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Burrows

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(54) **SYSTEM FOR SENSING THE OPENING AND CLOSING OF A PHARMACEUTICAL CONTAINER**

(76) Inventor: **Mark D. Burrows**, Princeton, NJ (US)

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G01N 7/14 (2006.01)
B65D 83/04 (2006.01)
G04B 47/00 (2006.01)

(52) **U.S. Cl.** **324/207.2**; 215/230; 206/534; 368/10

(58) **Field of Classification Search** .... None
See application file for complete search history.

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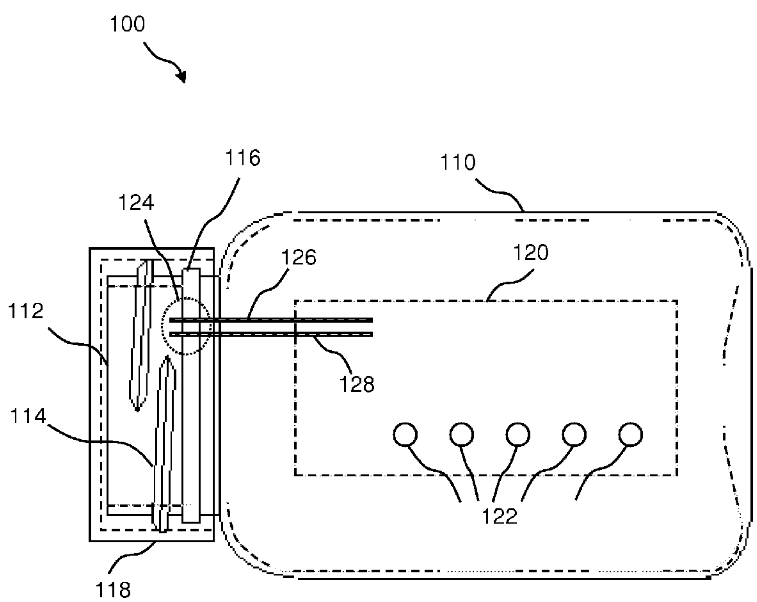
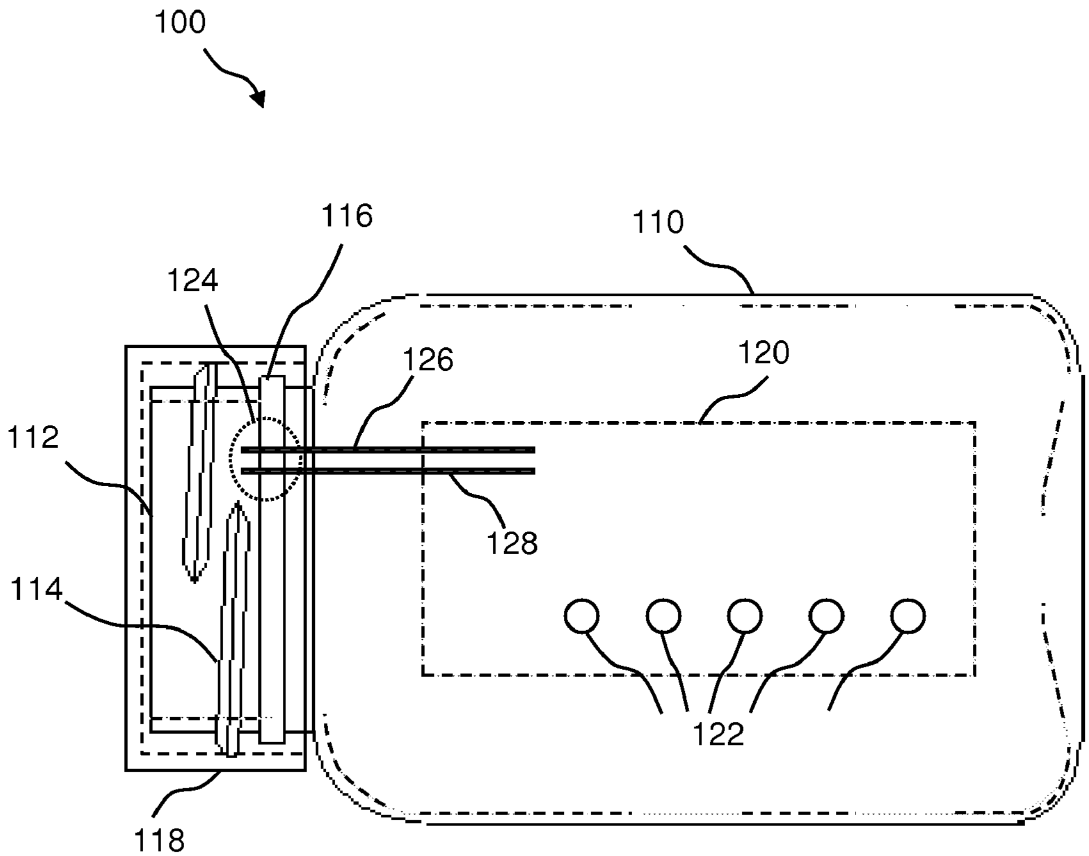
Primary Examiner — Jay Patidar
(74) *Attorney, Agent, or Firm* — Ward and Smith, P.A.

(57) **ABSTRACT**

Multiple embodiments of mechanisms for sensing the opening and closing of pharmaceutical containers are disclosed. In particular, the example sensing mechanisms of the invention trigger an automatic, built-in, electronic dosage reminder and open/close event logging operation while requiring no additional actions or otherwise changed behavior by the patient, in order to increase patient compliance with dosing regimens. Furthermore, certain embodiments of the sensing mechanisms are reliable and sufficiently low cost to be practical for use in commercial product applications. In one embodiment, the sensing mechanism includes two electrical conductors that have no electrical connection therebetween when the closure is not present on the container and a bridge conductor in the closure that provides an electrical connection therebetween when the closure is tightened onto the container. In this example embodiment, the state of the two electrical conductors may be monitored in order to sense a container opening and closing event.

