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(54) **IN-HEADER PERIMETER RF ANTENNA**

HF-ANTENNE IN KOPFTEIL-UMFASSUNG

ANTENNE RF AU PÉRIMÈTRE D'UNE PIÈCE DE TÊTE

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Description

BACKGROUND

[0001] Medical devices can be implanted in a body to perform tasks including monitoring, detecting, or sensing physiological information in or otherwise associated with the body, diagnosing a physiological condition or disease, treating or providing a therapy for a physiological condition or disease, or restoring or otherwise altering the function of an organ or a tissue. Examples of an implantable medical device can include a cardiac rhythm management device, such as a pacemaker, a cardiac resynchronization therapy device, a cardioverter or defibrillator, a neurological stimulator, a neuromuscular stimulator, or a drug delivery system. In certain examples, the implantable medical device can include a telemetry circuit and an antenna, coupled to the telemetry circuit, the combination of which can be configured to provide wireless communication between the implantable medical device and an external device, e.g., to send information (such as physiological or other information) from the implantable medical device to the external device, or to receive information (e.g., such as programming instructions) at the implantable medical device from the external device. Magnetic coupling can be used to provide short-range (e.g., a few centimeters) communication between an implantable medical device implanted in a body and an external device, or between an implantable medical device outside of the body and an external device. However, magnetic coupling communication largely relies on near-field radiation, where the field distribution is highly dependent upon the distance from, and orientation of, the antenna, which grossly limits the effective range of wireless communication between the implantable medical device and the external device.

[0002] As an alternative to magnetic coupling, or in addition to magnetic coupling, low power radio frequency (RF) communication, having an extended range over magnetic coupling, can be used to provide communication between an implantable medical device and an external device.

[0003] Published U.S. application US 2006/0224206 A1 discloses an implantable medical device ("IMD") including a housing, a connector header block coupled to the housing, and an optional telemetry antenna coupled to the header block. The optional antenna assembly is suitably configured to support the intended IMD application (e.g., the desired telemetry range, the intended IMD implant location, or other practical considerations). The optional antenna assembly may be utilized by itself or in cooperation with a permanent telemetry antenna of the IMD. In one practical embodiment, the optional antenna assembly has a connection end that is compliant with known pacemaker electrode lead standards, which allows the IMD to leverage existing connection methodologies.

[0004] Published U.S. application US 2005/0203584 A1 discloses a telemetry antenna for an implantable medical device includes one or more portions having a non-linear configuration. The non-linear configuration provides an antenna having a greater antenna length than the linear lengthwise dimension of the antenna structure. The non-linear configuration is a serpentine pattern.

OVERVIEW

[0005] The present invention relates to a system as set out in claim 1 and a method as set out in claim 11. Other embodiments are described in the dependent claims..

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] In the drawings, which are not necessarily drawn to scale, like numerals may describe similar components in different views. Like numerals having different letter suffixes may represent different instances of similar components. The drawings illustrate generally, by way of example, but not by way of limitation, various embodiments discussed in the present document.

FIG. 1 illustrates generally an example of a system including an implantable antenna coupled to an implantable telemetry circuit.

FIGS. 2A and 2B illustrate generally different views of an example of an implantable dielectric compartment including a channel in an outer surface of the implantable dielectric compartment.

FIGS. 3A-3F illustrate generally different views of an example of a cap configured to be coupled to a channel of an implantable dielectric compartment.

FIGS. 4A and 4B illustrate generally an example of an implantable dielectric compartment including a channel in an outer surface of the implantable dielectric compartment.

FIG. 5 illustrates generally an example of an implantable dielectric compartment having a channel in an outer surface of the implantable dielectric compartment, the channel configured to constrain a portion of an implantable antenna, the implantable antenna including a polymer covering the portion of the implantable antenna.

DETAILED DESCRIPTION

[0007] In an example, an implantable antenna (e.g., a wire antenna covered in a polyurethane tube or one or more other dielectrics) can be located in a channel in an outer surface of an implantable dielectric compartment (e.g., header) of an implantable medical device (e.g., pacemaker, defibrillator, etc.). The implantable antenna can be configured to wirelessly transfer information electromagnetically at a specified operating frequency. In an example, the specified operating frequency can be provided using one or more characteristics of the implantable antenna (e.g., the length of the implantable antenna,

the shape of the implantable antenna, the proximity of the implantable antenna to one or more other conductors in the implantable medical device, etc.).

[0008] In certain examples, positioning the implantable antenna about the perimeter or outer surface of the implantable dielectric compartment can increase the radio frequency efficiency of the implantable antenna or decrease losses due to metallic objects within the implantable dielectric compartment (e.g., one or more receptacles, leads, connector blocks, x-ray identification tags, anchor posts, etc.). In certain examples, the channel can be configured to constrain a portion of the implantable antenna in a specific configuration. In an example, at least one of a length of the implantable antenna, the specific configuration (e.g., shape, path, etc.) of the implantable antenna, or a distance between the implantable antenna and one or more other conductive components in the implantable dielectric compartment can be controlled to provide wireless communication at a specified operating frequency, or to increase the effectiveness of the implantable antenna at the specified operating frequency.

[0009] In an example, if the implantable antenna is only covered in the channel with a medical adhesive or other fill material, the reliability or repeatability of radiofrequency communication (e.g., range, efficiency, etc.) across multiple devices can diminish due to varying medical adhesive or other fill material thickness (medical adhesive thickness can vary between different operators, machines, processes, etc.). In an example, for a desired material thickness of 0.762 mm [30 thousandths of an inch] over the implantable antenna, medical adhesive applied by hand can vary by 0.762 mm [+30] to -0.254 mm [-10 thousandths of an inch] or more. In other examples, a machine or process (e.g., robotics) can reduce the variance to %10 of that applied by hand (e.g., $\pm$ 0.0762 mm [$\pm$3 thousandths of an inch]). In certain examples, a cap (e.g., an injection molded thermoplastic or other dielectric material cap) can further alleviate the variance of the medical adhesive or other fill material (e.g., to $\pm$ 0.0508 mm [$\pm$2 thousandths of an inch] or less), establishing a more precise distance between the implantable antenna and the body. Further, in certain examples, the cap can be used to establish a repeatable specific configuration for the implantable antenna (e.g., using one or more features of the implantable dielectric compartment, the channel, or the cap).

[0010] In other examples, the reliability or repeatability of radiofrequency communication across multiple devices can diminish due to varying implantable antenna placement or configuration. In an example, the channel can be sized and shaped to constrain the implantable antenna in a specific configuration. In certain examples, the specific configuration can affect the resonant frequency or the efficient operating point of the implantable antenna. In an example, by providing the specific configuration, the implantable antenna can maintain a specified distance from one or more other conductors in the implantable dielectric compartment.

[0011] In an example, the implantable antenna to body (e.g., fluid, tissue, or one or more other biological medium) interaction can be maintained using a specified depth of the channel and the specified thickness of the cap. In an example, the spacing between the implantable antenna and a biological medium can affect the impedance of the implantable antenna. By improving the control of the impedance, the implantable antenna range or efficiency can be improved or can become more repeatable across multiple devices.

