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Palmer et al.

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(54) **APPARATUS AND METHOD FOR EFFECTING SECURE PHYSICAL AND COMMERCIAL TRANSACTIONS IN A CONTACTLESS MANNER USING BIOMETRIC IDENTITY VALIDATION**

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(51) **Int. Cl.**
H04L 9/00 (2006.01)

(52) **U.S. Cl.** **713/186**

(58) **Field of Classification Search** 363/157–177; 902/24–29; 713/186
See application file for complete search history.

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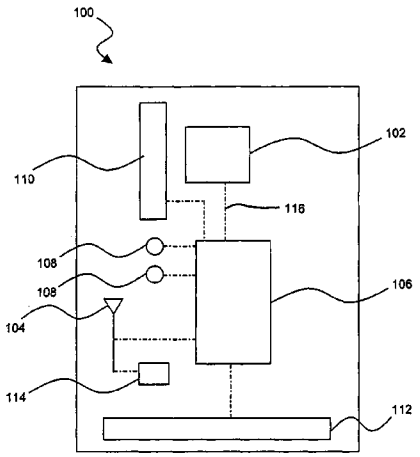
(57) **ABSTRACT**

Provided is an apparatus and method for effecting secure transactions in a contactless manner using biometric identity validation. The apparatus may include, for example, a biometric sensor that is operable to detect biometric information associated with a user of the apparatus. A processor that is accessible to the biometric sensor may be used to process the biometric information to verify the identity of the user. One or more antennae may also form part of the apparatus and may perform multiple functions. For example, the antennae may provide contactless communication with an external device and may also provide receive power from an external power source to power the device.

6 Claims, 14 Drawing Sheets



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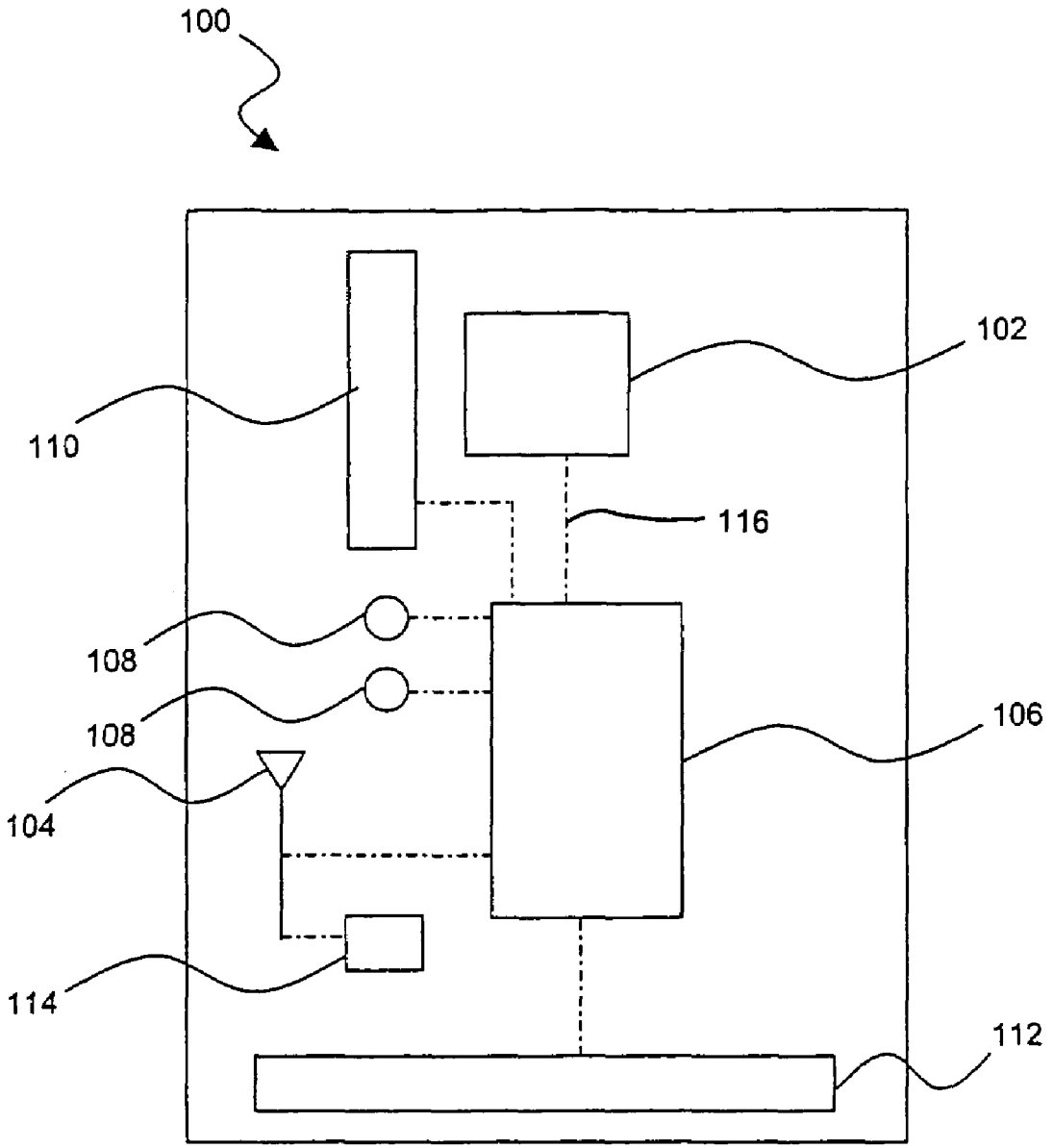