10 Claims, 5 Drawing Sheets




100
116
110
124
126
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128
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118

FIG. 1A

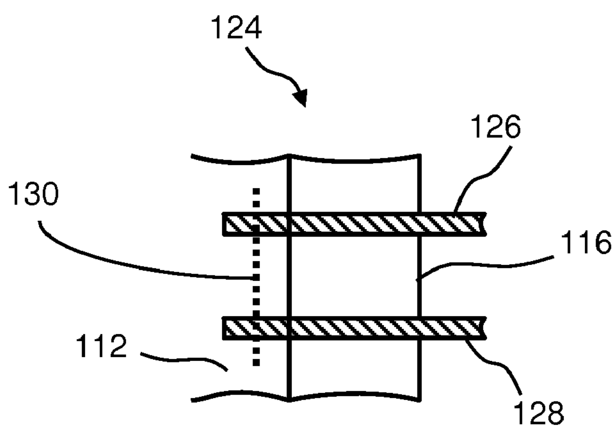
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FIG. 1B

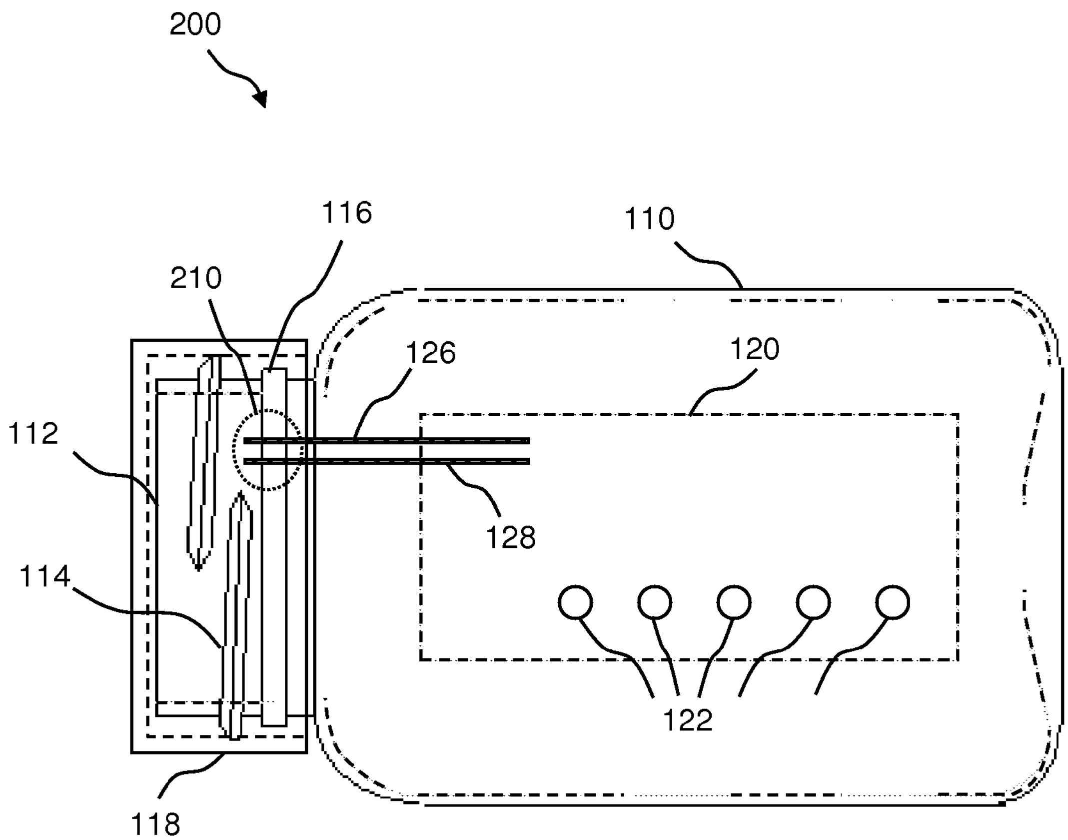
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FIG. 2A

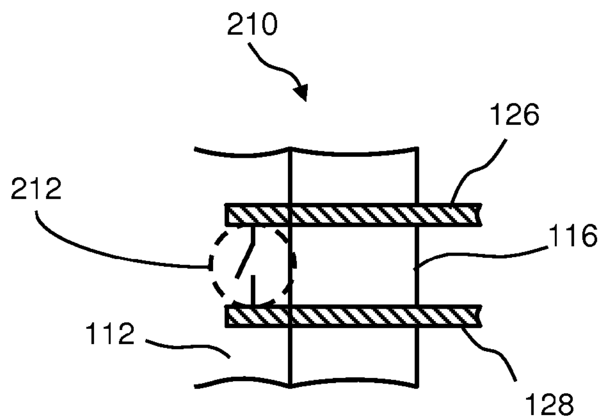
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FIG. 2B