[0012] In other examples, the channel can include a tapered channel configured to constrain the implantable antenna in a specific configuration at the bottom or center of the tapered channel. In certain examples, by providing a specific configuration of the implantable antenna, one or more fundamental or resonant operating frequencies can be more easily repeated or attained (e.g., across multiple devices, etc.). In certain examples, the implantable antenna can be covered by a polymer or other dielectric material (e.g., inserted into a polyurethane tube to isolate the implantable antenna from external shocks, etc.) and then inserted into the channel in the implantable dielectric compartment. In an example, medical adhesive can be applied to the channel before or after inserting the implantable antenna into the channel. In an example, the cap can be coupled to the channel using the medical adhesive or one or more interlocking features.

[0013] In certain examples, an identical or substantially identical channel, cap, or implantable antenna can be used among different implantable medical devices (e.g., a family of devices having a different number or receptacles, etc.) communicating at the same specified operating frequency.

[0014] In an example, a first implantable medical device can include a single set of receptacles, the single set of receptacles for the first implantable medical device consisting of a first number of receptacles (e.g., a first receptacle and a second receptacle), and a second implantable medical device can include a single set of receptacles, the single set of receptacles for the second implantable medical device consisting of a second number of receptacles (e.g., a first receptacle, a second receptacle, and a third receptacle). In this example, an identical or substantially identical channel, cap, or implantable antenna can be used for each of the first and second implantable medical devices.

[0015] In an example, in a two-receptacle implantable medical device, the channel can be located on an outer surface of the implantable dielectric compartment substantially between the first and second receptacles. In certain examples, a three-receptacle implantable medical device can include a third receptacle (or one or more other receptacles) added, for example, above the first and second receptacles of the two-receptacle implantable medical device, without changing the width of the implantable dielectric compartment, or without changing the orientation of the first and second receptacles with

respect to the first implantable medical device. In these examples, an identical or substantially identical channel, cap, or implantable antenna can be used to wirelessly transfer information electromagnetically at a specified operating frequency among different devices, saving manufacturing and design costs, and adding reliability in communication among the different devices. FIG. 1 illustrates generally an example of a system 100 including an implantable dielectric compartment 105 coupled to an implantable medical device housing 101 and a cap 110 coupled to a channel in an outer surface of the implantable dielectric compartment 105.

[0016] In the example of FIG. 1 , the implantable dielectric compartment 105 includes first and second receptacles configured to receive respective first and second leads. The implantable dielectric compartment 105 includes a first fastener 115 (e.g., set screw, etc.) configured to secure the first lead in the first receptacle and second fastener 116 configured to secure the second lead in the second receptacle. In an example, the first receptacle, the second receptacle, or one or more other receptacles can include one or more connector blocks configured to provide an electrical contact between electronics in the implantable medical device housing 101 and an electrical contact on one or more leads. In other examples, the implantable dielectric compartment 105 can include a different number of receptacles (e.g., a single receptacle, three- receptacles, etc.).

[0017] In the example of FIG. 1 , the first receptacle is located closer to the implantable medical device housing 101 than the second receptacle. In an example, the channel and the cap 110 can be located substantially between the first receptacle and the second receptacle, such that an implantable antenna in the channel can be configured to be located a certain distance (e.g., 1.27 mm [50 thousandths of an inch], etc.) from one or more other conductive structures of the system 100 (e.g., implantable medical device housing 101, the first fastener 115, the second fastener 116, one or more connector blocks, one or more leads, leads, etc.), such as to reduce interference by the one or more other conductive structures.

[0018] In other examples, the implantable dielectric compartment 105 can include one or more other receptacles configured to receive one or more other leads. For example, the implantable dielectric compartment 105 can include a third receptacle configured to receive a third lead, and a third fastener configured to secure the third lead in the third receptacle. In an example, the second receptacle can be located closer to the implantable medical device housing 101 than the third receptacle. In these examples, the cap 110 can be located in an identical or substantially identical position as the cap illustrated in the example of FIG. 1. Further, in these examples, the cap 110, the channel, or the implantable antenna can be identical or substantially identical (e.g., in shape, position, configuration, etc.) as illustrated in the example of FIG. 1.

[0019] FIGS. 2A and 2B illustrate generally different views of an example of an implantable dielectric compartment 105 including a channel 110 in an outer surface of the implantable dielectric compartment 105. FIG. 2A illustrates generally a first side, and FIG. 2B illustrates generally a second side, of the implantable dielectric compartment 105. In an example, the proximate end of the channel 115 can be located (as illustrated in FIG. 2A) at or near a feed-through configured to provide access from the implantable dielectric compartment 105 to electronic circuitry (e.g., a telemetry circuit, a processor, etc.) in the implantable medical device housing. The channel 115 can progress away from the implantable medical device housing and around the perimeter of the implantable dielectric compartment 105 to the second side of the implantable dielectric compartment 105 (as illustrated in FIG. 2B). In certain examples, the channel 115 can be formed during the manufacturing process of the implantable dielectric compartment 105 (e.g., during injection molding of the implantable dielectric compartment 105). In the example of FIG. 2B, the channel 115 is located substantially between the first fastener 115 and the second fastener 116. In an example, the path of the channel 115 can be configured to maximize a distance or provide a minimum spacing between an implantable antenna configured to be positioned or located in the channel and one or more other conductors (e.g., fasteners, connector blocks, the implantable medical device housing, etc.).

[0020] In an example, the implantable dielectric compartment 105 can include a first connector block 120 and a second connector block 121 configured to provide an electrical contact between electronic circuitry in the implantable medical device housing and an electrical contact on a first lead. Further, the implantable dielectric compartment 105 can include a third connector block 122 and a fourth connector block 123 configured to provide an electrical contact between electronic circuitry in the implantable medical device housing and an electrical contact on a second lead. In an example, the first connector block 120 and the second connector block 121 can be coupled to a first lead located in a first receptacle of the implantable dielectric compartment 105, and the third connector block 122 and the fourth connector block 123 can be coupled to a second lead located in a second receptacle of the implantable dielectric compartment 105. In other examples, the implantable dielectric compartment 105 can include one or more other connector blocks, or a different number of connector blocks. According to the invention, the implantable dielectric compartment 105 includes one or more interlocking features configured to interact with one or more features of a cap to couple the cap to the channel 115. In an example, the one or more interlocking features of the implantable dielectric compartment 105 can be located on or proximate to the channel 115. In the examples of FIGS. 2A and 2B, the one or more interlocking features include a first interlocking feature 125 on the first side of the implantable dielectric compartment 105, and a second interlocking feature 126 and a third interlocking feature 127 on the

second side of the implantable dielectric compartment 105. In other examples, one or more other interlocking features or a different number of interlocking features can be used.

