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(54) Title: METHODS AND SYSTEMS FOR VISUALLY EVALUATING ELECTRONIC DEVICES

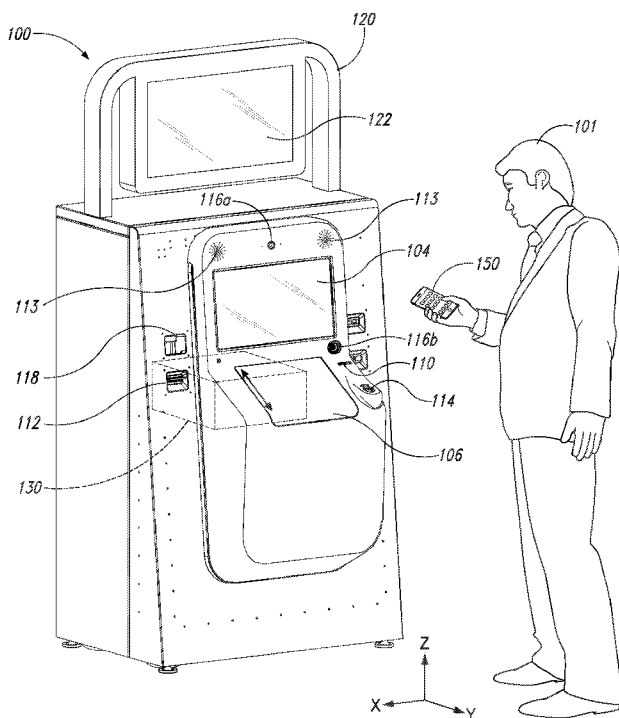


Fig. 1A

(57) Abstract: The present disclosure describes various embodiments of systems and methods for recycling mobile phones and other consumer electronic devices. In various embodiments, the systems and methods disclosed herein include device imaging systems for inspecting, evaluating, identifying, and/or obtaining other information about devices. Such imaging systems can include one or more flat-bed scanners, and can be employed by a user-operated kiosk to determine a price to offer a user for a mobile phone or other electronic device based on the information.



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## METHODS AND SYSTEMS FOR VISUALLY EVALUATING ELECTRONIC DEVICES

### TECHNICAL FIELD

**[0001]** The present disclosure is directed generally to methods and systems for processing mobile devices and other consumer electronic devices at, for example, a consumer operated kiosk, and in particular, to systems and methods for visually evaluating such devices.

### BACKGROUND

**[0002]** Consumer electronic devices, such as mobile phones, laptop computers, notebooks, tablets, MP3 players, etc., are ubiquitous. Currently there are over 6 billion mobile devices in use in the world; and this number is growing rapidly as more than 1.8 billion mobile phones were sold in 2014 alone. By 2017 it is expected that there will be more mobile devices in use than people on the planet. In addition to mobile phones, over 256 million tablet computers were shipped. Part of the reason for the rapid growth in the number of mobile phones and other electronic devices is the rapid pace at which these devices evolve, and the increased usage of such devices in developing countries.

**[0003]** As a result of the rapid pace of development, a relatively high percentage of electronic devices are replaced every year as consumers continually upgrade their mobile phones and other electronic devices to obtain the latest features or a better operating plan. According to the U.S. Environmental Protection Agency, consumers in the United States alone dispose of over 370 million mobile phones, PDAs, tablets, and other electronic devices every year. Millions of other outdated or broken mobile phones and other electronic devices are simply tossed into junk drawers or otherwise kept until a suitable disposal solution arises.

**[0004]** Although many electronic device retailers and cell carrier stores now offer mobile phone trade-in or buyback programs, many old mobile phones still end up in landfills or are improperly disassembled and disposed of in developing countries. Mobile phones and similar electronic devices, however, typically contain substances

that can be harmful to the environment, such as arsenic, lithium, cadmium, copper, lead, mercury and zinc. If not properly disposed of, these toxic substances can seep into groundwater from decomposing landfills and contaminate the soil with potentiality harmful consequences for humans and the environment.

**[0005]** As an alternative to retailer trade-in or buyback programs, consumers can now recycle and/or sell their used mobile phones using self-service kiosks located in malls, retail stores or other publically accessible areas. Such kiosks are operated by ecoATM, Inc., the assignee of the present application, and are disclosed in, for example, U.S. Patent Nos.: 8,463,646, 8,423,404, 8,239,262, 8,200,533, 8,195,511, and 7,881,965, which are commonly owned by ecoATM, Inc. and are incorporated herein by reference in their entireties.

**[0006]** When evaluating used mobile phones for possible purchase from consumers via, for example, a kiosk, it can be important to accurately determine the make and model of the phone, as well as the physical condition so that the phone can be accurately priced. Accordingly, improving the means available to determine these aspects of a phone can lead to more accurate pricing, and providing more accurate pricing can incentivize consumers to use such kiosks to dispose of their old electronic devices in an efficient and environmentally conscientious way.

#### BRIEF DESCRIPTION OF THE DRAWINGS

**[0007]** Figure 1A is an isometric view of a machine configured in accordance with an embodiment of the present technology for recycling mobile phones and/or other electronic devices; Figure 1B is an isometric view of the machine of Figure 1A with a portion of a housing removed; and Figure 1C is a rear isometric view of the machine of Figures 1A and 1B with another portion of the housing removed.

**[0008]** Figures 2A–2D are a series of isometric views of a portion of the machine of Figures 1A–1C with a number of exterior panels removed to illustrate operation of the machine in accordance with an embodiment of the present technology.

**[0009]** Figure 3A is an isometric view of a device imaging system configured in accordance with an embodiment of the present technology; Figure 3B is a partially

exploded isometric view of the device imaging system of Figure 3A; and Figure 3C is a partially exploded front view of the device imaging system of Figures 3A and 3B.

**[0010]** Figure 4A is an isometric view of a scanner assembly configured in accordance with an embodiment of the present technology; Figure 4B is a partially exploded isometric view of the scanner assembly of Figure 4A; Figure 4C is a partially exploded side view of the scanner assembly of Figures 4A and 4B; and Figure 4D is another isometric view of the scanner assembly of Figures 4A–4C.

**[0011]** Figure 5 is a flow diagram of a routine for recycling mobile phones and/or other electronic devices in accordance with an embodiment of the present technology.

**[0012]** Figures 6–11 are flow diagrams of routines for visually evaluating mobile phones and/or other electronic devices in accordance with various embodiments of the present technology.

**[0013]** Figure 12 is a schematic diagram illustrating various components associated with the machine of Figures 1A–2D.

**[0014]** Figure 13 is a schematic diagram of a suitable distributed computing environment for implementing various aspects of the present technology.

#### DETAILED DESCRIPTION

**[0015]** The following disclosure describes various embodiments of systems and methods for visually evaluating mobile phones and other consumer electronic devices, and for performing other operations associated with recycling electronic devices. Embodiments of the systems and methods described herein can be used in or with consumer-operated kiosks, counter-top machines, networked processing devices, retailer-assisted machines, and the like. Some embodiments of the present technology, for example, are directed to consumer-operated kiosks that can perform automatic visual and/or electrical inspections of mobile phones and/or other consumer electronic devices that are submitted to the kiosks for sale or recycling. As described in greater detail below, in various embodiments of the present technology, the visual inspections and/or evaluations can be performed using a device imaging system having one or more scanner assemblies.

**[0016]** When purchasing and/or recycling a used electronic device (e.g., a used smart phone), it can be important for a purchaser to inspect the device to identify any issues that may affect the value. For example, when purchasing a mobile phone, it can be important to properly identify the phone and determine if the phone has been damaged, if the phone has significant wear and tear, or if the phone has been reported stolen. In the case of a transaction executed via a consumer-operated kiosk or other machine, carrying out this inspection can be significantly more challenging than it would be in the case of a person-to-person transaction. For example, consumer-operated kiosks typically require the user to enter information at a kiosk touchscreen or keypad to help identify the make and model of the mobile device. Additionally, in some kiosks, a camera is used to acquire one or more images of the device so that the kiosk can process the images to determine the identity of the device (e.g., the device make and/or model), as well as the presence of any damage to the device. In some cases, however, the image quality may be poor, and as a result it may be difficult to detect the dimensions and other features of the device. As a result, the kiosk may not be able to recognize or sufficiently identify a device based on the images. Additionally, the images may not show some types of damage to the device (e.g., hairline cracks in the screen). Moreover, kiosks equipped with conventional cameras may require bulky domes to position the cameras far enough away from the device to capture an adequate image. Such dome-mounted cameras are typically optimized to focus at a particular distance, which can limit the detail that can be captured in images. Additionally, dome-mounted cameras may require diffuse lighting to achieve consistent imaging, but the use of diffuse lighting can limit the detection of cracks or other small defects as compared to spot lighting. Accordingly, such imaging systems may not be able to accurately identify some mobile devices and/or accurately assess the physical condition of the devices.

**[0017]** Apparatuses, systems, and methods configured in accordance with embodiments of the present technology can at least partially address one or more of the problems described above and/or other problems associated with conventional technologies whether or not stated herein. For example, self-service kiosks configured in accordance with at least some embodiments of the present technology include a device imaging system having a scanner (e.g., a flatbed scanner) configured to capture one or more images of an electronic device. In some embodiments, two flatbed scanner

assemblies can be positioned in a face-to-face relationship, with the electronic device disposed on a transparent plate between the two scanner assemblies. These embodiments enable the scanners to obtain images of an electronic device that can be used to accurately identify, inspect, assess the value, and/or authenticate the electronic device.

**[0018]** Certain details are set forth in the following description and in Figures 1–13 to provide a thorough understanding of various embodiments of the present technology. In other instances, well-known structures, materials, operations and/or systems often associated with consumer-operated kiosks and other such machines, scanner systems, smartphones and other handheld devices, consumer electronic devices, computer hardware, software, and network systems, etc. are not shown or described in detail in the following disclosure to avoid unnecessarily obscuring the description of the various embodiments of the technology. Those of ordinary skill in the art will recognize, however, that the present technology can be practiced without one or more of the details set forth herein, or with other structures, methods, components, and so forth. The terminology used below should be interpreted in its broadest reasonable manner, even though it is being used in conjunction with a detailed description of certain examples of embodiments of the technology. Indeed, certain terms may even be emphasized below; however, any terminology intended to be interpreted in any restricted manner will be specifically defined as such in this Detailed Description section.

**[0019]** The accompanying Figures depict embodiments of the present technology and are not intended to be limiting of its scope. The sizes of various depicted elements are not necessarily drawn to scale, and these various elements may be arbitrarily enlarged to improve legibility. Component details may be abstracted in the Figures to exclude details such as the position of components and certain precise connections between such components when such details are unnecessary for a complete understanding of how to make and use the invention.

**[0020]** In the Figures, identical reference numbers identify identical, or at least generally similar, elements. To facilitate the discussion of any particular element, the most significant digit or digits of any reference number refers to the Figure in which that

element is first introduced. For example, element 110 is first introduced and discussed with reference to Figure 1.

**[0021]** Figure 1A is an isometric view of a kiosk 100 having a device imaging system 130 configured in accordance with an embodiment of the present technology. In the illustrated embodiment, the kiosk 100 can be used for recycling and/or other processing of mobile phones and other consumer electronic devices in accordance with the present technology. The term “processing” is used herein for ease of reference to generally refer to various services and operations that may be performed or facilitated by the kiosk 100 on, with, or otherwise in relation to an electronic device. Such services and operations can include, for example, selling, reselling, donating, exchanging, identifying, evaluating, pricing, auctioning, decommissioning, transferring data from or to, reconfiguring, refurbishing, etc., mobile phones and other electronic devices..

**[0022]** Although many embodiments of the present technology are described herein in the context of mobile phones, aspects of the present technology are not limited to mobile phones and generally apply to other consumer electronic devices. Such devices include, as non-limiting examples, all manner of mobile phones, smart phones, handheld devices, PDAs, MP3 players, tablet, notebook and laptop computers, e-readers, cameras, etc. In some embodiments, it is contemplated that the kiosk 100 can facilitate selling and/or otherwise processing larger consumer electronic devices, such as desktop computers, TVs, game consoles, etc., as well smaller electronic devices such as Google Glass™, smart-watches, etc. The kiosk 100 and various features thereof can be at least generally similar in structure and function to the kiosks and corresponding components and features described in: U.S. Patent No. 8,463,646, titled SECONDARY MARKET AND VENDING SYSTEM FOR DEVICES, issued June 11, 2013, U.S. Patent No. 8,423,404, titled SECONDARY MARKET AND VENDING SYSTEM FOR DEVICES, issued April 16, 2013, U.S. Patent No. 8,239,262, titled SECONDARY MARKET AND VENDING SYSTEM FOR DEVICES, issued August 7, 2012, U.S. Patent No. 8,200,533, titled APPARATUS AND METHOD FOR RECYCLING MOBILE PHONES, issued June 12, 2012, U.S. Patent No. 8,195,511, titled SECONDARY MARKET AND VENDING SYSTEM FOR DEVICES, issued June 5, 2012 and U.S. Patent No. 7,881,965, titled SECONDARY MARKET AND VENDING SYSTEM FOR DEVICES, issued February 1, 2011; and in U.S. Patent Application No.

13/438,924, titled KIOSKS FOR RECYCLING ELECTRONIC DEVICES, filed April 4, 2012, U.S. Patent Application No. 13/753,539, titled METHOD AND APPARATUS FOR RECYCLING ELECTRONIC DEVICES, filed January 30, 2013, U.S. Patent Application No. 13/658,825, titled METHOD AND APPARATUS FOR RECYCLING ELECTRONIC DEVICES, filed October 24, 2012, U.S. Patent Application No. 13/733,984, titled METHOD AND APPARATUS FOR RECYCLING ELECTRONIC DEVICES, filed January 4, 2013, U.S. Patent Application No. 13/705,352, titled PRE-ACQUISITION AUCTION FOR RECYCLED ELECTRONIC DEVICES, filed December 5, 2012, U.S. Patent Application No. 13/492,835, titled APPARATUS AND METHOD FOR RECYCLING MOBILE PHONES, filed June 9, 2012, U.S. Patent Application No. 13/658,828, titled METHOD AND APPARATUS FOR RECYCLING ELECTRONIC DEVICES, filed October 24, 2012, 13/693,032, titled METHOD AND APPARATUS FOR REMOVING DATA FROM A RECYCLED ELECTRONIC DEVICE, filed December 3, 2012, U.S. Patent Application No. 13/792,030, titled MINI-KIOSK FOR RECYCLING ELECTRONIC DEVICES, filed March 9, 2013, U.S. Patent Application No. 13/794,814, titled METHOD AND SYSTEM FOR REMOVING AND TRANSFERRING DATA FROM A RECYCLED ELECTRONIC DEVICE, filed March 12, 2013, U.S. Patent Application No. 13/794,816, titled METHOD AND SYSTEM FOR RECYCLING ELECTRONIC DEVICES IN COMPLIANCE WITH SECOND HAND DEALER LAWS, filed March 12, 2013, U.S. Patent Application No. 13/113,497, titled SECONDARY MARKET AND VENDING SYSTEM FOR PRINTER CARTRIDGES, filed May 23, 2011, U.S. Patent Application No. 13/862,395, titled SECONDARY MARKET AND VENDING SYSTEM FOR DEVICES, filed April 13, 2013, U.S. Patent Application No. 13/913,408, titled SECONDARY MARKET AND VENDING SYSTEM FOR DEVICES, filed June 8, 2013, U.S. Patent Application No. 14/498,763, titled METHODS AND SYSTEMS FOR PRICING AND PERFORMING OTHER PROCESSES ASSOCIATED WITH RECYCLING MOBILE PHONES AND OTHER ELECTRONIC DEVICES, filed September 26, 2014, U.S. Patent Application No. 14/500,739, titled MAINTAINING SETS OF CABLE COMPONENTS USED FOR WIRED ANALYSIS, CHARGING, OR OTHER INTERACTION WITH PORTABLE ELECTRONIC DEVICES, filed September 29, 2014, U.S. Patent Application No. 14/506,449, titled SYSTEM FOR ELECTRICALLY TESTING MOBILE DEVICES AT A CONSUMER-OPERATED KIOSK,

AND ASSOCIATED DEVICES AND METHODS, filed October 3, 2014, U.S. Patent Application No. 14/663,331, titled DEVICE RECYCLING SYSTEMS WITH FACIAL RECOGNITION, filed March 19, 2015, U.S. Patent Application No. 14/660,768, titled SYSTEMS AND METHODS FOR INSPECTING MOBILE DEVICES AND OTHER CONSUMER ELECTRONIC DEVICES WITH A LASER, FILED March 17, 2015, U.S. Patent Application No. 14/568,051, titled METHODS AND SYSTEMS FOR IDENTIFYING MOBILE PHONES AND OTHER ELECTRONIC DEVICES, filed December 11, 2014, U.S. Patent Application No. 14/598,469, titled METHODS AND SYSTEMS FOR DYNAMIC PRICING AND PERFORMING OTHER PROCESSES ASSOCIATED WITH RECYCLING MOBILE PHONES AND OTHER ELECTRONIC DEVICES, filed January 16, 2015, U.S. Patent Application No. 62/059,129, titled WIRELESS-ENABLED KIOSK FOR RECYCLING CONSUMER DEVICES, filed October 2, 2014, U.S. Patent Application No. 62/059,132, titled APPLICATION FOR DEVICE EVALUATION AND OTHER PROCESSES ASSOCIATED WITH DEVICE RECYCLING, filed October 2, 2014, U.S. Patent Application No. 62/073,840, titled SYSTEMS AND METHODS FOR RECYCLING CONSUMER ELECTRONIC DEVICES, filed October 31, 2014, U.S. Patent Application No. 62/073,847, titled METHODS AND SYSTEMS FOR FACILITATING PROCESSES ASSOCIATED WITH INSURANCE SERVICES AND/OR OTHER SERVICES FOR ELECTRONIC DEVICES, filed October 31, 2014, U.S. Patent Application No. 62/076,437, titled METHODS AND SYSTEMS FOR EVALUATING AND RECYCLING ELECTRONIC DEVICES, filed November 6, 2014, U.S. Patent Application No. 62/090,855, titled METHODS AND SYSTEMS FOR PROVIDING INFORMATION REGARDING COUPONS/PROMOTIONS AT KIOSKS FOR RECYCLING MOBILE PHONES AND OTHER ELECTRONIC DEVICES, filed December 11, 2014, U.S. Patent Application No. 61/102,304 titled SECONDARY MARKET AND VENDING SYSTEM FOR DEVICES, filed October 2, 2008, U.S. Patent Application No. 61/183,510, titled SECONDARY MARKET AND VENDING SYSTEM FOR DEVICES, filed June 2, 2009, U.S. Patent Application No. 62/091,426, titled SYSTEMS AND METHODS FOR RECYCLING CONSUMER ELECTRONIC DEVICES, filed December 12, 2014, each of which is incorporated herein in its entirety by reference. All of the patents and patent applications listed above are commonly owned by the applicant of the present application, and they along with any other patents or

patent applications identified herein are incorporated herein by reference in their entireties.

**[0023]** In the illustrated embodiment, the kiosk 100 is a floor-standing self-service kiosk configured for use by a user 101 (e.g., a consumer, customer, etc.) to recycle, sell, and/or perform other operations on or with a mobile phone 150 or other consumer electronic device. In other embodiments, the kiosk 100 can be configured for use on a countertop or a similar raised surface. Although the kiosk 100 is configured for use by consumers, in various embodiments the kiosk 100 and/or various portions thereof can also be used by other operators, such as a retail clerk or kiosk assistant to facilitate the selling or other processing of mobile phones and other electronic devices.

**[0024]** In the illustrated embodiment, the kiosk 100 includes a housing 102 that is approximately the size of a conventional vending machine. The housing 102 can be of conventional manufacture from, for example, sheet metal, plastic panels, etc. A plurality of user interface devices are provided on a front portion of the housing 102 for providing instructions and other information to users, and/or for receiving user inputs and other information from users. For example, the kiosk 100 can include a display screen 104 (e.g., a liquid crystal display (LCD) or light emitting diode (LED) display screen, a projected display (such as a heads-up display or a head-mounted device), and so on) for providing information, prompts, etc., to users. The display screen 104 can include a touch screen for receiving user input and responses to displayed prompts. In addition or alternatively, the kiosk 100 can include a separate keyboard or keypad for this purpose. The kiosk 100 can also include an ID reader or scanner 112 (e.g., a driver's license scanner), a fingerprint reader 114, and one or more cameras 116 (e.g., digital still and/or video cameras, identified individually as cameras 116a and 116b). The kiosk 100 can additionally include output devices such as a label printer having an outlet 110, and a cash dispenser having an outlet 118. The kiosk 100 can further include a headphone jack 111 and speakers 113 for audibly communicating information to users, as well as one or more lights for visually communicating signals or other information to users, a handset or microphone for receiving verbal input from the user, and/or other user input and output devices. The input devices can include a touchpad, pointing device such as a mouse, joystick, pen, game pad, motion sensor, scanner, eye direction monitoring system, etc. Additionally the kiosk 100 can also include a bar code

reader, QR code reader, bag/package dispenser, a digital signature pad, etc. In the illustrated embodiment, the kiosk 100 additionally includes a header 120 having a display screen 122 for displaying marketing advertisements and/or other video or graphical information to attract users to the kiosk. In addition to the user interface devices described above, the front portion of the housing 102 also includes a retractable access panel or door 106 located directly beneath the display screen 104. The access door 106 is configured to automatically retract so that the user can place an electronic device (e.g., the mobile phone 150) in an inspection area 108 for automatic inspection by the kiosk 100.