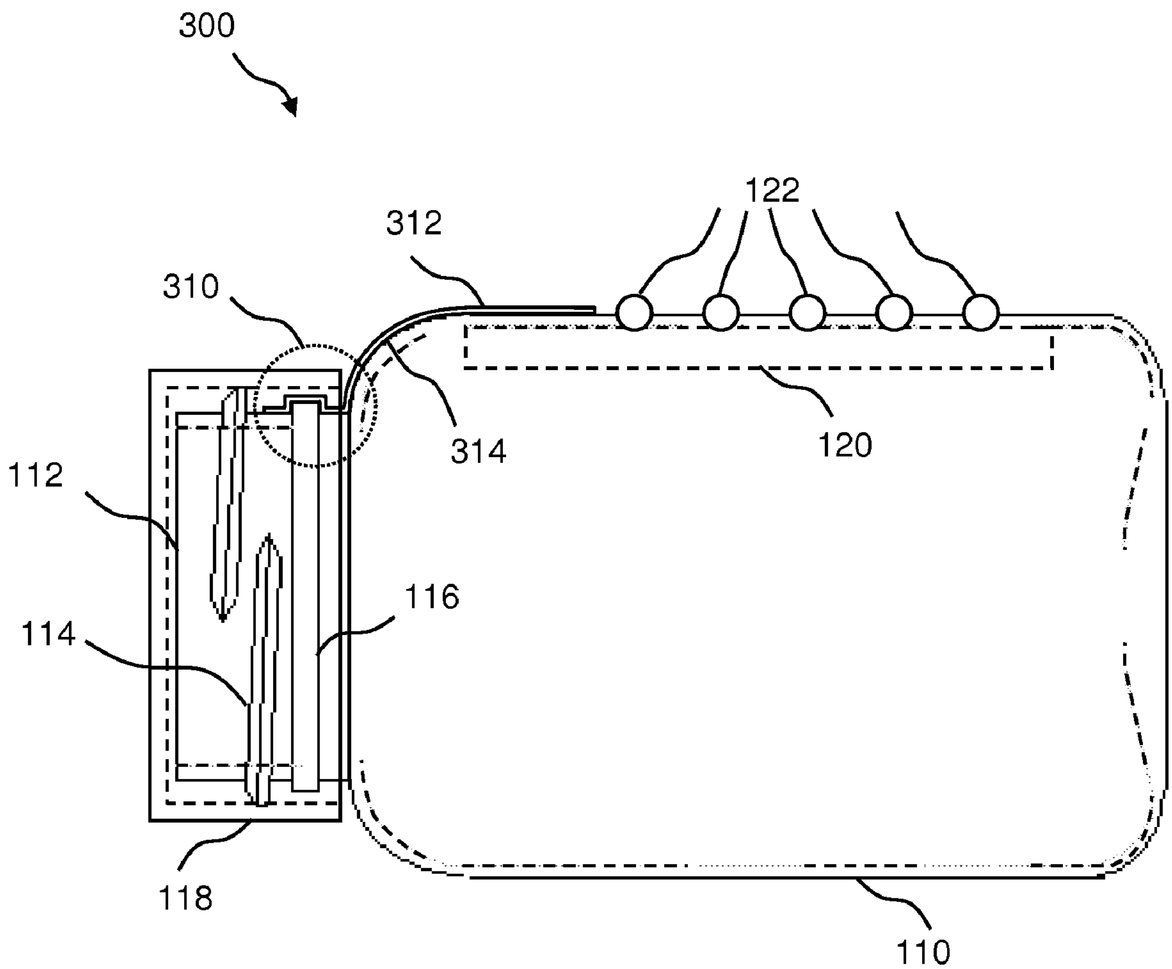
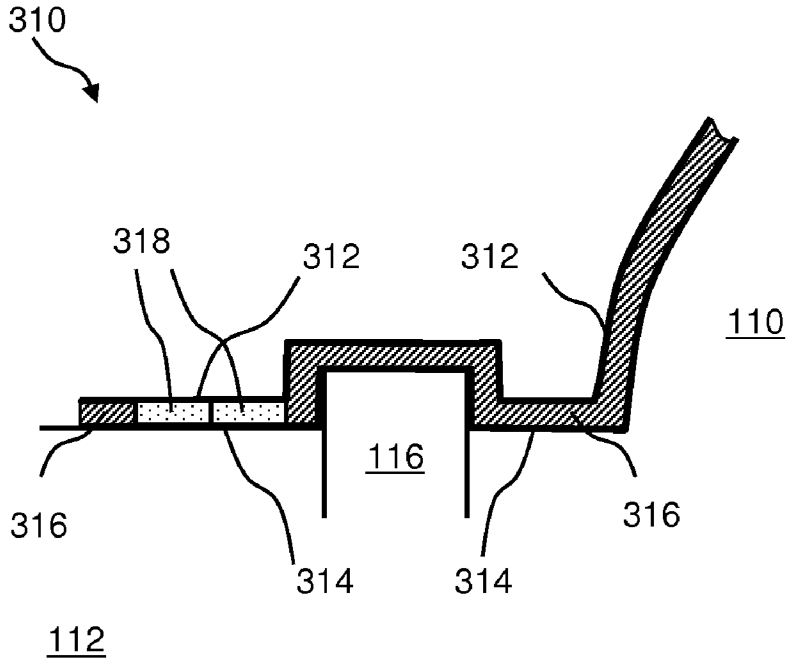


FIG. 3A


310
318
312
312
110
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314
314
112

FIG. 3B

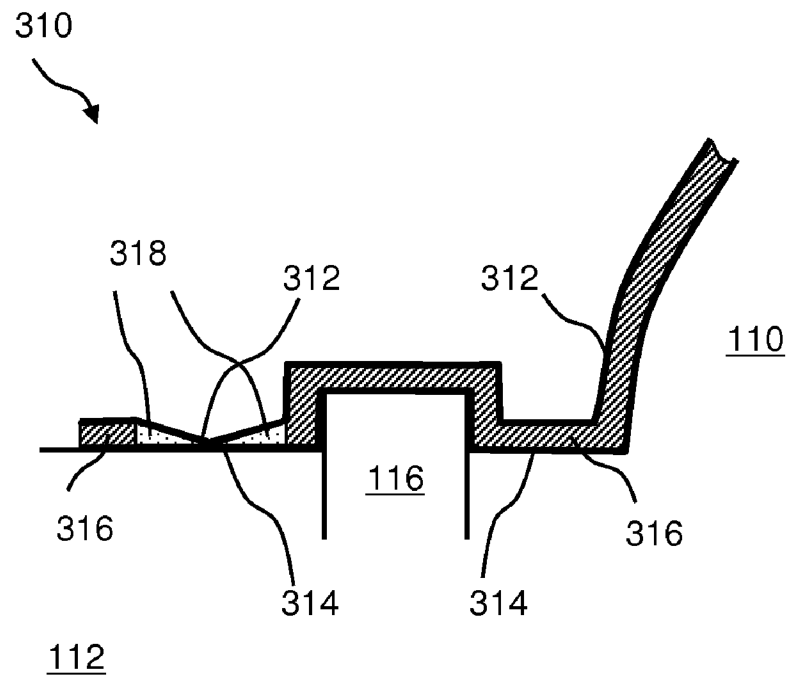
310
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FIG. 3C