[0021] FIGS. 3A-3F illustrate generally different views of an example of a cap 110 configured to be coupled to a channel of an implantable dielectric compartment. In certain examples, the cap 110 can include an injection molded cap. In an example, the cap 110 can be configured to cover a portion of an implantable antenna along the channel. In an example, the cap 110 can include one or more interlocking features configured to interact with one or more features of the channel to couple the cap 110 to the channel. In the examples of FIGS. 3A-3F, the one or more interlocking features include a first interlocking feature 130 on a first side of the cap 110, and a second interlocking feature 131 and a third interlocking feature 132 on a second side of the channel 110. In an example, the first interlocking feature 130 of the cap 110 can be configured to interlock with a first interlocking feature of the implantable dielectric compartment (e.g., the first interlocking feature 125 of the implantable dielectric compartment of FIG. 2A). According to the invention, the first interlocking feature 130 of the cap 110 includes a male connector configured to interact with a female connector on the implantable dielectric compartment, or the first interlocking feature 130 of the cap 110 includes a female connector or one or more other connectors configured to interact with a corresponding connector on the implantable dielectric compartment or the channel (e.g., a screw and a threaded portion, etc.). FIGS. 4A and 4B illustrate generally an example of an implantable dielectric compartment 105 including a channel 115 in an outer surface of the implantable dielectric compartment 105. In the example of FIG. 4A, the implantable dielectric compartment 105 includes first, second, and third receptacles configured to receive respective first, second, and third leads. In an example, the implantable dielectric compartment 105 can include a first fastener

[0022] 115 configured to secure the first lead in the first receptacle, a second fastener 116 configured to secure the second lead in the second receptacle, and a third fastener 117 configured to secure the third lead in the third receptacle. In certain examples, the implantable dielectric compartment 105 can include one or more interlocking features (e.g., a second interlocking feature 126 and a third interlocking feature 127) configured to interface with one or more features of a cap to couple the cap to the channel 115, and to contain the implantable antenna in a specific configuration in the channel 115.

[0023] In an example, the channel 115 can be configured to constrain a wire antenna placed in the channel 115. In certain examples, the distal end of the wire antenna can tend to protrude from the channel 115 during placement of the wire antenna. In certain examples, the second interlocking feature 126 and the third interlocking feature 127 can be located on either side of the distal end of the wire antenna, and can be configured to secure the distal end of the wire antenna in place in the channel 115.

[0024] In an example, the channel 115 can include one or more narrow portions (e.g., pinch points, etc.) configured to position the implantable antenna inside the channel 115. In the example of FIG. 4A, the channel 115 includes a first narrow portion 135, a second narrow portion 136, and a third narrow portion 137. In an example, the one or more narrow portions can have a cross section area smaller than a cross section area of the implantable antenna. In certain examples, using a wire antenna, the third narrow portion 137 can be configured to secure the distal end of the wire antenna in the channel 115.

[0025] FIG. 4B illustrates generally an example of a side view of the first narrow portion 135 in the channel 115, and the second narrow portion 136 in the channel 115. In an example, the one or more narrow portions can be configured to provide an interference fit with the implantable antenna. In an example, the implantable antenna can include a polymer or other dielectric material covering a portion of the implantable antenna configured to be located in the channel 115. In certain examples, the polymer can include a polyurethane tube or one or more other polymers or dielectrics. In an example, the narrow portion can be configured to provide the interference fit with the polymer covering the implantable antenna instead of or in conjunction with providing the interference fit with the implantable antenna (e.g., a wire antenna). In certain examples, the channel 115 can be sized and shaped to provide a specific configuration for the implantable antenna. In an example, one or more narrow portions can be configured to maintain the specific configuration of the implantable antenna in the channel 115.

[0026] FIG. 5 illustrates generally an example of an implantable dielectric compartment 105 having a channel 115 in an outer surface of the implantable dielectric compartment 105, the channel 115 configured to constrain a portion of an implantable antenna 140 in a specific configuration along the length of the portion of the implantable antenna. The implantable antenna 140 can include a polymer 141 covering the portion of the implantable antenna 140, and a cap 110 can be configured to contain the implantable antenna 140 in the channel 115. In an example, the channel 115 can include a tapered channel, sized and shaped to provide a specific configuration (e.g., antenna shape and route) for the implantable antenna 140. In certain examples, the sides of the tapered channel can be configured to constrain the length of the portion of the implantable antenna (e.g., the entire length of the portion of the implantable antenna 140 in the channel 115), such as illustrated by the cross-section view in the example of FIG. 5. In an example, the shape or diameter of the base of the channel 115 can be the same as or approximately equal to (e.g., in certain examples, slightly larger or smaller) one of the shape or diameter of the implantable antenna 140 or the polymer 141 covering the portion of the implantable antenna 140. In an example, the shape or diameter of the base of the channel 115

can be configured to constrain or provide the specific configuration for the portion of the implantable antenna 140.

[0027] In certain examples, a medical adhesive 145 or one or more other fill materials can be placed in the channel 115 before, during, or after the implantable antenna 140 (including the polymer 141 covering the implantable antenna 140) is placed in the channel 115. In the example of FIG. 5, the cap 110 can be placed in the channel 115, the cap 110 configured to cover the portion of the implantable antenna 140 along the channel 115 and to position the portion of the implantable antenna 140 in a specific configuration in the channel (e.g., along the inside of the tapered channel). In an example, the medical adhesive 145 can be configured to hold the implantable antenna 140 in place within the channel 115, to seal the channel 115 from one or more biological medium (e.g., tissue, blood, etc.), or to hold the cap 110 in place over the implantable antenna 140. In an example, the one or more interlocking features of the implantable dielectric compartment 105 and the cap 110 can be configured to hold the cap 110 in place within the channel 115.

[0028] In an example, the implantable antenna 140 can be configured to be constrained to an inside edge of the channel 115. In an example, the implantable antenna 140 can include a wire antenna having a circular cross section (e.g., 0.381 mm [15 thousandths of an inch]), and can be contained in a polyurethane tube (e.g., 0.508 mm [20 thousandths of an inch]). The implantable antenna 140 and the polyurethane tube can be configured to fit securely inside edge the channel 115 (e.g., a tapered channel).

[0029] In an example, the medical adhesive 145 and the cap 110 can be configured to secure the implantable antenna 140 in a specific configuration inside the channel 115. In certain examples, the medical adhesive 145 can be configured to only seal the connection between the cap 110 and the channel 115, and the shape of the channel 115 and the one or more features of the channel 115 (e.g., the one or more narrow portions) can be configured to provide the specific configuration of the implantable antenna 115. In certain examples, the outside surface of the cap 110 can be configured to reside below the outside surface of the implantable dielectric compartment 105 (e.g., 0.127 mm [5 thousandths of an inch]). In an example, the cap 110 can be configured to fit within the channel 115 having a space between the surfaces of the cap 110 proximate the channel 115 (e.g., 0.0508 mm [2 thousandths of an inch]), the space configured to be filled with medical adhesive 145 to seal the implantable antenna 140 in the channel 115.

