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Miller et al.

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(54) **RUGGEDIZED TRIGGERING HANDLE WITH MODULAR PERIPHERAL CONTROL SYSTEM**

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Related U.S. Application Data

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(60) Provisional application No. 62/430,710, filed on Dec. 6, 2016.

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G06K 7/10 (2006.01)
G06F 1/16 (2006.01)
H05K 5/02 (2006.01)

(52) **U.S. Cl.**
CPC **G06K 7/10881** (2013.01); **G06F 1/1632** (2013.01); **G06F 1/1656** (2013.01); **G06F 1/1698** (2013.01); **H05K 5/023** (2013.01)

(58) **Field of Classification Search**

CPC G06K 7/10881; G06K 7/10386; G06K 17/0025; G06Q 20/32

USPC 235/472.02, 462.45, 462.46, 472.01
See application file for complete search history.

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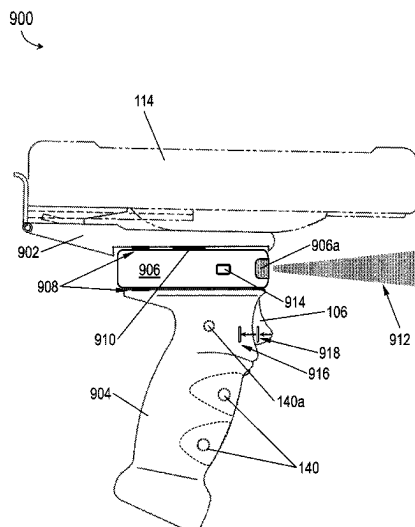
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(57) **ABSTRACT**

A ruggedized triggering handle device for a mobile scanning system supports a mobile device (tablet, smartphone) attachable by a bracket on the upper surface of the handle. The handle may establish a wireless link to the mobile device; a trigger of the handle device includes a magnetic switch which, when driven proximate to a triggering element enclosed within the handle, causes the triggering element to transmit key codes and instructions via the wireless link, enabling the user to trigger applications and peripheral sensing components (e.g., readers, scanners, imagers) of or proximate to the mobile device via the handle. The peripheral sensing components may be modular elements attachable between the upper and lower portions of the handle device, either individually or serially as needed, and operable via the trigger or the additional buttons without the need for visual reference to the handle.

7 Claims, 19 Drawing Sheets



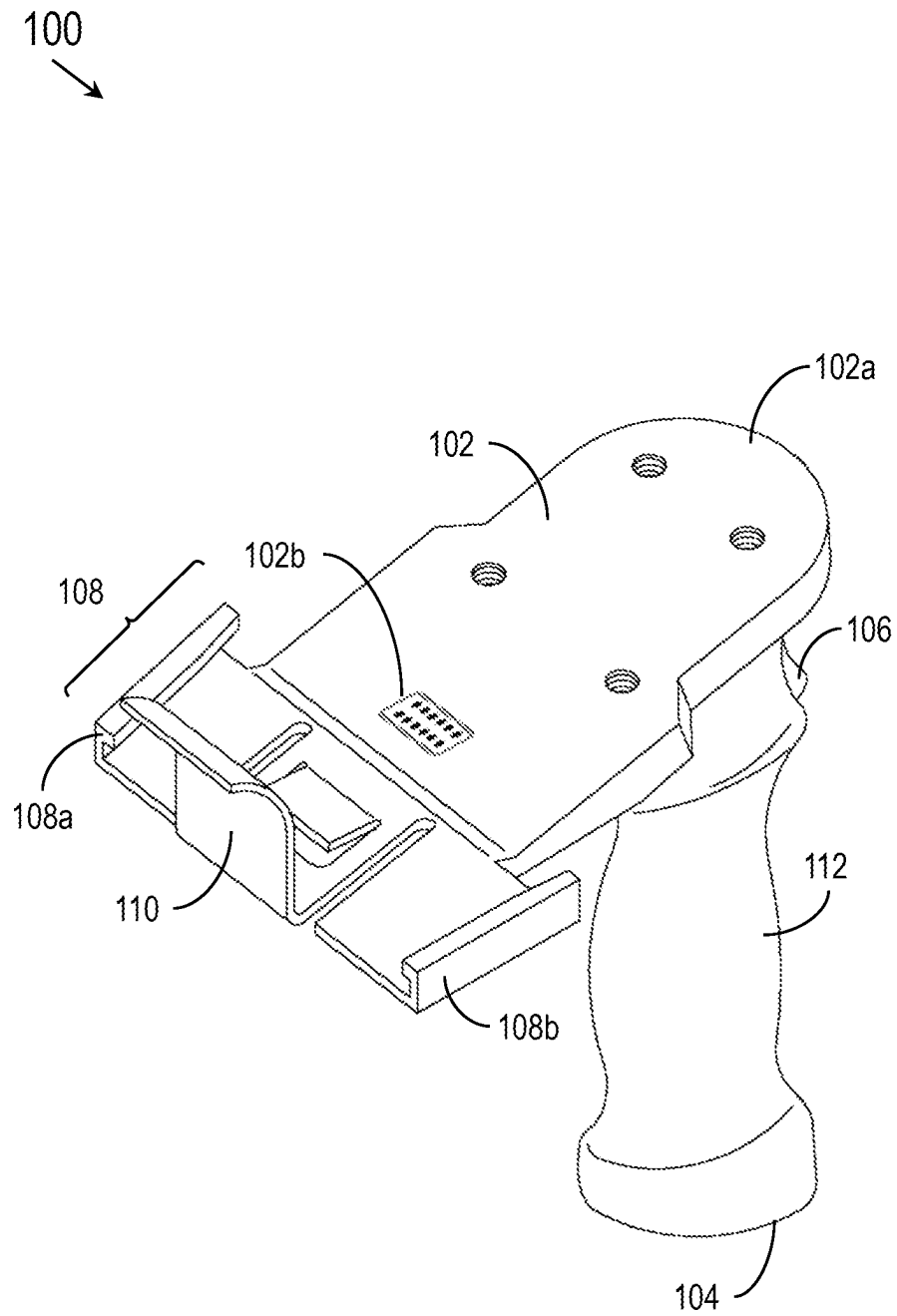
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**FIG. 1**

