the electronic device the first linkage arm 224 rotates about the second shaft 226 of the second hinge 220, thereby allowing the electronic device 100 to be opened to a conventional laptop operating configuration, as illustrated in Fig. 3C and Fig. 4C, or to a tent mode, as depicted in Fig. 3D and Fig. 4D.

Continued rotation of the second hinge ultimately causes the linkage arm 224 to make physical contact with the shaft 236, which limits the rotation of the second hinge 220. When second hinge 220 reaches the end of its rotation, continuing to apply torque to the hinge assembly 200 causes the second bracket 232 to rotate about the third shaft 236 to a position in which the electronic device 100 is in a tablet mode, as depicted in Fig. 3E and Fig. 5.

The first hinge 210 has a first rotational resistance which is less than the rotational resistance of the second hinge 220 which is, in turn, less than the rotational resistance of the third hinge 230. Thus, when the electronic device 100 is opened the first hinge 230 moves through its rotational range first, the second hinge 220 moves through its rotational range second, and the third hinge 230 moves through its rotational range last.

Thus, the hinge assembly 200 utilized three separate hinges which operate independently to provide for a full 360 degrees of rotation between the first section 162 and the second section 164 of the chassis 160 of electronic device 100. The first hinge 210 and the third hinge 230 are offset from the second hinge 220 by linkage arms 224 and 228, respectively. Thus, the first hinge 210 and the third hinge 230 orbit the second hinge 220 as the electronic device 100 is opened and/or closed.

As described above, in some examples the electronic device may be embodied as a computer system. Fig. 6 illustrates a block diagram of a computing system 600 in accordance with an example. The computing system 600 may include one or more central processing unit(s) 602 or processors that communicate via an interconnection network (or bus) 604. The processors 602 may include a general purpose processor, a network processor (that processes data communicated over a computer network 603), or other types of a processor (including a reduced instruction set computer (RISC) processor or a complex instruction set computer (CISC)).

Moreover, the processors 602 may have a single or multiple core design. The processors 602 with a multiple core design may integrate different types of processor cores on the same integrated circuit (IC) die. Also, the processors 602 with a multiple core design may be implemented as symmetrical or asymmetrical multiprocessors. In an example, one or more of the
5 processors 602 may be the same or similar to the processors 102 of Fig. 1.

A chipset 606 may also communicate with the interconnection network 604. The chipset 606 may include a memory control hub (MCH) 608. The MCH 608 may include a memory controller 610 that communicates with a memory 612 (which may be the same or similar to the memory 130 of Fig. 1). The memory 412 may store data, including sequences of instructions,
10 that may be executed by the processor 602, or any other device included in the computing system 600. In one example, the memory 612 may include one or more volatile storage (or memory) devices such as random access memory (RAM), dynamic RAM (DRAM), synchronous DRAM (SDRAM), static RAM (SRAM), or other types of storage devices. Nonvolatile memory may also be utilized such as a hard disk. Additional devices may communicate via the interconnection
15 network 604, such as multiple processor(s) and/or multiple system memories.

The MCH 608 may also include a graphics interface 614 that communicates with a display device 616. In one example, the graphics interface 614 may communicate with the display device 616 via an accelerated graphics port (AGP). In an example, the display 616 (such as a flat panel display) may communicate with the graphics interface 614 through, for example, a signal
20 converter that translates a digital representation of an image stored in a storage device such as video memory or system memory into display signals that are interpreted and displayed by the display 616. The display signals produced by the display device may pass through various control devices before being interpreted by and subsequently displayed on the display 616.

A hub interface 618 may allow the MCH 608 and an input/output control hub (ICH) 620 to
25 communicate. The ICH 620 may provide an interface to I/O device(s) that communicate with the computing system 600. The ICH 620 may communicate with a bus 622 through a peripheral bridge (or controller) 624, such as a peripheral component interconnect (PCI) bridge, a universal serial bus (USB) controller, or other types of peripheral bridges or controllers. The bridge 624 may provide a data path between the processor 602 and peripheral devices. Other types of
30 topologies may be utilized. Also, multiple buses may communicate with the ICH 620, e.g., through multiple bridges or controllers. Moreover, other peripherals in communication with the ICH 620 may include, in various examples, integrated drive electronics (IDE) or small computer system interface (SCSI) hard drive(s), USB port(s), a keyboard, a mouse, parallel port(s), serial port(s), floppy disk drive(s), digital output support (e.g., digital video interface (DVI)), or other
35 devices.

The bus 622 may communicate with an audio device 626, one or more disk drive(s) 628, and a network interface device 630 (which is in communication with the computer network 603). Other devices may communicate via the bus 622. Also, various components (such as the network interface device 630) may communicate with the MCH 608 in some examples. In addition, the processor 602 and one or more other components discussed herein may be combined to form a single chip (e.g., to provide a System on Chip (SOC)). Furthermore, the graphics accelerator 616 may be included within the MCH 608 in other examples.

Furthermore, the computing system 600 may include volatile and/or nonvolatile memory (or storage). For example, nonvolatile memory may include one or more of the following: read-only memory (ROM), programmable ROM (PROM), erasable PROM (EPROM), electrically EPROM (EEPROM), a disk drive (e.g., 628), a floppy disk, a compact disk ROM (CD-ROM), a digital versatile disk (DVD), flash memory, a magneto-optical disk, or other types of nonvolatile machine-readable media that are capable of storing electronic data (e.g., including instructions).

Fig. 7 illustrates a block diagram of a computing system 700, according to an example. The system 700 may include one or more processors 702-1 through 702-N (generally referred to herein as “processors 702” or “processor 702”). The processors 702 may communicate via an interconnection network or bus 704. Each processor may include various components some of which are only discussed with reference to processor 702-1 for clarity. Accordingly, each of the remaining processors 702-2 through 702-N may include the same or similar components discussed with reference to the processor 702-1.

In an example, the processor 702-1 may include one or more processor cores 706-1 through 706-M (referred to herein as “cores 706” or more generally as “core 706”), a shared cache 708, a router 710, and/or a processor control logic or unit 720. The processor cores 706 may be implemented on a single integrated circuit (IC) chip. Moreover, the chip may include one or more shared and/or private caches (such as cache 708), buses or interconnections (such as a bus or interconnection network 712), memory controllers, or other components.

In one example, the router 710 may be used to communicate between various components of the processor 702-1 and/or system 700. Moreover, the processor 702-1 may include more than one router 710. Furthermore, the multitude of routers 710 may be in communication to enable data routing between various components inside or outside of the processor 702-1.

The shared cache 708 may store data (e.g., including instructions) that are utilized by one or more components of the processor 702-1, such as the cores 706. For example, the shared cache 708 may locally cache data stored in a memory 714 for faster access by components of the processor 702. In an example, the cache 708 may include a mid-level cache (such as a level 2 (L2), a level 3 (L3), a level 4 (L4), or other levels of cache), a last level cache (LLC), and/or

combinations thereof. Moreover, various components of the processor 702-1 may communicate with the shared cache 708 directly, through a bus (e.g., the bus 712), and/or a memory controller or hub. As shown in Fig. 7, in some examples, one or more of the cores 706 may include a level 1 (L1) cache 716-1 (generally referred to herein as “L1 cache 716”).

5 Fig. 8 illustrates a block diagram of portions of a processor core 706 and other components of a computing system, according to an example. In one example, the arrows shown in Fig. 8 illustrate the flow direction of instructions through the core 706. One or more processor cores (such as the processor core 706) may be implemented on a single integrated circuit chip (or die) such as discussed with reference to Fig. 7. Moreover, the chip may include one or more shared
10 and/or private caches (e.g., cache 708 of Fig. 7), interconnections (e.g., interconnections 704 and/or 112 of Fig. 7), control units, memory controllers, or other components.

As illustrated in Fig. 8, the processor core 706 may include a fetch unit 802 to fetch instructions (including instructions with conditional branches) for execution by the core 706. The instructions may be fetched from any storage devices such as the memory 714. The core 706
15 may also include a decode unit 804 to decode the fetched instruction. For instance, the decode unit 804 may decode the fetched instruction into a plurality of uops (micro-operations).