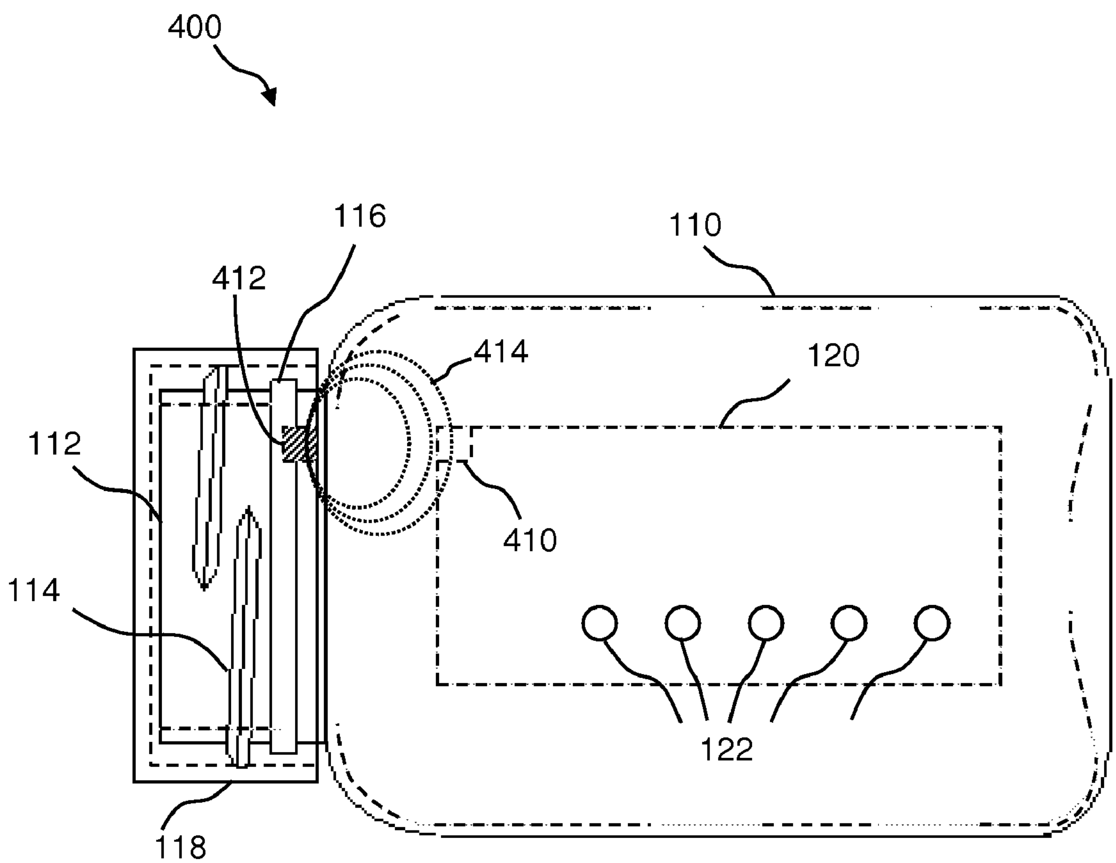

FIG. 4

SYSTEM FOR SENSING THE OPENING AND CLOSING OF A PHARMACEUTICAL CONTAINER

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of, and expressly incorporates herein by reference, the entire disclosure of U.S. provisional patent application Ser. No. 60/948,532, entitled MECHANISMS FOR SENSING THE OPENING AND CLOSING OF PHARMACEUTICAL CONTAINERS, filed Jul. 9, 2007.

FIELD OF THE INVENTION

The present invention generally relates to the field of pharmaceutical containers. In particular, the present invention is directed to mechanisms for sensing the opening and closing of pharmaceutical containers.

BACKGROUND

Outpatient prescription medication treatments are relied upon heavily for increased quality of life and lower lifetime healthcare costs. Medical experts have long held that taking at least 80% of a prescribed drug is required to achieve desired therapeutic outcomes and lower lifetime healthcare costs. For example, a patient who faithfully takes cholesterol-reducing medicine significantly reduces the likelihood of a coronary event that has attendant cost-intensive medical procedures and diminished quality of life. Outpatients strongly desire to avoid such events and hospital stays, yet only 20% of all outpatients take their prescription medicines according to doctor's instructions.

Pharmaceutical manufacturers also stand to gain from increased outpatient medication compliance in the form of increased medication sales. Accordingly, these manufacturers are actively investing in and testing compliance-increase techniques. A marketing executive at one major pharmaceutical company said that his market research has documented that patients want to comply, but will not take on the burden of any additional actions or otherwise change behavior.

For these reasons, a need exists for reminder mechanisms for increasing patient compliance with dosing regimens. In particular, a need exists for reminder mechanisms that place little or no burden on the patient and that are sufficiently low cost to be practical for use in commercial product applications.

BRIEF SUMMARY OF THE INVENTION

The present invention is a system for sensing the opening and closing of a pharmaceutical container. The system includes a pharmaceutical container, the pharmaceutical container further including a container body, a container neck disposed at one end of the container body, container threads disposed on the container neck, a rim disposed between the container threads and the container body, a container closure removably attached to the container neck via the container threads, control circuitry integrated within the container body, indicators integrated within the container body and an automatic sensing mechanism integrated within the pharmaceutical container body.

In one embodiment the automatic sensing mechanism, includes a first conductor disposed along the outside of the container body, a second conductor disposed along the outside of the container body, and a bridge conductor disposed on the inside of the container closure. The bridge conductor provides an electrical connection between the first conductor and second conductor when the container closure is attached to the container neck, and wherein the first conductor, second conductor, and bridge conductor provide a switch function for sensing the presence or absence of the container closure by detecting when an electrical connection exists or not between the first conductor and second conductor via the bridge conductor.

In another embodiment the automatic sensing mechanism includes a first conductor disposed along the outside of the container body, a second conductor disposed along the outside of the container body, and a micro-switch integrated into the container neck between the first conductor and the second conductor. The location of the micro-switch on the container neck is such that when the container closure is tightened upon the container neck a thread of the container closure makes physical contact with an actuator of the micro-switch to close the micro-switch thus providing an electrical connection between the first conductor and second conductor when the container closure is attached to the container neck, and wherein the first conductor, second conductor, and micro-switch provide a switch function for sensing the presence or absence of the container closure by detecting when an electrical connection exists or not between the first conductor and second conductor via the micro-switch.