Fig. 1

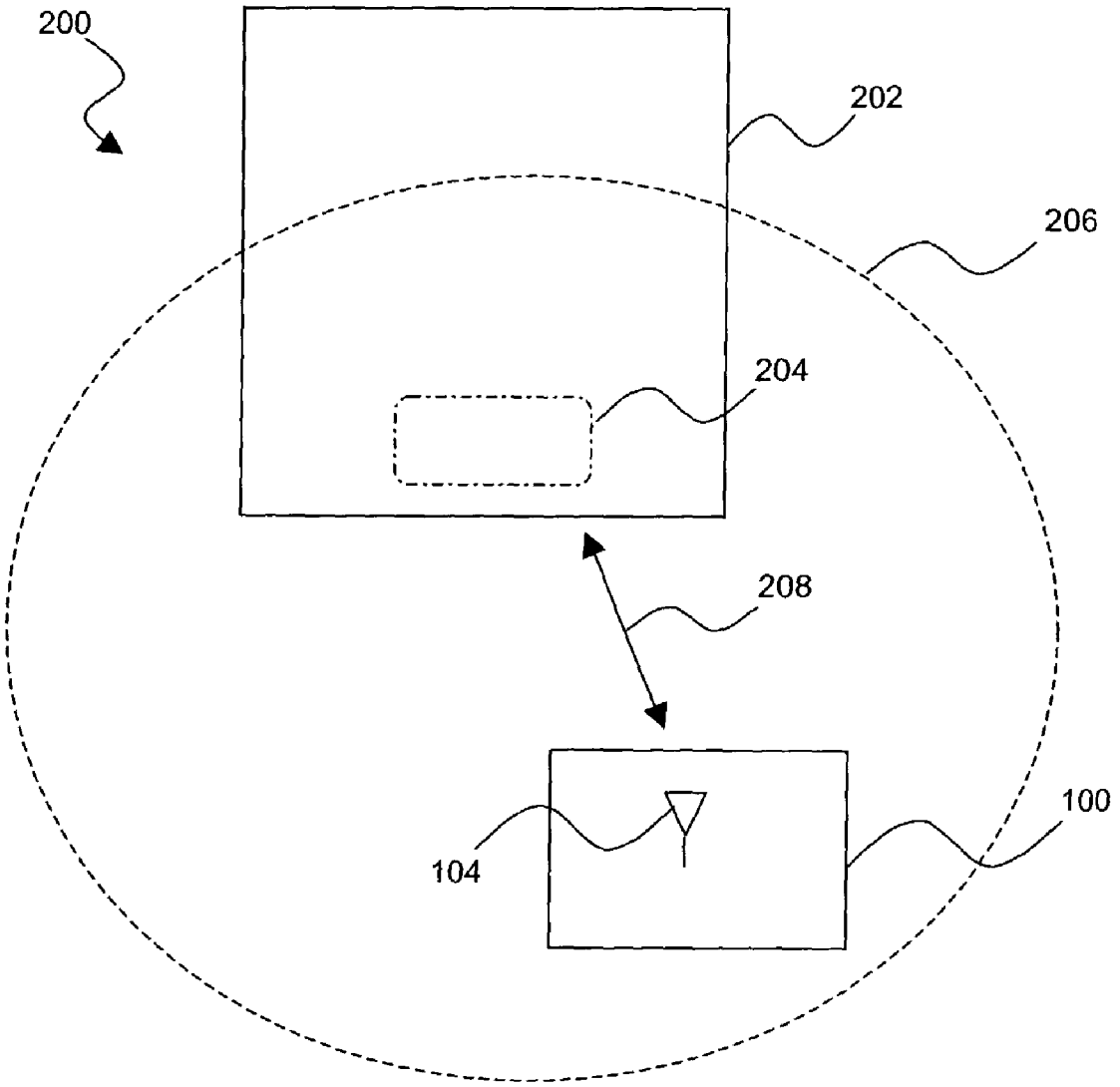

Fig. 2

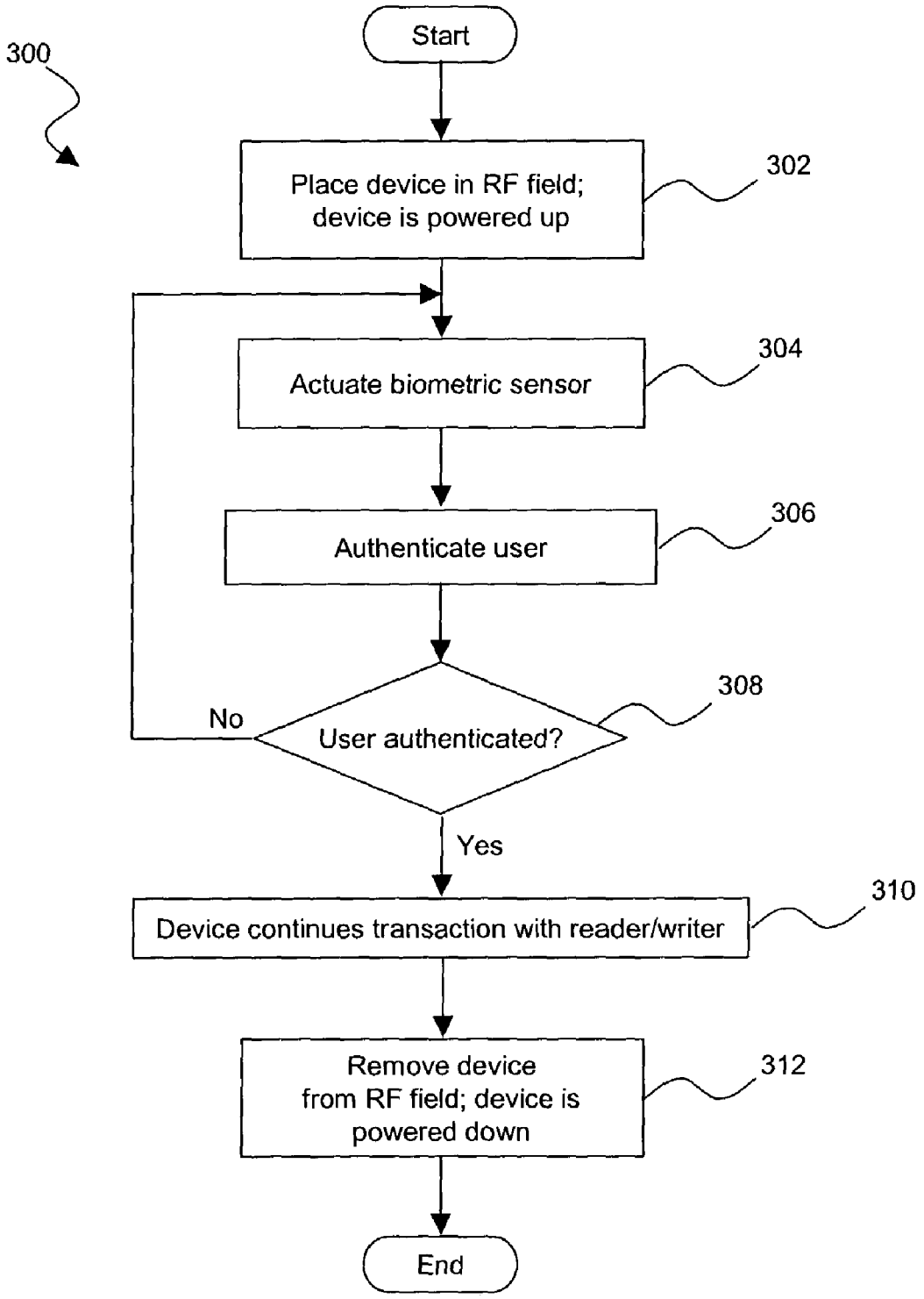
300
Start
Place device in RF field; device is powered up
302
Actuate biometric sensor
304
Authenticate user
306
User authenticated?
308
No
Yes
Device continues transaction with reader/writer
310
Remove device from RF field; device is powered down
312
End

