COMMUNICATION SYSTEM INCORPORATED IN AN INGESTIBLE PRODUCT

CROSS-REFERENCE TO RELATED APPLICATIONS

[001] This application is a continuation-in-part application of U.S. Application No. 13/180,507 filed July 11, 2011 and entitled "Communication System Incorporated in an Ingestible Product," published on January 5, 2012 as U.S. Publication No. 2012/0004527A1, which application is a continuation of U.S. Publication PCT/US20100081894A1 filed on Sept 21, 2009 (U.S. Patent Application No. 12/564,017, now US Patent 7,978,064) and entitled "Communication System with Partial Power Source", which is a continuation-in-part application of U.S. Patent Application No. 11/912,475 filed June 23, 2008, published on November 20, 2008 as U.S. Publication No. 2008/0284599A1: which application is a 371 application of PCT Application Serial No. PCT/US06/16370 filed April 28, 2006, published on January 17, 2008 as WO2006/116718A3; which application pursuant to 35 U.S.C. § 119 (e), claims priority to the filing dates of: United States Provisional Patent Application Serial No. 60/676,145 filed April 28, 2005; United States Provisional Patent Application Serial No. 60/694,078 filed June 24, 2005; United States Provisional Patent Application Serial No. 60/713,680 filed September 1, 2005 and United States Provisional Patent Application Serial No. 60/790,335 filed April 7, 2006; the disclosures of which are herein incorporated by reference.

[002] This application is related to the following US Applications filed on July 11, 2011, the disclosures of which are incorporate herein by reference: US Application Serial No. 13/180,516, filed July 11, 2011 and entitled COMMUNICATION SYSTEM WITH REMOTE ACTIVATION, published on January 12, 2012 as U.S. Publication No. 2012/0007734A1; US Application Serial No. 13/180,525 filed on July 11, 2011 and entitled COMMUNICATION SYSTEM WITH ENHANCED PARTIAL POWER AND METHOD OF MANUFACTURING SAME, published on May 10, 2012 as U.S. Publication No. US2012/0116188A1; US Application Serial No. 13/180,498, filed July 11, 2011 and entitled COMMUNICATION SYSTEM

WITH MULTIPLE TYPES OF POWER, published on January 5, 2012 as U.S. Publication No. 2012/0004520A1; US Application Serial No. US Application Serial No. 13/180,538, filed July 11, 2011 and entitled COMMUNICATION SYSTEM USING POLYPHARMACY CO-PACKAGED MEDICATION DOSING UNIT, published on February 2, 2012 as U.S. Publication No. 2012/0024889A1; US Application

Serial No. 13/180,539, filed July 11, 2011 and entitled COMMUNICATION SYSTEM USING AN IMPLANTABLE DEVICE, published on January 5, 2012 as U.S. Publication No. 2012/0004527A1.

FIELD

[003] The present invention is related to communication systems for detection of an event. More specifically, the present disclosure includes a system that includes a device for association with ingestible ingredients or products.

INTRODUCTION

[004] Ingestible devices that include electronic circuitry have been proposed for use in a variety of different medical applications, including both diagnostic and therapeutic applications. These devices typically require an internal power supply for operation. Examples of such ingestible devices are ingestible electronic capsules which collect data as they pass through the body, and transmit the data to an external receiver system. An example of this type of electronic capsule is an in-vivo video camera. The swallowable capsule includes a camera system and an optical system for imaging an area of interest onto the camera system. The transmitter transmits the video output of the camera system and the reception system receives the transmitted video output. Other examples include an ingestible imaging device, which has an internal and self-contained power source, which obtains images from within body lumens or cavities. The electronic circuit components of the device are enclosed by an inert indigestible housing (e.g. glass housing) that passes through the body internally. Other examples include an ingestible data recorder capsule medical device. The electronic circuits of the disclosed device (e.g. sensor, recorder, battery etc.) are housed in a capsule made of inert materials.

[005] In other examples, fragile radio frequency identification (RFID) tags are used in drug ingestion monitoring applications. In order for the RFID tags to be operational, each requires an internal power supply. The RFID tags are antenna structures that are configured to transmit a radio-frequency signal through the body.