In yet another embodiment the automatic sensing mechanism includes a first conductor disposed along the outside of the container body, a second conductor disposed along the outside of the container body, and a compression region formed by flexible insulator materials that are abutted one to another and disposed between the first conductor and second conductor. The placement of the flexible insulator material is in alignment with one or more threads of the container closure when the container closure is tightened upon the container neck, and wherein when the container closure is tightened upon the container, its threads apply pressure to the compression region which displaces the flexible insulator material where they abut one another thus causing the first conductor to flex toward the second conductor and make electrical contact thereto, forming a switch function for sensing the presence or absence of the container closure by detecting when an electrical connection exists or not between the first conductor and second conductor.

In yet another embodiment the automatic sensing mechanism includes a Hall effect sensor disposed on the outside of the container body, and a magnet disposed on an edge of the container closure such that it is in close proximity to the Hall effect sensor when the container closure is tightened to the closed position. An output voltage of the Hall effect sensor is at certain states based on the presence or absence of a magnetic field generated from the magnet and thus detects the presence or absence of container closure, thus providing a switch function for sensing the presence or absence of the container closure by detecting when a magnetic field is present or absent.

The present invention further provides a method of sensing the opening and closing of a pharmaceutical container. The method includes providing a pharmaceutical container having an automatic sensing mechanism, sensing the opening and/or closing of the pharmaceutical container, triggering the automatic sensing mechanism to automatically generate a dosage reminder signaling a user at dose time via the control circuitry and indicators which are actuated by opening and re-closing of the pharmaceutical container, and tracking container usage and dosage compliance.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1**A illustrates a side view of a pharmaceutical container that includes an example of a mechanism for sensing the opening and closing thereof, which triggers an automatic, built-in, electronic dosage reminder operation;

FIG. **1**B illustrates a close up side view of the example sensing mechanism of FIG. **1**A;

FIG. **2**A illustrates a side view of a pharmaceutical container that includes another example of a mechanism for sensing the opening and closing thereof, which triggers an automatic, built-in, electronic dosage reminder operation;

FIG. **2**B illustrates a close up side view of the example sensing mechanism of FIG. **2**A;

FIG. **3**A illustrates a side view of a pharmaceutical container that includes yet another example of a mechanism for sensing the opening and closing thereof, which triggers an automatic, built-in, electronic dosage reminder operation;

FIG. **3**B illustrates a side view of the example sensing mechanism of FIG. **3**A in the container open state;

FIG. **3**C illustrates a side view of the example sensing mechanism of FIG. **3**A in the container closed state; and

FIG. **4** illustrates a side view of a pharmaceutical container that includes yet another example of a mechanism for sensing the opening and closing thereof, which triggers an automatic, built-in, electronic dosage reminder operation.

DETAILED DESCRIPTION

The present invention is multiple embodiments of mechanisms for sensing the opening and closing of a container, such as, but not limited to, a pharmaceutical container. In particular, the sensing mechanisms trigger an automatic, built-in, electronic dosage reminder and open/close event logging operation while requiring no additional actions or otherwise changed behavior by the patient, in order to increase patient compliance with dosing regimens. Furthermore, certain embodiments of the sensing mechanisms are reliable and are sufficiently low cost to be practical for use in commercial product applications.

FIG. **1**A illustrates a side view of a pharmaceutical container **100** that includes an example of a mechanism for sensing the opening and closing thereof, which triggers an automatic, built-in, electronic reminder operation. Container **100** is, for example, a pharmaceutical container that contains active and passive electrical components for coupling to the sensing mechanism and providing a response thereto. For example, container **100** includes a hollow container body **110** for containing, for example, a quantity of pills, capsules, caplets, and the like, which are prescribed to a patient (not shown) according to a certain dosing regimen. Container **100** also includes a container neck **112** at one end of container body **110** that has container threads **114** and a rim **116** that is disposed between container threads **114** and container body **110**, as shown in FIG. **1**. Container neck **112** provides an opening by which the contents of container body **110** is accessed. Furthermore, container neck **112** accommodates a closure **118**, which may be a screw-type cap that includes threads (not shown) that correspond to container threads **114** for rotatably securing closure **118**. Container body **110**, container neck **112**, container threads **114**, rim **116**, and closure **118** may be formed of any suitably rigid, lightweight, and food-safe material, such as molded plastic high-density polyethylene (HDPE).

Additionally, integrated within container body **110** of container **100** are control circuitry **120**, a set of indicators **122**, and an example sensing mechanism **124** of the invention. Sensor circuitry **120** may be installed in a well (not shown) that is provided in the outside of container body **110**, such that there is no contact with the contents inside of container body **110**.

Control circuitry **120** is the electronics for providing the overall control of the automatic, built-in reminder functions of container **100**. For example, control circuitry **120** may include a control means and storage means for managing a dosing reminder operation that corresponds to the patient's prescribed dosing regimen. In one example, the patient's prescribed dosing regimen is one dose every 24 hours. In another example, the patient's prescribed dosing regimen is two doses daily. In yet another example, the patient's prescribed dosing regimen is three doses daily.

Additionally, control circuitry **120** monitors the state of sensing mechanism **124**, which is an indicator of whether the patient has consumed a dose of the contents of container **100**. More specifically, control circuitry **120** senses an opening and closing event by sensing the removal and replacement of closure **118** by use of sensing mechanism **124**. In response to the state of sensing mechanism **124**, control circuitry **120** determines the state of indicators **122**, which may be standard light-emitting diode (LED) devices. In one example, a first indicator **124** is a "close container" LED for prompting the user to install closure **118** upon container **100**, a second indicator **124** is a "status ok" LED for indicating that the current state of the dosing regimen is satisfactory, a third indicator **124** is a "missed dose" LED for indicating to the user that a dose has been missed, and a fourth indicator **124** is a "take prescribed dose" LED for indicating to the user that it is time to consume his/her prescribed dose of medication.

Sensing mechanism **124** is formed of a first conductor **126** and a second conductor **128** that are disposed along the outside of container **100**, such that one end of the conductor pair is electrically connected to control circuitry **120** and the opposite end of the conductor pair is disposed at container neck **112**. More details of sensing mechanism **124** are described in FIG. **1**B.