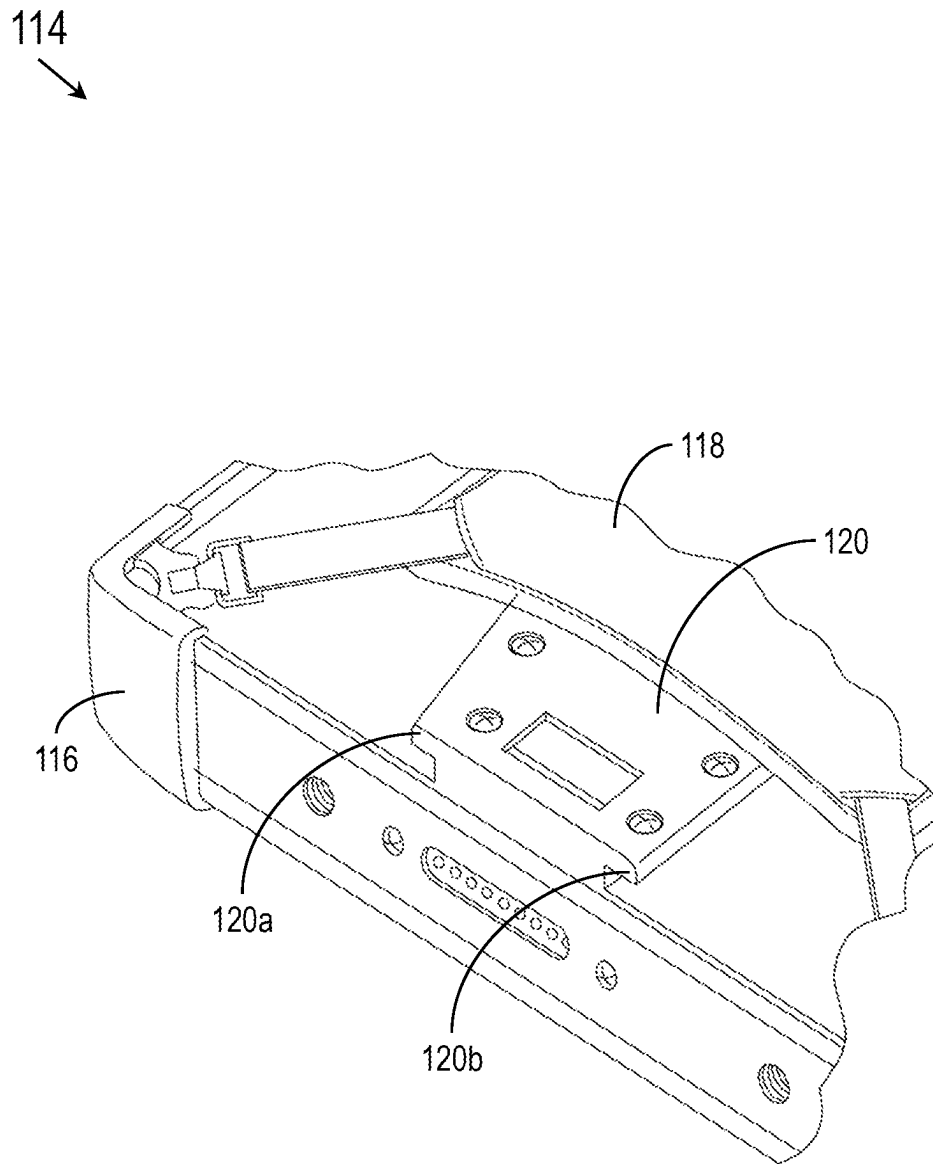


FIG. 2A

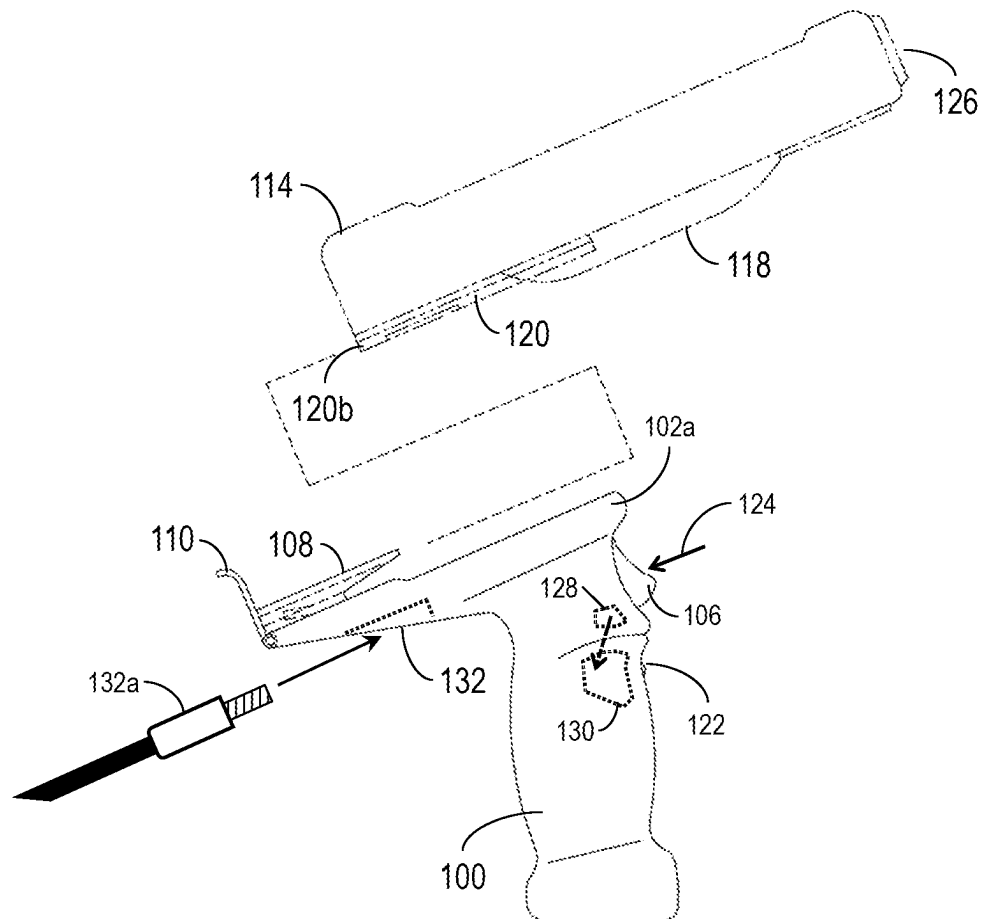


FIG. 2B

130
↘

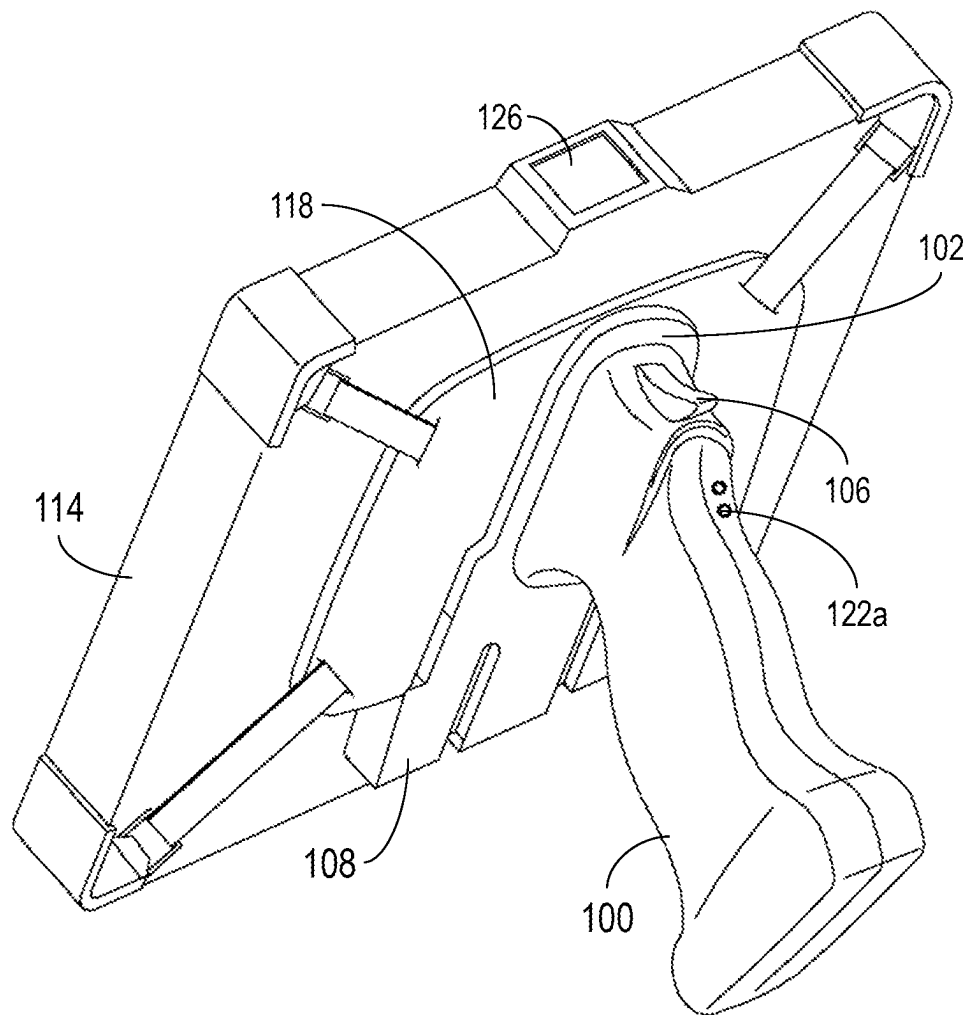
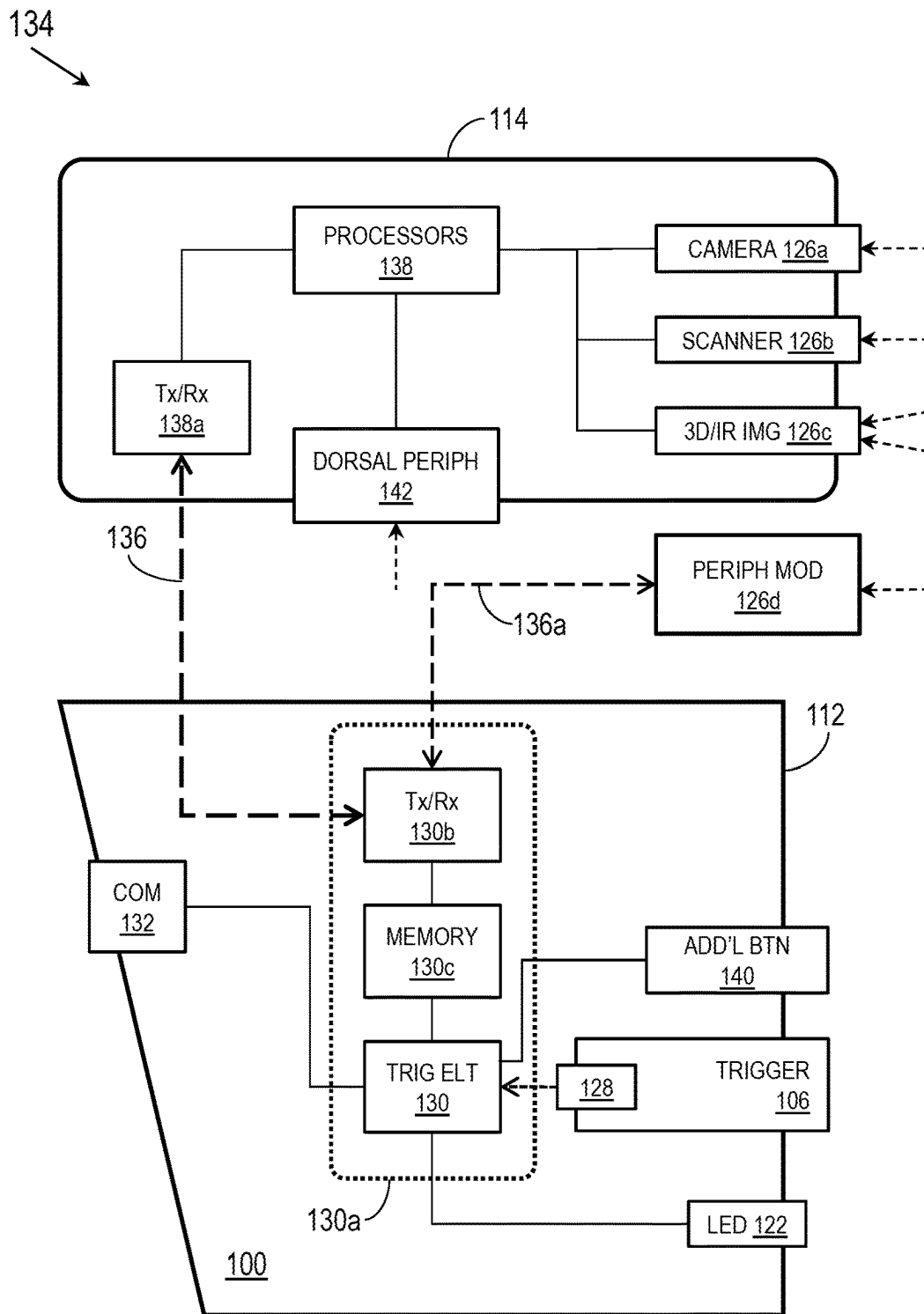


FIG. 3A

**FIG. 3B**

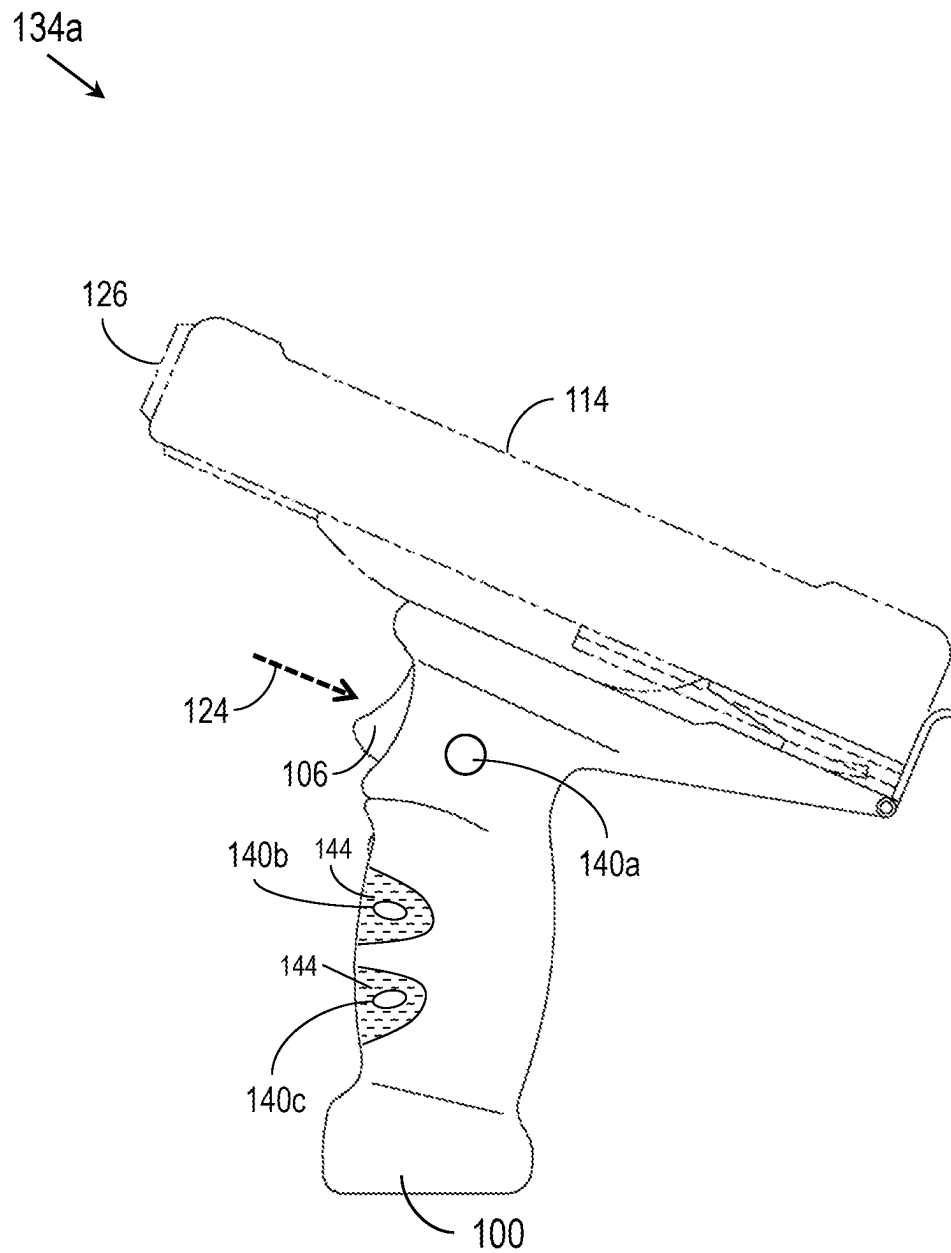
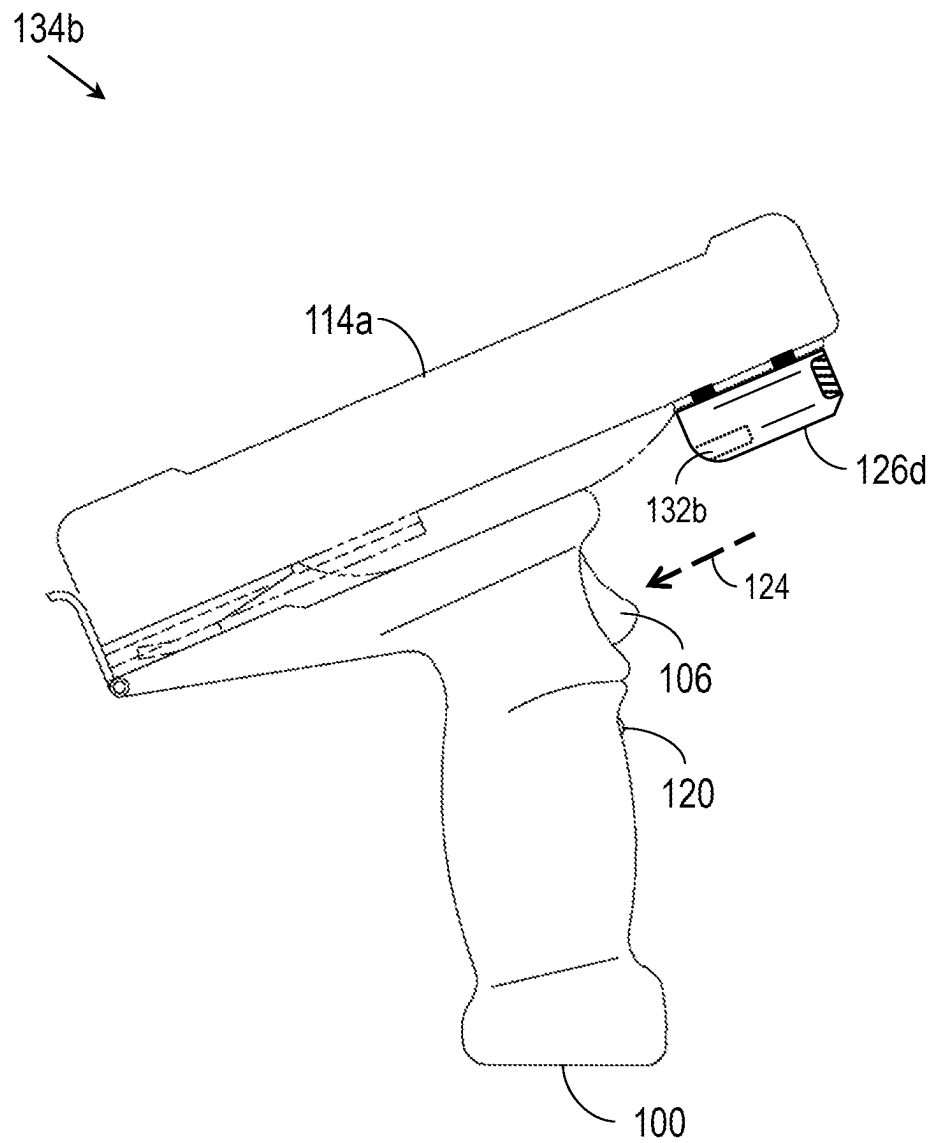