[0030] In certain examples, the cap 110 can increase the cost of the implantable dielectric compartment 105 (e.g., in contrast to providing medical adhesive or one or more other fill material to the channel 115 instead of the cap 110). Accordingly, in an example, the implantable antenna 140 can be constrained in the channel 115 without using the cap 110. Instead, a machine or process (e.g., robotics) can be configured to provide a uniform or substantially uniform layer of medical adhesive 145 or other fill material to the channel 115 over the implantable antenna 140. In these examples, the one or more interlocking features of the implantable dielectric compartment 105 can be excluded. Instead, one or more narrow portions (e.g., pinch points, etc.) in the channel 115 can be configured to position or retain the implantable antenna 140 in the channel 115.

Claims

1. A system comprising:

an implantable antenna (140) configured to wirelessly transfer information electromagnetically at a specified operating frequency, the specified operating frequency provided using a specific configuration of a portion of the implantable antenna; and

an implantable dielectric compartment (105) coupled to an implantable device housing (101), the implantable dielectric compartment including:

a channel (115) in an outer surface of the implantable dielectric compartment;

a first interlocking feature (125, 126, 127);

a cap (110) coupled to the channel (115), the cap (110) configured to cover a portion of the implantable antenna (140) along the channel (115) and the cap (110) including a second interlocking feature (130, 131, 132), the first (125, 126, 127) and second interlocking features (130, 131, 132) configured to couple the cap (110) to the channel (115); and

wherein the channel (115) is configured to constrain the portion of the implantable antenna (140) in the specific configuration along the length of the portion of the implantable antenna (140),

characterized in that

the second interlocking feature (130, 131, 132) of the cap (110) includes a male connector and the first interlocking feature (125, 126, 127) includes a female connector on the implantable dielectric compartment (105), or

the second interlocking feature (130, 131, 132) of the cap (110) includes a female connector configured to interact with the corresponding first interlocking feature (125, 126, 127) on the implantable dielectric compartment (105).

2. The system of claim 1, wherein the channel includes

a narrow portion (135, 136, 137) having a cross section area smaller than a cross section area of the implantable antenna, the narrow portion (135, 136, 137) configured to position the implantable antenna inside the channel.

3. The system of claim 2, wherein the implantable antenna includes a polymer (141) covering the portion of the implantable antenna, the polymer (141) providing interference fit in the narrow portion of the channel.

4. The system of any one of claims 1 through 3, wherein the implantable antenna is configured to wirelessly transfer information electromagnetically from within a biological medium using a specified operating frequency, the specified operating frequency provided using the specific configuration of the implantable antenna in the biological medium.

5. The system of any one of claims 1 through 4, wherein the channel and the cap are configured to establish a specified distance between the portion of the implantable antenna and a biological medium, the specified distance configured to control an impedance of the implantable antenna.

6. The system of any one of claims 1 through 5, wherein the channel includes a tapered channel, and wherein the cap is configured to position the portion of the implantable antenna in a specific configuration inside the tapered channel.

7. The system of any one of claims 1 through 6, wherein the implantable antenna includes a wire antenna configured to be positioned in the channel;
wherein the implantable dielectric compartment includes a third interlocking feature (125, 126, 127) and the cap includes a fourth interlocking feature (130, 131, 132), the third and fourth interlocking features separate from the first and second interlocking features; and wherein the first and second interlocking features are configured to couple the cap to the channel at a first point over the implantable antenna, and wherein the second and third interlocking features are configured to couple the cap to the channel at a second point, wherein the distal end of the implantable antenna is configured to be located substantially between the first and second points, such that the first, second, third, and fourth interlocking features are configured to secure the distal end of the implantable antenna in the channel.

8. The system of claim 7, wherein the implantable dielectric compartment includes a fifth interlocking feature (125, 126, 127) and the cap includes a sixth interlocking feature (130, 131, 132), the fifth and sixth interlocking features separate from the first, second, third, and fourth interlocking features; and
wherein the fifth and sixth interlocking features are configured to couple the cap to the channel at a third point, wherein the first and second points are located on a first side of the implantable dielectric compartment and the third point is located on a second side of the implantable dielectric compartment, the second side different from the first side.

9. The system of claim 8, wherein the first, third, and fifth interlocking features include female connectors and the second, fourth, and sixth interlocking features include male connectors.

10. The system of any one of claims 1 through 9, wherein the implantable dielectric compartment includes a first receptacle and a second receptacle, the first receptacle configured to receive a first lead and the second receptacle configured to receive a second lead, the first receptacle closer to the implantable medical device housing than the second receptacle; and wherein the channel is located in the outer surface of the implantable dielectric compartment substantially between first and second receptacles.

11. A method comprising:

providing an implantable antenna (140) configured to wirelessly transfer information electromagnetically at a specified operating frequency, the specified operating frequency provided using a specific configuration of a portion of the implantable antenna;
providing an implantable dielectric compartment (105) including a first interlocking feature (125, 126, 127);
providing a channel (115) in an outer surface of the implantable dielectric compartment (105);
inserting the implantable antenna (140) into the channel (115), the channel (115) being configured to constrain a portion of the implantable antenna in a specific configuration along the length of the portion of the implantable antenna (140);
providing a cap (110) including a second interlocking feature (130, 131, 132), the cap being configured to cover the portion of the implantable antenna (140) in the channel (115) and to position the implantable antenna in the specific configuration inside the channel;
wherein the second interlocking feature (130, 131, 132) of the cap (110) includes a male connector configured to interact with a corresponding female connector on the implantable dielectric compartment (105) of the first interlocking feature (125, 126, 127), or the second interlocking feature (130, 131, 132) of the cap (110) includes a female connector configured to interact

with a corresponding male connector on the implantable dielectric compartment (105) of the first interlocking feature (125, 126, 127);
coupling the cap (110) to the channel (115) using the first interlocking feature (125, 126, 127) of the implantable dielectric compartment and the second interlocking feature (130, 131, 132) of the cap.

12. The method of claim 11, wherein the channel (115) is a tapered channel.

13. The method of any one of claims 11 through 12, including providing a narrow portion (135, 136, 137) in the tapered channel having a cross section area smaller than a cross section area of the implantable antenna, the narrow portion configured to position the implantable antenna inside the tapered channel.

14. The method of claim 13, including providing an interference fit between a polymer (141) covering the portion of the implantable antenna and the narrow portion of the tapered channel, wherein the tapered channel is sized and shaped to provide the specific configuration for the implantable antenna.