Fig. 3

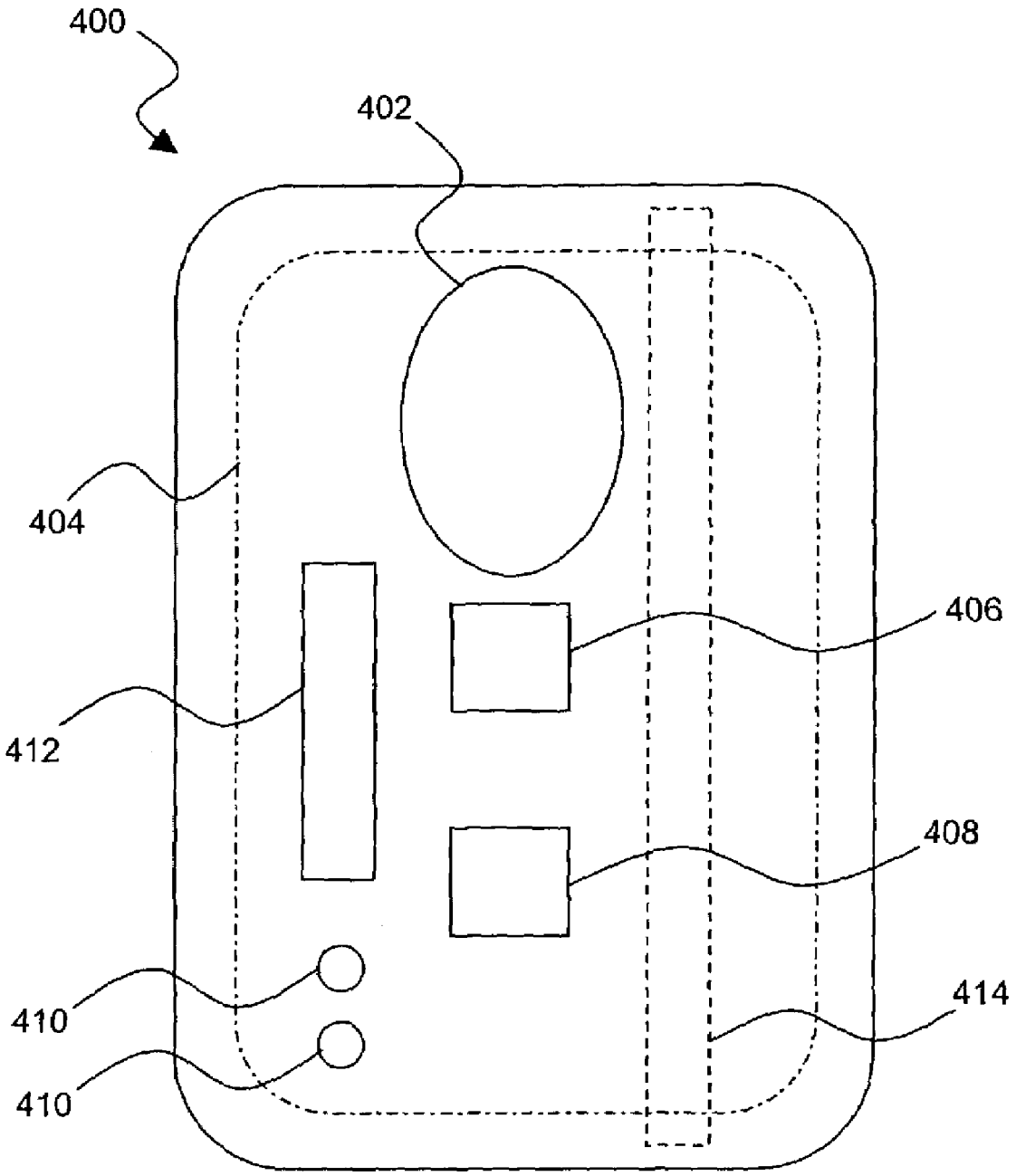

Fig. 4

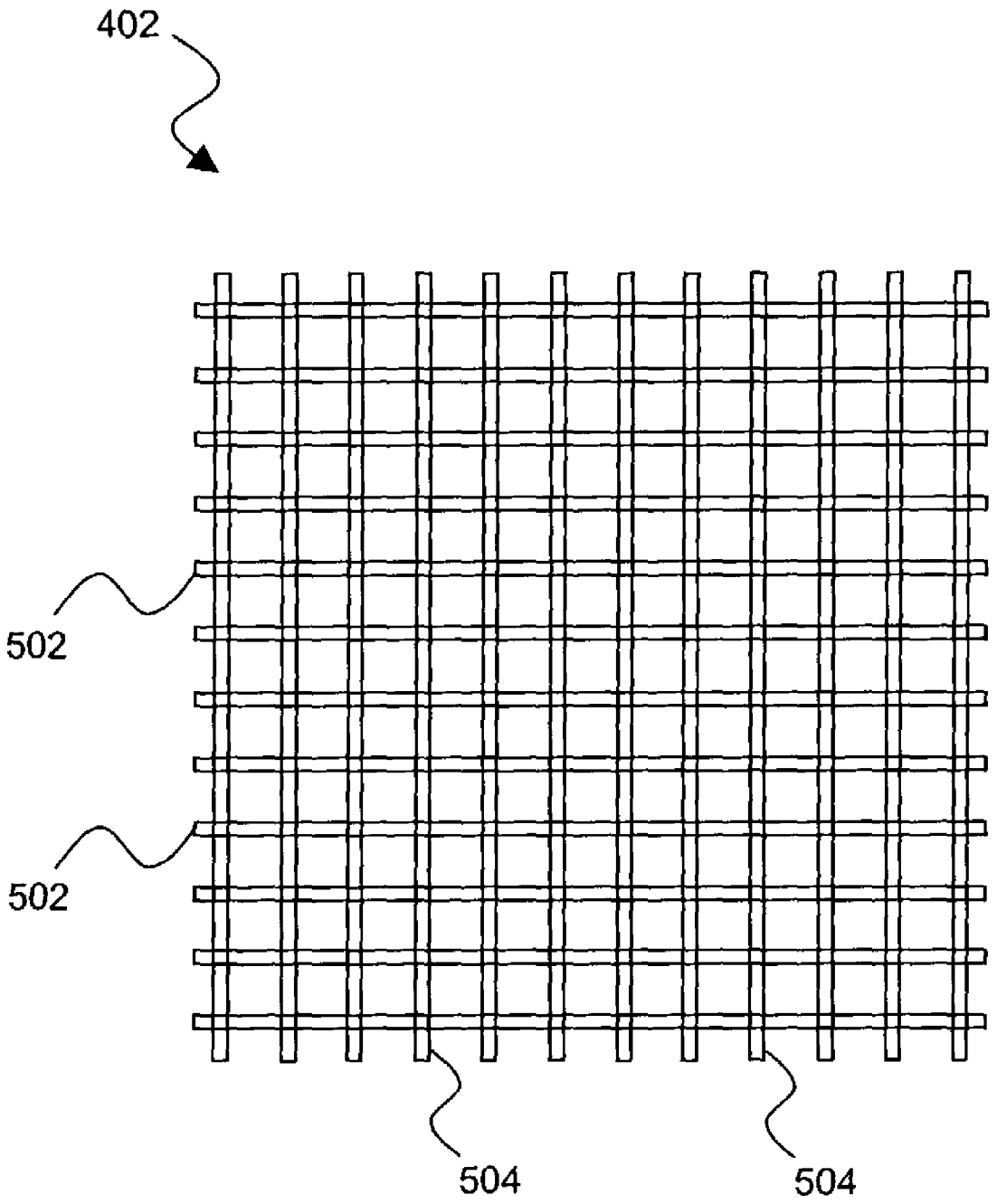

Fig. 5

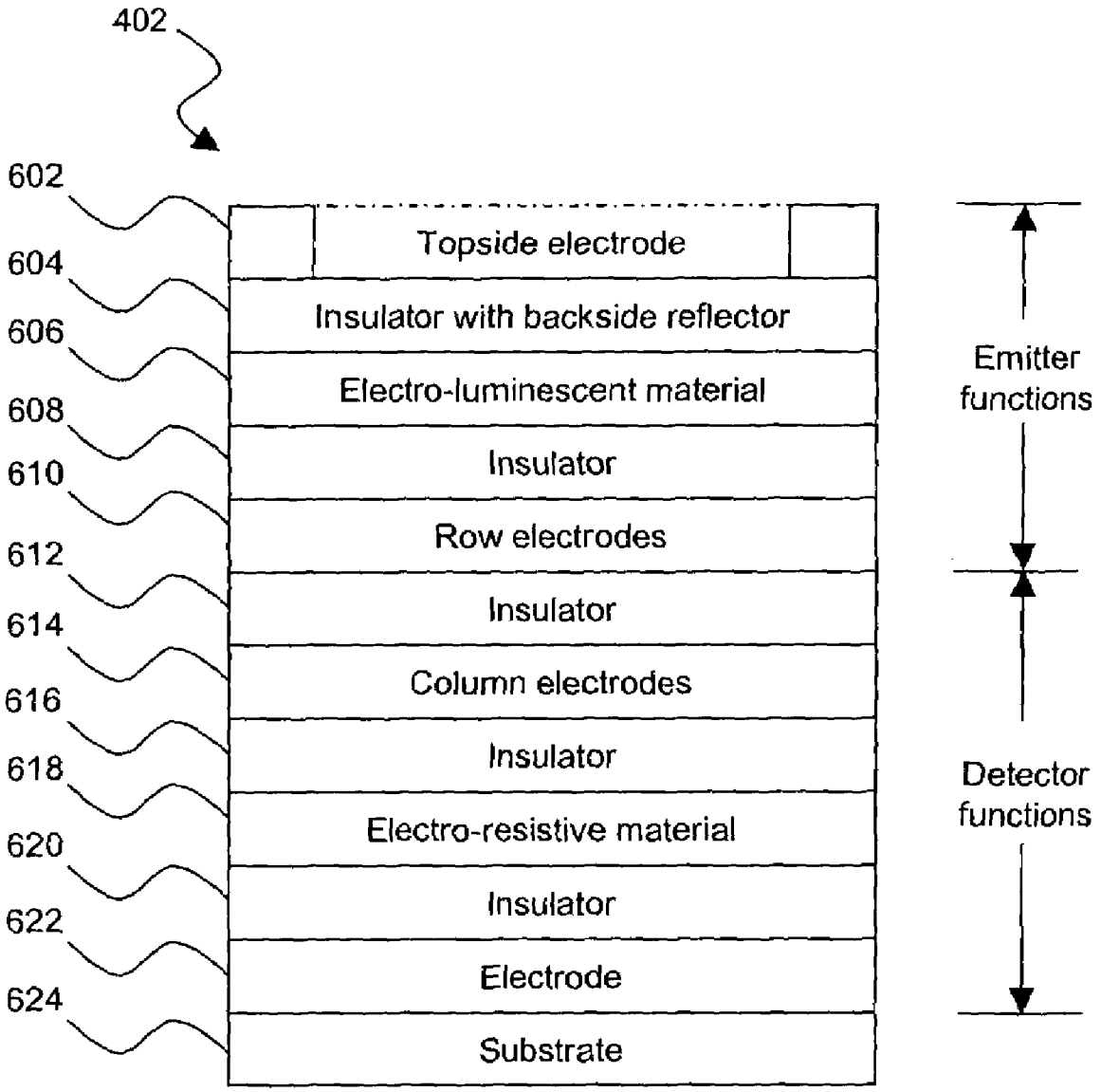
402
602
604
606
608
610
612
614
616
618
620
622
624
Topside electrode
Insulator with backside reflector
Electro-luminescent material
Insulator
Row electrodes
Insulator
Column electrodes
Insulator
Electro-resistive material
Insulator
Electrode
Substrate
Emitter functions
Detector functions

Fig. 6a

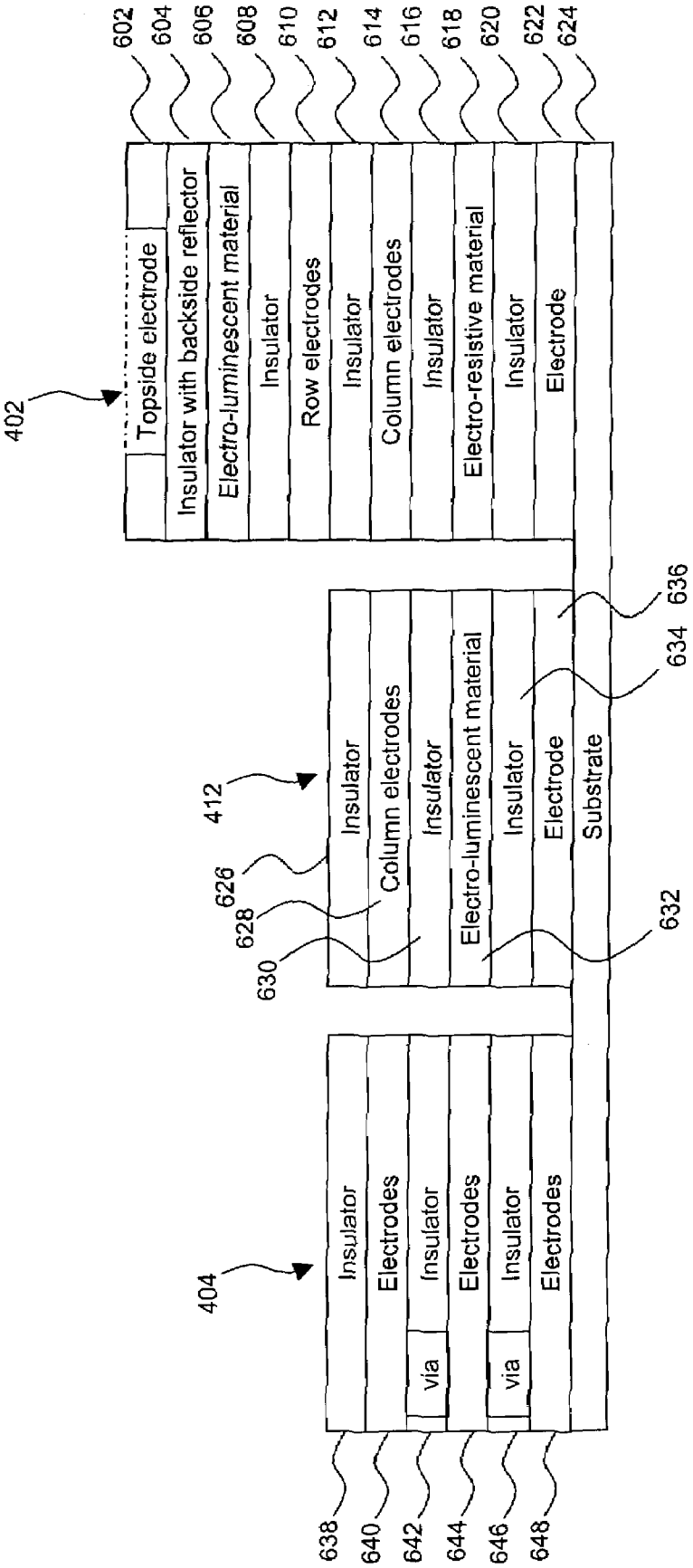
402
Topside electrode
Insulator with backside reflector
Electro-luminescent material
Insulator
Row electrodes
Insulator
Column electrodes
Insulator
Electro-resistive material
Insulator
Electrode
602
604
606
608
610
612
614
616
618
620
622
624
412
Insulator
Column electrodes
Insulator
Electro-luminescent material
Insulator
Electrode
Substrate
626
628
630
632
634
636
404
Insulator
Electrodes
Insulator
Electrodes
Insulator
Electrodes
via
via
638
640
642
644
646
648

Fig. 6b

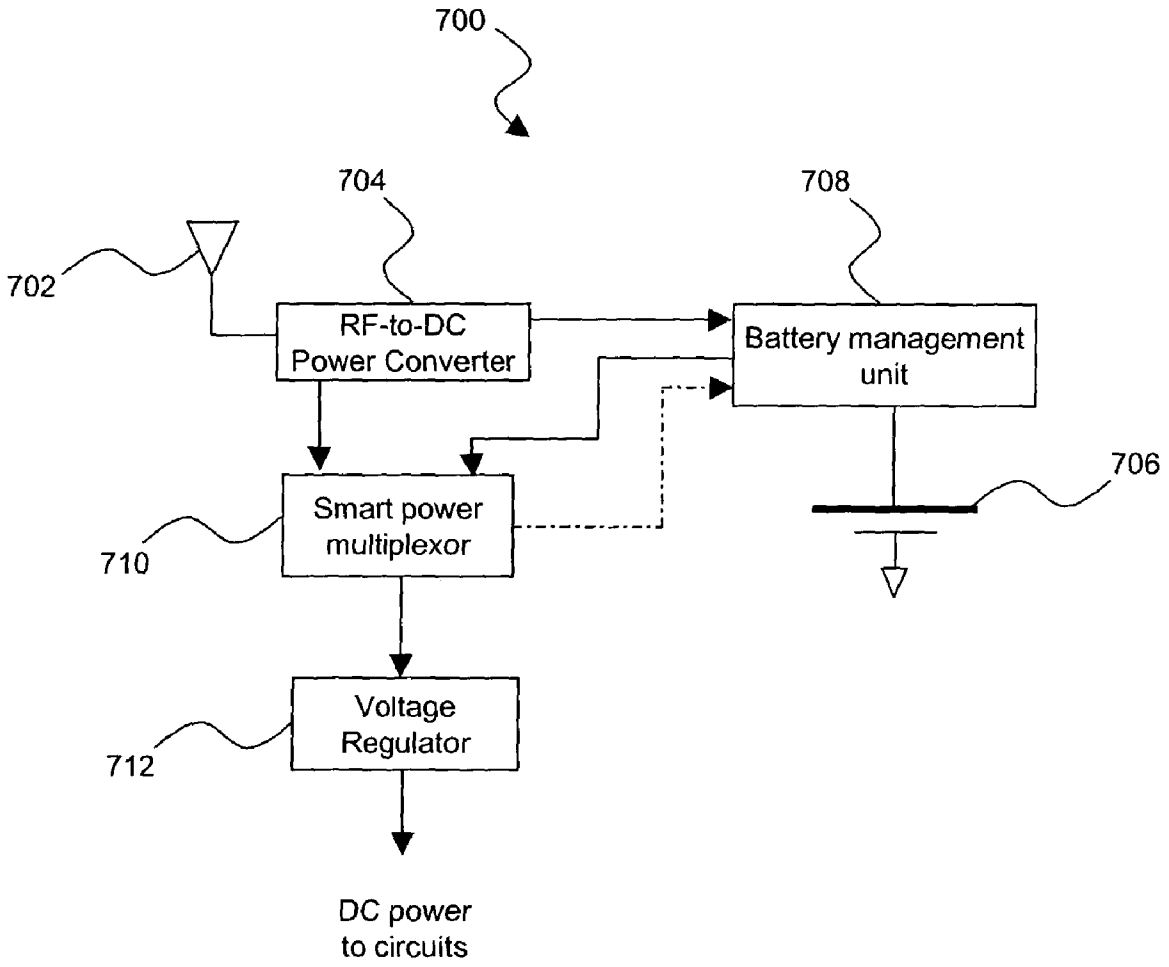
700
704
708
702
RF-to-DC
Power Converter
Battery management
unit
706
Smart power
multiplexor
710
Voltage
Regulator
712
DC power
to circuits