**[0025]** Figure 1B is an isometric view of the kiosk 100 of Figure 1A with the display screen 104, the access door 106, and a portion of the surrounding housing 102 removed for purposes of illustration. In the illustrated embodiment, the device imaging system 130 is disposed within the inspection area 108. A transparent inspection plate 144 is movably disposed in front of the device imaging system 130. As described in greater detail below, a user wishing to sell an electronic device (e.g., the mobile phone 150) can place a mobile phone 150 on the inspection plate 144 after the door 106 retracts. The inspection plate 144 can then move rearward in the direction of the y-axis to bring the mobile phone 150 into the proximity of the device imaging system 130 for visual inspection. A connector carrier 140 is disposed in front of and beneath the inspection plate 144. In the illustrated embodiment, the connector carrier 140 is a rotatable carousel configured to rotate about a generally horizontal central axis and carries a plurality of electrical connectors (not shown) distributed around an outer periphery thereof. In other embodiments, other types of connector carrying devices (including both fixed and movable arrangements) can be used. In some embodiments, the connectors can include a plurality of interchangeable USB connectors configured to provide power and/or exchange data with a variety of different mobile phones and/or other electronic devices. In operation, the connector carrier 140 is configured to automatically rotate about its axis to position an appropriate one of the connectors adjacent to the subject electronic device, such as the mobile phone 150, that has been placed on the inspection plate 144 for evaluation. The connector can then be manually and/or automatically withdrawn from the connector carrier 140 and connected to a port on the mobile phone 150 for electrical analysis. Such analysis can include, e.g., an

evaluation of the make, model, configuration, condition, etc., using one or more of the methods and/or systems described in detail in the commonly owned patents and patent applications identified herein and incorporated by reference in their entireties.

**[0026]** Figure 1C is a rear isometric view of the kiosk 100 of Figure 1A with a portion of the housing 102 removed for purposes of illustrating various internal components. In the illustrated embodiment, a collection bin 134 is disposed beneath the device imaging system 130. Following visual and electrical inspection of the mobile phone 150 and acceptance of remuneration by the user, the mobile phone 150 can be transferred into the collection bin 134 for later retrieval and recycling.

**[0027]** Figures 2A–2D are a series of isometric views of a portion of the kiosk 100 with the housing 102 removed to illustrate selected components associated with the device imaging system 130 in detail. In Figure 2B, an exterior housing 232 has been removed from the device imaging system 130 to better illustrate various internal components thereof. Referring first to Figures 2A and 2B together, in the illustrated embodiment, the device imaging system 130, the connector carrier 140, and the inspection plate 144 are operably disposed behind the access door 106 (Figure 1A). The inspection plate 144 is configured to translate back and forth along the y-axis (on, e.g., parallel mounting tracks 145a and 145b) to move an electronic device, such as the mobile phone 150, between a first position (Figure 2A) directly behind the access door 106, and a second position (Figure 2B) within or at least proximate to the device imaging system 130. A gate 238 can be raised to provide clearance for the mobile phone 150 to enter the device imaging system 130. The gate 238 can be raised, for example, by rotating a lead screw 239 which is threadably coupled to the gate 238 such that rotation of the lead screw 239 in a first direction causes the gate 238 to raise vertically along the z-axis, and rotation of the lead screw 239 in the opposite direction causes the gate 238 to lower vertically along the z-axis. In other embodiments the gate 238 can be raised and lowered using different actuation mechanisms, for example a belt drive, a pneumatic translation system, or other suitable mechanism for raising and lowering the gate 238.

**[0028]** In the illustrated embodiment, the inspection plate 144 is transparent, or at least partially transparent (e.g., formed of glass, Plexiglas, etc.) to enable the mobile

phone 150 to be scanned and/or otherwise optically evaluated from multiple viewing angles (e.g., top, bottom, sides, etc.) using, e.g., imaging system scanner assemblies positioned above and/or below the inspection plate 144. The inspection area 108 can also include weight scales, heat detectors, UV readers/detectors, and the like, for further evaluation of electronic devices placed therein. The kiosk 100 can further include an angled binning plate 236 for directing electronic devices from the inspection plate 144 into the collection bin 134 positioned in a lower portion of the kiosk 100.

**[0029]** As shown in Figure 2B, in the illustrated embodiment the device imaging system 130 includes an upper scanner assembly 202 disposed above the inspection plate 144, and a lower scanner assembly 204 disposed beneath the inspection plate 144. The upper scanner assembly 202 includes an upper scanner 264 configured to translate on an upper guide rail 256 along the y-axis. Similarly, the lower scanner assembly 204 includes a lower scanner 266 configured to translate along a lower guide rail 258 along the y-axis. The upper scanner 264 and the lower scanner 266 each include imaging elements as described in more detail below to capture images of the mobile phone 150 as the upper and lower scanners 264 and 266 translate with respect to the mobile phone 150 on the inspection plate 144. Imaging control electronics 206 are operably coupled to the upper scanner assembly 202 and the lower scanner assembly 204 and are configured to control movement of the scanners 264 and 266 as well as to control image capture. In some embodiments, the imaging control electronics 206 can include an integrated circuit chip, for example a processor or CPU configured to execute computer-readable instructions to control the upper and lower scanner assemblies 202 and 204, as described in more detail below. In some embodiments, the imaging control electronics 206 can perform image processing as well, while in other embodiments image processing can be performed by other components such as the kiosk CPU or remote electronic components. The imaging control electronics 206 can control movement of the upper and lower scanners 264 and 266 so that they move independently of each other or together in unison. That is, the upper scanner 264 and the lower scanner 266 can move in unison or as a unit, and they can also move independently of each other (e.g., with one stationary while the other moves), depending on what a particular visual inspection routine may require.

**[0030]** The kiosk 100 can be used in a number of different ways to efficiently facilitate the recycling, selling and/or other processing of mobile phones and other consumer electronic devices. Referring to Figures 1A–2D together, in one embodiment, a user wishing to sell a used electronic device, such as the mobile phone 150, approaches the kiosk 100 and identifies the type of device the user wishes to sell by selecting options (e.g., touch screen options) in response to prompts on the display screen 104. Next, the user may be prompted to remove any cases, stickers, or other accessories from the device so that it can be accurately evaluated. Additionally, the kiosk 100 may print and dispense a unique identification label (e.g., a small adhesive-backed sticker with a quick response code (“QR code”), barcode, or other machine-readable indicia, etc.) from the label outlet 110 for the user to adhere to the back of the mobile phone 150. After this is done, the door 106 retracts and opens allowing the user to place the mobile phone 150 onto the inspection plate 144 in the inspection area 108 (Figure 2A). The door 106 then closes, the gate 238 is raised along the z-axis, and the inspection plate 144 moves the mobile phone 150 along the y-axis to position the mobile phone 150 in a scanner field of view 257 as shown in Figure 2B. The scanning field of view 257 represents the operative field of view of the device imaging system 130, both from an upper and lower perspective.

**[0031]** As described in more detail below, the device imaging system 130 can perform a visual inspection of the mobile phone 150 when the inspection plate 144 is translated to the position shown in Figure 2B. In some embodiments, the visual inspection can include a computer-implemented visual analysis (e.g., a three-dimensional (“3D”) analysis) performed by a processing device within the kiosk 100 (e.g., a CPU) to confirm the identification of the mobile phone 150 (e.g. make, model and/or sub-model) and/or to evaluate or assess the condition and/or functionality of the mobile phone 150 and/or its various components and systems. For example, the visual analysis can include computer-implemented evaluation (e.g., a digital comparison) of images of the mobile phone 150 taken from top, side and/or end view perspectives to determine length, width, and/or height (thickness) dimensions of the mobile phone 150. The visual analysis can further include a computer-implemented inspection of a display screen on the mobile phone 150 to check for, e.g., cracks in the glass and/or other damage or defects in the LCD (e.g., defective pixels, etc.). In some embodiments, the

kiosk 100 can perform the visual analysis using one or more of the methods and/or systems described in detail in the commonly owned patents and patent applications identified herein and incorporated by reference in their entireties. Visual inspection of the mobile phone 150 by the device imaging system 130 is described in more detail below with respect to Figures 3A–11.

**[0032]** Referring next to Figure 2C, after the visual analysis is performed and the device has been identified, the inspection plate 144 returns the mobile phone 150 to its initial position near the door 106. The display screen 104 (Figure 1A) can also provide an estimated price, or an estimated range of prices, that the kiosk 100 may offer the user for the mobile phone 150 based on the visual analysis, and/or based on user input (e.g., input regarding the type, condition, etc. of the mobile phone 150). If the user indicates (by, e.g., input via the touch screen) that he wishes to proceed with the transaction, the connector carrier 140 automatically rotates an appropriate one of the connectors 242 into position adjacent the inspection plate 144, and the door 106 is again opened. The user can then be instructed (via, e.g., the display screen 104) to withdraw the selected connector 242 (and its associated wire or cable) from the connector carrier 140, plug the connector 242 into the corresponding port (e.g., a USB port) on the mobile phone 150, and reposition the mobile phone 150 on the inspection plate 144 in the inspection area 108. After doing so, the door 106 once again closes and the kiosk 100 (e.g. the kiosk CPU) performs an electrical inspection of the device via the connector 242 to further evaluate the condition of the phone as well as specific component and operating parameters such as the memory, carrier, etc. In addition or alternatively, in some embodiments the electrical inspection can include a determination of phone manufacturer information (e.g., a vendor identification number or VID) and product information (e.g., a product identification number or PID). In some embodiments, the kiosk 100 can perform the electrical analysis using one or more of the methods and/or systems described in detail in commonly owned U.S. Patent Application No. 14/506,449, filed October 3, 2014, and the other patents and patent applications identified herein and incorporated by reference in their entireties. After the electrical inspection, a retraction mechanism 246 can automatically disconnect the connector 242 from the mobile phone 150. In some embodiments, the retraction mechanism 246 can be substantially as described in commonly owned U.S. Patent

Application No. 13/794,816, filed March 12, 2013, which is hereby incorporated by reference in its entirety.

**[0033]** In some embodiments, the order of the device evaluation operations described above can be modified such that the electrical inspection is conducted before the visual inspection. For example, a user can begin the process by first indicating a phone type (via, e.g., input via the touch screen), and the connector carrier 140 then automatically rotates the appropriate one of the connectors 242 into position adjacent the inspection plate 144. Then the door 106 is opened, and the user can then be instructed (via, e.g., the display screen 104) to connect the selected connector 242 to the mobile phone 150 and to reposition the mobile phone 150 on the inspection plate 144 in the inspection area 108. The door 106 can then close, and electrical inspection of the device can be performed (e.g., via the kiosk CPU). After the electrical inspection, the electrical connector 242 can be automatically disconnected from the mobile phone 150 via the retraction mechanism 246. The inspection plate 144 can then be advanced along the y-axis to the device imaging system 130 for visual inspection of the mobile phone 150.

**[0034]** After the visual and electronic analysis of the mobile phone 150 using either of the two methods described above, the user is presented with a phone purchase price via the display screen 104. If the user declines the offer price, the door 106 opens, and the user can reach in and retrieve the mobile phone 150. If the user accepts the price, the door 106 remains closed and the user may be prompted to place his or her identification (e.g., a driver's license) in the ID scanner 112 and provide a thumbprint via the fingerprint reader 114. As a fraud prevention measure, the kiosk 100 can be configured to transmit an image of the driver's license to a remote computer screen, and an operator at the remote computer can visually compare the picture (and/or other information) on the driver's license to an image of the person standing in front of the kiosk 100 as viewed by one or more of the cameras 116a and 116b (Figure 1A) to confirm that the person attempting to sell the mobile phone 150 is in fact the person identified by the driver's license. In some embodiments, one or more of the cameras 116a and 116b can be movable to facilitate viewing of kiosk users, as well as other individuals in the proximity of the kiosk 100. Additionally, the person's fingerprint can be checked against records of known fraud perpetrators. If either of these checks indicate

that the person selling the phone presents a fraud risk, the transaction can be declined and the mobile phone 150 returned.

**[0035]** After the user's identity has been verified, the inspection plate 144 moves back toward the device imaging system 130. As shown in Figure 2D, as the inspection plate 144 slides under the gate 238 and the mobile phone 150 is stopped by the gate 238 and slides off of the inspection plate 144, onto the angled binning plate 236 and into the collection bin 134. The kiosk 100 can then provide payment of the purchase price to the user. In some embodiments, payment can be made in the form of cash dispensed from the cash outlet 118. In other embodiments, the user can receive remuneration for the mobile phone 150 in various other useful ways. For example, the user can be paid via a redeemable cash voucher, a coupon, an e-certificate, a prepaid card, a wired or wireless monetary deposit to an electronic account (e.g., a bank account, credit account, loyalty account, online commerce account, mobile wallet etc.), Bitcoin, etc.

**[0036]** As those of ordinary skill in the art will appreciate, the foregoing examples are but some of the ways in which the kiosk 100 can be used to recycle or otherwise process consumer electronic devices such as mobile phones. Although the foregoing examples are described in the context of mobile phones, it should be understood that the kiosk 100 and various embodiments thereof can also be used in a similar manner for recycling virtually any consumer electronic device, such as MP3 players, tablet computers, PDAs, and other portable devices, as well as other relatively non-portable electronic devices such as desktop computers, printers, devices for implementing games, entertainment or other digital media on CDs, DVDs, Blu-ray, etc. Moreover, although the foregoing example is described in the context of use by a consumer, the kiosk 100 in various embodiments thereof can similarly be used by others, such as a store clerk, to assist consumers in recycling, selling, exchanging, etc. their electronic devices.

**[0037]** Figure 3A is an isometric view of the device imaging system 130, and Figures 3B and 3C are partially exploded isometric and front views, respectively, of the device imaging system 130. Referring to Figures 3A–3C together, the device imaging system 130 includes the upper scanner assembly 202 operably disposed above the inspection

plate 144, and the lower scanner assembly 204 operably disposed beneath the inspection plate 144. The upper scanner assembly 202 includes the upper guide rail 256, which is supported on opposite ends by a first upper mount 352a and a second upper mount 352b, which in turn can be fixed to the housing 232 (Figure 2A). The upper guide rail 256 can be an elongate cylindrical member. The upper scanner 264 can be movably coupled to the upper guide rail 256 by a coupling 353 (having e.g., a cylindrical linear bearing) that can translate smoothly back and forth along the guide rail 256. In other embodiments, the upper guide rail 256 can have other shapes, such as rectangular cross sections. As described in more detail below with respect to Figures 4A–4D, translation of the upper scanner 264 along the guide rail 256 can be effected via an upper belt 368 and an associated drive system. For example, the scanner 264 can translate between a first position 357 at a first end of the guide rail 256 and a second position 359 at an opposite end of the guide rail 256. As the scanner 264 translates between the first position 357 and the second position 359, the scanner covers the field of view 257, which as noted above represents the operative field of view of the device imaging system 130. The upper scanner 264 is supported at a first end by the upper guide rail 256 and at an opposite second end by a parallel rail or other guide surface (not shown) that is movably received in a groove of a support fitting 232.

**[0038]** The lower scanner assembly 204 can be configured similarly to the upper scanner assembly 202. For example, the lower scanner assembly 204 includes a lower guide rail 258 secured to a first lower mount 354a and a second lower mount 354b. The lower scanner 266 is movably coupled to the lower guide rail 258 by a coupling 355 and configured to translate along its length in the y-direction to cover the scanner field of view 257. The lower scanner 266 is supported at a first end by the lower guide rail 258 and at the other end by a support fitting 365 that movably engages a corresponding guide rail or surface (not shown) on the housing 232 (Figure 2A). A lower belt 370 can be used to control movement of the lower scanner 266 along the length of the lower guide rail 258. In some embodiments, the upper scanner assembly 202 and the lower scanner assembly 204 can comprise scanners and/or scanner components available from Avison-Labs Inc. located in Newark, CA 94560, for example components of the flatbed scanner model AVA6 available from Avison-Labs Inc. In other embodiments, other scanner assemblies and components can be used.

**[0039]** In the illustrated embodiment, the upper scanner assembly 202 faces downwardly toward the inspection plate 144 and is configured to capture one or more images (e.g., top and side images) of a mobile phone 150 or other electronic device placed on the inspection plate 144. The lower scanner assembly 204 faces upwardly toward the inspection plate 144 and is configured to capture one or more other images (e.g., bottom and side images) of the mobile phone 150 or other electronic device placed on the inspection plate 144.

**[0040]** A first mirror assembly 360 is disposed over the inspection plate 144 along a first side or edge region, and a second mirror assembly 362 is disposed over the inspection plate 144 along a second side or edge region. In the illustrated embodiment, the first mirror assembly 360 is disposed over a left edge 361 of the inspection plate 144, and the second mirror assembly 362 is disposed over an opposite right edge 363 of the inspection plate 144. The first mirror assembly 360 includes a first mirror 372 supported at each end by a mirror mounts 374a and 374b, which in turn can be fixed to the housing 232 (Figure 2A). The first mirror 372 can be an elongate planar reflective surface (e.g., a rectangular surface) that is angled with respect to the inspection plate 144. For example, in the illustrated embodiment, the first mirror 372 is angled upwardly at an angle A1 of from about 115 degrees to about 155 degrees, or approximately 135 degrees with respect to the inspection plate 144 (Figure 3C). The upper scanner assembly 202 can be oriented such that the upper scanner 264 is positioned over the first mirror 372, and during imaging the upper scanner 264 can obtain an image of the first mirror 372. Due to the angled orientation of the first mirror 372, the image obtained via the upper scanner 264 includes a side view of the mobile phone 150 or other electronic device placed on the inspection plate 144.

**[0041]** The second mirror assembly 362 can be configured similarly to the first mirror assembly 360, and can accordingly include a second mirror 376 (e.g., an elongate planar reflective surface such as a rectangular surface) secured via mirror mounts 378a and 378b. However, the second mirror 376 can be angled downwardly with respect to the inspection plate at an angle A2 of from about 25 degrees to about 65 degrees, or approximately 45 degrees. The lower scanner assembly 204 can be oriented such that the lower scanner 266 is movably positioned under the second mirror 376 and configured to obtain an image of the second mirror 376 during imaging. Due to the

angled orientation of the second mirror 376, the image obtained by the lower scanner 266 includes a side view of the mobile phone 150 or other electronic device on the inspection plate 144. More specifically, the first mirror 372 can provide a view of a first side (e.g., the left side) of a mobile phone 150 and the second mirror 376 can provide a view of a second, opposite side (e.g., the right side) of the mobile phone 150.

**[0042]** In the illustrated embodiment, as shown in Figure 3C, the upper scanner 264 and the lower scanner 266 can be laterally offset from one another by a distance D along the x-axis, such that the upper scanner 264 does not image the second mirror 376 and the lower scanner 266 does not image the first mirror 372. The distance D can be between from about 0.25 inches to about 5 inches, or from about 0.5 inch to about 3 inches, or about 1 inch. This offset can advantageously minimize wasted imaging area, since views of the back sides of the first mirror 372 and the second mirror 376 would not be useful for evaluating a mobile phone or other electronic device.

**[0043]** In other embodiments, the mirrors 372 and 376 can have other positions and angular orientations. For example, in some embodiments, the first and second mirror assemblies 360 and 362 can be disposed in other positions over the inspection plate, for example over forward and rearward edges. In some embodiments, the mirrors 372 and 376 can be curved, or can include other optical elements such as lenses, lenslet arrays, prisms, etc. In some embodiments, the mirrors can be omitted altogether, while in still other embodiments there may be fewer or more mirrors (e.g., three, four, five or more mirrors).

**[0044]** Figure 4A is an upper isometric view of the upper scanner assembly 202, and Figures 4B and 4C are partially exploded isometric and side views, respectively, of the upper scanner assembly 202. Figure 4D is a lower isometric view of the upper scanner assembly 202, illustrating the lower surface of the scanner assembly 202. The lower scanner assembly 204 can be at least generally similar in structure and function to the upper scanner assembly 202 described herein. More specifically, both scanner assemblies 202 and 204 can have the same or similar housings, drive motors, belts, guide rails, light bar mounts, light bars, and/or diffusers, etc. Referring to Figures 4A–4D together, the upper scanner 264 is movably coupled to the upper guide rail 256 by means of the coupling 353 and is configured to translate along its length in the y-

direction. The coupling 353 can include one or more linear bearings 410 that coaxially receive the upper guide rail 256 to facilitate smooth movement thereon. The upper scanner 264 additionally carries a drive motor 480 (e.g., an electric rotary or stepper motor) coupled to a first drive gear 482, and a guide roller 481. The upper belt 368 is fixed at each end and passes around the drive gear 482 and the guide roller 481 to provide an open belt drive system for moving the upper scanner 264 on the guide rail 256. The upper belt 368 can be a toothed belt and can be configured to engage with corresponding teeth on the drive gear 482 and the guide roller 481. In operation, the drive motor 480 rotates the drive gear 482 in a first direction to translate the upper scanner 264 in a first direction along the upper guide rail 256, and rotates the drive gear 482 in a second direction, opposite to the first direction, to translate the upper scanner 264 in a second, opposite direction along the upper guide rail 256. A tensioner 483 coupled to the upper belt 368 allows the tension in the upper belt 368 to be adjusted for efficient operation of the open belt drive system. The drive motor 480 can be in electrical communication with the imaging control electronics 206 (Figure 2B), which can control operation of the drive motor 480 to effect movement of the upper scanner 264 along the upper guide rail 256. In other embodiments the upper scanner 264 can be translated along the upper guide rail 256 using different actuation mechanisms, for example a closed belt drive, a pneumatic drive system, a lead screw linear actuator, or other suitable mechanism for translating the upper scanner 264.