Patentansprüche

1. System, das Folgendes umfasst:

eine implantierbare Antenne (140), die dafür ausgelegt ist, drahtlos elektromagnetisch bei einer spezifizierten Betriebsfrequenz Informationen zu transferieren, wobei die vorgesehene spezifizierte Betriebsfrequenz eine spezifische Konfiguration eines Teils der implantierbaren Antenne verwendet; und
ein implantierbarer dielektrischer Einsatz (105), der mit einem implantierbaren Gerätegehäuse (101) gekoppelt ist, wobei der implantierbare dielektrische Einsatz Folgendes beinhaltet:

einen Kanal (115) in einer Außenoberfläche des implantierbaren dielektrischen Einsatzes;
ein erstes Einrastmerkmal (125, 126, 127);
eine Kappe (110), die mit dem Kanal (115) gekoppelt ist, wobei die Kappe (110) dafür ausgelegt ist, einen Teil der implantierbaren Antenne (140) entlang des Kanals (115) abzudecken, und die Kappe (110) ein zweites Einrastmerkmal (130, 131, 132) beinhaltet, wobei das erste Einrastmerkmal (125, 126, 127) und das zweite Einrastmerkmal (130, 131, 132) dafür ausgelegt sind, die Kappe (110) mit dem Kanal (115) zu koppeln; und
wobei der Kanal (115) dafür ausgelegt ist, den Teil der implantierbaren Antenne (140) in die spezifische Konfiguration entlang der Länge des Teils der implantierbaren Antenne (140) zu zwingen,
dadurch gekennzeichnet, dass
das zweite Einrastmerkmal (130, 131, 132) der Kappe (110) einen männlichen Verbinder beinhaltet und das erste Einrastmerkmal (125, 126, 127) einen weiblichen Verbinder an dem implantierbaren dielektrischen Einsatz (105) beinhaltet, oder
das zweite Einrastmerkmal (130, 131, 132) der Kappe (110) einen weiblichen Verbinder beinhaltet, der dafür ausgelegt ist, mit dem entsprechenden ersten Einrastmerkmal (125, 126, 127) auf dem implantierbaren dielektrischen Einsatz (105) zusammenzuwirken.

2. System nach Anspruch 1, wobei der Kanal einen engen Teil (135, 136, 137) beinhaltet, der eine Querschnittsfläche aufweist, die kleiner als eine Querschnittsfläche der implantierbaren Antenne ist, wobei der enge Teil (135, 136, 137) dafür ausgelegt ist, die implantierbare Antenne im Kanal zu positionieren.

3. System nach Anspruch 2, wobei die implantierbare Antenne ein Polymer (141) beinhaltet, das den Teil der implantierbaren Antenne abdeckt, wobei das Polymer (141) in dem engen Teil des Kanals eine Pressspassung bereitstellt.

4. System nach einem der Ansprüche 1 bis 3, wobei die implantierbare Antenne dafür ausgelegt ist, drahtlos elektromagnetisch unter Verwendung einer spezifizierten Betriebsfrequenz Informationen von innerhalb eines biologischen Mediums zu transferieren, wobei die vorgesehene spezifizierte Betriebsfrequenz die spezifische Konfiguration der implantierbaren Antenne in dem biologischen Medium verwendet.

5. System nach einem der Ansprüche 1 bis 4, wobei der Kanal und die Kappe dafür ausgelegt sind, einen spezifizierten Abstand zwischen dem Teil der implantierbaren Antenne und einem biologischen Medium herzustellen, wobei der spezifizierte Abstand dafür ausgelegt ist, eine Impedanz der implantierbaren Antenne zu steuern.

6. System nach einem der Ansprüche 1 bis 5, wobei der Kanal einen sich verjüngenden Kanal beinhaltet, und wobei die Kappe dafür ausgelegt ist, den Teil der implantierbaren Antenne in einer spezifischen Konfiguration in dem sich verjüngenden Kanal zu positionieren.

7. System nach einem der Ansprüche 1 bis 6, wobei die implantierbare Antenne eine Drahtantenne beinhaltet, die dafür ausgelegt ist, in dem Kanal positioniert zu werden; wobei der implantierbare dielektrische Einsatz ein drittes Einrastmerkmal (125, 126, 127) beinhaltet und die Kappe ein viertes Einrastmerkmal (130, 131, 132) beinhaltet, wobei das dritte und das vierte Einrastmerkmal vom ersten und vom zweiten Einrastmerkmal getrennt sind; und
wobei das erste und das zweite Einrastmerkmal dafür ausgelegt sind, die Kappe an einem ersten Punkt über der implantierbaren Antenne mit dem Kanal zu koppeln, und wobei das zweite und das dritte Einrastmerkmal dafür ausgelegt sind, die Kappe mit dem Kanal an einem zweiten Punkt zu koppeln, wobei das distale Ende der implantierbaren Antenne dafür ausgelegt ist, im Wesentlichen zwischen dem ersten und dem zweiten Punkt platziert zu sein, so dass das erste, das zweite, das dritte und das vierte Einrastmerkmal dafür ausgelegt sind, das distale Ende der implantierbaren Antenne in dem Kanal zu sichern.

8. System nach Anspruch 7, wobei der implantierbare dielektrische Einsatz ein fünftes Einrastmerkmal (125, 126, 127) beinhaltet und die Kappe ein sechstes Einrastmerkmal (130, 131, 132) beinhaltet, wobei das fünfte und das sechste Einrastmerkmal vom ersten, zweiten, dritten und vierten Einrastmerkmal getrennt sind; und
wobei das fünfte und das sechste Einrastmerkmal dafür ausgelegt sind, die Kappe an einem dritten Punkt mit dem Kanal zu koppeln, wobei sich der erste und der zweite Punkt auf einer Seite des implantierbaren dielektrischen Einsatzes befinden und sich der dritte Punkt auf einer zweiten Seite des implantierbaren dielektrischen Einsatzes befindet, wobei sich die zweite Seite von der ersten Seite unterscheidet.

9. System nach Anspruch 8, wobei das erste, das dritte und das fünfte Einrastmerkmal weibliche Verbinder beinhalten und das zweite, das vierte und das sechste Einrastmerkmal männliche Verbinder beinhalten.

10. System nach einem der Ansprüche 1 bis 9, wobei der implantierbare dielektrische Einsatz eine erste Aufnahme und eine zweite Aufnahme beinhaltet, wobei die erste Aufnahme dafür ausgelegt ist, eine erste Leitung aufzunehmen, und die zweite Aufnahme dafür ausgelegt ist, eine zweite Leitung aufzunehmen, wobei sich die erste Aufnahme dichter an dem Gehäuse des implantierbaren medizinischen Geräts als die zweite Aufnahme befindet; und wobei sich der Kanal in der Außenoberfläche des implantierbaren dielektrischen Einsatzes im Wesentlichen zwischen der ersten und der zweiten Aufnahme befindet.