Fig. 7

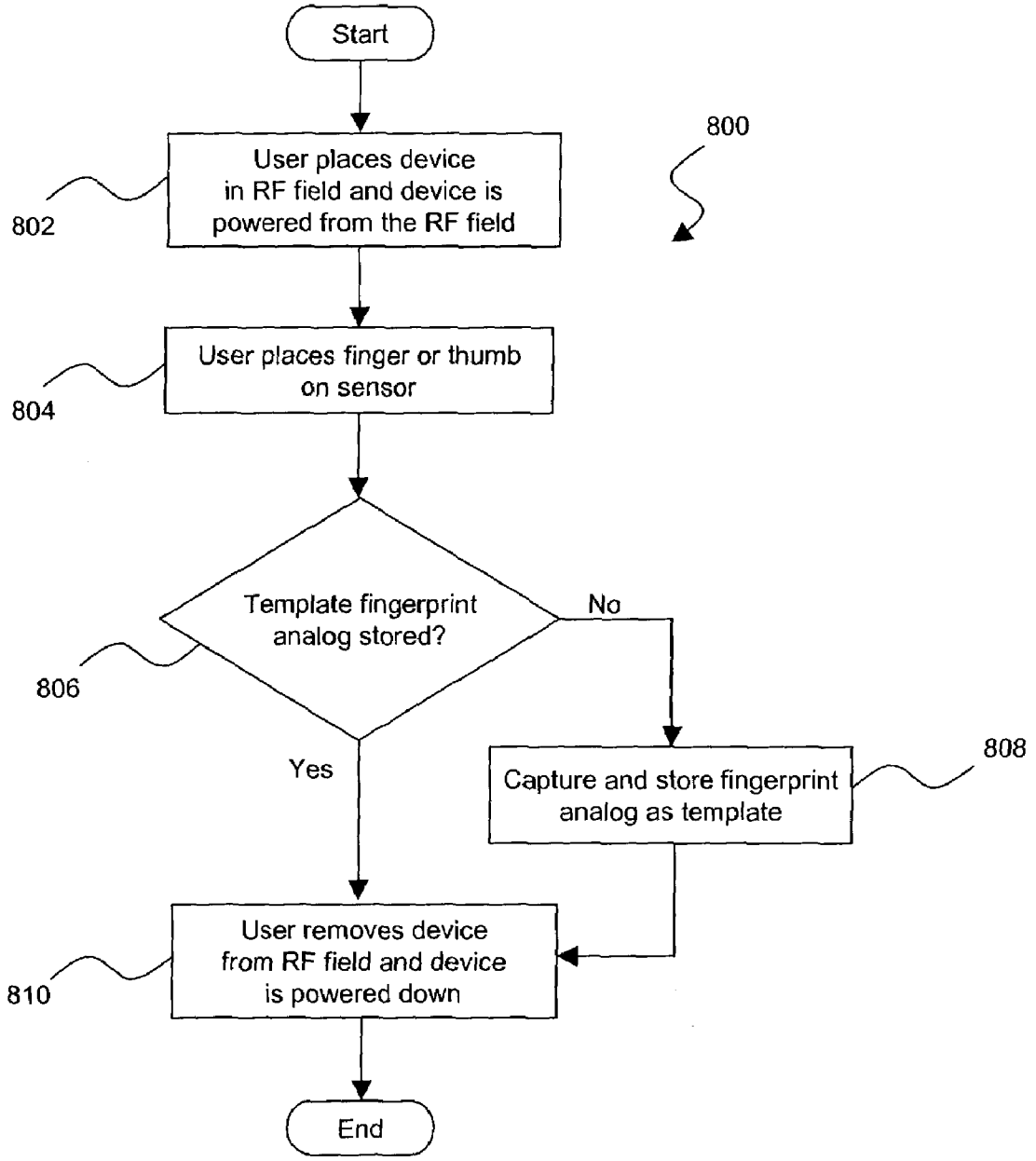
Start
800
User places device in RF field and device is powered from the RF field
802
User places finger or thumb on sensor
804
Template fingerprint analog stored?
806
No
Yes
Capture and store fingerprint analog as template
808
User removes device from RF field and device is powered down
810
End

Fig. 8

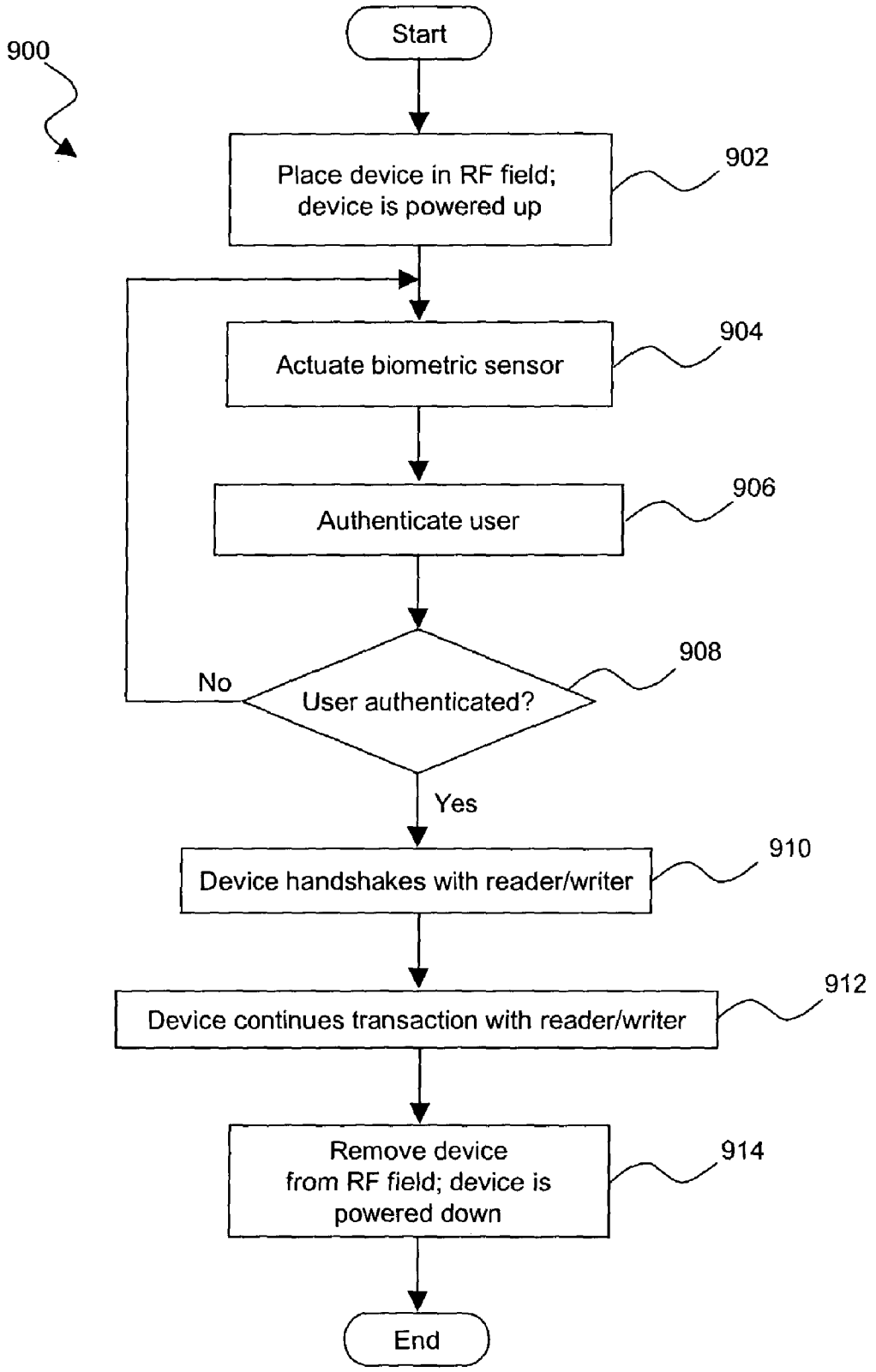
900
Start
Place device in RF field; device is powered up
902
Actuate biometric sensor
904
Authenticate user
906
User authenticated?
908
No
Yes
Device handshakes with reader/writer
910
Device continues transaction with reader/writer
912
Remove device from RF field; device is powered down
914
End

Fig. 9

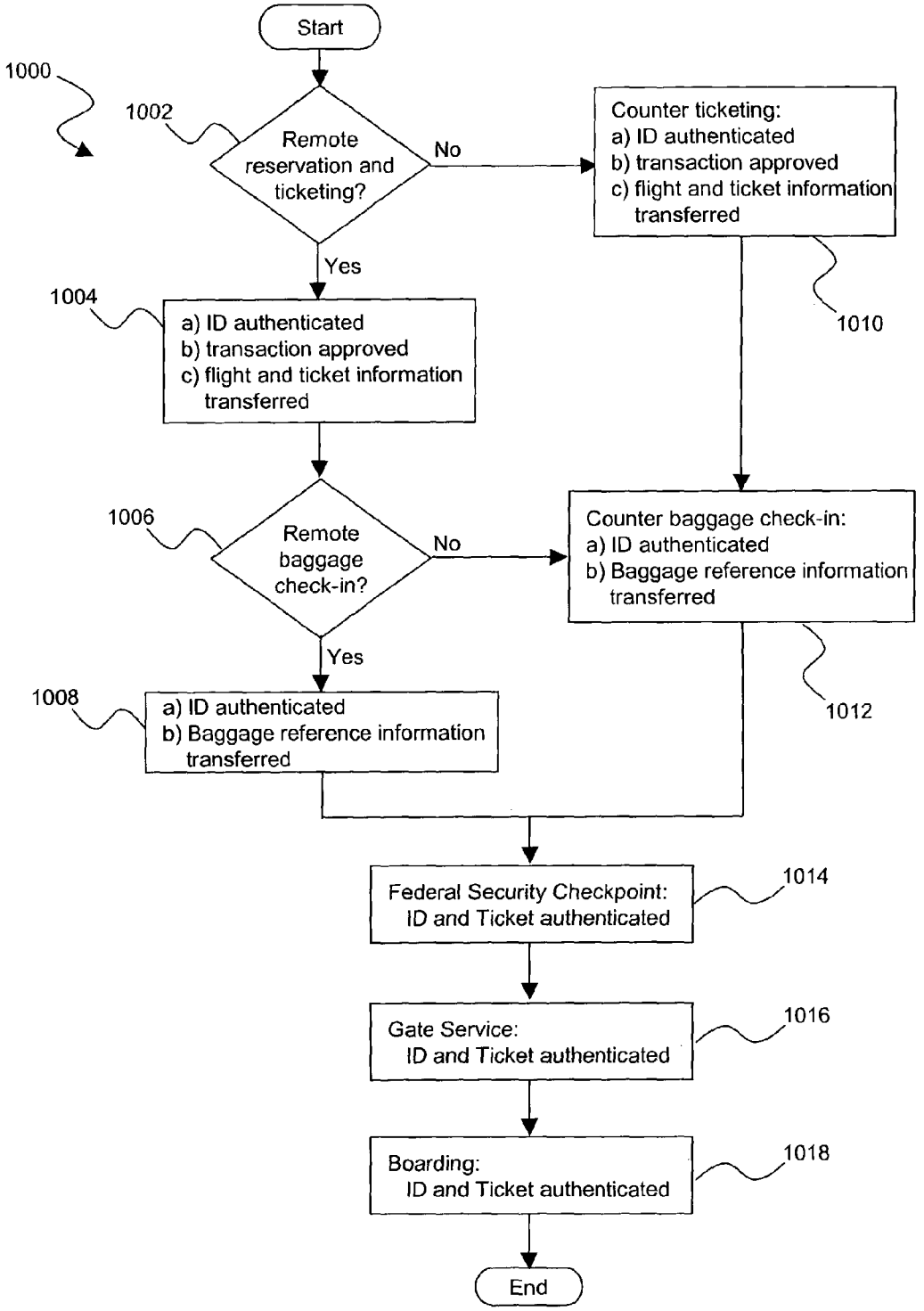
Start
1000
1002
Remote reservation and ticketing?
No
Yes
Counter ticketing:
a) ID authenticated
b) transaction approved
c) flight and ticket information transferred
1010
1004
a) ID authenticated
b) transaction approved
c) flight and ticket information transferred
1006
Remote baggage check-in?
No
Yes
Counter baggage check-in:
a) ID authenticated
b) Baggage reference information transferred
1012
1008
a) ID authenticated
b) Baggage reference information transferred
Federal Security Checkpoint:
ID and Ticket authenticated
1014
Gate Service:
ID and Ticket authenticated
1016
Boarding:
ID and Ticket authenticated
1018
End