FIG. 4A

**FIG. 4B**

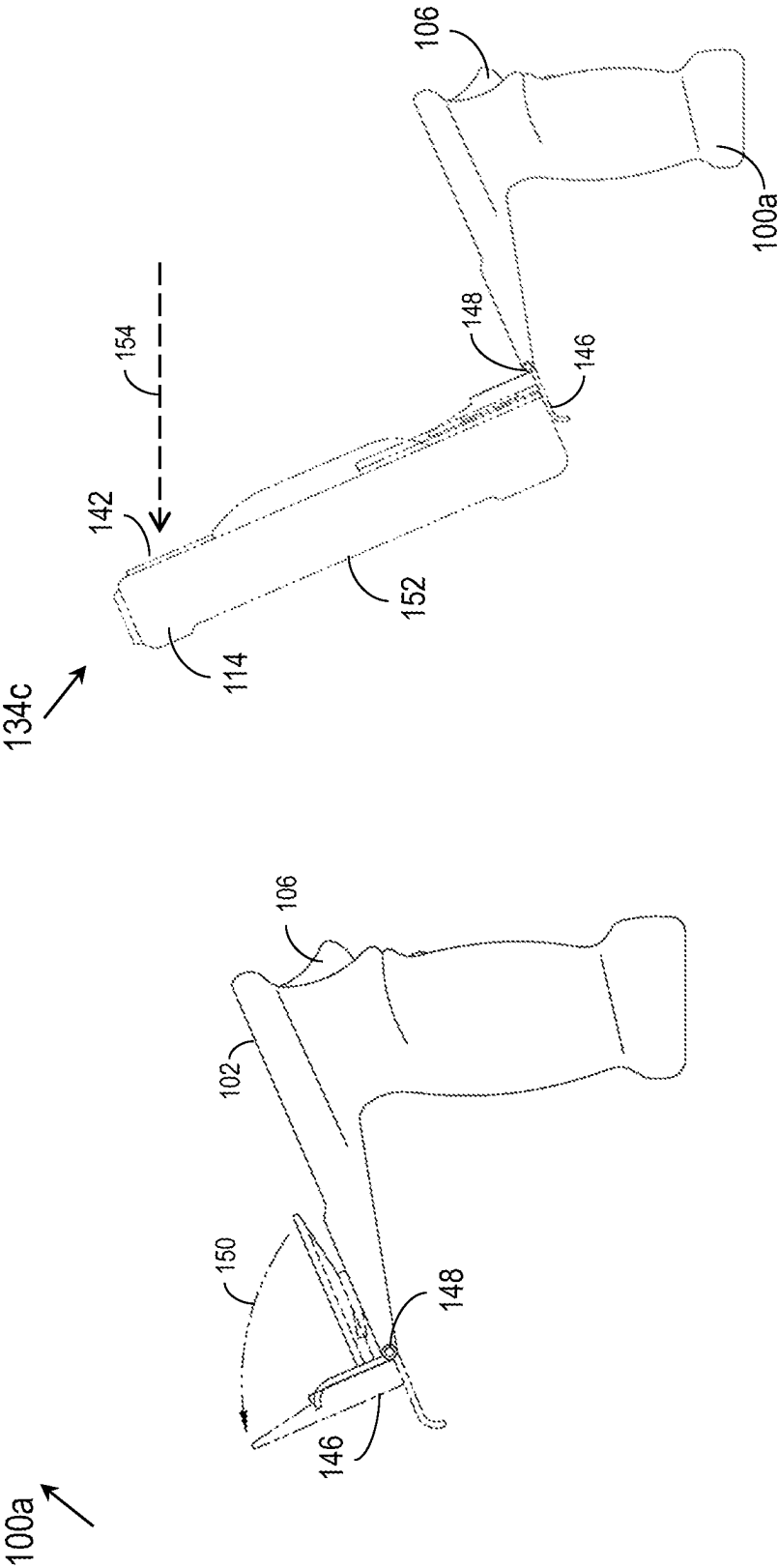


FIG. 5B

FIG. 5A

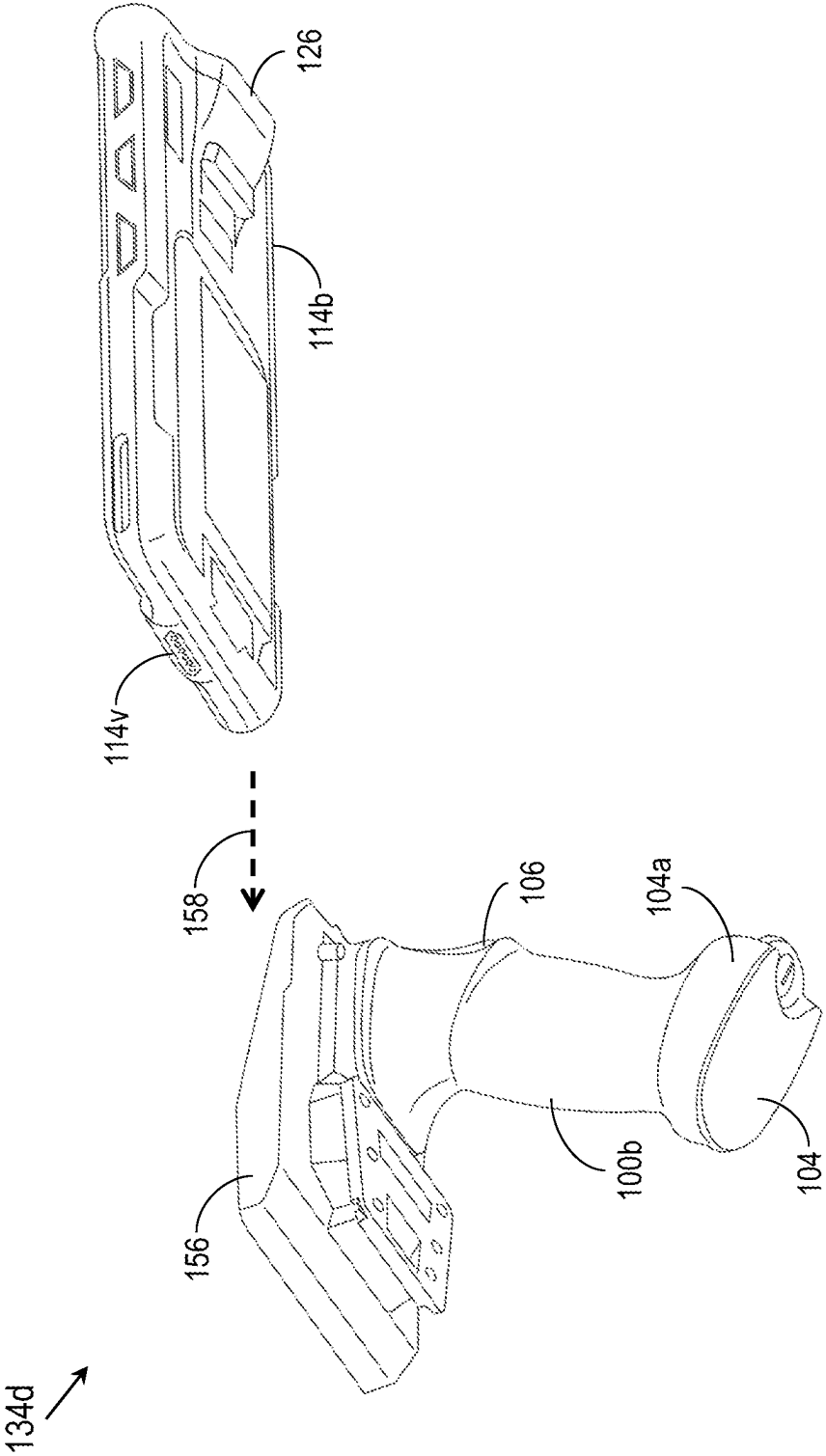


FIG. 6A

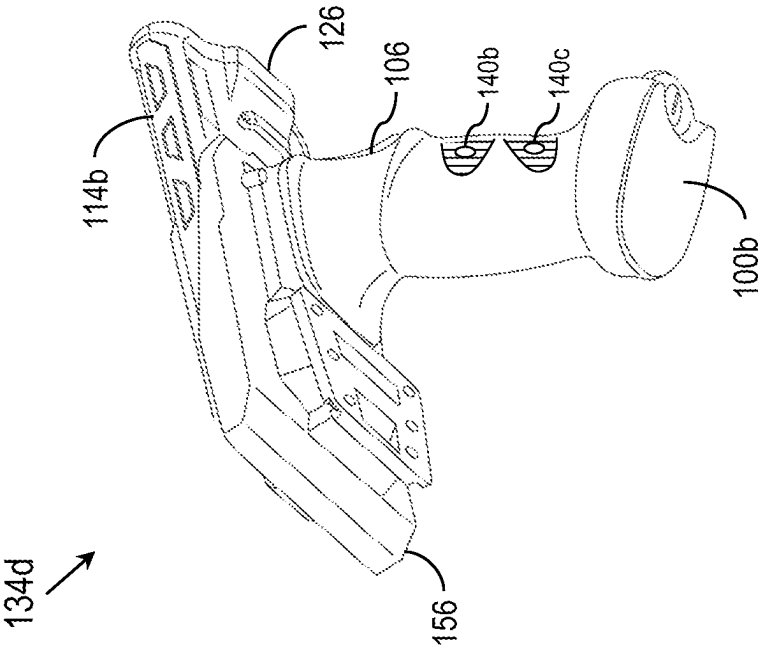


FIG. 6B

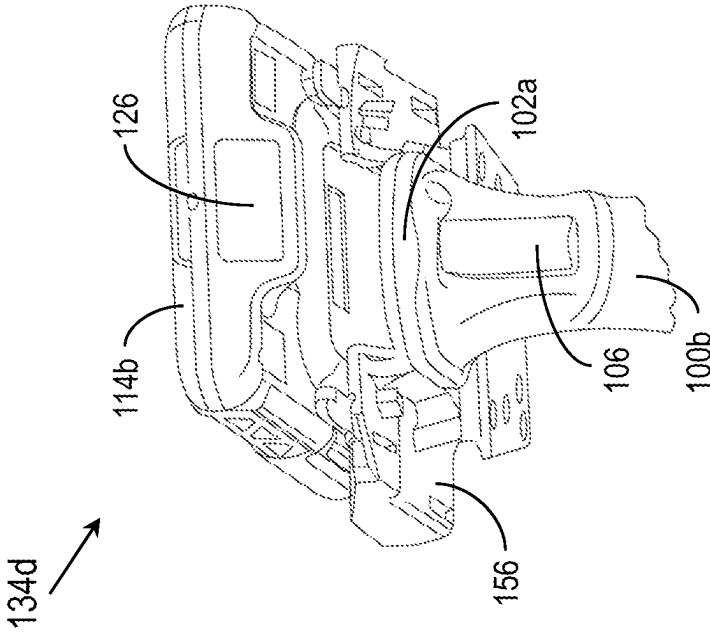


FIG. 6C

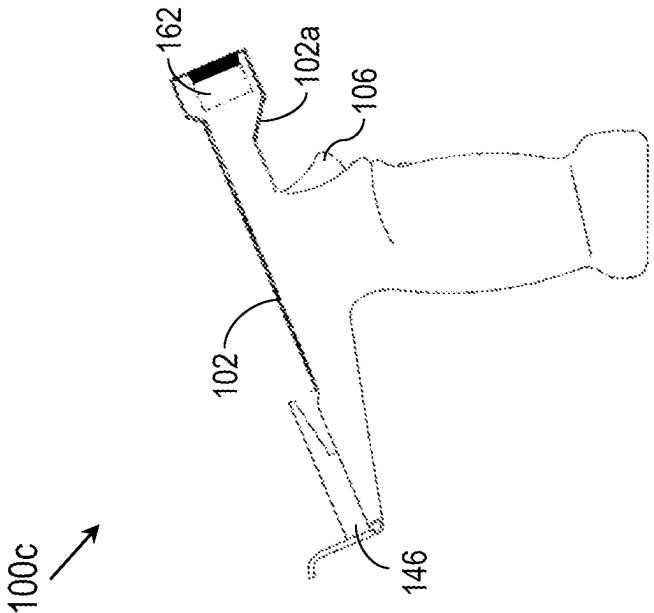


FIG. 7A

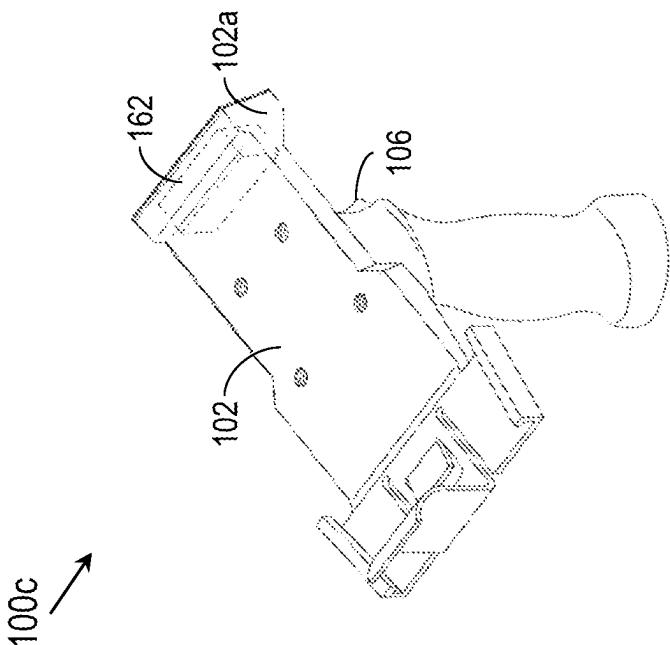
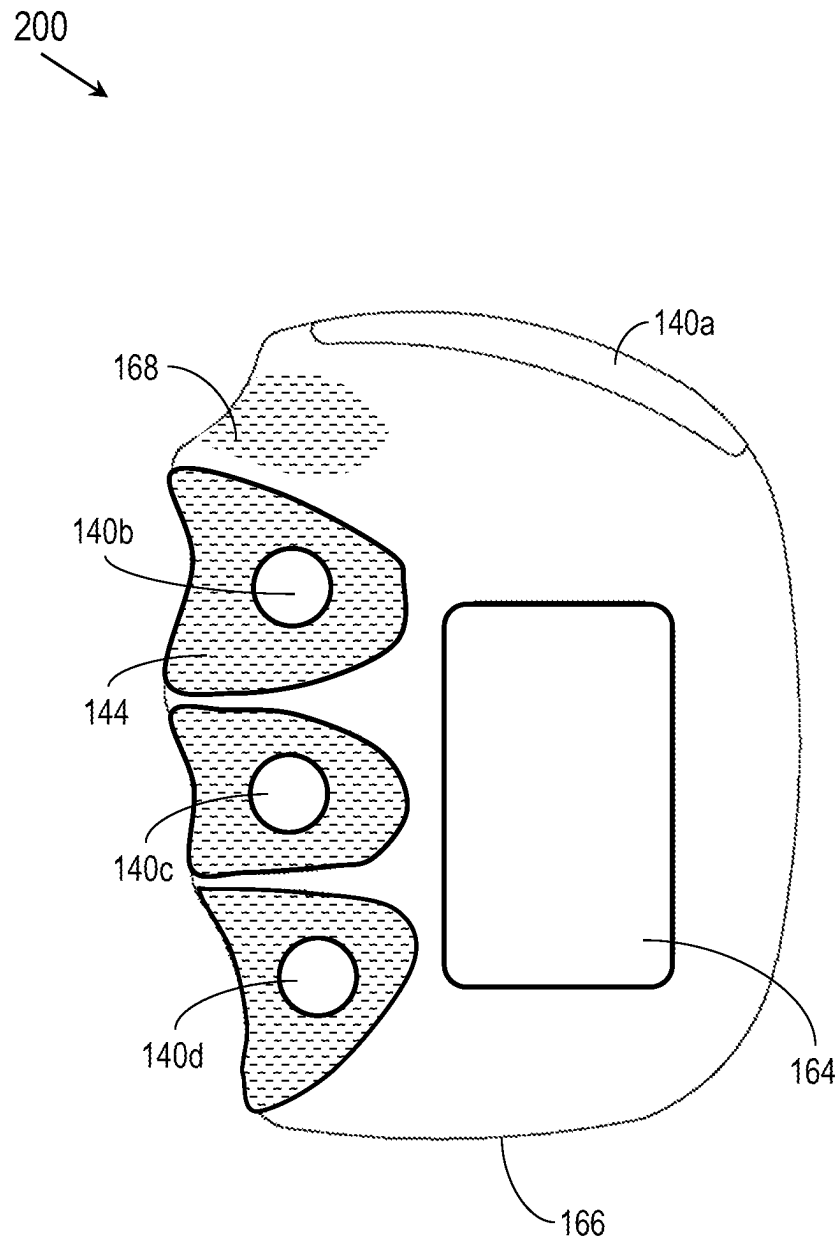