11. Verfahren, das die folgenden Schritte umfasst:

Bereitstellen einer implantierbaren Antenne (140), die dafür ausgelegt ist, drahtlos elektromagnetisch bei einer spezifizierten Betriebsfrequenz Informationen zu transferieren, wobei die vorgesehene spezifizierte Betriebsfrequenz eine spezifische Konfiguration eines Teils der implantierbaren Antenne verwendet; und
Bereitstellen eines implantierbaren dielektrischen Einsatzes (105), der ein erstes Einrastmerkmal (125, 126, 127) beinhaltet;
Bereitstellen eines Kanals (115) in einer Außenoberfläche des implantierbaren dielektrischen Einsatzes (105);
Einsetzen der implantierbaren Antenne (140) in den Kanal (115), wobei der Kanal (115) dafür ausgelegt ist, einen Teil der implantierbaren Antenne in eine spezifische Konfiguration entlang der Länge des Teils der implantierbaren Antenne (140) zu zwingen,
Bereitstellen einer Kappe (110), die ein zweites Einrastmerkmal (130, 131, 132) beinhaltet, wobei die Kappe dafür ausgelegt ist, den Teil der implantierbaren Antenne (140) in dem Kanal (115) abzudecken, und die implantierbare Antenne in der spezifischen Konfiguration innerhalb des Kanals zu positionieren;
wobei das zweite Einrastmerkmal (130, 131, 132) der Kappe (110) einen männlichen Verbinder beinhaltet, der dafür ausgelegt ist, mit einem entsprechenden weiblichen Verbinder an dem implantierbaren dielektrischen Einsatz (105) des ersten Einrastmerkmals (125, 126, 127) zusammenzuwirken, oder das zweite Einrastmerkmal (130, 131, 132) der Kappe (110) einen weiblichen Verbinder beinhaltet, der dafür ausgelegt ist, mit einem entsprechenden männlichen Verbinder auf dem implantierbaren dielektrischen Einsatz (105) des ersten Einrastmerkmals (125, 126, 127) zusammenzuwirken;
Koppeln der Kappe (110) mit dem Kanal (115) unter Verwendung des ersten Einrastmerkmals (125, 126, 127) des implantierbaren dielektrischen Einsatzes und des zweiten Einrastmerkmals (130, 131, 132) der Kappe.

12. Verfahren nach Anspruch 11, wobei der Kanal (115) ein sich verjüngender Kanal ist.

13. Verfahren nach einem der Ansprüche 11 bis 12, dass das Bereitstellen eines engen Teils (135, 136, 137) im sich verjüngenden Kanal beinhaltet, der eine kleinere Querschnittsfläche als eine Querschnittsfläche der implantierbaren Antenne aufweist, wobei der enge Teil dafür ausgelegt ist, die implantierbare Antenne innerhalb des sich verjüngenden Kanals zu positionieren.

14. Verfahren nach Anspruch 13, das das Bereitstellen einer Presspassung zwischen einem Polymer (141), das den Teil der implantierbaren Antenne abdeckt, und dem engen Teil des sich verjüngenden Kanals beinhaltet, wobei der sich verjüngende Kanal so dimensioniert und geformt ist, um die spezifische Konfiguration für die implantierbare Antenne bereitzustellen.

Revendications

1. Système comprenant :

une antenne implantable (140) configurée de façon à transférer sans fil des informations électromagnétiquement à une fréquence de fonctionnement spécifiée, cette fréquence de fonctionnement spécifiée étant fournie en utilisant une configuration spécifique d'une partie de cette antenne implantable ; et
un compartiment diélectrique implantable (105) rattaché à un boîtier de dispositif implantable (101), ce compartiment diélectrique implantable comprenant :

un canal (115) dans une surface extérieure du compartiment diélectrique implantable ;
un premier dispositif de verrouillage (125, 126, 127) ;
un chapeau (110) rattaché au canal (115), ce chapeau (110) étant configuré de façon à couvrir une partie de l'antenne implantable (140) le long du canal (115) et ce chapeau (110) comprenant un deuxième dispositif de verrouillage (130, 131, 132), le premier (125, 126, 127) et le deuxième (130, 131, 132) dispositif de verrouillage étant configurés de façon à rattacher le chapeau (110) au canal (115) ; et
le canal (115) étant configuré de façon à restreindre la partie de l'antenne implantable (140) dans la configuration spécifique le long de la longueur de la partie de l'antenne implantable (140),
caractérisé en ce que
le deuxième dispositif de verrouillage (130, 131, 132) du chapeau (110) comprend un connecteur mâle et le premier dispositif de verrouillage (125, 126, 127) comprend un connecteur femelle sur le compartiment diélectrique implantable (105), ou
le deuxième dispositif de verrouillage (130, 131, 132) du chapeau (110) comprend un connecteur femelle configuré de façon à interagir avec le premier dispositif de verrouillage correspondant (125, 126, 127) sur le compartiment diélectrique implantable (105).

2. Système selon la revendication 1, dans lequel le canal comprend une partie étroite (135, 136, 137) ayant une surface de section transversale plus petite qu'une surface de section transversale de l'antenne implantable, cette partie étroite (135, 136, 137) étant configurée de façon à positionner l'antenne implantable à l'intérieur du canal.

3. Système selon la revendication 2, dans lequel l'antenne implantable comprend un polymère (141) couvrant la partie de l'antenne implantable, ce polymère (141) fournissant un ajustement avec serrage dans la partie étroite du canal.

4. Système selon l'une quelconque des revendications 1 à 3, dans lequel l'antenne implantable est configurée de façon à transférer sans fil des informations électromagnétiquement depuis l'intérieur d'un milieu biologique en utilisant une fréquence de fonctionnement spécifiée, cette fréquence de fonctionnement spécifiée étant fournie en utilisant la configuration spécifique de l'antenne implantable dans le milieu biologique.

5. Système selon l'une quelconque des revendications 1 à 4, dans lequel le canal et le chapeau sont configurés de façon à établir une distance spécifiée entre la partie de l'antenne implantable et un milieu biologique, cette distance spécifiée étant configurée de façon à contrôler une impédance de l'antenne implantable.

6. Système selon l'une quelconque des revendications 1 à 5, dans lequel le canal comprend un canal dégressif, et dans lequel le chapeau est configuré de façon à positionner la partie de l'antenne implantable dans une configuration spécifique à l'intérieur du canal dégressif.

7. Système selon l'une quelconque des revendications 1 à 6, dans lequel l'antenne implantable comprend une antenne filaire configurée de façon à être positionnée dans le canal dans lequel le compartiment diélectrique implantable comprend un troisième dispositif de verrouillage (125, 126, 127) et le chapeau comprend un quatrième dispositif de verrouillage (130, 131, 132), ce troisième et ce quatrième dispositif de verrouillage étant séparés du premier et du deuxième dispositif de verrouillage ; et dans lequel le premier et le deuxième dispositif de verrouillage sont configurés de façon à rattacher le chapeau au canal au niveau d'un premier endroit au-dessus de l'antenne implantable, et dans lequel le deuxième et le troisième dispositif de verrouillage sont configurés de façon à rattacher le chapeau au canal au niveau d'un deuxième endroit, l'extrémité distale de l'anten-

ne implantable étant configurée de façon à être située essentiellement entre le premier et le deuxième endroit, de telle sorte que le premier, le deuxième, le troisième et le quatrième dispositif de verrouillage sont configurés de façon à fixer l'extrémité distale de l'antenne implantable dans le canal.

8. Système selon la revendication 7, dans lequel le compartiment diélectrique implantable comprend un cinquième dispositif de verrouillage (125, 126, 127) et le chapeau comprend un sixième dispositif de verrouillage (130, 131, 132), ce cinquième et ce sixième dispositif de verrouillage étant séparés du premier, du deuxième, du troisième et du quatrième dispositif de verrouillage ; et
dans lequel le cinquième et le sixième dispositif de verrouillage sont configurés de façon à rattacher le chapeau au canal au niveau d'un troisième endroit, dans lequel le premier et le deuxième endroit sont situés sur un premier côté du compartiment diélectrique implantable et le troisième endroit est situé sur un deuxième côté du compartiment diélectrique implantable, le deuxième côté étant différent du premier côté.