Additionally, the core 706 may include a schedule unit 806. The schedule unit 806 may perform various operations associated with storing decoded instructions (e.g., received from the decode unit 804) until the instructions are ready for dispatch, e.g., until all source values of a
20 decoded instruction become available. In one example, the schedule unit 806 may schedule and/or issue (or dispatch) decoded instructions to an execution unit 808 for execution. The execution unit 808 may execute the dispatched instructions after they are decoded (e.g., by the decode unit 804) and dispatched (e.g., by the schedule unit 806). In an example, the execution unit 808 may include more than one execution unit. The execution unit 808 may also perform
25 various arithmetic operations such as addition, subtraction, multiplication, and/or division, and may include one or more an arithmetic logic units (ALUs). In an example, a co-processor (not shown) may perform various arithmetic operations in conjunction with the execution unit 808.

Further, the execution unit 808 may execute instructions out-of-order. Hence, the processor core 706 may be an out-of-order processor core in one example. The core 706 may also include a
30 retirement unit 810. The retirement unit 810 may retire executed instructions after they are committed. In an example, retirement of the executed instructions may result in processor state being committed from the execution of the instructions, physical registers used by the instructions being de-allocated, etc.

The core 706 may also include a bus unit 714 to enable communication between
35 components of the processor core 706 and other components (such as the components discussed

with reference to Fig. 8) via one or more buses (e.g., buses 804 and/or 812). The core 706 may also include one or more registers 816 to store data accessed by various components of the core 706 (such as values related to power consumption state settings).

Furthermore, even though Fig. 7 illustrates the control unit 720 to be coupled to the core 706 via interconnect 812, in various examples the control unit 720 may be located elsewhere such as inside the core 706, coupled to the core via bus 704, etc.

In some examples, one or more of the components discussed herein can be embodied as a System On Chip (SOC) device. Fig. 9 illustrates a block diagram of an SOC package in accordance with an example. As illustrated in Fig. 9, SOC 902 includes one or more processor cores 920, one or more graphics processor cores 930, an Input/Output (I/O) interface 940, and a memory controller 942. Various components of the SOC package 902 may be coupled to an interconnect or bus such as discussed herein with reference to the other figures. Also, the SOC package 902 may include more or less components, such as those discussed herein with reference to the other figures. Further, each component of the SOC package 902 may include one or more other components, e.g., as discussed with reference to the other figures herein. In one example, SOC package 902 (and its components) is provided on one or more Integrated Circuit (IC) die, e.g., which are packaged into a single semiconductor device.

As illustrated in Fig. 9, SOC package 902 is coupled to a memory 960 (which may be similar to or the same as memory discussed herein with reference to the other figures) via the memory controller 942. In an example, the memory 960 (or a portion of it) can be integrated on the SOC package 902.

The I/O interface 940 may be coupled to one or more I/O devices 970, e.g., via an interconnect and/or bus such as discussed herein with reference to other figures. I/O device(s) 970 may include one or more of a keyboard, a mouse, a touchpad, a display, an image/video capture device (such as a camera or camcorder/video recorder), a touch surface, a speaker, or the like.

Fig. 10 illustrates a computing system 1000 that is arranged in a point-to-point (PtP) configuration, according to an example. In particular, Fig. 10 shows a system where processors, memory, and input/output devices are interconnected by a number of point-to-point interfaces. The operations discussed with reference to Fig. 2 may be performed by one or more components of the system 1000.

As illustrated in Fig. 10, the system 1000 may include several processors, of which only two, processors 1002 and 1004 are shown for clarity. The processors 1002 and 1004 may each include a local memory controller hub (MCH) 1006 and 1008 to enable communication with memories 1010 and 1012.

In an example, the processors 1002 and 1004 may be one of the processors 702 discussed with reference to Fig. 7. The processors 1002 and 1004 may exchange data via a point-to-point (PtP) interface 1014 using PtP interface circuits 1016 and 1018, respectively. Also, the processors 1002 and 1004 may each exchange data with a chipset 1020 via individual PtP
5 interfaces 1022 and 1024 using point-to-point interface circuits 1026, 1028, 1030, and 1032. The chipset 1020 may further exchange data with a high-performance graphics circuit 1034 via a high-performance graphics interface 1036, e.g., using a PtP interface circuit 1037.

As shown in Fig. 10, one or more of the cores 106 and/or cache 108 of Fig. 1 may be located within the processors 1004. Other examples, however, may exist in other circuits, logic
10 units, or devices within the system 1000 of Fig. 10. Furthermore, other examples may be distributed throughout several circuits, logic units, or devices illustrated in Fig. 10.

The chipset 1020 may communicate with a bus 1040 using a PtP interface circuit 1041. The bus 1040 may have one or more devices that communicate with it, such as a bus bridge 1042 and I/O devices 1043. Via a bus 1044, the bus bridge 1043 may communicate with other devices
15 such as a keyboard/mouse 1045, communication devices 1046 (such as modems, network interface devices, or other communication devices that may communicate with the computer network 1003), audio I/O device, and/or a data storage device 1048. The data storage device 1048 (which may be a hard disk drive or a NAND flash based solid state drive) may store code 1049 that may be executed by the processors 1004.

20 The following pertains to further examples.

Example 1 is a hinge assembly for an electronic device, comprising a first hinge comprising a first bracket coupled to a first bushing disposed at a first end of the first bracket and rotatable about a first shaft extending through the first bushing, a second hinge comprising, a second bushing, a first linkage arm rotatable about a second shaft extending through the second
25 bushing, and a second linkage arm rotatable about the second shaft extending through the second bushing and a third hinge comprising a second bracket coupled to a third bushing disposed at a first end of the second bracket and rotatable about a third shaft extending through the third bushing, wherein the first linkage arm is rotatably coupled to the first shaft and the second linkage arm is rotatably coupled to the third shaft.

30 In Example 2, the subject matter of Example 1 can optionally include an arrangement in which the first bracket is rotatable about the first shaft through a first range of angular rotation.

In Example 3, the subject matter of any one of Examples 1–2 can optionally include an arrangement in which the first bushing provides a first rotational resistance.

In Example 4, the subject matter of any one of Examples 1–3 can optionally include an arrangement in which the first linkage arm and the second linkage arm are rotatable about the second shaft through a second range of angular motion.

5 In Example 5, the subject matter of any one of Examples 1–4 can optionally include an arrangement in which the second bushing comprises a torque engine to provide a second rotational resistance.

In Example 6, the subject matter of any one of Examples 1–5 can optionally include an arrangement in which the second bracket is rotatable about the third shaft through a third range of angular rotation.

10 In Example 7, the subject matter of any one of Examples 1–6 can optionally include an arrangement in which the second bushing provides a third rotational resistance.

In Example 8, the subject matter of any one of Examples 1–7 can optionally include an arrangement in which the first hinge, the second hinge, and the third hinge operate independently.

15 Example 9 is a chassis for an electronic device, comprising a first section and a second section and a hinge assembly to connect the first section of the chassis to the second section of the chassis, comprising a first hinge coupled to the first section and comprising a first bracket coupled to a first bushing disposed at a first end of the first bracket and rotatable about a first shaft extending through the first bushing, a second hinge comprising a second bushing, a first
20 linkage arm rotatable about a second shaft extending through the second bushing and a second linkage arm rotatable about the second shaft extending through the second bushing; and a third hinge coupled to the second section and comprising a second bracket coupled to a second bushing disposed at a first end of the second bracket and rotatable about a third shaft extending through the second bushing, wherein the first linkage arm is rotatably coupled to the first shaft
25 and the second linkage arm is rotatably coupled to the third shaft.

In Example 10, the subject matter of Example 9 can optionally include an arrangement in which the first bracket is rotatable about the first shaft through a first range of angular rotation.

In Example 11, the subject matter of any one of Examples 9–10 can optionally include an arrangement in which the first bushing provides a first rotational resistance.

30 In Example 12, the subject matter of any one of Examples 9–11 can optionally include an arrangement in which the first linkage arm and the second linkage arm are rotatable about the second shaft through a second range of angular motion.

In Example 13, the subject matter of any one of Examples 9–12 can optionally include an arrangement in which the second bushing comprises a second torque engine to provide a second
35 rotational resistance.

In Example 14, the subject matter of any one of Examples 9–13 can optionally include an arrangement in which the second bracket is rotatable about the third shaft through a third range of angular rotation.

5 In Example 15, the subject matter of any one of Examples 9–14 can optionally include an arrangement in which the second bushing provides a third rotational resistance.

In Example 16, the subject matter of any one of Examples 9–15 can optionally include an arrangement in which the first hinge, the second hinge, and the third hinge operate independently.