FIG. 7B

**FIG. 8A**

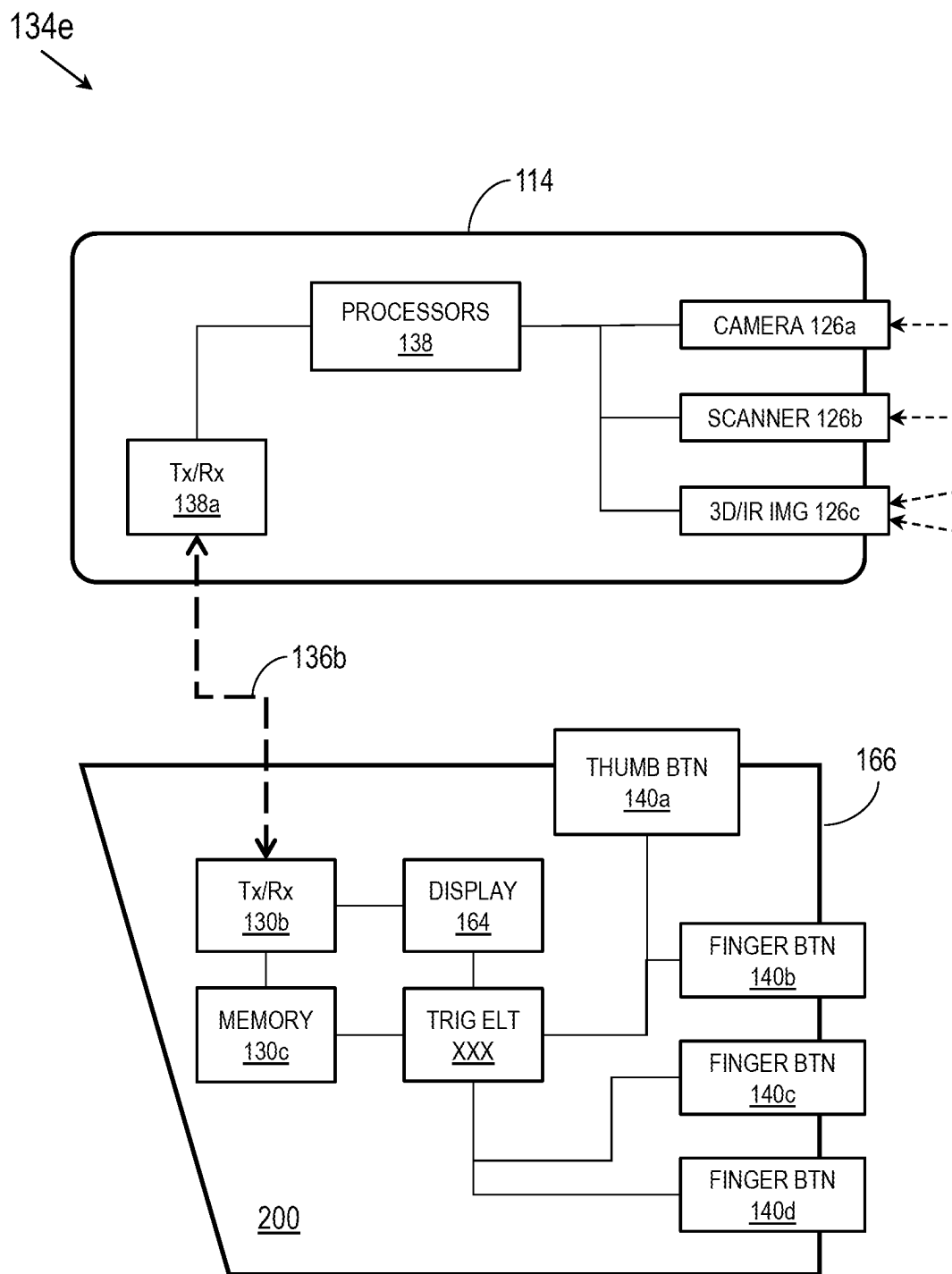


FIG. 8B

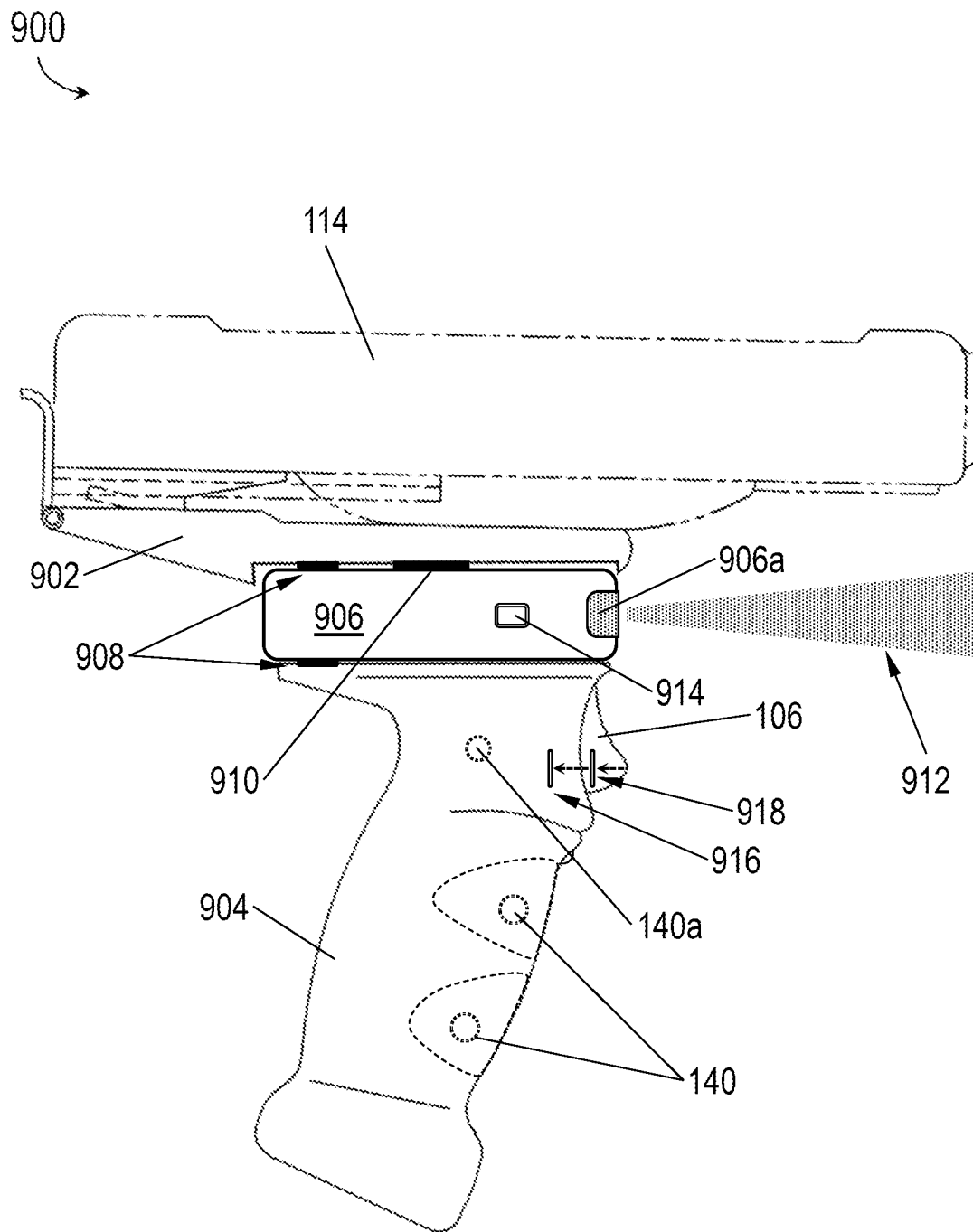


FIG. 9

900
↘

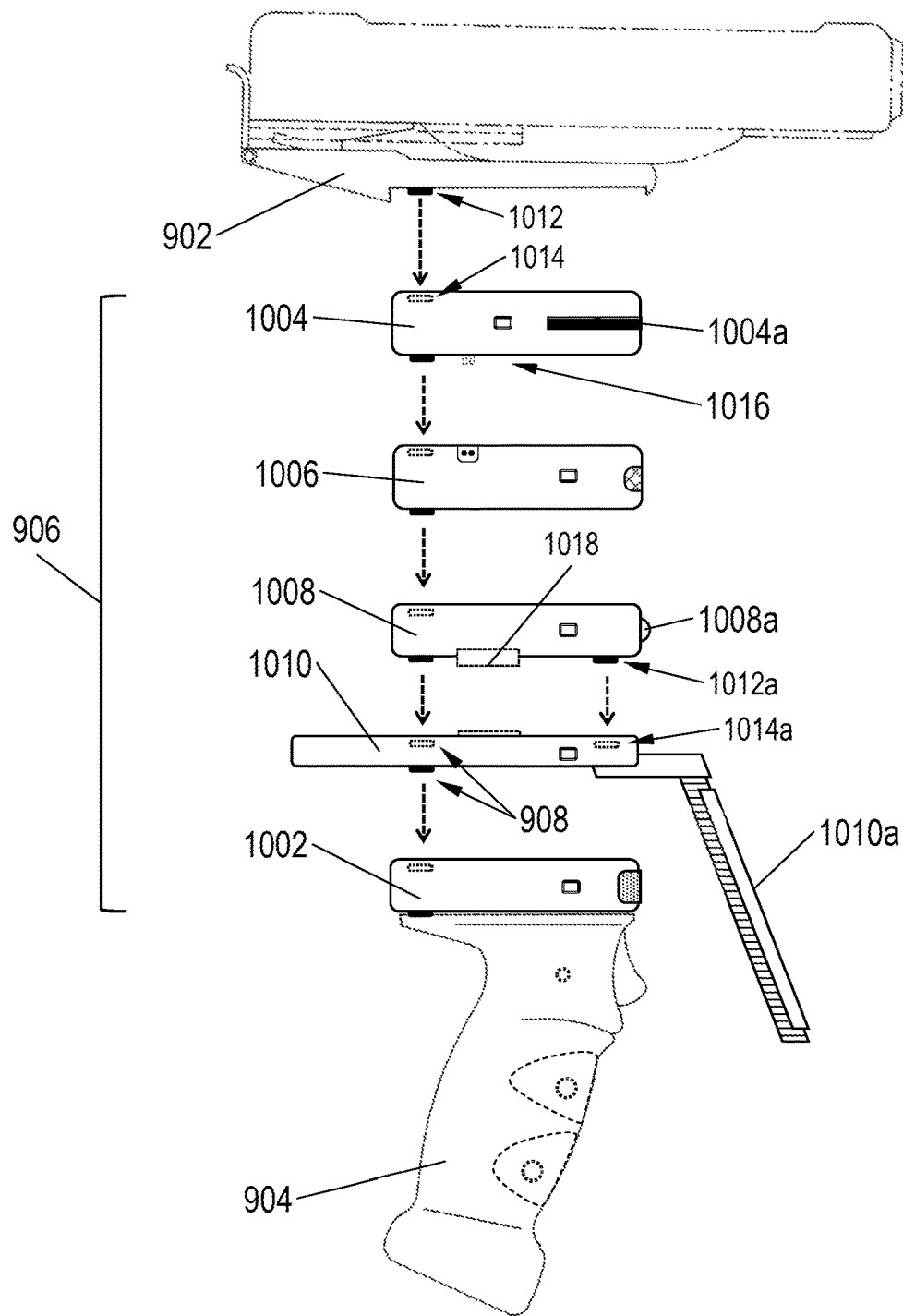


FIG. 10

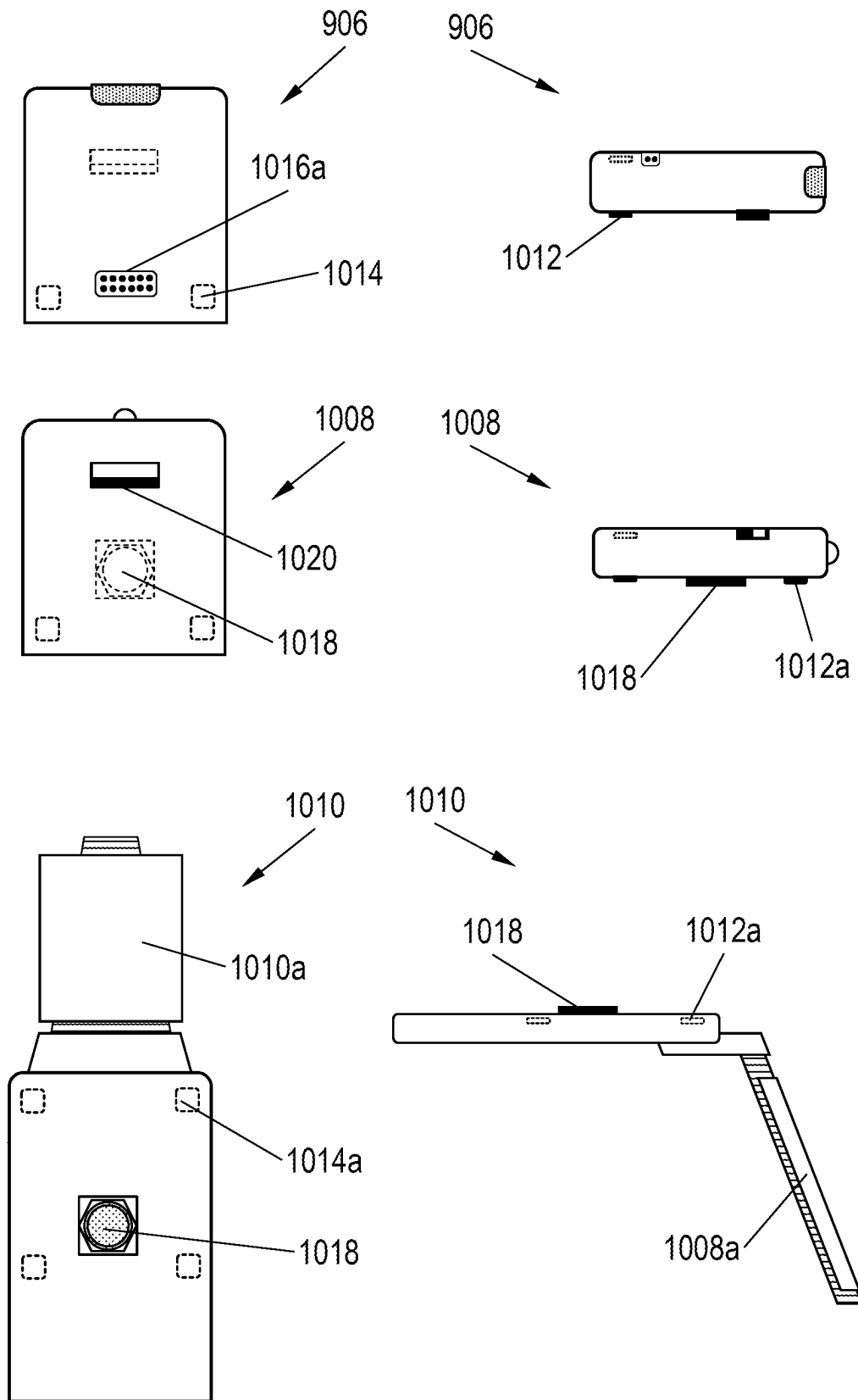


FIG. 11

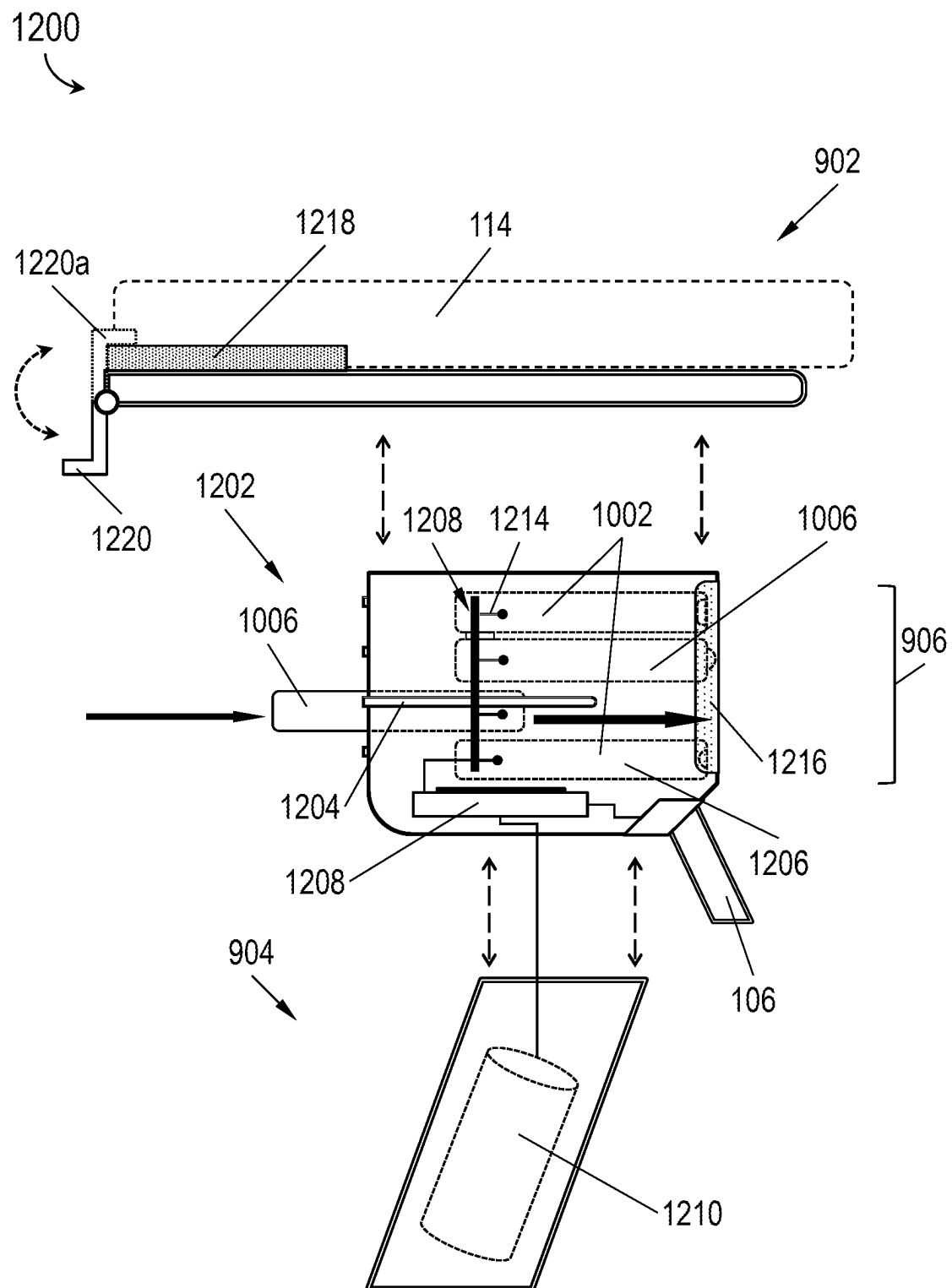


FIG. 12A

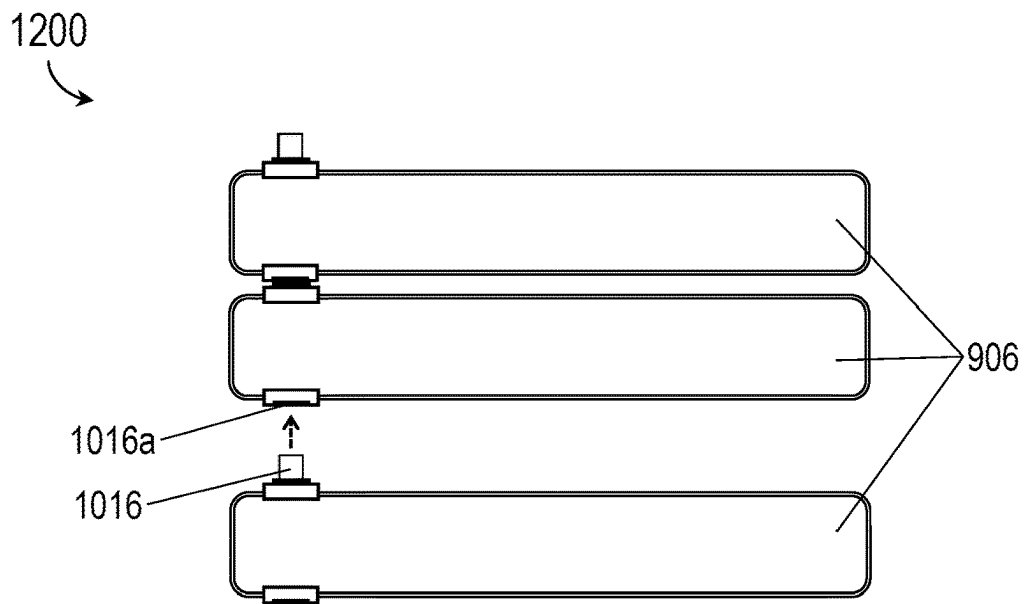


FIG. 12B

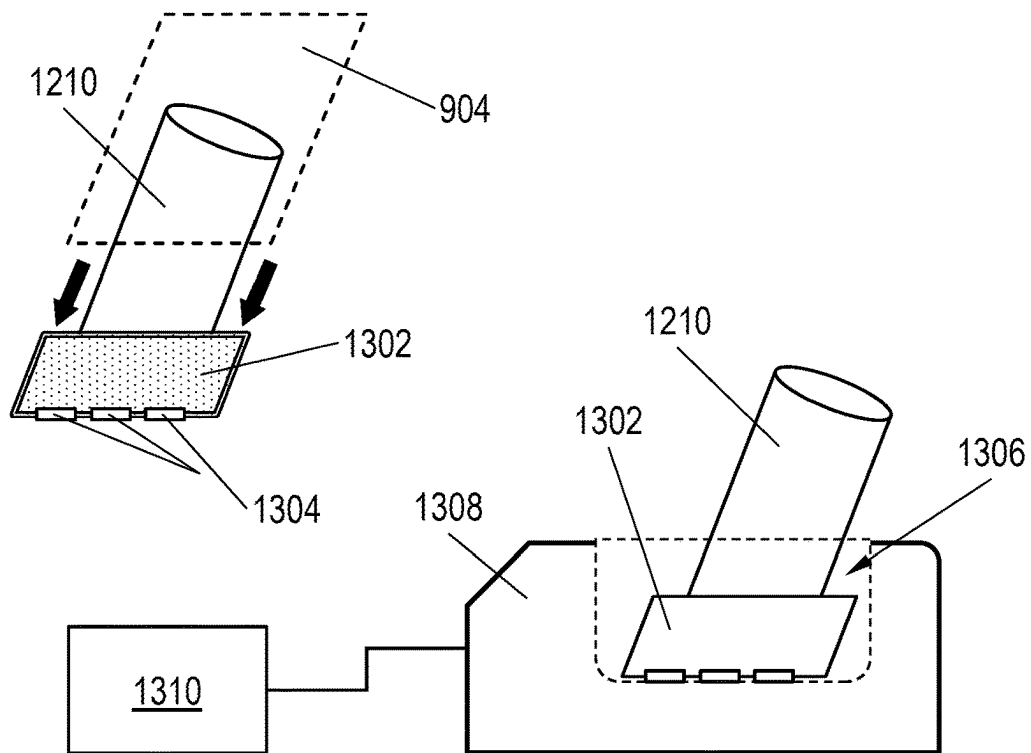


FIG. 13

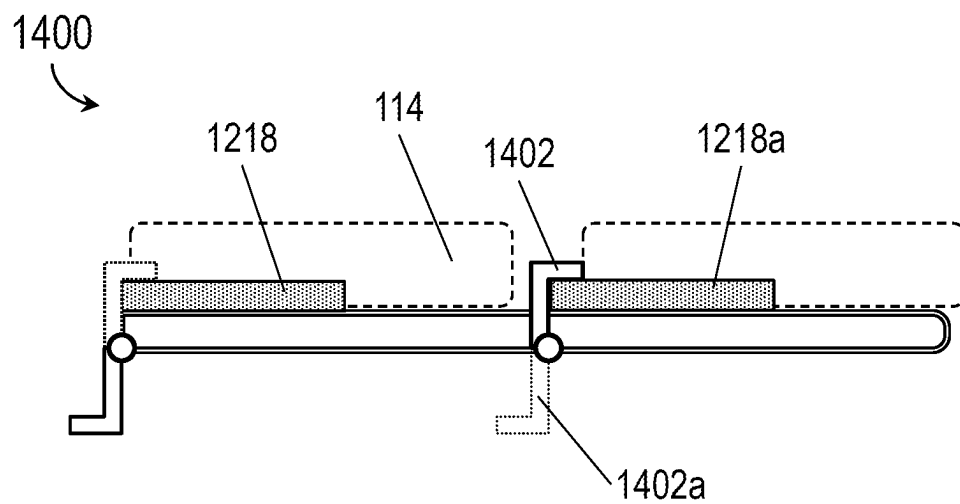


FIG. 14A

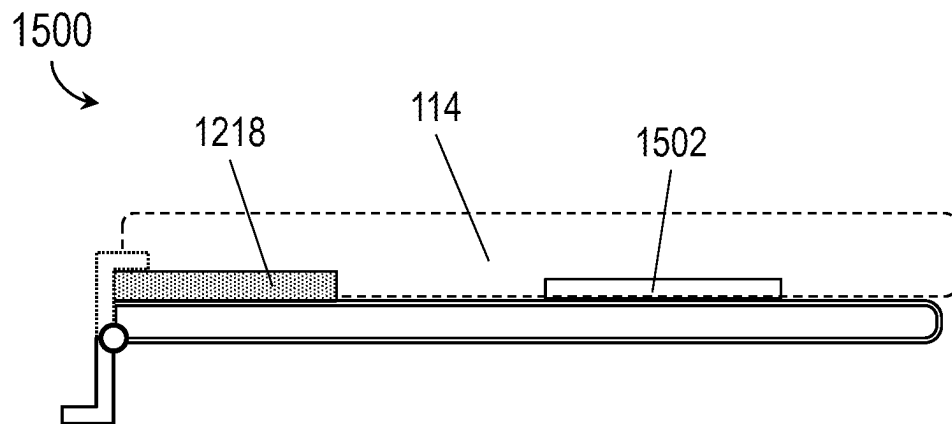


FIG. 14B

RUGGEDIZED TRIGGERING HANDLE WITH MODULAR PERIPHERAL CONTROL SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application is related to and claims the benefit of the earliest available effective filing dates from the following listed applications (the "Related Applications") (e.g., claims earliest available priority dates for other than provisional patent applications (e.g., under 35 USC § 120 as a continuation in part) or claims benefits under 35 USC § 119(e) for provisional patent applications, for any and all parent, grandparent, great-grandparent, etc. applications of the Related Applications).

RELATED APPLICATIONS

U.S. patent application Ser. No. 15/833,815 entitled RUGGEDIZED TRIGGERING HANDLE FOR MOBILE SCANNING SYSTEM and filed Dec. 6, 2017, which application issued Mar. 2, 2021 as U.S. Pat. No. 10,936,002;

U.S. Provisional Patent Application Ser. No. 62/430,710 entitled RUGGEDIZED TRIGGERING HANDLE FOR MOBILE SCANNING SYSTEM and filed Dec. 6, 2016;

Said U.S. patent application Ser. No. 15/833,815 and 62/430,710 are herein incorporated by reference in their entirety.

BACKGROUND

Tablets, portable computing devices, multifunction smartphones, and other such mobile devices with peripheral components embedded in their edges or faces (e.g., scanners, cameras, imagers) may not be ideally configured for one-handed use of these peripherals, especially if the mobile device is partially or fully housed in a protective casing. Such a protective casing shields the mobile device from extreme