9. Système selon la revendication 8, dans lequel le premier, le troisième et le cinquième dispositif de verrouillage comprennent des connecteurs femelles et le deuxième, le quatrième et le sixième dispositif de verrouillage comprennent des connecteurs mâles.

10. Système selon l'une quelconque des revendications 1 à 9, dans lequel le compartiment diélectrique implantable comprend une première prise et une deuxième prise, la première prise étant configurée de façon à recevoir un premier fil et la deuxième prise étant configurée de façon à recevoir un deuxième fil, la première prise étant plus près du boîtier du dispositif médical implantable que la deuxième prise ; et dans lequel le canal est situé dans la surface extérieure du compartiment diélectrique implantable, essentiellement entre la première et la deuxième prise.

11. Procédé comprenant :

la prévision d'une antenne implantable (140) configurée de façon à transférer sans fil des informations électromagnétiquement à une fréquence de fonctionnement spécifiée, cette fréquence de fonctionnement spécifiée étant fournie en utilisant une configuration spécifique d'une partie de cette antenne implantable ;
la prévision d'un compartiment diélectrique implantable (105) comprenant un premier dispositif de verrouillage (125, 126, 127) ;
la prévision d'un canal (115) dans une surface extérieure du compartiment diélectrique implantable (105) ;
l'insertion de l'antenne implantable (140) dans le canal (115), le canal (115) étant configuré de façon à restreindre une partie de l'antenne implantable dans une configuration spécifique le long de la longueur de la partie de l'antenne implantable (140) ;
la prévision d'un chapeau (110) comprenant un deuxième dispositif de verrouillage (130, 131, 132), ce chapeau étant configuré de façon à couvrir la partie de l'antenne implantable (140) dans le canal (115) et à positionner l'antenne implantable dans la configuration spécifique à l'intérieur du canal ;
le deuxième dispositif de verrouillage (130, 131, 132) du chapeau (110) comprenant un connecteur mâle configuré de façon à interagir avec un connecteur femelle correspondant sur le compartiment diélectrique implantable (105) du premier dispositif de verrouillage (125, 126, 127), ou le deuxième dispositif de verrouillage (130, 131, 132) du chapeau (110) comprenant un connecteur femelle configuré de façon à interagir avec un connecteur mâle correspondant sur le compartiment diélectrique implantable (105) du premier dispositif de verrouillage (125, 126, 127) ;
la fixation du chapeau (110) au canal (115) en utilisant le premier dispositif de verrouillage (125, 126, 127) du compartiment diélectrique implantable et le deuxième dispositif de verrouillage (130, 131, 132) du chapeau.

12. Procédé selon la revendication 11, dans lequel le canal (115) est un canal dégressif.

13. Procédé selon l'une quelconque des revendications 11 à 12, comprenant la prévision d'une partie étroite (135, 136, 137) dans le canal dégressif ayant une surface de section transversale plus petite qu'une surface de section transversale de l'antenne implantable, cette partie étroite étant configurée de façon à positionner l'antenne implantable à l'intérieur du canal dégressif.

14. Procédé selon la revendication 13, comprenant la prévision d'un ajustement avec serrage entre un polymère (141) couvrant la partie de l'antenne implantable et la partie étroite du canal dégressif, le canal dégressif étant dimensionné et formé de façon à fournir la configuration spécifique pour l'antenne implantable.