**[0045]** The upper scanner 264 can house an imaging sensor 485 to obtain images as the upper scanner 264 translates along the upper guide rail 256. The imaging sensor can include, for example, charge-coupled device (CCD) or complementary metal-oxide semiconductor (CMOS) imaging sensors arranged in a linear array to capture images in successive lines extending parallel to the x-axis across the field of view 257 (Figure 3B). These lines can then be combined after the upper scanner 264 has swept along the upper guide rail 256 to produce a single scanned image of the inspection plate 144 and any electronic device or other object placed thereon.

**[0046]** As shown in Figures 4B–4D, a light bar mount 487 is fastened to a bottom surface of the upper scanner 264. The light bar mount 487 can be configured to support a plurality of light bars 484a–c on a lower surface thereof that are directed downwardly to project light toward the inspection plate 144. Electrical interconnections between the

light bars 484a–c and control electronics within the upper scanner 264 can be integrated into the light bar mount 487. In some embodiments, the light bars 484a–c can each be a linear array of a plurality of individual lighting elements, such as light-emitting diodes (LEDs). In other embodiments, the light bars 484a–c can include an edge light configured to provide light along the length of the respective bar 484a–c with accompanying optics (e.g., facets) configured to redirect propagating light outwardly along an edge of the respective light bar 484a–c.

**[0047]** In the illustrated embodiment, a diffuser 486 is disposed beneath the light bars 484a–c and attached to the light bar mount 487. The diffuser 486 can be made of translucent plastic or other material and can include diffusing or scattering elements that diffuse light from the light bars 484a–c for a more uniform illumination of the inspection plate 144 and a mobile phone or other electronic device to be imaged. An elongate imaging slot 488 is formed in a portion of the diffuser 486 and is configured to align with the imaging sensor 485 within the upper scanner 264. A corresponding imaging slot 490 is formed in the light bar mount 487, and the light bars 484a–c are arranged on either side of the imaging slot 488. In other embodiments, the diffuser 486 may be omitted, or one or more of the light bars 486a–c can have individual diffusers coupled thereto, thereby eliminating the need for a separate diffuser with an imaging slot formed therein.

**[0048]** In the illustrated embodiment, the light bars 484a–c are each elongate rectangular plates with a plurality of individual lighting elements disposed thereon. The light bars 484a–c are aligned parallel to the x-axis and parallel to the imaging sensor 485. The first light bar 484a and the second light bar 484b are disposed such that the principal direction of emitted light is along the z-axis. The third light bar 484c is angled such that the principle direction of emitted light is angled relative to the z-axis. As shown in Figure 4C, for example, the third light bar 484c can be angled with respect to the z-axis at an angle of between 25 degrees and 65 degrees, or approximately 45 degrees. This angling permits light from the light bar 484c to be directed towards the object of interest despite the lateral spacing of the third light bar 484c further away from the imaging slots 488 and 490 than the first and second light bars 484a and 484b. In other embodiments, the first and second light bars 484a and 484b can be angled towards or away from the imaging slot 488. In some embodiments, the third light bar

484c can be oriented similarly to the first and second white light bars 484a and 484b, such that the principal direction of emitted light from the third light bar 484c is along the z-axis.

**[0049]** In operation, light from the light bars 484a–c is directed downwardly toward the inspection plate 144 and the object of interest to be scanned (e.g., a mobile phone). The light from each light bar 484a–c can extend the full width, or at least approximately the full width, of the inspection plate 144. The light bars 484a–c can be configured to produce various wavelength bands of emitted light. For example, in one embodiment the first light bar 484a and the second light bar 484b can each be white light bars configured to emit broad spectrum white light, and the third light bar 484c can be configured to emit infrared or near-infrared light. In other embodiments, the light bars 484a–c can be configured to provide different wavelength bands, for example red, green, blue, ultraviolet, or other wavelengths of light. As described in more detail below, images can be obtained using different combinations of the light bars 484a–c activated separately or in conjunction with each other. The variety of images obtained using different lighting configurations can enable visual inspection of a mobile phone 150 or other electronic device. The use of two different types of light sources can be advantageous as materials which look very similar under white light can appear different under infrared, and vice versa. Additionally, cracks, dents, scuffs, and other defects may be more visible under infrared light than white light, or vice versa.

**[0050]** During a scan of, e.g., a mobile phone, light from the light bars 484a–c passes through the diffuser 486 and reflects off the mobile phone 150 or other electronic device placed on the inspection plate 144. A portion of the reflected light passes through the imaging slot 488 in the diffuser 486 and through the aligned imaging slot 490 in the light bar mount 487 before being received by the imaging sensor 485. This process is repeated continuously for successive lines extending across the inspection plate 144 parallel to the x-axis until the entire imaging area has been captured by the imaging sensor as the upper scanner 264 sweeps across the inspection plate 144.

**[0051]** The Figures described herein and below include representative flow diagrams and other information that depict processes used in some embodiments of the present technology. These flow diagrams may not show all functions or exchanges of data, but

instead they provide an understanding of commands and data exchanged under the systems described herein. Those skilled in the relevant art will recognize that some functions or exchange of commands and data may be repeated, varied, omitted, or supplemented, and other (less important) aspects not shown may be readily implemented. Those skilled in the art will appreciate that the blocks shown in the flow diagrams discussed below may be altered in a variety of ways. For example, while processes or blocks are presented in a given order, alternative implementations may perform routines in a different order, and some processes or blocks may be rearranged, deleted, moved, added, subdivided, combined, and/or modified to provide alternative or sub-combinations. Each of these processes or blocks may be implemented in a variety of different ways. Also, although processes or blocks are at times shown as being performed in series, these processes or blocks may instead be performed or implemented in parallel, or may be performed at different times. The steps depicted in the flow diagrams and/or represented by other tables, formulas, etc. can themselves include a sequence of operations that need not be described herein. Those of ordinary skill in the art can create source code, microcode, program logic arrays and/or computer-readable instructions to implement the depicted steps and routines based on the flowcharts and the detailed description provided herein. The routines and portions thereof can be stored in non-volatile memory that forms part of a processor contained in the kiosk 100 or otherwise associated with the kiosk 100 (e.g., a remote processor operably connected to the kiosk 100 via a wired/wireless communication link, etc.), or they can be stored in removable media, such as disks, or hardwired or preprogrammed in chips, such as EEPROM semiconductor chips.

**[0052]** Figure 5 is a flow diagram of a routine 500 that can be performed by the kiosk 100 for purchasing devices, e.g., mobile phones and/or other electronic devices, from users in accordance with an embodiment of the present technology. The routine can be executed by a processing device (e.g., a kiosk CPU) in accordance with computer-executable instructions stored on memory. In step or block 502, the routine receives the device from the user (e.g., in the inspection area 108 of the kiosk 100 (Figures 1A–1C)). In block 504, the routine performs an evaluation, e.g., a visual and/or electrical inspection of the device, to determine various information about the device that can affect the device value. The visual inspection can include visual inspection of the

electronic device via the device imaging system 130 described in detail above with reference to Figures 2A–4D. Information determined obtained from the visual and/or electrical inspection can include, for example, the make, model, and/or sub-model of the device; the device features (e.g., memory size, cell service carrier, etc.); device operability; device charge and/or rechargeability; physical condition; display function and condition; etc.

**[0053]** After the device has been evaluated, the routine proceeds to block 506 to determine a price to offer the user for the device. In block 508, the routine presents the offer to the user (via, e.g., a textual message on the display screen 104, an audio speaker, etc.). In decision block 510, the routine determines if the user has accepted the offer price (by, e.g., providing input via a touch screen, key pad, microphone, etc. operably coupled to the kiosk 100). If the user declines the offer, the routine proceeds to block 512 and returns the device to the user. Conversely, if the user accepts the offer, the routine proceeds to block 514 and provides remuneration to the user in the amount of the purchase price. Such remuneration or payment can be in the form of, e.g., cash, a voucher redeemable for cash, merchandise, services, etc., electronic value (e.g., bitcoin, e-certificates, credit to electronic payment account, etc.), credit (e.g., a prepaid credit card, debit card, gift card, etc.), coupons, loyalty points, and/or other forms of value. In block 516, the routine retains the device (e.g., in the collection bin 134 of the kiosk 100) and the routine ends.

**[0054]** Figure 6 is a flow diagram of a routine 600 for the visual inspection of an electronic device, such as a mobile phone 150 in accordance with an embodiment of the present technology with the device imaging system 130 described in detail above. The routine 600 can be performed with a single scanner or with multiple scanners. The routine can be executed by a processing device (e.g., the imaging control electronics 206 and/or a kiosk CPU) in accordance with computer-executable instructions stored on memory. The routine 600 can be performed as a portion of block 504 in the routine 500 of Figure 5.

**[0055]** Referring to Figure 6, in block 602 the routine receives the electronic device (e.g., mobile phone 150) on the inspection plate 144 (Figure 2A). In block 604, the inspection plate 144 is translated to position the electronic device with respect to the

scanner field of view 257 (Figure 3A). For example, in one embodiment the inspection plate 144 is translated to position the mobile phone 150 between the upper scanner assembly 202 and the lower scanner assembly 204 as shown in Figures 3A–3C. In block 606, the routine initiates the scanner assembly light source configuration.

**[0056]** As noted above, the scanner assembly 202 can include a plurality of light sources such as light bars 484a–c. In some embodiments, the light bars 484a–c can include a first white light bar (e.g., the first light bar 484a), a second white light bar (e.g., the second light bar 484b), and an infrared or near-infrared light bar (referred to herein as an infrared light bar) (e.g., the third light bar 484c. Additionally, in some embodiments backlighting for one scanner assembly can be provided by the other scanner assembly. For example, white light bars on the lower scanner assembly 204 can provide backlight for an image obtained via the upper scanner assembly 202 while the lights on the upper scanner are off. In this embodiment, the lower scanner 266 can be positioned slightly in front of or slightly behind the upper scanner 264 (e.g., approximately 1 inch in front or approximately 1 inch behind) so that the light from the lower scanner 266 does not blind the imaging sensor 485 in the upper scanner 264 (e.g., light emitted from the lower scanner 266 is not directly aligned with the imaging sensor 485 in the upper scanner 264) as the scanner assemblies move in unison relative to the electronic device. The backlit image obtained via the upper scanner 264 can produce a silhouette-like image, which can be useful for determining dimensions of the mobile phone 150 and other visual information for evaluation.

**[0057]** The scanner can have various different initial light source configurations, including: a first white light bar alone, a second white light bar alone, both the first and second white light bar together, an infrared light bar alone, either or both white light bars together with the infrared light bar, an image with no light bars activated, and backlighting provided by the opposing scanner, etc. For each light source configuration, the scanner can take a separate image (e.g., by translating the scanner 264 across the scanner field of view 257 and capturing image data with the image sensor 458). As described in more detail below, these various different lighting configurations can provide different benefits and advantages for use in visual inspection and evaluation of an electronic device.

**[0058]** The routine continues in block 608 by translating the scanner (e.g., the upper scanner 264) with respect to the electronic device to obtain images. As described above, an open belt drive utilizing a rotary motor can be used to effect translation of the scanner 264 along the upper guide rail 268 in the x-direction. As the scanner 264 translates, the imaging sensor 485 housed within the scanner 264 can obtain one or more images of the inspection plate and the electronic device placed thereon. In block 610, the routine analyzes the obtained image or images. As described in more detail below, the one or more images can be analyzed by further image processing techniques, including combining, subtracting, averaging, or other techniques. The analysis can identify, e.g., the make and model of the device, as well as identify any defects (e.g., cracks, scuffs, missing buttons, etc.), and/or identify fraudulent devices (e.g., devices with false display screens).

**[0059]** Figure 7 is a flow diagram of a routine 700 for visual inspection of an electronic device, such as a mobile phone 150 in accordance with another embodiment of the present technology. The routine 700 can be performed using a single scanner (e.g., upper scanner 264) or using two scanners (e.g., the upper and lower scanners 264 and 266). The routine 700 begins in block 702 by imaging the electronic device with a scanner (e.g., the upper scanner 264) using a first white light bar (e.g., the first light bar 484a). As described above, “imaging” with the scanner includes translating the scanner (e.g., the upper scanner 264) across a scanner field of view (e.g., the field of view 257) and capturing image data using the image sensor 458. After imaging with a particular light source configuration, the scanner can return to the initial position before proceeding with additional scans.

**[0060]** In block 704, the routine 700 images the electronic device with the scanner using a second white light bar (e.g., the second white light bar 484b). In block 706, the routine images the electronic device with the scanner using both the first and second white light bars simultaneously (e.g., with both the first light bar 484a and the second light bar 484b illuminated simultaneously). Next, in block 708 the device is imaged using an infrared light bar (e.g., the third light bar 484c). In block 712, the electronic device is imaged with the scanner using backlighting. For example, white light bars (e.g., the first light bar 484a and/or the second white light bar 484b) on the lower scanner 266 can provide backlight for an image obtained via the upper scanner 264. As

noted above, the lower scanner 266 can sweep slightly in front of or slightly behind the upper scanner 264 with the two scanners moving in unison so that the light from the lower scanner 266 does not blind the image sensor 458 in the upper scanner 264. The routine 700 continues in block 712 by obtaining an image the electronic device with the scanner (e.g., upper scanner 264) without any lights illuminating the electronic device. The routine 700 proceeds in block 714 by analyzing the obtained images.

**[0061]** The routine 700 is but one routine for scanning an electronic device with the device imaging system 130. For example, in other embodiments an electronic device can be scanned using only a single pass with white light, or for example by scanning only to obtain an upper view without obtaining a bottom view from a separate scan. In other embodiments, the light sources can take other forms, for example using light bars or other light sources with varying wavelength bands, for example red, green, blue, ultraviolet, or other wavelengths of light. The use of different types of light sources can be advantageous, for example as materials which look very similar under white light can appear different under infrared, and vice versa. Additionally, cracks, dents, scuffs, and other defects may be more visible under infrared light than white light, or vice versa.

**[0062]** Figures 8–11 are flow diagrams of routines for analyzing images obtained with the imaging system 130 (e.g., the images obtained via the routine 700) in accordance with embodiments of the present technology. In some embodiments, the imaging control electronics 206 can perform these routines, while in other embodiments the routines can be performed by or in combination with other processing components, such as the kiosk CPU. Figure 8 is a flow diagram of a routine 800 for performing the image analysis of block 714. The routine 800 begins in block 802 by comparing the first white light bar image (e.g., an image obtained with the scanner 264 using the first light bar 484a) and the second white light bar image (e.g., an image obtained with the scanner 264 using the second light bar 484b). Since the first and second white light bars 484a and 484b are disposed on opposite sides of the imaging slots 488 and 490 (Figure 4D), reflections on the mobile phone 150 from the first and second white light bars 484a and 484b will present differently. For example, a particular region of the mobile phone 150 may provide a strong reflection when imaged using the first white light bar 484a, while an image obtained with the second white light bar 484b may have

a much lower reflection in that region since the two light bars 484a and 484b are disposed at different positions with respect to the imaging slot 488. These reflections can also be rotation dependent, so that the orientation of the mobile phone 150 with respect to the scanner assembly can affect how the reflections appear on the scanned images. In some embodiments, the first white light bar image and the second white light bar image can be compared to determine the brightest pixel or region of pixels between each of the images for each location on the mobile phone 150.

**[0063]** The routine 800 continues in block 804 by synthesizing the first white light bar image and the second white light bar image. For example, in some embodiments the first white light bar image and the second white light bar image can be averaged to reduce the intensity of any particularly bright reflections and to increase the intensity in any particularly dim or dark regions of the mobile phone image. In some embodiments, the images can be averaged using standard image processing techniques known to those of skill in the art, for example using image stacking or other suitable technique. In other embodiments, the images can be synthesized by selecting the highest intensity for each pixel or group of pixels of the two images for each location on the mobile phone, thereby creating a high-contrast image. In other embodiments, the images can be synthesized by selecting the lowest intensity for each pixel or group of pixels of the two images for each location, thereby creating an image of the mobile phone in which the reflections are removed or at least reduced.

**[0064]** In some embodiments, mechanical damage such as cracks, dents, or scuffs in the mobile phone 150 can be detected best when the images are combined for maximum contrast because the heightened contrast increases visibility of light reflected from such aberrations. Other types of damage may be seen better with only one of the images, for example a small dent or scratch or crack may be better seen with one light bar, but light from the other light bar may fill in the crack or dent so that it is more difficult to detect. For phone rotation variance, the reflections can be reduced by subtraction (e.g., by preserving lowest valued pixels between each scan). For example, if the user puts the mobile phone 150 on the inspection plate 144 at a rotated angle relative to, e.g., the y-axis, it may be desirable to minimize reflections in the synthesized image because those reflections change with the angle at which the mobile phone 150 is placed. As such, an image in which reflections have been subtracted by preserving

the lowest valued pixels between each scan may be preferable in some circumstances. In other embodiments, it can be advantageous to balance the synthesized image without too many reflections or too few reflections (e.g., because the reflection can serve as a unique signature of the mobile phone 150 that can help with identification), then the first white light bar image and the second white light bar image can be averaged as noted above. The routine 800 continues in block 806 by analyzing the synthesized image, for example to identify the make and/or model of the device, to detect any cracks, dents, scuffs or other defects, and/or to detect broken screens or fraudulent devices with nonfunctional displays. For example, the synthesized image can be compared to trained images in a database to compare dimensions, particular identifiable features (e.g., screen size, home button, etc.), reflection signatures, etc.

**[0065]** Figure 9 is a flow diagram of another routine 900 for performing the image analysis of block 714 in accordance with another embodiment of the present technology. The routine 900 begins in block 902 by comparing the infrared image with images from a database of trained devices. For example, a database associated with the imaging system 130 and/or accessible by the kiosk CPU can store a plurality of images of different devices obtained using an infrared light source. The infrared image of the mobile phone 150 can be compared with these database images to compare dimensions of the mobile phone 150 with known trained devices, as well as to compare various other signatures such as intensity in different regions of the device under infrared light.

**[0066]** The routine 900 continues in block 904 by comparing a white light image with images from a database of trained devices. For example, the database can store a plurality of images of different devices obtained using a white light source or multiple white light sources. The white light image of the mobile phone 150 can be compared to these database images to compare dimensions, intensity signatures in different regions of the mobile phone 150, and/or to identify other features (e.g., location of the home button, display size, volume buttons, etc.). The routine 900 continues in block 906 by identifying the device based on the comparisons. For example, a nearest neighbor match can be found in the database based on the comparisons in blocks 402 and 404 between the captured infrared and white light images of the mobile phone 150 and the white light and infrared images of trained devices stored in the database. The use of

two different types of light sources can be advantageous as materials which look very similar under white light can appear significantly different under infrared light, and vice versa.

**[0067]** In block 908, the routine 900 detects whether the mobile phone 150 is a fraud and/or has defects based on the comparisons of blocks 902 and 904. For example, fake screens (e.g., colored paper placed behind display glass to represent an activated LCD screen) may appear unusually dim or unusually bright under infrared light. Accordingly, by comparing the infrared image of the device with the infrared image of the trained device (which can be identified based on dimensions and other comparisons), the routine 900 can determine whether the screen is unusually bright or dim under infrared light, indicating a fraudulent device. Similarly, cracks, dents, scuffs, and other defects may be more visible under infrared light than white light, or vice versa. By comparing both sets of images to images of trained devices, such defects can be detected.

**[0068]** Figure 10 is a flow diagram of a routine 1000 for performing the image analysis of block 714 in accordance with another embodiment of the present technology. The routine 1000 begins in block 1002 by subtracting the no light image (e.g., an image of the subject electronic device obtained using the scanner with no light bars activated) from the white light image (e.g., an image of the device obtained using the scanner with one or both of the white light bars activated). The no light image may generally be dark except for any light coming from the screen or other light sources on the device (e.g., a notification indicator light). By subtracting the no light image from the white light image, the resulting image provides a white light image in which the screen and notification lights are not illuminated. For example, the initial white light image of the mobile phone 150 might include an activated screen. The image obtained with no lights will only show the activated screen. By subtracting the image obtained with no lights (showing the activated screen only) from the initial white light image (showing the entire mobile phone 150 including the activated screen), the resulting image shows the entire mobile phone 150 without the screen. This can approximate an image of the mobile phone 150 in which the screen is not activated. This subtraction can aid in identification and evaluation of the device, as it can provide for a more accurate comparison from one device to the next. For example, since different screen

configurations (e.g., different wallpaper, icons, etc.) can make otherwise identical phones appear markedly distinct, removing the screen from the image can improve comparison between devices because the devices can be compared by, e.g., the size, shape, and/or location of the display screen. The routine 1000 continues in block 1004 by analyzing the resulting image, for example, to identify the make and/or model of the device, to detect any cracks, dents, scuffs or other defects, and/or to detect broken screens or fraudulent devices with nonfunctional displays. For example, the resulting image can be compared to trained images in a database to compare dimensions, particular identifiable features (e.g., screen size, home button, etc.), reflection signatures, etc.

**[0069]** Figure 11 is a flow diagram of a routine 1100 for performing the image analysis of block 714 in accordance with another embodiment of the present technology. The routine 1100 begins in block 1102 by identifying a screen refresh rate from a scanned image (e.g., an image of the mobile phone 150 or other electronic device using the scanner 264 under any of the lighting conditions described herein). For example, for many mobile phones, the pattern presented on the display screen in a scanned image can indicate the refresh rate or the frequency of the pulsed width modulation of the screen, depending on the type of display screen. As used herein, the term “screen refresh rate” includes both actual screen refreshes and the frequency of the pulsed width modulation of the display light source or other scanned image artifacts that indicate the type of display screen technology. For example, scanned images of certain types of LCD screens may show lines on the screen due to the pulsed width modulation or screen refresh rate. Other types of LCD screens can use different technologies that do not present such artifacts in scanned images. Accordingly, these lines, or the absence of such lines, can be used to determine the screen refresh rate of the device. The routine 1100 continues in block 1104 by evaluating the screen refresh rate to identify the device and/or defect whether the device is a fraud. For example, the refresh rate or other artifacts present on the scanned image can aid in identifying the make and model of the mobile phone 150, and can also indicate the presence of a fake display screen or an aftermarket display screen which employs different display technology than the original device. In some embodiments, the detected screen refresh rate can be compared to a table of known screen refresh rates for different phones.