FIG. **1**B illustrates a close up side view of the example sensing mechanism **124** of FIG. **1**A. First conductor **126** and second conductor **128** may be formed of any food-safe, electrically conductive material. In one example, first conductor **126** and second conductor **128** may be formed of non-toxic, electrically conductive ink, available widely from sources such as Creative Materials, in Tyngsboro, Mass. (www.creativematerials.com). In another example, first conductor **126** and second conductor **128** may be formed of non-toxic, electrically conductive metal, such as copper. Optionally, the color of first conductor **126** and second conductor **128** may be the same as the color of container **100**, in order to be inconspicuous such that the user is not prone to tampering therewith. The thickness of first conductor **126** and second conductor **128** may be a few microns. First conductor **126** and second conductor **128** may be spaced anywhere along the perimeter of container neck **112**, e.g., from few microns to about half the circumference of container neck **112**.

FIG. **1**B shows one end of first conductor **126** and second conductor **128** at container neck **112** and near rim **116**. A bridge conductor **130** is provided on the inside of closure **118**, such as along a thread (not shown) of closure **118**. Bridge conductor **130** may be formed of any non-toxic, electrically conductive material. In one example, bridge conductor **130** may be formed of non-toxic, electrically conductive ink, widely available from suppliers such as Creative Materials, in Tyngsboro, Mass. (www.creativematerials.com). In another example, bridge conductor **130** may be formed of non-toxic, electrically conductive metal, such as copper. The contact point of bridge conductor **130** along first conductor **126** and second conductor **128** is not critical.

The combination of first conductor **126** and second conductor **128** and bridge conductor **130** provide a switch function for sensing the presence or absence of closure **118** and, thereby, sense an opening/closing event. More specifically, control circuitry **120** may detect when an electrical connection exists or not between first conductor **126** and second conductor **128** via bridge conductor **130**. This may be accomplished by use of well-known analog or digital circuit elements (not shown) of control circuitry **120**. In one example, first conductor **126** may be connected to about ground (i.e., about 0 volts) and second conductor **128** may be connected to a pull-up resistor to a voltage, such as to about 1 volts. Consequently, when there is no electrical connection between first conductor **126** and second conductor **128**, first conductor **126** is at about ground and second conductor **128** is at about 1 volts. By contrast, when there is an electrical connection between first conductor **126** and second conductor **128**, second conductor **128** is shorted to ground and, thus, both first conductor **126** and second conductor **128** are at about ground. Control circuitry **120** may detect the state of second conductor **128** toggling between about ground and about 1 volt.

Therefore, in operation, when closure **118** is tightened upon container neck **112**, bridge conductor **130** comes into contact with first conductor **126** and second conductor **128** and, thus, provides an electrical connection therebetween. In doing so, control circuitry **120** may detect that second conductor **128** is shorted to ground, which indicates that closure **118** is installed (i.e., container **100** is closed). By contrast, when closure **118** is removed from container neck **112**, bridge conductor **130** is not present and, thus, there is no electrical connection between first conductor **126** and second conductor **128**. In doing so, control circuitry **120** may detect that second conductor **128** is at about 1 volt, which indicates that closure **118** is not installed (i.e., container **100** is open). As a result, a reliable and inexpensive mechanism is provided by use of the example sensing mechanism **124** of FIGS. **1**A and **1**B for sensing a container opening/closing event, which automatically triggers the control functions of control circuitry **120** and, in particular, triggers the dose reminder operations thereof, which triggers the various indicators **122** that are used to prompt the user.

FIG. **2**A illustrates a side view of a pharmaceutical container **200** that includes another example of a mechanism for sensing the opening and closing thereof, which triggers an automatic, built-in, electronic dosage reminder operation. Container **200** is, for example, a pharmaceutical container that contains active and passive electrical components for coupling to the sensing mechanism and providing a response thereto. Container **200** is substantially the same as container **100** of FIGS. **1**A and **1**B, except for the inclusion of sensing mechanism **210** in place of sensing mechanism **124**.

Referring to FIG. **2**B, which illustrates a close up side view of the example sensing mechanism **210** of FIG. **2**A, sensing mechanism **210** includes first conductor **126** and second conductor **128**, as described in FIGS. **1**A and **1**B. However, the electrical connection between first conductor **126** and second conductor **128** of sensing mechanism **210**, which is a function of whether closure **118** is installed or not, is provided via a micro-switch **212**. More specifically, micro-switch **212** is integrated into container neck **112** between first conductor **126** and second conductor **128**. In one example, micro-switch **212** is a normally-open miniature membrane switch, widely available from such suppliers as Xymox of Milwaukee Wis. (www.xymox.com). The location of micro-switch **212** is such that when closure **118** is tightened upon container neck **112**, a thread of closure **118** makes physical contact with the actuator of the normally-open micro-switch **212** in order to close micro-switch **212**. Preferably, micro-switch **212** is installed in an inconspicuous manner, such that the user is not prone to tampering therewith.

In operation, when closure **118** is tightened upon container neck **112**, micro-switch **212** is closed and control circuitry **120**, therefore, detects the presence of closure **118** and that container **100** is closed. By contrast, when closure **118** is not installed upon container neck **112**, micro-switch **212** is open and control circuitry **120**, therefore, detects the absence of closure **118** and that container **100** is open. As a result, a reliable and inexpensive mechanism is provided by use of the example sensing mechanism **200** of FIGS. **2**A and **2**B for sensing a container opening/closing event, which automatically triggers the control functions of control circuitry **120** and, in particular, triggers the dose reminder operations thereof, which triggers the various indicators **122** that are used to prompt the user.

FIG. **3**A illustrates a side view of a pharmaceutical container **300** that includes yet another example of a mechanism for sensing the opening and closing thereof, which triggers an automatic, built-in, electronic dosage reminder operation. Container **300** is, for example, a pharmaceutical container that contains active and passive electrical components for coupling to the sensing mechanism and providing a response thereto. Container **300** is substantially the same as container **100** of FIGS. **1**A and **1**B, except for the inclusion of sensing mechanism **310** in place of sensing mechanism **124**. Sensing mechanism **310** includes a first conductor **312** and a second conductor **314**. More details of sensing mechanism **310** are described in FIGS. **3**B and **3**C.