temperatures and pressures, moisture, or impacts that might otherwise cause damage or hinder the operation of the device. Further, the mobile device may include a strap or handle to allow a user to support the mobile device with one hand while operating its touchscreen with the other hand. However, protective casings may add dimension and weight to the mobile device, and may interfere with the straps or handles (if, for example, the handles require a physical connection to a port of the mobile device). The handles may still require the user to support the mobile device with one hand and operate applications and peripherals (e.g., via a touchscreen of the mobile device) with the other hand. Finally, some mobile devices may not incorporate built-in peripherals, requiring the attachment of discrete scanning or imaging modules to the mobile device, or to the protective casing, to achieve the desired functionality; establishing a physical datalink between the module and the mobile device may add still more bulk or complexity

SUMMARY

Embodiments of the inventive concepts disclosed herein are directed to a ruggedized triggering handle device for a mobile scanning system supports a mobile device (tablet, smartphone) attachable by a bracket on the upper surface of the handle. The handle may establish a wireless link to the mobile device; a trigger of the handle device includes a magnetic switch which, when driven proximate to a trigger-

ing element enclosed within the handle, causes the triggering element to transmit key codes and instructions via the wireless link, enabling the user to trigger applications and peripheral sensing components (e.g., readers, scanners, imagers) of or proximate to the mobile device via the handle. The peripheral sensing components may be modular elements attachable between the upper and lower portions of the handle device, either individually or serially as needed, and operable via the trigger or the additional buttons without the need for visual reference to the handle.