Accordingly, comparing the refresh rate of the imaged device with that of trained devices can aid in identifying the device and/or detecting whether the device is fraudulent.

**[0070]** The routines described above for analyzing the images obtained using the device imaging system 130 can be combined in various ways. For example, while processes or blocks are presented in a given order, alternative implementations may perform routines having steps, or employ systems having blocks in a different order, and some processes or blocks may be deleted, moved, added, subdivided, combined, and/or modified to provide alternative or sub-combinations. As indicated above with respect to Figure 5, visual and/or electrical inspection of the device (block 504) can be followed by determining a price (block 506) and presenting an offer to the customer (block 508).

**[0071]** The flow diagrams described herein (e.g., those described with reference to Figures 5–11) are representative flow diagrams that depict routines and processes used in some embodiments. These processes and routines can be executed by a processing device, such as a processor or CPU associated with the kiosk 100 (as described below with reference to, e.g., Figure 12) and/or the device imaging system 130, an associated server computer, wireless device, personal computer, etc. in accordance with computer-executable instructions stored on a computer-readable medium. In some embodiments, the routines disclosed herein can be performed by computing devices that are separate from a kiosk, for example a user's home computer, a mobile electronic device (e.g., smartphone or tablet), etc. Those skilled in the relevant art will appreciate that aspects of the invention can be practiced with other communications, data processing, or computer system configurations, including: Internet appliances, hand-held devices (including personal digital assistants (PDAs)), wearable computers, all manner of cellular or mobile phones (including Voice over IP (VoIP) phones), dumb terminals, media players, gaming devices, multi-processor systems, microprocessor-based or programmable consumer electronics, set-top boxes, network PCs, mini-computers, mainframe computers, and the like. Indeed, the terms "computer," "server," "host," "host system," and the like, are generally used interchangeably herein and refer to any of the above devices and systems, as well as any data processor. These flow diagrams may not show all functions or exchanges of

data, but instead they provide an understanding of commands and data exchanged under the system. Those skilled in the relevant art will recognize that some functions or exchange of commands and data may be repeated, varied, omitted, or supplemented, and other (less important) aspects not shown may be readily implemented. Each of these processes or blocks may be implemented in a variety of different ways. Also, while processes or blocks are at times shown as being performed in series, these processes or blocks may instead be performed or implemented in parallel, or may be performed at different times. Various steps depicted in the flow diagrams can be of a type well known in the art and can itself include a sequence of operations that need not be described herein. Those of ordinary skill in the art can create source code, microcode, program logic arrays or otherwise implement the inventions described herein based on the Figures and the detailed description provided herein. The routines described above can be stored in non-volatile memory, or in removable media, such as disks, or hardwired or preprogrammed in chips, such as EEPROM semiconductor chips.

**[0072]** Figure 12 provides a schematic representation of an architecture of the kiosk 100 in accordance with an embodiment of the present technology. In the illustrated embodiment, the kiosk 100 includes a suitable processor or central processing unit (“CPU”) 1200 that controls operation of the kiosk 100 in accordance with computer-readable instructions stored on system memory 1206. The CPU 1200, for example, can control performance of all or a portion of the various routines described herein with reference to, for example, Figures 5–11. The CPU 1200 may be any logic processing unit, such as one or more CPUs, digital signal processors (DSPs), application-specific integrated circuits (ASICs), etc. The CPU 1200 may be a single processing unit or multiple processing units in a device or distributed across multiple devices. The CPU 1200 is connected to the memory 1206 and may be coupled to other hardware devices, for example, with the use of a bus (e.g., a PCI Express or Serial ATA bus). The CPU 1200 can include, by way of example, a standard personal computer (“PC”) (e.g., a DELL OPTIPLEX 780 or 7010 PC) or other type of embedded computer running any suitable operating system, such as Linux, Windows, Android, iOS, MAC OS, or an embedded real-time operating system. In some embodiments, the CPU 1200 can be a small form factor PC with integrated hard disk drive (“HDD”) or solid-state drive (“SSD”)

and universal serial bus (“USB”) or other ports to communicate with the other components of the kiosk 100. In other embodiments, the CPU 1200 can include a microprocessor with a standalone motherboard that interfaces with a separate HDD. The memory 1206 can include read-only memory (ROM) and random access memory (RAM) or other storage devices, such as disk drives or SSDs, that store the executable applications, test software, databases and other software required to, for example, implement the various routines described herein (e.g., those described with reference to Figures 5–11), control kiosk components, process electronic device information and data (to, e.g., evaluate device make, model, condition, pricing, etc.), communicate and exchange data and information with remote computers and other devices, etc.

**[0073]** The CPU 1200 can provide information and instructions to kiosk users via the display screen 104 and/or an audio system (e.g., speakers 113). The CPU 1200 can also receive user inputs via, e.g., a touch screen 1208 associated with the display screen 104, a keypad with physical keys, and/or a microphone 1210. Additionally, the CPU 1200 can receive personal identification and/or biometric information associated with users via the ID reader 112, one or more of the external cameras 116, and/or the fingerprint reader 114. In some embodiments, the CPU 1200 can also receive information (such as user identification and/or account information) via a card reader 1212 (e.g., a debit, credit, or loyalty card reader having, e.g., a suitable magnetic stripe reader, optical reader, etc.). The CPU 1200 can also control operation of the label dispenser 110 and systems for providing remuneration to users, such as the cash dispenser 118 and/or a receipt or voucher printer and an associated dispenser 1220.

**[0074]** As noted above, the kiosk 100 additionally includes a number of electronic, optical and electromechanical devices for electrically, visually and/or physically analyzing electronic devices placed therein for recycling. Such systems can include the scanners 264 and 266 associated with the device imaging system 130 for visually inspecting electronic devices to, e.g., determine the external dimensions and condition, and one or more of the electrical connectors 242 (e.g., USB connectors) for, e.g., powering up electronic devices and performing electronic analyses. As noted above, the connectors 242 can be movably and interchangeably carried by the connector carrier 140 (Figures 2A–2D). The kiosk 100 further includes a plurality of mechanical components that are electronically actuated for carrying out the various functions of the

kiosk 100 during operation. The mechanical components 1218 can include, for example, the inspection area access door 106 and one or more of the movable components (e.g. the inspection plate 144, the scanner assemblies 202 and 204 of the device imaging system 130 etc.) operably disposed within the inspection area 108 (Figure 1B). The kiosk 100 further includes power 1202, which can include battery power and/or facility power for operation of the various electrical components associated with kiosk operation.

**[0075]** In the illustrated embodiment, the kiosk 100 further includes a network connection 1222 (e.g., a wired connection, such as an Ethernet port, cable modem, FireWire cable, Lightning connector, USB port, etc.) suitable for communication with, e.g., all manner of remote processing devices via a communication link 1250, and a wireless transceiver 1224 (e.g., including a Wi-Fi access point, Bluetooth transceiver, near-field communication (NFC) device, and/or wireless modem or cellular radio utilizing GSM, CDMA, 3G and/or 4G technologies) for data communications suitable for communication with, e.g., all manner of remote processing devices via the communication link 1250 and/or directly via, e.g., a wireless peer-to-peer connection. For example, the wireless transceiver 1224 can facilitate wireless communication with handheld devices, such as a mobile device 1230 (e.g., a smartphone) either in the proximity of the kiosk 100 or remote therefrom. By way of example only, in the illustrated embodiment the mobile device 1230 can include one or more features, applications and/or other elements commonly found in smartphones and other known mobile devices. For example, the mobile device 1230 can include a CPU and/or a graphics processing unit ("GPU") 1234 for executing computer readable instructions stored on memory 1236. In addition, the mobile device 1230 can include an internal power source or battery 1232, a dock connector 1246, a USB port 1248, a camera 1240, and/or well-known input devices, including, for example, a touch screen 1242, a keypad, etc. In many embodiments, the mobile device 1230 can also include a speaker 1244 for two-way communication and audio playback. In addition to the foregoing features, the mobile device 1230 can include a mobile operating system (OS) 1231 and/or a device wireless transceiver that may include one or more antennas 1238 for wirelessly communicating with, for example, other mobile devices, websites, and the kiosk 100. Such communication can be performed via, e.g., the communication link

1250 (which can include the Internet, public and private intranet, a local or extended Wi-Fi network, cell towers, the plain old telephone system (POTS), etc.), direct wireless communication, etc.

**[0076]** Unless described otherwise, the construction and operation of the various components shown in Figure 12 are of conventional design. As a result, such components need not be described in further detail herein, as they will be readily understood by those skilled in the relevant art. In other embodiments, the kiosk 100 and/or the mobile device 1230 can include other features that may be different from those described above. In still further embodiments, the kiosk 100 and/or the mobile device 1230 can include more or fewer features similar to those described above.

**[0077]** Figure 13 is a schematic diagram of a suitable network environment for implementing various aspects of an electronic device recycling system 1300 configured in accordance with embodiments of the present technology. In the illustrated embodiment, a plurality of the kiosks 100 (identified individually as kiosks 100a-100n) can exchange information with one or more remote computers (e.g., one or more server computers 1304) via the communication link 1250. Although the communication link 1250 can include a publically available network (e.g., the Internet with a web interface), a private communication link, such as an intranet or other network may also be used. Moreover, in various embodiments the individual kiosk 100 can be connected to a host computer (not shown) that facilitates the exchange of information between the kiosks 100 and remote computers, other kiosks, mobile devices, etc.

**[0078]** The server computer 1304 can perform many or all of the functions for receiving, routing and storing electronic messages, such as webpages, audio signals and electronic images necessary to implement the various electronic transactions described herein. For example, the server computer 1304 can retrieve and exchange web pages and other content with an associated database or databases 1306. In some embodiments, the database 1306 can include information related to mobile phones and/or other consumer electronic devices. Such information can include, for example, make, model, serial number, IMEI, MEID, carrier plan information, pricing information, owner information, etc., as well as dimensional information (size, shape, location of displays, ports, etc.) and other visual information (e.g., logo shapes, sizes, locations,

etc.) associated with known devices, such as particular device models, sub-models, etc. In various embodiments the server computer 1304 can also include a server engine 1308, a web page management component 1310, a content management component 1312, and a database management component 1314. The server engine 1308 can perform the basic processing and operating system level tasks associated with the various technologies described herein. The web page management component 1310 can handle creation and/or display and/or routing of web or other display pages. The content management component 1312 can handle many of the functions associated with the routines described herein. The database management component 1314 can perform various storage, retrieval and query tasks associated with the database 1306, and can store various information and data such as animation, graphics, visual and audio signals, etc. Those of ordinary skill in the art will appreciate that many of the routines and/or portions thereof and other functions and methods described above can be performed by the kiosk 100 (e.g., the processor 1200), the server computer 1304, or both.

**[0079]** In the illustrated embodiment, the kiosks 100 can also be operably connected to a plurality of other remote devices and systems via the communication link 1250. For example, the kiosks 100 can be operably connected to a plurality of user devices 1318 (e.g., personal computers, laptops, handheld devices, etc.) having associated browsers 1320. Similarly, as described above the kiosks 100 can each include wireless communication facilities for exchanging digital information with mobile devices, such as the mobile device 1230. The kiosks 100 and/or the server computer 1304 are also operably connectable to a series of remote computers for obtaining data and/or exchanging information with necessary service providers, financial institutions, device manufactures, authorities, government agencies, etc. For example, the kiosks 100 and the server computer 1304 can be operably connected to one or more cell carriers 1322, one or more device manufacturers 1324 (e.g., mobile phone manufacturers), one or more electronic payment or financial institutions 1328, one or more databases (e.g., the GSMA International Mobile Equipment Identity Database, etc.), and one or more computers and/or other remotely located or shared resources associated with cloud computing 1326. The financial institutions 1328 can include all manner of entity associated with conducting financial transactions, including banks, credit/debit card

facilities, online commerce facilities, online payment systems, virtual cash systems, money transfer systems, etc.

**[0080]** In addition to the foregoing, the kiosks 100 and the server computer 1304 can also be operably connected to a resale marketplace 1330 and a kiosk operator 1332. The resale marketplace 1330 represents a system of remote computers and/or services providers associated with the reselling of consumer electronic devices through both electronic and brick-and-mortar channels. Such entities and facilities can be associated with, for example, online auctions for reselling used electronic devices as well as for establishing market prices for such devices. The kiosk operator 1332 can be a central computer or system of computers for controlling all manner of operation of the network of kiosks 100. Such operations can include, for example, remote monitoring and facilitating of kiosk maintenance (e.g., remote testing of kiosk functionality, downloading operational software and updates, etc.), servicing (e.g., periodic replenishing of cash and other consumables), performance, etc. In addition, the kiosk operator 1332 can further include one or more display screens operably connected to cameras located at each of the kiosks 100 (e.g., one or more of the cameras 116 described above with reference to Figures 1A–1C). This remote viewing capability enables operator personnel to verify user identification and/or make other visual observations at the kiosks 100 in real-time during transactions, as described above with reference to Figures 1A–1C.

**[0081]** The foregoing description of the electronic device recycling system 1300 illustrates but one possible network system suitable for implementing the various technologies described herein. Accordingly, those of ordinary skill in the art will appreciate that other systems consistent with the present technology can omit one or more of the facilities described in reference to Figure 13 or may include one or more additional facilities not described in detail in Figure 13.

**[0082]** Those of ordinary skill in the art will appreciate that the routines and other functions and methods described above can be performed by various processing devices, such as the kiosk processor 1200 (Figure 12), the server computer 1304 (Figure 13), or both. The processes can be implemented as an application specific integrated circuit (ASIC), by a digital signal processing (DSP) integrated circuit, through

conventional programmed logic arrays or circuit elements. While many of the embodiments are shown and described as being implemented in hardware (e.g., one or more integrated circuits designed specifically for a task), such embodiments could equally be implemented in software and be performed by one or more processors. Such software can be stored on any suitable computer-readable medium, such as microcode stored in a semiconductor chip, on a computer-readable disk, or downloaded from a server and stored locally at a client.

**[0083]** The kiosks 100, mobile devices 1230, server computers 1304, user computers and/or other user devices 1318, etc. may include one or more central processing units or other logic-processing circuitry, memory, input devices (e.g., keyboards and pointing devices), output devices (e.g., display devices and printers), and storage devices (e.g., magnetic, solid state, fixed and floppy disk drives, optical disk drives, etc.). Such computer devices may include other program modules such as an operating system, one or more application programs (e.g., word processing or spread sheet applications), and the like. The user computers may include wireless computers, such as mobile phones, personal digital assistants (PDAs), palm-top computers, etc., which communicate with the Internet via a wireless link. The computers may be general-purpose devices that can be programmed to run various types of applications, or they may be single-purpose devices optimized or limited to a particular function or class of functions. Aspects of the invention may be practiced in a variety of other computing environments.

**[0084]** While the Internet is shown, a private network, such as an intranet may likewise be used herein. The network may have a client-server architecture, in which a computer is dedicated to serving other client computers, or it may have other architectures such as peer-to-peer, in which one or more computers serve simultaneously as servers and clients. A database or databases, coupled to the server computer(s), stores much of the web pages and content exchanged between the user computers. The server computer(s), including the database(s), may employ security measures to inhibit malicious attacks on the system and preserve the integrity of the messages and data stored therein (e.g., firewall systems, message encryption and/or authentication (e.g., using transport layer security (TLS) or secure socket layers (SSL)),

password protection schemes, encryption of stored data (e.g., using trusted computing hardware), and the like).

**[0085]** One skilled in the relevant art will appreciate that the concepts of the invention can be used in various environments other than location based or the Internet. In general, a display description may be in HTML, XML or WAP format, email format or any other format suitable for displaying information (including character/code-based formats, algorithm-based formats (e.g., vector generated), and bitmapped formats). Also, various communication channels, such as local area networks, wide area networks, or point-to-point dial-up connections, may be used instead of the Internet. The system may be conducted within a single computer environment, rather than a client/server environment. Also, the user computers may comprise any combination of hardware or software that interacts with the server computer, such as television-based systems and various other consumer products through which commercial or noncommercial transactions can be conducted. The various aspects of the invention described herein can be implemented in or for any e-mail environment.

**[0086]** Although not required, aspects of the invention are described in the general context of computer-executable instructions, such as routines executed by a general-purpose data processing device, e.g., a server computer, wireless device or personal computer. Those skilled in the relevant art will appreciate that aspects of the invention can be practiced with other communications, data processing, or computer system configurations, including Internet appliances, hand-held devices (including personal digital assistants (PDAs)), wearable computers, all manner of cellular or mobile phones (including Voice over IP (VoIP) phones), dumb terminals, media players, gaming devices, multi-processor systems, microprocessor-based or programmable consumer electronics, set-top boxes, network PCs, mini-computers, mainframe computers, and the like. Indeed, the terms "computer," "server," "host," "host system," and the like, are generally used interchangeably herein, and refer to any of the above devices and systems, as well as any data processor. Input devices may include a touchpad, keyboard and/or a pointing device such as a mouse. Other input devices are possible such as a microphone, joystick, pen, game pad, scanner, digital camera, video camera, and the like. The data storage devices may include any type of computer-readable media that can store data accessible by a computer, such as magnetic hard and floppy

disk drives, optical disk drives, magnetic cassettes, tape drives, flash memory cards, digital video disks (DVDs), Bernoulli cartridges, RAMs, ROMs, smart cards, etc. Indeed, any medium for storing or transmitting computer-readable instructions and data may be employed, including a connection port to a network such as a local area network (LAN), wide area network (WAN) or the Internet.

**[0087]** Aspects of the invention can be embodied in a special purpose computer or data processor that is specifically programmed, configured, or constructed to perform one or more of the computer-executable instructions explained in detail herein. While aspects of the invention, such as certain functions, are described as being performed exclusively on a single device, the invention can also be practiced in distributed environments where functions or modules are shared among disparate processing devices, which are linked through a communications network, such as a Local Area Network (LAN), Wide Area Network (WAN), or the Internet. In a distributed computing environment, program modules may be located in both local and remote memory storage devices.

**[0088]** Aspects of the invention may be stored or distributed on tangible computer-readable media, including magnetically or optically readable computer discs, hard-wired or preprogrammed chips (e.g., EEPROM semiconductor chips), nanotechnology memory, biological memory, or other data storage media. The data storage devices may include any type of computer-readable media that can store data accessible by a computer, such as magnetic hard and floppy disk drives, optical disk drives, magnetic cassettes, tape drives, flash memory cards, DVDs, Bernoulli cartridges, RAM, ROMs, smart cards, etc. Indeed, any medium for storing or transmitting computer-readable instructions and data may be employed, including a connection port to a network such as a LAN, WAN, or the Internet. Alternatively, computer implemented instructions, data structures, screen displays, and other data under aspects of the invention may be distributed over the Internet or over other networks (including wireless networks), on a propagated signal on a propagation medium (e.g., an electromagnetic wave(s), a sound wave, etc.) over a period of time, or they may be provided on any analog or digital network (packet switched, circuit switched, or other scheme). The terms “memory” and “computer-readable storage medium” include any combination of temporary, persistent, and/or permanent storage, e.g., ROM, writable memory such as RAM, writable non-

volatile memory such as flash memory, hard drives, solid state drives, removable media, and so forth, but do not include a propagating signal per se.

**[0089]** The above Detailed Description of examples and embodiments of the invention is not intended to be exhaustive or to limit the invention to the precise form disclosed above. While specific examples for the invention are described above for illustrative purposes, various equivalent modifications are possible within the scope of the invention, as those skilled in the relevant art will recognize. References throughout the foregoing description to features, advantages, or similar language do not imply that all of the features and advantages that may be realized with the present technology should be or are in any single embodiment of the invention. Rather, language referring to the features and advantages is understood to mean that a specific feature, advantage, or characteristic described in connection with an embodiment is included in at least one embodiment of the present technology. Thus, discussion of the features and advantages, and similar language, throughout this specification may, but do not necessarily, refer to the same embodiment. Furthermore, the described features, advantages, and characteristics of the present technology may be combined in any suitable manner in one or more embodiments. One skilled in the relevant art will recognize that the present technology can be practiced without one or more of the specific features or advantages of a particular embodiment. In other instances, additional features and advantages may be recognized in certain embodiments that may not be present in all embodiments of the present technology.

**[0090]** Any patents and applications and other references noted above, including any that may be listed in accompanying filing papers, are incorporated herein by reference. Aspects of the invention can be modified, if necessary, to employ the systems, functions, and concepts of the various references described above to provide yet further implementations of the invention.

**[0091]** Unless the context clearly requires otherwise, throughout the description and the claims, the words "comprise," "comprising," and the like, are to be construed in an inclusive sense, as opposed to an exclusive or exhaustive sense; that is to say, in the sense of "including, but not limited to." As used herein, the terms "connected," "coupled," or any variant thereof, means any connection or coupling, either direct or

indirect, between two or more elements; the coupling or connection between the elements can be physical, logical, or a combination thereof. Additionally, the words "herein," "above," "below," and words of similar import, when used in this application, refer to this application as a whole and not to any particular portions of this application. Where the context permits, words in the above Detailed Description using the singular or plural number may also include the plural or singular number respectively. The word "or," in reference to a list of two or more items, covers all of the following interpretations of the word: any of the items in the list, all of the items in the list, and any combination of the items in the list.