[006] The problem these existing devices pose is that the power source is internal to device and such power sources are costly to produce and potentially harmful to

electrode materials upon contact of the metals of the power source with the target physiological site is 0.001 V or higher, including 0.01 V or higher, such as 0.1 V or higher, e.g., 0.3 V or higher, including 0.5 volts or higher, and including 1.0 volts or higher, where in certain aspects, the voltage ranges from about 0.001 to about 10 volts, such as from about 0.01 to about 10V.

[046] Referring again to Fig. 3, the materials 34 and 36 provide the voltage potential to activate the control device 38. Once the control device 38 is activated or powered up, the control device 38 can alter conductance between the materials 34 and 36 in a unique manner. By altering the conductance between materials 34 and 36, the control device 38 is capable of controlling the magnitude of the current through the conducting liquid that surrounds the system 30. This produces a unique current signature that can be detected and measured by a receiver (not shown), which can be positioned internal or external to the body. Illustrative examples of receivers are shown in Figs. 7 to 12, as described hereinafter. In addition to controlling the magnitude of the current path between the materials, non-conducting materials, membrane, or "skirt" are used to increase the "length" of the current path and, hence, act to boost the conductance path, as disclosed in the U.S. Patent Application Serial No. 12/238,345 entitled, "In-Body Device with Virtual Dipole Signal Amplification" filed September 25, 2008, and published on March 26, 2009 as U.S. Publication No. 2009/0082645A1, the entire content of which is incorporated herein by reference. Alternatively, throughout the disclosure herein, the terms "non-conducting material", "membrane", and "skirt" are interchangeably with the term "current path extender" without impacting the scope or the present aspects and the claims herein. The skirt, shown in portion at 35 and 37, respectively, may be associated with, e.g., secured to, the framework 32. Various shapes and configurations for the skirt are contemplated as within the scope of the present invention. For example, the system 30 may be surrounded entirely or partially by the skirt and the skirt maybe positioned along a central axis of the system 30 or off-center relative to a central axis. Thus, the scope of the present invention as claimed herein is not limited by the shape or size of the skirt. Furthermore, in other aspects, the materials 34 and 36 may be separated by one skirt that is positioned in any defined region between the materials 34 and 36.

[047] Referring now to Fig. 4, in another aspect, the systems 12 and 22 of Figs. 2A and 2B, respectively, are shown in more detail as system 40. The system 40 includes a framework 42. The framework 42 is similar to the framework 32 of Fig. 3. In this aspect of the system 40, a digestible or dissolvable material 44 is deposited on a portion of one side of the framework 42. At a different portion of the same side of the framework 42, another digestible material 46 is deposited, such that materials 44 and 46 are dissimilar. More specifically, material 44 and 46 are selected such that they form a voltage potential difference when in contact with a conducting liquid, such as body fluids. Thus, when the system 40 is in contact with and/or partially in contact with the conducting liquid, then a current path, an example is shown in Fig. 5, is formed through the conducting liquid between material 44 and 46. A control device 48 is secured to the framework 42 and electrically coupled to the materials 44 and 46. The control device 48 includes electronic circuitry that is capable of controlling part of the conductance path between the materials 44 and 46. The materials 44 and 46 are separated by a non-conducting skirt 49. Various examples of the skirt 49 are disclosed in US Provisional Application No. 61/173,511 filed on April 28, 2009 and entitled "HIGHLY RELIABLE INGESTIBLE EVENT MARKERS AND METHODS OF USING SAME" and US Provisional Application No. 61/173,564 filed on April 28, 2009 and entitled "INGESTIBLE EVENT MARKERS HAVING SIGNAL AMPLIFIERS THAT COMPRISE AN ACTIVE AGENT"; as well as U.S. Application No. 12/238,345 filed September 25, 2008 and entitled "IN-BODY DEVICE WITH VIRTUAL DIPOLE SIGNAL AMPLIFICATION", and published on March 26, 2009 as U.S. Publication No. 2009/0082645A1; the entire disclosure of each is incorporated herein by reference.