In a first aspect, embodiments of the inventive concepts disclosed herein are directed to a ruggedized handle device for a modular mobile sensing system. In embodiments, the handle device has an outer shell or housing contoured to a user's hand and fashioned of a high impact material. The outer shell has an upper portion terminating in a top surface and a lower portion terminating in a bottom surface, and encloses an inner shell fashioned of the same high impact material. The upper and lower portions are physically attachable and detachable via physical connectors; one or more modular peripheral sensing devices (e.g., scanners, readers, imagers) may be attached between the upper and lower portions and operated via the handle device. The top surface of the upper portion may include a cradle, bracket, or like docking component for securely supporting a mobile computing, communications, or scanning device attachable to the handle device. The handle device includes a memory enclosed within the outer shell for storing encoded instruction sets or key codes associated with particular applications or peripheral devices (e.g., cameras, scanners, imagers) of the mobile device. The handle device includes a triggering element enclosed by the inner shell. The triggering element may establish a wireless link between the handle device and mobile device, and transmit particular stored key codes or instruction sets to the mobile device, activating the associated applications or peripherals, when the handle device is in an active state. The handle device includes a trigger corresponding to the user's index finger; actuation of the trigger thereby drives a magnetic switch or element proximate to the triggering element, initiating the active state. The handle device includes one or more light emitting diodes (LED) or similar luminous elements for indicating the active state or the status of the wireless link.

In some embodiments, the modular peripheral sensing components include, but are not limited to: imaging devices (2D or 3D/IR); barcode scanners; card readers (e.g., magnetic stripe and/or integrated circuit chip); LED illuminators for lighting the area around the handle device or an area of the user's choosing; or RFID tag readers.

In some embodiments, supported mobile computing devices include, but are not limited to, tablets, smartphones, phablets, and other portable computing devices.

In some embodiments, the lower portion of the handle device includes auxiliary buttons operable by the thumb or other fingers of the hand using the device (e.g., devices may be configured for right-hand or left-hand use), the auxiliary buttons set into recesses in the outer shell and oriented for use by specific fingers, the recesses capable of supporting the corresponding fingers when the buttons are not in use.

In some embodiments, the trigger includes a magnetic element having a default or resting position within the outer shell and an active position closer to the triggering element, such that actuation of the trigger initiates the active state of the trigger by moving the magnetic element toward the triggering element.

In some embodiments, the trigger is capable of an intermediate position between the default and active positions,

such that holding the trigger in the intermediate position for a particular duration may transmit key codes or commands to the mobile device or peripheral sensing components other than those associated with the default and active positions.

BRIEF DESCRIPTION OF THE FIGURES

FIG. 1 is an overhead perspective view of a triggering handle according to embodiments of the inventive concepts disclosed herein;

FIGS. 2A and 2B illustrate the attachment of the triggering handle of FIG. 1 to a mobile device according to the inventive concepts disclosed herein;

FIG. 3A is a right-side low-angle view of a system including the triggering handle of FIG. 1 and the mobile device of FIG. 2A;

FIG. 3B is a diagrammatic illustration of the system of FIG. 3A;

FIG. 4A is a left-side view of the system of FIG. 3A;

FIG. 4B is a right-side view of the system of FIG. 4A;

FIG. 5A is a right-side view of a triggering handle according to the inventive concepts disclosed herein; and

FIG. 5B is a right-side view of a system including the mobile device of FIG. 2A and the triggering handle of FIG. 5A;

FIG. 6A is a right-side view of an exemplary embodiment of a system including a triggering handle and a mobile device according to the inventive concepts disclosed herein;

FIGS. 6B and 6C are respectively front and right-side views of the system of FIG. 6A;

FIGS. 7A and 7B are respectively top- and right-side views of a triggering handle according to the inventive concepts disclosed herein;

FIG. 8A is an exemplary embodiment of an enumerating device according to the inventive concepts disclosed herein;

FIG. 8B is a diagrammatic illustration of the enumerating device of FIG. 8A;

FIG. 9 is a right-side profile illustration of a multi-sensor triggering handle incorporating modular peripheral sensing devices according to embodiments of the inventive concepts disclosed herein;

FIG. 10 is an exploded view of the multi-sensor triggering handle and modular peripheral sensing devices of FIG. 9;

FIG. 11 illustrates overhead and profile views of the modular peripheral sensing devices of FIGS. 9 and 10;

FIGS. 12A and 12B are diagrammatic illustrations of a multi-sensor triggering handle incorporating a module housing for peripheral sensing modules according to embodiments of the inventive concepts disclosed herein;

FIG. 13 is a diagrammatic illustration of an onboard power management system for the triggering handles of FIGS. 9 through 12B;

and FIGS. 14A-B are diagrammatic illustrations of variant upper portion docking mechanisms for the triggering handles of FIGS. 9 through 13.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

Before explaining at least one embodiment of the inventive concepts disclosed herein in detail, it is to be understood that the inventive concepts are not limited in their application to the details of construction and the arrangement of the components or steps or methodologies set forth in the following description or illustrated in the drawings. In the following detailed description of embodiments of the instant inventive concepts, numerous specific details are set forth in

order to provide a more thorough understanding of the inventive concepts. However, it will be apparent to one of ordinary skill in the art having the benefit of the instant disclosure that the inventive concepts disclosed herein may be practiced without these specific details. In other instances, well-known features may not be described in detail to avoid unnecessarily complicating the instant disclosure. The inventive concepts disclosed herein are capable of other embodiments or of being practiced or carried out in various ways. Also, it is to be understood that the phraseology and terminology employed herein is for the purpose of description and should not be regarded as limiting.

As used herein a letter following a reference numeral is intended to reference an embodiment of the feature or element that may be similar, but not necessarily identical, to a previously described element or feature bearing the same reference numeral (e.g., 1, 1a, 1b). Such shorthand notations are used for purposes of convenience only, and should not be construed to limit the inventive concepts disclosed herein in any way unless expressly stated to the contrary.

Further, unless expressly stated to the contrary, “or” refers to an inclusive or and not to an exclusive or. For example, a condition A or B is satisfied by anyone of the following: A is true (or present) and B is false (or not present), A is false (or not present) and B is true (or present), and both A and B are true (or present).

In addition, use of the “a” or “an” are employed to describe elements and components of embodiments of the instant inventive concepts. This is done merely for convenience and to give a general sense of the inventive concepts, and “a” and “an” are intended to include one or at least one and the singular also includes the plural unless it is obvious that it is meant otherwise.

Finally, as used herein any reference to “one embodiment,” or “some embodiments” means that a particular element, feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the inventive concepts disclosed herein. The appearances of the phrase “in some embodiments” in various places in the specification are not necessarily all referring to the same embodiment, and embodiments of the inventive concepts disclosed may include one or more of the features expressly described or inherently present herein, or any combination of sub-combination of two or more such features, along with any other features which may not necessarily be expressly described or inherently present in the instant disclosure.

Broadly, embodiments of the inventive concepts disclosed herein are directed to a ruggedized triggering handle physically attachable, and wirelessly connectible, to a mobile device which may be housed in a protective casing. The triggering handle may allow a user to securely support the mobile device in one hand (whether the user is right- or left-handed) while “aiming” the device in such a way that one or more peripherals or applications may be activated with the same supporting hand, via the triggering handle. The triggering handle may be configured or programmed to activate specific applications or peripherals via specific actuations (or actuation sequences) of the trigger or of other buttons dedicated to specific fingers of the supporting hand. In this way, the triggering handle may link to a mobile device and execute multiple, repetitive, or varied applications of the mobile device via the single supporting hand and without the need for visual reference to the handle.

Referring to FIG. 1, a triggering handle 100 according to embodiments of the inventive concepts disclosed herein may include an upper portion terminating in a top surface 102, a

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lower portion terminating in a bottom surface **104**, a trigger **106**, an attachment bracket **108** (e.g., docking component), and a release tab **110**.

The triggering handle **100** may be formed of enterprise-grade rigid high-impact plastic or any similar durable, lightweight material. The exterior of the triggering handle **100** may include an outer shell (**112**) and an inner shell enclosed within the outer shell (the outer shell being at least partially hollow so as to enclose components of the triggering handle), such that a triggering element may be situated within a sealed weather-resistant internal area defined by the inner shell, which may be fashioned of the same material as the outer shell. In some embodiments, the triggering handle **100** may be rated at least IP65 (dust-tight and resistant to water jets). The attachment bracket **108** may be configured to be removably attached to the rear face of a suitably equipped mobile device (e.g., a mobile communications or computing device such as a smartphone, tablet, or phablet). For example, the attachment bracket **108** may include one or more grooves **108a**, **108b** configured to slidably interact with matching tabs on the rear face of the mobile device (or a corresponding attachment component incorporated into, or attached to, the mobile device). In this way, the triggering handle **100** may be intuitively attached to the mobile device such that the mobile device may be “pointed” or “aimed” at a desired target by a user grasping the mobile device via the triggering handle **100**. The triggering handle **100** may be detached from a mobile device via the release tab **110**. In some embodiments, the top surface **102** may include surface contacts **102b** (e.g., pogo pins, spring pins) configured to directly interface with a suitably equipped tablet, smartphone, or other like mobile device (rather than linking wirelessly to the mobile device, e.g., via Bluetooth or a similar wireless protocol).

Referring also to FIGS. 2A and 2B, a mobile device **114** may be encased in a protective casing including reinforced corners (**116**) and/or a carrying strap (**118**), which the attachment of the mobile device **114** to the triggering handle **100** may accommodate. The top surface **102** of the triggering handle **100** may be configured to accommodate the carrying strap **118** such that the carrying strap need not be removed or detached from the mobile device **114** in order to physically attach the triggering handle **100**. For example, the dorsal face of the mobile device **114** (e.g., the face opposite the display surface of the mobile device and proximate to the top surface **102** of the triggering handle **100**) may include an attachment plate **120**. The attachment plate **120** may include left and right tabs **120a**, **120b** compatible with the grooves (**108a**, **108b**, FIG. 1) of the attachment bracket **108** of the triggering handle **100**.

The top surface **102** may partially support the mobile device **114** in place once the mobile device is physically attached to the triggering handle **100**. The bottom surface **104** may be configured to support the triggering handle **100** in a stable level state on a flat surface whether or not the triggering handle is physically connected to the mobile device **114**.

Referring in particular to FIG. 2B, the mobile device **114** may slidably attach to the triggering handle **100**, the tabs (**120b**) of the attachment plate **120** sliding into the grooves (**108b**) of the attachment bracket **108** until the mobile device **114** is secured in place by the release tab **110**. The triggering handle **100** may include one or more luminous elements, such as an LED **122** or similar indicator, configured to indicate a current state of the handle. For example, when the triggering handle **100** is attached to a mobile device **114**, the triggering handle **100** may attempt to establish a wireless

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link to the mobile device **114** (e.g., via Bluetooth or any appropriate similar wireless protocol). The LED **122** may blink on and off during this process, changing to a solid “on” state once a connection has been established. For example, once the triggering handle **100** is attached and linked to the mobile device **114**, a user may actuate or activate (**124**) the trigger **106** in order to “wake up” a mobile device **114** currently set to a “sleep” mode.

One or more desired peripheral components (**126**) of the mobile device **114**, such as a barcode scanner or imager (e.g., 2D cameras, 3D/infrared (IR) imagers and imaging systems), may align with the triggering handle **100**, such that the desired peripheral **126** is positioned directly above the front (**102a**) of the top surface **102**. Any object at which the user points while grasping the triggering handle **100** may thus be scanned, or its image captured, by the desired peripheral **126**, the target object being within the field of vision (FOV) of the peripheral. The desired peripheral **126** (or, e.g., a software application configured to execute on processors of the mobile device **114**) may be activated by pressing the trigger **106**, e.g., with the user’s index finger.

For example, an actuation (**124**) of the trigger **106** may articulate a small magnetic element **128** (e.g., magnetic switch) embedded in the end of the trigger. The magnetic element **128** or magnetic switch may include, for example, a solid-state switch or magnet capable of detection by a Hall effect or similar magnetic-field sensor within, or proximate to, a triggering element **130**. The triggering element **130** (e.g., wireless transmitter/receiver) may be sealed within the inner shell of the triggering handle **100** to protect the triggering element from damage due to moisture, wind, or shock. The triggering element **130** may be positioned just outside a predetermined proximate range from to the end of the trigger **106** containing the magnetic element **128**. If the magnetic element **128** is brought proximate to the triggering element **130** by actuation (**124**) of the trigger, an active trigger state (e.g., active state of the triggering handle) may commence. In the event of an active trigger state, one or more key codes (e.g., encoded instructions or instruction sets) may be wirelessly transmitted from the triggering handle **100** to the linked mobile device **114**. The mobile device **114** may include software configured to initiate specific actions of the mobile device **114**, or of its peripheral components **126**, upon the receipt of a particular key code. For example, key codes may be programmed to activate the peripheral devices **126** or components of the mobile device **114**, e.g., a barcode scanner, a camera, or a 3D imager. A transmitted key code, or combination of key codes, may additionally activate software installed on the mobile device **114** and configured to operate in conjunction with the activated peripherals **126**, such as a volume dimensioning system of the mobile device **114** configured to receive and process input received from a 3D imager. For example, a 3D imager may be activated to capture imagery associated with a package or parcel; the volume dimensioning system may assess the dimensions of the parcel. A barcode scanner may determine shipping or handling information of the parcel based on detecting and decoding data encoded on the exterior of the parcel, such as a barcode or QR code. The triggering handle **100** may include additional internal circuitry such as a USB port **132** (or any appropriate similar communications port) capable of receiving a USB cable **132a** (or like cable compatible with the connection port) and thereby charging internal batteries of the triggering handle.

Referring to FIGS. 3A and 3B, a system **134** according to embodiments of the inventive concepts disclosed herein may

include the triggering handle **100** of FIG. **1** physically attached to, and wirelessly linked to, the mobile device **114** of FIGS. **2A-B**.