**[0092]** The teachings of the invention provided herein can be applied to other systems, not necessarily the system described above. The elements and acts of the various examples described above can be combined to provide further implementations of the invention. Some alternative implementations of the invention may include not only additional elements to those implementations noted above, but also may include fewer elements. Further any specific numbers noted herein are only examples—alternative implementations may employ differing values or ranges.

**[0093]** While the above description describes various embodiments of the invention and the best mode contemplated, regardless how detailed the above text, the invention can be practiced in many ways. Details of the system may vary considerably in its specific implementation, while still being encompassed by the present disclosure. As noted above, particular terminology used when describing certain features or aspects of the invention should not be taken to imply that the terminology is being redefined herein to be restricted to any specific characteristics, features, or aspects of the invention with which that terminology is associated. In general, the terms used in the following claims should not be construed to limit the invention to the specific examples disclosed in the specification, unless the above Detailed Description section explicitly defines such terms. Accordingly, the actual scope of the invention encompasses not only the disclosed examples, but also all equivalent ways of practicing or implementing the invention under the claims.

**[0094]** From the foregoing, it will be appreciated that specific embodiments of the invention have been described herein for purposes of illustration, but that various

modifications may be made without deviating from the spirit and scope of the various embodiments of the invention. Further, while various advantages associated with certain embodiments of the invention have been described above in the context of those embodiments, other embodiments may also exhibit such advantages, and not all embodiments need necessarily exhibit such advantages to fall within the scope of the invention. Accordingly, the invention is not limited, except as by the appended claims. Although certain aspects of the invention are presented below in certain claim forms, the applicant contemplates the various aspects of the invention in any number of claim forms. Accordingly, the applicant reserves the right to pursue additional claims after filing this application to pursue such additional claim forms, in either this application or in a continuing application.

## CLAIMS

I/We claim:

1. An apparatus for recycling consumer electronic devices, the apparatus comprising:
  - a housing configured to receive an electronic device; and
  - an imaging system positioned within the housing, wherein the imaging system includes—
    - a first scanner operably positioned to obtain a first image of the electronic device; and
    - a second scanner operably positioned to obtain a second image of the electronic device.
2. The apparatus of claim 1 wherein the first scanner is movably positioned on a first side of the electronic device, and wherein the second scanner is movably positioned on a second side of the electronic device, opposite to the first side.
3. The apparatus of claim 1 wherein the first scanner is movably positioned above the electronic device, and wherein the second scanner is movably positioned below the electronic device.
4. The apparatus of claim 1 wherein the first scanner is operably positioned to obtain an image of a front surface of the electronic device, and wherein the second scanner is operably positioned to obtain an image of a back surface of the electronic device.
5. The apparatus of claim 1 wherein the first scanner is configured to move horizontally relative to the electronic device to obtain the first image, and wherein the second scanner is configured to move horizontally relative to the electronic device to obtain the second image.

6. The apparatus of claim 1 wherein the first scanner and the second scanner move in unison to obtain the first and second images.

7. The apparatus of claim 1, further comprising:  
a processor operably coupled to the imaging system; and  
a non-transitory computer readable medium containing instructions that are executable by the processor to determine one or more physical attributes of the electronic device based at least in part on the first and second images of the electronic device.

8. The apparatus of claim 1 wherein the first scanner comprises:  
an imaging sensor;  
a light source; and  
an optical element configured to redirect light reflected from the electronic device toward the imaging sensor.

9. The apparatus of claim 8 wherein the light source comprises a white light source and an infrared light source.

10. The apparatus of claim 8 wherein the first scanner further comprises a diffuser disposed between the light source and the electronic device.

11. The apparatus of claim 8 wherein the second scanner comprises:  
a second imaging sensor;  
a second light source; and  
a second optical element configured to redirect light reflected from the electronic device towards the second imaging sensor.

12. The apparatus of claim 11 wherein the second light source comprises a second white light source and a second infrared light source.

13. The apparatus of claim 11 wherein the second scanner further comprises a diffuser disposed between the second movable light source and the electronic device.

14. The apparatus of claim 1, further comprising a mirror disposed between the first scanner and the second scanner, the mirror configured to redirect light from the first scanner laterally toward a portion of the electronic device to enable the first scanner to obtain an image of the portion of the electronic device,

wherein the first image includes the image of the portion of the electronic device.

15. The apparatus of claim 14 wherein the portion of the electronic device is a first side of the electronic device, and wherein the apparatus further comprises a second mirror disposed between the first scanner and the second scanner, the second mirror configured to redirect light from the second scanner laterally toward a second side of the electronic device to enable the second scanner to obtain an image of the second side of the electronic device.

16. The apparatus of claim 15 wherein the first and second mirrors are disposed on opposite sides of the electronic device.

17. The apparatus of claim 16 wherein the first mirror faces upwardly toward the first scanner and wherein the second mirror faces downwardly toward the second scanner.

18. The apparatus of claim 1 wherein the first scanner includes a first flatbed scanner, and wherein the second scanner comprises a second flatbed scanner.

19. A kiosk for recycling consumer electronic devices, the kiosk comprising:  
an inspection area configured to receive an electronic device therein;  
a flatbed scanner configured to obtain an image of the electronic device in the inspection area;  
a processor operably coupled to the flatbed scanner; and

a non-transitory computer readable medium having instructions stored therein that are executable by the processor to cause the flatbed scanner to obtain the image of the electronic device and to determine one or more physical attributes of the electronic device based at least in part on evaluation of the image.

20. The kiosk of claim 19 wherein the flatbed scanner is a first flatbed scanner, and wherein the kiosk further comprises a second flatbed scanner facing the first flatbed scanner, the second flatbed scanner configured to obtain a second image of the electronic device,

wherein the processor is operably coupled to the second flatbed scanner, and wherein the instructions further cause the second flatbed scanner to capture the second image of the electronic device and to determine one or more physical attributes of the electronic device based on evaluation of the second image.

21. The kiosk of claim 20 wherein the first and second flatbed scanners each comprises:

an imaging sensor;

a light source; and

an optical element configured to redirect light reflected from the electronic device towards the imaging sensor.

22. The kiosk of claim 21 wherein the light source comprises a white light source and an infrared light source.

23. The kiosk of claim 20, further comprising first and second mirrors disposed between the first flatbed scanner and the second flatbed scanner, the first mirror configured to redirect light from the first flatbed scanner laterally towards a first portion of the electronic device to enable the first flatbed scanner to obtain an image of the first portion of the electronic device, the second mirror configured to redirect light from the second flatbed scanner laterally toward a second portion of the electronic

device to enable the second flatbed scanner to obtain an image of the second portion of the electronic device.

24. The kiosk of claim 23 wherein the first and second mirrors are disposed on opposite sides of the electronic device.

25. A kiosk for recycling electronic devices, the kiosk comprising:  
means for receiving an electronic device from a user;  
means for scanning a first surface of the electronic device;  
means for scanning a second surface of the electronic device; and  
a processor for evaluating the first surface scan and the second surface scan  
and determining one or more physical attributes of the electronic device  
based at least in part on the evaluation.

26. The kiosk of claim 25 wherein the processor is configured to identify the electronic device based at least in part on the one or more physical attributes.

27. A method for recycling an electronic device, the method comprising:  
receiving the electronic device from a user in an inspection area of a machine;  
scanning the electronic device to obtain a scanned image; and  
determining one or more physical attributes of the electronic device based at  
least in part on an evaluation of the scanned image.

28. The method of claim 27, wherein scanning the electronic device to obtain a scanned image comprises scanning a first surface of the electronic device to obtain a first scanned image, and wherein the method further comprises scanning a second surface of the electronic device to obtain a second scanned image.

29. The method of claim 27, further comprising identifying the electronic device based at least in part on the determined physical attributes.

30. The method of claim 27, further comprising determining a value of the electronic device based at least in part on the determined physical attributes.

31. The method of claim 27 wherein scanning the electronic device comprises scanning the electronic device with a scanner using a white light source.

32. The method of claim 27 wherein scanning the electronic device comprises scanning the electronic device with a scanner using an infrared light source.

33. The method of claim 27 wherein determining one or more physical attributes includes at least one of: detecting a dimension of the electronic device, or detecting a damaged region of the electronic device,

34. The method of claim 27, further comprising  
receiving user input at the machine, wherein the user input is related to the  
electronic device;  
identifying the electronic device based at least in part on the one or more  
physical attributes; and  
authenticating the electronic device based on the user input and the identification  
of the device.

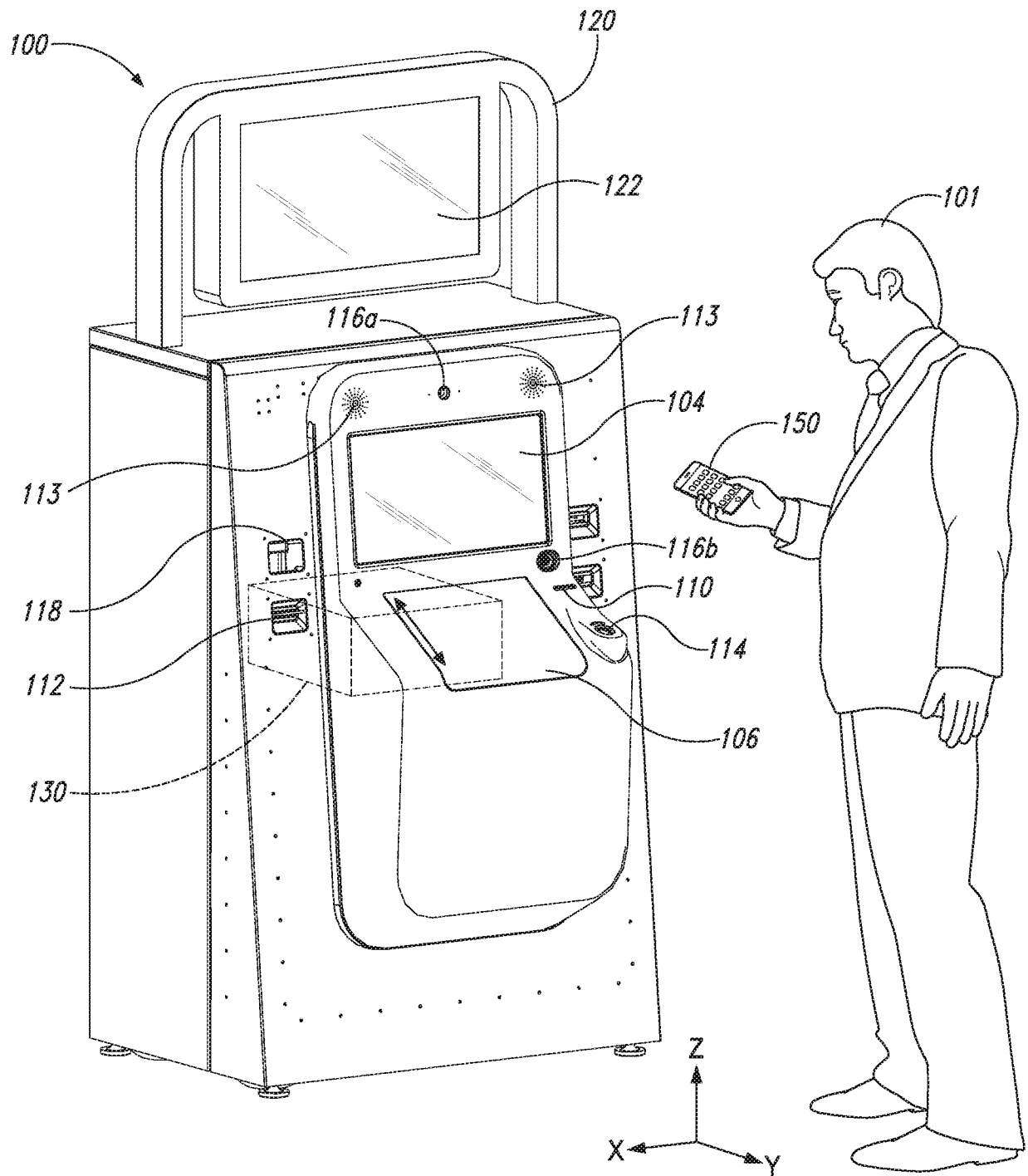
35. The method of claim 27 further comprising querying a database for information associated with the physical attributes to determine a make and/or model of the electronic device.

36. The method of claim 27 wherein scanning the electronic device comprises scanning the electronic device with an upper scanner using a backlit light source.

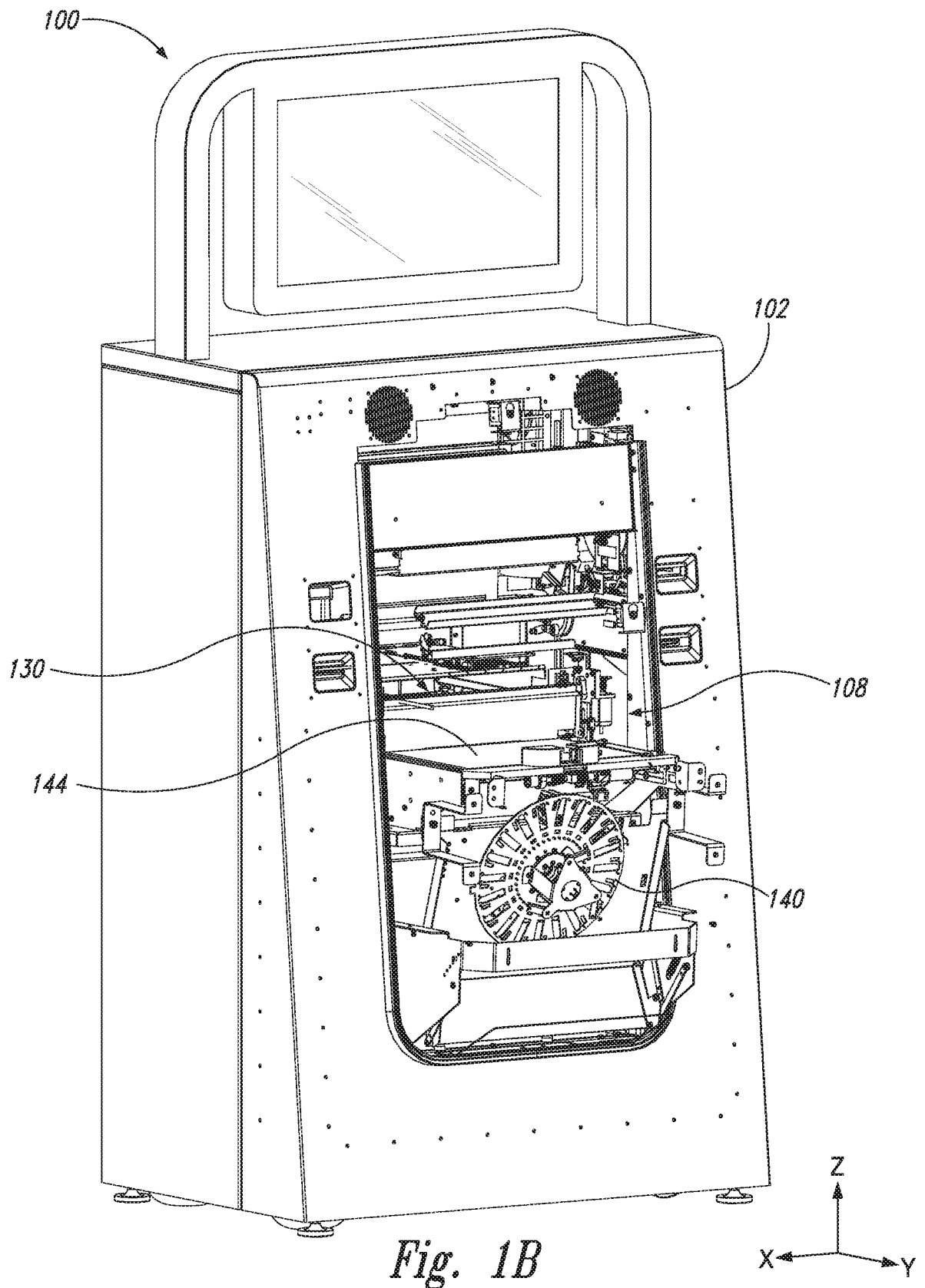
37. The method of claim 36 wherein the backlit light source is provided by a lower scanner.

38. The method of claim 37 wherein the lower scanner moves in conjunction with movement of the upper scanner to provide the backlit light source.

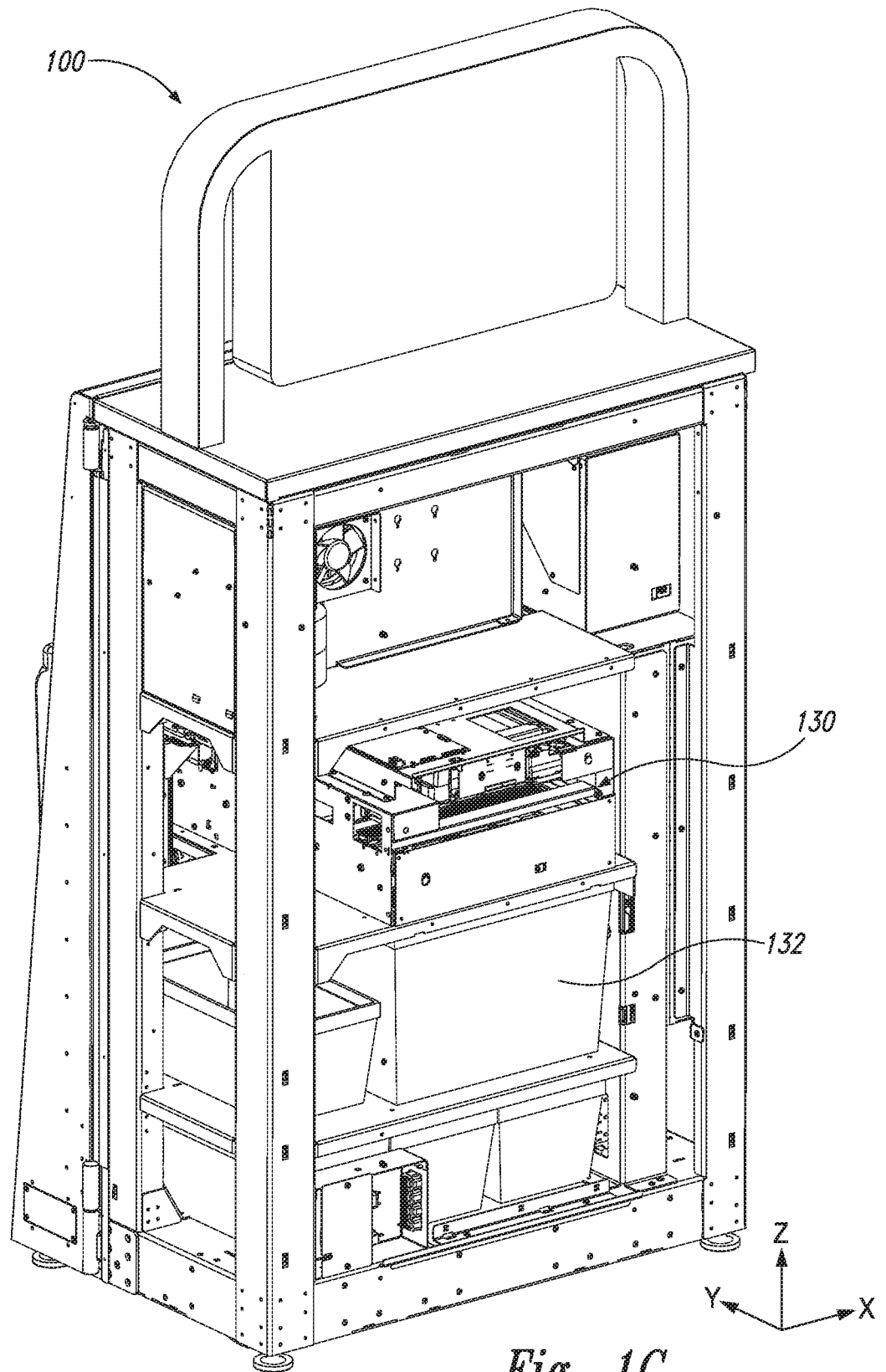
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*Fig. 1A*