[048] Once the control device 48 is activated or powered up, the control device 48 can alter conductance between the materials 44 and 46. Thus, the control device 48 is capable of controlling the magnitude of the current through the conducting liquid that surrounds the system 40. As indicated above with respect to system 30, a unique current signature that is associated with the system 40 can be detected by a receiver (not shown) to mark the activation of the system 40. Illustrative examples of receivers are shown in Figs. 7 to 12, as described hereinafter. In order to increase

[066] In accordance with the various aspects of the present invention, the system of the present invention can be inside specific food products (e.g. a granola bar), with one of the data encoded and communicated by the system being the caloric content of the food or other relevant dietary information, e.g. fiber sugar content, fat type and content etc. This may help people on a diet monitor their daily intakes, get incentives for staying on-diet, etc. Also, the system is co-ingested with food, using on-board sensing to measure food release into the stomach, e.g. fat content. Various aspects may include an instrumented cup that detects when the system of the present invention has been dropped into the cup and whether the user or person took a drink (similar, for example, to the inhaler product described in PCT Application Ser. No. PCT/US11/31986, filed April 11, 2011, and published on January 19, 2012 as WO2011/130183A3, the entire disclosure of which is incorporated herein by reference), and how much they drank. An advantage of this aspect of the present invention is that it may be useful for people who take regular supplements in the form of a powder or other, which is mixed with water before drinking.

[067] In accordance with other aspects of the present invention, chemical markers can incorporate certain marker species into the food (e.g. salt, iow-or-high pH, protein, and lipid). When ingested, a marker species is released into stomach environment. With the sensing capability, the system of the present invention can detect chemical-binding receptors on the surface or by coating on the system that reacts with a chemically-active coating (e.g. a coating such as a specific-ion-conducting glass membrane that allows only the desired marker species to penetrate), in various aspects, the ingestible device is co-ingested with the food, and may be used, among other things, to measure/detect the presence of the "marker species". The system that is ingestible and masticable can contain a detector capable of measuring endocanabinoids, as described for example, in the publication by DiPatrizio et al. entitled, "Endocannabinoid signal in the gut controls dietary fat intake", for example reference, the entire disclose of which is incorporated herein by reference). When the signal is detected - e,.g., a sign that high fat food intake has occurred - the user or patient is instructed via phone message or other communication to take a prescription (also RIS-enabled) to disrupt the endocannabinoid signal, thus reducing the craving for more high fat foods.

21. An apparatus, comprising:

a food product;

an ingestible medication stored within the food product;

a plurality of ingestible devices stored within the food product; and

a coating material surrounding each ingestible device from the plurality of ingestible devices, the coating material configured to insulate each ingestible device from the plurality of ingestible devices from the ingestible medication when the coating material is not in contact with an electrically conductive fluid,

the food product configured to release at least one ingestible device from the plurality of ingestible devices upon mastication of the food product, the at least one ingestible device, upon contact with the electrically conductive fluid, configured to generate a current signature associated with the ingestible medication.

22. An apparatus, comprising:

a housing unit defining a cavity, the housing being flexible to withstand mastication pressures, the housing unit dissolvable by an electrically conductive fluid;

an ingestible medication stored within the cavity of the housing unit; and

an ingestible device stored within the cavity of the housing unit, the ingestible device associated with the ingestible medication,

the housing unit configured to release the ingestible device upon dissolution by the electrically conductive fluid,

the ingestible device, upon contact with the electrically conductive fluid, configured to generate a current signature associated with the ingestible medication.

23. The apparatus of claim 22, further comprising:

a food product, the housing unit stored within the food product.

24. An apparatus, comprising:

a food product;

an ingestible medication stored within the food product; and

an ingestible device stored within the food product, the ingestible device including a protective layer, the ingestible device associated with the ingestible medication,

the food product configured to release the ingestible device upon mastication of the food product by a user, the protective layer configured to retain the ingestible device substantially intact upon mastication by the user, the protective layer configured to be dissolved by the user's stomach fluid,

the ingestible device, upon contact with the stomach fluid after dissolution of the pH-sensitive layer, configured to generate a current signature that includes encoded information associated with the ingestible medication.