Fig. 10

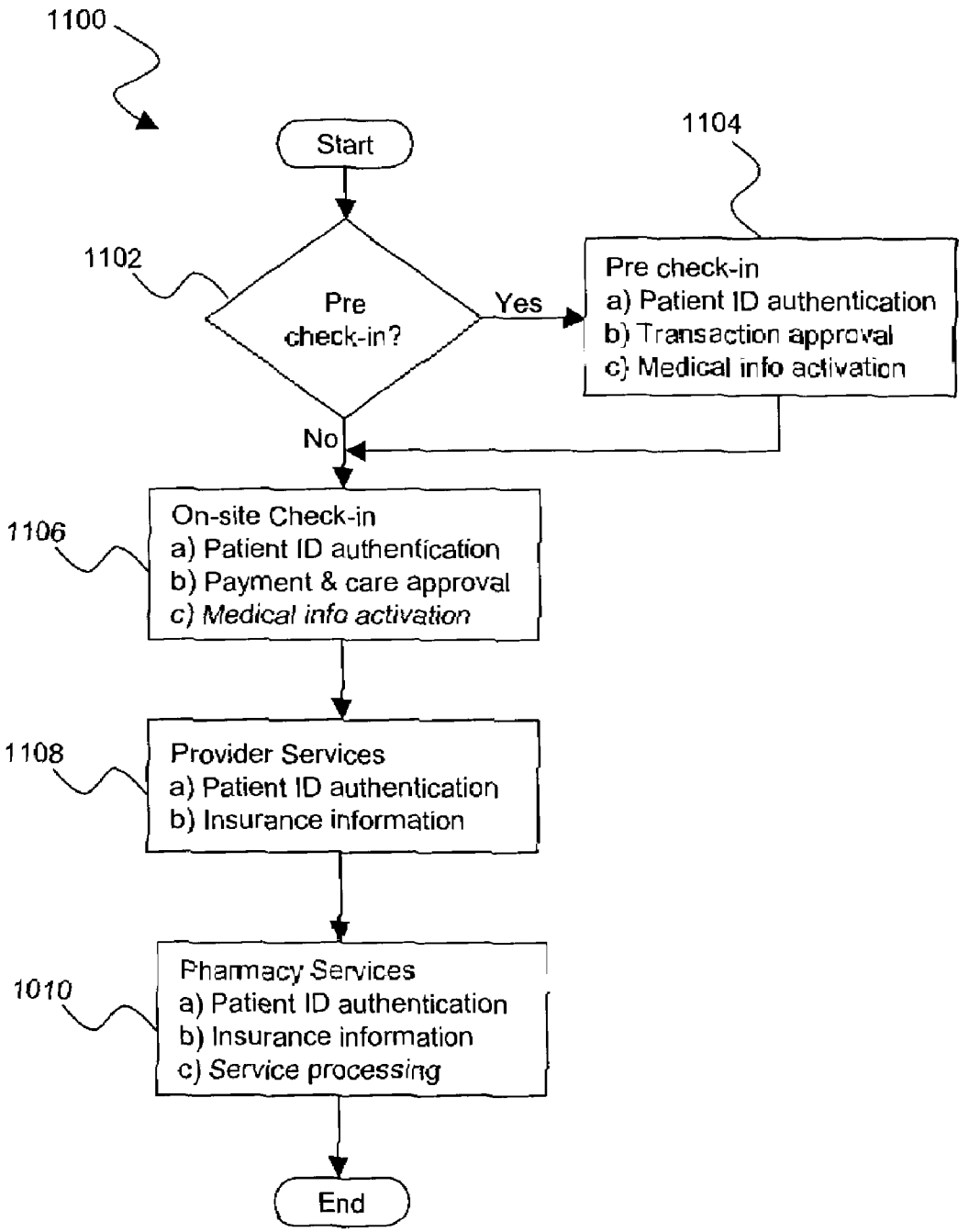
1100
Start
1104
1102
Pre check-in?
Yes
Pre check-in
a) Patient ID authentication
b) Transaction approval
c) Medical info activation
No
1106
On-site Check-in
a) Patient ID authentication
b) Payment & care approval
c) Medical info activation
1108
Provider Services
a) Patient ID authentication
b) Insurance information
1010
Pharmacy Services
a) Patient ID authentication
b) Insurance information
c) Service processing
End

Fig. 11

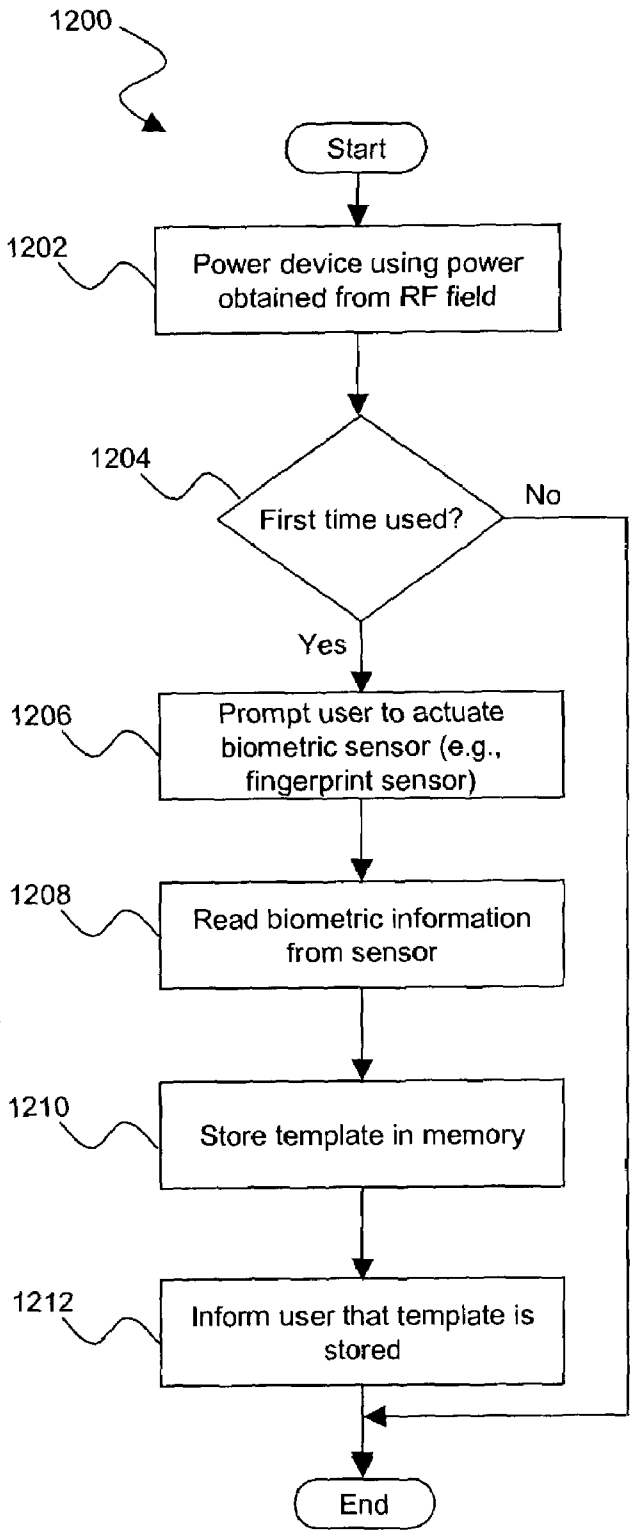
1200
Start
1202
Power device using power obtained from RF field
1204
First time used?
No
Yes
1206
Prompt user to actuate biometric sensor (e.g., fingerprint sensor)
1208
Read biometric information from sensor
1210
Store template in memory
1212
Inform user that template is stored
End

Fig. 12

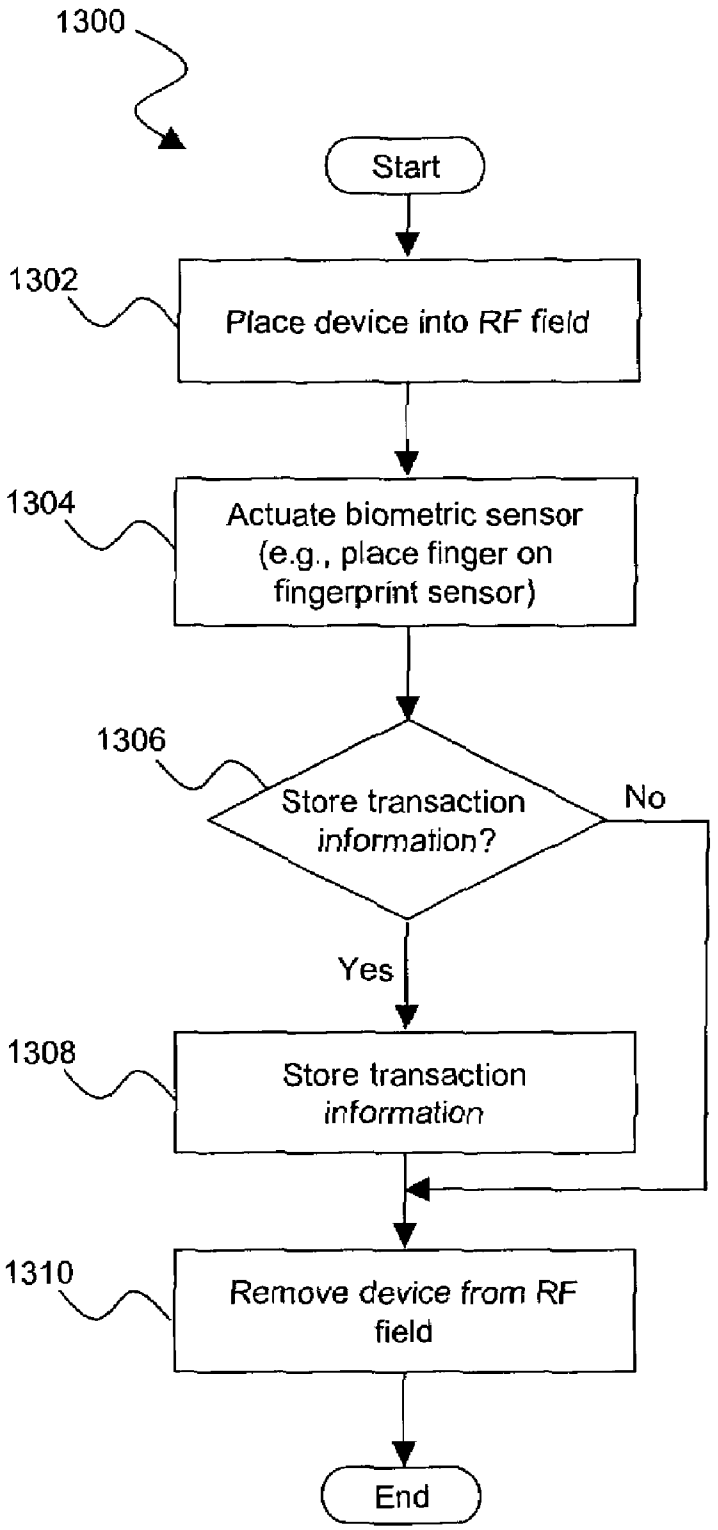
1300
Start
1302
Place device into RF field
1304
Actuate biometric sensor (e.g., place finger on fingerprint sensor)
1306
Store transaction information?
No
Yes
1308
Store transaction information
1310
Remove device from RF field
End