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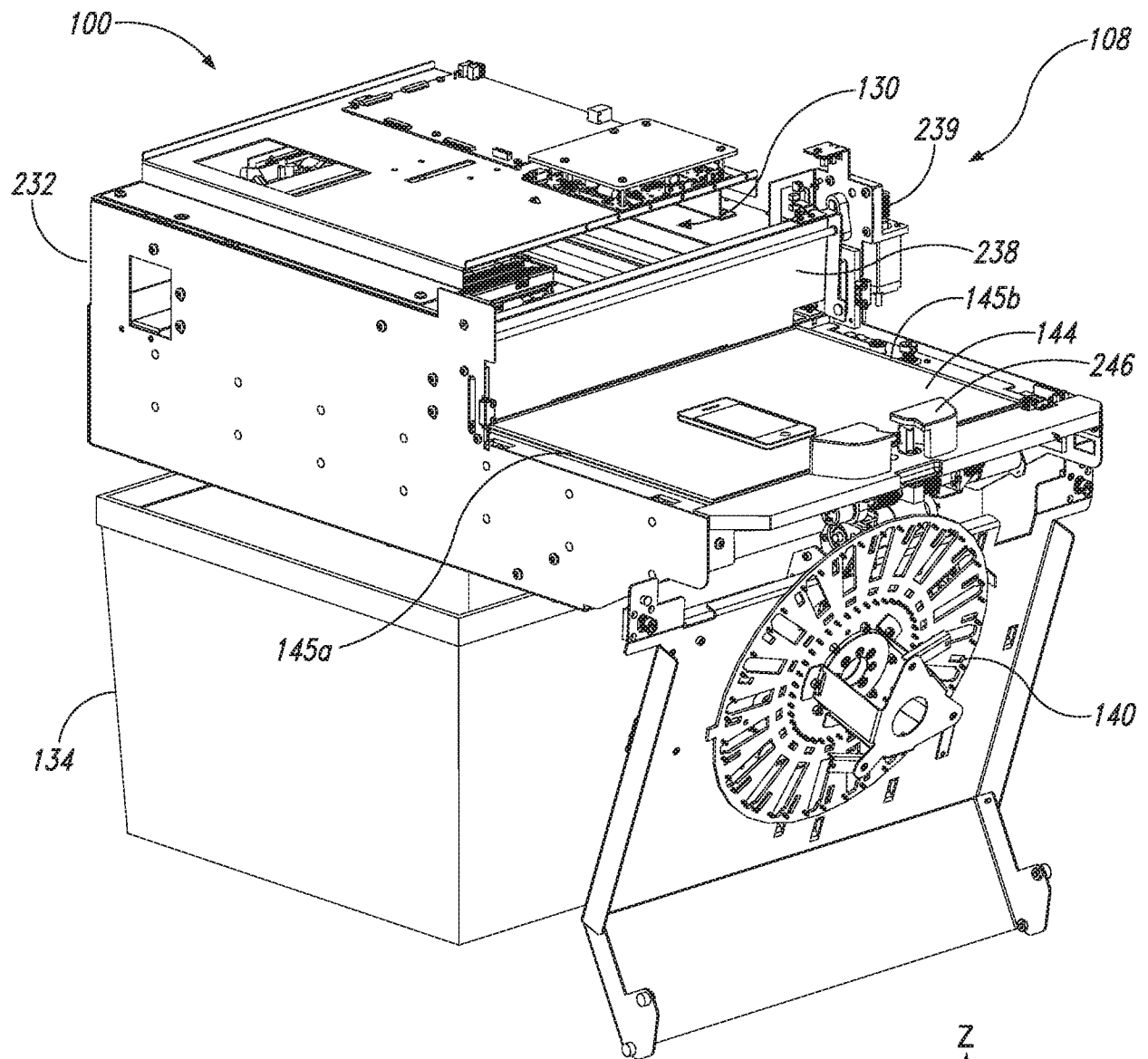


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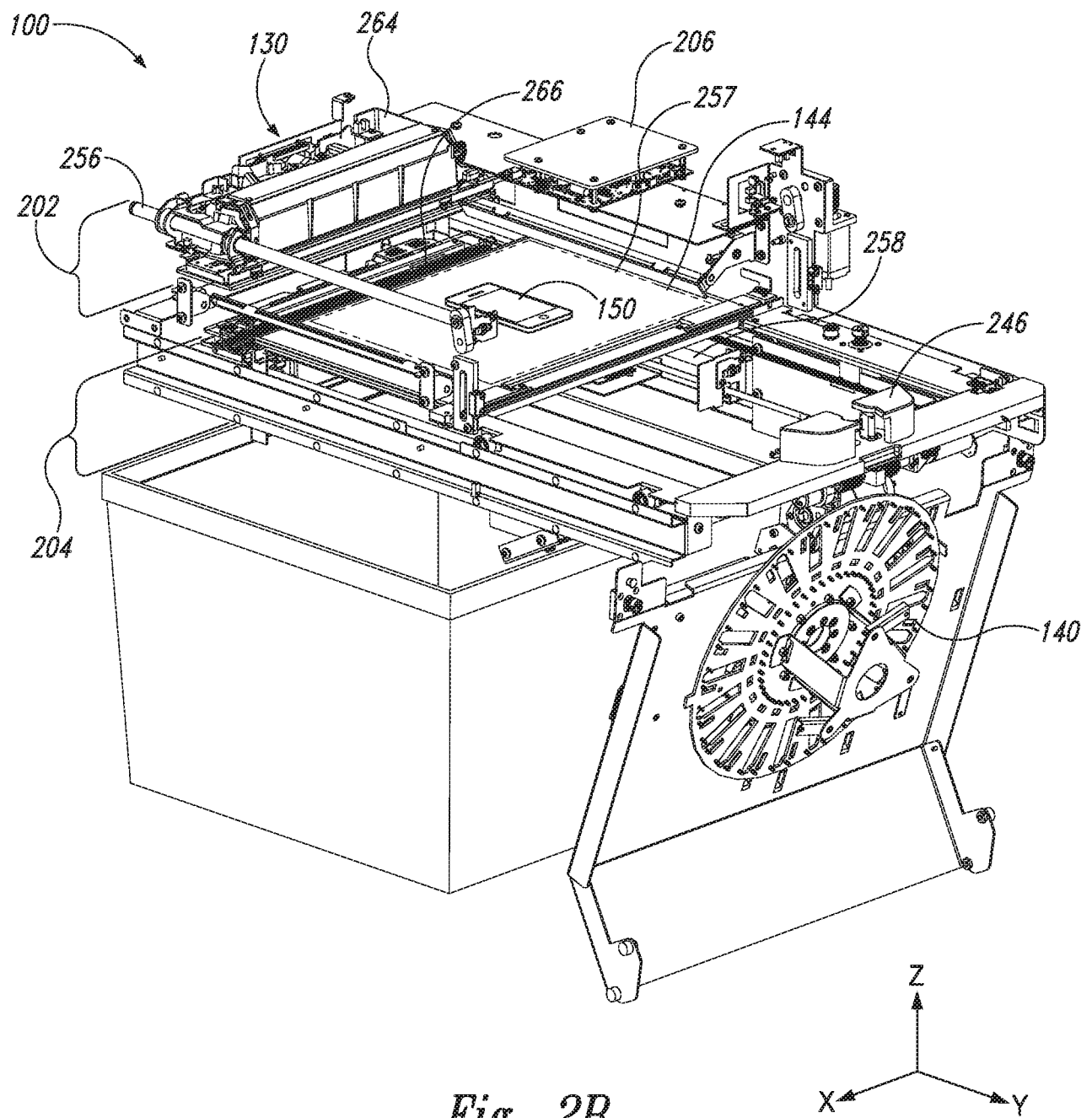
*Fig. 1C*

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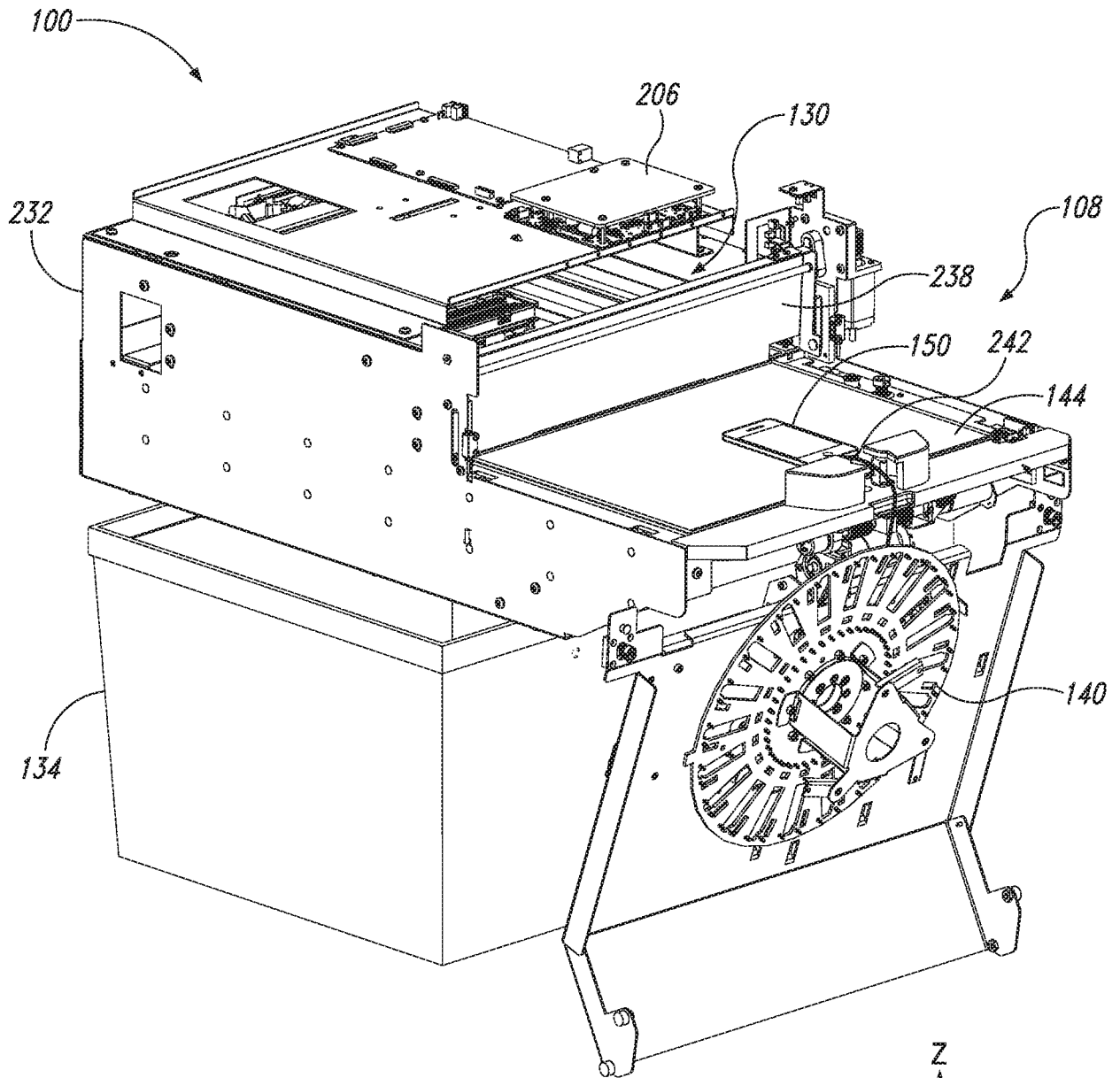


*Fig. 2A*

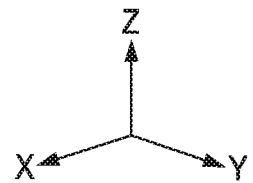
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*Fig. 2B*

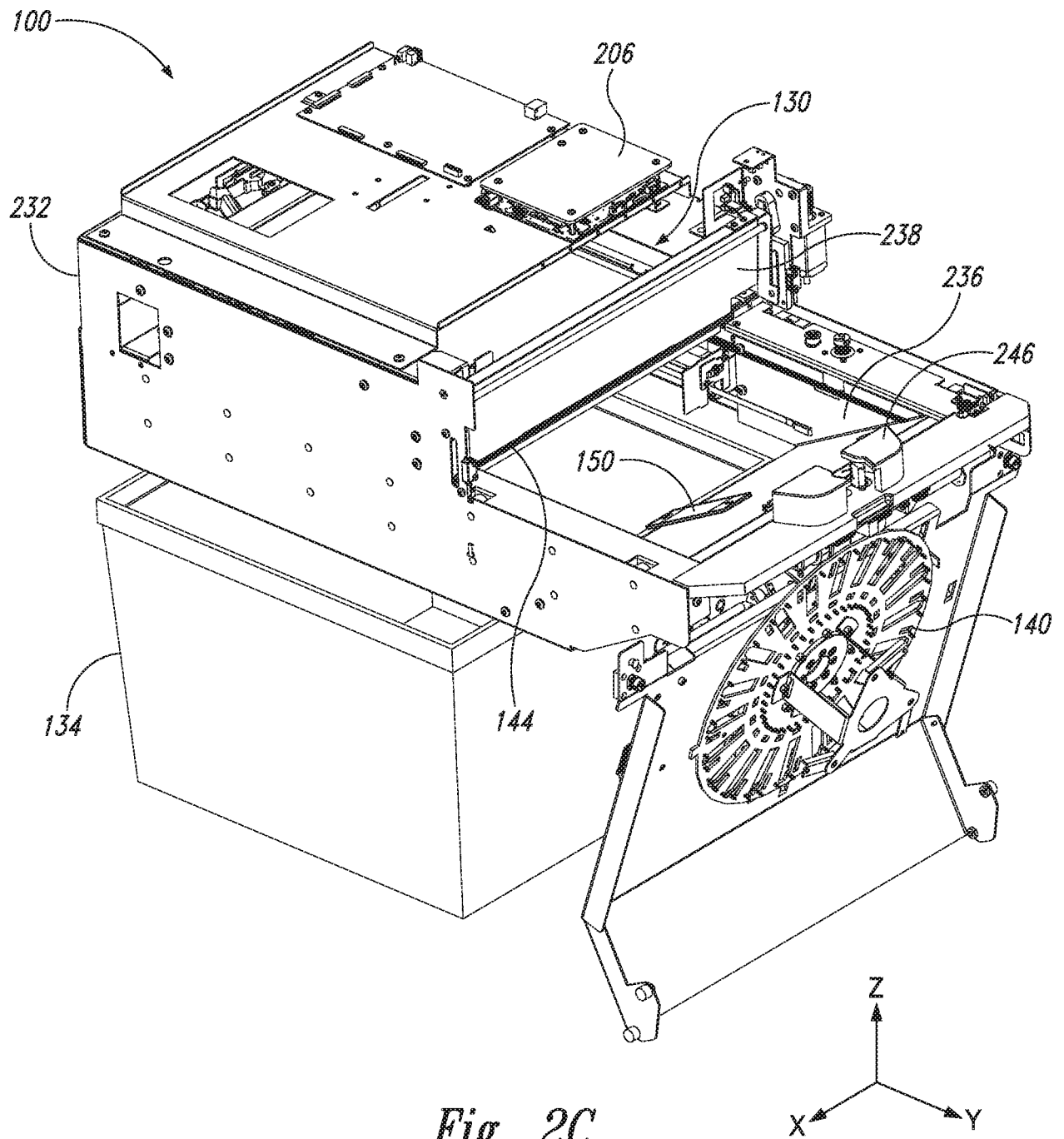
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*Fig. 2C*



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*Fig. 2C*

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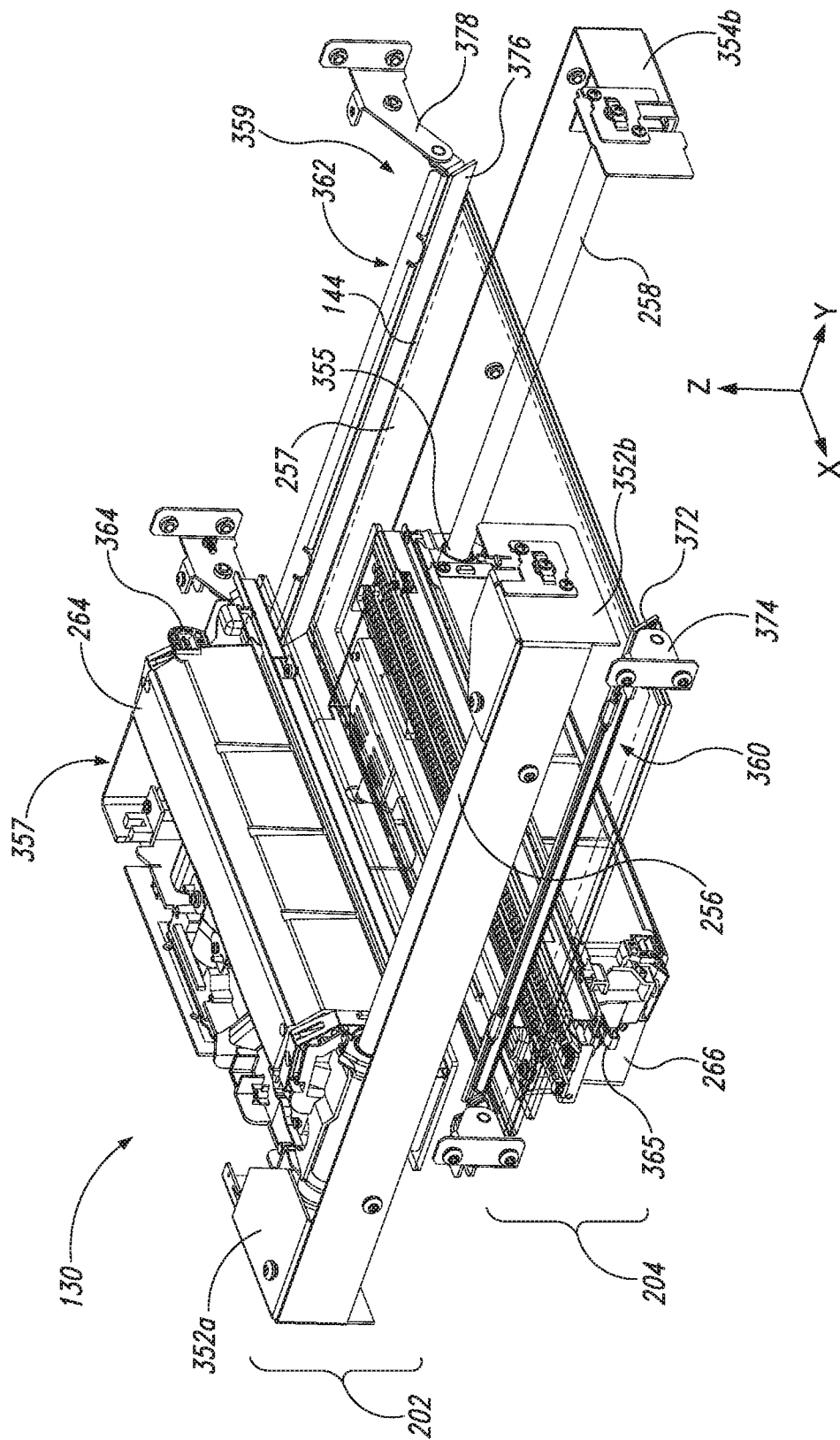
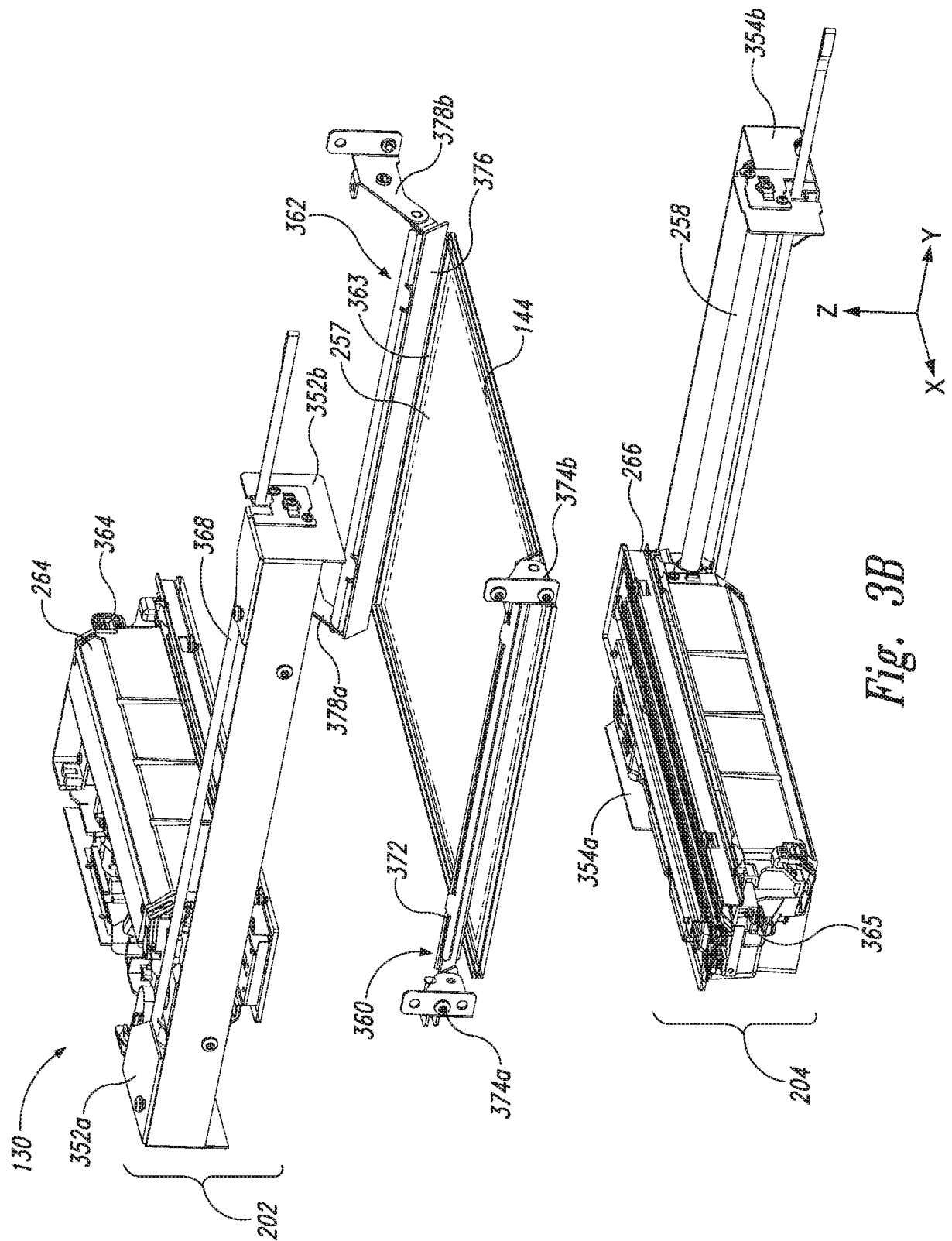
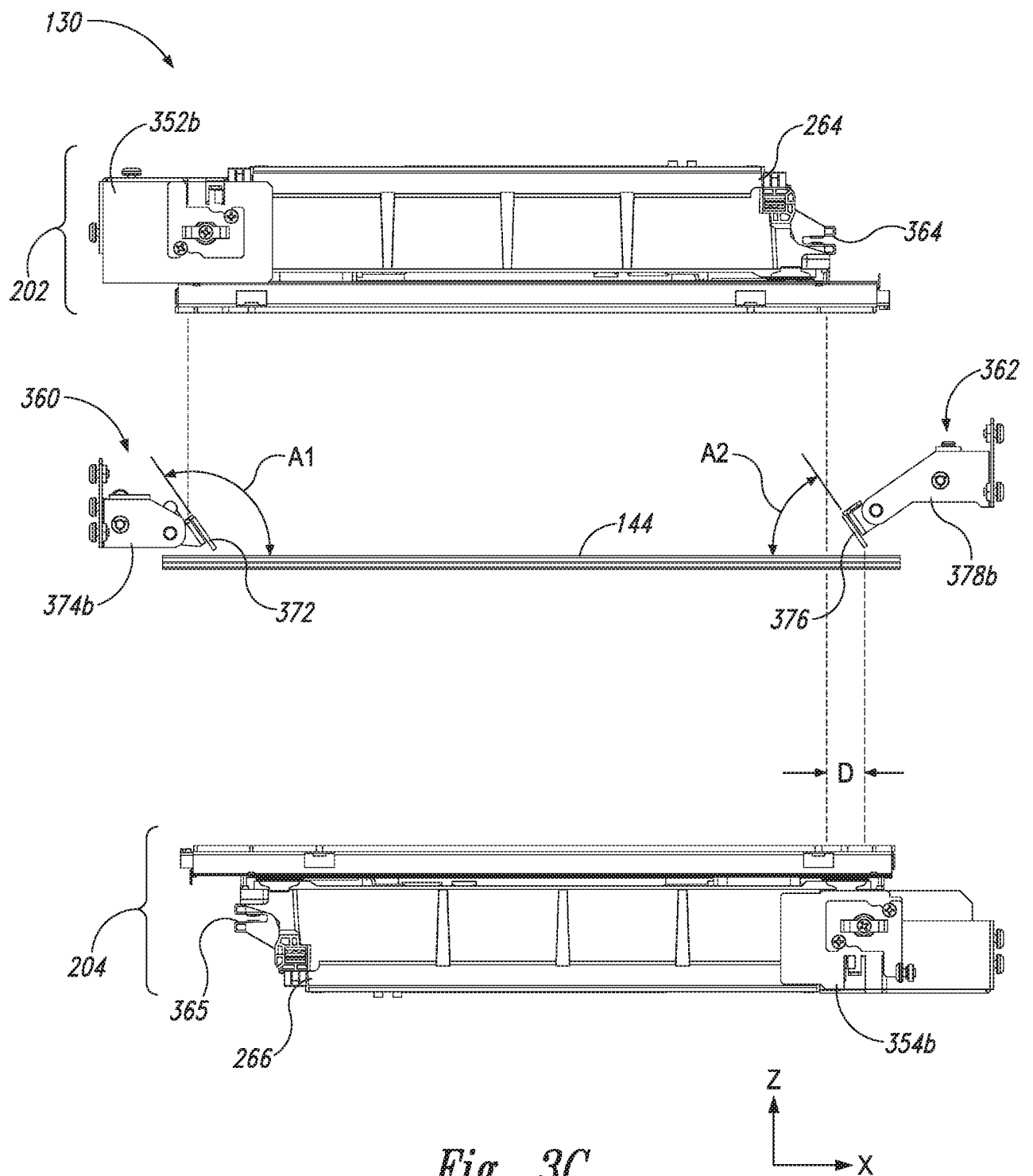