FIG. **3**B illustrates a side view of the example sensing mechanism **310** of FIG. **3**A in the container open state. FIG. **3**B shows that first conductor **312** and second conductor **314** are oriented one atop the other in relation to the outer surface of container body **110** and container neck **112**. In one example, first conductor **312** and second conductor **314** may be formed of non-toxic, flexible electrically conductive metal, such as, but not limited to, 3M™ electrically conductive tape from 3M Corporation (St. Paul, Minn.). First conductor **312** and second conductor **314** are separated along a portion of their length by an insulator material **316**, which may be, for example, a solid dielectric material, such as, but not limited to, epoxy. Additionally, a compression region of sensing mechanism **310** is formed by, for example, two pieces of flexible insulators **318** that are abutted one to another. Flexible insulators **318** are formed of a compressible insulator material, such as, but not limited to, special conductive tape such as may be available from 3M Corporation (St. Paul, Minn.) or such as may be custom manufactured to application specifications by such suppliers as Creative Materials, in Tyngsboro, Mass. (www.creativematerials.com). The placement of flexible insulators **318** between first conductor **312** and second conductor **314** is in alignment with, for example, one or more threads (not shown) of closure **118**, when closure **118** is tightened upon container neck **112**. The space between first conductor **312** and second conductor **314** and, thus, the thickness of insulator material **316** and flexible insulators **318** may be a few microns.

FIG. **3**C illustrates a side view of the example sensing mechanism **310** of FIG. **3**A in the container closed state. More specifically, when closure **118** is tightened upon container neck **112**, its threads (not shown) apply pressure to flexible insulators **318** (i.e., a compression region) of sensing mechanism **310**, which displaces the material of flexible insulators **318** where they abut one another, as shown in FIG. **3**C. In doing so, first conductor **312** flexes slightly toward second conductor **314** and makes physical and electrical contact thereto, forming a switch mechanism.

Optionally, the color of first conductor **312** and second conductor **314** may be the same as the color of container **300**, in order to be inconspicuous such that the user is not prone to tampering therewith.

In operation and referring again to FIGS. **3**A, **3**B, and **3**C, when closure **118** is tightened upon container neck **112**, first conductor **312** flexes slightly toward second conductor **314** and makes physical and electrical contact thereto, as shown in FIG. **3**C. Consequently, the switch mechanism is closed and, thus, control circuitry **120** detects the presence of closure **118** and that container **100** is closed. By contrast, when closure **118** is not installed upon container neck **112**, second conductor **314** is in its unflexed position, as shown in FIG. **3**B, and not making contact with second conductor **314**. Consequently, the switch mechanism is open and, thus, control circuitry **120** detects the absence of closure **118** and that container **100** is open. As a result, a reliable and inexpensive mechanism is provided by use of the example sensing mechanism **300** of FIGS. **3**A, **3**B, and **3**C for sensing a container opening/closing event, which automatically triggers the control functions of control circuitry **120** and, in particular, triggers the dose reminder operations thereof, which triggers the various indicators **122** that are used to prompt the user.

FIG. **4** illustrates a side view of a pharmaceutical container **400** that includes yet another example of a mechanism for sensing the opening and closing thereof, which triggers an automatic, built-in, electronic dosage reminder operation. Container **400** is, for example, a pharmaceutical container that contains active and passive electrical components for coupling to the sensing mechanism and providing a response thereto. Container **400** is substantially the same as container **100** of FIGS. **1**A and **1**B, except for the inclusion of a Hall effect sensor **410** and a magnet **412** in place of sensing mechanism **124**. More specifically, magnet **412** is installed within closure **118**, preferably at the edge of closure **118** that is closest to container body **110** and in close proximity to Hall effect sensor **410** when closure **118** is tightened.

The Hall effect refers to the potential difference (i.e., Hall voltage) on the opposite sides of an electrical conductor through which an electric current is flowing. The Hall voltage is created by a magnetic field that is applied perpendicular to the current. A Hall effect sensor, such as Hall effect sensor **410**, is a type of position sensor that senses magnetic field strength and produces a voltage that changes with this strength. Hall sensors may have digital or analog outputs. In one example, Hall effect sensor **410** may be selected from widely available offerings, such as by Digi-Key Corporation in Thief River Falls, Minn. (www.digikey.com).

In operation, an output voltage of Hall effect sensor **410** is a certain state when closure **118** is tightened upon container neck **112** because Hall effect sensor **410** senses a magnetic field **414** from magnet **412**. Consequently, control circuitry **120** detects the presence of closure **118**, which indicates that container **100** is closed. By contrast, the output voltage of Hall effect sensor **410** is a certain different state when closure **118** is removed from container neck **112**, such as by unscrewing, because Hall effect sensor **410** no longer senses sufficient magnetic field **414** from magnet **412** to register a circuit-closed state. Consequently, control circuitry **120** detects absence of closure **118**, which indicates that container **100** is open. The strength of magnetic field **414** of magnet **412** may be optimized for the distance between magnet **412** and Hall effect sensor **410** when closure **118** is in the tightened position upon container neck **112**. In one example, magnet **412** is a magnet having a field strength range of several hundred Gauss to several thousand Gauss, depending on the sensitivity of readily available, low-cost Hall effect sensors. Preferably, magnet **412** is a miniature magnet that is installed in an inconspicuous manner in closure **118**, such that the user is not prone to tampering therewith.

Additionally, in order to optimize the lifetime of the battery (not shown) of container **400**, control circuitry **120** polls the state of Hall effect sensor **410** periodically, such as every 100 milliseconds, instead of continuously.

Referring again to FIG. **4**, a reliable mechanism is provided by use of Hall effect sensor **410** and magnet **412** for sensing a container opening/closing event, which automatically triggers the control functions of control circuitry **120** and, in particular, triggers the dose reminder operations thereof, which triggers the various indicators **122** that are used to prompt the user.

The present invention is not limited to prescription medication applications only. Alternatively, the invention may apply to any non-prescription medication application. Additionally, the present invention is not limited to pharmaceutical applications only. Alternatively, the invention may apply to any product dispensing application within which it is beneficial to improve the dispensing regimen or usage of a product in a container. In one example, in a paint or urethane container application, it is beneficial to issue a reminder that sufficient time has passed to apply a second coat of paint or urethane. In another example, in a glue container application, it is beneficial to issue a reminder that sufficient time has passed for the glue to set, which indicates that the glued item may be ready to use. In yet another example, wound-dressing regimens require strict observance in order to maximize infection prevention. In yet another example, sunscreen packages may remind parents users when to reapply sunscreen, given its finite life once applied.