10 Example 17 is an electronic device, comprising a controller, a chassis comprising a first section and a second section and a hinge assembly to connect the first section of the chassis to the second section of the chassis, comprising a first hinge coupled to the first section and comprising a first bracket coupled to a first bushing disposed at a first end of the first bracket and rotatable about a first shaft extending through the first bushing, a second hinge comprising a second bushing, a first linkage arm rotatable about a second shaft extending through the second
15 bushing, and a second linkage arm rotatable about the second shaft extending through the second bushing, and a third hinge coupled to the second section and comprising a second bracket coupled to a second bushing disposed at a first end of the second bracket and rotatable about a third shaft extending through the second bushing, wherein the first linkage arm is rotatably coupled to the first shaft and the second linkage arm is rotatably coupled to the third shaft.

20 In Example 18, the subject matter of Example 17 can optionally include an arrangement in which the first bracket is rotatable about the first shaft through a first range of angular rotation.

In Example 19, the subject matter of any one of Examples 17–18 can optionally include an arrangement in which the first bushing provides a first rotational resistance.

25 In Example 20, the subject matter of any one of Examples 17–19 can optionally include an arrangement in which the first linkage arm and the second linkage arm are rotatable about the second shaft through a second range of angular motion.

In Example 21, the subject matter of any one of Examples 17–20 can optionally include an arrangement in which the second bushing comprises a second torque engine to provide a second rotational resistance.

30 In Example 22, the subject matter of any one of Examples 17–21 can optionally include an arrangement in which the second bracket is rotatable about the third shaft through a third range of angular rotation.

In Example 23, the subject matter of any one of Examples 17–22 can optionally include an arrangement in which the second bushing provides a third rotational resistance.

In Example 24, the subject matter of any one of Examples 17–23 can optionally include an arrangement in which the first hinge, the second hinge, and the third hinge operate independently.

The terms “logic instructions” as referred to herein relates to expressions which may be understood by one or more machines for performing one or more logical operations. For example, logic instructions may comprise instructions which are interpretable by a processor compiler for executing one or more operations on one or more data objects. However, this is merely an example of machine-readable instructions and examples are not limited in this respect.

The terms “computer readable medium” as referred to herein relates to media capable of maintaining expressions which are perceivable by one or more machines. For example, a computer readable medium may comprise one or more storage devices for storing computer readable instructions or data. Such storage devices may comprise storage media such as, for example, optical, magnetic or semiconductor storage media. However, this is merely an example of a computer readable medium and examples are not limited in this respect.

The term “logic” as referred to herein relates to structure for performing one or more logical operations. For example, logic may comprise circuitry which provides one or more output signals based upon one or more input signals. Such circuitry may comprise a finite state machine which receives a digital input and provides a digital output, or circuitry which provides one or more analog output signals in response to one or more analog input signals. Such circuitry may be provided in an application specific integrated circuit (ASIC) or field programmable gate array (FPGA). Also, logic may comprise machine-readable instructions stored in a memory in combination with processing circuitry to execute such machine-readable instructions. However, these are merely examples of structures which may provide logic and examples are not limited in this respect.

Some of the methods described herein may be embodied as logic instructions on a computer-readable medium. When executed on a processor, the logic instructions cause a processor to be programmed as a special-purpose machine that implements the described methods. The processor, when configured by the logic instructions to execute the methods described herein, constitutes structure for performing the described methods. Alternatively, the methods described herein may be reduced to logic on, e.g., a field programmable gate array (FPGA), an application specific integrated circuit (ASIC) or the like.

In the description and claims, the terms coupled and connected, along with their derivatives, may be used. In particular examples, connected may be used to indicate that two or more elements are in direct physical or electrical contact with each other. Coupled may mean that two or more elements are in direct physical or electrical contact. However, coupled may

also mean that two or more elements may not be in direct contact with each other, but yet may still cooperate or interact with each other.

Reference in the specification to “one example” or “some examples” means that a particular feature, structure, or characteristic described in connection with the example is
5 included in at least an implementation. The appearances of the phrase “in one example” in various places in the specification may or may not be all referring to the same example.

Although examples have been described in language specific to structural features and/or methodological acts, it is to be understood that claimed subject matter may not be limited to the specific features or acts described. Rather, the specific features and acts are disclosed as sample
10 forms of implementing the claimed subject matter.

CLAIMS

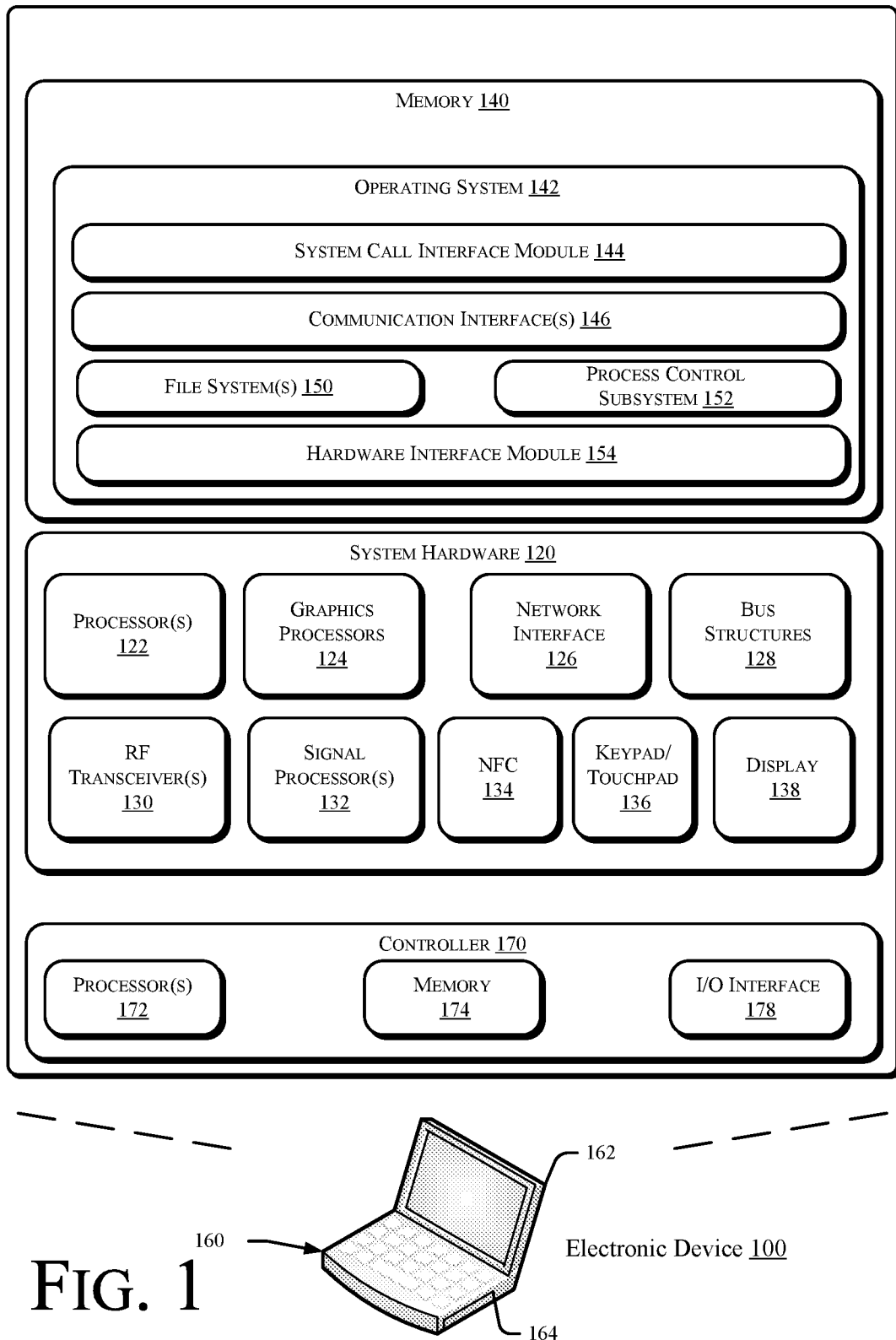
What is claimed is:

1. A hinge assembly for an electronic device, comprising:
 - a first hinge comprising a first bracket coupled to a first bushing disposed at a first end of the first bracket and rotatable about a first shaft extending through the first bushing;
 - a second hinge comprising:
 - a second bushing;
 - a first linkage arm rotatable about a second shaft extending through the second bushing; and
 - a second linkage arm rotatable about the second shaft extending through the second bushing; and
 - a third hinge comprising a second bracket coupled to a third bushing disposed at a first end of the second bracket and rotatable about a third shaft extending through the third bushing,wherein the first linkage arm is rotatably coupled to the first shaft and the second linkage arm is rotatably coupled to the third shaft.
2. The hinge assembly of claim 1, wherein the first bracket is rotatable about the first shaft through a first range of angular rotation.
3. The hinge assembly of claim 1, wherein the first bushing provides a first rotational resistance.
4. The hinge assembly of claim 1, wherein the first linkage arm and the second linkage arm are rotatable about the second shaft through a second range of angular motion.
5. The hinge assembly of claim 1, wherein the second bushing comprises a torque engine to provide a second rotational resistance.
6. The hinge assembly of claim 1, wherein the second bracket is rotatable about the third shaft through a third range of angular rotation.
7. The hinge assembly of claim 1, wherein the second bushing provides a third rotational resistance.
8. The hinge assembly of claim 1, wherein:
 - the first hinge, the second hinge, and the third hinge operate independently.