Fig. 13

APPARATUS AND METHOD FOR EFFECTING SECURE PHYSICAL AND COMMERCIAL TRANSACTIONS IN A CONTACTLESS MANNER USING BIOMETRIC IDENTITY VALIDATION

CROSS-REFERENCE

This application claims priority from U.S. Provisional Patent Application Ser. No. 60/368,363, filed on Mar. 28, 2002.

BACKGROUND

The present disclosure relates generally to authentication and, more specifically, to an apparatus and method for effecting secure physical and commercial transactions in a contactless manner using biometric identity validation.

Identity validation, transaction approval, and similar issues are becoming increasingly important. The widespread use of credit cards for remote transactions presents the need to ensure that the person making a purchase is authorized to do so. In addition, security concerns increase the need for convenient and reliable identity validation for access to secure areas of businesses, government offices, and similar areas.

Although attempts have been made to solve meet these needs, a satisfactory solution has not yet been achieved. Many proposed solutions are unwieldy, fail to provide identity validation, require connections to external devices, or have similar issues.

Accordingly, what is needed is an apparatus and method for effecting secure physical and commercial transactions in a contactless manner using biometric identity validation. It is desirable that the apparatus be relatively self-contained and that it interact with other devices without requiring physical contact. It is also desirable that the apparatus be easy to transport and use, and that it accommodate a variety of different applications.

SUMMARY

Provided is an apparatus and method for effecting secure transactions in a contactless manner. In one embodiment, the apparatus comprises

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a diagram illustrating one embodiment of an exemplary device for effecting secure physical and commercial transactions in a contactless manner using biometrics identity validation.

FIG. **2** illustrated an exemplary environment in which the device of FIG. **1** may operate.

FIG. **3** is a flow chart of an exemplary method for using the device of FIG. **1** in the environment of FIG. **2**.

FIG. **4** is a diagram illustrating another embodiment of an exemplary device for effecting secure physical and commercial transactions in a contactless manner using biometrics identity validation.

FIG. **5** is an illustration of one embodiment of a biometric sensor that may be used in the device of FIG. **4**.

FIG. **6***a* illustrates a plurality of layers that form one embodiment of the biometric sensor of FIG. **5**.

FIG. **6***b* illustrates a plurality of layers that form a portion of one embodiment of the device of FIG. **4**.

FIG. **7** is a diagram of an exemplary power circuit that may be used in the device of FIG. **4**.

FIG. **8** is a flow chart of an exemplary method for storing a template fingerprint analog in the device of FIG. **4**.

FIG. **9** is a flow chart of an exemplary method for using the device of FIG. **4**.

FIG. **10** is a flow chart of an exemplary method for using the device of FIG. **1** in an air transportation environment.

FIG. **11** is a flow chart of an exemplary method for using the device of FIG. **1** in a healthcare environment.

FIG. **12** is a flow chart of an exemplary method for storing a biometric template analog in the device of FIG. **1**.

FIG. **13** is a flow chart of an exemplary method for using the device of FIG. **1** in a financial transaction.

DETAILED DESCRIPTION

The present disclosure relates generally to authentication and, more specifically, to an apparatus and method for effecting secure physical and commercial transactions in a contactless manner using biometric identity validation. It is understood, however, that the following disclosure provides many different embodiments or examples. Specific examples of components and arrangements are described below to simplify the present disclosure. These are, of course, merely examples and are not intended to be limiting. In addition, the present disclosure may repeat reference numerals and/or letters in the various examples. This repetition is for the purpose of simplicity and clarity and does not in itself dictate a relationship between the various embodiments and/or configurations discussed.

Referring to FIG. **1**, one embodiment of an intelligent device **100** is depicted. As will be described later in greater detail, the device **100** is comprised of multiple components, including a biometric sensor **102**, a radio frequency ("RF") antenna **104**, a controller **106**, control buttons **108**, a dynamic information display **110**, a magnetic information media component **112**, and a RF power conversion and power management unit **114**. A plurality of inter-component communication paths **116** provide connections between various components of the device **100**.

The RF antenna **104** may perform multiple functions. For example, it may capture RF energy from a RF field emanated by a RF power source and may also support two-way communication with an associated reader/writer device (not shown). The antenna **104** may be a single antenna capable of performing both functions or may comprise multiple antennae, with one antenna for capturing RF energy from the RF field and another antenna for supporting the two-way communication with the reader/writer device. The communications envisioned include, for example, authenticated identification of a person operating the device **100**, various purchases and financial transactions, air ticket booking and airport security check points, and other interactions between the device **100** and the reader/writer device. These communications may be secured using mechanisms such as data encryption. It is understood that other communications components, such as audio or optical components, may replace or supplement the antenna **104**. In addition, the antenna **104** may be operable to function with wavelengths other than RF.

The biometric sensor **102** is used for sensing a physical attribute of a user of the device **100** and generating an analog of this physical attribute. The analog may then be made available to the controller **106**. More specifically, the biometric sensor **102** is designed to sense some physical attribute of a person and extract a distinctive analog of that

person. To be useful for establishing positive identification, the analog may need to be individualized sufficiently so as to be unique to every person. In addition, a trusted copy—a template—of the analog should be captured. Analogs later sensed by the biometric sensor **102** may then be compared against the template analog. Various physical attributes may be used for identification purposes, such as fingerprints, voice prints, and retinal prints.

The controller **106** interacts with the biometric sensor **102** and other components of the device **100** to perform various functions. For example, the controller **106** may capture the analog of the physical attribute for long term storage as a trusted template analog of an authorized user, as well as for immediate comparison to a stored trusted template analog during an authentication procedure. The controller **106** may also determine whether the comparison indicates a match between the template analog and the analog captured by the biometric sensor **102**. In addition, the controller **106** may control the dynamic information display **110**, respond to input from the control buttons **110**, and control the magnetic information media component **112**. Furthermore, the controller **106** may support two-way communications with an associated reader/writer device (FIG. **2**) via the RF antenna **104**. The controller may be a single controller/processor or may comprise multiple controllers/processors.

The dynamic information display **110** may be used to display information to a user, as well as to enable a process with which the user may interact using the control buttons **110**. The magnetic information media component **112** may be manipulated so that it provides information via a magnetic field. The RF power control unit **114** may convert RF radio energy to electrical energy, and may control storage and distribution of this electrical energy to the other components in the device **100**. It is understood that the device **100** may also have a battery and/or other power means to use as a backup or alternative power source for the RF power control unit **114**.

Referring now to FIG. **2**, the device **100** is illustrated in an exemplary environment **200** that enables contactless interaction with a reader/writer device **202**. To achieve this contactless interaction, the device **100** is shown with the antenna **104**, as described in reference to FIG. **1**. The device **202** uses one or more antennae **204** to communicate with the device **100**, as well as emanate a RF power field **206** with the purpose of supplying power to compatible devices, such as the device **100**. In operation, a two-way communication link **208** may be established between the reader/writer device **202** and the device **100**.

It is understood that many different reader/writer configurations may be used. For example, the reader/writer device **202** may be in communication with other devices or with a network. Furthermore, the reader/writer device **202** may include the RF power source, or they may be separate devices. For purposes of clarity, the reader/writer device **202** of the present example includes the RF power source.

Referring now to FIG. **3** and with continued reference to FIGS. **1** and **2**, the device **100** may be operated in the environment **200** using a method **300** as follows. In step **302**, the device **100** is placed into the RF field **206** emanated by the reader/writer device **202**. When placed into the RF field, the device **100** captures power from the RF field **206**, which powers up the device **100**'s electronics. In step **304**, the biometric sensor **102** is actuated by a user. The method of actuation may depend on the type of biometric sensor (e.g., a fingerprint for a fingerprint sensor, speaking for a voice sensor, etc.). In step **306**, an authentication process is performed by the device **100**. As in the previous step, the authentication process may depend on the type of biometric sensor. For example, the detected fingerprint or voice may be compared to a template in the memory of the device **100**. In step **308**, a determination is made as to whether the user is authenticated. If the authentication process fails to validate the user, the method **300** may return to step **304**. If the user is validated by the authentication process, the method continues to step **310**, where the device **100** continues the desired transaction with the reader/writer device **202**. Once this occurs, the device **100** may be removed from the RF field **206** in step **312**, which powers down the device **100**.

Referring now to FIG. **4**, in another embodiment, a device **400** illustrates an implementation of the present disclosure using a form factor similar to that of a credit card. The credit card form factor of the device **400** includes a plurality of components, such as a fingerprint sensor **402**, a RF antenna **404**, a first controller **406**, a second controller **408**, function selector buttons **410**, an electro-luminescent display **412**, and a magnetic strip **414**. In the present example, the first controller **406** is an application specific integrated circuit ("ASIC") chip and the second controller **408** is a smart card chip, although it is understood that the functionality of both controllers may be provided by a single controller.

The ASIC **406** is a custom integrated circuit chip developed for use in the device **400**. The ASIC **406** includes Random Access Memory ("RAM") which may be used for temporarily storing a current fingerprint analog detected by the fingerprint sensor **402** and for temporarily storing intermediate results of processing calculations (e.g., fingerprint comparisons, etc.). The ASIC **406** may also include non-volatile memory (e.g., Flash memory or EEPROM) to store and retrieve one or more fingerprint template analogs that are used for comparison against the current fingerprint analog.