Fig. 3A

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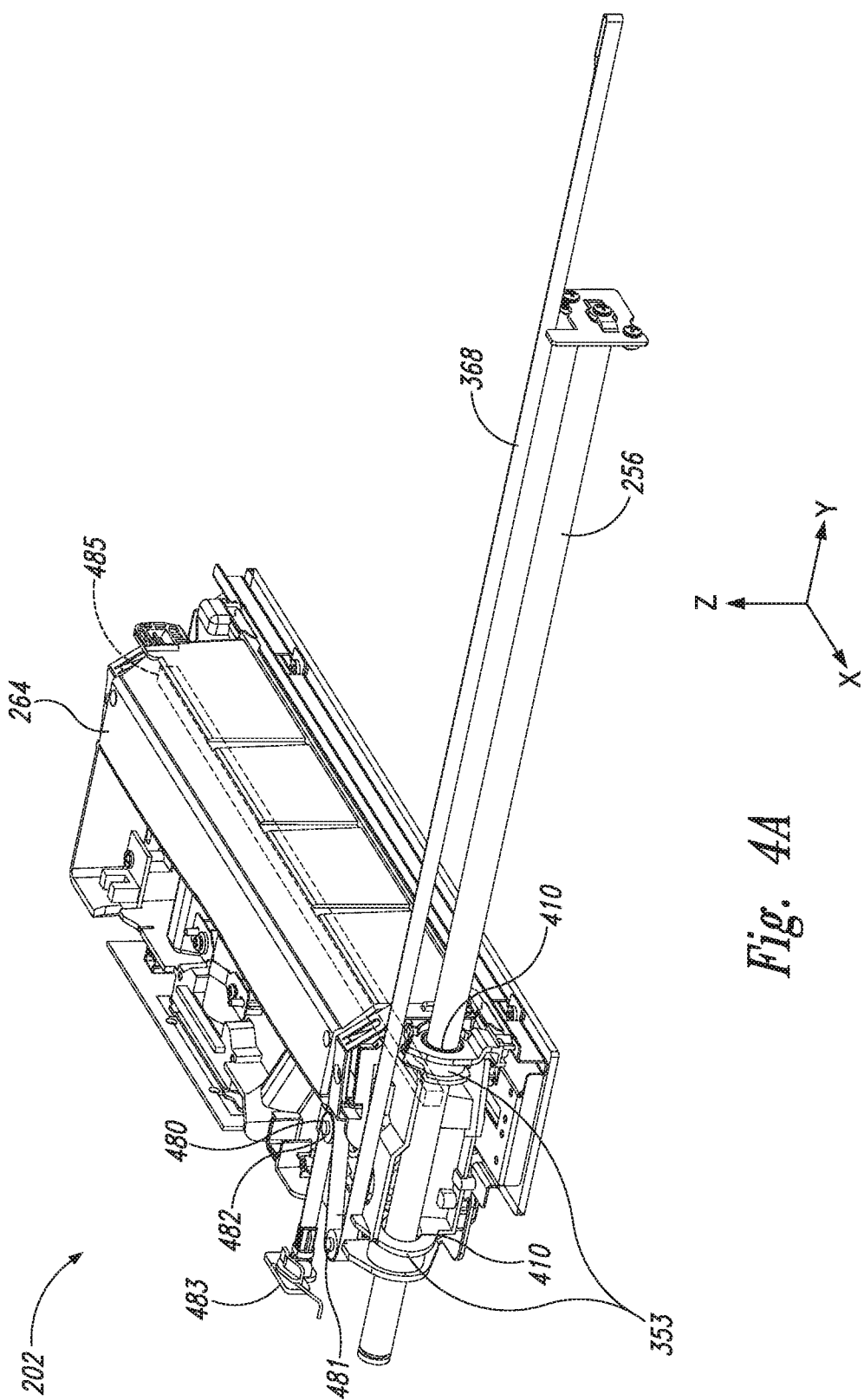


Fig. 4A

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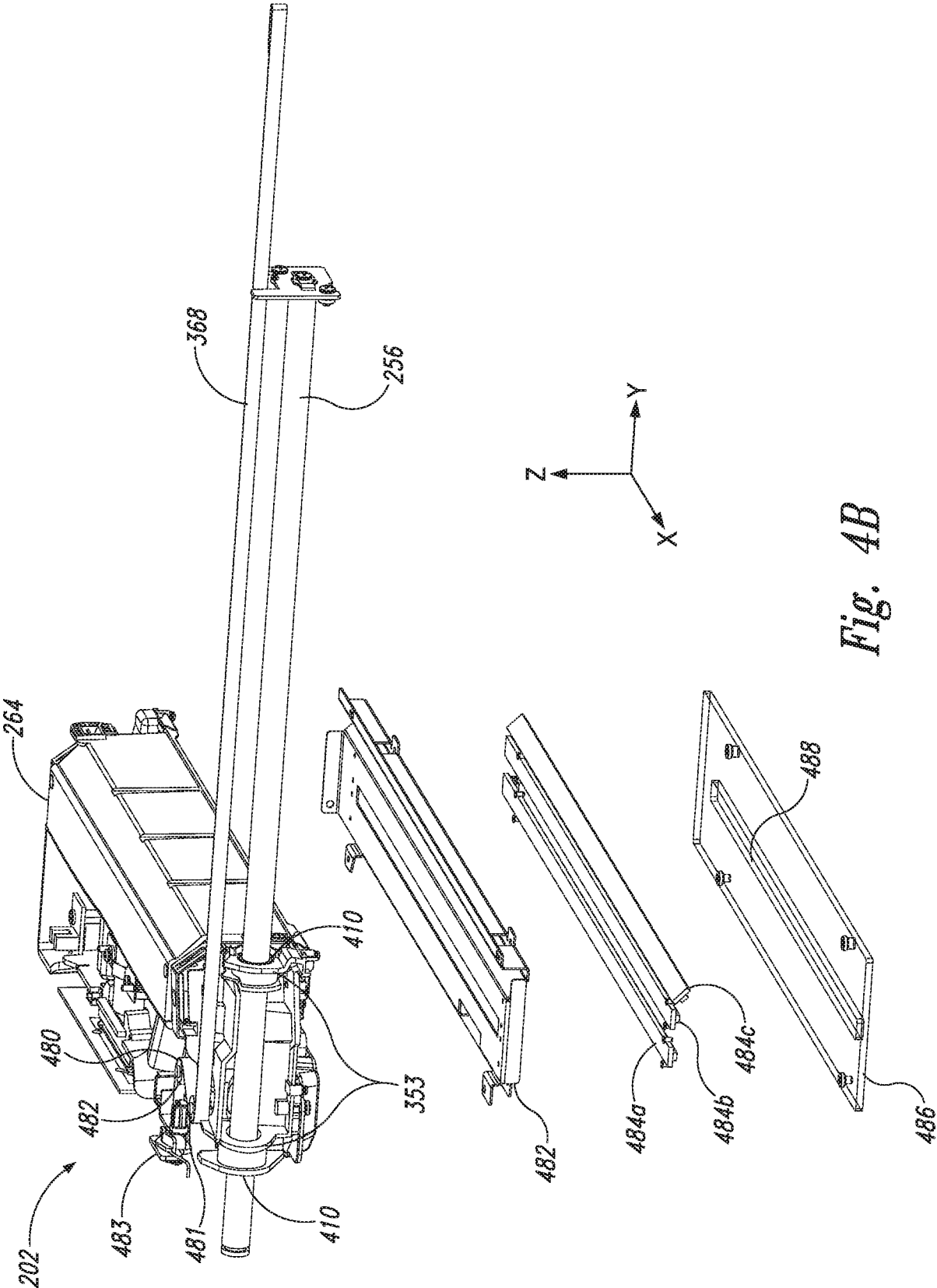
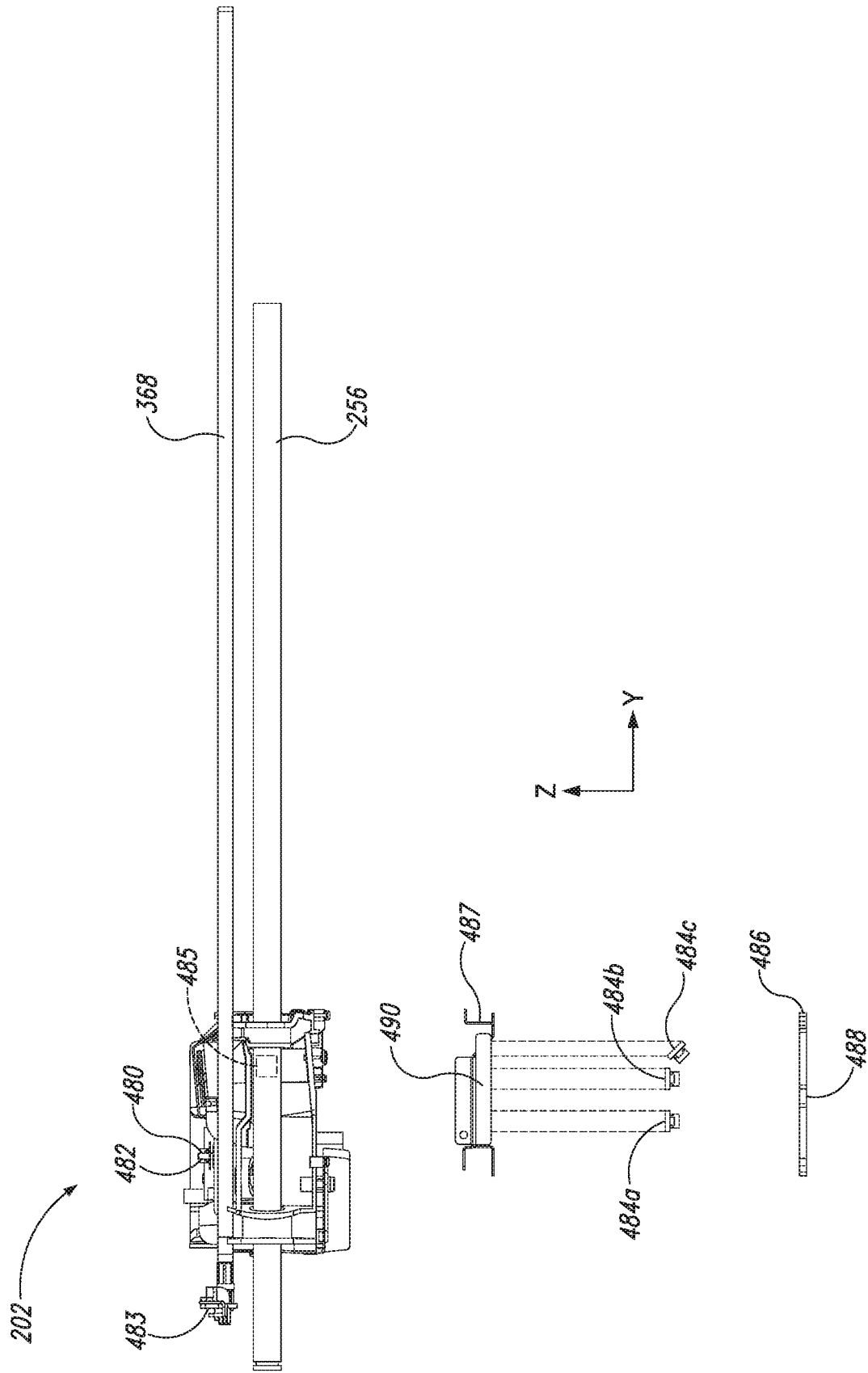


Fig. 4B



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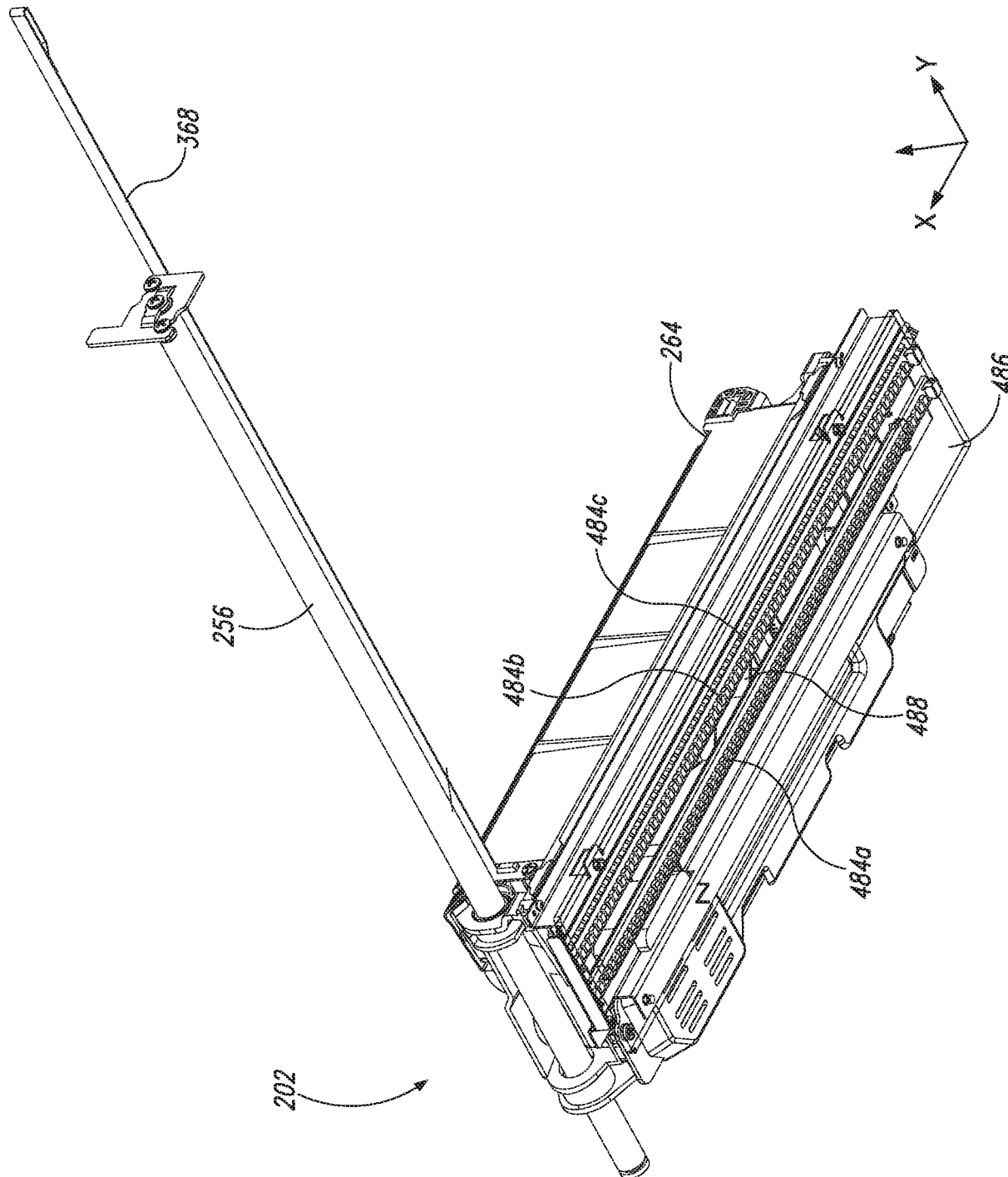
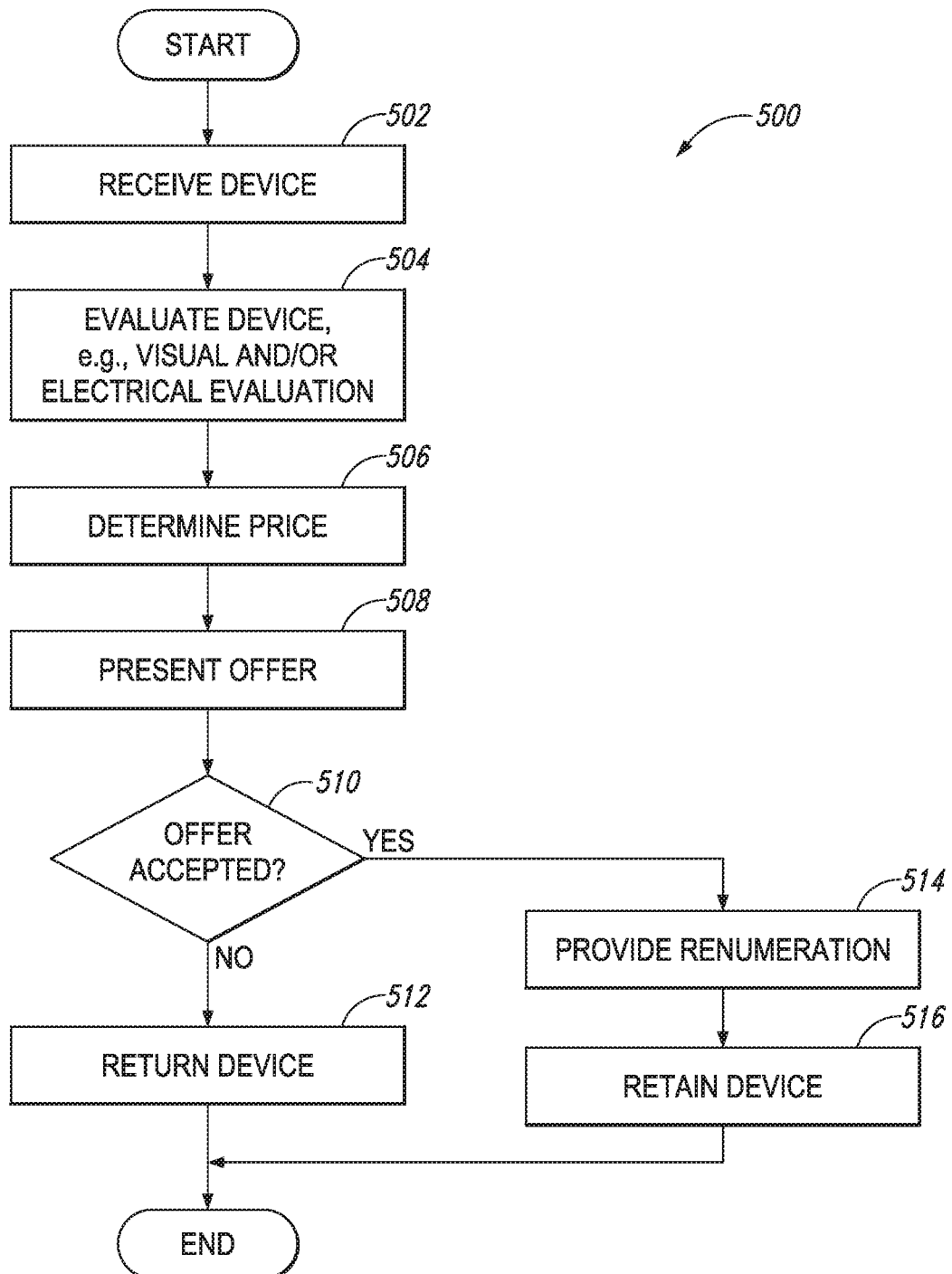