9. A chassis for an electronic device, comprising:
a first section and a second section; and
a hinge assembly to connect the first section of the chassis to the second section of the chassis, comprising:
a first hinge coupled to the first section and comprising a first bracket coupled to a first bushing disposed at a first end of the first bracket and rotatable about a first shaft extending through the first bushing;
a second hinge comprising:
a second bushing;
a first linkage arm rotatable about a second shaft extending through the second bushing; and
a second linkage arm rotatable about the second shaft extending through the second bushing; and
a third hinge coupled to the second section and comprising a second bracket coupled to a second bushing disposed at a first end of the second bracket and rotatable about a third shaft extending through the second bushing,
wherein the first linkage arm is rotatably coupled to the first shaft and the second linkage arm is rotatably coupled to the third shaft.
10. The chassis of claim 9, wherein the first bracket is rotatable about the first shaft through a first range of angular rotation.
11. The chassis of claim 9, wherein the first bushing provides a first rotational resistance.
12. The chassis of claim 9, wherein the first linkage arm and the second linkage arm are rotatable about the second shaft through a second range of angular motion.
13. The chassis of claim 9, wherein the second bushing comprises a second torque engine to provide a second rotational resistance.
14. The chassis of claim 9, wherein the second bracket is rotatable about the third shaft through a third range of angular rotation.
15. The chassis of claim 9, wherein the second bushing provides a third rotational resistance.

16. The chassis of claim 9, wherein:
the first hinge, the second hinge, and the third hinge operate independently.
17. An electronic device, comprising:
a controller;
a chassis comprising a first section and a second section; and
a hinge assembly to connect the first section of the chassis to the second section of the chassis, comprising:
a first hinge coupled to the first section and comprising a first bracket coupled to a first bushing disposed at a first end of the first bracket and rotatable about a first shaft extending through the first bushing;
a second hinge comprising:
a second bushing;
a first linkage arm rotatable about a second shaft extending through the second bushing; and
a second linkage arm rotatable about the second shaft extending through the second bushing; and
a third hinge coupled to the second section and comprising a second bracket coupled to a second bushing disposed at a first end of the second bracket and rotatable about a third shaft extending through the second bushing,
wherein the first linkage arm is rotatably coupled to the first shaft and the second linkage arm is rotatably coupled to the third shaft.
18. The electronic device of claim 17, wherein the first bracket is rotatable about the first shaft through a first range of angular rotation.
19. The electronic device of claim 17, wherein the first bushing provides a first rotational resistance.
20. The electronic device of claim 17, wherein the first linkage arm and the second linkage arm are rotatable about the second shaft through a second range of angular motion.
21. The electronic device of claim 17, wherein the second bushing comprises a second torque engine to provide a second rotational resistance.
22. The electronic device of claim 17, wherein the second bracket is rotatable about the third shaft through a third range of angular rotation.

23. The electronic device of claim 17, wherein the second bushing provides a third rotational resistance.
24. The electronic device of claim 17, wherein:
the first hinge, the second hinge, and the third hinge operate independently.



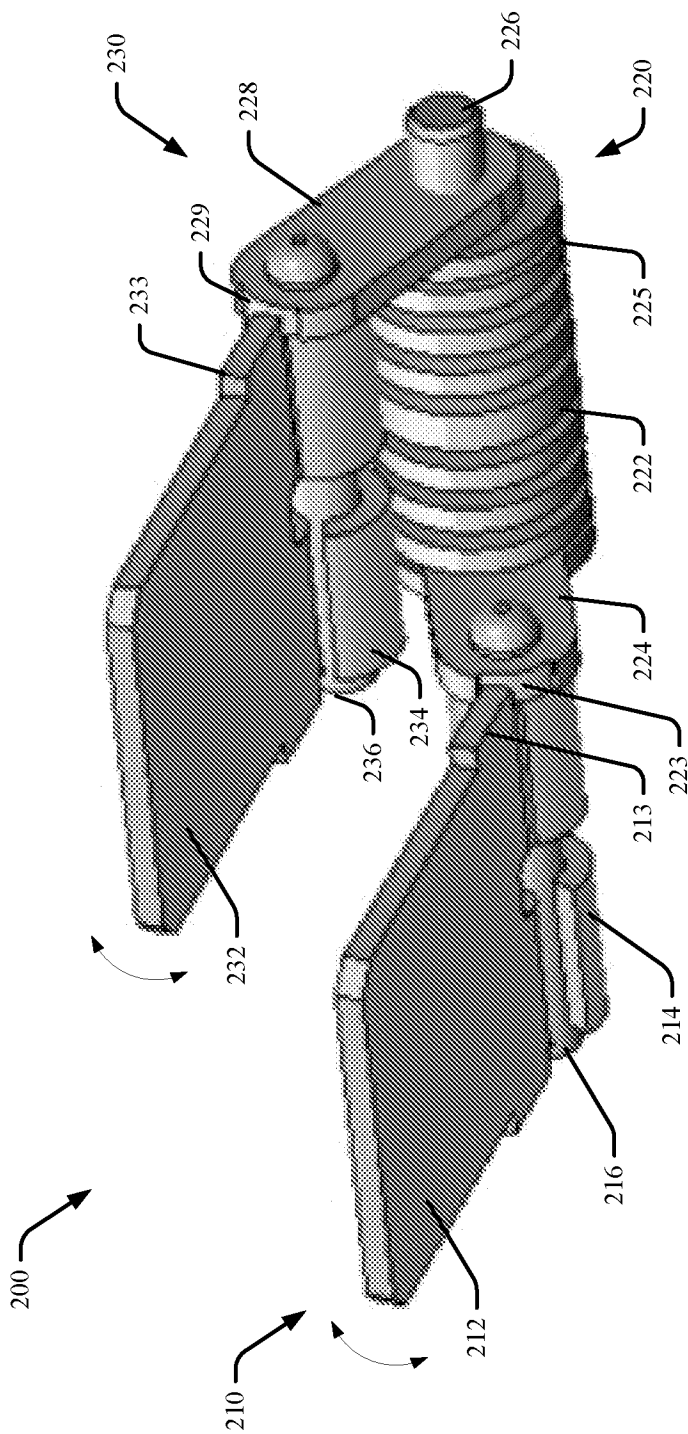
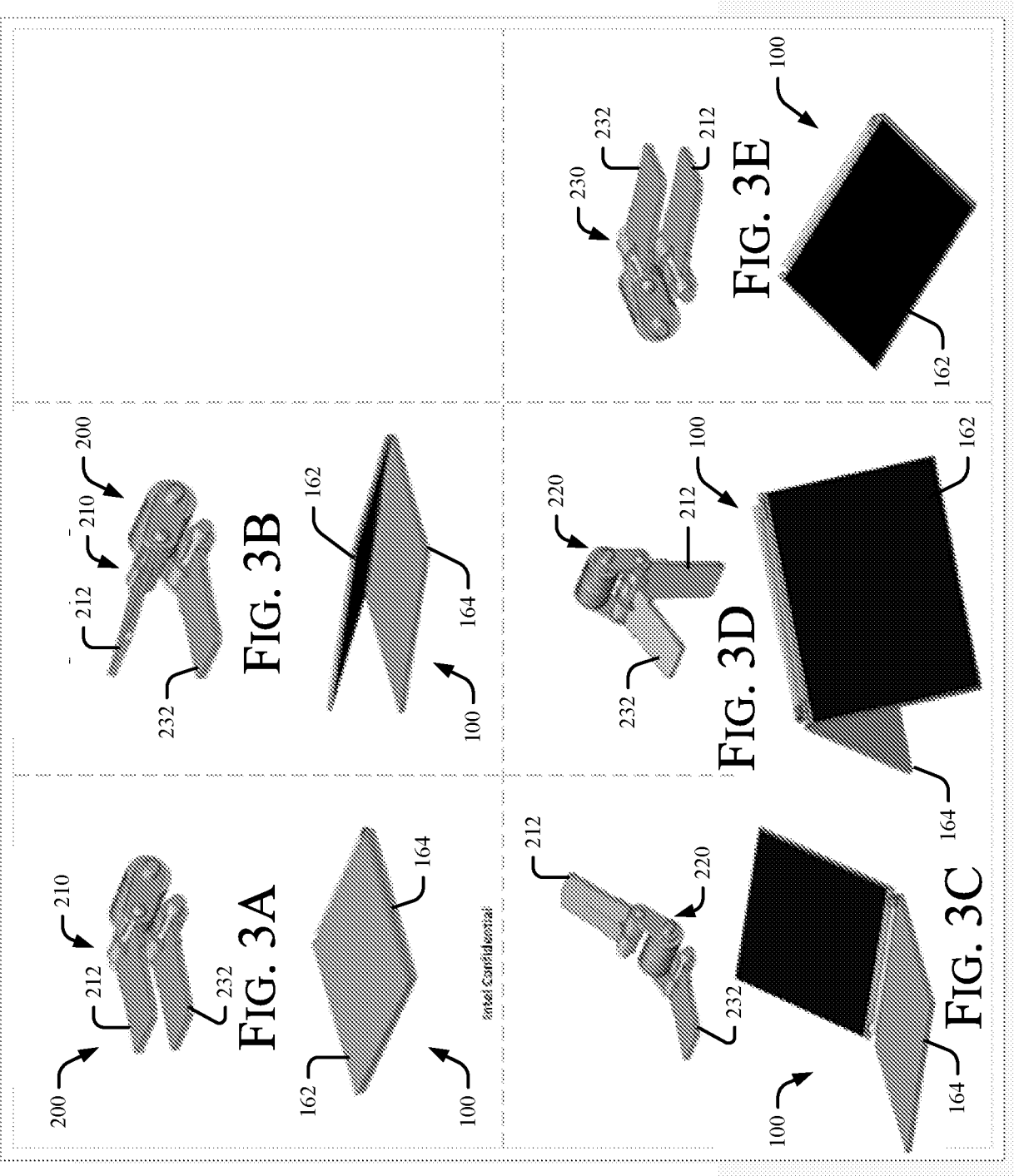