In some embodiments, the triggering handle **100** may include an additional luminous element or LED (**122a**) for indicating an active trigger state (e.g., the light is “on” when the trigger **106** is pressed), an attempt to wirelessly link the triggering handle **100** to the mobile device **114**, or a successfully established wireless link (**136**) between the triggering handle and mobile device. An active trigger state may cause the triggering element **130** (enclosed within the inner shell, **130a**) to transmit (**130b**) to the mobile device **114** key codes or instructions for executing a predetermined keyboard sequence associated with the activation of a particular component or peripheral (**126**) or application associated with the peripheral **126** (e.g., activating a 2D camera **126a** or barcode scanner **126b**, or commencing a volume dimensioning process by activating a 3D imager **126c**). The mobile device **114** may communicate the successful triggering of the desired peripheral **126a-c** or application via audio prompts or a tone specific to the triggered peripheral or application.

Key codes and instructions transmitted by the triggering handle **100** to the mobile device **114** may be stored to a memory **130c** of (or proximate to) the triggering element **130**. For example, the memory **130c** may include Flash memory, solid-state memory, electrically erasable programmable read-only memory (EEPROM), or any appropriate similar memory capable of storing and erasing the encoded key codes and instructions. The key codes and instructions may be assembled or determined by a user of the system **134** via the mobile device **114** (which may include onboard processors **138**) and sent (**138a**) to the triggering handle **100** via wireless link (**136**), thereby “initializing” or “configuring” the triggering handle **100** for control of the mobile device or its peripherals **126a-c**. For example, in response to an actuation of the trigger **106** (or a combination of a trigger actuation with actuations of additional buttons (**140**)), events associated with the mobile device **114** may include: activation of a camera **132a**, barcode scanner **132b**, or 3D/IR imager **132c**; interfacing with another peripheral, such as a dorsally incorporated peripheral (**142**) mounted to the dorsal face (e.g., underside, face opposite the display screen) of the mobile device **114**; launching or deactivating additional software applications; and incrementing a counter (e.g., trackable and displayable by the mobile device). Software executing on the mobile device **114** may include a configuration interface providing for the unique mapping of specific actuations (**124**) or sequences of actuations of the trigger **106** and additional buttons **140** to the desired applications or peripherals **126a-c** activated in response.

The processors **138** of the mobile device **114** may include software configured to execute on the mobile device **114** based on key codes and instructions received from the triggering handle **100** (e.g., user applications or system services/processes). For example, the software may monitor the wireless link **136**, processing events as the key codes are received from the triggering handle **100**. The key codes may include, e.g., key press/release events processed as hotkey events by the mobile device **114**. Similarly, the triggering handle **100** may function as a serial-connected device via the COM port (**132**) for serial emulation via USB or Bluetooth. Alternatively, the triggering handle **100** may function as a USB-connected Human Interface Device (USB-HID), sending HID event codes over a physical USB link via the COM port **132**; the mobile device **114** may process events specific to the particular HID device type.

The triggering handle **100** may alternatively or additionally wirelessly link to (**136a**), and operate in conjunction with, a remote peripheral module **126d**. For example, the remote peripheral module **126d** may be mechanically or physically attached to the mobile device **114** or its protective housing (e.g., via screws, bolts, or other removable or permanent fasteners), but not operatively or logically connected to the mobile device in any way.

Referring to FIG. **4A**, the system **134a** may be implemented and may function similarly to the system **134** of FIG. **3A**, except that the triggering handle **100** of the system **134a** may be contoured and configured for left-hand or right-hand use, or for ambidextrous use by either hand. For example, the triggering handle **100** may be contoured or augmented with additional padding or cushioning material (not shown) to fit either the left or right hand and configured such that the trigger **106** may be actuated (**124**) with the index finger of the hand (left or right) currently grasping the triggering handle. Additional buttons (**140**, FIG. **3B**) of triggering handle **100** may include a thumb button **140a** configured for actuation by the thumb of the hand holding the triggering handle **100** and recessed buttons **140b-c** configured for actuation by non-index fingers of the hand (the index finger reserved for actuation of the trigger **106**).

For example, the thumb button **140a** which may be programmed to activate additional peripherals or applications of the mobile device **114** when activated (e.g., apart from those configured for activation in response to an actuation **124** of the trigger **106**). As shown by FIG. **4A**, the thumb button **140a** may be positioned on the upper left side of the triggering handle **100** to facilitate rapid actuation of the thumb button with the right thumb (e.g., without the need to visually locate the thumb button). For example, if the trigger **106** activates a peripheral **126** of the mobile device **114** (e.g., barcode scanner (**126b**, FIG. **3B**)), the thumb button **140a** may cause the mobile device to transmit the scanned information, e.g., to one or more preprogrammed remote users. In some embodiments, the thumb button **140a** may function as a “reset button” for refreshing a wireless link (**136**, FIG. **3B**) to the mobile device **114**, e.g., if said mobile device is in a “sleep” or hibernation mode.

Similarly, the recessed buttons **140b-c** may be positioned and programmed/configured to activate additional peripherals or applications of the mobile device **114** in response to actuation by other fingers of the hand holding the triggering handle **100**. For example, as shown by FIG. **4A**, the recessed buttons **140b-c** may be positioned for rapid actuation by the middle and ring fingers of the right hand respectively. Similarly, the key codes or encoded instructions stored to the memory (**130c**, FIG. **3B**) may include specific codes or instructions dedicated to the thumb button **140a** and recessed buttons **140b-c**. The recessed buttons **140b-c** (as well as the thumb button **140a**) may be surrounded by dedicated recesses (**144**) set into the outer shell (**112**, FIG. **1**). For example, the recesses **144** may be textured so that the user may quickly match the appropriate fingers to their corresponding recessed buttons **140b-c** without looking at the triggering handle **100**. Similarly, the recesses **144** may be sized and shaped to allow the corresponding fingers to rest in or on the recesses, quickly actuating the appropriate recessed buttons **140b-c** when desired without inadvertently actuating the wrong recessed buttons.

Referring to FIG. **4B**, the system **134b** may be implemented and may function similarly to the system **134a** of FIG. **4A**, except that the system **134b** may include a remote peripheral module **126d** mechanically or physically attached to a mobile device **114a** or to its protective case/housing

(e.g., bolted, screwed, fastened) and aligned with the triggering handle **100**, e.g., oriented so as to be operable by grasping the triggering handle and pointing the system **134b** in the appropriate direction.

However, the remote peripheral module **126d** may not be logically or operatively connected to, or controlled by, the mobile device (e.g., via physical data link). For example, the remote peripheral module **126d** may include (but is not limited to) a barcode scanner, fingerprint scanner, 2D/visible-light camera, or 3D/IR imager, independently powered by a self-contained battery or power source (e.g., a capacitive power source able to rapidly recharge via USB port (**132b**)). The remote peripheral module **126d** may not be electronically linked to the mobile device **114a** yet sufficiently proximate to the triggering handle **100** that the remote peripheral module may be configurable (e.g., via a triggering handle software interface application executing on the mobile device **114a**, or via Bluetooth Low Energy (BLE) or any appropriate similar short-range wireless protocol) for remote activation (e.g., via by actuation (**124**) of the trigger **106**) by key codes or instructions transmitted by the triggering handle.

Referring to FIGS. **5A** and **5B**, the triggering handle **100a** may be implemented and may function similarly to the triggering handle **100** of FIG. **1**, except that the triggering handle **100a** may include a hinged attachment bracket **146**. The hinged attachment bracket **146** may be implemented and may function similarly to the attachment bracket **108** of FIG. **1**, except that the hinged attachment bracket **146** may include a hinge **148** configured to pivot or rotate the hinged attachment bracket “upward” (**150**; e.g., toward the user, orthogonal to a line of sight of a forward-oriented peripheral (**126b**, FIG. **4A**) aligned with the top surface **102** and trigger **106** of the triggering handle **100a**)) through a continuous arc of substantially 90 degrees.

Referring in particular to FIG. **5B**, the system **134c** may be implemented and may operate similarly to the systems **134a-b** of FIGS. **4A-B**, except that the mobile device **114** of the system **134c**, attached to the triggering handle **100a** via the hinged attachment bracket **146**, may be pivoted and maintained at a desired angle (via the hinge **148**). For example, the user’s view of the display screen (**152**) of the mobile device **114** may be improved, and a dorsally mounted peripheral **142** (e.g., a 3D/IR imager set into the dorsal face of the mobile device **114**) may be aimed at a subject and activated (**154**), e.g., by actuation of the trigger **106** and/or other buttons (e.g., thumb button **140a**, recessed buttons **140b-c**; FIG. **4A**) of the triggering handle **100a**.

Referring to FIGS. **6A** through **6C**, the system **134d** may be implemented and may function similarly to the systems **134a-c** of FIGS. **4A-B** and **5B**, except that the system **134c** may include a triggering handle **100b** scaled to, attachable to, and wirelessly linkable to, a smartphone **114b** or similarly scaled-down mobile device. For example, the triggering handle **100b** may include an attachment cradle **156** sized to fit the smartphone **114b**, and into which the smartphone may slidably be mounted (**158**). Once the smartphone **114b** is mounted to the attachment cradle **156** and thereby attached to the triggering handle **100b**, the triggering handle may establish a wireless link to the smartphone **114b**, via which key codes may be transmitted to activate components or peripherals (**126**) of the smartphone according to articulation of the trigger **106** or buttons (e.g., thumb button **140a**, recessed buttons **140b-c**; FIG. **4A**) of the triggering handle **100b**. The triggering handle **100b** may include surface contacts (not shown) positioned within the attachment cradle **156**, via which the triggering handle **100b** may establish a

physical data link to the smartphone **114b** by connecting to opposing surface contacts **114c** (e.g., pogo pins) of the smartphone. The lower portion of the triggering handle **100b** may include a battery compartment (**104a**) for insertion of a battery or portable power source, the battery compartment **104a** accessible through the bottom surface **104**. In some embodiments, the triggering handle **100b** may include one or more induction coils (not shown) for wireless charging of the onboard battery power source.

Referring in particular to FIGS. **6B** and **6C**, the smartphone **114b** may include a scanner, 3D imager, or other similar component or peripheral (**126**) which may be pointed and “aimed” by pointing the triggering handle **100b**, with which the front (**102a**) of the peripheral **126** is aligned. Actuating the trigger **106** (or, alternatively, the appropriately programmed recessed button **140b-c**) may transmit key codes to the smartphone **114b**, receipt of which by the smartphone may activate the peripheral **126** and/or related software installed to the smartphone (e.g., scanning encoded information or capturing imagery for processing by a volume dimensioning system).

Referring to FIGS. **7A** and **7B**, the triggering handle **100c** may be implemented and may function similarly to the triggering handle **100b** of FIGS. **6A-C**, except that the triggering handle **100c** may include a specialized peripheral (**162**) embedded into the front (**102a**) of the top surface **102** of the triggering handle. For example, the specialized peripheral **162** may include an imager, 3D imager, or scanner mounted into the front **102a** of the triggering handle **100c**. Similarly to the peripheral **126** of FIG. **6B**, a user may “aim” the specialized peripheral **162** at a desired subject or target by pointing the triggering handle **100c**. Similarly, the user may program the trigger **106** or another button (e.g., thumb button **140a**, recessed buttons **140b-c**; FIG. **4A**) of the triggering handle **100c** to activate, via actuation of the trigger or button/s, the specialized peripheral **162** (e.g., capturing images, scanning encoded data, or opening software installed to an attached mobile device (**114**, FIG. **3**; **114a**, FIG. **6A-C**) and compatible with the specialized peripheral), which may transmit the captured data stream to the attached mobile device **114**. The triggering handle **100c** may be physically attached, or mounted, to the mobile device **114**, and the specialized peripheral **158** may be wirelessly linked thereto. Referring in particular to FIG. **7B**, the triggering handle **100c** may include a hinged attachment bracket **146**.

Referring to FIGS. **8A** and **8B**, an exemplary embodiment of an enumerating device **200** according to the inventive concepts disclosed herein is shown. The system **134e** as shown by FIG. **8B** may be implemented and may function similarly to the system **134** of FIG. **3**, except that the enumerating device **200** of the system **134e** may be held in the hand of, and operated by, a user whose eyes and/or attention may be directed away from the enumerating device.

The enumerating device **200** may be fashioned of high impact materials similar to the triggering handle **100** (FIG. **1**) and variably proportioned in order to optimally accommodate users of either handedness or a broad variety of hand sizes. The enumerating device **200** may include an internal battery or like power supply (not shown) and may link wirelessly to the mobile device **114**, e.g., when activated via the thumb button **140a**. While the enumerating device **200** may include a display screen (**164**) for displaying status updates related to operations of the enumerating device, functions associated with each recessed button (**140a-d**) of the enumerating device, or an active wireless link (**136b**)

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between the enumerating device and the mobile device **114**, it is contemplated that the enumerating device may be operated without the need for visual reference by the user to the screen **164** or to any other part of the enumerating device. Similarly, the enumerating device **200** may be operated in conjunction with the mobile device **114** without the physical attachment of the enumerating device to the mobile device.

The user, for example, may hold the enumerating device **200** in the right hand, transmitting (**130b**) key codes and instructions (stored to the onboard memory **130c**) to trigger specific corresponding functions (e.g., software applications, camera **126a**, scanner **126b**, 3D/IR imager **126c**) of the mobile device **114** with the thumb and/or fingers of said right hand (e.g., by actuating the thumb button **140a** and recessed buttons **140b-d**, corresponding to the right index, middle, and little fingers respectively). Each of the thumb and recessed buttons **140a-d** may be configured or programmed (e.g., via the linked mobile device **114**) to transmit (**130b**) specific key codes, instructions, or sets and sequences thereof to the mobile device, thereby activating particular software applications and/or peripherals (**126a-c**) of the mobile device.

Similarly to the recessed buttons **140b-c** shown by FIG. 4A, the recessed buttons **140b-d** may be recessed (**144**) into the outer housing (**166**) of the enumerating device **200** to prevent the user from too easily inadvertently actuating the wrong button. The recesses **144** may support the fingers of the user's hand in a non-actuating position that allows for rapid actuation of the appropriate recessed buttons **140b-d** by the appropriate fingers without visual reference. Alternatively, a right-handed user may hold the enumerating device **200** in the right hand, rest the right index finger in a recession (**168**) of the outer housing **164** and the thumb atop the thumb button **140a**, and actuate the recessed buttons **140b-d** via simple articulation of the middle, ring, and little fingers respectively (rather than the index, middle, and ring fingers). In this way, the user may use the enumerating device **200** to efficiently execute large sets of repetitive tasks in conjunction with the mobile device **114** without visual reference to the enumerating device, e.g., counting several categories of objects, while the other hand is free to execute other tasks or operate other devices.