Circuitry contained within the ASIC **406** provides an interface between the ASIC **406** and the fingerprint sensor **402**. In the present example, the ASIC **406** contains a microprocessor core with dedicated program and temporary memory, enabling the ASIC **406** to use an array of processing elements for executing instructions stored within the ASIC **406** in parallel. The instructions enable the ASIC **406** to perform a comparison between the current fingerprint analog and a template fingerprint analog. Other instructions included within the ASIC **406** may provide support for an authorization signal to be sent to the smart card chip **408** after an authentication process has been completed. In addition, the ASIC **406** may be used to drive the electro-luminescent display **412**, read the function control buttons **410**, and drive the programmable magnetic strip **414**.

The smart card chip **408** may support various application programs. These applications may include, for example, storage/retrieval of personal demographics information, storage/retrieval of a digitized picture of the cardholder, an "electronic purse" functionality, financial transactions, purchases, etc. In addition, the smart card chip **408** may support two-way communication data transfers and may perform various encryption functions to support secure communications. In the present example, the communications and encryption are based on known standards, but proprietary protocols may be used if desired. It is envisioned that the smart card chip **408** may support standard smart card interactions such as identification validation, credit card transactions, and others.

The fingerprint sensor **402** is designed to detect fingerprint information and provide the detected information to other components of the device **400**. In the present example, the fingerprint sensor **402** comprises a polymer thick film

("PTF") construction, which provides the fingerprint sensor **402** with the flexibility and ruggedness needed for implementation on the device **400**. As is described in greater detail below in FIGS. **5** and **6***a*, the fingerprint sensor **402** comprises a matrix of points that are operable to detect high and low points corresponding to ridges and valleys of a fingerprint. The points are captured and used by the ASIC **406** to determine whether the detected fingerprint analog matches a fingerprint template analog that is stored in memory.

Referring now to FIG. **5**, in one embodiment, the PTF sensor **402** comprises a rectangular arrangement of row electrodes **502** and column electrodes **504**. It is noted that more or fewer columns and rows may be included in the PTF sensor **402**, depending on such factors as the desired resolution of the PTF sensor **402** (e.g., the number of data points desired). Electrical connections from the row and column electrodes **502**, **504** may route to the ASIC **306**.

In operation, a fingerprint analog detected by the PTF sensor **402** may be captured by the ASIC **406** as a sequence of numerical values. For purposes of illustration, the row and column electrodes **502**, **504** may be viewed as a two dimensional matrix of pixels, with numerical values representing intersections between the row and column electrodes. The numerical values may be associated with gray scale values, and an analog representing a fingerprint may be generated from the matrix of gray scale values. It is understood that there is no need to transform the captured analog into a visible image since the matching between the stored template fingerprint analog and the candidate fingerprint analog need not rely on a visual process. However, it is convenient to conceptualize the numerical values as an image for purposes of evaluating the sensor resolution used to support fingerprint authentication. It is generally accepted that a graphical resolution of from 100 dots per inch ("dpi") to 500 dpi is sufficient for fingerprint authentication. In the present example, the PTF sensor **402** comprises 200 row electrodes and 200 column electrodes arranged in a ½" by ½" matrix, which corresponds to a graphical resolution of 400 dpi.

Referring now to FIG. **6***a*, a schematic depiction of functional layers of one embodiment of the PTF sensor **402** of FIG. **4** is shown. The PTF sensor **402** is comprised of functional layers including an annularly shaped topside electrode **602**; an insulator with backside reflector **604**; an electro-luminescent layer **606**; insulator layers **608**, **612**, **616**, and **620**; row electrodes **610**; column electrodes **614**; an electro-resistive layer **618**; an electrode **622**; and a substrate layer **624**. The substrate layer **624** may be a portion of the substrate for the entire device **400**.

In operation, when a user of the device **400** places a finger or thumb (henceforth only finger will be specified, although it is understood that both fingers and thumb are intended) on the surface of the PTF sensor **402**, the finger contacts the topside electrode **602** and becomes electrically grounded to the topside electrode **602**. When a voltage is applied to row electrodes **610**, an electric field is generated between the row electrodes **610** and the topside electrode **602**. The strength of the generated field varies depending on how close the finger is to the topside electrode **602**. For example, fingerprint ridges may be relatively close to the topside electrode **602** of the PTF sensor **402**, varying the generated field in a detectable manner. Fingerprint valleys may be more distant from the PTF sensor **402** than the fingerprint ridges, which may vary the generated field in a detectable manner that may be differentiated from the variations caused by the fingerprint ridges.

The electro-luminescent layer **606** may emit more or less light as the electric field that impinges upon it varies, thereby generating an analog of the fingerprint incident upon the PTF sensor **402**. The reflector component of the insulator with backside reflector layer **604** serves to reflect the omni directional light emitted by the electro-luminescent layer **606** and thus intensify the fingerprint analog. The PTF sensor **402** may be operated by applying a bias voltage to only one row electrode at a time, successively biasing and unbiasing one row after another. This has the effect of causing the electro-luminescent layer **606** to generate an analog of an elongated thin strip of the fingerprint. By sensing each of these analogs and combining them upon completion of row sequencing, a complete analog may be collected.

It is a property of the electro-resistive layer **618** that when it is placed in an electrical field its resistance varies with the intensity of light incident upon it. The light emitted by the electro-luminescent layer **606**, which is an analog of the fingerprint, passes through the intervening layers **608**, **610**, **612**, **614**, and **616** to impinge upon the electro-resistive layer **618**. The electro-resistive layer **618** is placed in an electric field by placing a DC voltage bias on the electrode **622** relative to the column electrodes **614**, causing the electro-resistive layer to exhibit varying resistance depending upon the intensity of light incident upon it and thereby forming an analog of the fingerprint. A voltage is applied to the column electrodes **614**, and the impedance between the column electrodes **614** and the electrode **622** can be measured. This measured impedance is directly related to the varying resistance of the electro-resistive layer **618** and hence an analog of the fingerprint. So by activating each row electrode in succession, as described above, an analog of the fingerprint can be captured and stored.

The ASIC **306** may control the sequential activation of the row electrodes **610**, the reading back of the varying resistance from the column electrodes **614**, and other functions of the PTF sensor **402**. It is understood that other approaches may be used, such as reading one column at a time for each row or reading multiple row/columns at once. Furthermore, while the preceding description focuses on the use of the PTF sensor **402** as a fingerprint sensor, the principle of operation of the PTF sensor **402** is general and not limited to capturing fingerprint analogs.

Referring now to FIG. **6***b*, one embodiment of a portion of the device **400** illustrates the biometric sensor **402**, display **412**, and RF antenna **404** formed on the substrate **624**. The biometric sensor comprises layers **602**-**622** as described with respect to FIG. **6***a*, the display **412** comprises layer **626**-**636**, and the RF antenna comprises layers **638**-**648**. As is illustrated in FIG. **6***b*, each of the components **402**, **412**, **404** share a number of layers (e.g., **622**, **636**, and **648**). This sharing simplifies the design of the device **400** and may also reduce manufacturing costs.

Referring again to FIG. **4**, the RF antenna **404**, which may comprise one or more antennae, may capture RF energy from a RF field emanated by a RF power source and may also support two-way communication with an associated reader/writer device (not shown). The RF energy which is captured is converted to electrical energy and accumulated within the device **400**. In some embodiments of the device **400**, a rechargeable battery may power the electronic components when no RF energy field is present. Such a battery may be charged via an RF energy field or alternative charging means.

The electro-luminescent display **412** provides the capability to display information to a user of the device **400**. For

example, the information may include a credit card number to support "card not present" transactions, a residual balance of an "electronic purse," air travel flight and seat assignment information, and similar information. Furthermore, interaction with the display **412** may be accomplished via the function control buttons **410**. For example, the buttons **410** may be used to select a credit card number (if the device **400** stores multiple numbers) viewed via the display **412** or to enter a personal identification number. The pliability of the electro-luminescent display **412** aids its use in the card-like form factor of the device **400**. While two function control buttons **410** are illustrated, it is understood that other numbers and configurations of function control buttons may be used.

A dynamic magnetic strip **414** is provided to provide compatibility with existing reader devices. The dynamic magnetic strip **414** may be used in either fixed or dynamic mode. In dynamic mode, magnetically stored information—such as a credit card number—may be changed under control of the ASIC **406**.

Referring now to FIG. **7**, an illustrative power circuit **700**, such as may be used in the device **400** of FIG. **4**, is depicted. When appropriate RF energy is incident upon the device **400**, the RF energy couples into a RF antenna **702**. From the antenna **702**, the energy enters a RF-to-DC power converter **704**, which includes a full-wave rectifier to convert the AC RF field into a DC-like circuit. Capacitance may be provided to buffer the AC peak variations into a DC-like source. The intermediate power generated by this process may be used for a variety of purposes, such as charging a battery **706** if the battery **706** is below its full capacity and feeding power to the device **400**. The battery **706** may be charged through a battery management unit **708**. A smart power multiplexer **710** may be used to determine whether to draw power from the battery management unit **708**, directly from the RF-to-DC power converter **704**, or from both.

A voltage regulator **712** creates a stable DC voltage level to power the device **400**. When no RF energy is coupled into the RF antenna **702**, the RF-to-DC converter **704** may not function and power may be drawn from the battery management unit **708** by the smart power multiplexer **710**. As before, the voltage regulator **412** creates a stable DC voltage level to power the device **400**. It is understood that, in other embodiments, the power circuit **700** may not employ a battery or rechargeable battery, and may rely solely on power captured from the RF field.

Referring now to FIG. **8**, an exemplary template storage method **800** illustrates one embodiment for capturing and storing a template of a fingerprint analog for the device **400** of FIG. **4**. In step **802**, a user places the device **400** in a RF field emanated by a reader/writer device. As described previously, the device **400** captures power from the RF field. In step **804**, the user places his thumb or finger on the fingerprint sensor **402** and, in step **806**, the device **400** determines whether a template fingerprint analog is already stored. If it is determined that no template fingerprint analog is stored, the method **800** continues to step **808**. In step **808**, the user's incident fingerprint is sensed by the fingerprint sensor **402**, a fingerprint analog is generated by the fingerprint sensor **402**, and the ASIC **406** stores the fingerprint analog as a template fingerprint analog. If a fingerprint template analog is already stored, the method **800** continues to step **810**, where the device **400** is removed from the RF field. It is understood that other events may occur before step **810** if a fingerprint template analog is already stored, such are illustrated in FIG. **9**.

Although not shown in the present example, multiple template fingerprint analogs may be stored in the device **400**. The template fingerprint analogs may represent multiple fingerprints of a single person or may represent the fingerprints of different people. This may be accomplished, for example, by implementing a method for allowing the device **400**'s owner to securely control initialization of multiple template fingerprint analogs and to selectively enable which template fingerprint analog will be used to authenticate identity and authorize transactions. Alternatively, if the device **400** is to be used in environments requiring higher security, the user of the device **400** may need to appear in person and validate his or her identify using traditional methods (e.g., a driver's license, birth certificate, etc.). After validation, the user's template fingerprint analog may be placed into the device **300** as described above or through other means (e.g., a scanner that transfers the template fingerprint analog into the device **300**).