The foregoing description of various aspects of the disclosure has been presented for purposes of illustration and description. It is not intended to be exhaustive or to limit the disclosure to the precise form disclosed, and obviously, many modifications and variations are possible. Such modifications and variations that may be apparent to a person skilled in the art are intended to be included within the scope of the disclosure as defined by the accompanying claims.

What is claimed is:

1. A system for sensing the opening and closing of a pharmaceutical container, the system comprising:
- a pharmaceutical container, comprising:
- a container body;
- a container neck disposed at one end of the container body;
- container threads disposed on the container neck;
- a container closure removably attached to the container neck via the container threads;
- control circuitry attached to the external surface of the container and integrated with the container body;
- indicators, comprising a plurality of light emitting diodes (LEDs) connected to the control circuitry, attached to the external surface of the container and integrated with the container body, comprising a first indicator, a second indicator, a third indicator, and a fourth indicator, wherein the first indicator represents a LED for prompting a user to install the closure upon pharmaceutical container, the second indicator represents a LED for indicating that current state of a dosing regimen is satisfactory, the third indicator represents a LED for indicating to the user that a dose has been missed, and the

fourth indicator represents a LED for indicating to the user that it is time to consume his/her prescribed dose of medication;

and an automatic sensing mechanism integrated within the pharmaceutical container body.

2. The system of claim **1**, wherein the control circuitry is installed in a well formation that is provided in the outside of the container body, such that the control circuitry is not in direct contact with the contents inside of the container body.

3. The system of claim **1**, wherein the control circuitry provides control for the automatic sensing mechanism.

4. The system of claim **1**, wherein the control circuitry provides a control means and storage means for managing the automatic sensing mechanism.

5. The system of claim **1**, wherein the automatic sensing mechanism, comprises

a Hall effect sensor disposed on the outside of the container body; and

a magnet disposed on an edge of the container closure such that it is in close proximity to the Hall effect sensor when the container closure is tightened to the closed position, wherein, an output voltage of the Hall effect sensor is at certain states based on the presence or absence of a magnetic field generated from the magnet and thus detects the presence or absence of container closure, thus providing a switch function for sensing the presence or absence of the container closure by detecting when a magnetic field is present or absent.

6. A system for sensing the opening and closing of a pharmaceutical container, comprising:

a pharmaceutical container, comprising:

a container body;

a container neck disposed at one end of the container body;

container threads disposed on the container neck;

a container closure removably attached to the container neck via the container threads:

control circuitry attached to the external surface of the container and integrated with the container body;

indicators attached to the external surface of the container and integrated with the container body; and

an automatic sensing mechanism integrated within the pharmaceutical container body, comprising:

a first conductor disposed along the outside of the container body;

a second conductor disposed along the outside of the container body;

a first end of the first and second conductors is electrically connected to the control circuitry and a second end of the first and second conductors is disposed at the container neck; and

a bridge conductor disposed on the inside of the container closure, wherein the bridge conductor provides an electrical connection between the first conductor and second conductor when the container closure is attached to the container neck, and wherein the first conductor, second conductor, and bridge conductor provide a switch function for sensing the presence or absence of the container closure by detecting when an electrical connection exists or not between the first conductor and second conductor via the bridge conductor.

7. The mechanism of claim **6**, wherein the first conductor and the second conductor extend parallel to one another and are spaced a defined distance apart along the perimeter of the container neck.

8. The mechanism of claim **6**, wherein the bridge conductor is provided on a thread on the inside of the container closure.

9. A system for sensing the opening and closing of a pharmaceutical container, comprising:

a pharmaceutical container, comprising:

a container body;

a container neck disposed at one end of the container body;

container threads disposed on the container neck;

a container closure removably attached to the container neck via the container threads:

control circuitry attached to the external surface of the container and integrated with the container body;

indicators attached to the external surface of the container and integrated with the container body; and

an automatic sensing mechanism integrated within the pharmaceutical container body, comprising:

a first conductor disposed along the outside of the container body;

a second conductor disposed along the outside of the container body;

a first end of the first and second conductors is electrically connected to the control circuitry and a second end of the first and second conductors is disposed at the container neck; and

a micro-switch integrated into the container neck between the first conductor and the second conductor, wherein the location of the micro-switch on the container neck is such that when the container closure is tightened upon the container neck a thread of the container closure makes physical contact with an actuator of the micro-switch to close the micro-switch thus providing an electrical connection between the first conductor and second conductor when the container closure is attached to the container neck, and wherein the first conductor, second conductor, and micro-switch provide a switch function for sensing the presence or absence of the container closure by detecting when an electrical connection exists or not between the first conductor and second conductor via the micro-switch.

10. A system for sensing the opening and closing of a pharmaceutical container, the system comprising:

a pharmaceutical container, comprising:

a container body;

a container neck disposed at one end of the container body;

container threads disposed on the container neck;

a container closure removably attached to the container neck via the container threads:

control circuitry attached to the external surface of the container and integrated with the container body;

indicators attached to the external surface of the container and integrated with the container body;

an automatic sensing mechanism integrated within the pharmaceutical container body, comprising:

a first conductor disposed along the outside of the container body;

a second conductor disposed along the outside of the container body;

a first end of the first and second conductors is electrically connected to the control circuitry and a second end of the first and second conductors is disposed at the container neck; and

a compression region formed by flexible insulator materials that are abutted one to another and disposed between the first conductor and second conductor, wherein the placement of the flexible insulator material is in alignment with one or more threads of the container closure when the container closure is tightened upon the container neck, and wherein when the container closure is tightened upon the container, its threads apply pressure to the compression region which displaces the flexible insulator material where they abut one another thus causing the first conductor to flex toward the second conductor and make electrical contact thereto, forming a switch function for

sensing the presence or absence of the container closure by detecting when an electrical connection exists or not between the first conductor and second conductor.

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