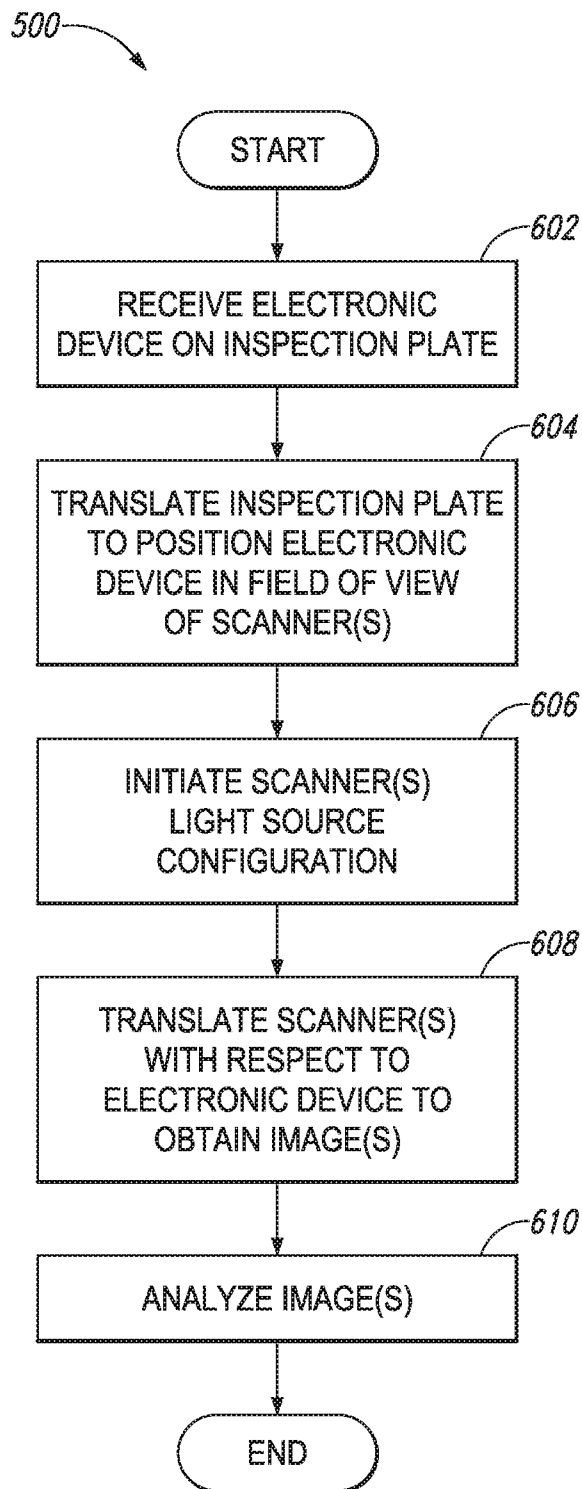
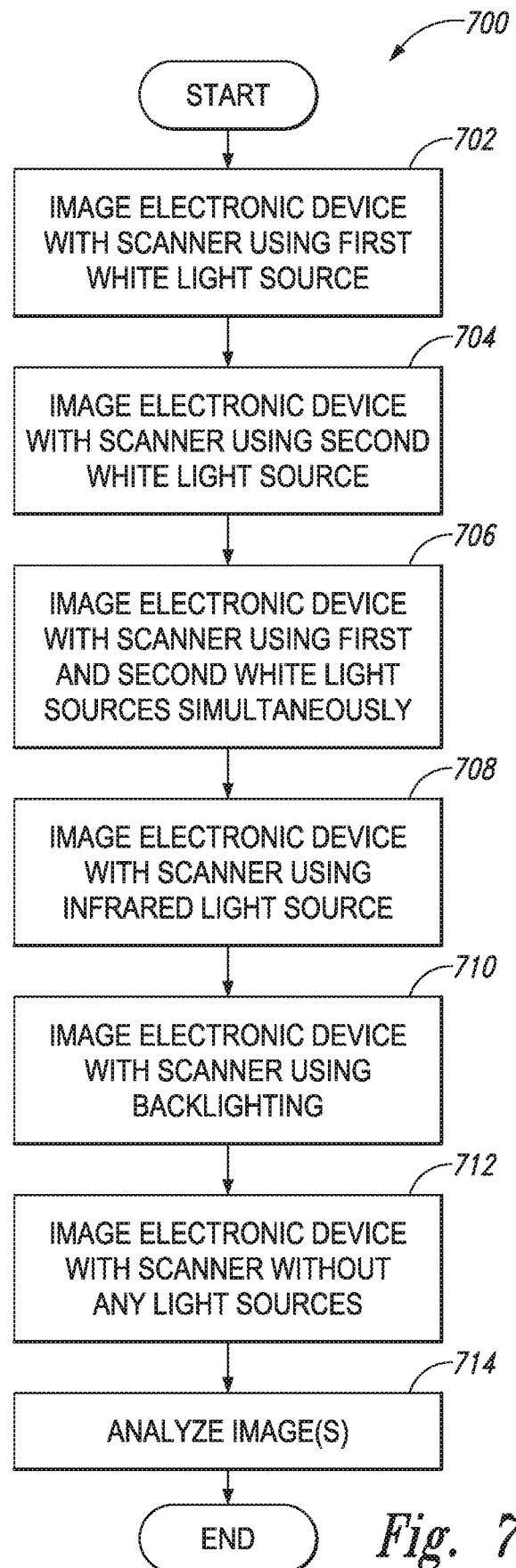
Fig. 4D

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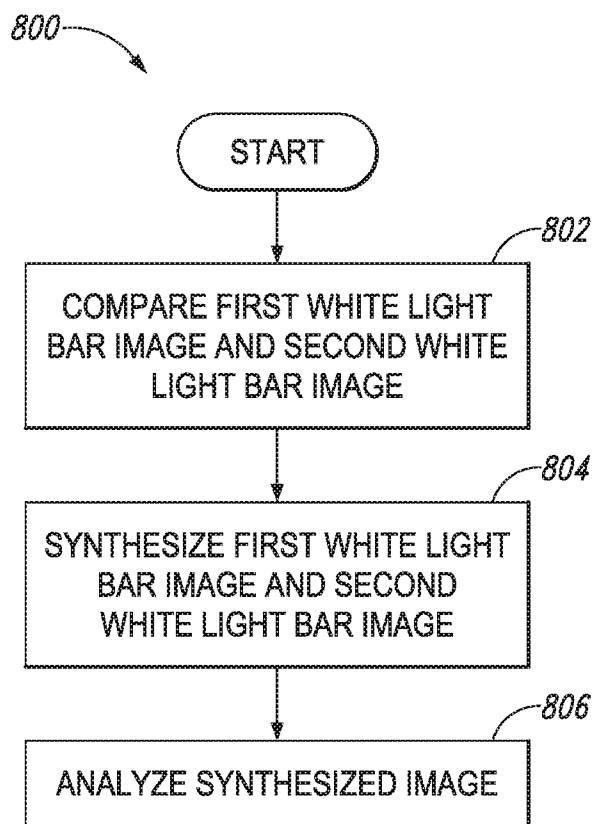
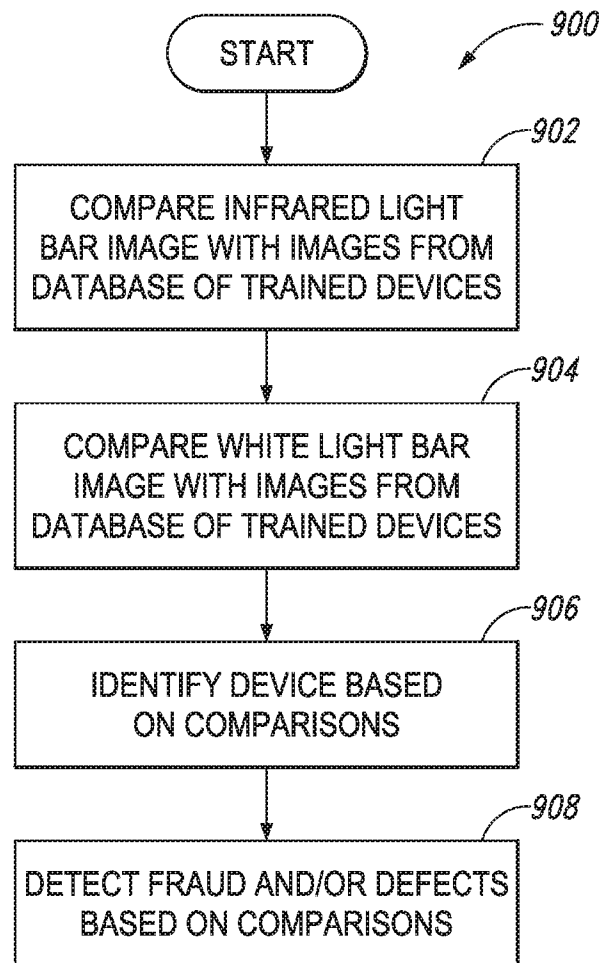
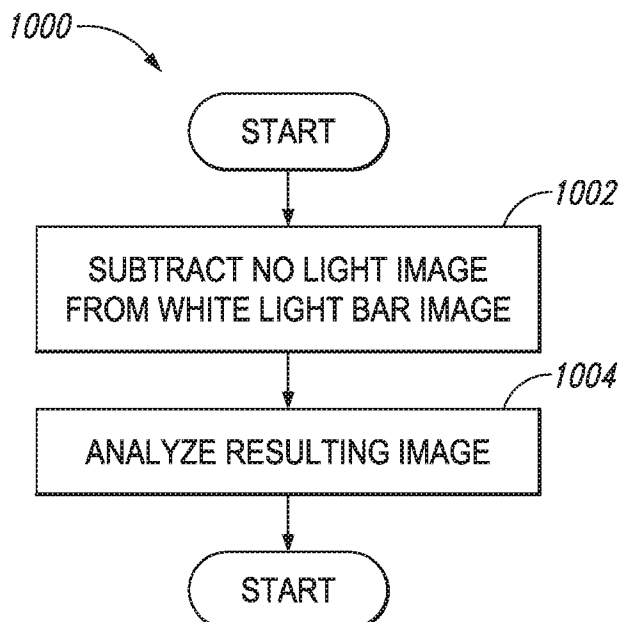
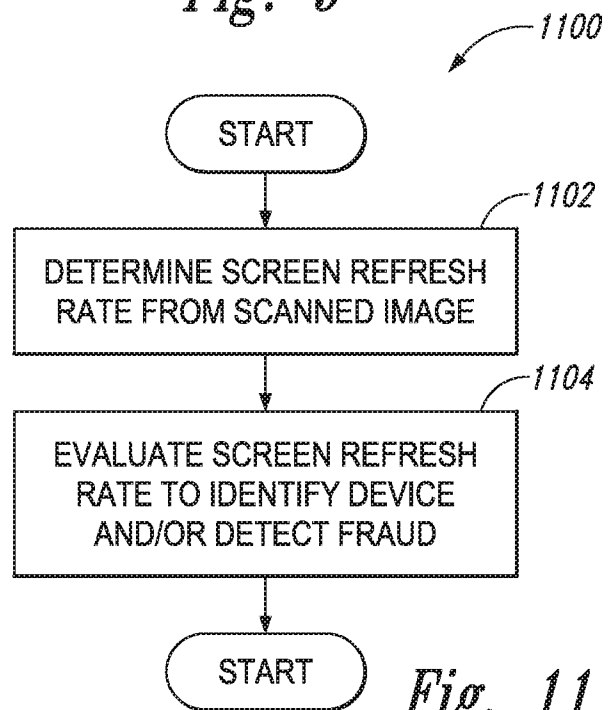
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*Fig. 5*

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*Fig. 6**Fig. 7*

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*Fig. 8**Fig. 9**Fig. 10**Fig. 11*

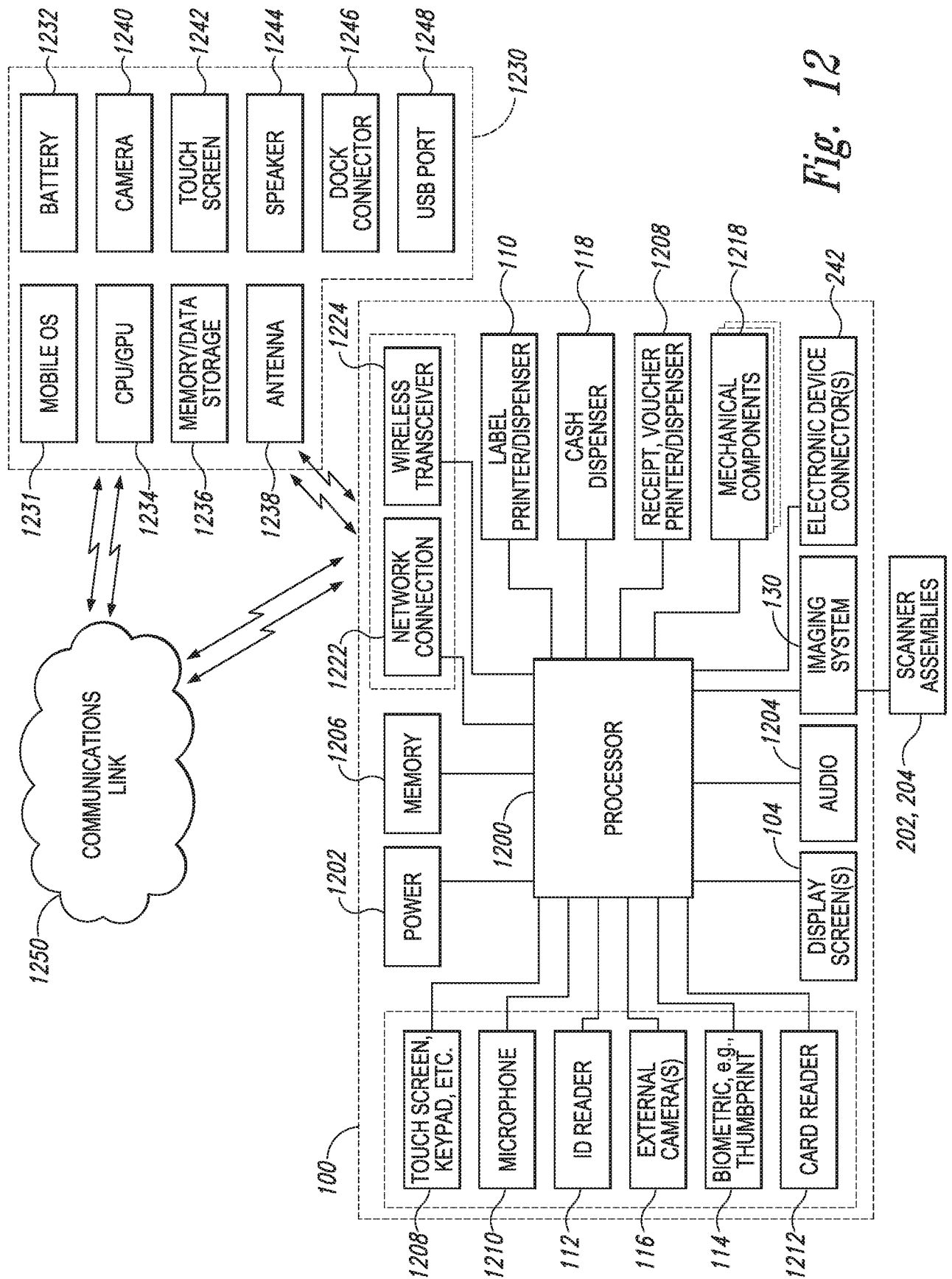


Fig. 12

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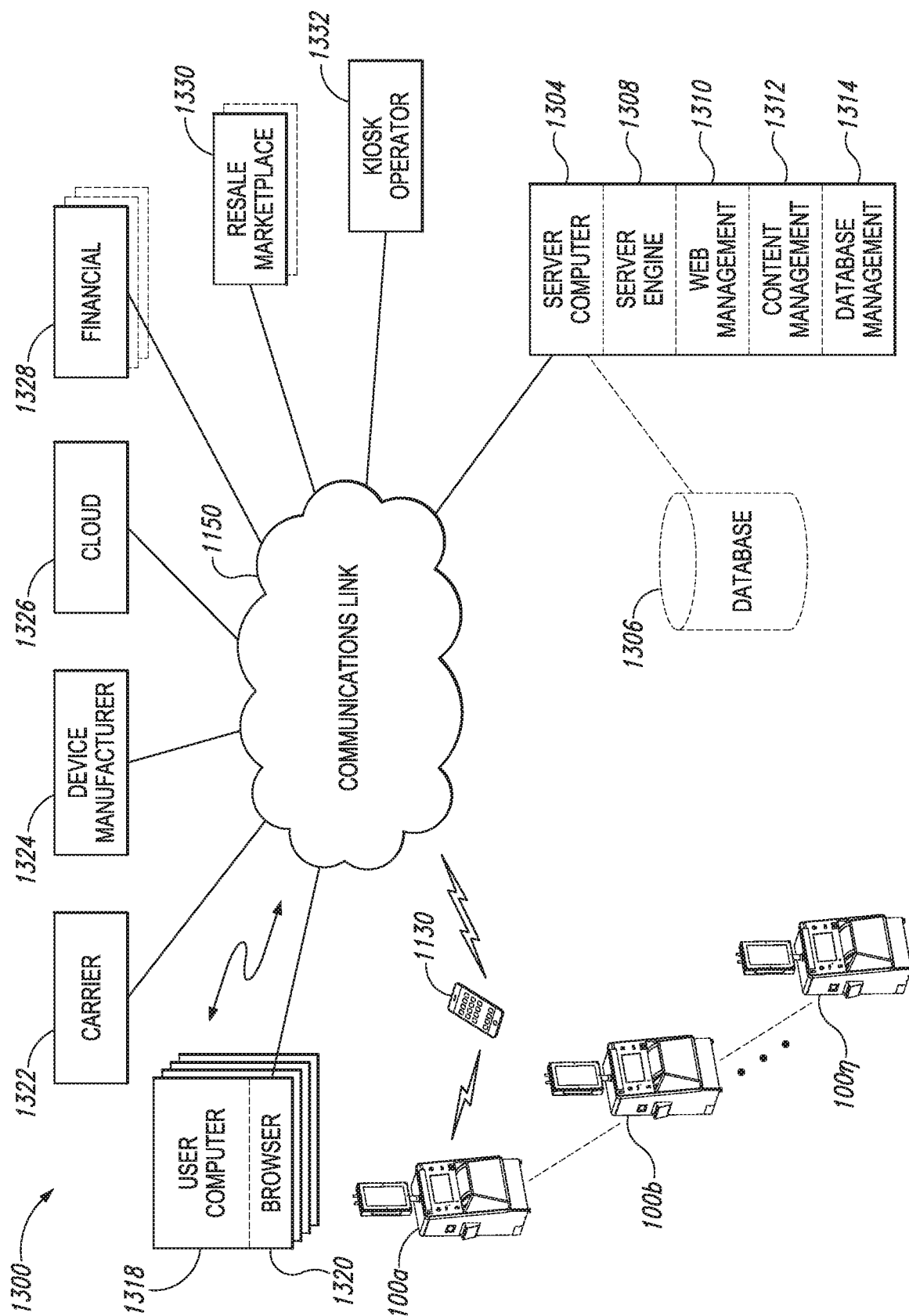


Fig. 13

# INTERNATIONAL SEARCH REPORT

International application No  
PCT/US2016/034278

## A. CLASSIFICATION OF SUBJECT MATTER

INV. G06Q10/00 G06Q40/08 G06Q30/02  
ADD.

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)

G06Q

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

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

EPO-Internal, WPI Data

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                                                                                              | Relevant to claim No. |
|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| X         | US 2013/144797 A1 (BOWLES MARK VINCENT [US] ET AL) 6 June 2013 (2013-06-06)<br>paragraph [0012]<br>paragraph [0066]<br>figures 1,7-9                                            | 1,27                  |
| A         | -----<br>US 2010/169231 A1 (BOWLES MARK [US] ET AL) 1 July 2010 (2010-07-01)<br>paragraph [0041] - paragraph [0043]<br>paragraph [0067]<br>paragraph [0069]<br>paragraph [0097] | 1-38                  |
| A         | -----<br>US 2010/147953 A1 (BARKAN EDWARD D [US]) 17 June 2010 (2010-06-17)<br>paragraph [0034]<br>paragraph [0040]<br>Dual camera assemblies.;<br>figures 2,3,7-9<br>-----     | 1-38                  |



Further documents are listed in the continuation of Box C.



See patent family annex.

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

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"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

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Date of the actual completion of the international search

13 July 2016

Date of mailing of the international search report

21/07/2016

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Fax: (+31-70) 340-3016

Authorized officer

Mennerun, Steeve

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2016/034278

| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s) | Publication<br>date         |
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