Referring now to FIG. **9**, in another embodiment, a method **900** illustrates one method of operation for the device **400**. In step **902**, as has been described previously, the device **400** is placed into an RF field emanated by a reader/writer device. When placed into the RF field, the device **400** captures power, energizing its electronics. In step **904**, a user places one of his fingers onto the fingerprint sensor **402**. As described above, the fingerprint sensor **402** captures an analog of the fingerprint and passes the analog to the ASIC **406**.

In step **906**, an authentication process is performed by comparing the captured fingerprint analog to one or more template fingerprint analogs stored in memory. In step **908**, a determination is made as to whether the user is authenticated (e.g., whether the captured fingerprint analog matches a stored template fingerprint analog). If the authentication process fails to validate the user, the method **900** may return to step **904** as shown or may end, requiring the user to remove the device **400** from the RF field and begin again with step **902**. If the user is validated by the authentication process, the method continues to step **910**, where the device **400** conducts a communications handshake process with the reader/writer device via a contactless two-way communication link. In step **912**, the device **400** continues the desired transaction with the reader/writer device. Once this occurs, the device **400** may be removed from the RF field, which powers down the device **400**.

Referring now to FIG. **10**, in another embodiment, a method **1000** illustrates using the present disclosure in an air transportation environment. A traveler desiring to make a remote reservation presents a device (such as the device **100** of FIG. **1**) to a reader/writer device. In the present example, the reader/writer device is attached to a personal computer ("PC") via a wired or wireless connection. The PC may enable the traveler to access an application, such as a web based flight reservation application.

In step **1002**, a determination is made as to whether the traveler has selected a remote reservation and ticketing process. If the traveler has selected such a process, the method **1000** continues to step **1004**, where the device **100** is used in conjunction with PC and the reader/writer to verify the traveler's identification and approve the transaction and associated payments. In addition, flight information may be transferred from the reader/writer device into the device **100**.

The method **1000** then continues to step **1006**, where a determination is made as to whether the traveler has selected to remotely check-in baggage. If the traveler has not selected to remotely check-in baggage, the method **1000** continues to step **1012**. If the traveler has selected to remotely check-in

baggage, the method **1000** continues to step **1008**, where the device **100** is used in conjunction with PC and the reader/writer to verify the traveler's identification. In addition, flight and ticket information may be read from the device **100** to further automate the baggage check-in process. After the traveler has entered any desired information (e.g., number of bags, etc.), baggage reference information may be transferred into the traveler's device **100**.

Returning to step **1002**, if it is determined that the traveler has not selected a remote reservation and ticketing process, the method **1000** continues to step **1010**, where the traveler may use the device **100** with a reader/writer device at a counter or self-service kiosk in a manner similar to the process of the remote check-in of step **1004**. More specifically, the traveler may use the device **100** to verify the traveler's identification and approve a purchase transaction, as well as any associated payments. In addition, flight information may be transferred from the reader/writer device into the device **100**.

Continuing to step **1012**, the traveler may use the device **100** with the reader/writer device at the counter or self-service kiosk in a manner similar to the process of the remote baggage check-in of step **1008**. More specifically, the traveler may use the device **100** to verify the traveler's identification, provide flight and ticket information, and store baggage reference information that is transferred from the reader/writer device.

After the ticketing and baggage check-in, the method **1000** continues to steps **1014**, **1016**, and **1018**, where the traveler may present the device **100** to other reader/writer devices for identification and ticket authentication. For example, this may occur at security checkpoints, gates, and/or at boarding. It is understood that some of the reader/writer devices may be in communication with airline and/or government databases.

Referring now to FIG. **11**, in another embodiment, a method **1100** illustrates using the present disclosure in a health care environment. In step **1102**, a determination is made as to whether a patient desires to perform a pre check-in process before arriving at a healthcare facility. If it is determined that the patient does desire to perform a pre check-in process, the method **1100** continues to step **1104**, where the patient may present a device (such as the device **100** of FIG. **1**) to a reader/writer device. In the present example, the reader/writer device is attached to a personal computer ("PC") via a wired or wireless connection. The PC may enable the patient to access an application, such as a web based healthcare application. Upon presentation of the device in step **1104**, the patient may be identified, payment and care instructions may be approved, and medical information (e.g., records, prescriptions, etc.) may be activated. The device **100** may also be used to provide the patient with medical alerts.

In step **1106**, if the patient has not performed the pre check-in process of step **1104**, the patient may use the device **100** to perform similar functions at the healthcare facility. The method then continues to step **1108**, where the device may be used to access provider services. For example, the device **100** may be used to interact with a reader/writer device at a desk or workstation in the healthcare facility (e.g., an examination room). This interaction may authenticate the patient's identification, provide access to pertinent medical records, verify that the records are updated, and store one or more prescriptions.

Continuing to step **1110**, the patient may present the device **100** to a reader/writer device at a pharmacy. The device **100** may be used to authenticate the patient's identification for a prescription and provide the prescription to the pharmacy. Furthermore, the device **100** may provide insurance/payment information and enable the patient to approve the transaction.

Referring now to FIGS. **12** and **13**, in another embodiment, methods **1200** and **1300** illustrate using the present disclosure in a financial transaction environment. The financial transaction environment includes making retail purchases in either a physical store or on-line (e.g., over the Internet). The present disclosure may be implemented in the financial transaction environment by using a device, such as the device **100** of FIG. **1**, to identify buyers, verify the identity of the buyer rapidly in a localized venue, associate the buyer's identity with a credit or debit account, and/or assure the availability and legitimacy of funds in these accounts for payment transactions.

Payments for retail purchases are generally accomplished in one of three ways: with cash; with a check; or with a credit or debit card. In a cash transaction, there is generally no need for validating the identification of the buyer. In a transaction where a check is used, there generally is a need for identification of the buyer. This identification may occur by way of the buyer's presentation of a driver's license or alternate, approved identification card, presentation of a credit card to indicate credit-worthiness, or by a telecommunication connection to a check security processing service to assure funds availability for, and legitimacy of, the check presented for payment.

In a transaction where a credit or debit card is used, there are generally various procedural mechanisms in place to assure buyer identification and legitimate ownership of the card presented for the payment transaction. For example, the payment may require the entry of a numeric PIN (Personal Identification Number) security code by the buyer and assumed owner of the card. Alternatively, sales personnel may compare the buyer's signature on the back of the card presented for payment versus the requested signature on the purchase receipt provided for the goods or services purchased. In some cases, cards have a photograph of the card owner on them, and sales personnel may make cursory comparisons of this photograph with the buyer to establish identification. However, both photographic comparison and PIN-based card authorization have weaknesses for assuring identification, and both have potential risk for fraudulent processing. Photographs can be falsified and PIN numbers can be stolen. In the case of on-line purchases, buyers are not present to provide authorizing signatures, photographic comparisons cannot be made with existing processing infrastructure, and PIN-based transactions can be compromised with identity theft.

Referring specifically to FIG. **12**, before the device **100** is usable in financial transactions, it should be initialized by the buyer/owner with the registration of a selected fingerprint pattern into secured memory of the device **100**. To register a selected fingerprint, the device owner holds the device **100** in the RF field generated by a point of sale (POS) device, which may be a kiosk, personal computer, cash register, or similar device. The RF energy from the POS device provides for the power of the device **100** and display activation in step **1202**. In step **1204**, a determination is made as to whether the device **100** has been previously used. For example, the device **100** may determine if a fingerprint template analog is already stored in memory. If the device **100** has been previously used, the method **1200** ends. If the device has not been previously used, the device **100** continues to step **1206**, where the owner is prompted to actuate the biometric sensor. For example, this may entail the owner briefly touching the

biometric sensor **102** on the device **100** with a selected finger or thumb. The fingerprint information is read from the biometric sensor **102** and stored in the device **100** in steps **1208**, **1210** while the owner maintains contact with the biometric sensor **102**. The owner may maintain contact with the biometric sensor **102** until, in step **1212**, an acknowledgement is displayed on the display **110** that the fingerprint pattern has been successfully registered in the device **100** as an encrypted template.

Referring specifically to FIG. **13**, to authorize a payment transaction where invoice information is displayed by the POS device, the user of the device **100** holds the device **100** within an RF field generated by an RF reader connected to the POS device in step **1302**. For example, the user may hold the device **110** at an approximate six inch distance from the RF reader. In step **1304**, the user actuates the biometric sensor **102** (e.g., touches the fingerprint sensor with his/her finger or thumb) to effect a comparative match with his/her previously registered fingerprint securely stored in the memory of the card. A successful match effects an encrypted approval and transfer of cardholder account data to the seller's administrative accounts receivables processing system.

In step **1306**, a determination is made as to whether the user desires to transfer electronic receipt information to the device **100**. If not, the method **1300** continues to step **1310**, where the device **100** is removed from the RF field. If it is determined in step **1306** that the user does want to transfer electronic receipt information to the device **100**, the method **1300** continues to step **1308**, where the device **100** stores the information in memory. The method **1300** may then continue to step **1308**, where the device **100** is removed from the RF field.

While the preceding description shows and describes one or more embodiments, it will be understood by those skilled in the art that various changes in form and detail may be made therein without departing from the spirit and scope of the present disclosure. For example, the present disclosure may be implemented in a variety of form factors, such as a wristwatch or wristwatch band, a key ring, or a variety of other physical structures. Therefore, the claims should be interpreted in a broad manner, consistent with the present disclosure.

What is claimed is:

1. An apparatus comprising a flexible device having approximately the size and shape of a credit card, the device including circuitry and the circuitry including a biometric sensor that can detect biometric information associated with a user of the device, the biometric sensor being flexible;

wherein the device has an edge portion with approximately the size and shape of an edge portion of a credit card;

wherein the biometric sensor includes a fingerprint sensor; and

wherein the circuitry further includes:

a flexible display;

memory that can store biometric template information and a plurality of account numbers;

a manually operable button;

a processor coupled to the fingerprint sensor, the display, the memory and the button, the processor being responsive to biometric input information from the fingerprint sensor for comparing the biometric input information with the biometric template information, and being responsive to manual operation of the button for selecting one of the account numbers in the memory;

a section that is coupled to the processor, that the processor can use to receive and transmit radio frequency signals, and that is responsive to electromagnetic fields external to the device for supplying operating power to other portions of the circuitry, the section including an antenna;

a part that is disposed on the portion of the device, that is coupled to the processor, and that under control of the processor can produce externally of the device a magnetic field readable by a magnetic strip reader; and

a contact smart card chip coupled to the processor.

2. An apparatus according to claim **1**, wherein the processor transmits through the section a communication that is a function of whether the stored biometric template information matches the biometric input information obtained with the biometric sensor.

3. An apparatus according to claim **1**, wherein the processor effects variation of the magnetic field.

4. An apparatus according to claim **1**, wherein the processor effects variation of the magnetic field as a function of biometric input information obtained with the biometric sensor.

5. An apparatus according to claim **1**, wherein the processor effects variation of the magnetic field as a function of whether the stored biometric template information matches biometric input information obtained with the biometric sensor.

6. An apparatus according to claim **1**, wherein the circuitry includes a rechargeable battery, the battery being recharged by the operating power produced by the section from external electromagnetic fields.

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