FIG. 2



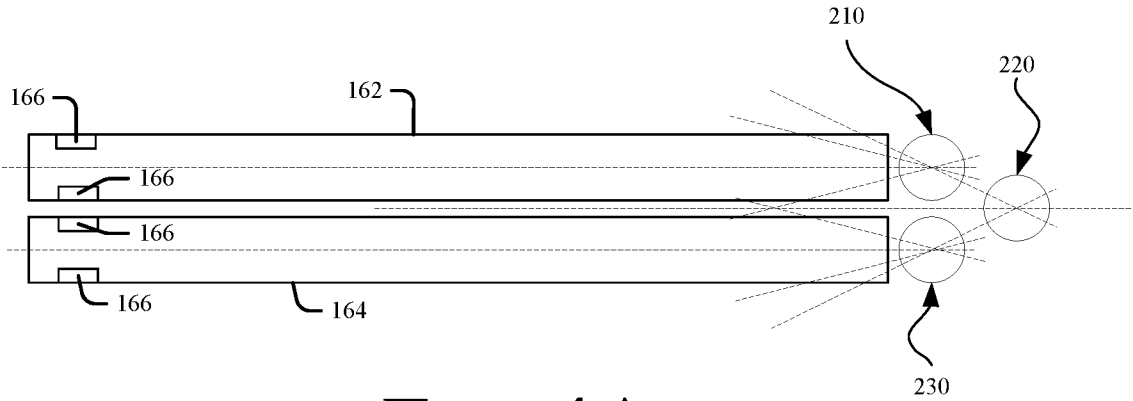


FIG. 4A

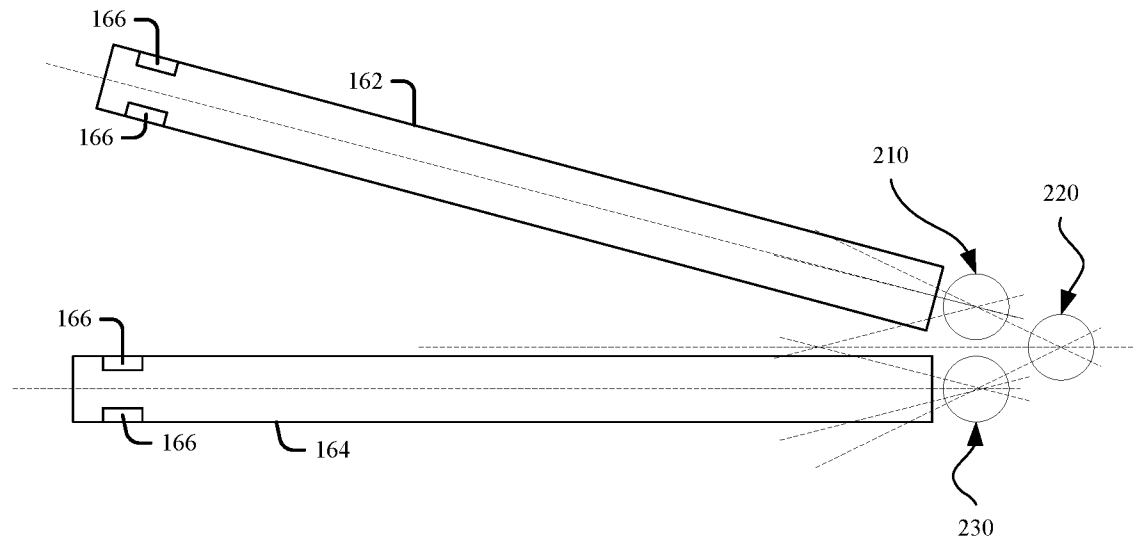


FIG. 4B

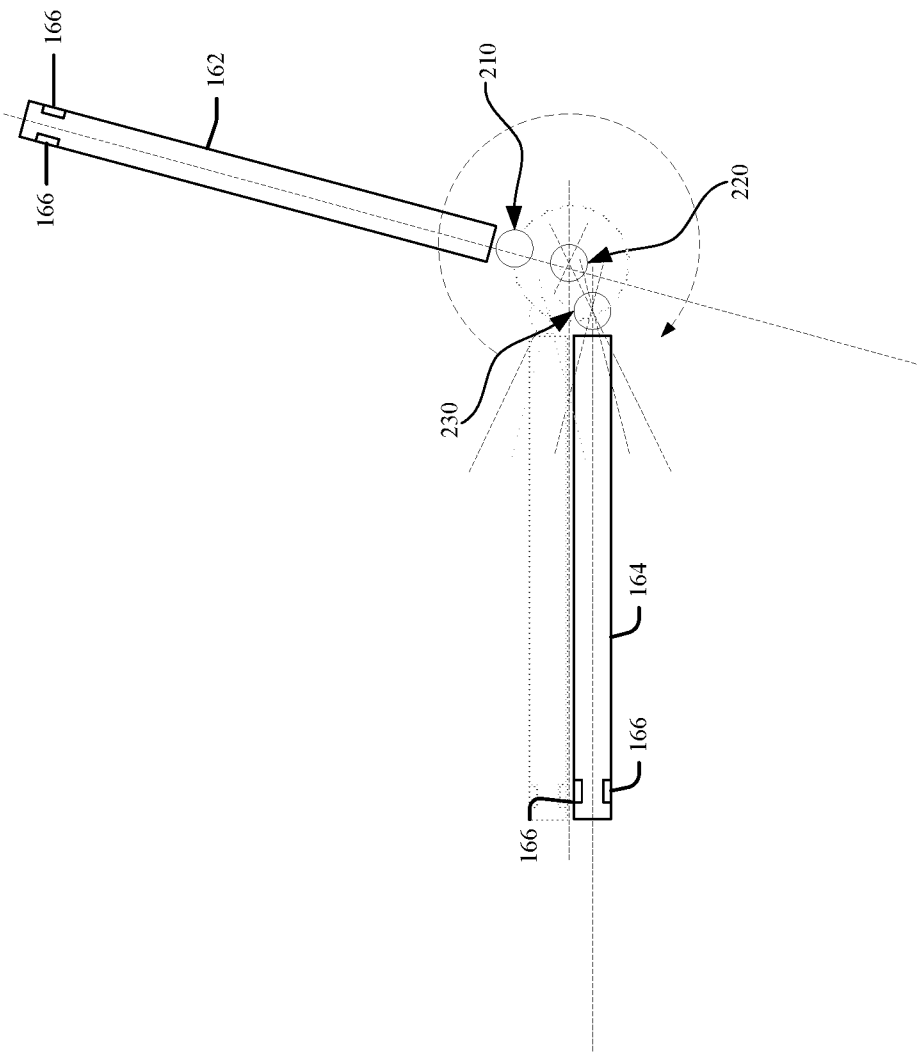


FIG. 4C

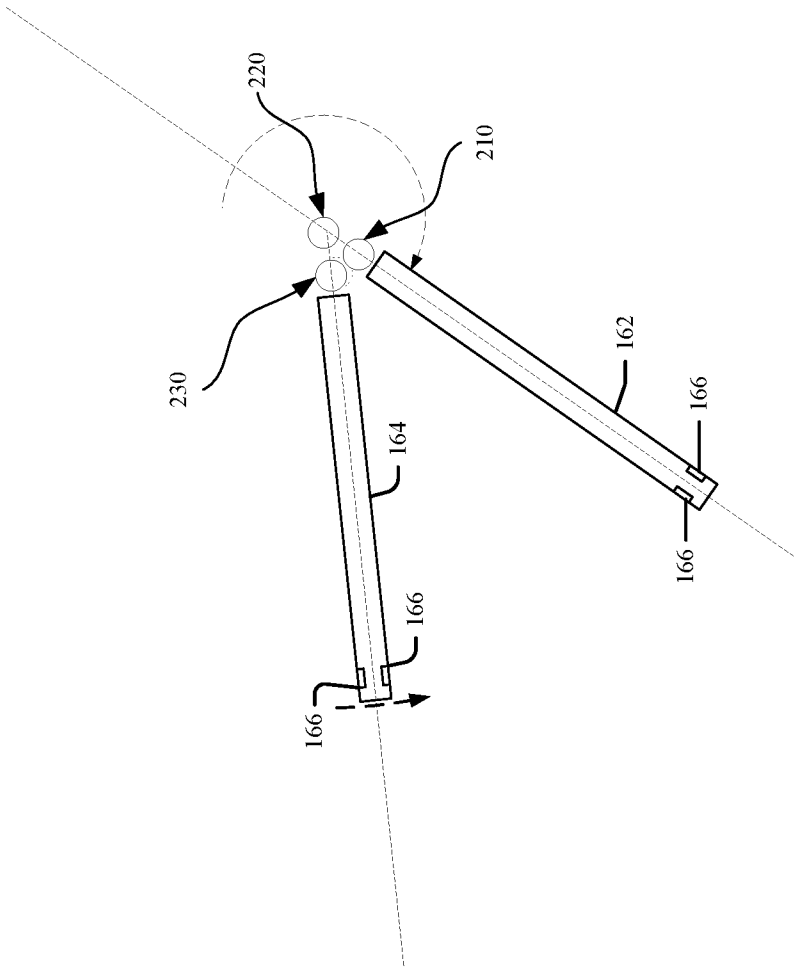


FIG. 4D

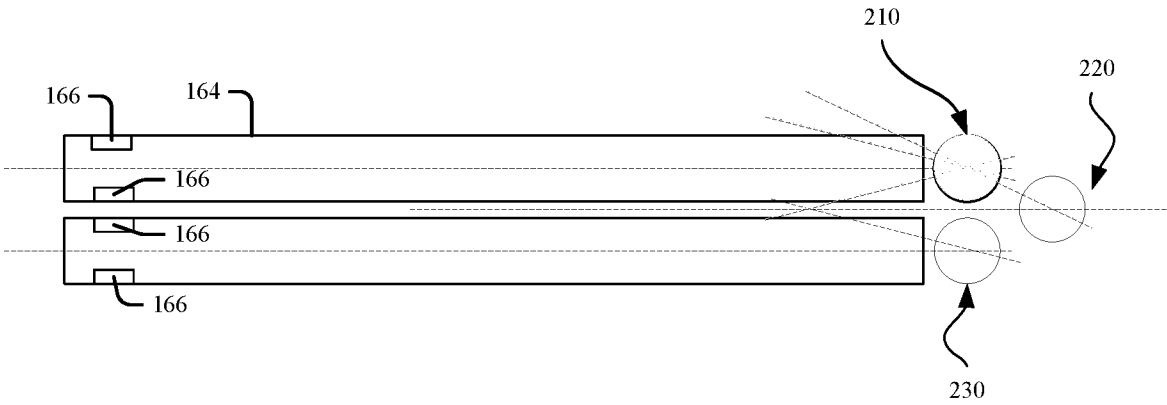


FIG. 5

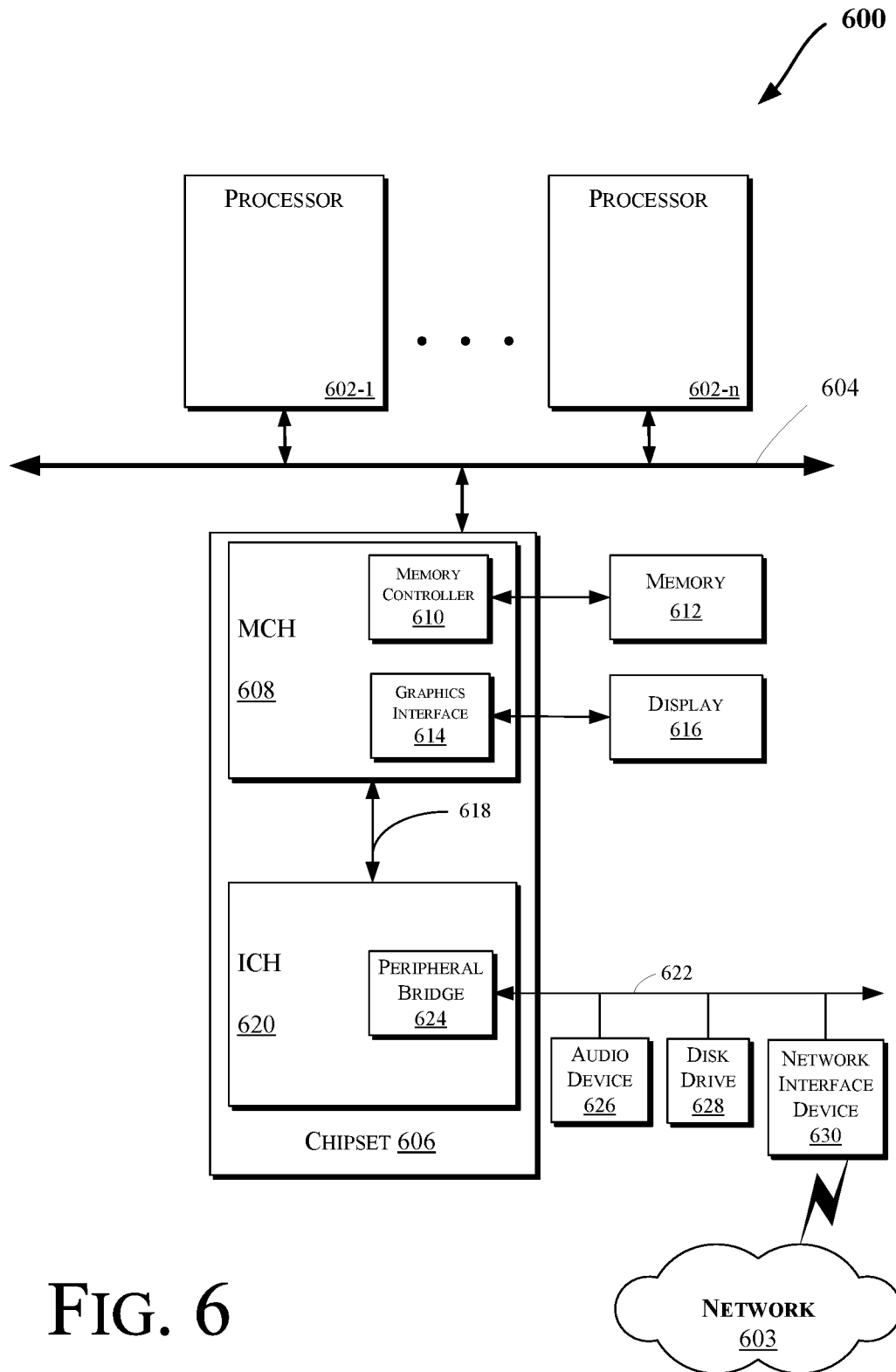


FIG. 6

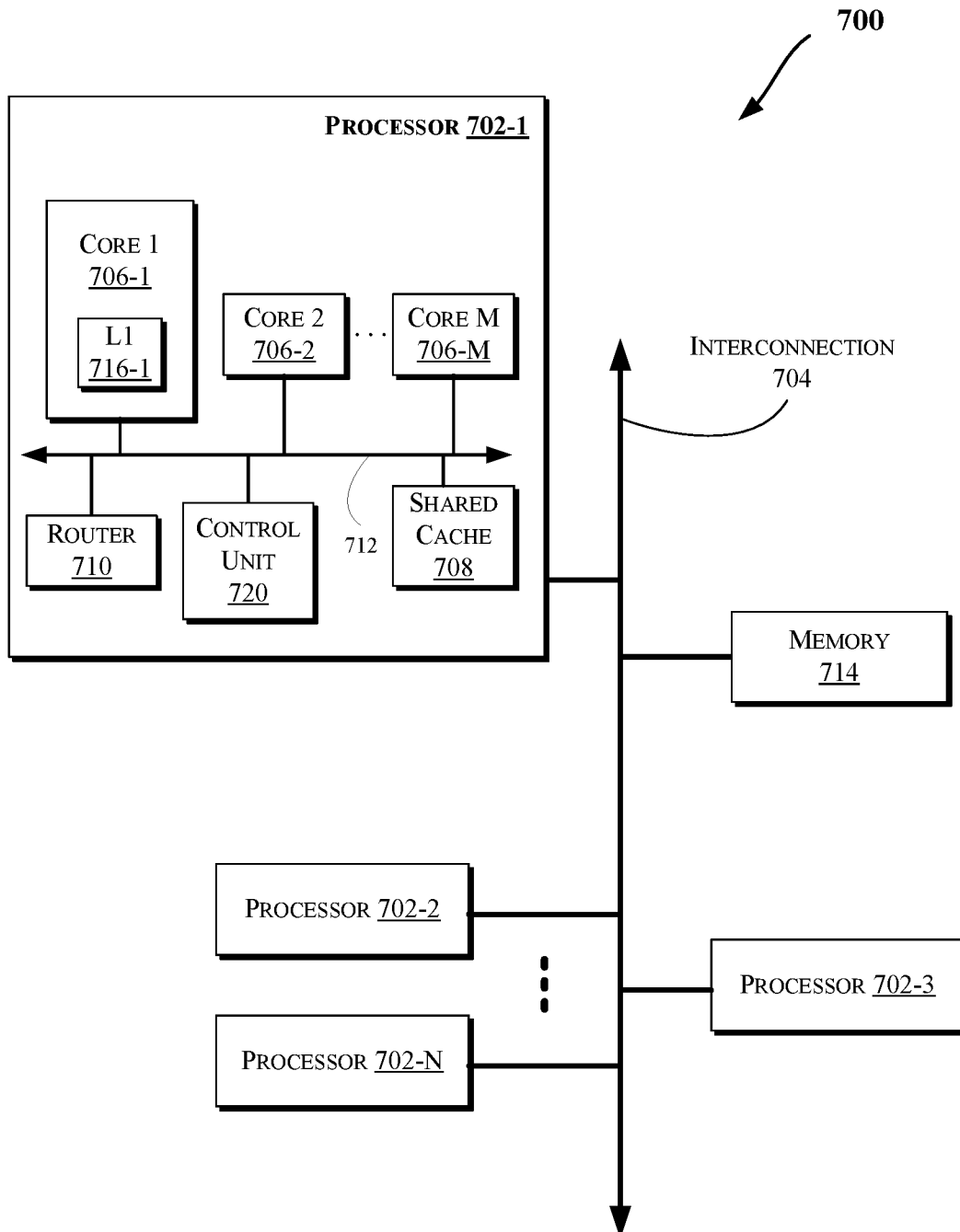


FIG. 7

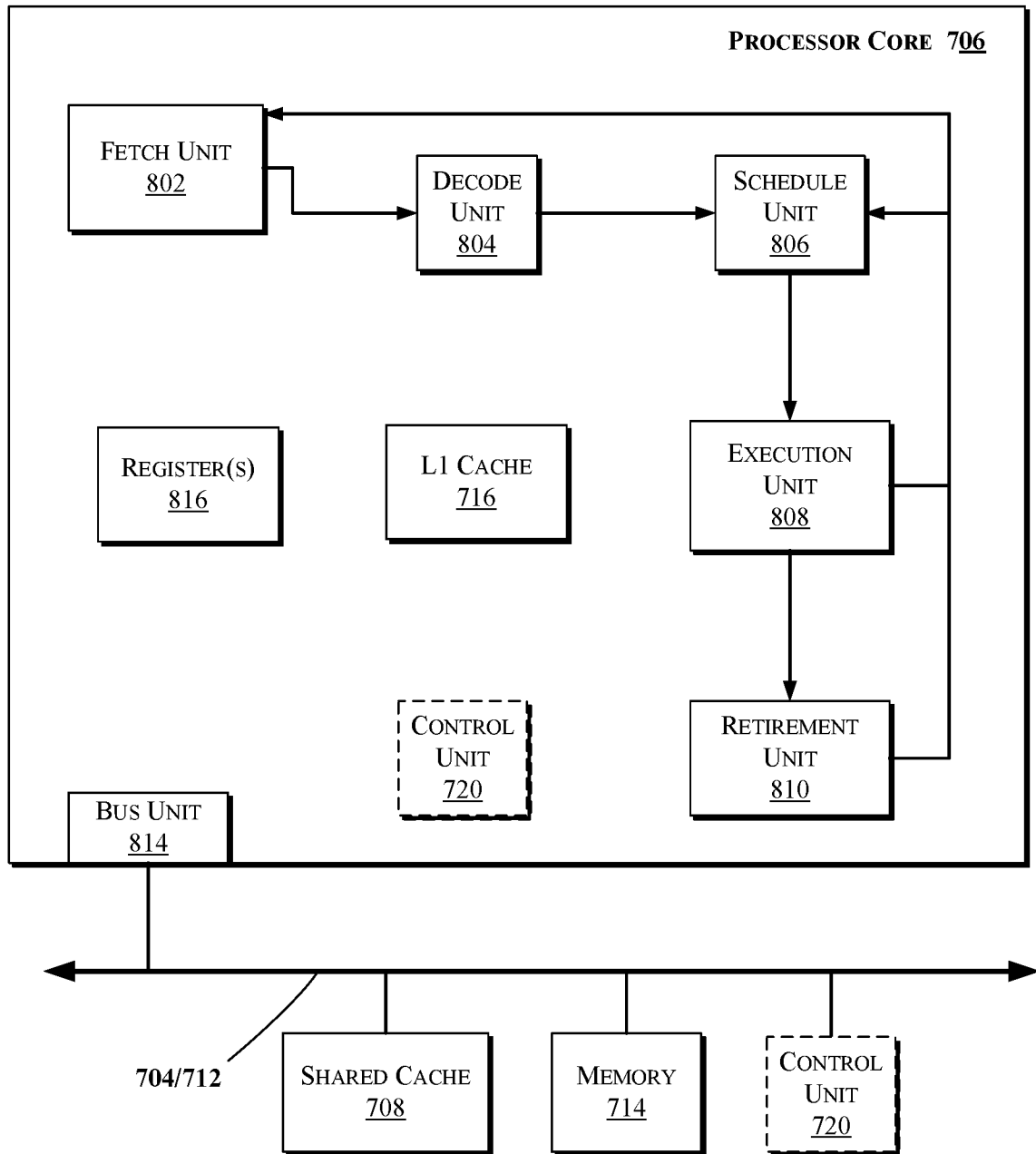


FIG. 8

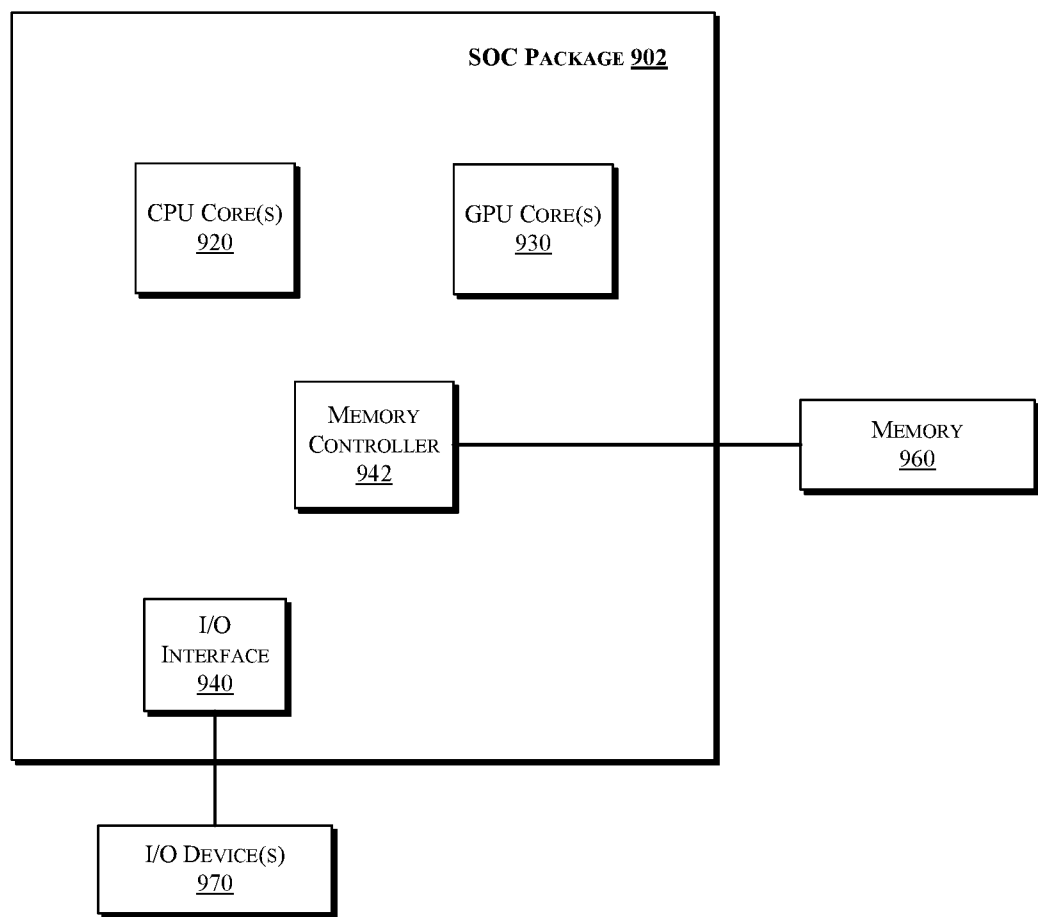


FIG. 9

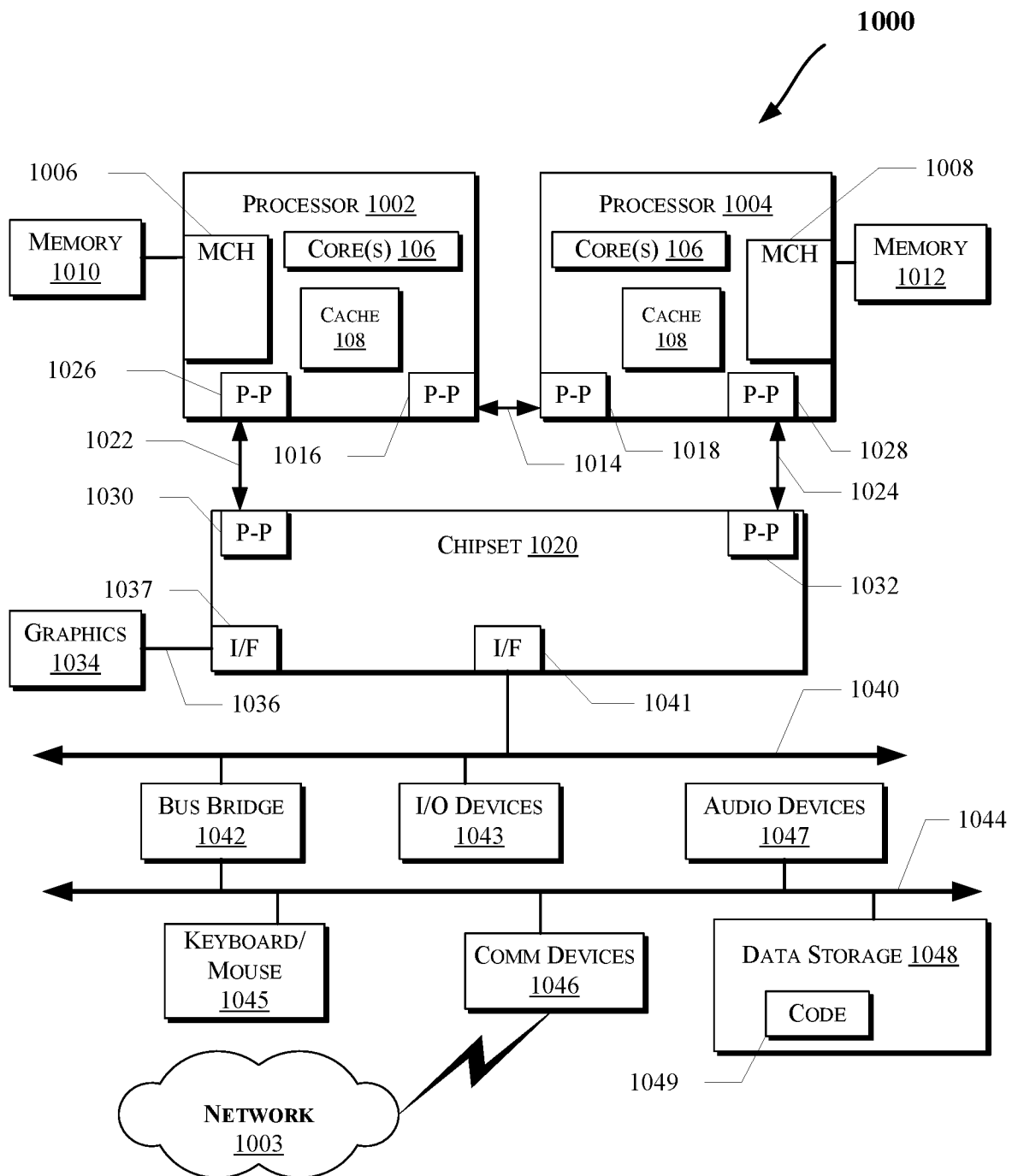