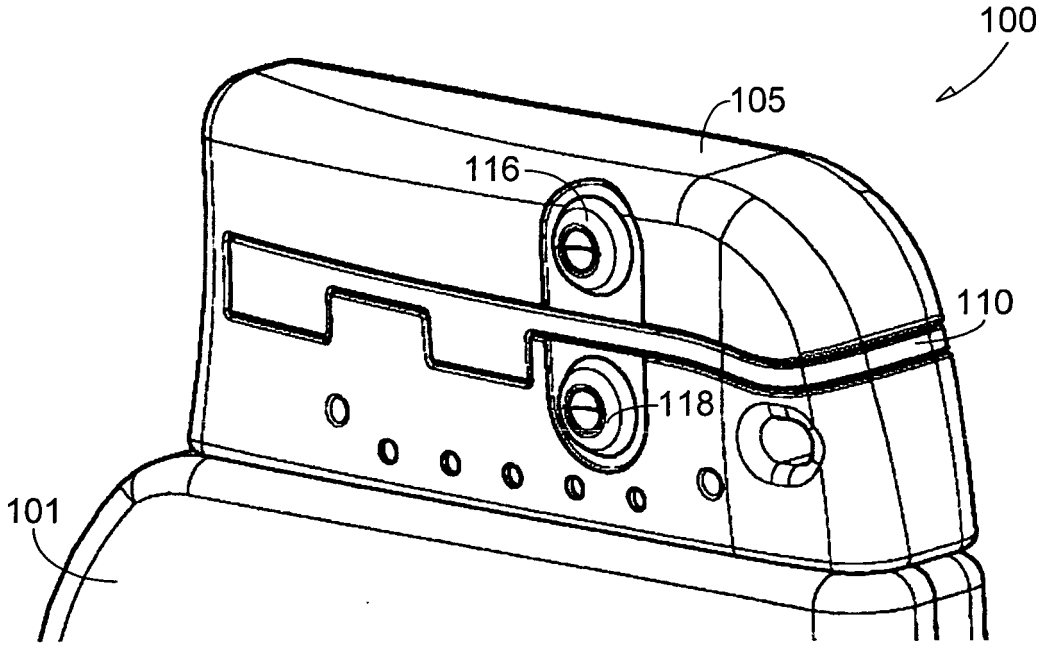

FIG. 1

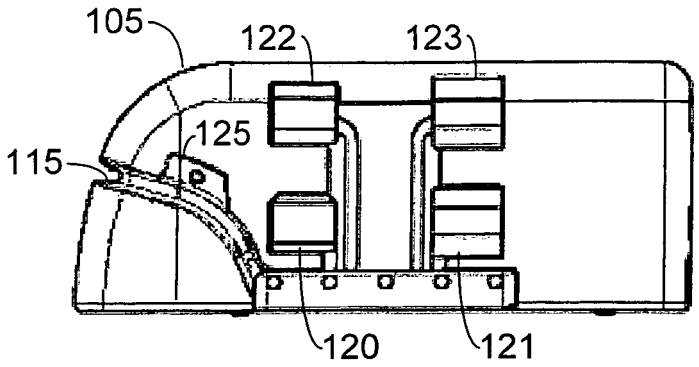

FIG. 2A

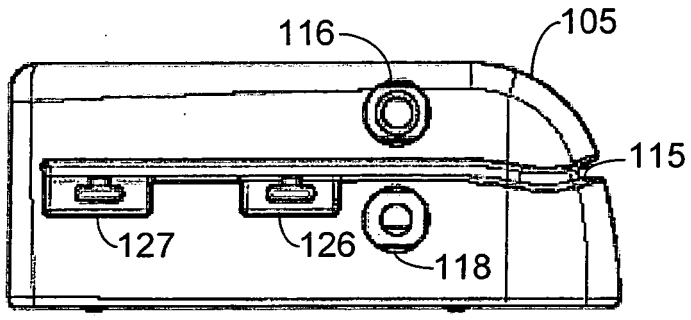

FIG. 2B

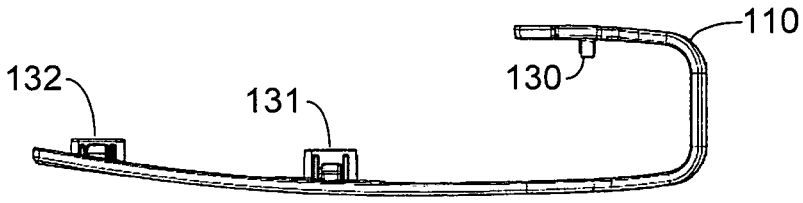

FIG. 3A

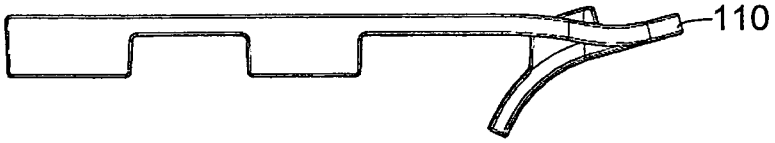

FIG. 3B

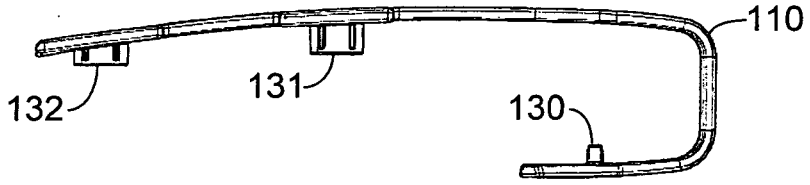

FIG. 3C

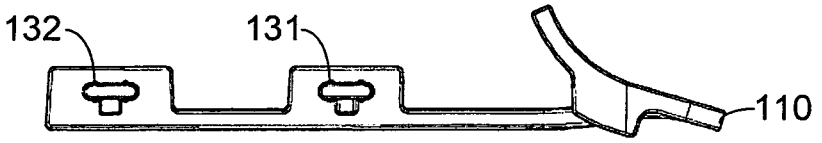

FIG. 3D

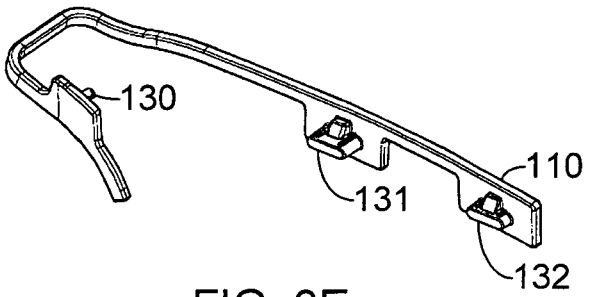

FIG. 3E

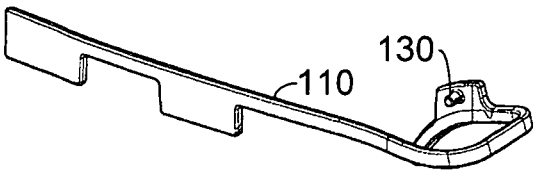

FIG. 3F

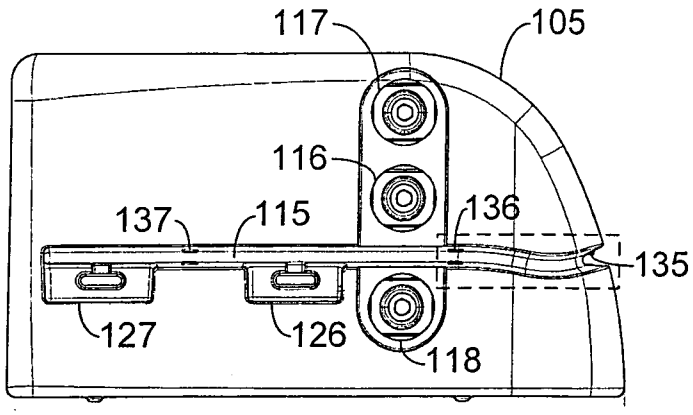

FIG. 4A

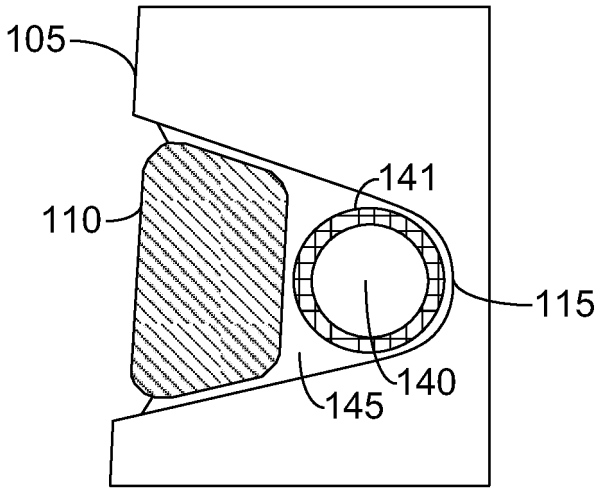

FIG. 5

REFERENCES CITED IN THE DESCRIPTION

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- US 20060224206 A1 **[0003]**
- US 20050203584 A1 **[0004]**

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优先权	61/106068 2008-10-16 US 61/228109 2009-07-23 US		
其他公开文献	EP2369975A1		
外部链接	Espacenet		

摘要(译)

该文件尤其讨论了可植入电介质隔室，该可植入电介质隔室包括在可植入电介质隔室的外表面中的通道，该通道被配置为沿着可植入天线的该部分的长度以特定配置约束可植入天线的一部分。 。在某些示例中，可植入天线可以被配置为使用可植入天线的该部分的特定配置提供的以指定操作频率电磁地无线传输信息。

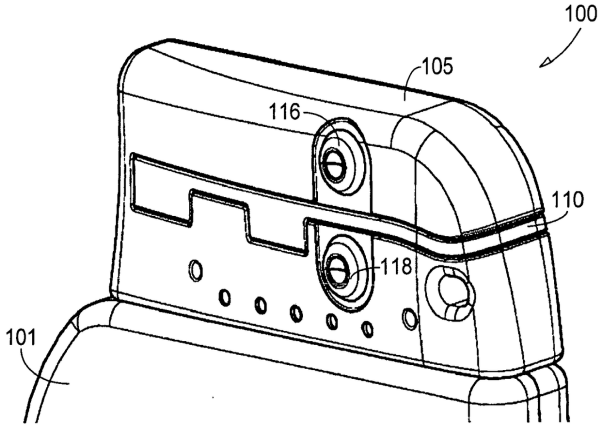

FIG. 1