The enumerating device **200** may be similarly fashioned to accommodate a left-handed user. Alternatively, the enumerating device **200** may be fashioned for ambidextrous use, including a set of recessed buttons **140b-d** and a display screen **162** on either side, and thus contoured and alternatively configurable for use in either hand. A user may initialize the enumerating device **200** (e.g., upon activation of the enumerating device via the thumb button **140a**) by selecting right- or left-handedness, whereby the set of recessed buttons **140b-d** contoured to the preferred hand remains active and configurable, while the opposing set of recessed buttons (and the opposing display screen **164**) are rendered inert for that session.

Referring now to FIG. 9, the triggering handle **900** may be implemented and may function similarly to the triggering handles **100**, **100a-c** of FIGS. 1 through 7B, except that the triggering handle **900** may comprise an upper portion **902** (e.g., cradle portion) and lower portion **904** (e.g., handle portion) physically attachable to (and detachable from) each other.

In embodiments, the triggering handle **900** may incorporate, between the upper portion **902** and lower portion **904**, one or more peripheral sensing modules **906** attachable between the lower portion and upper portion and operable

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via the trigger **106** or via auxiliary buttons **140** (e.g., recessed buttons, additional buttons, thumb button **140a**) according to, e.g., Bluetooth, Bluetooth Low Energy (BLE), near field communication (NFC), or any other appropriate short-range wireless protocol. (It should be noted that if the triggering handle **900** is configured for right-hand use (e.g., For example, the mobile device **114** secured to the upper portion **902** may not physically incorporate one or more desired built-in peripherals (**126**, FIG. 3A); e.g., barcode or other scanners, imaging devices (e.g., 2D cameras, 3D/IR cameras), card readers, or any other like peripheral sensing devices or components. Accordingly, each peripheral sensing module **906** may incorporate a barcode scanner, camera, card reader, or other like peripheral component.

In embodiments, the upper portion **902** and lower portion **904** may be mutually attached via paired physical connectors **908**. Similarly, each peripheral sensing module **906** may similarly incorporate paired physical connectors **908**, such that the upper portion **902** may attach to the upper surface or top side of the peripheral sensing module, which may in turn attach (via the underside of the peripheral sensing module) to the upper surface of the lower portion **904**. For example, the physical connectors **908** may be oriented such that the upper portion **902** and lower portion **904**, and any peripheral sensing modules **906** installed therebetween, are capable of secure attachment to each other in only a single correct configuration or orientation (e.g., any installed peripheral sensing modules will be aligned with the orientation of the triggering handle **900**). In some embodiments, the physical connectors **908** may allow the serial attachment of two, three, or more peripheral sensing modules **906** between the upper portion **902** and lower portion **904**, in any desired sequence (as described in greater detail below).

In some embodiments, peripheral sensing modules **906** may further connect to the upper portion **902** or lower portion **904** (or both) via electrical connectors **910**. For example, electrical connectors **910** may supply operating power to the peripheral sensing module **906** (e.g., via an onboard battery or power source of the triggering handle **900**); in some embodiments, the electrical connectors may supplement wireless connectivity between the peripheral sensing module **906** and the mobile device **114** by providing a physical link to the mobile device **114**.

In embodiments, the peripheral sensing module **906** may be activated (e.g., triggered) by operating the trigger **106** or an auxiliary button **140**. For example, depressing the trigger **106** or an auxiliary button **140** may activate key codes configured to wirelessly initiate a scanning operation (**912**) and/or activate a sensing element (**906a**; e.g., barcode scanner) of the peripheral sensing module **906**. Similarly, to the LED **122** of the handle device **900**, each peripheral sensing module **906** may include a status indicator **914**, e.g., an LED configured to activate when the peripheral sensing module is active.

In some embodiments, key codes stored to the memory (**130c**, FIG. 3B) of the triggering handle **900** may be preprogrammed to activate a particular peripheral sensing module **906** via a particular auxiliary button **140**. For example, key codes may provide that the upper auxiliary button **140** is assigned to control the first peripheral sensing module **906** attached between the upper portion **902** and lower portion **904**; should an additional peripheral sensing module be added, the lower auxiliary button may be assigned to control the additional peripheral sensing module.

In some embodiments, the trigger **106** may be a multi-stage trigger capable of multiple functions. For example, the trigger **106** may have a default state and a fully retracted

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state **916** (e.g., active trigger state) as described above. However, the trigger **106** may be positionable in an intermediate state **918** between the default and fully retracted states; when held in the intermediate state **918**, e.g., for a predetermined amount of time, different key codes may be transmitted for execution by the mobile device **114** and/or peripheral sensing module **906**.

Referring now to FIGS. **10** and **11**, the triggering device **900** is shown.

In some embodiments, the peripheral sensing module **906** attached to the lower portion **904** may be a barcode scanner **1002**, and other peripheral sensing modules may be serially attached between the barcode scanner **1002** and the upper portion **902**. For example, additional peripheral sensing modules may include, but are not limited to: payment card readers **1004** (e.g., configured to read data from a magnetic stripe or embedded integrated circuit chip of a payment card inserted into a slot **1004a**); 3D/IR imagers **1006** or other cameras/imaging devices; illuminators **1008** (e.g., including a wide-angle and/or diffused LED **1008a** capable of illuminating an area directly proximate to the triggering handle **900**; and RFID readers **1010** (including RFID antenna **1010a**).

In some embodiments, physical connectors **908** may comprise a set of tabs **1012** set into the underside of each peripheral sensing module **906** (e.g., as well as the upper portion **902** of the triggering handle **900**) and a corresponding set of snap points **1014** set into the upper surface or upper side of each peripheral sensing module (e.g., as well as the lower portion **904** of the triggering handle). For example, the tabs **1012** may be configured to secure to the snap points **1014** (e.g., via spring-loading, sliding laterally into a secure position, or any like means of connection) and hold two adjacent peripheral sensing modules **906** together until detached from each other. A peripheral sensing module **906** may include a pair of tabs/snap points **1012**, **1014** (e.g., at the rear, relative to the orientation of the triggering handle **900**) or, in some embodiments, may include an additional pair of tabs/snap points (**1012a**, **1014a**) toward the front. In some embodiments, electrical connectors **910** may include, but are not limited to, pogo pins **1016** (and corresponding slots **1016a**), or (e.g., if a more robust physical data link is needed or desired) a coaxial **1018**, USB port (**1020**), flexible cord/cable, or other like power/data connector. In some embodiments, the peripheral sensing modules **906** may be connected, e.g., via a USB port **1020**, to external power sources and/or computing devices.

Referring to FIG. **12A**, the triggering handle **1200** may be implemented and may function similarly to the triggering handle **900** of FIGS. **9** through **11**, except that the triggering handle **1200** may incorporate a module housing **1202** to which the upper portion **902** and lower portion **904** may be attached.

In embodiments, the module housing **1202** may provide for the installation and removal of peripheral sensing modules **906** as well as power and control functionality. For example, the module housing **1202** may house the trigger **106** as well as multiple slots or brackets **1204** into which barcode scanners **1002**, illuminators **1008**, 3D/IR imagers **1006**, laser measurement units **1206**, payment card readers (**1004**, FIG. **10**), RFID readers (**1010**, FIG. **10**), and any other appropriate peripheral sensing modules may be mounted (e.g., and secured into place until removed from the module housing).

In embodiments, the module housing **1202** may include a control module **1208**, e.g., an onboard processor or integrated circuit (IC) configured for power and control man-

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agement of any peripheral sensing modules **906** currently installed within the control module. For example, the control module **1208** may be powered by an onboard battery **1210** or other like rechargeable power source (e.g., situated within the lower portion **904** and described in greater detail below), which may provide operating power for installed peripheral sensing modules **906**. In embodiments, the control module **1208** may manage wireless connectivity (e.g., via Bluetooth, WiFi, NFC, or any other like wireless protocol) to any mobile devices **114** mounted to the upper portion **902**.

In embodiments, the module housing **1202** may include a control bus **1212** linked to electrical connectors **910** (e.g., serial, USB) and providing wired communications links **1214** to each installed peripheral sensing module **906**. (Selected peripheral sensing modules **906**, depending on the particular type of module, may wirelessly connect to the control module **1208** and be controlled thereby, e.g., via the trigger **106** housed within the module housing).

In embodiments, the module housing **1202** may include one or more forward windows or portals **1216**. For example, the windows or portals **1216** may be open, transparent, translucent, or otherwise configured to allow any peripheral sensing devices **906** to operate at full capacity. Transparent or translucent windows or portals **1216** may provide impact protection to any sensitive external components of the peripheral sensing devices **906**.

In embodiments, the upper portion **902** may include snap rails **1218** for securing mobile devices **114** mounted to the upper portion. For example, the mobile device **114** may be locked into the snap rails **1218** by a release lever **1220** (e.g., the release lever may swing upward (**1220a**) to lock the mobile device in place, and downward to release the mobile device from the snap rails).

Referring also to FIG. **12B**, in some embodiments adjacent peripheral sensing modules **906** may additionally maintain surface contacts via rear-mounted electrical connectors (**910**, FIG. **9**). For example, each peripheral sensing module **906** may incorporate a set of pogo pins **1016** on or near the back of its top side and a corresponding set of slots **1016a** on or near the back of its underside (or, e.g., the pogo pins may be situated on the underside and the slots on the top side), such that power, grounding, and/or communications connectivity is provided (e.g., in addition to the control bus **1212**) by electrical connectors **910** between each adjacent pair of peripheral sensing modules.

Referring now to FIG. **13**, in some embodiments the onboard battery **1210** may be detachable from the lower portion **904**. For example, the onboard battery **1210** and the base **1302** of the lower portion **904** may be removable from the rest of the lower portion. In some embodiments, the base **1302** may include electrical contacts **1304**, such that the onboard battery **1210** may be inserted into a cradle **1306** of a charging device **1308** connectable to a power supply **1310** (e.g., standard AC power supply) to recharge the battery. For example, either the detached onboard battery **1210** and base **1302** may be inserted into the cradle **1306**, or the entire triggering handle (**1200**, FIG. **12A**; e.g., with integrated onboard battery) may be inserted into the cradle.

Referring now to FIG. **14A**, the upper portion **1400** may be implemented and may function similarly to the upper portion **902** of FIGS. **9** and **12**, except that the upper portion **1400** may incorporate an additional snap rail **1218a** forward of the snap rail **1218**. For example, the mobile device **114** may be locked into the forward snap rail **1218a** (e.g., and released therefrom) via a side-mounted release lever **1402** (also having a down position **1402a**).

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Referring also to FIG. 14B, the upper portion 1500 may be implemented and may function similarly to the upper portions 902, 1400 of FIGS. 9 through 14, except that the upper portion 1500 may include an alignment slot 1502 forward of the snap rail 1218. For example, the forward snap rail 1218a and/or alignment slot 1502 may provide additional stability for the mounted mobile device 114 or, in some embodiments, may provide the mounting of an additional mobile device 114a to the upper portion 1400, 1500.

We claim:

1. A ruggedized handle device for a modular mobile sensing system, comprising:

an outer shell fashioned of a high impact material and enclosing an inner shell fashioned of the high impact material,

the outer shell comprising an upper portion removably attached to a lower portion via at least one physical attachment component,

the lower portion at least partially contoured to a hand of a user,

the upper portion configured to securely support a mobile computing device,

at least one memory disposed within the outer shell and configured to store one or more encoded instructions associated with the mobile computing device;

at least one triggering element disposed within the inner shell and coupled to the at least one memory, the triggering element configured to:

establish a wireless link to the mobile computing device according to at least one wireless protocol;

and transmit the one or more encoded instructions to the mobile computing device when the handle device is in an active state;

a trigger corresponding to an index finger of the hand and capable of actuation by the index finger, the actuation configured to initiate the active state;

one or more peripheral sensor modules configured to be serially attachable between the lower portion and the upper portion,

the physical attachment component configured to be connected to one of the one or more peripheral sensor modules;

the upper portion and lower portion configured to be connected to the one or more peripheral sensors configured to be connected in series to each other, wherein the outer shell is configured to provide operating power in series to the one or more peripheral sensors via at least one electrical connector of one or more electrical connectors, each electrical connector of the one or more electrical connectors configured to power an adjacent peripheral sensor module of the one or more peripheral sensor modules connected in series;

and

wherein the at least one physical attachment component includes at least one hinged attachment bracket configured to pivot the mobile computing device toward the user.

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2. The ruggedized handle device of claim 1, wherein: the upper portion includes at least one docking component configured to removably secure the mobile computing device to the handle device, the at least one docking component configured to pivot the mobile computing device relative to the handle device.

3. The ruggedized handle device of claim 1, wherein: the one or more peripheral sensor modules are selected from a group including:

an imaging device;

a barcode scanner configured to detect and decode encoded information;

a card reader device configured to accept a payment card and read data from the payment card;

an illuminator including one or more luminous elements configured to illuminate an area proximate to the handle device;

or

an RFID reader including an RFID antenna.

4. The ruggedized handle device of claim 1, wherein the mobile computing device includes at least one of a tablet, a smartphone, and a portable computing device.

5. The ruggedized handle device of claim 1, wherein the lower portion further comprises:

one or more auxiliary buttons selected from a group including:

a first auxiliary button corresponding to a non-index finger of the hand;

and

a second auxiliary button corresponding to a thumb of the hand;

each auxiliary button embedded within a recess set into the outer shell, the recess surrounding the auxiliary button and configured to support at least one of the non-index finger and the thumb in a non-actuating position proximate to the button;

and

each auxiliary button configured for one of:

initiating the active state;

or

operating an attached peripheral sensor module.

6. The ruggedized handle device of claim 1, wherein: the trigger includes at least one magnetic element having at least a resting position within the outer shell and an active position proximate to the triggering element, the actuation configured to initiate the active state by moving the magnetic element into the active position.

7. The ruggedized handle device of claim 1, wherein:

the trigger has a default state;

the trigger is positionable in a fully retracted state and at least one intermediate state between the default state and the fully retracted state; the trigger configured for: when in the fully retracted state, at least one of 1) initiating the active state and 2) transmitting an auxiliary instruction executable via one of the mobile computing device and the one or more peripheral sensor modules;

and

when in the at least one intermediate state, transmitting the at least one auxiliary instruction.

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