FIG. 10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2017/029157**A. CLASSIFICATION OF SUBJECT MATTER****G06F 1/16(2006.01)i**

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

G06F 1/16; H04M 1/02; F16C 11/04; E05D 11/08; E05D 3/12; A47B 81/00; H05K 5/00; F16G 13/16

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords: 360 degree hinge, shaft, brushing, linkage, rotation axis

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2013-0010405 A1 (FLETCHER R. ROTHKOPF et al.) 10 January 2013 See paragraphs [0036]–[0071]; claim 21; and figures 10–11.	1–24
Y	US 2016-0090766 A1 (INTEL CORPORATION) 31 March 2016 See paragraphs [0003]–[0031] ; claim 1; and figures 4–5.	1–24
A	KR 10-2015-0135666 A (SENEKA CO., LTD.) 03 December 2015 See paragraphs [0020]–[0031]; claims 1–5; and figures 1–2, 7–8.	1–24
A	JP 2008-228249 A (SANYO ELECTRIC CO., LTD.) 25 September 2008 See paragraphs [0025]–[0035]; claim 1; and figures 7–9.	1–24
A	US 2013-0187525 A1 (CHIH-KUANG CHUANG) 25 July 2013 See paragraphs [0028]–[0036]; claim 1; and figures 3–4.	1–24



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

03 August 2017 (03.08.2017)

Date of mailing of the international search report

04 August 2017 (04.08.2017)

Name and mailing address of the ISA/KR

International Application Division

Korean Intellectual Property Office

189 Cheongsa-ro, Seo-gu, Daejeon, 35208, Republic of Korea

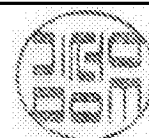


Facsimile No. +82-42-481-8578

Authorized officer

KIM, Seong Woo

Telephone No. +82-42-481-3348



INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2017/029157

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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